Errata

Title & Document Type: **8673 Synthesized Signal Generator Operating and Service Manual**

Manual Part Number: **08673-90053**

Revision Date: **September 1985**

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We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

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Agilent Technologies

OPERATING AND SERVICE MANUAL

HP 8673E SYNTHESIZED SIGNAL GENERATOR 2.0 — 18.0 GHz

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2529A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

HEWLETT PACKARD

1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

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CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

CONTENTS

CONTENTS

CONTENTS (cont'd)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont'd)

LIST OF ILLUSTRATIONS (cont'd)

LIST OF ILLUSTRATIONS (cont'd)

LIST OF ILLUSTRATIONS (cont'd)

TABLES

TABLES (cont'd)

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Attenuator Driver Board Assembly	18
A1A2	Detector Module Assembly	14,17
A1A2A1	ALC Board Assembly	14,17
A1A2A2	Detector Board Assembly	17
A1A3	Function Board Assembly	20
A1A4	Pulse Driver Board Assembly	15
A1A5	DAC and Enable Board Assembly	22
A1A6	Meter Board Assembly	21
A1A7	YTM Driver Board Assembly	16
A1A8	SRD Bias Board Assembly	19
A1A9	Preamp Assembly	14,16
A1A10	YTM Assembly	16
A1A10A1	YIG Heater Control Assembly	16
A1A11	Power Amplifier Assembly	16
A1A12	Motherboard Assembly	14-16,18-22, 30,31
A1A13	Terminal Strip	15
A1A14	Amp Bias Board Assembly	17
A2A1	Panel Driver Board Assembly	25
A2A2	Key Code Board Assembly	24
A2A3	VCO Assembly	8
A2A4	Phase Detector Assembly	7
A2A5	Divider Assembly 20/30	6
A2A6	Not Assigned	
A2A7	I/O Board Assembly	30,31
A2A8	Microprocessor Board Assembly	26
A2A9	Frequency/HP-IB Board Assembly	29
A2A10	RAM Board Assembly	28
A2A11	ROM Board Assembly	27
A2A12	Not Assigned	
A2A13	Motherboard Assembly	6-8,10,20-32
A2A14	Rear Interconnect Board Assembly	24,29,31
A2A15	HP-IB Connector Board Assembly	29
A3A1	Rectifier Assembly	33
A3A1A1	Reference Phase Detector Assembly	1,2
A3A1A2	100 MHz VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator	4
A3A1A4A2	VCO Board Assembly	4
A3A1A5	M/N Output Assembly	5
A3A1A6	M/N Reference Motherboard Assembly	1-3,5
A3A1A7	Reference Housing Assembly	
A3A2	Not Assigned	
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	DAC Assembly	9
A3A6	YTO Driver Assembly	10
A3A7	FM Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 — 6.6 GHz YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Sampler Assembly	11
A3A9A6	Attenuator Assembly	13
A3A9A7	6.2 GHz Low Pass Filter	13
A3A10	Motherboard Assembly	1,3,4,6,10, 12-14,21-23, 26,29-31, 33-35
A4A1	Front Panel Board Assembly	20,22,23,32

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to neutral (that is, the grounded side of the mains supply).

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

SAFETY SYMBOLS

⚠ Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (see Table of Contents for page references).

Indicates hazardous voltages.

⏚ Indicates earth (ground) terminal.

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

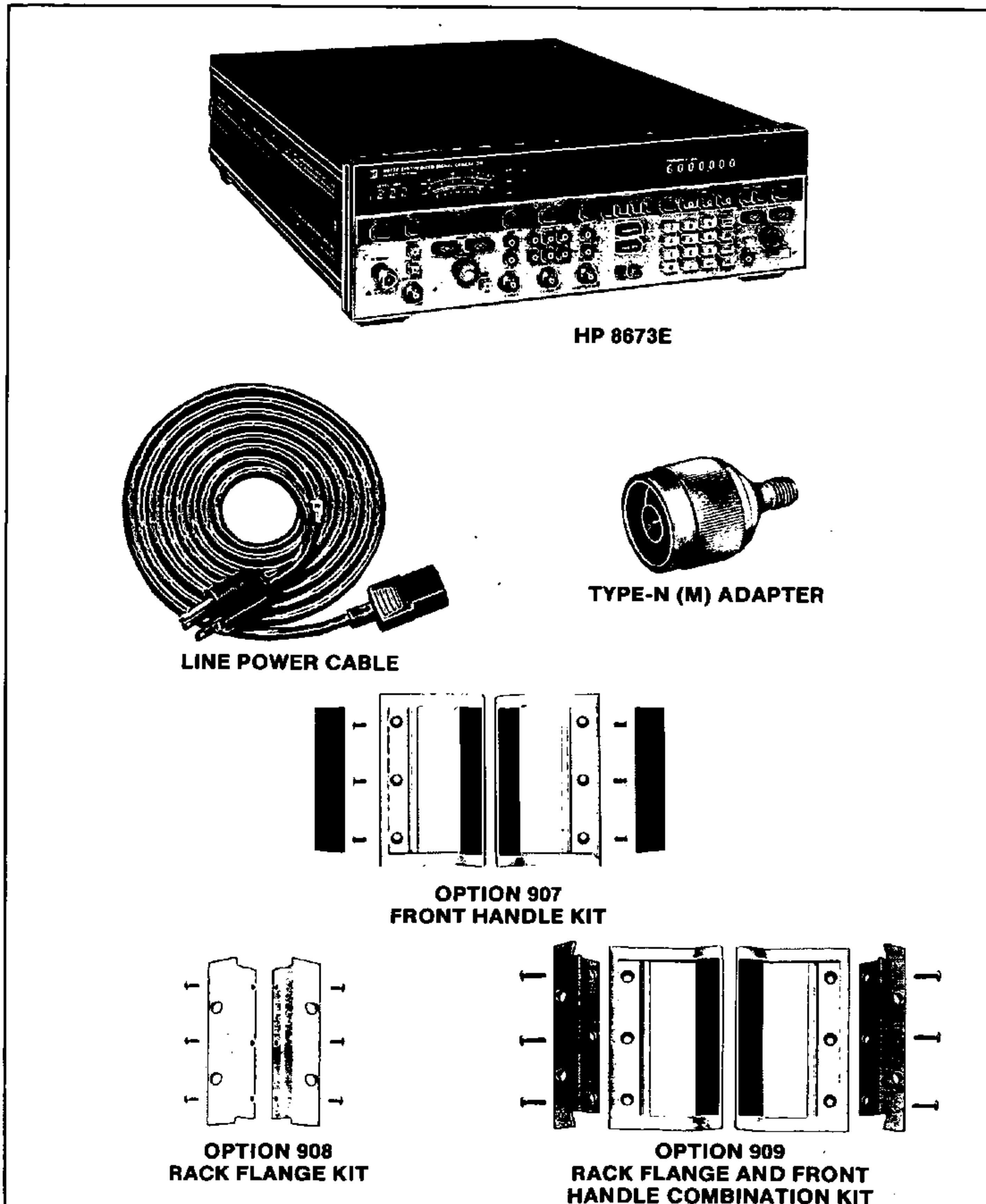


Figure 1-1. HP Model 8673E Accessories Supplied, and Options 907, 908, and 909

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, adjust and service the Hewlett-Packard 8673E Synthesized Signal Generator. Figure 1-1 shows the Signal Generator with all of its externally supplied accessories.

The 8673E Operating and Service manual has eight sections. The subjects addressed are:

Section I, General Information
Section II, Installation
Section III, Operation
Section IV, Performance Tests
Section V, Adjustments
Section VI, Replaceable Parts
Section VII, Manual Changes
Section VIII, Service

Two copies of the operating information are supplied with the Signal Generator. One copy is in the form of an Operating Manual. The Operating Manual is a copy of the first three sections of the Operating and Service Manual. The Operating Manual should stay with the instrument for use by the operator. Additional copies of the Operating Manual can be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

Also listed on the title page of this manual, below the manual part number, is a microfiche part number. This number may be used to order 100 x 150 millimetre (4 x 6 inch) microfilm transparencies of this manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement, as well as all pertinent Service Notes.

1-2. SPECIFICATIONS

Instument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested. Supplemental characteristics are listed in Table 1-2. Supplemental characteristics are not warranted specifications, but are typical characteristics included as additional information for the user.

1-3. SAFETY CONSIDERATIONS

This product is a Safety Class I instrument, that is, one provided with a protective earth terminal. The Signal Generator and all related documentation should be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information for installation, operation, performance testing, adjustment, or service is found in appropriate places throughout this manual.

1-4. INSTRUMENTS COVERED BY THIS MANUAL

Attached to the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. The first four digits and the letter are the serial number prefix. The last five digits are the suffix. The prefix is the same for identical instruments; it changes only when a configuration change is made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-5. MANUAL CHANGES SUPPLEMENT

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those documented in this manual. The manual for this newer instrument is accompanied by a Manual Changes supplement. The supplement contains "change information" that explains how to adapt this manual to the newer instrument.

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep the manual as current and as accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement is identified with the manual print date and part number, both

MANUAL CHANGES SUPPLEMENT (cont'd)

of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-6. DESCRIPTION

The HP 8673E Synthesized Signal Generator has a frequency range of 2.0 to 18.0 GHz. The output is leveled and calibrated from +8 dBm to −120 dBm. AM, FM, and pulse modulation can be selected. Frequency, output level, modulation modes, and most other functions can be remotely programmed via HP-IB.

Long-term frequency stability is dependent on the time base, either an internal or external reference oscillator. The internal crystal reference oscillator operates at 10 MHz while an external oscillator may operate at 5 or 10 MHz. The output of the Signal Generator is exceptionally flat due to the action of the internal automatic leveling control (ALC) loop.

External drives are required for all modulation modes. AM depth and FM deviation vary linearly with the applied external voltage. Full scale modulation is attained with a 1.0 volt peak signal. Pulse modulation is compatible with TTL levels.

Two ranges of AM depth can be selected: 30% and 100%. The front panel meter can be used to set AM depth. Specified AM rates are from 100 Hz to 100 kHz. However, usable amplitude modulation can be performed at any modulation frequency between 20 Hz and 100 kHz.

Six ranges of FM deviation are selectable: 0.03, 0.1, 0.3, 1, 3, and 10 MHz. FM peak deviation can be set using the front panel meter. Except for 10 MHz/V deviation range, at output frequencies below 6.6 GHz, peak deviation is limited to 10 MHz or five times the modulation frequency, whichever is lower. From 6.6 to 12.3 GHz, peak deviation is limited to the lesser of 10 MHz or ten times the modulation frequency; from 12.3 to 18.0 GHz the lesser of 10 MHz or fifteen times the modulation frequency. Usable modulation rates fall between 100 Hz and 10 MHz except when the deviation range is 10 MHz/V, in which case, the frequency range is limited to 10 Hz to 2 MHz.

Pulse modulation has two operating modes: NORM (normal mode) and COMPL (complement mode). In the normal mode the RF output is ON when the drive signal is the TTL high state. In the complement mode the RF output is ON when the drive signal is in the TTL low state.

The Signal Generator is compatible with HP-IB to the extent indicated by the following codes: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, C0 and E1. The Signal Generator interfaces with the bus via three-state TTL circuitry. An explanation of the compatibility code can be found in IEEE Standard 488 (1978), "IEEE Standard Digital Interface for Programmable Instrumentation" or the identical ANSI Standard MC1.1. For more detailed information relating to programmable control of the Signal Generator, refer to Remote Operation, Hewlett-Packard Interface Bus in Section III of this manual.

1-7. OPTIONS

1-8. Mechanical Options

The following options may have been ordered and received with the Signal Generator. If they were not ordered with the original shipment and are now desired, they can be ordered from the nearest Hewlett-Packard office using the part numbers included in each of the following paragraphs.

Option 907 (Front Handle Kit). Ease of handling is increased with the front panel handles. The Front Handle Kit part number is 5061-9689.

Option 908 (Rack Flange Kit). The Signal Generator can be solidly mounted to the instrument rack using the flange kit. The Rack Flange Kit part number is 5061-9677.

Option 909 (Rack Flange and Front Handle Combination Kit). This is a unique part which combines both functions. It is not simply a front handle kit and a rack flange kit packaged together. The Rack Flange and Front Panel Combination Kit part number is 5061-9683.

1-9. ACCESSORIES SUPPLIED

The accessories supplied with the Signal Generator are shown in Figure 1-1.

ACCESSORIES SUPPLIED (cont'd)

a. The line power cable is supplied in several configurations, depending on the destination of the original shipment. Refer to Power Cables in Section II of this manual.

b. An additional fuse is shipped only with instruments that are factory configured for 100/120 Vac operation. This fuse has a 2A rating and is for reconfiguring the instrument for 220/240 Vac operation.

c. One adapter is provided: a Type-N to SMA 50 ohm coaxial adapter, HP Part No. 1250-1250.

1-10. EQUIPMENT REQUIRED BUT NOT SUPPLIED

An external signal source is required if amplitude, frequency, or pulse modulation is desired. For AM, the source should have a variable output of 0 to 1 volt peak into 600 ohms, frequency rates up to 100 kHz, and distortion of less than 1%. For FM, the source should have a variable output of 0 to 1 volt peak into 50 ohms, frequency rates up to 10 MHz, and distortion of less than 1%. For pulse modulation, the source should have TTL output levels (>2.4V for a TTL high state and <0.4V for a TTL low state) and 50 ohms nominal impedance. Pulse repetition frequency rates should be 1 Hz to 1 MHz with transition times <10 ns.

1-11. ELECTRICAL EQUIPMENT AVAILABLE

The Signal Generator has an HP-IB interface and can be used with any HP-IB compatible computing controller or computer for automatic systems applications.

The HP-IB Controller and various ROMs are needed to do the automated SRD Bias, YTM Tune, Flatness and ALC, and Pulse adjustment procedures. Specific equipment needed for automated adjustments are:

Test Cassette HP Part No. 11726-10002
HP 85B/82937A/82936A Controller
00085-15005 Advanced Programming ROM
00085-15002 Plotter/Printer ROM
00085-15004 Matrix ROM
HP 3455A or 3456A Digital Voltmeter
HP 436A/HP 8481A Power Meter and Sensor

Although the test cassette is part of the HP 11726A Support Kit, it can be ordered separately through the nearest Hewlett-Packard Office. The HP 11726A Support Kit is available for maintaining and servicing the Signal Generator. It consists of cables, adapters, termination, prerecorded programs, extender boards and test extender boards.

The HP 8013B Pulse/Function Generator is adequate for modulating the Signal Generator and meeting stated standards. This remotely programmable signal source is convenient for full remote control of modulation levels and rates.

For pulse modulation requiring pulse delay, the HP 8112A Pulse Generator is recommended.

1-12. RECOMMENDED TEST EQUIPMENT

Table 1-3 lists the test equipment recommended for testing, adjusting and servicing the Signal Generator. Essential requirements for each piece of test equipment are described in the Critical Specifications column. Other equipment can be substituted if it meets or exceeds these critical specifications.

Table 1-1. Specifications (1 of 3)

Note: Specifications apply after 1-hour warm-up, over the temperature range 0 to 55°C (except specifications for harmonically related spurious signals, RF output level, pulse peak level accuracy, and amplitude modulation; which apply over the range 15 to 35 degrees C), after an AUTO PEAK operation has been performed. For additional information concerning the use of AUTO PEAK, refer to Section III. Specifications for output flatness, absolute level accuracy, and modulation apply only when internal leveling is used.

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—18.0 GHz (1.95—18.6 GHz overrange)	
Resolution	1 kHz 2 kHz 3 kHz	2.0 to 6.6 GHz >6.6 to 12.3 GHz >12.3 to 18.0 GHz
Accuracy and Stability	Same as reference oscillator	Except in FM deviation mode, 10 MHz/volt range
Reference Oscillator Frequency	10 MHz	
Aging Rate	>1.5 x 10^{-9}/day	After a 10 day warmup (typically 24 hours in a normal operating environment)
SPECTRAL PURITY		
Single-sideband Phase Noise	≤−60 dBc	CW mode, 1 Hz bandwidth 1 kHz offset
Harmonics	<−40 dBc	At +3 dBm
Subharmonics and multiples thereof	<−35 dBc	At +3 dBm
Spurious Signals, nonharmonically related, except power line and fan rotation related	<−60 dBc	CW and AM modes
Residual AM	<−50 dBc	In a 200 kHz post-detection bandwidth
RF OUTPUT		
Output Power	+8 dBm to −120 dBm	+15° to +35°C
Resolution (digital display)	0.1 dB	
Level Flatness	±2 dB	At +3 dBm, +15° to +35°C
Absolute Level Accuracy		+15° to +35°C
2.0—12.0 GHz	±4 dB ±5.5 dB	+8 to −60 dBm <−60 to −120 dBm
>12.0—18.0 GHz	±5.0 dB ±6.5 dB	+8 to −60 dBm <−60 to −120 dBm

Table 1-1. Specifications (2 of 3)

Electrical Characteristics	Performance Limits	Conditions
PULSE MODULATION ON-OFF Ratio	≥70 dB	
Overshoot/Ringing	≤20%	
Pulse IN Connector	BNC Female	
AMPLITUDE MODULATION Depth	0 to 75%	15° to 35°C at 0 dBm maximum carrier level
Rate	10 Hz—50 kHz, ±3 dB	30% depth
Sensitivity	30%/V and 100%/V (depending on range)	Maximum input 1 Vpk into 600Ω nominal; AM depth is linearly controlled by varying input level between 0 and 1V peak
Distortion	<8%	50% modulation depth with 1 kHz rate a 0 dBm
AM IN Connector	BNC Female	
FREQUENCY MODULATION Rate	±3 dB,100 Hz—2 MHz ±3 dB,100 Hz—2 MHz ±3 dB, 3 kHz—2 MHz ±3 dB, 3 kHz—2 MHz ±3 dB, 3 kHz—2 MHz	0.03 MHz/V Range 0.1 MHz/V Range 0.3 MHz/V Range 1 MHz/V Range 3 MHz/V Range
Maximum peak deviation is 10 MHz	50 Hz—2 MHz (typical)	10 MHz/V Range (unlocked)
Maximum Peak Deviation:	The smaller of 3 MHz or f_{mod} x 5 The smaller of 3 MHz or f_{mod} x 10 The smaller of 3 MHz or f_{mod} x 15	2.0—6.6 GHz; 0.03, 0.1, 0.3, 1, 3 MHz/V range 6.6—12.3 GHz; .03, 0.1, 0.3, 1, 3 MHz/V range 12.3—18 GHz; .03, 0.1, 0.3, 1, 3 MHz/V range
Sensitivity	1V peak for maximum deviation in each range	
Incidental AM	<5% at <100 kHz rate	Peak deviation <1 MHz
FM IN Connector	BMC Female	

Table 1-1. Specifications (3 of 3)

Electrical Characteristics	Specification
DIGITAL SWEEP	
Sweep Function	Start/Stop or ΔF (span) sweep
Sweep Modes	Manual, Auto, Single sweep
Step Size	Maximum of 9999 frequency points per sweep; minimum step size equals frequency resolution. Step size set directly or as number of frequency points per sweep.
Dwell Time	Set from 1 to 255 ms per frequency
Markers	5 independent, fixed frequency markers set from front panel. Resolution and accuracy are identical to RF output.
REAR PANEL CONNECTORS	
Frequency Reference Output	1V/GHz ramp; +18V maximum
Sweep Output	0 to +10V ramp start to stop (maximum adjustable from +4V to +12V)
Tone Marker Output	5 kHz sine wave output markers for sweeps
Z-axis Blanking/Marker Penlift	Provides Z-axis control for a CRT display compatible with recording devices that have penlift control.
Aux Connector	14-pin connector for remote control of frequency increment, display blanking, sequential register recall, start and stop sweep, and more.
10 MHz Output	0 dBm (nominal) into 50 ohms
100 MHz Output	0 dBm (nominal) into 50 ohms
HP-IB Capability	All front panel controls, except the line power switch are HP-IB programmable
Output Data	Frequency and output level settings, error/malfunction messages, operational status codes, and learn mode strings
Interface Function Codes	SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, C0, and E1.
GENERAL	
Operating Temperture	0 to +55°C (see note at the beginning of this table)
Power	100, 120, 220, or 240V, +5%, −10%, 48—66 Hz
E.M.I.	Conducted and radiated interference is within the requirements of methods CE03 and RE02 of MIL-STD 461A, VDE 0871, and CISPR publication 11.
Net Weight	29 kg (64 lb)
Dimensions: Height Width Depth	146 mm (5.7 in.) 425 mm (16.8 in.) 620 mm (24.4 in.) For ordering cabinet accessories, module sizes are 5-1/4H, 1 MW, 23D, System II
Accessories	Power Cord, Operating and Service Manual and Type N (M) to SMA (F) adapter

Table 1-2. Supplemental Characteristics

Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters. They apply to the 8673E in "Normal" mode, CW operation, and with AUTO PEAK on, except where noted.

FREQUENCY

Internal Reference: The internal reference oscillator accuracy is a function of time base calibration ± aging rate, ± temperature effects, and ± line voltage effects. Typical temperature and line voltage effects are $<1 \times 10^{-7}/°C$ and $<5 \times 10^{-10}/+5\%$ to -10% line voltage change: Reference oscillator is kept at operating temperature in STANDBY mode with the instrument connected to mains power. The aging rate is $<1.5 \times 10^{-9}$/day after a 24 hour warmup.

External Reference Input: 5 or 10 MHz at a level of 0.1 to 1 Vrms into 50Ω. Stability and spectral purity of the microwave output will be partially determined by characteristics of the external reference frequency.

Reference Outputs: 10 MHz at a level of 0.2 Vrms into 50 ohms. 100 MHz at a level of 0.2 Vrms into 50 ohms.

SPECTRAL PURITY

Residual FM: 250 Hz in a 50 Hz—15 kHz Post-detection bandwidth.

Spurious Signals: Power line and fan rotational related, are located at <−40 dBc.

RF OUTPUT

For power settings >0 dBm, changes in frequency of several GHz in one step may require additional AUTO PEAK enabling to stabilize power at the desired level. Spurious output oscillations may occur for settings above +8 dBm.
External leveling device characteristics will determine output flatness, absolute level accuracy, and switching time in external leveling modes.

Maximum Reverse Power: 1W RF input; 1 MHz—20 GHz, 0 Vdc.

Impedance: 50 ohms.

Source SWR: ≤2.5:1.

PULSE MODULATION

Pulse Input:

Impedance: 50 ohms nominal.

Pulse Repetition Frequency: 50 Hz to 1 MHz.

Minimum Duty Cycle: <0.001 for internally levelled performance, no restriction when unlevelled.

Pulse Width: ≥80 ns.

Levels and Triggering: Rising or falling edge triggered; >3V on, <0.5V off, Normal Mode; <0.05V on, >3V off, Pulse Complement Mode.

Waveform: any.

Level Accuracy: (relative to CW, 15°C to 35°C) ±2 dB, pulse width >100 ns.

Rise/Fall Time: <50 ns.

Video Feedthrough: <−50 dBc.

AMPLITUDE MODULATION

Incidental FM: is the Incidental Phase Modulation times the Modulation Frequency, where Incidental Phase Modulation (at 30% depth) is <1.2 radians, from 2.0 to 18 GHz.

AM Impedance: 600 ohms.

FREQUENCY MODULATION

FM Distortion: ≤5% at >20 kHz rate.
Input Impedance: 50 ohms.

Table 1-3. Recommended Test Equipment (1 of 4)

Instrument	Critical Specifications	Recommended Model	Use*
AC Voltmeter	Range: 1 mV to 10V Accuracy: ±1.5% of full scale ±1.5% of reading Frequency Response: 3 kHz to 3 MHz	HP 400E	P, A
Attenuator, Fixed 3 dB	Range: dc to 1 GHz Accuracy: ±0.5 dB SWR: < 1.3	HP 8491A Option 003	P, A
Attenuator, Fixed 6 dB	Range: dc to 18 GHz Accuracy: ±0.6 dB SWR: < 1.6	HP 8491B Option 006	P
Attenuator, Fixed 10 dB	Range: dc to 12.4 GHz Accuracy: ±0.6 dB SWR: < 1.3	HP 8491B Option 010	C, P
Attenuator, Fixed 20 dB	Range: dc to 18 GHz Accuracy: ±1.0 dB SWR: < 1.6	HP 8491B Option 020	P
Attenuator, 10 dB Step	Range: dc to 18 GHz Accuracy: ±7% SWR: < 2.2	HP 8495B Option 001	P, A
Audio Analyzer[1]	Frequency Range: 20 Hz to 100 kHz Accuracy: ±4% of full scale	HP 8903A	P
Audio Source[1]	Frequency Range: 20 Hz to 100 kHz Output Level: 1 mV to 6V open circuit Flatness: ±2.5%	HP 8903A	P
Cable, Special Interconnect	Special (see Figure 1-2)	Locally Fabricated	A
Controller, HP-IB	HP-IB compatibility as defined by IEEE Standard 488-1978 and the identical ANSI Standard MC1.1: SH1, AH1, T2, TE0, L2, LE0, SR0, RL0, PP0, DC0, DT0, and C1, 2, 3, 4, 5. Automated adjustment programs require specific test equipment. Therefore no substitute is recommended	HP 85B/82937A/82936A 00085-15002 00085-15004 00085-15005	C, A, T
Crystal Detector	Frequency Range: 2 to 18 GHz Frequency Response: ±1.5 dB	HP 08673-60083	P, A
Current Probe	Frequency Range: 2 to 35 MHz	HP 1110B	A

Table 1-3. Recommended Test Equipment (2 of 4)

Instrument	Critical Specifications	Recommended Model	Use*
Digital Voltmeter (DVM)	Automated adjustment programs require specific test equipment. No substitute is recommended.	HP 3456A or HP 3455A	P, A, T
Foam Pads (2 required)	43 × 58 cm (17 × 23 in.), 5 cm (2 in.) thick		P
Frequency Counter	Range: 10 MHz to 18 GHz Resolution: 100 Hz 10 MHz Frequency Standard Output: ≥0.1 Vrms	HP 5343A	P, A, T
Frequency Standard	Long Term Stability: Better than 10^{-10}/day	HP 5065A	P, A
High Impedance Probe	Frequency: 400 MHz Output Impedance: 50Ω (compatible with Spectrum Analyzer).	HP 1121A	T
Local Oscillator	Range: 10 MHz to 18 GHz Level: 10 MHz to 18.6 GHz — +7 dBm Single Sideband Phase Noise and Signals: Same as HP 8340A.	HP 8340A	P, A
Local Oscillator (for pulse test)	Range: 2—18 GHz Level: +7 dBm	HP8673E Any HP 8673 Signal Generator can be used.	P
Logic Pulser	TTL compatible	HP 546A	T
Mixer	Response: 2 to 18 GHz VSWR, LO: ≤ 2.5:1 VSWR, RF: ≤ 4.0:1	RHG DMS1—18[2]	P, A
Modulation Analyzer	Frequency Range: 150 to 990 MHz Input Level: −20 to +13 dBm Amplitude Modulation: Rates — 10 Hz to 50 kHz Depth — to 75% Accuracy — ±2% at 1 kHz Flatness — ±0.5% Demodulated Output Distortion —<0.3% for 50% depth Incidental Phase Modulation — <0.05 radians for 50% depth at 1 kHz rate (50 Hz to 3 kHz bandwidth) Frequency Modulation: Rates — 25 Hz to 25 kHz Deviation — to 99 kHz Accuracy — ±2% at 1 kHz	HP 8902A/ HP 11722A	A, T
Oscilloscope	Bandwidth: 100 MHz Vertical Sensitivity: 10 mV/div Vertical Input: 50Ω ac or dc coupled External Trigger Capability	HP 1980B	C, P, A, T

Table 1-3. Recommended Test Equipment (3 of 4)

Instrument	Critical Specifications	Recommended Model	Use*
Power Meter	Automated adjustment programs require specific test equipment. Therefore, no substitute is recommended.	HP 436A	P, A, T
Power Sensor	Frequency Range: 50 MHz to 18 GHz Input Impedance: 50Ω SWR: < 1.28 Must be compatible with power meter	HP 8481A	P, A, T
Power Source, Variable Frequency AC	Range: 60 Vac to 240 Vac Frequency: 48 to 400 Hz Accuracy ± 2 Hz	California Instruments 501TC/800T[3]	P
Power Supply	0 to 40 Vdc	HP 6200B	A, T
Preamp	Preamp Frequency: 100 kHz to 400 MHz Gain: 20 ± 5 dB Output Power: >6 dBm Noise Figure: <5 dBm Impedance: 50Ω	8447A	P
Preamp — Power Amp	Preamp Frequency: 100 kHz to 1.3 GHz Gain: 26 ± 6 dB Output Power: > 7 dBm Noise Figure: < 8.5 dB Impedance: 50Ω	HP 8447D	P, A
	Power Amp Frequency: 100 kHz to 1.3 GHz Gain: 22 ± 5 dB Output Power: > 6 dBm Noise Figure: < 5 dB Impedance: 50Ω	HP 8447E Note: HP 8447F is a dual amplifier and will satisfy both requirements.	P, A
Probe, 10:1	Must be compatible with the oscilloscope.	HP 10017A	P, A
Pulse Generator	Rate: 10 Hz to 4 MHz Rise and Fall Times: < 5 ns Output Impedance: 50Ω Output Level: 0 to +3.5V Pulse Width: 80 ns to 2 μs	HP 8013B or HP 8031A	C, P, A, T
Pulse Shunt Adapter	See Pulse Modulation Adjustment in Section V.	Locally fabricated	A
Signal Generator	Output Level: −5 to −20 dBm at 240 MHz	HP 8640B or HP 8340A	P, A, T

Table 1-3. Recommended Test Equipment (4 of 4)

Instrument	Critical Specifications	Recommended Model	Use*
Signature Analyzer	Because the signatures are dependent upon the model selected, only the models listed are approved for usage.	HP 5005A/B, HP 5006A	T
Spectrum Analyzer	Frequency Range: 20 Hz to 300 kHz Frequency Span/Division: 20 Hz minimum Noise Sidebands: > 90 dB below CW signal, 3 kHz offset, 100 Hz IF bandwidth Input Level Range: −10 to −60 dBm Log Reference Control: 70 dB dynamic range in 10 dB steps Accuracy: ± 0.2 dB	HP 8556A/ 8552B/141T	P, A, T
Spectrum Analyzer	Frequency Range: 5 Hz to 40 kHz Resolution Bandwidth: 3 Hz minimum Frequency Span/Division: 50 Hz to 500 MHz Amplitude Range: 0 to −70 dB	HP 3580A	P, T
Spectrum Analyzer System	Frequency Range: 10 MHz to 18 GHz Frequency Span/Division: 1 kHz minimum Amplitude Range: 0 to −70 dB Noise Sideband: > 75 dB down 30 kHz from signal at 1 kHz resolution bandwidth	HP 8566B	P, A
Support Kit Adjustment Cassette	Required for servicing and troubleshooting. No substitute. Part of 11726A Support Kit.	HP 11726A HP 11726-10002	P, A, T A
Sweep Oscillator	Center Frequency: 150 to 200 MHz Center Frequency Resolution: 0.1 MHz Sweep Range: 10 and 200 MHz	HP 86222B/ 8620C or HP 8340A	A
Termination 50Ω	50Ω BNC 50Ω Type N	HP 11593A HP 909A Opt. 012	P, A A
Test Oscillator	Level: 0 to 3V into 50Ω or 300Ω Range: 10 kHz to 10 MHz	HP 3335A	C, P A, T

* C = Operator's Check, P = Performance Tests, A = Adjustments, T = Troubleshooting

[1] The HP 8903A is recommended for the combined use as an analyzer and audio source. A separate audio analyzer and an audio source can be used if critical specifications are met.

[2] RHG Electronics Laboratory, Inc., 161 East Industry Court, Deer Park, NY 11729, Tel. (516) 242-1100, TWX 510-227-6083.

[3] California Instruments, 5150 Convoy Street, San Diego, CA 92111, Tel. (714) 279-8620.

II Installation

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section provides the information needed to install the Signal Generator. Included is information pertinent to initial inspection, power requirements, line voltage selection, power cables, interconnection, environment, instrument mounting, storage and shipment.

2-2. INITIAL INSPECTION

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, meters).

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

2-3. PREPARATION FOR USE

2-4. Power Requirements

The Signal Generator requires a power source of 100, 120, 220 or 240 Vac, +5% to −10%, 48 to 400 Hz single phase. However, line voltage is limited to a nominal 100 or 120 Vac if the line frequency is >66 Hz. Power consumption is 400 VA maximum.

WARNING

This is a Safety Class I product (that is, provided with a protective earth terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an external autotransformer, make sure the autotransformer's common terminal is connected to the neutral (that is, the grounded side of the mains supply).

2-5. Line Voltage and Fuse Selection

CAUTION

BEFORE PLUGGING THIS INSTRUMENT into the mains (line) voltage, be sure the correct voltage and fuses have been selected.

Verify that the line voltage selection cards and the fuses are matched to the power source. Refer to Figure 2-1, Line Voltage and Fuse Selection.

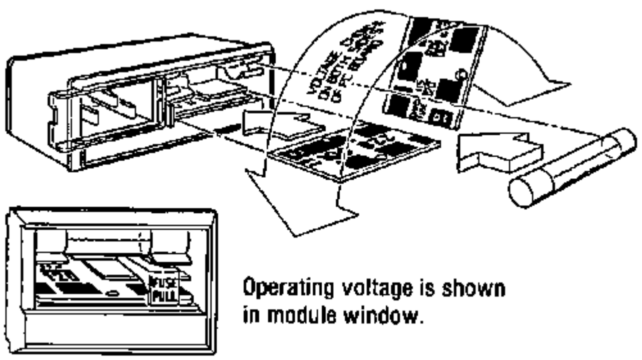
Fuses may be ordered under HP part numbers 2110-0055, 4.0A (250V) for 100/120 Vac operation and 2110-0002, 2.0A (250V) for 220/240 Vac operation.

2-6. Power Cables

WARNING

BEFORE CONNECTING THIS INSTRUMENT, the protective earth terminal of this instrument must be connected to the protective conductor of the (mains) power cables. The mains plug shall only be inserted in socket outlets provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding).

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument



SELECTION OF OPERATING VOLTAGE

1. Open cover door, pull the FUSE PULL lever and rotate to left. Remove the fuse.
2. Remove the Line Voltage Selection Card. Position the card so the line voltage appears at top-left corner. Push the card firmly into the slot.
3. Rotate the FUSE PULL lever to its normal position. Insert a fuse of the correct value in the holder. Close the cover door.

WARNING

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz [leakage currents at these line settings may exceed 3.5 mA].

Figure 2-1. Line Voltage and Fuse Selection

cabinet. The power cable plugs shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of power cables available.

2-7. HP-IB Address Selection

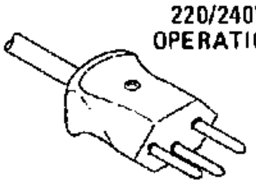
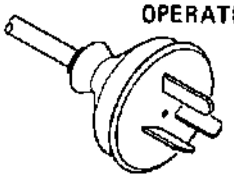
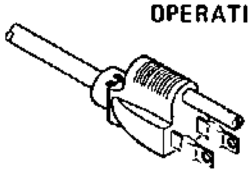
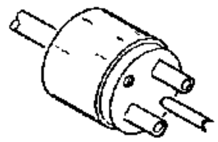
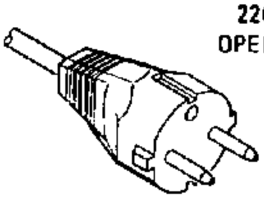
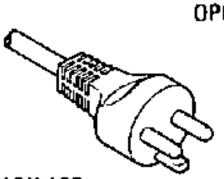
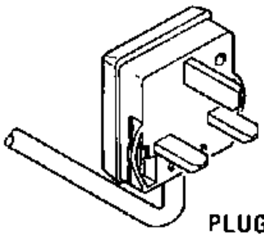
In the Signal Generator, the HP-IB talk and listen addresses can be selected by an internal switch or by a front panel setting. Refer to Table 2-1 for a listing of talk and listen addresses. The address is factory set for a Talk address of "S" and a Listen address of "3". (In binary this is 10011; in decimal this is 19.)

Front Panel HP-IB Address Setting. To set the Signal Generator's HP-IB address set from the front panel, the FRONT PNL ENABLE switch on the HP-IB address switch must be set to "1". To change the address from the front panel, key in the desired address, press the STO key, then press the LOCAL key. Refer to Remote Operation, HP-IB, in Section III for additional information.

Internal Switch Setting. To change the internal HP-IB address switch, proceed as follows:

WARNINGS

Internal switch settings should be changed only by service trained persons who are

220/240V OPERATION  PLUG*: SEV 1011.1959-24507 TYPE 12 CABLE*: HP 8120-2104	220/240V OPERATION  PLUG*: NZSS 198/AS C112 CABLE*: HP 8120-1369	100/120V OPERATION  PLUG*: NEMA 5-15P CABLE*: 8120-1378	220/240V OPERATION  PLUG*: NEMA 6-15P CABLE*: HP 8120-0698
220/240V OPERATION  PLUG*: CEE7-VII CABLE*: HP 8120-1689	220/240V OPERATION  PLUG*: DHCK 107 CABLE*: HP 8120-2956	220/240V OPERATION  PLUG*: BS 1363A CABLE: HP 8120-1351	

*The number shown for the plug is the industry identifier for the plug only.
The number shown for the cable is an HP part number for a complete cable including the plug.

Figure 2-2. Power Cable and Mains Plug Part Numbers

Table 2-1. Allowable HP-IB Address Codes

Address Switches					Talk Address Char-acter	Listen Address Char-acter	Decimal Equiva-lent
MSB				LSB			
0	0	0	0	0	@	SP	0
0	0	0	0	1	A	!	1
0	0	0	1	0	B	"	2
0	0	0	1	1	C	#	3
0	0	1	0	0	D	$	4
0	0	1	0	1	E	%	5
0	0	1	1	0	F	&	6
0	0	1	1	1	G	'	7
0	1	0	0	0	H	(	8
0	1	0	0	1	I	)	9
0	1	0	1	0	J	*	10
0	1	0	1	1	K	+	11
0	1	1	0	0	L	,	12
0	1	1	0	1	M	–	13
0	1	1	1	0	N	.	14
0	1	1	1	1	O	/	15
1	0	0	0	0	P	0	16
1	0	0	0	1	Q	1	17
1	0	0	1	0	R	2	18
1	0	0	1	1	S	3	19
1	0	1	0	0	T	4	20
1	0	1	0	1	U	5	21
1	0	1	1	0	V	6	22
1	0	1	1	1	W	7	23
1	1	0	0	0	X	8	24
1	1	0	0	1	Y	9	25
1	1	0	1	0	Z	:	26
1	1	0	1	1	[	;	27
1	1	1	0	0	6	<	28
1	1	1	0	1	]	=	29
1	1	1	1	0	0	>	30

HP-IB Address Selection (cont'd)

WARNINGS (cont'd)

aware of the potential shock hazard of working on an instrument with protective covers moved.

To avoid hazardous electrical shock, the line (mains) power cables should be disconnected before attempting to change the internal HP-IB address switch settings.

a. Set the LINE switch to STBY. Disconnect the line power cables.

b. Remove the Signal Generator's top cover by removing the two plastic feet from the rear of the top cover and loosening the screw at the middle of the rear edge of the top cover.

c. Remove the A2 Assembly's protective cover.

d. Remove the A2A9 Freq Output HP-IB Assembly. This assembly can be recognized as having one black and one white printed circuit board extractor.

e. Set the switches to the desired HP-IB address (in binary) and the Talk Only or Listen Only condition. The switch is illustrated in Figure 2-3. If both the Talk Only and the Listen Only switches are set to "1", the Talk Only setting overrides the Listen Only setting.

f. Reinstall the A2A9 Assembly.

g. To confirm the setting, press and hold the LOCAL/DISPLAY ADDRESS key on the front panel. The current HP-IB address will be displayed in decimal in the FREQUENCY MHz display.

h. Replace the A2 Assembly's internal cover and the Signal Generator's top cover.

i. Connect the line (mains) power cables to the Line Power Module and set the LINE switch to ON.

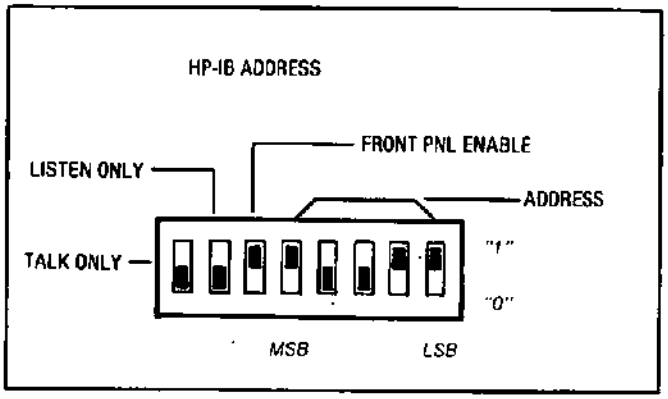


Figure 2-3. HP-IB Address Switch Shown as Set by the Factory

2-8. Interconnections

Interconnection data for the Hewlett-Packard Interface Bus is provided in Figure 2-4.

2-9. Mating Connectors

HP-IB Interface Connector. The HP-IB mating connector is shown in Figure 2-4.

AUX Interface Connector. The rear panel AUX control connector requires a male 14-pin Micro-

Mating Connectors (cont'd)

Ribbon (57 Series) connector. The HP part number is 1251-0142. This connector is also available from Amphenol (Oak Brook, Illinois 60521). Interconnection data for the rear panel AUX control connector is provided in Figure 2-5.

Coaxial Connectors. Coaxial mating connectors used with the Signal Generator should be 50Ω Type N male connectors.

2-10. Operating environment

The operating environment should be within the following limitations:

Temperature .... 0 to +55°C
Humidity .... <95% relative
Altitude .... <4570 metres (15 000 feet)

2-11. Bench Operation

The instrument cabinet has plastic feed and fold-away tilt stands for convenience in bench operation. (The plastic feet are shaped to ensure self-aligning of the instruments when stacked.) The tilt stands raise the front of the instrument for easier viewing of the front panel.

2-12. Rack Mounting

WARNING

The Signal Generator weighs 29 kg (64 lbs), therefore extreme care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting the instrument.

Rack mounting information is provided with the rack mounting kits. If the kits were not ordered with the instrument as options, they may be ordered through the nearest Hewlett-Packard office. Refer to the paragraph entitled Mechanical Options in Section I.

2-13. STORAGE AND SHIPMENT

2-14. Environment

The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature .... −55 to +75°C
Humidity .... <95% relative
Altitude.............. 15 300 metres (50 000 feet)

2-15. Packaging

Preparation for Packaging. Remove handles and/or rack mount flanges before packaging instrument for shipping.

Tagging for Service. If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the back of this manual and attach it to the instrument.

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. Mark the container "FRAGILE" to assure careful handling. In any correspondence refer to the instrument by model number and full serial number.

Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

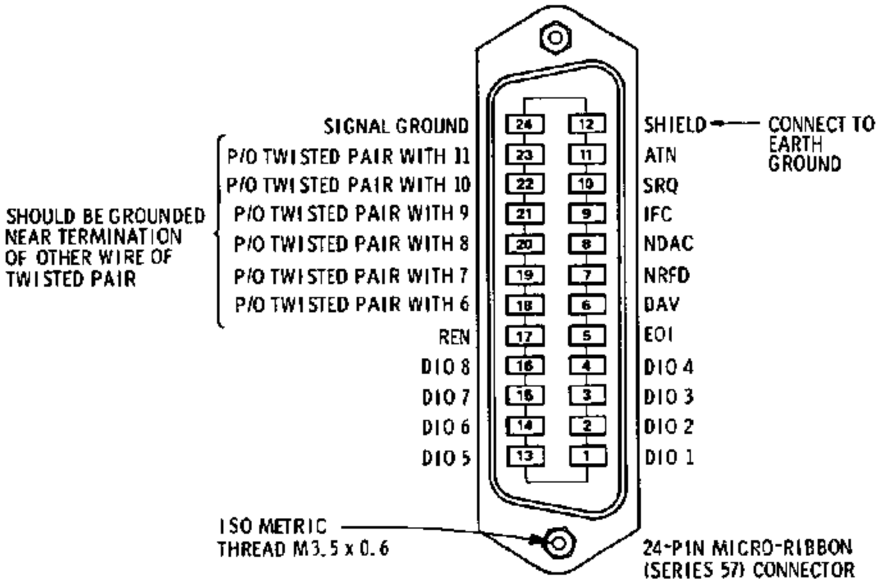
a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, complete one of the blue tags mentioned above and attach it to the instrument.)

b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

c. Use enough shock-absorbing material (75 to 100 mm layer; 3 to 4 inches) around all sides of the instrument to provide firm cushion and prevent movement in the container. Protect the front panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container "FRAGILE" to assure careful handling.



Logic Levels

The Hewlett-Packard Interface Bus Logic Levels are TTL compatible, i.e., the true (1) state is 0.0 Vdc to +0.4 Vdc and the false (0) state is +2.5 Vdc to +5.0 Vdc.

Programming and Output Data Format

Refer to Section III, Operation.

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

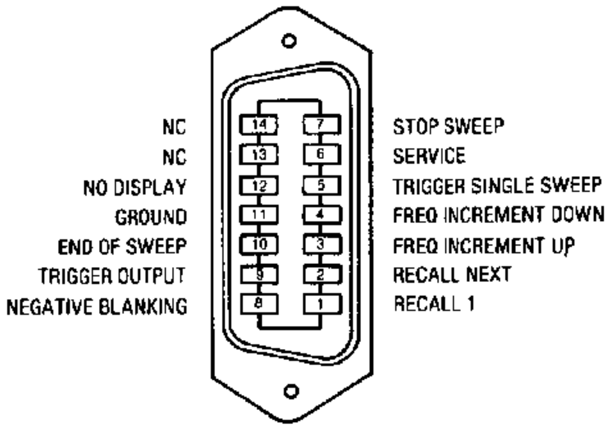
HP 10833A, 1 metre (3.3 ft), HP 10833B, 2 metres (6.6 ft)
HP 10833C 4 metres (13.2 ft), HP 10833D, 0.5 metres (1.6 ft)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus system may contain no more than 2 metres (6 ft) of connecting cable per instrument.

2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus system is 20.0 metres (65.6 ft).

Figure 2-4. Hewlett-Packard Interface Bus Connection



14-Pin Micro-Ribbon (57 Series) Connector

Logic Levels

The rear panel AUX connector logic levels are TTL compatible (5 microseconds negative-true TTL pulse or a contact closure to ground).

Internal Jumper Selection

If the signals to the rear panel AUX connector require contact debouncing (e.g., for mechanical switches), an internal jumper must be changed. The jumper is installed at the factory for electronically clean input signals (i.e., those signals that do not require the use of the debounce circuit). The jumper is located on the A2A2 Key-Code board. To change the jumper position, the top cover of the Signal Generator must be removed.

WARNINGS

This task should be performed by service trained persons who are aware of the potential shock hazard of working on an instrument with protective covers removed.

To avoid hazardous electrical shock, the line (mains) power cable should be disconnected before removing the Signal Generator's cover.

The following procedure describes how to locate and change the jumper position.

a. Set the LINE switches to STBY and Off. Disconnect the line power cables.

b. Remove the Signal Generator's top cover by removing the two plastic feet from the rear of the top cover and loosening the screw at the middle of the rear edge of the top cover.

c. Remove the A2A2 Key-Code board by gently lifting the board's extractors (the extractors are color-keyed red and black).

d. The jumper is located on the center of the board.

e. To enable the debounce circuit remove the jumper from W2 and reinstall the jumper at W1.

f. Reinstall the A2A2 Key-Code board and the Signal Generator's top cover.

Figure 2-5. AUX Interface Connector

III Operation

SECTION III
OPERATION

3-1. INTRODUCTION

This section provides complete operating information for the Signal Generator. Included in this section are both general and detailed operating instructions, detailed descriptions of the front and rear panel, local and remote operator's checks, and operator's maintenance procedures.

3-2. Operating Characteristics

Table 3-1 briefly summarizes the major operating characteristics of the Signal Generator. This table is not intended to be an in-depth listing of all operations and ranges but gives a rough idea of the instrument's capabilities. For more information on the Signal Generator's capabilities, refer to Table 1-1, Specifications, and Table 1-2, Supplemental Characteristics. For information on HP-IB capabilities, refer to the summary contained in Table 3-4, Message Reference Table.

3-3. Local Operation

Information covering front panel operation of the Signal Generator is given in the sections described below. To rapidly learn the operation of the instrument, begin with Simplified Operation and Operator's Checks. Once familiar with the general operation of the instrument, use the Detailed Operating Instructions for in-depth and complete information about operating the Signal Generator.

Turn-On Information. Instructions relating to the Signal Generator's turn-on procedure are presented to acquaint the user with the general operation of the instrument.

Simplified Operation. The instructions located on the inside of this fold provide a quick introduction to front panel operation of the Signal Generator. These instructions are designed to rapidly acquaint the new user with basic operating procedures and therefore are not an exhaustive listing of all Signal Generator functions.

Panel Features. Front and rear panel features are described in detail in Figures 3-1 through 3-7.

Operating Information Pull-Out Card. The Operating Information pull-out card is a flexible plastic reference sheet located in a tray below the front panel. It presents general operating instructions. With examples of most of the Signal Generator's features, it is a good learning aid as well as a quick reference.

3-4. Remote Operation

HP-IB. The Signal Generator is capable of remote operation via the Hewlett-Packard Interface Bus (HP-IB). Instructions pertinent to HP-IB operation cover all considerations and instructions specific to remote operation including capabilities, addressing, input and output formats, the status byte, and service requests. At the end of the discussion is a complete summary of all codes.

In addition to the section described above, information concerning remote operation appears in several other locations. General information about HP-IB codes and formats appear on the Operating Information pull-out card. Numerous examples of program strings appear throughout the Detailed Operating Instructions described under Local Operation above.

Auxiliary. The following keyboard functions can be controlled by TTL signals at the rear panel AUX connector:

RECALL 1
FREQ INCREMENT (up and down)
SINGLE Sweep

In addition, several remote-only functions are available. These controls are described in detail in the paragraph titled Auxiliary Control.

3-5. Operator's Checks

Operator's Checks are procedures designed to verify the proper operation of the Signal Generator's main functions. Two procedures are provided as described below.

Operator's Checks (cont'd)

Basic Functional Checks. This procedure requires a function generator, a microwave frequency counter, a power meter, a power sensor, a crystal detector, and interconnecting cables. It assures that most front panel controlled functions are being properly executed by the Signal Generator.

HP-IB Functional Checks. These procedures require an HP-IB compatible computing controller, an HP-IB interface, and connecting cable. The procedures check all of the applicable bus messages summarized in Table 3-3. The HP-IB Checks assume that front panel operation has been verified by performing the Basic Functional Checks.

3-6. Operator's Maintenance

WARNING

For continued protection against fire hazard, replace the line fuses with a 250V fuse of the same rating only. Do not use repaired fuses or short-circuited fuseholders.

Operator's maintenance consists of replacing defective fuses and adjusting the mechanical zero of the front panel meter.

The primary power fuse is located within the Line Power Module Assembly. Refer to Figure 2-1 for instructions on how to change the fuse.

To mechanically zero the front panel meter, set the LINE switch to the STBY position and place the Signal Generator in its normal operating position. Turn the mechanical zeroing adjustment clockwise to move the needle up scale or counterclockwise to move the needle down scale. The zero point is located at the left end of the 0—1 or the 0—3 scales. DO NOT zero on the left end of the top dB scale at −10 because this is not the proper zeroing point.

If the instrument does not operate properly and is being returned to Hewlett-Packard for service, please complete one of the blue tags located at the end of this manual and attach it to the instrument. Refer to Section II for packaging instructions.

Table 3-1. Operating Characteristics

Frequency	Range: 2.0 to 18.0 GHz Resolution: 1 kHz 2.0 to 6.6 GHz 2 kHz 6.6 to 12.3 GHz 3 kHz 12.3 to 18.0 GHz
Output Level	Range: −110 to +10 dBm in 10 dB steps Vernier: −12 to +3 dB continuously variable
Modulation	AM Depth: 30%/V and 100%/V ranges Maximum Input: 1 Vpk into 600 ohms nominal Rates (3 dB bandwidth): 10 Hz to 50 kHz FM Ranges: 30 kHz/V, 100 kHz/V, 300 kHz/V, 1 MHz/V, 3 MHz/V, and 10 MHz/V Maximum Input: 1 Vpk into 50 ohms nominal Maximum Peak Deviation (except 10 MHz/V range): the smaller of 3 MHz or f_{mod} x 5 2.0 to 6.6 GHz f_{mod} x 10 6.6 to 12.3 GHz f_{mod} x 15 12.3 to 18.0 GHz Rates (3 dB bandwidth): 100 Hz to 2 MHz for 30 kHz/V and 100 kHz/V ranges; 3 kHz to 2 MHz for 300 kHz/V, 1 MHz/V, and 3 MHz/V ranges; 50 Hz to 2 MHz for 10 MHz/V range Pulse Pulse Input: Normal Mode: >3V on, <0.5V off Complement Mode: <0.5V on, >3V off Impedance: 50 ohms nominal RF Output: ON/OFF Ratio: >70 dB Minimum Leveled Pulse Width: 80 ns Pulse Repetition Frequency: dc to 1 MHz
Sweep	Configuration: Start-Stop Frequencies or Center Frequency ΔF (Span) Modes: Automatic, Single, and Manual Step Size: as large as sweep span to as small as 1 kHz 2.0 to 6.6 GHz 2 kHz 6.6 to 12.3 GHz 3 kHz 12.3 to 18.0 GHz Number of Steps: 1 to 9999 Dwell Time: 1 to 255 ms per step Markers: 5 Markers Rear Panel BNC Sweep Connections: Sweep Out; Sweep Reference; Z-Axis Blanking/Markers; Tone Marker Output; Penlift

FRONT PANEL FEATURES

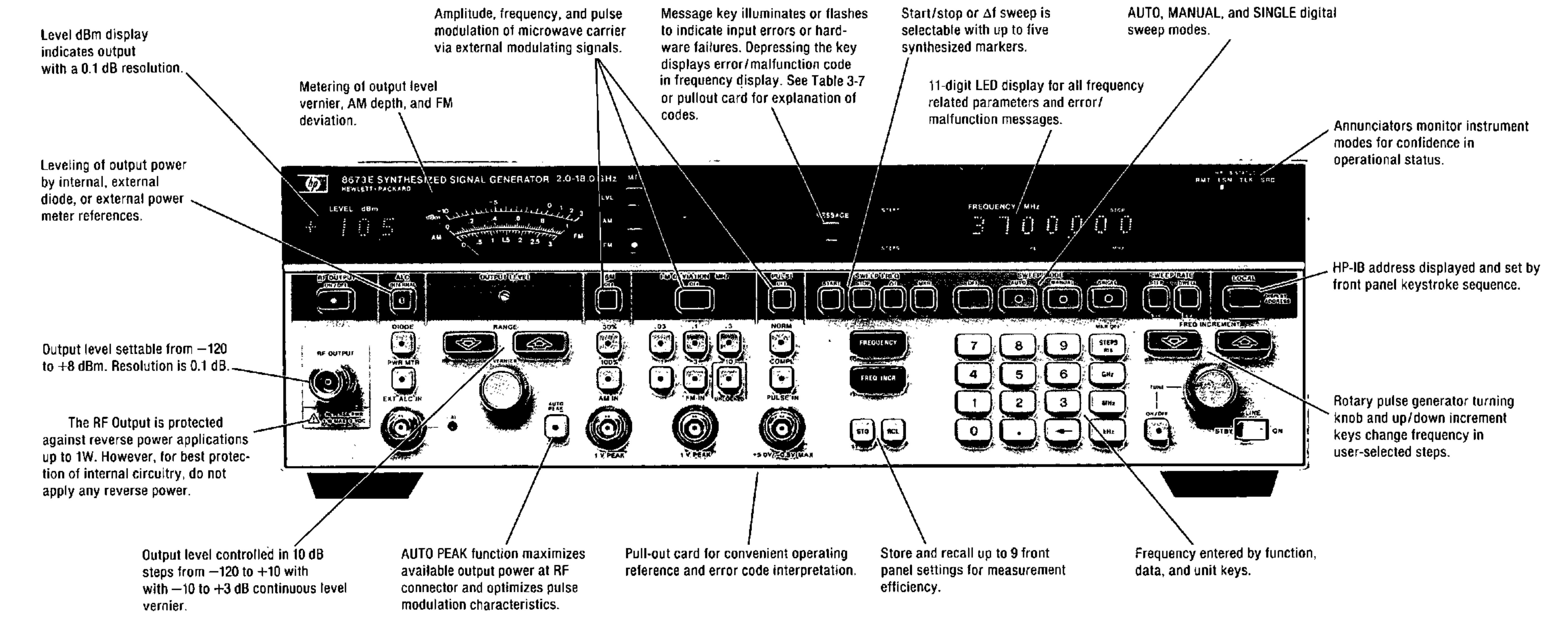


Figure 3-1. Front Panel Features

SIMPLIFIED OPERATION

PRESETTING FRONT PANEL

Press RCL 0 to set the front panel to the following conditions:

RF OUTPUT to ON
ALC INTERNAL to ON
OUTPUT LEVEL between −82 and −67 dBm
(RANGE to −70 dBm and VERNIER remains at last selected value)
AUTO PEAK to ON
Meter Scale to LVL
AM, FM, and PULSE Modulation to OFF
FREQUENCY to 3000.000 MHz
FREQ INCR to 1.000 MHz
START to 2000.000 MHz
STOP to 4000.000 MHz
ΔF to 2000.000 MHz
MKRS to OFF (initialized to 3, 6, 9, 12, and 15 GHz)
SWEEP MODE to OFF
STEP to 100 steps (20.000 MHz)
DWELL to 20 ms
TUNE Knob to ON

FREQUENCY

Frequency and frequency increment values are set in a Function-Data-Units format.

For example, to set frequency to 4.5 GHz and frequency increment to 500 MHz:

FUNCTION	DATA	UNITS
FREQUENCY	4 . 5	GHz
FREQ INCR	5 0 0	MHz

Frequencies may be entered in GHz, MHz, or kHz, but are always displayed in MHz.

To change the current frequency by the selected increment value, use:

FREQ INCREMENT ⇩ ⇧ or TUNE ON/OFF

SETTING OUTPUT LEVEL

The output level is set with the RANGE and VERNIER controls.

First press RANGE ⇩ ⇧

to step the output level down or up by increments of 10 dB.

Use the VERNIER to change output level across a continuous 15 dBm range. Absolute RF output level can be read in the LEVEL dBm display with 0.1 dB resolution.

To maintain output power at a constant level press ALC INTERNAL.

Press AUTO PEAK to maximize power at the output frequency, to minimize power of spurious signals and to optimize pulse shape for pulse modulation.

STORE/RECALL

Up to nine front panel settings can be stored for later use. All Signal Generator front panel functions can be stored, although OUTPUT LEVEL VERNIER is stored in remote mode only.

STO 3 stores a front panel setting in register 3.

RCL 4 recalls a front panel setting stored in register 4 and changes the output of the Signal Generator to the recalled parameters.

MODULATION

Three types of modulation are available: amplitude (AM), frequency (FM), and pulse. Each type requires an external drive signal. Front panel keys select the maximum AM depth, FM deviation in MHz, and normal (NORM) or complement (COMPL) pulse mode. For AM and FM, a 1 Vpk signal develops full scale modulation. Modulation varies linearly with the input signal. For pulse modulation, a TTL level positive-true pulse turns RF on in normal mode. A TTL level negative-true pulse turns RF on in complement mode. When 10 MHz/V deviation is selected, output frequency, accuracy and stability are degraded. In the 10 MHz/V deviation range the NOT φ LOCKED annunciator will come on and should be ignored.

MESSAGES

Entry errors, hardware malfunctions, and other significant conditions are indicated by the lighted MESSAGE key.

Press MESSAGE to read the two-digit code in the FREQUENCY MHz display. The codes are explained in the Error Message Table (3-7) and on the operating information pull-out card.

SWEEP

Values for SWEEP FREQ (START, STOP, ΔF, and MKR) and SWEEP RATE (STEP and DWELL) are entered in a Function-Data-Units format.

SWEEP FREQ

The SWEEP FREQ keys set the span of the sweep (that is, the range that the sweep covers). The sweep span can be set with either the START and STOP keys or with the FREQUENCY and ΔF keys.

For example, to set a sweep span of 4 GHz with a start frequency of 2 GHz and a stop frequency of 6 GHz press:

FUNCTION	DATA	UNITS		FUNCTION	DATA	UNITS
START	2	GHz	or	FREQUENCY	4	GHz
STOP	6	GHz		ΔF	4	GHz

SWEEP RATE

During a sweep, the Signal Generator changes frequency in discrete steps. Sweep rate is determined by the number of steps and the dwell time. The number of steps can be set in either of two ways.

To set the number of steps to be used in a sweep press STEP, use the numeric keys to enter the number of steps,

then press STEPS ms.

The sweep span is divided by the number of steps to determine the step size.

To set the step size, press STEP, use the numeric keys to enter the frequency of the step, then press

GHz or MHz or kHz.

The sweep span is divided by the step size to determine the number of steps.

The dwell time determines how much time elapses before the next frequency step is taken.

To set the dwell time press DWELL, use the numeric keys to enter the time in milliseconds, then press STEPS ms.

SWEEP MODE

To start a sweep press:

AUTO for a repetitive sweep.

MANUAL for a sweep that is controlled by the TUNE knob or the FREQ INCREMENT Up and Down keys.

SINGLE for one sweep only. Press this key once to tune the Signal Generator to the start frequency. Then, press this key again to actually initiate the sweep.

To stop a sweep, in any mode, press OFF

3-7. TURN-ON INSTRUCTIONS

WARNINGS

Before the instrument is switched on, all protective earth terminals, extension cords, autotransformers and devices connected to it should be connected to a protective earth grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

Only 250V normal blow fuses with the required rated current should be used. Do not use repaired fuses or short circuit fuseholders. To do so could cause a shock or fire hazard.

CAUTIONS

Before the instrument is switched on, it must be set to the voltage of the power source or damage to the instrument may result.

The Signal Generator's RF OUTPUT is protected against reverse power applications up to 1W. However, for greatest protection of expensive internal components, be careful not to apply any reverse power to the RF OUTPUT.

3-8. Turn-On

Turn-On Procedure. The Signal Generator has a standby state and an on state. Whenever the power cable is plugged in, an oven is energized to keep the reference oscillator at a stable operating temperature. If the Signal Generator is already plugged in, set the LINE switch to ON.

If the power cable is not plugged in, follow these instructions.

On the rear panel:

1. Check the line voltage switch for correct voltage selection.
2. Check that the fuse rating is appropriate for the line voltage used (see Figure 2-1). Fuse ratings are printed on the rear panel.
3. Plug in the power cable.

On the front panel, set the LINE switch to ON.

NOTE

The OVEN COLD status annunciator should light to indicate that the Signal Generator requires warming up. The annunciator should turn off within fifteen minutes and the Signal Generator should be ready for general use.

Turn-On Configuration. The Signal Generator turns on to the same control settings it had before it was switched to STBY or even completely off (that is, if line power was removed). The exception to this rule is that it always turns on in local mode.

Turn-On Memory Check. The Signal Generator performs a quick memory check at turn-on. It checks for a failure in ROM (permanent memory) or in RAM (temporary memory), and for the presence of correct data stored in RAM.

NOTE

An internal battery is used to retain data in RAM during standby and off periods. The data restores the last control setup and the nine storage registers.

If a ROM or serious RAM failure occurs, the Signal Generator will attempt to turn on to its last control setup. The Signal Generator might be useable but does require service.

If any, but not all, of the stored data is found to be incorrect, the Signal Generator will turn on to the configuration stored in the first good register. This control setup will then be stored in registers 1 through 9. Incorrect stored data could be caused by even a single bit of data being lost due to line transients, noise or other unpredictable conditions. The Signal Generator should be useable and does not require service unless this situation occurs repeatedly.

If all of the register data has been altered (for example, if the battery failed) the Signal Generator will reinitialize to the front panel preset values stored in register 0 (refer to Simplified Operation for a list of preset values). The initialized control setup will then be stored in all of the registers. The Signal Generator might be useable but does require service.

3-9. Frequency Standard Selection

A FREQ STANDARD INT/EXT switch and two connectors are located on the rear panel. A jumper

Frequency Standard Selection (cont'd) normally connects the FREQ STANDARD INT connector (A3J9) to the FREQ STANDARD EXT connector (A3J10). The FREQ STANDARD EXT connector can accept a reference signal to be used instead of the Signal Generator's internal frequency standards.

The internal frequency standard is a 10.000 MHz signal at +7 dBm (nominal) with an aging rate of $<15 \times 10^{-9}$/day after warmup (typically 24 hours). When the FREQ STANDARD INT/EXT switch is in the INT position and the jumper is connected between A3J9 and A3J10, the internal reference is enabled.

When the FREQ STANDARD INT/EXT switch is in the EXT position and the jumper is disconnected from the FREQ STANDARD EXT connector, a frequency standard of 5 or 10 MHz at 0 dBm (nominal) can be connected.

NOTE

The EXTERNAL REF status annunciator on the front panel will light when an external reference is being used. Also, the NOT ϕ LOCKED status annunciator may light if the external reference is not of sufficient accuracy in frequency or has an insufficient power level. The external reference must be within ±200 Hz of 10 MHz or ±100 Hz of 5 MHz for reliable locking to occur. If the external reference level is not within the specified limits (0.1 to 1 Vrms into 50 ohms), its level may be sufficient to turn off the NOT ϕ LOCKED status annunciator. However, the phase noise of the Signal Generator may be degraded.

3-10. ADDITIONAL OPERATING INFORMATION

Performance, from the Signal Generator, can be maximized and optimized by considering the effect of the following controls on the RF output:

a. AUTO PEAK
b. ALC
c. PULSE Modulation Mode
d. SWEEP Mode in a Master/Slave configuration

3-11. AUTO PEAK

Major power and pulse modulation specifications are not warranted unless an AUTO PEAK operation has been performed. An AUTO PEAK operation is automatically performed when the frequency changes by more than 50 MHz while AUTO PEAK is enabled. AUTO PEAK is automatically enabled when the instrument is turned on, or when PULSE mode is selected. The front panel AUTO PEAK button toggles the state of the instrument between AUTO PEAK enabled and disabled mode. A user-initiated AUTO PEAK operation may be performed manually at any time by pressing the AUTO PEAK button twice to disable and re-enable AUTO PEAK. The actual peaking operation occurs when the AUTO PEAK is switched from the disabled to enabled mode. Under program control, disabling, enabling, and performing an AUTO PEAK operation can all be controlled separately with the K0, K1, and K2 commands. See Table 3-7.

3-12. ALC (Automatic Level Control)

Output power leveling for the instrument's frequency range occurs from three sources selected by the operator. These sources are:

a. INTERNAL
b. DIODE
c. PWR MTR (Power Meter)

INTERNAL. RF power output from the signal generator is automatically leveled.

DIODE. RF output power is leveled externally using a diode detector connected to the instrument's EXT ALC IN connector.

PWR MTR (Power Meter). RF output power is leveled externally using a power meter connected to the instrument EXT ALC IN connector.

CAL Adjustment. Power level at the load is adjusted to agree with the OUTPUT LEVEL Meter when external leveling is used in DIODE or PWR MTR. External leveling techniques are discussed in Hewlett-Packard Application Note 281-5 Microwave Synthesizer Series, May 1981, HP Part number 5952-8251. Application Note 218-5 specifically applies to the 8672A; however, the main principles of applications also apply to the 8673E. Additionally, the input voltage fed back to the 8673E EXT ALC IN connector should be within a −1 V to +1 V range. Polarity is of no consequence because an internal circuit in the 8673E performs an absolute value function on the input voltage.

3-13. PULSE Modulation

The automatic execution of the AUTO PEAK function by the instrument's internal microprocessor ensures that key power and pulse specifications are met for nearly all circumstances (see Section 3-11). Three conditions that may necessitate a user-activated AUTO PEAK are: load changes, extreme frequency changes, and, in rare circumstances, frequency changes slightly less than 50 MHz.

a. Changes of load impedance can shift the center frequency of internal filters and necessitate another AUTO PEAK operation. This could occur if highly reactive loads are switched in and out in automatic test systems.

b. Large frequency changes cause extreme changes in the self-heating of internal YIG filters. Although most of the resulting drift occurs in 15-20 seconds, complete settling may take up to 15 minutes. Some experimentation may be needed to determine when AUTO PEAK is necessary for this type of measurement.

c. Finally, on rare occasions, pulse overshoot parameters may drift out of specified range for frequency changes just less than 50 MHz.

To be confident of obtaining warranted instrument performance, perform an AUTO PEAK operation just before each measurement is taken.

Another automatic instrument function determines the optimum injected pulse amplitude to the YTM. This occurs during an AUTO PEAK operation, and for vernier power level changes $\geq$0.4 dB. During itches briefly to CW for about 200 μs. Pulse mode this operation, the instrument swis then re-enabled and the injected pulse amplitude is the correct value to produce fast risetime pulses. Frequency switching speed is slowed to about 100 ms by this process.

If these bursts of CW power are objectionable, they can be eliminated by exploiting the following feature. At any one frequency, when the vernier is used to change the output power level by more than 0.4 dB, a "scratch pad" memory stores the correct injected pulse amplitude for that power level. Subsequent operation at that power level uses the "scratch pad" data instead of switching to CW to update the pulse control parameters. By sweeping over the entire −10 to +10 dBm power range for each frequency of operation, the "scratch pad" memory will contain all the necessary data for pulse operation at any power level, and no further switching to CW will occur at that frequency.

3-14. SWEEP Mode in MASTER/SLAVE Configuration

In a Master/Slave configuration, two signal generators are interconnected to obtain two swept microwave signals, at a fixed offset from each other. The two instruments are interconnected through the Hewlett-Packard Interface Bus (HP-IB). The MASTER is set to HP-IB address 50 and the SLAVE unit is set to HP-IB address 40. The desired sweep start and stop frequencies are set to identical frequencies on both the master and slave instruments. Desired offsets are then entered on the slave unit using the FREQ INCREMENT control. Swept signals from the instruments will be offset by the FREQ INCREMENT value.

In each sweep mode of operation, the designated Slave Unit will have the MANUAL and SINGLE pushbutton lamps lit. The designated Master Unit will have only the selected mode pushbutton lamp lit. A step-by-step example follows:

a. Interconnect two instruments for HP-IB Operation. Designate one instrument as the Master Unit and set its HP-IB Address to 50. Designate the other instrument as the Slave Unit and set its HP-IB Address to 40.

b. On both units, set SWEEP START to 2000 MHz and SWEEP STOP to 12000 MHz. On the Slave Unit set either the number of steps or step size. (As one example: set both master and slave units for 500 steps.)

c. On the Slave Unit select a 50 MHz offset using the FREQ INCR and the FREQ INCREMENT (▲) or (▼).

d. Press and hold SWEEP START on the Slave Unit and check for a 50 MHz offset (Display should read 12050 MHz).

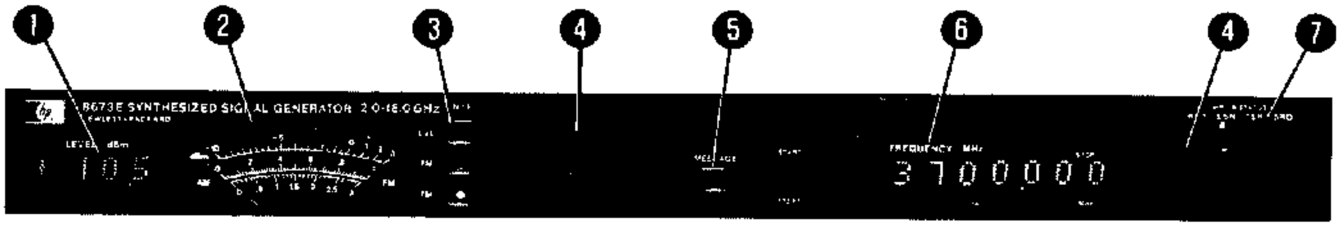
e. For AUTO Mode: Press AUTO on Master Unit; Slave Unit will have MANUAL and SINGLE pushbutton lamps lit.

f. For MANUAL Mode: Press MANUAL on Master Unit; Slave Unit will have MANUAL and SINGLE pushbutton lamps lit. On Master Unit enable TUNE ON/OFF. Use the TUNE Knob to tune both Master and Slave Units according to STEP SIZE set on respective units.

Sweep Mode in Master/Slave Configuration (cont'd)

g. For SINGLE Mode: On Master Unit, press SINGLE once to enable the sweep. Press it a second time to start one sweep. If SINGLE is pressed during a sweep, the in-progress sweep stops and re-enables.

Disabling Master/Slave Mode. Press SWEEP OFF on both Master and Slave Units. All sweep lamps will be off and only the Master Unit TUNE Knob will cause changes on the Master Unit Display.



1 LEVEL dBm Display. Indicates output level between −120 and +13 dBm with a resolution of 0.1 dB. Level is controlled by the RANGE (▲ and ▼) and vernier knob.

2 Meter. Monitors power level, AM depth, or FM deviation. Meter function is selected by the MTR keys.

3 MTR Keys. Select the meter function.

LVL: selects OUTPUT LEVEL VERNIER for −10 to +3 dB scale indication.

AM: selects 30% (read on the 0 to 3 scale) or 100% (read on the 0 to 1 scale) AM depth, full scale. A 1 volt peak signal applied to the AM IN connector develops full scale modulation.

FM: selects FM deviation. Full scale indication read on the 0 to 3 scale is 30 kHz, 300 kHz, or 3 MHz. Full scale indication read on the 0 to 1 scale is 100 kHz, 1 MHz, or 10 MHz. A 1 volt peak signal applied to the FM IN connector develops full scale modulation.

4 Status Annunciators. Display the internal conditions of the Signal Generator.

ALC UNLEVELED: lights when RF OUTPUT is turned off, more power is requested than is available, no signal is applied to EXT ALC IN when PWR MTR or DIODE is selected, no signal is applied to PULSE IN when NORM pulse mode is selected, overmodulation occurs in AM mode, or pulse width is less than 100 ns.

NOT ϕ LOCKED: lights when one or more of the phase lock loops is unlocked, the RF OUTPUT is OFF, or the INT-EXT switch is in the EXT position with no external reference connected. Whenever the 10 MHz/V range is selected this indicator will be lit and should be ignored.

FM OVERMOD: lights when the signal applied to the FM IN connector exceeds 1 volt peak.

STANDBY: lights when power is applied but the LINE switch is in the STBY position.

OVEN COLD: lights when the internal reference oscillator oven is not up to nominal operating temperature.

OUT OF RANGE: lights only in sweep mode when a combination of ΔF and FREQUENCY would cause the sweep frequency to be out of range.

EXTERNAL REF: lights when the rear panel INT-EXT switch is in the EXT position.

5 MESSAGE Key. Lights to indicate entry errors and flashes to indicate hardware malfunctions. A two-digit code appears in the FREQUENCY MHz display when this key is pressed. Refer to the pull-out card or the Messages Detailed Operating Instruction for an explanation of the codes.

6 FREQUENCY MHz Display. Normally indicates output frequency. Message codes and previously set values for FREQ INCR, SWEEP FREQ, and SWEEP RATE functions are displayed for as long as their respective keys are pressed.

7 HP-IB STATUS Annunciators. Indicate the status of the Signal Generator when it is operating via the HP-IB.

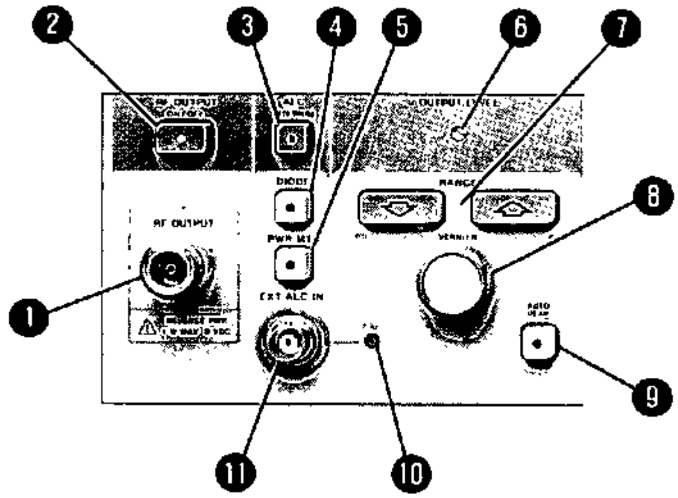
RMT: lights when the Signal Generator is in remote mode.

LSN: lights when the Signal Generator is addressed to listen.

TLK: lights when the Signal Generator is addressed to talk.

SRQ: lights when the Signal Generator is issuing the Require Service message.

Figure 3-2. Displays and Status Annunciators



1 RF OUTPUT Connector. 50 ohm Type N female connector supplies RF output over the entire frequency range of 2 to 18 GHz.

2 RF OUTPUT ON/OFF Key. Completely turns off the RF output when set to OFF. Setting the RF output to OFF causes the NOT φ LOCKED and ALC UNLEVELED status annunciators to light. When the RF OUTPUT is set to ON, the Signal Generator returns to normal operation.

3 INTERNAL Key. Selects internal circuitry for leveling the output power at the front panel RF OUTPUT connector.

4 DIODE Key. Selects external leveling mode for leveling power using an external diode detector. The output of the diode is connected to the EXT ALC IN connector.

5 PWR MTR Key. Selects external leveling mode for leveling power using an external power meter. The output of the power meter is connected to the EXT ALC IN connector.

6 Mechanical Meter Zero. Sets meter suspension so that the meter indicates zero when power is removed from the Signal Generator and the Signal Generator is in its normal operating position.

7 OUTPUT LEVEL RANGE Keys (▲ and ▼). Select the RF output level in 10 dB steps from −110 dBm.

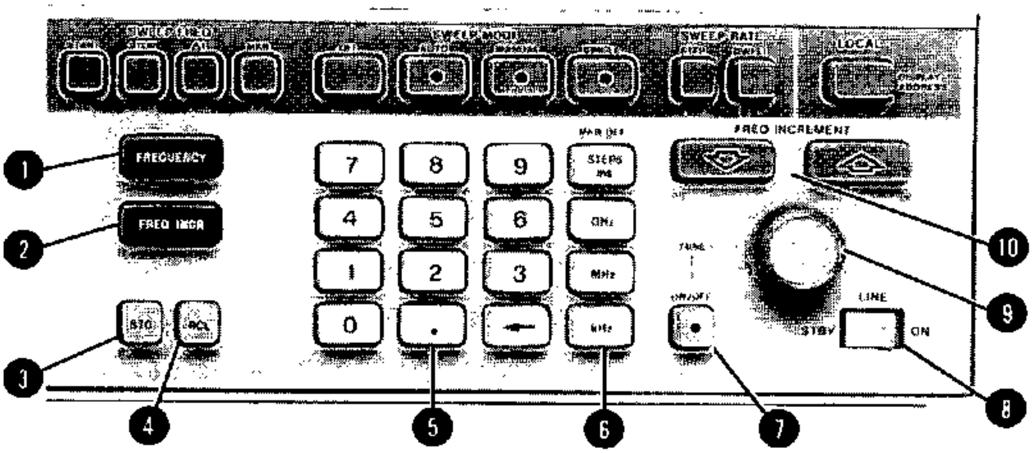
8 OUTPUT LEVEL VERNIER. Adjusts the RF output level over the range of −10 to +3 dB, relative the LVL scale as read on the meter. Although it is possible to select combinations of vernier and output level above +8 dBm, specifications apply only to the −120 to +8 dBm range.

9 AUTO PEAK Key. Maximizes power at the output frequency and optimizes pulse shape for pulse modulation.

10 CAL Control. Adjusts the power level at the load when using a diode detector or power meter for external leveling.

11 EXT ALC IN Connector. BNC female connector with high input impedance (approximately 50 kΩ). Accepts positive or negative leveling signals from either a diode detector or power meter.

Figure 3-3. Output Level Features



1 **FREQUENCY Key.** Used as a prefix to the Data and Units keys to set a continuous wave (CW) frequency or center frequency for a ΔF sweep.

2 FREQ INCR Key. Used as a prefix to the Data and Units keys to set the step size for the FREQ INCREMENT ⬇ and ⬆ keys or the TUNE knob. Pressing the FREQ INCR key recalls the current increment value to the FREQUENCY MHz display (for as long as the key is depressed).

3 **STO Key.** Used as a prefix to a numeric key (a single digit 1—9 to identify the storage register) to save the current instrument settings in an internal storage register. All front panel functions can be stored, although OUTPUT LEVEL VERNIER can be stored only in remote mode.

4 **RCL Key.** Used as a prefix to a numeric key (a single digit 0—9 to identify the storage register) to recall the contents saved in that register. The instrument settings change to the recalled parameter values.

RCL 0 is used to preset the front panel. Refer to Simplified Operation in this section for a list of preset conditions.

5 **Data Keys (0-9, ., and ←).** Used with Function keys (that is, FREQUENCY, FREQ INCR, and sweep function keys) and Units keys to set value-selectable parameters. Data keys 1—9 are also used with STO and RCL to identify the storage register.

The backspace key (←) clears one digit at a time starting with the least significant digit. It is used only during data entry and before any Units key is pressed.

6 **Units Keys (MKR OFF/STEPS/ms, GHz, MHz, and kHz).** Used as a suffix to Function and Data keys to set value-selectable parameters. Frequency entries can terminate in GHz, MHz, or kHz but they are always displayed in MHz.

The MKR OFF/STEPS/ms key serves as a terminator for setting the number of steps in a sweep, the dwell time in ms, or as a means of turning off markers. The selected function automatically determines the applicable terminator.

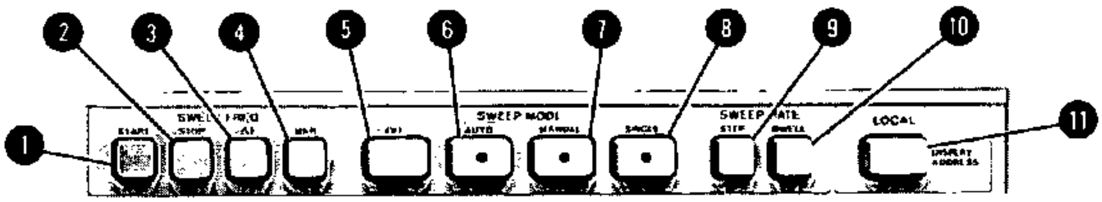
7 **TUNE ON/OFF key.** Enables the TUNE knob when ON; disables the TUNE knob when OFF. The key LED lights when it is ON.

8 **LINE Switch.** Applies power to the Signal Generator when set to the ON position. Power is supplied to the crystal oven and the battery charger circuit in the STBY and ON positions.

9 **TUNE Knob.** Changes the CW frequency by the value set with FREQ INCR. The knob is enabled by the ON/OFF key. The knob also serves as a manual sweep mode control.

10 **FREQ INCREMENT ⬆ and ⬇ Keys.** Decrease or increase the CW frequency in steps; the step size is set with the FREQ INCR key. Holding either key down causes the frequency to continuously change. These keys also serve as a manual sweep mode control.

Figure 3-4. Frequency Control Features and LINE Switch



SWEEP FREQ

❶ **START Key.** Used as a prefix to the Data and Units keys to set the beginning frequency of a sweep. Pressing this key displays the present START value in the FREQUENCY MHz display (for as long as the key is depressed).

❷ **STOP Key.** Used as a prefix to the Data and Units keys to set the ending frequency of a sweep. Pressing this key displays the present STOP value in the FREQUENCY MHz display (for as long as the key is depressed).

❸ **ΔF Key.** Used as a prefix to the Data and Units keys to set sweep span. Pressing this key displays the present span value in the FREQUENCY MHz display (for as long as the key is depressed). Center frequency of the span is set with the FREQUENCY key.

❹ **MKR Key.** Enables previously selected marker frequencies when used as a prefix to Data keys 1 through 5. For example, pressing MKR and 1 enables Marker 1. When used as prefix to the Data and Unit keys, it sets marker frequencies. For example, pressing MKR, 3, 15, and GHz sets the frequency of Marker 3 to 15 GHz. (The first digit pressed after the MKR key is always the marker number.) Pressing the MKR key displays all currently enabled marker numbers within the set sweep range in the FREQUENCY MHz display. Pressing the MKR key and a Data key displays the present frequency of the requested marker.

SWEEP MODE

❺ **OFF Key.** Disables the sweep.

❻ **AUTO Key.** Starts a repetitive sweep (restarting at the end of each sweep).

❼ **MANUAL Key.** Enables the sweep circuitry. It does not start a sweep. The TUNE knob (if enabled) or the FREQ INCREMENT (▲ and ▼ keys control the sweep.

❽ **SINGLE Key.** Arms the trigger for single sweep and tunes the Signal Generator to the start frequency. The sweep does not begin until the key is pressed again to trigger the sweep. When pressed during a sweep, the in-progress sweep aborts and rearms the trigger.

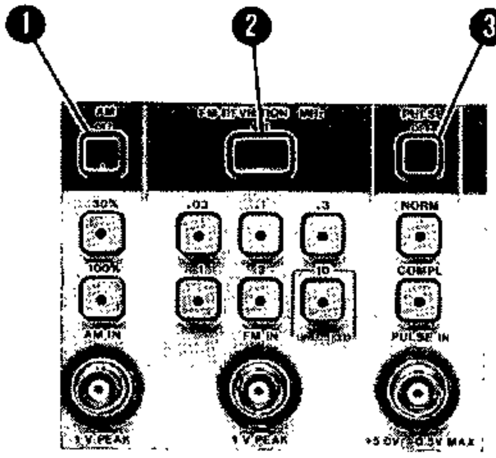
SWEEP RATE

❾ **STEP Key.** Used as a prefix to the Data and Units keys to set the number of steps or the size of each step of a sweep. When the entry is terminated by STEPS, the number of steps is set. When the entry is terminated by GHz, MHz, or kHz, the step size is set. When this key is pressed, the number of steps is displayed on the left side of the FREQUENCY MHz display and the step size is displayed on the right side. The maximum number of steps allowed is 9999.

❿ **DWELL Key.** Used as a prefix to the Data and ms keys to set the time interval between sweep steps. Pressing this key displays the present dwell time value in the FREQUENCY MHz display (for as long as the key is depressed). The allowable values for dwell time range from 1 to 255 ms.

⓫ **LOCAL/DISPLAY ADDRESS Key.** Returns the Signal Generator to local keyboard control from HP-IB (remote) control provided the instrument is not in local lockout. Also displays the current HP-IB address in the FREQUENCY MHz display for as long as the key is depressed.

Figure 3-5. Sweep Features and LOCAL Key



AM

❶ **AM OFF Key.** Disables AM.

AM 30% Key. Enables AM and selects 30% full scale modulation for 1 volt peak applied to the AM IN connector.

❷ **AM 100% Key.** Enables AM and selects 100% full scale modulation for 1 volt peak applied to the AM IN connector.

❸ **AM IN Connector.** BNC female connector with an input impedance of 600 ohms. 1 volt peak sets full scale modulation as selected by the AM 30% or 100% key. AM depth varies linearly with the input signal level.

FM DEVIATION

❹ **FM DEVIATION MHz OFF Key.** Disables FM.

❺ **FM DEVIATION Keys (.03, .1, .3, 1, 3, and 10).** Enables FM and selects the peak deviation sensitivity in MHz obtained when a signal is applied to the FM IN connector. The peak deviation is read on the meter. When 10 MHz/V is selected NOT ϕ LOCKED annunciator will come on.

❻ **FM IN Connector.** BNC female connector with an input impedance of 50 ohms. 1 volt peak gives full scale modulation. Deviation varies linearly with the input signal level. Deviation ranges are controlled by the FM DEVIATION keys.

PULSE

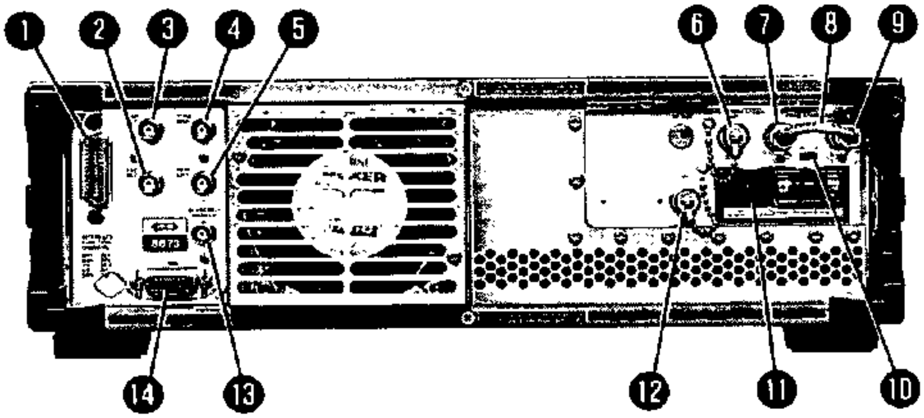
❼ **PULSE OFF Key.** Disables pulse modulation.

❽ **NORM (Normal Mode) Key.** Triggers RF output on when the signal to the PULSE IN connector is greater than 2.4 volts.

❾ **COMP (Complement Mode) Key.** Triggers RF output on when the signal to the PULSE IN connector is less than 0.4 volts.

❿ **PULSE IN Connector.** BNC female connector with an input impedance of 50 ohms. Accepts TTL levels.

Figure 3-6. Modulation Features



1 **HP-IB Connector.** Connects the Signal Generator to the Hewlett-Packard Interface Bus for remote operation. An adapter/extender has been installed to facilitate HP-IB cable connection.

2 **FREQ REF.** BNC female connector. Output impedance is 100Ω nominal. Provides a 1V/GHz ramp (+18V maximum) that is always on, even when sweep is off.

3 **SWP OUT.** BNC female connector. Output impedance is 100Ω nominal. Provides a 0 to +10V ramp from start to stop. An internal adjustment can set the slope of the ramp from 0 to between +4 and +12V.

4 **TONE MKR.** BNC female connector. Output impedance is 600Ω nominal, 5 kHz sine wave. Can be connected to front panel AM IN to provide AM markers.

5 **PEN LIFT.** BNC female connector. TTL-high lifts pen; TTL-low lowers pen. 100 ms delay to lift or lower pen in single sweep mode.

6 **10 MHz OUT (A3J8).** 0 dBm (nominal) into 50Ω, can be used as an external timebase and for troubleshooting.

7 **FREQ STANDARD Output (A3J9).** 10.000 MHz into 50Ω at +7 dBm (nominal) from the internal frequency standard except when INT/EXT switch is in the EXT position.

8 **Jumper (A3W3).** Normally connects the Internal Frequency Standard Output (A3J9) to the External Frequency Standard Input (A3J10).

9 **FREQ STANDARD Input (A3J10).** Normally connected by A3W3 to A3J9. Also used to connect an external frequency standard of 5 or 10 MHz at 0 dBm to the Signal Generator.

10 **FREQ STANDARD INT/EXT Switch.** Normally left in the INT position. Removes power from internal frequency standard when in the EXT position.

11 **Line Power Module.** Permits operation from 100, 120, 220, or 240 Vac. The number visible in the window displays the nominal line (mains) voltage for which the Signal Generator is set (see Figure 2-1). The protective grounding conductor connects to the Signal Generator through this module. The line power fuse is part of this module and is the only part to be changed by the operator.

12 **100 MHz OUT (A3J7).** 0 dBm (nominal) into 50Ω; can be used as an external timebase and for troubleshooting.

13 **BLANKING/MARKER.** BNC female connector. Output impedance is 100Ω nominal. Provides +5V at the beginning of each frequency change for blanking a swept display (to eliminate display of switching transients). Goes to −5V during remainder of frequency step for Z-Axis intensity marker or to 0V for non-marker frequencies.

14 **AUX Connector.** Allows remote control of frequency increment, display blanking, register recall, and start and stop sweep. Refer to Table 3-2, AUX Connector Functions, for additional information.

Figure 3-7. Rear Panel Features

3-15. OPERATOR'S CHECKS

3-16. Basic Functional Checks

Description

The purpose of these checks is to give reasonable assurance that the instrument is operating properly.

Each check has been designed to be performed with a minimum of test equipment, and in as short a time as possible. Therefore, although these checks are extremely valuable in locating malfunctions, they are not a substitute for the Performance Tests in Section IV, which verify that the instrument is performing within its published specifications.

Each check is independent from the others and can be performed separately. Simply press RCL 0 to preset the Signal Generator to a known state before beginning an individual check.

If a malfunction is suspected and the Signal Generator is being returned to Hewlett-Packard for service, perform the entire procedure. Document the checks that failed on a blue repair tag located at the rear of this manual and attach the tag to the instrument. This will help ensure that the malfunction has been accurately described to service technicians for the best possible service.

Equipment

Test Oscillator .... HP 3335A
Pulse Generator .... HP 8013B
Oscilloscope .... HP 1980B
Attenuator, 10 dB .... HP 8491B, Option 010

Procedure

Turn-On Check

1. Set the LINE switch to STBY. Remove all external cables from the front and rear panels of the Signal Generator, including the power cable connecting the instrument to mains power.

2. Set the rear panel FREQ STANDARD INT/EXT switch to INT and the JUMPER (A3W3) to connect A3J9 and A3J10.

3. After the power cable has been disconnected from the Signal Generator for at least 1 minute, reconnect it to the Signal Generator. Check the front panel of the instrument to verify that the STANDBY and OVEN COLD status annunciators are on.

4. Leave the instrument's LINE switch set to STBY until the OVEN COLD status annunciator turns off. This should occur in 15 minutes or less, depending upon how long the Signal Generator was disconnected from mains power. (The OVEN COLD annunciator may flicker off and on temporarily just as the oven stabilization temperature is reached. This is normal operation.) Once the OVEN COLD status annunciator is off set the LINE switch to ON.

NOTES

If the MESSAGE key light is on or flashing, the instrument self-diagnostics detected a malfunction during turn-on. Press and hold the MESSAGE key to display the message code in the FREQUENCY MHz display. Any code other than 00 represents an error. Refer to the operating information pull-out card for a complete listing of message codes and the malfunctions they represent.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

NOTES (cont'd)

Occasionally, due to line transients or other external conditions, the instrument self-diagnostics may indicate a false error. Pressing the MESSAGE key and repeating the turn-on procedure will usually differentiate between real and false errors. Errors that repeat are usually real.

5. Set the FREQ STANDARD INT/EXT switch to EXT. Verify that the EXT REFERENCE and NOT ϕ LOCKED status annunciators turn on. Set the switch back to INT. The status annunciators should then turn off.

6. Press RCL 0. Verify that the instrument is now preset to the following conditions:
   RF OUTPUT to ON
   ALC INTERNAL to ON
   OUTPUT LEVEL between −82 and −67 dBm
   (RANGE to −70 dBm and the VERNIER setting remains at the last selected level)
   AUTO PEAK to ON
   Meter scale to LVL
   AM, FM, and Pulse Modulation to OFF
   FREQUENCY to 3000.000 MHz
   FREQ INCR to 1.000 MHz
   START to 2000.000 MHz
   STOP to 4000.000 MHz
   ΔF to 2000.000 MHz
   Markers off but set to 3, 6, 9, 12 and 15 GHz
   SWEEP to OFF
   STEP to 100 Steps (20.000 MHz)
   DWELL to 20 ms
   TUNE Knob to ON
   All Status Annunciators off
   MESSAGE key light off

Frequency Check:

The FREQUENCY MHz display and NOT ϕ LOCKED status annunciator are used to check that the internal phase-lock loops remain phase locked across their tuning range. The actual frequency at the RF OUTPUT connector is not checked. However, this connector can be monitored with a microwave frequency counter or spectrum analyzer for greater assurance that the Signal Generator is operating properly.

7. Press RCL 0. Then, set the Signal Generator's frequency to 2 GHz and frequency increment to 1 kHz. Slowly tune from 2000.000 MHz to 2000.010 MHz. Verify that the NOT ϕ LOCKED annunciator remains off at each step.

8. Set FREQ INCR to the values shown in the following table. For each FREQ INCR value, slowly tune from the corresponding start frequency to the stop frequency. Each time, verify that the NOT ϕ LOCKED status annunciator remains off. (Each phase-lock loop is tuned over its entire range.)

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

FREQ INCR	Start Frequency	Stop Frequency
10 kHz	2000.010 MHz	2000.100 MHz
100 kHz	2000.100 MHz	2001.000 MHz
1 MHz	2001.000 MHz	2010.000 MHz
10 MHz	2010.000 MHz	2100.000 MHz
100 MHz	2100.000 MHz	3000.000 MHz
1 GHz	3000.000 MHz	18000.000 MHz

9. Set FREQUENCY to 1.95 GHz and then to 18.6 GHz. (This is the overrange region of operation.) Verify that the NOT ϕ LOCKED annunciator remains off at both frequencies.

Output Level Check

The Signal Generator's output leveling loop is checked to ensure that it remains locked at all specified power levels. The internal output leveling loop monitors most of the RF output circuitry.

10. Press RCL 0 to set the Signal Generator to a known state.

11. Connect a 50-ohm load or 10 dB attenuator to the Signal Generator's RF OUTPUT connector. (This reduces unwanted power reflections back into the RF OUTPUT connector, thereby preventing a false ALC UNLEVELED annunciator indication.)

12. Set FREQUENCY to 6.6 GHz and Output Level to −72.0 dB. Press the RF OUTPUT key to OFF. Verify that the ALC UNLEVELED and NOT ϕ LOCKED status annunciators turn on and that the meter indicates <−10dB.

13. Press the RF OUTPUT ON/OFF key to ON. Verify that the status annunciators turn off and that the meter indicates −2 dB.

14. Step the output level down in 10 dB steps from −72 to −92 dBm using the RANGE ⬇ key. Then, step the output level up in 10 dB steps from −92 to +8 dBm. Verify that the ALC UNLEVELED annunciator remains off.

15. Set Output Level to 0 dBm and sweep the Output Level VERNIER across its entire range. Verify that the ALC UNLEVELED annunciator remains off at all VERNIER settings.

16. Set FREQ INCR to 10 MHz. Then, set the output level to +8 dBm. Tune from 2000.000 MHz to 18000.000 MHz. Verify that the indicated power level on the meter remains constant and stable and that the ALC UNLEVELED annunciator remains off. (This ensures that the instrument can generate specified output power and remain leveled.)

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

Sweep Check

The FREQUENCY MHz display is used to check the ability of the internal phase-lock loops to remain phase locked while sweeping. A spectrum analyzer can be used to monitor the signal at the RF OUTPUT connector for greater assurance that the Signal Generator is operating properly.

17. Press RCL 0 to set the instrument to a known state. Then, press the AUTO sweep key. Verify that the FREQUENCY MHz display now shows a start frequency of 2000 MHz and a stop frequency of 4000 MHz. The AUTO key light should flash once each time a new sweep begins.

18. Press SWEEP MODE OFF. Verify that the FREQUENCY MHz display returns to 3000.000 MHz.

19. Press the MANUAL sweep key. The FREQUENCY MHz display should show 2000.000 MHz. Tune the frequency up by turning the TUNE knob clockwise. Verify that the FREQUENCY MHz display changes in 20 MHz increments and stops at 4000.000 MHz.

20. Tune the frequency down to 2000.000 MHz by turning the TUNE knob counter-clockwise. Verify that the FREQUENCY MHz display changes in 20 MHz steps and stops at 2000.000 MHz.

21. Press the SWEEP MODE OFF key and verify that the FREQUENCY MHz returns to 3000.000 MHz.

22. Press the SINGLE sweep key. Verify that the key light turns on and the FREQUENCY display shows 2000.000 MHz.

23. Press the SINGLE sweep key again. A single sweep should now be executed. Verify that the FREQUENCY MHz display changes in 20 MHz steps very rapidly until 4000.000 MHz is reached. The display then returns to the START frequency of 2000.000 MHz.

24. Press the SWEEP OFF key. Verify that the FREQUENCY MHz display returns to 3000.000 MHz.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

AM Check

The front panel meter is used as an indication of AM. The meter monitors input signal level only, rather than actual AM. A spectrum analyzer can be used to monitor the signal at the RF output connector for greater assurance of AM performance. The ALC UNLEVELED status annunciator is used to verify that overmodulation does not occur.

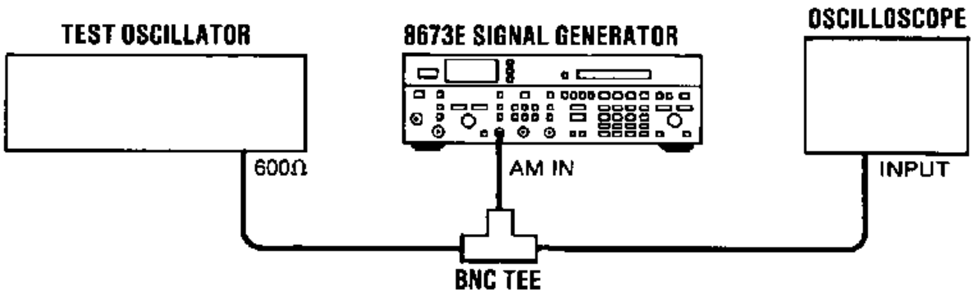


Figure 3-8. AM Functional Check Setup

25. Press RCL 0 to preset the Signal Generator to a known state.

26. Set the test oscillator to 10 kHz at an output level of 0V. Then, connect the test oscillator and oscilloscope to the Signal Generator as shown in Figure 3-8.

27. Set the Signal Generator to 18 GHz, 0 dBm, and AM 100% on. Slowly increase the test oscillator's output level (starting from 0V) while observing the Signal Generator's meter in AM mode. The meter should indicate a smooth and continuous increase in AM depth. When the meter displays 75% AM, verify that the oscilloscope displays a 0.75V peak sinewave. The ALC UNLEVELED status annunciator should remain off at all times.

28. Press AM OFF and disconnect the test oscillator and oscilloscope from the Signal Generator.

FM Check

The front panel meter is used to monitor input signal level, which is proportional to FM deviation. A spectrum analyzer can be used to monitor the signal at the RF OUTPUT connector for greater assurance of FM performance. The NOT ϕ LOCKED status annunciator detects a deliberate FM overmodulation condition.

29. Press RCL 0 to preset the Signal Generator to a known state. Set Output Level to 0 dBm. Then, set the meter scale to FM.

30. Set the test oscillator to 100 kHz at an output level of 0V. Then, connect test oscillator and oscilloscope to the Signal Generator as shown in Figure 3-9.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

FM Check (cont'd):

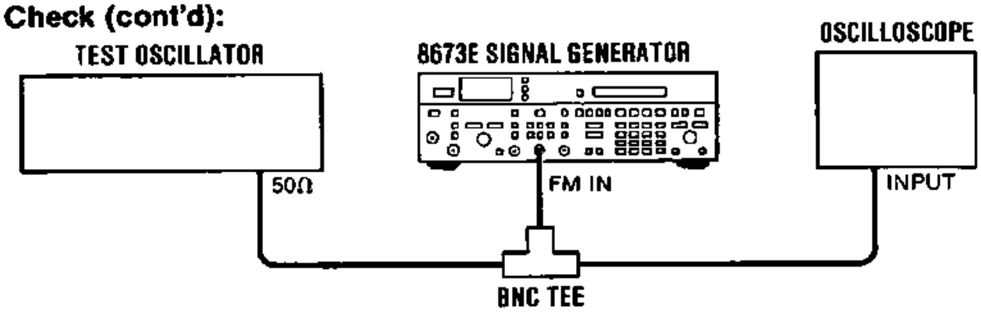


Figure 3-9. FM Functional Check Setup

31. Slowly increase the output level of the test oscillator (starting from 0V) until the Signal Generator's meter reads full scale. Verify that the meter increases slowly and continuously and that the NOT φ LOCKED status annunciator remains off. The oscilloscope display should be approximately 1V peak.

32. Repeat step 31 for each of the following FM deviation ranges: .1, .3, 1, 3, and 10 MHz.

NOTE

In the 10 MHz range, the NOT φ LOCKED annunciator will be on constantly and should be ignored.

Pulse Modulation Check

Pulse modulation is checked using various front panel status annunciators. Although pulse modulation is not monitored at the RF OUTPUT connector, the status annunciators give a high degree of confidence that pulse modulation is functionally working.

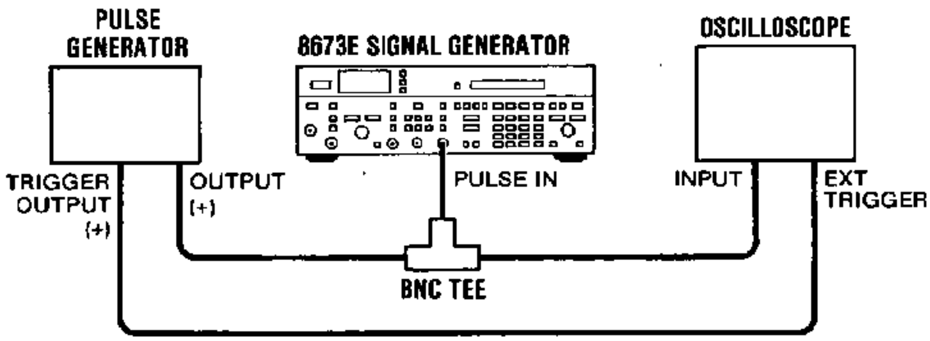


Figure 3-10. Pulse Modulation Functional Check Setup

33. Press RCL 0. Set Output Level to 0 dBm.

34. Press the PULSE COMPL key. The ALC UNLEVELED status annunciator should remain off.

35. Press the PULSE NORM key. Verify that the ALC UNLEVELED status annunciator turns on. Press PULSE OFF and verify that ALC UNLEVELED status annunciator now turns off.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

Pulse Modulation Check (cont'd):

36. Connect the pulse generator and oscilloscope to the Signal Generator as shown in Figure 3-10.

37. Set the oscilloscope to 50 ohm input and external horizontal trigger.

38. Set the pulse generator to the following:

    pulse period range .... 20 ns—1 μs
    pulse delay range .... 35 ns—1 μs
    pulse width range .... 10 ns—1 μs
    amplitude range .... 2—5V

    In addition, internal load and normal pulse should be selected. (Internal load places a 50Ω internal load on output pulse for proper impedance matching.)

39. On the pulse generator, adjust the pulse period vernier for an oscilloscope display of 1 pulse per microsecond. Then, adjust the pulse width vernier (and oscilloscope) for an individual pulse width of approximately 150 ns. Adjust the amplitude vernier for a pulse height of approximately 3V peak.

40. With Pulse OFF selected (CW mode), note the indicated power level on the Signal Generator's meter (should be 0 dBm). Press PULSE NORM and PULSE COMPL keys while observing any change in indicated output power level. Indicated level should not vary more than ± 2 dB from the level referenced with pulse off.

41. While in PULSE NORM mode, slowly reduce the pulse width from 150 ns to 50 ns. The ALC UNLEVELED annunciator should come on as 80 ns pulse width is approached. It should remain on down to at least 50 ns. The output level indicated on Signal Generator meter may also vary >2 dB as the ALC UNLEVELED annunciator comes on. This is normal instrument operation, indicating a "pulse unleveled" condition.

42. Press PULSE OFF and disconnect the oscilloscope and test oscillator from the Signal Generator.

Memory Check

43. Press RCL 0 to preset the Signal Generator to a known state. Set FREQUENCY to 15 GHz and Output Level to −20 dBm.

44. Turn the Signal Generator's LINE switch to STBY, wait 30 seconds, then turn the LINE switch to ON. Verify that the FREQUENCY MHz display shows 15000.000 MHz and the LEVEL dBm display shows −20 dBm.

Message Check

45. Press RCL 0 to preset the Signal Generator to a known state. Set FREQUENCY to 30 GHz and verify that the MESSAGE key light turns on.

46. Press and hold the MESSAGE key. The FREQUENCY MHz display should show message code 01 (frequency out of range).

47. Release the MESSAGE key. Verify that the key light turns off.

OPERATOR'S CHECKS

3-17. HP-IB FUNCTIONAL CHECKS

Description

These procedures check the Signal Generator's ability to process or send the HP-IB messages described in Table 3-4. Only the Signal Generator, a controller, and an HP-IB interface are needed to perform these checks.

These procedures do not check if all Signal Generator program codes are being properly interpreted and executed by the instrument. However, if the power-up sequence (including the memory checks) and the front panel operation is good, the program codes, in all likelihood, will be correctly implemented.

The validity of these checks is based on the following assumptions:

a. The Signal Generator performs properly when operated via the front panel keys (that is, in local mode). This can be verified by the Basic Functional Checks.

b. The bus controller properly executes HP-IB operations.

c. The bus controller's HP-IB interface properly executes the HP-IB operations.

If the Signal Generator appears to fail any of these HP-IB checks, the validity of the above assumptions should be confirmed before attempting to service the instrument.

The select code of the controller's HP-IB interface is assumed to be "7". The address of the Signal Generator is assumed to be "19" (its address as set at the factory). This particular select code address combination (that is, 719) is not necessary for these checks to be valid. However, the program lines presented here have to be modified for any other combination. Press and hold LOCAL/DISPLAY ADDRESS to see the current address in the FREQUENCY MHz display. Instructions for changing the address are in Section II, Installation.

These checks can be performed together or separately. Any special requirements for a check are described at the beginning of the check.

Initial Setup

The test setup is the same for all of the checks. Connect the Signal Generator to the bus controller via the HP-IB interface.

Equipment

HP IB Controller .... HP 85B/82936A (ROM Drawer) /00085-15005 (Advanced Programming ROM)
—or—
HP 9826A Option 011 (Basic 2.0 ROM based system)

HP-IB Interface .... HP 82937A (HP 855B only)

Remote and Local Messages and the LOCAL Key

NOTE: This check determines if the Signal Generator properly switches from local to remote control, from remote to local control, and if the LOCAL key returns the instrument to local control. If the Signal Generator is in remote mode (that is, the front panel RMT annunciator is on), switch the instrument to STBY, then to ON.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Send the Remote message (by setting Remote Enable, REN, true and addressing the Signal Generator to listen).	REMOTE 719	REMOTE 719

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT and LSN annuncuators are on.

Send the Local message to the Signal Generator	LOCAL 719	LOCAL 719

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is off but its LSN annunciator is on.

Send the Remote message to the Signal Generator	REMOTE 719	REMOTE 719

OPERATOR'S RESPONSE: Check that both the Signal Generator's RMT and LSN annunciators are on. Press the LOCAL key on the Signal Generator. Check that the Signal Generator's RMT annunciator is now off, but that its LSN annunciator remains on.

Receiving the Data Message

NOTE: This check determines if the Signal Generator properly receives Data messages.

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Send the first part of the Remote message (enabling the Signal Generator to remote).	REMOTE 7	
Address the Signal Generator to listen (completing the Remote message), then send a Data message.	OUTPUT 719; "FR15GZ"	OUTPUT 719; "FR15GZ"

Sending the Data Message

NOTE: This check determines if the Signal Generator properly issues Data messages when addressed to talk. Before beginning this check, turn the Signal Generator's LINE switch to STBY, then to ON. Then key in RCL 0 to preset the front panel. (If an HP 9826A controller is used, a short program is required to perform the check.)

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Sending the Data Message (cont'd)

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Send the Remote message	10 REMOTE 719	REMOTE 719
Send a Data message causing Generator to output its lock frequency.	20 OUTPUT 719; "OK"	OUTPUT 719; "OK"
Address the Generator to talk and store its output in variable V.	30 ENTER 719;V	ENTER 719;V
Display the value of V.	40 DISP V	DISP V
	50 END	

OPERATOR'S RESPONSE: Check that the Signal Generator's TLK annunciator is on. The controller's display should read 3.E + 9 (HP 9826A) or 3000000000 (HP 85B). This corresponds to the data output shown in the FREQUENCY MHz display.
Check that the Signal Generator's RMT annunciator is off but its LSN annunciator is on.

Local Lockout and Clear Lockout/Set Local Messages

NOTE: This check determines if the Signal Generator properly receives the Local Lockout message, disabling the LOCAL key. The check also determines if the Clear Lockout/Set Local message is properly received and executed by the Signal Generator. This check assumes that the Signal Generator is in the remote mode.

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Send the Local Lockout message.	LOCAL LOCKOUT 7	LOCAL LOCKOUT 7

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is on. Press the Signal Generator's LOCAL key. The RMT annunciator should remain on.

Send the Clear Lockout/Set Local message.	LOCAL 7	LOCAL 7

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is off.

Return the Signal Generator to remote mode if the remaining checks in this section are to be performed.	REMOTE 719	REMOTE 719

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is on.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Clear Message

NOTE: This check determines if the Signal Generator properly responds to the Clear message. This check assumes that the Signal Generator is in the remote mode.

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Send a Data message that turns AUTO PEAK off.	OUTPUT 719;"K0"	OUTPUT 719; "K0"

OPERATOR'S RESPONSE: Check that the Signal Generator's AUTO PEAK key light is off.

Send the Clear message (turning the Signal Generator's AUTO PEAK function on.)	CLEAR 719	CLEAR 719

OPERATOR'S RESPONSE: Check that the Signal Generator's AUTO PEAK key light is on.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Abort Message

NOTE: This check determines if the Signal Generator becomes unaddressed when it receives the Abort message. This check assumes that the Signal Generator is in the remote mode.

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Address the Signal Generator to listen.	OUTPUT 719	OUTPUT 719

OPERATOR'S RESPONSE: Check that the Signal Generator's LSN annunciator is on.

Send the Abort message, unaddressing the Signal Generator from listening.	ABORT 7	ABORTIO 7

OPERATOR'S RESPONSE: Check that the Signal Generator's LSN annunciator is off.

Status Byte Message

NOTE: This check determines if the Signal Generator sends the Status Byte message. Before beginning this check, turn the Signal Generator's LINE switch to STBY, then to ON.

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Place the Signal Generator in serial-poll mode (causing it to send the Status Byte message). Display the value of V (the Status Byte).	SPOLL (719)	SPOLL (719)

OPERATOR'S RESPONSE: The controller's display should read 12 .

Require Service Message

NOTE: This check determines if the Signal Generator can issue the Require Service message (set the SRQ bus control line true). This check can be performed in either local or remote mode.

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Send a Data message to set the RQS Mask to 32.	OUTPUT 719 USING "2A, B"; "@1", 32	OUTPUT 719 USING "2A, B"; "@1", 32
Send a Data message containing an invalid HP-IB code. This causes a Require Service message to be sent.	OUTPUT 719; "FR35GZ"	OUTPUT 719; "FR35GZ"

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Require Service Message (cont'd)

OPERATOR'S RESPONSE: Check that the SRQ annunciator is on.

NOTE: In the next step, a short program is required if the HP 9826A is the controller.

Read the binary status of the controller's HP-IB interface and store the data in variable V (in this step, 7 is the interface's select code).	10 V=0 20 STATUS 7, 7; V	STATUS 7, 2;V
Display the value of the SRQ bit (in this step 10 is the SRQ bit for the HP 9826A and 5 is the SRQ bit for the HP 85B, numbered from 0).	30 DISP "SRQ="; BIT (V, 10) 40 END	DISP"SRQ=";BIT(V, 6)

OPERATOR'S RESPONSE: Check that the SRQ value is 1, indicating the Signal Generator issued the Require Service message.

Status Bit Message

NOTE: This check determines whether or not the Signal Generator sends the Status Bit message. This check can be performed in either local or remote mode. If the Signal Generator's SRQ annunciator is off, perform the first part of the Require Service Message check before beginning this check. If an HP 9826A controller is used, two short programs are required to perform this check.

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Configure the Signal Generator to respond to a parallel poll on HP-IB data line DI03.	10 PPOLL CONFIGURE (719)	SEND 7; LISTEN 19 CMD 5 SCG 10
Place the Signal Generator in parallel poll mode (causing it to send the Status Bit message) and store the result in variable V.	20 V = PPOLL(7)	V = PPOLL(7)
Display the value of V.	30 DISP V 40 END	DISP V

OPERATOR'S RESPONSE: Check that the SRQ annunciator is on and that the response to the parallel poll is 4, indicating that the Signal Generator issued the Status Bit message.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Status Bit Message (cont'd)

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Unconfigure the Signal Generator from responding to a parallel poll.	10 PPOLL UNCONFIGURE(719); 10	SEND 7; LISTEN 19 CMD 5 SCG 18
Place the Signal Generator in parallel poll mode.	20 V = PPOLL(7)	V = PPOLL (7)
Display the value of V.	30 DISP V	DISP V
	40 END	

OPERATOR'S RESPONSE: Check that the SRQ annunciator is on and that the response to the parallel poll is 0, indicating that Signal Generator is no longer configured to respond to a parallel poll. Then, turn the LINE switch to STBY, then to ON, to turn the SRQ annunciator off.

Trigger Message

NOTE: This check determines if the Signal Generator responds to the Trigger message.

Description	HP 9826A (BASIC)	HP 85B (BASIC)
Send the Remote message.	REMOTE 719	REMOTE 719
Send a Data message to set the Signal Generator's frequency to 9999 MHz.	OUTPUT 719; "FR 9999 MZ"	OUTPUT 719; "FR 9999 MZ"
Set the Signal Generator's frequency increment to 1111 MHz.	OUTPUT 719; "FI 1111 MZ"	OUTPUT 719; "FI 1111 MZ"

OPERATOR'S RESPONSE: Check that the Signal Generator's frequency is set to 9999 MHz. Then press the Signal Generator's FREQ INCR key to check for an increment of 1111 MHz. This keyboard function is possible in the remote state (even if local lockout is enabled).

Configure the Signal Generator's trigger response to be an INCREMENT (down) function (that is, DN).	OUTPUT 719; "CT DN"	OUTPUT 719; "CT DN"
Send a Trigger message.	TRIGGER 719"	TRIGGER 719

OPERATOR'S RESPONSE: Check that the Signal Generator's frequency changes to 8888 MHz.

3-18. REMOTE OPERATION, AUXILIARY CONTROL

3-19. AUX Input Lines

A limited number of instrument functions can be controlled through the rear panel AUX connector. These functions are listed in the table below.

The input lines are TTL compatible and negative-edge sensitive. They require a minimum of 5 μs between negative edges. Input signals can be generated by clean TTL drivers or by mechanical switches that require debouncing. The Signal Generator has a built-in debouncing circuit that should be enabled or bypassed depending upon which type of driver is used.

The Signal Generator is shipped from the factory configured for electrically-clean control signals (that is, the internal debouncing circuit is bypassed). One way to determine if the debouncing circuit is bypassed is described below.

- Set FREQ INCR to 1 GHz.
- Ground pin 3 (FREQ INCREMENT Up) several times and observe the change in frequency.
- If the FREQ INCREMENT steps are erratic, the debouncing circuit is still bypassed.
- If the frequency consistently changes in steps of 1 GHz, the debouncing circuit is enabled.

Refer to Section II, Installation, for the procedure for enabling or bypassing the debouncing circuit.

NOTE

Section II, Installation, also shows the pinout configuration of the AUX connector as well as information for a recommended mating connector.

3-20. AUX Output Lines

The AUX connector also has a ground line and three TTL-compatible output lines. The output lines are normally held at the high TTL level. The End of Sweep line produces one 5 μs low-going pulse at the end of each sweep. The Trigger line produces one 5 μs low-going pulse when the Signal Generator has made a large frequency change that may cause loss of phase lock in an instrument tracking the Signal Generator. The Negative Blanking line produces −5V for Z-axis blanking of CRT displays that require a negative blanking voltage.

Table 3-2 AUX Connector Functions

	Pin	Function	Description
INPUTS	1	Recall 1	Recalls the contents of internal storage register 1.
	2	Recall Next	Sequential recall of internal storage registers 2 through 9
	3	FREQ INCREMENT Up	Same as FREQ INCREMENT Up key
	4	FREQ INCREMENT Down	Same as FREQ INCREMENT Down key
	5	Trigger Single Sweep	Same as SINGLE key
	6	Service	Same as internal service switch (on A2A2 Key Code Assembly). Refer to Section VIII, Service
	7	Stop Sweep	Stops sweep. Sweep resumes when this line goes high
	12	No Display	Blanks FREQUENCY MHz display when this pin is grounded and the existing display changes
OUTPUTS	8	Negative Blanking	−5V for blanking
	9	Trigger	One pulse when the Signal Generator has made a frequency change that may cause loss of phase lock to an instrument tracking the Signal Generator
	10	End of Sweep	One pulse at end of each sweep
	11	Ground	

3-21. REMOTE OPERATION, HEWLETT-PACKARD INTERFACE BUS

The Signal Generator can be operated through the Hewlett-Packard Interface Bus (HP-IB). Bus compatibility, programming, and data formats are described in the following paragraphs.

All front panel functions (except that of the LINE switch and the backspace key) and remote-only functions are programmable via HP-IB.

A quick test of the Signal Generator's HP-IB interface is described earlier in this section under Remote Operator's Checks. These checks verify that the Signal Generator can respond to or send each of the applicable bus messages described in Table 3-3.

3-22. HP-IB Compatibility

The Signal Generator has a three-state, TTL, HP-IB interface which can be used with any HP-IB computing controller or computer for automatic system applications. The Signal Generator is programmable via the HP Interface Bus. Its programming capability is described by the twelve HP-IB messages listed in Table 3-3. The Signal Generator's compatibility with HP-IB is further defined by the following list of interface functions: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DT1, and C0. A more detailed explanation of these compatibility codes can be found in IEEE Standard 488-1978 (and the identical ANSI Standard MC1.1). For more information about HP-IB, refer to the Hewlett-Packard Electronic Instruments and Systems catalog and the booklet titled "Improving Measurements in Engineering and Manufacturing" (HP part number 5952-0156).

3-23. Remote Mode

Remote Capability. The Signal Generator communicates on the bus in both remote and local modes. In remote, most of the Signal Generator's front panel controls are disabled. Exceptions are the LINE switch, the LOCAL key, the MTR keys, the MESSAGE key, and the FREQUENCY, FREQ INCR, SWEEP FREQ and SWEEP RATE keys for displaying "hidden" parameters. However, front panel displays remain active and valid. In remote, the Signal Generator can be addressed to talk or listen. When addressed to listen, the Signal Generator automatically stops talking and responds to the following messages: Data, Trigger (if configured), Clear (SDC), Remote, Local, Local Lockout, and Abort. When addressed to talk, the Signal Generator automatically stops listening and sends one of the following messages: Data, Require Service, or Status Byte. Whether addressed or not, the Signal Generator responds to the Clear (DCL), Local Lockout, Clear Lockout/Set Local, and Abort messages. In addition, the Signal Generator can issue the Require Service message and the Status Bit message.

Local-to-Remote Mode Changes. The Signal Generator switches to remote operation upon receipt of the Remote message. The Remote message has two parts. They are:

a. Remote enable bus control line (REN) set true.

b. Device listen address received once (while REN is true).

When the Signal Generator switches to remote, the RMT annunciator on the front panel turns on. With the exception of VERNIER, which may change by less than 0.1 dB, the Signal Generator's control settings remain unchanged with the Local-to-Remote transition.

3-24. Local Mode

Local Capability. In local, the Signal Generator's front panel controls are fully operational and the instrument responds to the Remote message. The Signal Generator can send a Require Service message, a Status Byte messsage, and a Status Bit message.

Remote-to-Local Mode Changes. The Signal Generator always switches to local from remote whenever it receives the Local message (GTL) when addressed to listen or the Clear Lockout/Set Local message. (The Clear Lockout/Set Local message sets the Remote Enable control line [REN] false.) The Signal Generator can also be switched to local by pressing the front panel LOCAL key (assuming Local Lockout is not in effect). With the exception of VERNIER, which may change by less than 0.1 dB, the Signal Generator's control settings remain unchanged with the Remote-to-Local transition.

Local Lockout. When a data transmission is interrupted, which can happen by pressing the LOCAL key to return the Signal Generator to local mode, the data could be lost. This would leave the Signal Generator in an unknown state. To prevent this, a local lockout is recommended for purely automatic

Table 3-3. Message Reference Table (1 of 2)

HP-IB Message	Appli- cable	Response	Related Commands and Controls	Inter- face Func- tions*
Data	Yes	All front panel functions (except the LINE switch and the Backspace key) and remote-only functions are bus programmable		AH1 SH1 T5 TE0 L3 LE0
Trigger	Yes	If in remote and addressed to listen, the Signal Generator executes a previously selected program code. It responds equally to the Group Execute Trigger (GET) bus command and program code TR (a Data message).	GET	DT1
Clear	Yes	Sets output to 3000.000 MHz at −70 dBm with sweep and modulation off. Resets many additional parameters as shown in Table 3-5. Responds equally to Device Clear (DCL) and Selected Device Clear (SDC) bus commands.	DCL SDC	DC1
Remote	Yes	Remote mode is enabled when the REN bus control line is true. However, remote mode is not entered until the first time the Signal Generator is addressed to listen. The front panel RMT annunciator lights when the instrument is actually in the remote mode.	REN	RL1
Local	Yes	The Signal Generator returns to local mode (front panel control). It responds equally to the Go To Local (GTL) bus command and the front panel LOCAL key.	GTL	RL1
Local Lockout	Yes	The LOCAL key is disabled. Only the controller can return the Signal Generator to local (front panel control).	LLO	RL1
Clear Lockout/ Set Local	Yes	The Signal Generator returns to local (front panel control) and local lockout is cleared when the REN bus control line goes false.	REN	RL1
Pass Control/Take Control	No	The Signal Generator has no controller capability.		C0
Require Service	Yes	The Signal Generator sets the SRQ bus control line true if one of the following conditions exists and it has been enabled by the Request Mask to send the message for that condition: Front Panel Key Pressed, Front Panel Entry Complete, Change in Extended Status, Source Settled, End of Sweep, Entry Error, and Change in Sweep Parameters.	SRQ	SR1
Status Byte	Yes	The Signal Generator responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit byte when addressed to talk. If the instrument is holding the SRQ control line true (issuing the Require Service message) bit 7 (RQS bit) in the Status Byte and the bit representing the condition causing the Require Service message to be issued will both be true. The bits in the Status Byte are latched but can be cleared upon receiving the Clear Status (CS) program code, executing the Output Status function, or executing a serial poll while the SRQ control line is held true.	SPE SPD	T5

Table 3-3. Message Reference Table (2 of 2)

HP-IB Message	Appli-cable	Response	Related Commands and Controls	Interface Functions*
Status Bit	Yes	The Signal Generator responds to a Parallel Poll Enable (PPE) bus command by sending a bit on a controller selected HP-IB data line.	PPE PPD PPC PPU	PP1
Abort	Yes	The Signal Generator stops talking and listening.	IFC	T5,TE0 LE,LE0

*Commands, Control lines, and Interface Functions are defined in IEEE Std 488-1978. Knowledge of these may not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left column.

Complete HP-IB capability as defined in IEEE Std 488 and ANSI Std MC1.1 is: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, C0, and E1.

Local Mode (cont'd)

applications. Local lockout disables the LOCAL key and allows return-to-local only under program control.

NOTE

Return-to-local can also be accomplished by turning the Signal Generator's LINE switch to STBY, then back to ON. However, this technique has some disadvantages:

a. It defeats the purpose and advantage of local lockout (that is, the system controller loses control of a system element).

b. There are several HP-IB conditions that reset to default states at turn-on.

3-25. Addressing

The Signal Generator interprets the byte on the eight HP-IB data lines as an address or a bus command if the bus is in the command mode. The command mode is defined as attention control line (ATN) true and interface clear control line (IFC) false. Whenever the Signal Generator is addressed (if in local or remote), either the TLK or LSN annunciator on the front panel turns on.

The Signal Generator's Talk and Listen addresses can be set from switches located inside the instrument or from the front panel. The address selection procedure is described in Section II.

The decimal equivalent of the addresses can be displayed in the FREQUENCY MHz display by pressing and holding the LOCAL key. This is the decimal equivalent of the last five bits of both the Talk and Listen ASCII address codes. Refer to Table 2-1 for a comprehensive listing of all valid HP-IB address codes.

Listen Only Mode. If the internal Listen Only switch is set to "1", the Signal Generator is placed in the Listen Only mode. The instrument then responds to all Data messages, and the Trigger, Clear, and Local Lockout messages. It can also respond to a parallel poll with the Status Bit message. However, the Signal Generator cannot send Data messages and cannot respond to a serial poll with the Status Byte message.

The Signal Generator's Listen Only address can also be set from the front panel by keying in 4 0, then pressing the STO key and the LOCAL key. Note that the FRONT PNL ENABLE switch on the internal HP-IB address switch must be set to "1" to allow front panel entries.

Talk Only Mode. If the internal address switches are set to a valid Talk address and the Talk Only switch is set to "1", the Signal Generator is placed in the Talk Only mode. In this mode the instrument is configured to send Data messages whenever the bus is in the data mode. It can also send the Status Byte message in response to a serial poll.

Addressing (cont'd)
The Signal Generator's Talk Only address can also be set from the front panel by keying in 5 0, then pressing the STO key and the LOCAL key. Note that the FRONT PNL ENABLE switch on the internal HP-IB address switch must be set to "1" to allow front panel entries.

3-26. Turn-on Default Conditions

Several HP-IB parameters are reset at turn-on. The parameters and their default conditions are listed below.

- HP-IB Local Mode
- Immediate Execution Mode
- Unaddressed
- Trigger Configuration cleared
- Request Mask cleared
- SRQ cleared

3-27. Displays

The RMT annunciator is on when the Signal Generator is in the remote mode and after it has received its first Data message. The TLK annunciator is on when the Signal Generator is currently addressed to talk; the LSN annunciator is on when the Signal Generator is currently addressed to listen. The SRQ annunciator is on when the Signal Generator is sending the Require Service message.

The MESSAGE key lights for the same conditions in remote as in local. The message can be read in either remote or local when the Signal Generator is under program control. Once the message has been read the key light turns off, whether or not the causing condition has been corrected.

The FREQUENCY MHz and RANGE dBm displays operate in remote mode just as they do in local. Hidden parameters can still be displayed in the FREQUENCY MHz display by pressing and holding their front panel keys. (This capability is not available to the controller since it cannot hold a program code in the same manner that an operator can hold down a key. However, the Output Active Parameter talk function allows the controller to use its display for showing the current value of hidden parameters.)

3-28. Output Level

Setting output level is the only front panel feature that is not operated in an identical manner in local and remote modes. In local, RANGE is set in steps of 10 dB. The VERNIER knob sets the intermediate values of output power. A selection of programming codes allows either combined or independent setting of the RANGE and VERNIER power. The entry format is [Program Code] [Numeric Value] [Units Terminator]. The code LE sets both range and vernier. The code RA sets just the range. The code VE sets just the vernier.

In going from local to remote the output level might change by a fraction of a dB. In going from remote to local the front panel knob takes control. There is no assurance of whether the power will go up, go down, or stay the same within the 15 dB range of the Vernier.

3-29. Data Messages

The Signal Generator communicates on the interface bus primarily with Data messages. Data messages consist of one or more bytes sent over the bus' data lines when the bus is in the data mode (attention control line [ATN] false). Unless it is set to Talk Only, the Signal Generator receives Data messages when addressed to listen. Unless it is set to Listen Only, the Signal Generator sends Data messages or the Status Byte message when addressed to talk. Virtually all instrument operations available in local mode can be performed in remote mode via Data messages. The major exceptions are changing the LINE switch setting and changing the HP-IB address of the Signal Generator.

3-30. Receiving Data Messages

The Signal Generator responds to Data messages when it is enabled to remote (REN control line true) and it is addressed to listen. The instrument remains addressed to listen until it receives an Abort message or until its talk address or a universal unlisten command is sent by the controller.

Data Message Input Format. The Data message string, or program string, consists of a series of ASCII codes. Each code is typically equivalent to a front panel keystroke in local mode and follows one of three formats:

- [Program Code] [Numeric Value] [Units Terminator] [EOS]
- [Program Code] [Numeric Value] [EOS]
- [Program Code] [EOS]

Receiving Data Messages (cont'd)
Program codes are typically 2 character mnemonics. All codes normally used by the operator to control the Signal Generator are given in Table 3-7, HP-IB Program Codes.

Numeric values are either a single decimal digit, a set of 11 characters or less representing a number, or a string of binary bytes. A string of 11 characters maximum can be expressed in decimal form only. Digits beyond the front panel display capability of a particular parameter are truncated. Therefore, it is best to format the data so that it is rounded to the correct number of digits.

Units terminators are 2 character codes that terminate and scale the associated numeric value. Frequency can be entered in GHz, MHz, kHz, or Hz. Sweep time values are entered in milliseconds. Power values are entered in dB.

End-of-String messages (EOS) can be the ASCII characters Line Feed (LF), semicolon (;), or the bus END message (that is, bus lines EOI true and ATN false). The at sign (@) acts as an EOS when the Signal Generator is in the Deferred Execution mode.

Valid Characters. The ASCII characters used for program strings are: A-Z a-z 0-9 . − + LF , ; @. The alpha program codes can be either upper or lower case since the Signal Generator will accept either type (they can be interchanged). Spaces, unnecessary signs (+, −), leading zeros, and carriage returns (CR) are ignored. However, if a space or other such character were inserted between 2 characters of a program code, the program code would be invalid and any remaining characters in a string might be misinterpreted by the Signal Generator. After receiving an invalid program code, the Signal Generator requires a valid program code before it will respond to numeric entries.

Immediate Execution Mode. ASCII characters can be accepted in the Deferred or Immediate execution modes. Immediate Execution is the default mode at turn-on. It can be set, if necessary, by sending the program code @3. In this mode the Signal Generator produces an End-of-String (EOS) message at the end of each character and does not require one from the controller. The Signal Generator processes each character before accepting the next one. Therefore, the Immediate Execution mode does slow down overall data transfer. However, the Signal Generator can switch faster after the final EOS message than it can in the other mode. This is useful when the system controller is slow enough (data rate <1000 bytes/second) that it cannot take advantage of the Deferred mode's transfer speed or when switching time, independent of message length, is more important than program execution speed.

Deferred Execution Mode. This ASCII mode must be selected by sending the program code @2. In this mode, the Signal Generator accepts strings up to 96 characters at a time, executing the string upon receiving an EOS message. The Signal Generator produces its own EOS message upon receipt of the 96th character in a string. If a block of strings containing more than 96 characters is sent, the first 96 characters are accepted and the Signal Generator holds the bus busy until it executes them. Then the next 96 characters are accepted and so on until the entire block is accepted. If only one string of less than 96 characters is sent, the Signal Generator accepts the strings and frees the bus allowing program execution to continue.

Binary Mode. The Signal Generator's Request Mask is programmed in binary format. Also, learn mode data is sent and received in binary. Binary data is always processed in the Immediate Execution mode.

3-31. Sending the Data Message

The Signal Generator can send Data messages when addressed to talk. It remains configured to talk until it is unaddressed to talk by the controller. To unaddress the Signal Generator, the controller must send the Signal Generator's listen address, an Abort message, a new talk address, or a universal untalk command.

Talk Functions. The types of information that the Signal Generator can send in a Data message are:

- Front Panel Learn Mode
- Special Function Learn Mode
- Messages
- Output Active Parameter
- Output Couple
- Output Lock Frequency
- Test Interface
- Output Status
- Output Request Mask Value (explained later under Sending the Request Mask Value).

Each function is enabled by first addressing the Signal Generator to listen. Then, the Signal Gen-

Sending the Data Message (cont'd)

erator must receive a Data message with the appropriate program code. When the Signal Generator is addressed to talk, it will output data for the selected talk function. If the controller does not repeat the program code or send a new one, the Signal Generator sends data for the last selected talk function when it is addressed to talk. However, it is recommended that a talk function program code be sent each time, prior to addressing the Signal Generator to talk. This will ensure that the Signal Generator sends the appropriate data. Refer to Table 3-4 for a summary of talk functions.

Front Panel Learn Mode. The front panel learn mode uses the controller's memory to learn and store a data string that describes the Signal Generator's current front panel setting. Once an instrument state has been learned, the Signal Generator can be restored to that configuration at a later time. The learn mode requires a controller that can transfer information in binary form.

After receiving an L1 program code (Front Panel Learn Mode) and when addressed to talk, the Signal Generator sends 2 ASCII characters, @ and A, followed by a string of 94 8-bit binary bytes containing information on the front panel configuration. This binary data can then be stored in the controller's memory for future use. In addition, as each configuration goes out onto the bus, it is also stored in the Signal Generator's register 9. The most straight-forward way to program the system controller is to use a loop to read 96 binary characters and store them in an array.

When the Signal Generator is addressed to listen, the binary data can be returned to it in 96-byte strings. When the Signal Generator detects the @A, it will expect the next 94 characters to be in the learn mode string. A checksum is embedded in the string so that possible errors in the storage or transmission of the data will be detected, and the input will be ignored.

Whenever data is being transferred between controller and Signal Generator, it must do so in uninterrupted strings. If a data string is broken or interrupted, the data could be lost or offset, and misinterpreted by the Signal Generator. An offset of data bytes can persist through later data strings until the Signal Generator is eventually switched to standby, then on again.

Special Function Learn Mode. This mode is intended for servicing the Signal Generator. It is similar in operation to the front panel learn mode. After receiving an L2 program code (Special Function Learn Mode) and when addressed to talk, the Signal Generator sends 2 ASCII charcters, @ and 9, followed by a string of 24 8-bit binary bytes. This binary data can then be stored in the controller's memory.

The binary characters are directly related to the digital outputs of the Signal Generator's internal controller. There is no checksum or other error detecting scheme, allowing diagnostic and other special functions that are not normally possible with the Signal Generator. Refer to Section VIII, Service, for additional information.

Messages. This function enables the MESSAGE key to be read under program control. After receiving an MG program code (Message) and when addressed to talk, the Signal Generator sends a two-digit number coded in ASCII followed by a Line Feed (LF) and EOI. The codes represent entry errors and instrument malfunctions. The two-digit codes are explained on the operating information pull-out card and in the Message Detailed Operating Instruction. The Message can always be read by pressing the MESSAGE key, even when the Signal Generator is in remote mode. However, reading the Message once, either in remote or local, clears it to 00 (No Error) whether or not the causing condition has been corrected.

Output Active Parameter. This function allows the user to determine the present value of a specific parameter. After receiving the program code for a value-selectable parameter followed by the program code OA (Output Active) and when addressed to talk, the Signal Generator will output a string over the bus consisting of the following: [Selected Program Code] [Current Numeric Value] [Units Terminator] [LF and EOI]. Any parameter that has a numeric value associated with it can be interrogated. An exception to this output format is Steps. When the controller sends "SPOA", the Signal Generator returns with the string: SP [Step Size] HZ, SP [Number of Steps] SS, [LF and EOI]. The Signal Generator may output a program code that differs from the code sent to it by the consponds troller. For example, the Signal Generator rewith the program code CF (center frequency) when sent FR (frequency) and MK (marker) when sent M1, M2, M3, M4, or M5 (Markers 1 through 5).

Table 3-4. Talk Functions

Function	Program Code	Signal Generator Output Response to Program Code	Comments
Front Panel Learn Mode	L1	96 Binary Bytes [EOI]	
Special Function Learn Mode	L2	26 Binary Bytes [EOI]	See Section VIII, Service
Message	MG	2 Digits [LF and EOI]	
Output Active Parameter	[Progam Code] OA	[Program Code] [Numeric Value] [Units Terminator] [LF and EOI]	Valid Functions: CF, FI, FA, FB, FS, M1-5, DW, LE, VE, RA
	SPOA	SP [Step Size] Hz, SP [# of Steps] SSSP [LF and EOI]	
Output Couple	OC	[START Value], [Center-Frequency Value], [Dwell Value] [LF and EOI]	Frequency is in Hz; dwell is in seconds.
Output Lock Frequency	OK	FR [Numeric Value] Hz [LF and EOI]	
Test Interface	TI [1 Byte]	1 Byte [EOI]	
Output Status	OS	2 Bytes [EOI]	
Output Request Mask	OR	1 Byte [EOI]	

Sending the Data Message (cont'd)

Output Couple. After receiving the program code OC (Output Couple) and when addressed to talk, the Signal Generator sends a data string that gives the current numeric values for the following parameters in the order listed: [START], [Center Frequency], [DWELL] [LF and EOI]. No program codes prefix the numeric values. Hz is the implied terminator for start and center frequency; seconds is the implied terminator for dwell time.

Output Lock Frequency. This function causes the Signal Generator to output the value of its tuned frequency. After receiving the program code OK and when addressed to talk, the Signal Generator sends the value of the frequency at which it is currently phase locked. The data output from the Signal Generator is in the following format: FR [Numeric Value] HZ [LF and EOI].

Test Interface Function. This function allows testing of the HP-IB interface. After receiving the program code TI, followed by an 8-bit byte representing one or more data lines (see table below) and when addressed to talk, the Signal Generator sends the binary byte that it just received. Refer to Section VIII, Service, for additional information.

HP-IB Data Line	DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1
Weight	128	64	32	16	8	4	2	1

Output Status. After receiving the program code OS (Output Status) and when addressed to talk, the Signal Generator sends two binary bytes, each 8 bits wide. The first byte is identical to the Status Byte of the Serial Poll. The second byte is the Extended Status Byte which provides additional information. See Figure 3-11 for a description of each Status Byte. Bits in the main Status Byte are cleared upon execution of the Output Status function or the Clear Status (CS) program code. Bits on the Extended Status Byte are cleared by removing the causing condition and performing the Output Status function.

3-32. Receiving the Clear Message

The Signal Generator responds to the Clear message by assuming the settings detailed in Table 3-5. The Signal Generator responds equally to the Selected Device Clear (SDC) bus command when addressed to listen, and the Device Clear (DCL) bus command whether addressed or not. The Clear message clears any pending Require Service message.

Table 3-5. Response to a Clear Message

Parameter	Condition
Execution Mode	Immediate
Request Mask	Cleared
Require Service (SRQ)	Cleared
Trigger Configuration	Cleared
MESSAGE	Cleared (set to 00)
RF OUTPUT	ON
ALC	INTERNAL
LEVEL dBm	−70 dBm
AUTO PEAK	ON
MTR	LVL
AM, FM, and Pulse Modulation	OFF
FREQUENCY	3000.000 MHz
FREQ INCR	1.000 MHz
START	2000.000 MHz
STOP	4000.000 MHz
ΔF	2000.000 MHz
MKR	OFF
SWEEP MODE	OFF
STEP	100 steps (20.000 MHz)
DWELL	20 ms
TUNE Knob	ON

3-33. Receiving the Trigger Message

The Signal Generator responds to a Trigger message only if a response has been pre-programmed (see Configure Trigger). Otherwise, it ignores a Trigger message. It responds equally to a Trigger message (with bus command GET) and a Data message with program code TR (Trigger).

Configure Trigger. The Signal Generator's response to a Trigger message is set when it receives a Data message containing the program code CT followed by one valid program code. For example, CTW6 causes a single sweep (W6) when the Trigger message is received.

3-34. Receiving the Remote Message

The Remote message has two parts. First, the remote enable bus control line (REN) is held true; second, the device listen address is sent by the controller. These two actions combine to place the Signal Generator in remote mode. Thus, the Signal Generator is enabled to go into remote when the controller begins the Remote message, but it does not actually switch to remote until addressed to listen the first time. When actually in remote, the Signal Generator's front panel RMT annunciator lights.

3-35. Receiving the Local Message

The Local message is the means by which the controller sends the Go To Local (GTL) bus command. If addressed to listen, the Signal Generator returns to front panel control when it receives the Local message.

When the Signal Generator goes to local mode, the front panel RMT annunciator turns off. However, even when in local, if the Signal Generator is being addressed, its front panel LSN or TLK annunciator turns on.

3-36. Receiving the Local Lockout Message

The Local Lockout message is the means by which the controller sends the Local Lockout (LLO) bus command. If in remote, the Signal Generator responds to the Local Lockout Message by disabling the front panel LOCAL key. The local lockout mode prevents loss of data or system control due to someone accidentally pressing front panel keys. If, while in local, the Signal Generator is enabled to remote (that is, REN is set true) and it receives the Local Lockout message, it will switch to remote mode with local lockout the first time it is addressed to listen. When in local lockout, the Signal Generator can be returned to local only by the controller (using the Local or Clear Lockout/Set Local messages), by setting the LINE switch to STBY and back to ON, or by removing the bus cable.

3-37. Receiving the Clear Lockout/Set Local Message

The Clear Lockout/Set Local message is the means by which the controller sets the Remote Enable (REN) bus control line false. The Signal Generator returns to local mode (full front panel control) when it receives the Clear Lockout/Set Local message. When the Signal Generator goes to local mode, the front panel RMT annunciator turns off.

3-38. Receiving the Pass Control Message

The Signal Generator does not respond to the Pass Control message because it does not have this controller capability.

3-39. Sending the Require Service Message

The Signal Generator sends a Require Service message if one or more of the following conditions exist and if it has been pre-programmed to send the message by the Request Mask.

- Front Panel Key Pressed: when the Signal Generator is in local mode and one of the front panel keys is pressed.
- Front Panel Entry Complete: when the Signal Generator is in local mode and is finished processing a front panel entry.
- Change in Extended Status: when one of the bits on the Extended Status Byte changes.
- Source Settled: when the Signal Generator is settled. Switching transients occur when RF and AUTO PEAK are turned on, and when FM ranges and frequency are changed. If the controller responds to the Signal Generator as soon as the source is settled, instead of waiting a specified time, program speed is increased.
- Entry Error: When an invalid keystroke or program command occurs.
- New Sweep Parameters: when the value of START, STOP, ΔF, DWELL, STEP, or any Marker changes.

The Signal Generator can send a Require Service message in either the local or remote mode.

The Signal Generator sends a Require Service message by setting the Service Request (SRQ) bus line true. The SRQ annunciator on the front panel turns on when the Require Service message is being sent. The Require Service message is cleared after the Output Status function or the Clear Status (CS) program code has been executed by the controller.

Request Mask. The Request Mask functions within the Status Byte. It determines which bits can set the RQS bit true (see Figure 3-11) and consequently set the SRQ bus line true.

The Request Mask is set by the program code P1 followed by an 8-bit byte (a Data Message). The value of the byte is determined by summing the weight of each bit to be checked. Each bit, if true, enables a corresponding conditon to set the RQS bit true. This message is executed immediately and does not require an End-of-String message to be sent. At turn-on, the Request Mask is cleared (that is, set to 0).

Sending the Request Mask Value (a Data Message). After receiving an OR program code (Output Request Mask) and when addressed to talk, the Signal Generator will send a single binary word (8 bits) that describes the present state of the mask. The bit pattern can be interpreted with the information in Figure 3-11.

NOTE

This byte is sent with the bus EO1 line true, thus terminating the message.

3-40. Sending the Status Byte Message

After receiving a Serial Poll Enable bus command (SPE) and when addressed to talk, the Signal Generator sends a Status Byte message. The message consists of one 8-bit byte of which 7 bits correspond to the pattern and descriptions for the Request Mask. The remaining bit, bit 7, is the RQS Request Service bit (see Figure 3-11).

The RQS bit is set when one of the other seven conditions exists and that condition has been enabled by the Request Mask. Bits 1—6 and 8 might be true regardless of conditioning by the Request Mask. However, if a condition has not been selected by the mask, it cannot cause the RQS bit to be set true.

Extended Status Byte. A second status byte is available but can only be accessed via the Output Status function (see explanation under Sending the Data Message). Bit 3 of the Status Byte indicates whether a change has occurred in the Extended Status Byte. If Bit 3 is true, the second status byte should be accessed via the Output Status function to determine the cause of the status change. The bit pattern can be interpreted with the information in Figure 3-11.

3-41. Clearing the Status Byte

Once the Signal Generator sets the SRQ bus line true, it is no longer allowed to alter the Status Byte. If a bit has been enabled and the condition occurs after the SRQ bus line has been set true, the

STATUS BYTE (#1)								
BIT	8	7	6	5	4	3	2	1
WEIGHT	128	64	32	16	8	4	2	1
Condition	Change in Sweep Parameters	RQS Bit Request Service	Entry Error	End of Sweep	Source Settled	Change in Extended Status	Front Panel Entry Complete	Front Panel Key Pressed

EXTENDED STATUS BYTE (#2)								
BIT	8	7	6	5	4	3	2	1
WEIGHT	128	64	32	16	8	4	2	1
Condition	0 (always)	ALC Unleveled	Power Failure/On	Not Locked	External Ref	0 (always)	FM Overmod	Self-Test Failed

Figure 3-11. Status Byte Information

Clearing the Status Byte (cont'd)

bit is stored in a buffer and is read the next time the Signal Generator receives the Serial Poll Enable (SPE) bus command. When addressed to talk (following SPE), the Signal Generator sends the Status Byte message.

After the Status Byte message has been sent it will be cleared if the Serial Poll Disable (SPD) bus command is received, if the Abort message is received, or if the Signal Generator is unaddressed to talk. However, bits stored in the buffer waiting to be read are not cleared. Regardless of whether or not the Status Byte message has been sent, the Status Byte and any Require Service message pending will be cleared if a Clear Status (CS) program code is received or the Output Status function is executed.

NOTE

The Signal Generator must receive a universal untalk command after sending the Status Byte message. Most system controllers send this automatically. However, if a universal untalk command is not sent, the SRQ bus line may not be re-initialized and pending Service Requests may get lost.

3-42. Sending the Status Bit Message

The Signal Generator sends the Status Bit message (if configured) as part of the interface's response byte to the Parallel Poll Enable (PPE) bus command. In order for the Signal Generator to respond to a Parallel Poll Enable bus command it must be assigned a single HP-IB data line by the controller. The controller also assigns the logic level of the bit. Both tasks can be accomplished by the Parallel Poll Configure (PPC) bus command. If the Signal Generator is sending the Require Service message, it will set its assigned status bit true. The Signal Generator can send the Status Bit message without being addressed to talk.

The data line that the Signal Generator is assigned to respond on can be cleared by turning the instrument to STBY or by sending the Parallel Poll Unconfigure (PPU) bus command.

3-43. Receiving the Abort Message

The Abort message is the means by which the controller sets the Interface Clear (IFC) bus control line true. When the Abort message is received, the Signal Generator becomes unaddressed and stops talking or listening.

Table 3-6. HP-IB Program Codes

Program Code	Parameter
AO	AM OFF
AP	Level (RANGE and VERNIER)
A0	AM OFF
A1	AM OFF
A2	AM 30%
A3	AM 100%
CF	Center Frequency
CS	Clear Status
CT	Configure Trigger
CW	CW Frequency
C1	ALC INTERNAL
C2	ALC DIODE
C3	ALC PWR MTR
DB	dB
DF	ΔF
DM	dB
DN	FREQ INCREMENT (Down)
DO	FM DEVIATION OFF
DW	DWELL
D0	FM DEVIATION OFF
D1	FM DEVIATION OFF
D2	FM DEVIATION .03 MHz
D3	FM DEVIATION .1 MHz
D4	FM DEVIATION .3 MHz
D5	FM DEVIATION 1 MHz
D6	FM DEVIATION 3 MHz
D7	FM DEVIATION 10 MHz
FA	START Sweep Frequency
FB	STOP Sweep Frequency
FI	FREQ INCR
FN	FREQ INCR
FR	FREQUENCY
FS	ΔF
F1	FREQ INCR
GZ	GHz
HZ	Hz
IF	FREQ INCREMENT (Up)
IP	Instrument Preset
KZ	kHz
K0	AUTO PEAK OFF
K1	AUTO PEAK ON
K2	AUTO PEAK without extra settling time
LE	Level (RANGE and VERNIER)
L1	Front Panel Learn Mode
L2	Special Function Learn Mode
MG	MESSAGE
MO	Marker(s) OFF
MS	milliseconds
MZ	MHz
M0	Marker(s) OFF
M1	Marker 1
M2	Marker 2
M3	Marker 3
M4	Marker 4
M5	Marker 5
NO	TUNE Knob OFF
N0	TUNE Knob OFF
N1	TUNE Knob ON
OA	Output Active Parameter
OC	Output Couple

Program Code	Parameter
OK	Output Lock Frequency
OL	Front Panel Learn Mode
OR	Output Request Mask
OS	Output Status
PL	Power Level (RANGE and VERNIER)
PO	PULSE OFF
P0	PULSE OFF
P1	PULSE OFF
P2	PULSE NORM
P3	PULSE COMP
RA	RANGE
RC	Recall (RCL)
RD	RANGE Down 10 dB
RF0	RF OFF
RF1	RF ON
RL	Recall (RCL)
RM	RQS Mask
RO	RF OFF
RS	Reset Sweep
RU	RANGE Up 10 dB
R0	RF OFF
R1	RF ON
SD	Slave Down
SF	STEP
SM	MANUAL Sweep
SP	STEP
SS	Steps (suffix)
ST	Store (STO)
SU	Slave Up
SV	Service Function
TI	Test Interface
TR	Execute Trigger
T1	Meter LVL
T2	Meter AM
T3	Meter FM
UP	FREQ INCREMENT (Up)
VE	VERNIER
WO	SWEEP MODE OFF
W0	SWEEP MODE OFF
W1	SWEEP MODE OFF
W2	AUTO Sweep
W3	MANUAL Sweep
W4	SINGLE Sweep
W5	SINGLE Sweep: Arm Only
W6	SINGLE Sweep: Arm and Begin
W7	Master Sweep
W8	Slave Sweep
X0	Marker(s) OFF
X1	Marker 1
X2	Marker 2
X3	Marker 3
X4	Marker 4
X5	Marker 5
Y1	Display On
Y0	Display Off
PA	Start of Front Panel Learn Mode
P1	Prefix for Request Mask
P2	Deferred Execution Mode
P3	Immediate Execution Mode
P9	Start of Special Function Learn Mode

Table 3-7. Error Messages

Code	Definition
00	NO ERROR
	Messages 01 — 09 are operator errors. The entry is ignored and the previous values are retained.
01	FREQUENCY OUT OF RANGE
02	FREQ INCR OUT OF RANGE
04	CANNOT STORE 0
05	STEP SIZE OUT OF RANGE
07	NUMBER OF STEPS OUT OF RANGE
08	DWELL OUT OF RANGE
09	MARKER NUMBER NOT 1 — 5
	Messages 10 through 16 are "soft errors" that result from unusual combinations of sweep entries. A message is displayed and all entered values are stored in anticipation that further entries will resolve the conflict.
10	START FREQ"STOP FREQ. No sweep.
11	SWEEP SPAN RESULTS IN START FREQUENCY TOO HIGH. Truncated sweep will result.
12	SWEEP SPAN RESULTS IN STOP FREQUENCY TOO LOW. Truncated sweep will result.
13	NUMBER OF STEPS ADJUSTED TO GIVE STEP SIZE IN EVEN kHz. Press STEP to see result.

Code	Definition
14	STEP SIZE TOO SMALL FOR SPAN. Press STEP to see result (maximum number of steps is 9999).
15	STEP SIZE >SPAN. Step size is set to span.
16	BAND CROSSING IN AUTO SWEEP
	Messages 20 — 24 are HP-IB errors. The entry is ignored.
20	INVALID HP-IB CODE
21	HP-IB DATA WITHOUT VALID PREFIX
22	INVALID HP-IB ADDRESS ENTRY
23	TALK FUNCTION NOT PROPERLY SPECIFIED.
24	OUTPUT LEVEL OUT OF RANGE
	Messages 30 — 99 are service-related errors. Refer to Section VIII in the manual.
90	AUTO PEAK MALFUNCTION
92	RECALL CHECKSUM ERROR
95	LOSS OF DATA ON POWER UP
96	MEMORY TEST FAILURE
97	ROM TEST FAILURE, A2A10
98	RAM TEST FAILURE, A2A11
99	RAM NOT FUNCTIONAL AT POWER UP

IV Performance Tests

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. These tests are suitable for incoming inspection, troubleshooting, and preventive maintenance. All tests can be performed without accessing the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

4-2. ABBREVIATED PERFORMANCE TEST

In most cases, it is not necessary to perform all of the tests in this section. Table 4-1, Operation Verification, lists the tests that are recommended for various conditions. The Operator's Checks in Section III should always be the first step.

NOTE

To consider the performance tests valid, the following conditions must be met:

a. The Signal Generator must have a 1-hour warm-up for all specifications.

b. The line voltage must be 100, 120, 220, or 240 Vac +5%, −10%; the line frequency can be 48 to 440 Hz, but the line voltage is limited to a nominal 100 or 120 Vac if the line frequency is >66 Hz.

c. The ambient temperature must be 0°C to 55°C.

4-3. CALIBRATION CYCLE

This instrument requires periodic verification of performance to ensure that it is operating within specified tolerances. The performance tests described in this section should be performed at least once each year; under conditions of heavy usage or severe operating environments, the tests should be more frequent. Adjustments that may be required are described in Section V, Adjustments.

4-4. PERFORMANCE TEST RECORD

Results of the performance tests may be tabulated in Table 4-2, Performance Test Record. The Performance Test Record lists all of the performance test specifications and the acceptable limits for each specification. If performance test results are recorded during an incoming inspection of the instrument, they can be used for comparison during periodic maintenance or troubleshooting. The test results may also prove useful in verifying proper adjustments after repairs are made.

4-5. EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in Table 1-3, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted.

4-6. TEST PROCEDURES

It is assumed that the person performing the following tests understands how to operate the specified test equipment. Equipment settings, other than those for the Signal Generator, are stated in general terms. For example, a test might require that a spectrum analyzer's resolution bandwidth be set to 100 Hz; however, the time per division would not be specified and the operator would be expected to set that control and other controls as required to obtain an optimum display. It is also assumed that the technician will select the cables, adapters, and probes (listed in Table 1-3) required to complete the test setups illustrated in this section.

Table 4-1. Operation Verification

NOTE

The following table of abbreviated performance tests lists tests done after instrument repair. Doing these tests verifies that the instrument meets all major specifications to a 90% confidence level. If a higher level of confidence or a more thorough check is needed, do the entire performance tests with no omissions.

Para. No.	Performance Test	Alteration	Remark
4-7	Frequency Range and Resolution Tests	Omit steps 1—5.	Normally within specification if all frequencies remain phase-locked.
4-8	Output Level, High Level Accuracy and Flatness Tests	Do steps 11—14 at 4 GHz only. Omit steps 15 and 16.	Normally within specification.
4-9	Low Level Accuracy Tests	Omit test.	Normally within specification.
4-10	Harmonics, Subharmonics and Multiples Tests	No Change.	
4-11	Non-Harmonically Related Spurious Signals (CW and AM Modes) Tests	Omit test.	Normally within specification.
4-12	Single-Sideband Phase Noise Tests	Do all testing only at 6.6 GHz, but at all specified offsets.	If within specifications at 6.6 GHz, frequencies in other bands are normally within specifications.
4-13	Residual AM Test	Omit test.	Secondary importance.
4-14	Amplitude Modulation Tests	Omit test.	Normally within specification.
4-15	FM Frequency Response Tests	Omit step 6.	If in specifications at 4 GHz, normally within specification.
4-16	Incidental AM Tests	Omit test.	Secondary importance.
4-17	Pulse Tests	Omit steps 20—25.	Secondary importance.

PERFORMANCE TESTS

4-7. FREQUENCY RANGE AND RESOLUTION

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—18.0 GHz (1.95—18.6 GHz overrange)	
Resolution	1 kHz 2 kHz 3 kHz	2.0 to 6.6 GHz 6.6 to 12.3 GHz 12.3 to 18.0 GHz

Description This test checks the resolution in each frequency band using a frequency counter. The frequency range is checked by increasing the frequency in 0.111111 GHz steps and ensuring that the Signal Generator remains phase locked at all frequencies. A final check tests the full range of the Signal Generator.

Equipment Frequency Counter .... HP 5343A

Procedure

1. Connect the equipment as shown in Figure 4-1. Set the Signal Generator rear panel INT/EXT switch to EXT. Remove FREQ STANDARD jumper and connect A3J10 to 10 MHz frequency standard output from counter.

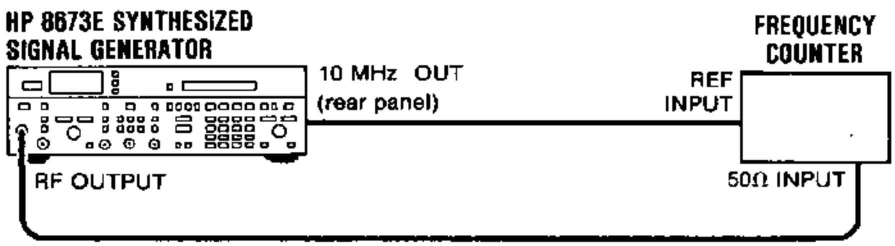


Figure 4-1. Frequency Range and Resolution Test Setup

2. Select 1 kHz display resolution on the counter.

3. Set Signal Generator to 4 GHz, FREQ INCR to 1 kHz, and the output power to 0 dBm. The counter should read 4.000000 GHz ±1 count on the counter.

3.999999 GHz ________ (√) 4.000001 GHz

4. Step frequency up 1 kHz, then step it down 1 kHz while observing the counter. Ensure that the Signal Generator output frequency is accurate within ±1 count.

1 kHz resolution ________ (√)

PERFORMANCE TESTS

4-7. FREQUENCY RANGE AND RESOLUTION (cont'd)

Procedure (cont'd)

5. Repeat steps 3 and 4 using frequencies of 8 GHz and 15 GHz. The Signal Generator frequency should step up by 2 and 3 kHz respectively even though the FREQ INCR is set to 1 kHz. This is due to the minimum resolution in each band.

8.0 GHz, 2 kHz Resolution	________ (√)
15.0 GHz, 3 kHz Resolution	________ (√)

6. Set the Signal Generator frequency to 2.0 GHz and FREQ INCR to 0.111111 GHz.

7. Step the Signal Generator from 2.000000 GHz to 2.999999 GHz in 0.111111 GHz steps and read counter frequency at each step. The counter reading should agree with the Signal Generator front panel reading within ±1 count. In addition the Signal Generator NOT PHASED LOCKED front panel annunciator should remain off at all frequencies.

2.000 000 GHz	1.999 999 GHz	________ (√)	2.000 001 GHz
2.111 111 GHz	2.111 110 GHz	________ (√)	2.111 112 GHz
2.222 222 GHz	2.222 221 GHz	________ (√)	2.222 223 GHz
2 333 333 GHz	2.333 332 GHz	________ (√)	2.333 334 GHz
2.444 444 GHz	2.444 443 GHz	________ (√)	2.444 445 GHz
2.555 555 GHz	2.555 554 GHz	________ (√)	2.555 556 GHz
2.666 666 GHz	2.666 665 GHz	________ (√)	2.666 667 GHz
2.777 777 GHz	2.777 776 GHz	________ (√)	2.777 778 GHz
2.888 888 GHz	2.888 887 GHz	________ (√)	2.888 889 GHz
2.999 999 GHz	2.999 998 GHz	________ (√)	3.000 000 GHz

NOTE

Fast stepping or tuning of frequency may cause the NOT PHASED-LOCKED annunciator to flash on momentarily. This is normal and does not indicate a malfunction.

8. Press RCL 0 and set FREQ INCR to 1 GHz. Press FREQ INCREMENT to step the frequency from 3 to 18 GHz. The frequency reading should increase by 1 GHz at each step and the counter reading should agree with the Signal Generator front panel reading within ± 1 count.

9. Disconnect the frequency standard cable and replace the jumper removed in step 1. Set the switch to INT.

PERFORMANCE TESTS

4-8. OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT		
Output Level (Leveled):	+8 dBm to −120 dBm	+15° to +35°C
Absolute Level Accuracy		+15° to +35°C
2.0—12.0 GHz	±4.0 dB	+8 to −60 dBm output
>12.0—18.0 GHz	±5.0 dB	+8 to −60 dBm output level
Flatness	±3 dB	+3 dBm, +15° to +35°C

Description High level accuracy (+8 dBm to −20 dBm) and flatness are verified using a power meter and sensor.

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8481A

Procedure

Output Level Test

1. Connect the power sensor to the power meter. Calibrate and zero the power meter.

2. Connect the power sensor to the RF OUTPUT connector of the Signal Generator as shown in Figure 4-2.

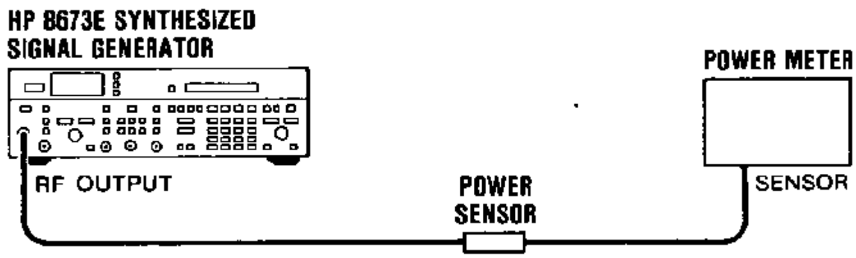


Figure 4-2. High Level Accuracy and Flatness Test Setup

3. Set the Signal Generator frequency to 2.0 GHz and the output level to +8 dBm.

4. Peak the Signal Generator output with the AUTO PEAK key.

5. Tune the Signal Generator in 100 MHz steps from 2 to 18 GHz, adjusting the power meter's calibration factor and recording the frequency at which minimum power occurs. At that frequency, reset VERNIER to +8 dBm as read on the power meter to ensure that the minimum specified power level can be met.

Frequency ________ Power +8 dBm ________

PERFORMANCE TESTS

4-8. OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TESTS (cont'd)

Procedure (cont'd)

Level Flatness

6. Set frequency to 2 GHz, output level to +3 dBm, and power meter to dB Relative. Tune to 18.0 GHz in 100 MHz steps and record the minimum and maximum power outputs. Maximum variation should be within 4 dB (highest point to lowest point).

NOTE

The plus and minus specification for power output is not referenced to a particular frequency. The specification, rather, represents the total power variation over the entire frequency range.

2.0 — 18.0 GHz ±2 dB	Minimum	__________	
	Maximum	__________	
	Total Variation	__________	4 dB

High Level Accuracy Test

7. Connect the power sensor to the power meter. Calibrate and zero the power meter in the dBm mode.

8. Connect the power sensor to the RF OUTPUT connector of the Signal Generator.

9. Set the Signal Generator frequency to 2.0 GHz and adjust the output level to give a reading of +8.0 dBm on the instrument's LEVEL dBm display.

10. Peak the Signal Generator output with the AUTO PEAK key.

11. Tune the Signal Generator in 2 GHz steps from 2 to 18 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency. The power meter readings should be within the limits specified in Table 4-2, Performance Test Record.

12. Set the Signal Generator frequency to 2.0 GHz. Press the RANGE ⬇ key once, then adjust the VERNIER control to give a reading of +3 dBm on the instrument's LEVEL dBm display.

13. Tune the Signal Generator in 2 GHz steps from 2 to 18 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency. The power meter readings should be within the limits specified in Table 4-2, Performance Test Record.

14. Using the VERNIER control set the output level to 0, −5, and −10 dBm and repeat step 13 for each level.

15. Press the RANGE ⬇ key once, then, using the VERNIER control, set the output level to −10 dBm. Repeat step 13 for this level.

16. Using the RANGE ⬇ key, set the output level to −20 dBm, and repeat step 13 for this level.

PERFORMANCE TESTS

4-9. LOW LEVEL ACCURACY TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT		
Absolute Level Accuracy (+15 to +35°C)		
2.0 to 12.0 GHz	±4 dB	+8 to −60 dBm
	±5.5 dB	<−60 to −120 dBm
>12.0—18.0 GHz	±5.0 dB	+8 to −60 dBm
	±6.5 dB	<−60 to −120 dBm

Description Low level accuracy (−30 dBm and below) is verified using a local oscillator and mixer to produce a 100 kHz IF signal. The IF signal is then amplified and its level read on a spectrum analyzer.

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8485A
Local Oscillator .... HP 8340A
Mixer .... RHG DMS1-18
Spectrum Analyzer .... HP 8556A/8552B/141T
20 dB Preamplifier .... HP 8447A
40 dB Amplifier .... HP 8447F
20 dB Attenuator .... HP 8491B Option 020

Procedure

1. Calibrate and zero the power meter in the dBm mode.
2. Connect the equipment as shown in Figure 4-3.

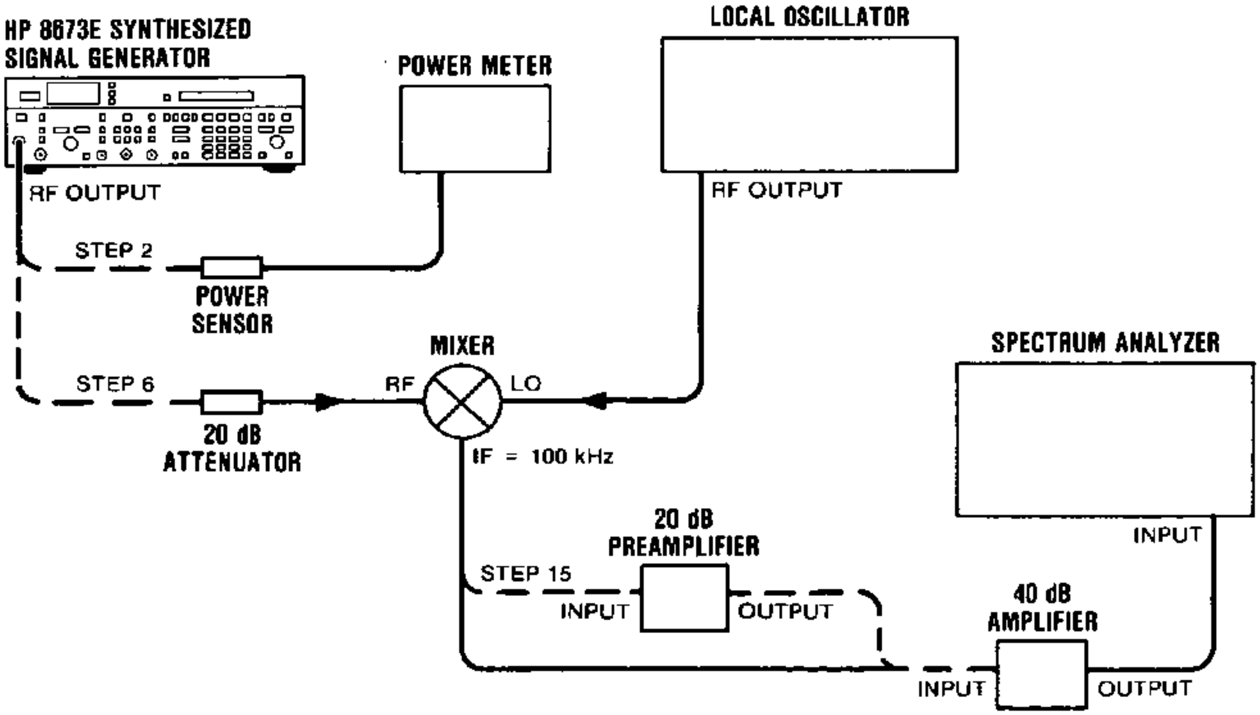


Figure 4-3. Low Level Accuracy Test Setup

PERFORMANCE TESTS

4-9. LOW LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

NOTE

Connect the mixer directly to the local oscillator to void any power loss.

3. Set the Signal Generator frequency to 2.0 GHz and set the output level to −25 dBm. Setting the Signal Generator to this level ensures that the Signal Generator is in the proper attenuation range.

4. Peak the Signal Generator power with the AUTO PEAK key.

5. Adjust the VERNIER for a power meter reading of −20 dBm ±0.01 dB.

6. Disconnect the power meter and connect the Signal Generator to the mixer as shown in Figure 4-3.

7. Set the local oscillator to a frequency 100 kHz ±1 kHz higher than the Signal Generator setting in step 3. Set the local oscillator output power to maximum but not greater than +8 dBm.

8. Set the resolution bandwidth on the spectrum analyzer to 300 kHz or less. Set the vertical sensitivity so that the amplitude of the 100 kHz IF signal is set to the center horizontal graticule as a reference. This calibrates the center graticule line for an absolute reference power level of −20 dBm.

9. Adjust the Signal Generator's VERNIER for a reading of −30.0 dBm as indicated by the Signal Generator's LEVEL dBm display.

10. Press the RANGE ⬇ key once.

11. Set the spectrum analyzer reference level 10 dB lower with the IF sensitivity control. This should bring the signal level back up near the center graticule line.

12. Read the difference between the new signal level and the center reference graticule line. Calculate the actual power as follows:

    ____________ Level set in step 10.
    \+ ____________ Difference measured in step 12.
    ____________ Actual level.

    The actual level calculated should be within the limits listed in Table 4-2, Performance Test Record.

13. Repeat steps 10 through 12, with Signal Generator settings of −40 dBm through −50 dBm.

14. Note the Signal Generator's signal level (at −50 dBm) on the spectrum analyzer display. This will be a reference for step 15. Remove the 20 dB attenuator, set the spectrum analyzer IF sensitivity 20 dB higher, and set the vertical sensitivity to bring the signal back to the reference level noted.

15. Repeat steps 10 through 12 with Signal Generator settings of −60 dBm through −90 dBm.

PERFORMANCE TESTS

4-9. LOW LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

16. Note the Signal Generator's level (at −90 dBm) on the spectrum analyzer display. This will be a reference in Step 17.

17. Connect the 20 dB Preamplifier as shown in Figure 4-3. Set the spectrum analyzer IF sensitivity 20 dB higher, and set the vertical sensitivity to bring the signal back to the reference level noted in step 16.

18. Repeat steps 10 through 12, with Signal Generator settings of −100 dBm and −110 dBm.

19. Repeat steps 3 through 18 for Signal Generator frequencies of 10 GHz and 18 GHz.

PERFORMANCE TESTS

4-10. HARMONICS, SUBHARMONICS, & MULTIPLES TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Harmonics	<−40 dBc	Output level +3 dBm
Subharmonics and Multiples Thereof	−35 dBc	Output level +3 dBm

Description In this test a spectrum analyzer is used to observe the amplitude of various harmonics of the Signal Generator. In the multiplied bands, subharmonics and multiples (harmonics of the unmultiplied signal) are checked. Reasonable care must be taken to ensure that the harmonics being measured are not generated in the spectrum analyzer.

Equipment Spectrum Analyzer .... HP 8566B

Procedure

1. Connect the Signal Generator RF OUTPUT to the input of the spectrum analyzer as shown in Figure 4-4.

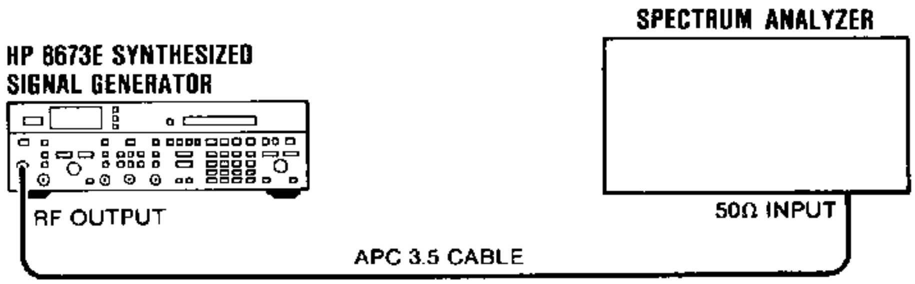


Figure 4-4. Harmonics, Subharmonics, and Multiples Test Setup

2. Set the Signal Generator to 4.000 GHz and output level of −3 dBm. Readjust the vernier to 0.0 dBm as indicated by the Signal Generator's LEVEL dBm display.

3. Set the spectrum analyzer controls to display the fundamental signal. Set the resolution bandwidth to 10 kHz and the input attenuation to 40 dB. Adjust the log reference level to set the signal to the top graticule line of the display.

4. Tune the Signal Generator to 2.000 GHz. The second harmonic, now at 4.000 GHz, viewed on the analyzer display, should be greater than 40 dB below the reference.

5. Repeat steps 2 through 4, at the other Signal Generator frequencies listed, to check each harmonic, subharmonic, and multiple listed in the following table.

PERFORMANCE TESTS

4-10. HARMONICS, SUBHARMONICS, & MULTIPLES TESTS (cont'd)

Procedure (cont'd)

NOTE

This procedure may be repeated for any fundamental frequency of interest within the Signal Generator frequency range.

Harmonics, Subharmonics, and Multiples

Set Signal Generator to	Check Harmonic Levels at:			
FUNDAMENTAL	HARMONIC	SUBHARMONIC		MULTIPLE
(GHz)	(GHz)	1/3	1/2	2/3
2.0000	4.0000			
4.0000	8.0000			
6.0000	12.0000			
8.0000	16.0000		4.0000	
10.0000	20.0000		5.0000	
12.0000	24.0000		6.0000	
14.0000		4.6667		9.3333
16.0000		5.3333		10.6667
18.0000		6.0000		12.0000
LIMITS	<−40 dBc	−35 dBc		

PERFORMANCE TESTS

4-11. NON-HARMONICALLY RELATED SPURIOUS SIGNALS (CW AND AM MODES) TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY Spurious: Non-Harmonically Related	<−60 dBc	CW and AM modes

Description

A spectrum analyzer, calibrated for −50 dBc, is tuned to any frequency from 2 to 26 GHz in search of spurious signals.

NOTE

The non-harmonically related spurious signals will always increase in amplitude above 6.6 GHz, due to multiplication in the internal YIG-tuned multiplier. The increase is determined by a strict mathematical relationship. Therefore, satisfactory performance in the 2 to 6.6 GHz range will always ensure meeting the less stringent specification in the multiplied ranges, that is, from 6.6 to 18.0 GHz.

Equipment

Spectrum Analyzer .... HP 8566B

Procedure

1. Connect the Signal Generator RF OUTPUT to the input of the spectrum analyzer as shown in Figure 4-5.

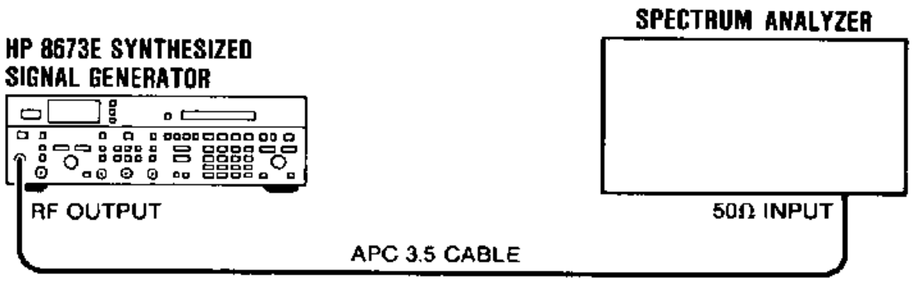


Figure 4-5. Non-Harmonically Related Spurious (CW and AM Modes) Test Setup

2. Set the Signal Generator to 3.000 GHz and output level to −43 dBm. Readjust the Vernier for an output of −47 dBm as indicated by the Signal Generator's LEVEL dBm display.
3. Set the spectrum analyzer controls to display the fundamental signal. Set the resolution bandwidth to 1 kHz and the frequency span per division to 10 kHz.
4. Set the spectrum analyzer controls so that the carrier signal is at the top graticule line.
5. Using the RANGE ⬆ key, increase the Signal Generator output to −7 dBm and then use the Vernier to adjust the output level to +3 dBm as indicated by the Signal Generator's LEVEL dBm display. Do not adjust the spectrum analyzer amplitude calibration. The top graticule line now represents −50 dBc.

PERFORMANCE TESTS

4-11. NON-HARMONICALLY RELATED SPURIOUS SIGNALS (CW AND AM MODES) TESTS (cont'd)

Procedure (cont'd)

6. Tune the spectrum analyzer to any desired frequency in search of non-harmonically related spurious signals. Verify that any signals found are non-harmonically related and are not generated by the spectrum analyzer. Verify that the spurious signals are below the specified limits. Record the results.

Carrier Frequency	Spurious Signal Frequency	Spurious Signal Frequency
__________	__________	__________
__________	__________	__________
__________	__________	__________
__________	__________	__________

7. Repeat step 2 through 6 for any desired carrier frequency from 2 to 6.6 GHz. Record the results. (Checking non-harmonically related spurious signals from 2.0 to 6.6 GHz provides a high level of confidence that the instrument meets its published specifications from 2 to 18 GHz.)

Carrier Frequency	Spurious Signal Frequency	Spurious Signal Frequency
__________	__________	__________
__________	__________	__________
__________	__________	__________
__________	__________	__________

PERFORMANCE TESTS

4-12. SINGLE-SIDEBAND PHASE NOISE TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY Single-Sideband Phase Noise (1 Hz bandwidth; CW mode)	−60 dBc	2.0—18.0 GHz

Description

The RF output of the Signal Generator is mixed with a local oscillator to obtain a 200 kHz IF signal. The noise sidebands are observed on a spectrum analyzer. Correction factors are applied to compensate for using the spectrum analyzer in the log mode, for local oscillator noise contributions, and for using bandwidths wider than 1 Hz.

NOTE

Normally, phase quadrature needs to be maintained between the Signal Generator and the local oscillator for true phase noise measurement. However, the additional amplitude noise components are so small that they are not significant in these tests.

Equipment

Local Oscillator .... HP 8340A
Spectrum Analyzer (20 Hz — 300 kHz) .... HP 8556A/8552B/141T
Mixer .... RHG DMS1-18

NOTE

The signal-to-phase noise ratio as measured must be corrected to compensate for 3 errors contributed by the measurement system. These are:

a. Using the spectrum analyzer in the log mode requires a +2.5 dB correction.

b. Equal noise contributed by the local oscillator requires a −3 dB correction.

c. The spectrum analyzer noise measurement must be normalized to a 1 Hz noise equivalent bandwidth. The noise equivalent bandwidth for HP spectrum analyzers is 1.2 times the 3 dB bandwidth.

For a 30 Hz bandwidth, the correction factor for the normalized measurement bandwidth would be:

$$\text{Normalizing Factor dB} = 10 \log (1.2 \times 30\ \text{Hz}/1\ \text{Hz}) = 15.56\ \text{dB}.$$

The total correction for 30 Hz bandwidth would be:

$$\text{True measurement (dBc)} = \text{Reading (dBc)} - 15.56 + 2.5 - 3 = -16.06\ \text{dB}.$$

Procedure

1. Set the spectrum analyzer's bandwidth to 30 Hz, and frequency span per division to 200 Hz.
2. Connect the equipment as shown in Figure 4-6.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

PERFORMANCE TESTS

4-12. SINGLE-SIDEBAND PHASE NOISE TESTS (cont'd)

Procedure (cont'd)

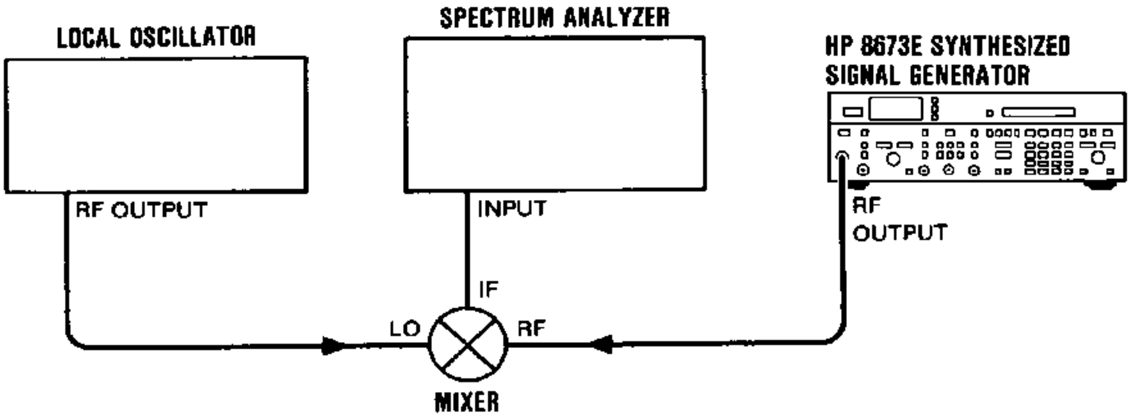


Figure 4-6. Single-Sideband Phase Noise Test Setup

3. Set the Signal Generator to 6600 MHz at −20 dBm.
4. Set the local oscillator to 6599.800 MHz at +8 dBm.
5. Tune the spectrum analyzer to place the 200 kHz IF signal at the left edge of the display. Set the spectrum analyzer controls to place the peak of the signal at the top graticule line. Increase the log reference level control to move the peak of the carrier 20 dB above the top graticule line. (The top graticule line is now −20 dBc.)
6. Observe the noise level 1 kHz from the carrier. It should be greater than 60 dB below the carrier. Record the measured level.

   Measured ________
   Correction −16.06 dB
   Actual Level ________

7. Set the Signal Generator and the local oscillator to 13 300 MHz and 12 299.800 MHz respectively.
8. Observe the noise level 1 kHz from the carrier. It should be greater than 60 dB below the carrier. Record the measured level.

   Measured ________
   Correction −16.06 dB
   Actual Level ________

9. Set the Signal Generator and the local oscillator to 18 000 MHz and 17 999.800 MHz respectively.
10. Observe the noise level 1 kHz from the carrier. It should be greater than 60 dB below the carrier. Record the measured level.

   Measured ________
   Correction −16.06 dB
   Actual Level ________

PERFORMANCE TESTS

4-13. RESIDUAL AM TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
Residual AM	<−50 dBc	200 kHz post-detection bandwidth

Description The RF output of the Signal Generator is mixed with a local oscillator to obtain a 500 MHz IF signal. The IF signal is measured for residual AM.

Equipment

Local Oscillator .... HP 8340A
Mixer .... RHG DMS1-18
Modulation Analyzer .... HP 8902A

Procedure

1. Connect equipment as shown in Figure 4-7.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

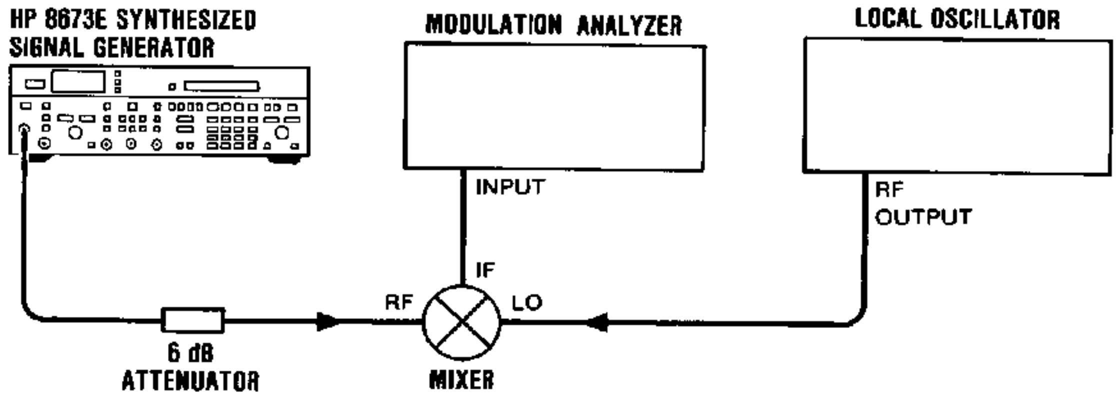


Figure 4-7. Residual AM Test Setup

2. Key in RCL 0 and set the Signal Generator to 6.6 GHz and −10 dBm output level.
3. Set the local oscillator to 6.1 GHz at +8 dBm with all modulation off.
4. Select AM mode on the modulation analyzer and set the high pass filter for 50 Hz and the low pass filter for 3 kHz.
5. Read the actual AM depth on the modulation analyzer. Complete the following table and ensure all measurement data points are within the specified limits.

Signal Generator Frequency	Local Oscillator Frequency	Max AM Depth	Actual Depth
6.6 GHz	6.1 GHz	0.5%	________
12.2 GHz	11.7 GHz	0.5%	________
18.0 GHz	17.5 GHz	0.5%	________

PERFORMANCE TESTS

4-14. AMPLITUDE MODULATION TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
AMPLITUDE MODULATION		
Depth (+15°C to +35°C)	0 to 75%	2.0 to 18.0 GHz; 0 dBm maximum carrier level
Rate	±3 dB	10 Hz to 50 kHz, 30% depth
Sensitivity (% AM per Vpk)	30%/V and 100%/V ranges	Maximum input 1 Vpk into 600 ohms nominal; AM depth is linearly controlled by varying input level between 0 and 1V peak
Distortion	≤8%	50% depth, 1 kHz rate, 0 dBm

Description

The Signal Generator under test is amplitude modulated with an audio source and mixed down with a local oscillator to produce a modulated 500 MHz IF. The AM rate is measured on the modulation analyzer. The detected audio output from the modulation analyzer is then measured using an audio analyzer. A 0 dB reference is stored at a 1 kHz rate, and the rate stepped from 20 Hz to 50 kHz to measure the AM bandwidth. Distortion is also checked with the modulation analyzer and audio analyzer.

Equipment

Local Oscillator .... HP 8340A
Mixer .... RHG DMS1-18
Audio Analyzer (and Source) .... HP 8903A
Modulation Analyzer .... HP 8902A
6 dB Attenuator .... HP 8491B Option 006
Digital Voltmeter .... HP 3456A or HP 3455A

Procedure

AM Rate

1. Connect equipment as shown in Figure 4-8.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

2. Key in RCL 0. Set the Signal Generator to 4.0 GHz frequency, and 0 dBm output level. Select the AM 100% range.
3. Set the local oscillator to 3.5 GHz at +8 dBm with all modulation off.
4. Select AM mode on the modulation analyzer.
5. Connect the modulation analyzer detected audio output to the input of the audio analyzer.
6. Set the audio source to 1 kHz rate. Adjust the level for 30% AM modulation depth, as read on the modulation analyzer (about 0.212 Vrms). Record this level as a reference.

_______ Vrms.

PERFORMANCE TESTS

4-14. AMPLITUDE MODULATION TESTS (cont'd)

Procedure (cont'd)

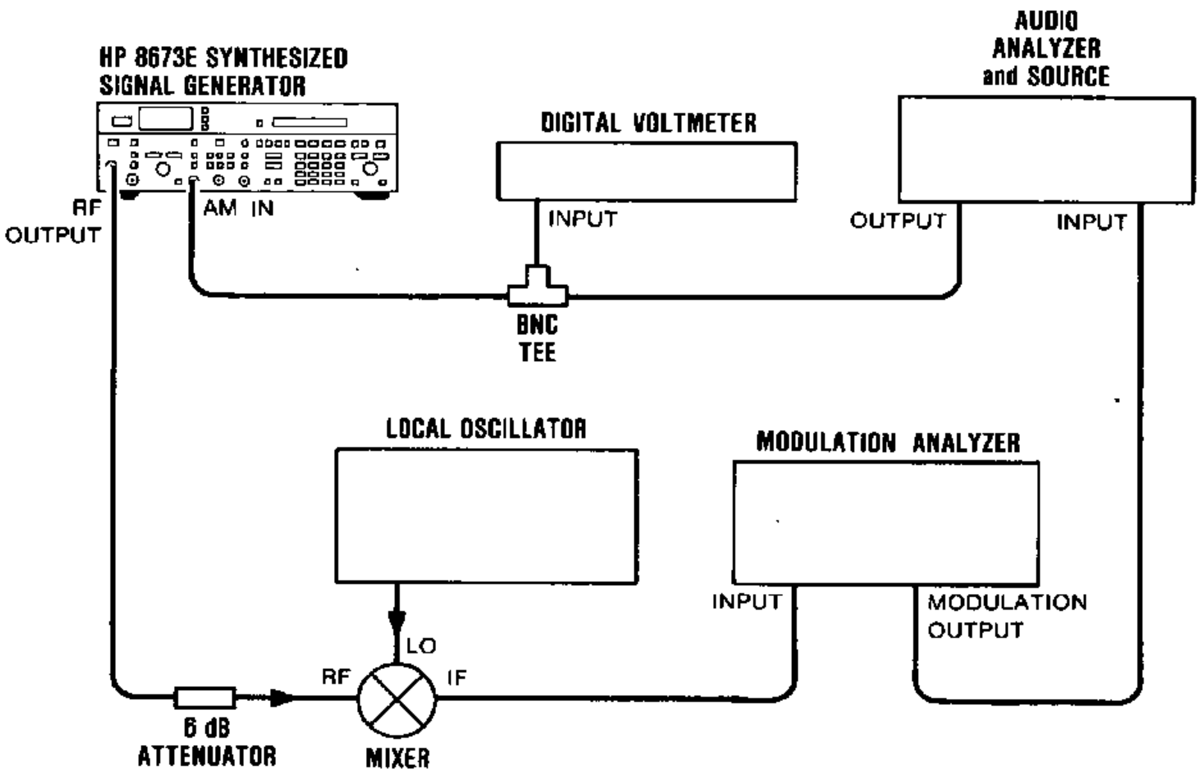


Figure 4-8. AM Modulation Test Setup

7. Set audio analyzer to read the amplitude of the input signal.
8. Press "Ratio", then "LOG" keys to set the audio analyzer to the dB relative mode using the output signal of the modulation analyzer as a 0 dB reference.
9. Set the audio source to 20 Hz and step the frequency up to 50 kHz. Ensure that the input signal level as read on the audio analyzer does not change more than ±3 dB from the reference at any frequency from 20 Hz to 50 kHz.
10. Repeat steps 6 through 9 for the remaining frequencies and levels listed below.

Signal Generator Frequency	Local Oscillator Frequency	Modulation Level (at 30% AM Depth)		Distortion (at 50% AM Depth)	
		Frequency	Change		
4.0 GHz	3.5 GHz	______	______	______	8%
6.7 GHz	6.2 GHz	______	______	______	8%
15.0 GHz	14.5 GHz	______	______	______	8%

NOTE

Audio source level may need slight adjustment to hold it at the reference level in step 6.

PERFORMANCE TESTS

4-14. AMPLITUDE MODULATION TESTS (cont'd)

Procedure (cont'd)

Distortion

11. Set the Signal Generator to 4.0 GHz and the Local Oscillator to 3.5 GHz.

12. Set the audio source to 1 kHz rate and adjust the level for 50% modulation depth as read on the modulation analyzer.

13. Set the audio analyzer to read distortion with the 30 kHz low pass filter. Distortion should not exceed 8%.

14. Repeat steps 12 and 13 for the frequencies listed above. In all cases, distortion should not exceed 8%. Record results in the table above, and in Table 4-2.

PERFORMANCE TESTS

4-15. FM FREQUENCY RESPONSE TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY MODULATION Frequency Response Relative to a 100 kHz Rate	±3 dB ±3 dB	100 Hz to 2 MHz, 30 and 100 kHz/V ranges 3 kHz to 2 MHz, 0.3, 1, and 3 MHz/V ranges

Description

The test oscillator is tuned to 100 kHz and the output level is adjusted to obtain a Bessel (first carrier) null (2.404). The output level and the 100 kHz rate are the references for later calculations. At other modulation rates, the output level is set and measured for the first carrier null. The measured voltage and the rate are then compared to the established reference to determine frequency response.

Equipment

Spectrum Analyzer .... HP 8566B
Test Oscillator .... HP 3335A
Frequency Counter .... HP 5343A
AC Voltmeter .... HP 400E

Procedure

1. Connect the equipment as shown in Figure 4-9.

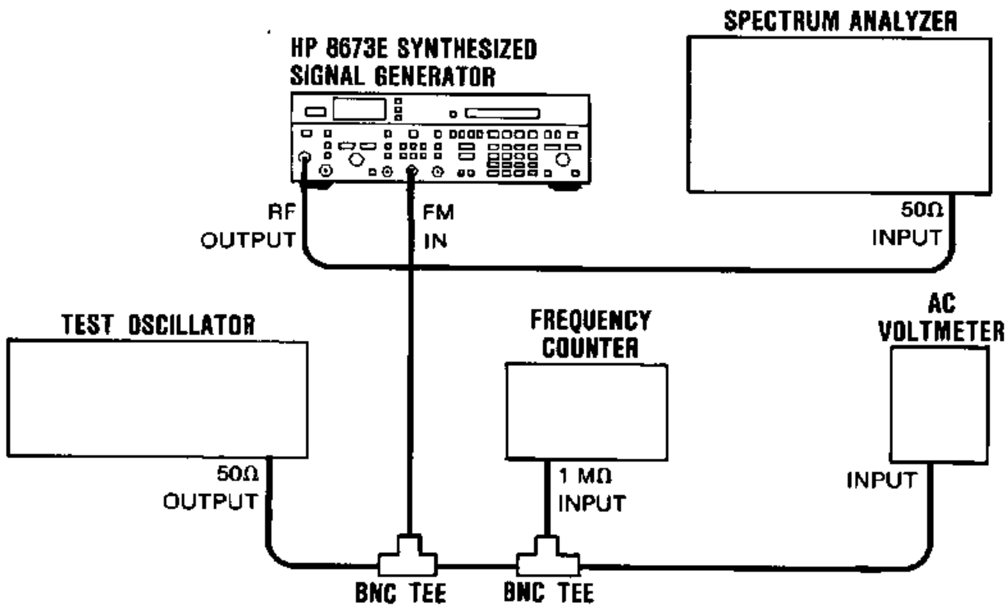


Figure 4-9. FM Frequency Response Test Setup

2. Set the Signal Generator to 4 GHz at 0 dBm. Adjust the spectrum analyzer controls to display the RF signal. Set the frequency span per division to 100 kHz. Set other controls as needed for a calibrated display.
3. Set FM DEVIATION to 3 MHz. Tune the test oscillator to 100 ±1 kHz.

PERFORMANCE TESTS

4-15. FM FREQUENCY RESPONSE TESTS (cont'd)

Procedure (cont'd)

4. Adjust the test oscillator voltage to obtain the first carrier null. The voltage should be about 0.056 Vrms. Record the voltmeter reading in the following table.

5. Tune the test oscillator to 3 kHz and adjust the output voltage to obtain the first carrier null. Record the measured frequency and voltage in the table.

6. Repeat step 5 for each of the remaining frequencies in the table.

FM Rate (in kHz)	Measured Frequency f_x (kHz)	Measured Voltage V_x (mVrms)	Calculated Response (in dB)
3	______	______	______
30	______	______	______
100	100.0	______	0
300	______	______	______
1000	______	______	______
2000	______	______	______

7. Use the following equation to calculate FM frequency response:

$$dB = 20 \log \frac{V_x}{V_{100\ kHz}} - 20 \log \frac{f_x}{100\ kHz}$$

where dB = the calculated frequency response

V_x = the voltage measured at f_x

$V_{100\ kHz}$ = the reference voltage measured at 100 kHz

f_x = the measured frequency.

PERFORMANCE TESTS

4-16. INCIDENTAL AM TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY MODULATION Incidental AM	<5%	Rates <100 kHz; peak deviations <1 MHz

Description

A reference is established by modulating the Signal Generator at 5% AM (the maximum allowable incidental AM). The detected signal is measured with a voltmeter. Then the Signal Generator is frequency modulated and the detected AM level is compared to the reference level.

Equipment

Digital Voltmeter .... HP 3455A or 3456A
Test Oscillator .... HP 3335A
Crystal Detector .... HP 08673-60083
50 Ohm Termination .... HP 11593A

Procedure

1. Connect the equipment as shown in Figure 4-10.

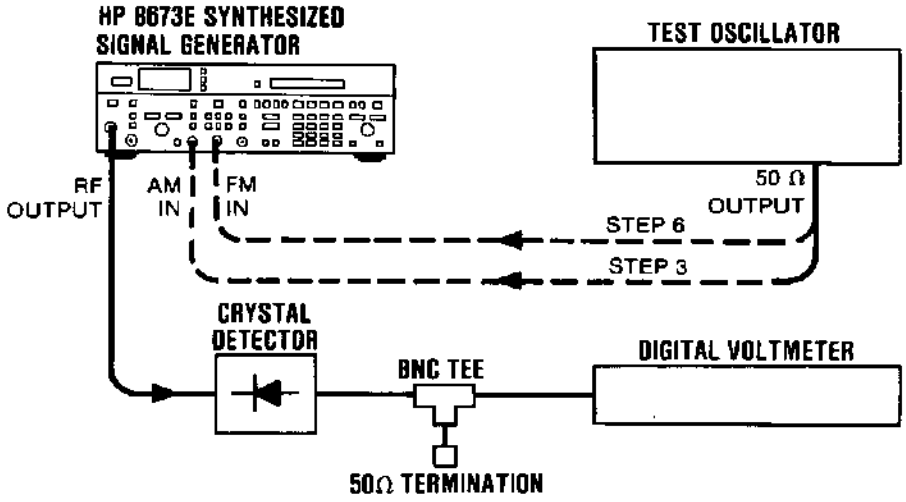


Figure 4-10. Incidental AM Test Setup

2. Set the Signal Generator to 2 GHz at 0 dBm. Select the 30% AM range and AM meter mode.

3. Connect the test oscillator's 50 ohm output to the AM IN connector of the Signal Generator.

4. Set the test oscillator to 10 kHz, and adjust the output for a 5% AM reading on the Signal Generator's OUTPUT LEVEL meter.

PERFORMANCE TESTS

4-16. INCIDENTAL AM TESTS (cont'd)

Procedure (cont'd)

5. Record the detected level of AM as indicated by the digital voltmeter.

   Reference Level __________ Vrms

6. Move the cable from the AM IN connector to the FM IN connector.

7. Set the Signal Generator to AM OFF and FM DEVIATION to the 1 MHz range and select the FM meter mode.

8. Set the test oscillator frequency to 100 kHz.

9. Vary the test oscillator amplitude to vary the deviation range between 0 and 500 kHz as read on the Signal Generator's meter. Verify that the voltmeter reading is less than the level recorded in step 4. Record the level.

   2.0 GHz __________ Vrms

10. Set the Signal Generator to 6.7 GHz at 0 dBm. Vary the test oscillator amplitude to vary the deviation over a 0 to 1 MHz range. Verify that the voltmeter reading does not exceed the level recorded in step 4. Record the maximum level.

    6.7 GHz __________ Vrms

11. Repeat step 8 for Signal Generator frequencies of 12.4 GHz and 18.0 GHz.

    12.4 GHz __________ Vrms

    18.0 GHz __________ Vrms

PERFORMANCE TESTS

4-17. PULSE TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
PULSE MODULATION		
On-Off Ratio	>70 dB	
Overshoot, Ringing	<0.2 (<20%)	2.0 to 18.0 GHz

Description

The pulse tests are performed in two parts. The first part tests overshoot and ringing. In this test, the pulse modulated output of the Signal Generator is mixed with a local oscillator using a double balanced mixer. The resulting 70 MHz IF signal is amplified and viewed on an oscilloscope to determine pulse performance.

The second part tests the On-Off ratio. A spectrum analyzer is used to measure the change in power output when the pulse modulator is switched from normal mode to complement mode.

Equipment

Local Oscillator .... HP 8673E
Pulse Generator .... HP 8013B
Oscilloscope .... HP 1980B
Pre Amp-Power Amp .... HP 8447F
Mixer .... RHG DMS1-18
Spectrum Analyzer .... HP 8566B
Variable Step Attenuator .... HP 8495B Option 001
3 dB Attenuator .... HP 8491B Option 003
10 dB Attenuator .... HP 8491B Option 010
Pulse Mixer Cable .... HP 11726-20007
Pulse DUT Cable .... HP 11726-20006

Procedure

Overshoot and Ringing

1. Connect equipment as shown in Figure 4-11. See Figure 4-12 for the required physical interconnections.

NOTES

The Pulse DUT cable and the Pulse Mixer cable are part of the HP 11726A Support Kit.

Make sure there are no sharp bends in the cable, and that all connections are tight. Connect the LO port of the mixer directly to the output connector of the local oscillator. Connect the 3 dB attenuator directly to the IF port of the mixer. This will minimize distortion of the pulse shape, and thus give more accurate measurements.

2. Set the variable step attenuator for 20 dB.

3. Press RCL 0 on the Signal Generator and on the local oscillator. Set equipment controls as follows:

Signal Generator:		Local Oscillator:	
OUTPUT LEVEL	+8 dBm	Power Level	+8 dBm
PULSE	NORM	Sweep Start Frequency	2070 MHz
SWEEP FREQ START	2000 MHz	Sweep Stop Frequency	6670 MHz
SWEEP FREQ STOP	6600 MHz	Frequency Increment	10 MHz
FREQ INCR	10 MHz	HP-IB Address	40
HP-IB Address	50		

PERFORMANCE TESTS

4-17. PULSE TESTS (cont'd)

Procedure (cont'd)

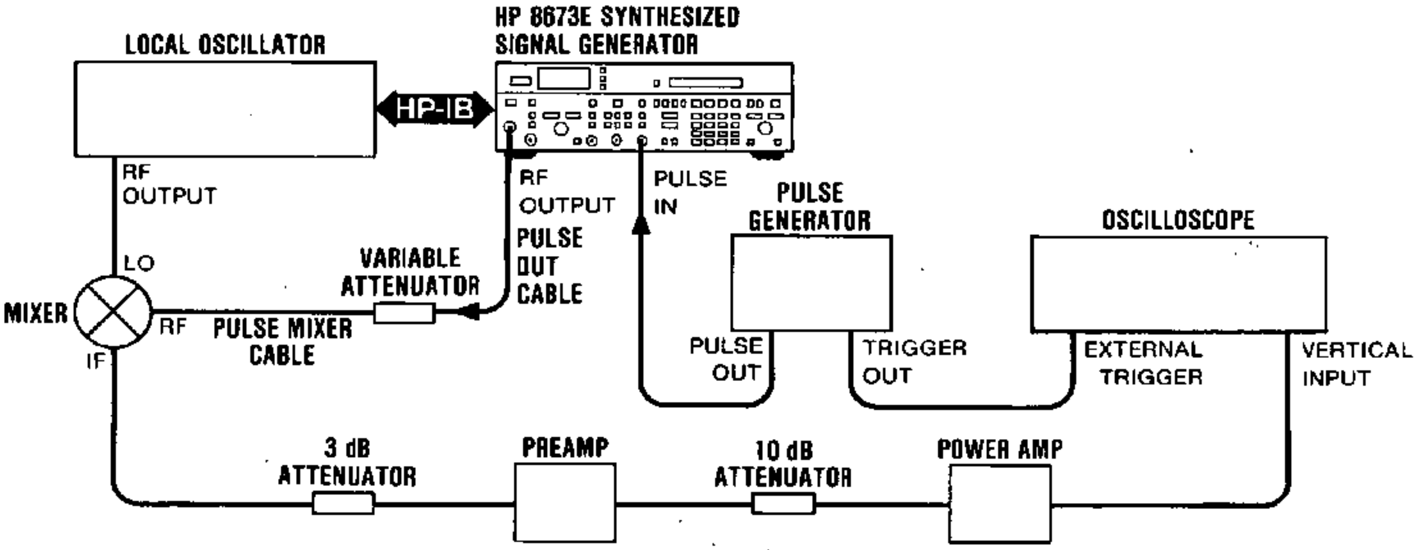


Figure 4-11. Pulse Overshoot and Ringing Test Setup

4. The TLK annunciator should be lighted on the Signal Generator, indicating that it will "talk" to, or control, the local oscillator. The LSN annunciator should be lighted on the local oscillator indicating that it will "listen" to, or follow, commands from the Signal Generator. This is referred to as the Master/Slave mode of operation.

5. Set SWEEP MODE to MANUAL on the Signal Generator. Both MANUAL and SINGLE annunciators should be lighted on the Signal Generator. Tuning the frequency of the Signal Generator with the TUNE knob will also cause the local oscillator to change frequency a corresponding amount. Therefore the difference frequency (IF) will remain the same (70 MHz).

6. Set the pulse generator and oscilloscope controls as follows:

Pulse Generator:		Oscilloscope:	
Pulse Rate	1 MHz	Vert Display	Channel 1, 50 ohms
Pulse Width	120 ns	Time/Div Main	0.2 μs
+ Output	Norm	Time/Div Delayed	20 ns
Int Load	Out	Vertical Sensitivity	0.02 V/div.
Pulse Output Level	5V peak	Trigger	External DC Coupled
Double/Norm	Norm	Sweep	Mixed

4-17. PULSE TESTS (cont'd)

Procedure (cont'd)

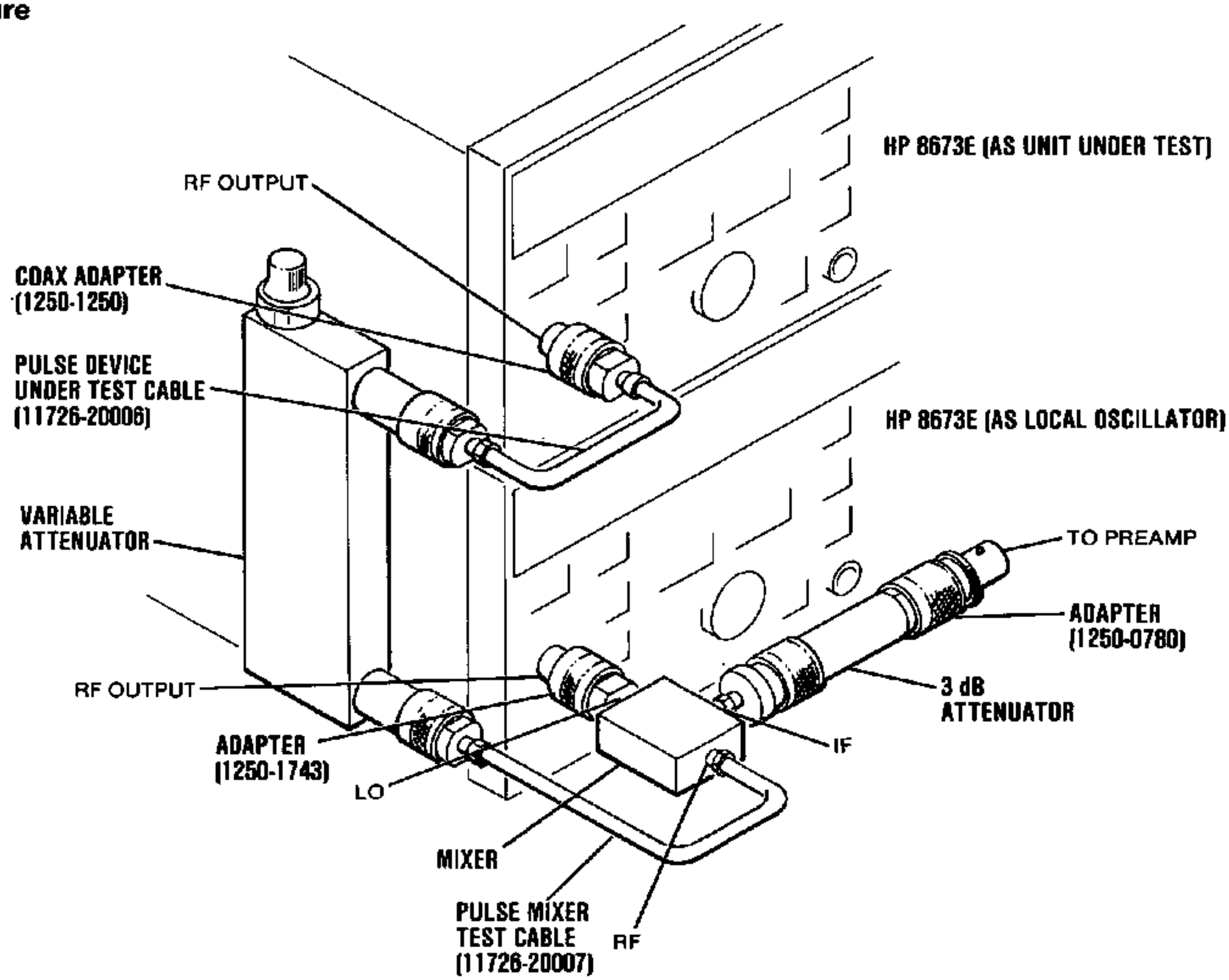


Figure 4-12. Equipment Interconnection for Pulse Test

7. Adjust the sweep delay on the oscilloscope to center the modulated 70 MHz RF pulse. Adjust the vertical controls for a 5 division peak pulse display. See Figure 4-13.

8. Tune the Signal Generator to 2000.000 MHz. The local oscillator should track the Signal Generator frequency with a 70 MHz offset.

9. Measure the pulse overshoot and ringing. Record the results.

   Overshoot and ringing ________ 20%

10. Tune the Signal Generator to 6600.000 MHz. Measure the pulse rise time, fall time, overshoot and ringing. Record the results.

   Overshoot and Ringing ________ 20%

PERFORMANCE TESTS

4-17. PULSE TESTS (cont'd)

Procedure (cont'd)

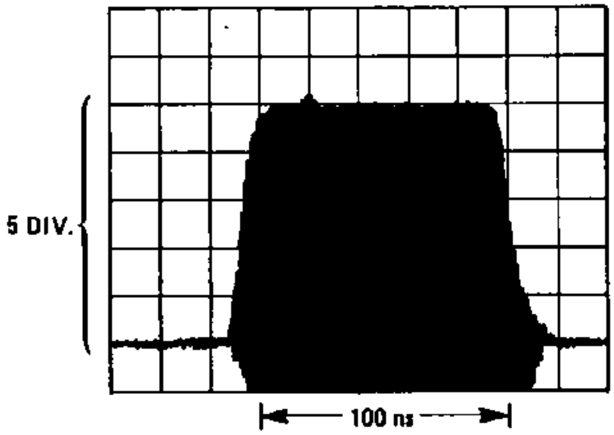


Figure 4-13. Overshoot and Ringing Measurement Display

NOTE

In the following tests, it is important that the VERNIER be set to give the approximate output level meter reading indicated in the tables. For instance, it is possible to get a −10 dBm output with the VERNIER near maximum on one attenuator range, or near minimum on the next higher range. The level indicated in each test is needed to make the test valid.

11. Scan the entire frequency band from 2 to 6.6 GHz at output levels of +8 and −10 dBm. Verify that overshoot and ringing are less than 20%. Record the worst case results.

FREQUENCY (MHz)	LEVEL dBm	Approximate Meter Reading	Variable Attenuator	Overshoot and Ringing (%)
________	+18 dBm	−2 dB	20 dB	________
________	−10 dBm	−10 dB	10 dB	________

NOTE

As the frequency band is scanned using the TUNE knob on the Signal Generator, the peak level of the pulse displayed on the oscilloscope may vary several divisions in amplitude, due to measurement system variations. To compensate for this, adjust the vertical sensitivity controls on the oscilloscope to maintain a constant 5-division peak amplitude while making measurements.

12. Set the SWEEP FREQ START to 6600.002 MHz on the Signal Generator. Set the SWEEP FREQ STOP to 12300.000 MHz.

13. Set the sweep start frequency to 6670.000 MHz on the local oscillator and the sweep stop frequency to 12370.002 MHz.

4-17. PULSE TESTS (cont'd)

Procedure (cont'd)

14. Tune the Signal Generator to each frequency shown in the table below. Set the OUTPUT LEVEL RANGE and VERNIER as shown for each frequency. Measure overshoot and ringing at each frequency. Overshoot and ringing should be less than 20% from 6.6 to 12.3 GHz. Record the results.

FREQUENCY (MHz)	LEVEL dBm	Approximate Meter Reading	Variable Attenuator	Overshoot and Ringing (%)
6600.002	+8 dBm	−2 dB	20 dB	______
6600.002	0 dBm	0 dB	20 dB	______
6600.002	−10 dBm	−10 dB	10 dB	______
6700.002	+8 dBm	−2 dB	20 dB	______
6700.002	0 dBm	0 dB	20 dB	______
6700.002	−10 dBm	−10 dB	10 dB	______
12290.002	+8 dBm	−2 dB	20 dB	______
12290.002	0 dBm	0 dB	20 dB	______
12290.002	−10 dBm	−10 dB	10 dB	______

15. Scan the entire band from 6.6 GHz to 12.3 GHz. Ensure that overshoot, and ringing are within the limits specified above at power levels of −10 dBm, 0 dBm, and +8 dBm for all frequencies within this range. Record the worst case results.

FREQUENCY (MHz)	LEVEL dBm	Approximate Meter Reading	Variable Attenuator	Overshoot and Ringing (%)
______	+8 dBm	−2 dB	20 dB	______
______	0 dBm	0 dB	20 dB	______
______	−10 dBm	−10 dB	10 dB	______

16. Set the SWEEP FREQ START to 12300.003 MHz on the Signal Generator. Set the SWEEP FREQ STOP to 18000.000 MHz.
17. Set the sweep start frequency to 12370.002 MHz on the local oscillator and the sweep stop frequency to 18070.002 MHz.
18. Tune the Signal Generator to each frequency shown in the following table. Set the OUTPUT LEVEL RANGE and VERNIER, and variable step attenuator to the values shown at each frequency. Measure overshoot and ringing at each setting. Overshoot and ringing should be less than 20%. Record the measurements.

FREQUENCY (MHz)	LEVEL dBm	Approximate Meter Reading	Variable Attenuator	Overshoot and Ringing (%)
12300.003	+8 dBm	−2 dB	20 dB	______
12300.003	0 dBm	0 dB	20 dB	______
12300.003	−10 dBm	−10 dB	10 dB	______
17990.003	+8 dBm	−2 dB	20 dB	______
17990.003	0 dBm	0 dB	20 dB	______
17990.003	−10 dBm	−10 dB	10 dB	______

PERFORMANCE TESTS

4-17. PULSE TESTS (cont'd)

Procedure (cont'd)

19. Scan the entire band from 12.3 GHz to 18.0 GHz at output levels of −10, 0, and +8 dBm. Verify that overshoot and ringing are less than 20%. Record the worst case results.

FREQUENCY (MHz)	LEVEL dBm	Approximate Meter Reading	Variable Attenuator	Overshoot and Ringing (%)
________	+8 dBm	−2 dB	20 dB	________________
________	0 dBm	0 dB	10 dB	________________
________	−10 dBm	−10 dB	0 dB	________________

On-Off Ratio Tests

20. Connect the equipment as shown in Figure 4-14.

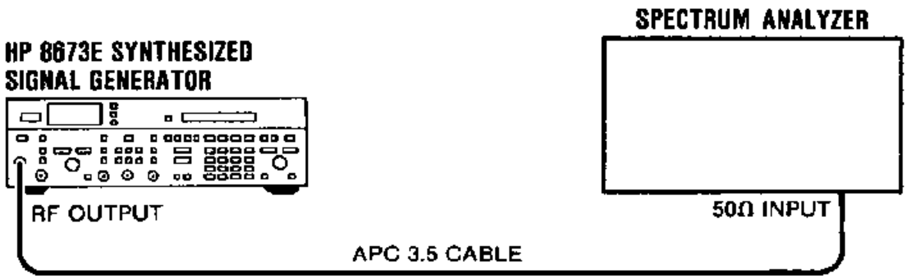


Figure 4-14. On-Off Ratio Test Setup

21. Set the Signal Generator controls as follows:

FREQUENCY	2.0 GHz
PULSE	COMPL
AM	OFF
FM DEVIATION	OFF
SWEEP MODE	OFF

22. Set the Signal Generator so that the LEVEL dBm display reads −5 dBm, then use the VERNIER to set the level to −10 dBm.

23. Adjust the spectrum analyzer to establish a reference signal at the top graticule line. Use at least 40 dB of input attenuation and a bandwidth of 1 kHz or less.

24. Set PULSE MODE to NORM.

25. Reduce the spectrum analyzer reference level as needed to observe the residual signal. It should be >70 dB below the reference established in step 23.

PERFORMANCE TESTS

4-17. PULSE TESTS (cont'd)

Procedure (cont'd)

Frequency GHz	Level (dB below reference signal)
2.0	70 ________

26. Repeat steps 23 through 25 for Signal Generator frequencies listed below. Record the results.

Frequency GHz	Level (dB below reference signal)
3.0	70 ________
4.0	70 ________
5.0	70 ________
6.0	70 ________
6.6	70 ________

PERFORMANCE TESTS

4-18. INTERNAL TIME BASE AGING RATE

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Reference Oscillator		
Frequency	10 MHz	After a 10 day warmup (typically 24 hours in a normal operating environment)
Aging Rate	$<1.5 \times 10^{-9}$/day	
Accuracy and Stability	Same as reference oscillator	

Description

A reference signal from the Signal Generator (10 MHz OUT) is connected to the oscilloscope's vertical input. A frequency standard (with long term stability greater than 1×10^{-10}) is connected to the trigger input. The time required for a specific phase change is measured immediately and after a period of time. The aging rate is inversely proportional to the absolute value of the difference in the measured times.

Equipment

Frequency Standard .... HP 5065A
Oscilloscope .... HP 1980B

NOTE

Be sure the Signal Generator has had 10 days to warm up before beginning this test. If the Signal Generator was disconnected from the power line for less than 24 hours, only a 24 hour warm-up is needed.

Procedure

1. Set the rear panel FREQ REFERENCE INT-EXT switch to the INT position.

2. Connect the equipment as shown in Figure 4-15.

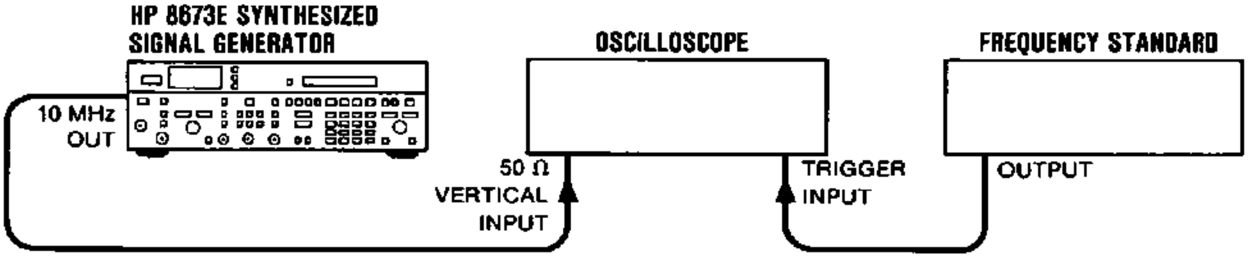


Figure 4-15. Internal Time Base Aging Rate Test Setup

3. Adjust the oscilloscope controls for a stable display of the 10 MHz Signal Generator output.

PERFORMANCE TESTS

4-18. INTERNAL TIME BASE AGING RATE (cont'd)

Procedure (cont'd)

4. Measure the time required for a phase change of 360°. Record the time (T_1) in seconds.

T_1 = ________ s

5. Wait for a period of time (from 3 to 24 hours) and re-measure the phase change time. Record the period of time between measurements (T_2) in hours and the new phase change time (T_3) in seconds.

T_2 = ________ h

T_3 = ________ s

6. Calculate the aging rate from the following equation:

$$\text{Aging Rate} = \left| \left(\frac{1\text{ cycle}}{f} \right) \left(\frac{1}{T_1} - \frac{1}{T_3} \right) \left(\frac{T}{T_2} \right) \right|$$

where: 1 cycle = the phase change reference for the time measurement (in this case, 360°)
f = Signal Generator's reference output frequency (10 MHz)
T = specified time for aging rate (24h)
T_1 = initial time measurement(s) for a 360° (1 cycle) change
T_2 = time between measurements (h)
T_3 = final time measurement(s) for a 360° (1 cycle) change

for example:

if T_1 = 351s
T_2 = 3h
T_3 = 349s

then:

$$\text{Aging Rate} = \left| \left(\frac{1\text{ cycle}}{10\text{ MHz}} \right) \left(\frac{1}{351\text{s}} - \frac{1}{349\text{s}} \right) \left(\frac{24\text{h}}{3\text{h}} \right) \right|$$

$$= 1.306 \times 10^{-11}$$

7. Verify that the aging rate is less than 1.5×10^{-9}.

NOTE

If the absolute frequencies of the frequency standard and the Signal Generator's reference oscillator are extremely close, the measurement time in steps 5 and 6 (T_1 and T_3) can be reduced by measuring the time required for a phase change of something less than 360°. Change 1 cycle in the formula (i.e., 180° = 1/2 cycle, 90° = 1/4 cycle).

Table 4-2. Performance Test Record (1 of 6)

Hewlett-Packard Company
Model 8673E
Signal Generator
Serial Number ____________

Tested by ____________

Date ____________

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-7.	**FREQUENCY RANGE AND RESOLUTION**			
	Resolution			
	4.0 GHz, 1 kHz Resolution		______ (√)	
	8.0 GHz, 2 kHz Resolution		______ (√)	
	15.0 GHz, 3 kHz Resolution		______ (√)	
	Range and Accuracy (GHz)			
	All readings within ± one count			
	2.000 000	1.999 999	______ (√)	2.000 001
	2.111 111	2.111 110	______ (√)	2.111 112
	2.222 222	2.222 221	______ (√)	2.222 223
	2 333 333	2.333 332	______ (√)	2.333 334
	2.444 444	2.444 443	______ (√)	2.444 445
	2.555 555	2.555 554	______ (√)	2.555 556
	2.666 666	2.666 665	______ (√)	2.666 667
	2.777 777	2.777 776	______ (√)	2.777 778
	2.888 888	2.888 887	______ (√)	2.888 889
	2.999 999	2.999 998	______ (√)	3.000 000
4-8.	**OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS**			
	Output Level			
	Frequency and Power at Minimum Power Point			
	2.0—18.0 GHz			
	Frequency ______			
	Minimum power	+8 dBm	______ (√)	
	Level Flatness (total variation)			
	2—18 GHz ±2 dB		______	4.00 dB
	High Level Accuracy			
	+8 dBm 2 GHz	+4.00 dBm	______	+12.00 dBm
	4 GHz	+4.00 dBm	______	+12.00 dBm
	6 GHz	+4.00 dBm	______	+12.00 dBm
	8 GHz	+4.00 dBm	______	+12.00 dBm
	10 GHz	+4.00 dBm	______	+12.00 dBm
	12 GHz	+4.00 dBm	______	+12.00 dBm
	14 GHz	+3.00 dBm	______	+13.00 dBm
	16 GHz	+3.00 dBm	______	+13.00 dBm
	18 GHz	+3.00 dBm	______	+13.00 dBm

Table 4-2. Performance Test Record (2 of 6)

Para. No.	Test		Results Min.	Actual	Max.
4-8.	OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS (cont'd)				
	High Level Accuracy (cont'd)				
	+3 dBm	2 GHz	−1.00 dBm	______	+7.00 dBm
		4 GHz	−1.00 dBm	______	+7.00 dBm
		6 GHz	−1.00 dBm	______	+7.00 dBm
		8 GHz	−1.00 dBm	______	+7.00 dBm
		10 GHz	−1.00 dBm	______	+7.00 dBm
		12 GHz	−1.00 dBm	______	+7.00 dBm
		14 GHz	−2.00 dBm	______	+8.00 dBm
		16 GHz	−2.00 dBm	______	+8.00 dBm
		18 GHz	−2.00 dBm	______	+8.00 dBm
	0 dBm	2 GHz	−4.00 dBm	______	+4.00 dBm
		4 GHz	−4.00 dBm	______	+4.00 dBm
		6 GHz	−4.00 dBm	______	+4.00 dBm
		8 GHz	−4.00 dBm	______	+4.00 dBm
		10 GHz	−4.00 dBm	______	+4.00 dBm
		12 GHz	−4.00 dBm	______	+4.00 dBm
		14 GHz	−4.00 dBm	______	+5.00 dBm
		16 GHz	−4.00 dBm	______	+5.00 dBm
		18 GHz	−4.00 dBm	______	+5.00 dBm
	−5 dBm	2 GHz	−9.00 dBm	______	−1.00 dBm
		4 GHz	−9.00 dBm	______	−1.00 dBm
		6 GHz	−9.00 dBm	______	−1.00 dBm
		8 GHz	−9.00 dBm	______	−1.00 dBm
		10 GHz	−9.00 dBm	______	−1.00 dBm
		12 GHz	−9.00 dBm	______	−1.00 dBm
		14 GHz	−10.00 dBm	______	0.00 dBm
		16 GHz	−10.00 dBm	______	0.00 dBm
		18 GHz	−10.00 dBm	______	0.00 dBm
	−10 dBm	2 GHz	−14.00 dBm	______	−6.00 dBm
		4 GHz	−14.00 dBm	______	−6.00 dBm
		6 GHz	−14.00 dBm	______	−6.00 dBm
		8 GHz	−14.00 dBm	______	−6.00 dBm
		10 GHz	−14.00 dBm	______	−6.00 dBm
		12 GHz	−14.00 dBm	______	−6.00 dBm
		14 GHz	−15.00 dBm	______	−5.00 dBm
		16 GHz	−15.00 dBm	______	−5.00 dBm
		18 GHz	−15.00 dBm	______	−5.00 dBm
	−20 dBm	2 GHz	−24.00 dBm	______	−16.00 dBm
		4 GHz	−24.00 dBm	______	−16.00 dBm
		6 GHz	−24.00 dBm	______	−16.00 dBm
		8 GHz	−24.00 dBm	______	−16.00 dBm
		10 GHz	−24.00 dBm	______	−16.00 dBm
		12 GHz	−24.00 dBm	______	−16.00 dBm
		14 GHz	−25.00 dBm	______	−15.00 dBm
		16 GHz	−25.00 dBm	______	−15.00 dBm
		18 GHz	−25.00 dBm	______	−15.00 dBm

Table 4-2. Performance Test Record (3 of 6)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-8.	OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS (cont'd)				
	High Level Accuracy (cont'd)				
	−30 dBm	2 GHz	−34.00 dBm	______	−26.00 dBm
		4 GHz	−34.00 dBm	______	−26.00 dBm
		6 GHz	−34.00 dBm	______	−26.00 dBm
		8 GHz	−34.00 dBm	______	−26.00 dBm
		10 GHz	−34.00 dBm	______	−26.00 dBm
		12 GHz	−34.00 dBm	______	−26.00 dBm
		14 GHz	−35.00 dBm	______	−25.00 dBm
		16 GHz	−35.00 dBm	______	−25.00 dBm
		18 GHz	−35.00 dBm	______	−25.00 dBm
4-9.	LOW LEVEL ACCURACY				
	2.0 GHz				
	Frequency ______				
	−40 dBm		−44.00 dBm	______	−36.00 dBm
	−50 dBm		−54.00 dBm	______	−46.00 dBm
	−60 dBm		−64.00 dBm	______	−56.00 dBm
	−70 dBm		−75.50 dBm	______	−64.50 dBm
	−80 dBm		−85.50 dBm	______	−74.50 dBm
	−90 dBm		−95.50 dBm	______	−84.50 dBm
	−100 dBm		−105.50 dBm	______	−94.40 dBm
	−110 dBm		−115.50 dBm	______	−104.50 dBm
	10.0 GHz				
	Frequency ______				
	−40 dBm		−44.00 dBm	______	−36.00 dBm
	−50 dBm		−54.00 dBm	______	−46.00 dBm
	−60 dBm		−64.00 dBm	______	−56.00 dBm
	−70 dBm		−75.50 dBm	______	−64.50 dBm
	−80 dBm		−85.50 dBm	______	−74.50 dBm
	−90 dBm		−95.50 dBm	______	−84.50 dBm
	−100 dBm		−105.50 dBm	______	−94.40 dBm
	−110 dBm		−115.50 dBm	______	−104.50 dBm
	18.0 GHz				
	Frequency ______				
	−40 dBm		−45.00 dBm	______	−35.00 dBm
	−50 dBm		−55.00 dBm	______	−45.00 dBm
	−60 dBm		−65.00 dBm	______	−55.00 dBm
	−70 dBm		−76.50 dBm	______	−63.50 dBm
	−80 dBm		−86.50 dBm	______	−73.50 dBm
	−90 dBm		−96.50 dBm	______	−83.50 dBm
	−100 dBm		−106.50 dBm	______	−93.40 dBm
	−110 dBm		−116.50 dBm	______	−103.50 dBm

Table 4-2. Performance Test Record (4 of 6)

Para. No.	Test		Results Min.	Results Actual	Results Max.
4-10.	**HARMONICS, SUBHARMONICS, AND MULTIPLES**				
	Harmonic Subharmonic	Fundamental			
	4.0000 GHz 2f	2.000 GHz		______	−40 dBc
	4.0000 GHz 1/2f	8.000 GHz		______	−35 dBc
	4.6667 GHz 1/3f	14.000 GHz		______	−35 dBc
	5.0000 GHz 1/2f	10.000 GHz		______	−35 dBc
	5.3333 GHz 1/3f	16.000 GHz		______	−35 dBc
	6.0000 GHz 1/2f	12.000 GHz		______	−35 dBc
	6.0000 GHz 1/3f	18.000 GHz		______	−35 dBc
	8.0000 GHz 2f	4.000 GHz		______	−40 dBc
	9.3333 GHz 2/3f	14.000 GHz		______	−35 dBc
	10.6667 GHz 2/3f	16.000 GHz		______	−35 dBc
	12.0000 GHz 2f	6.000 GHz		______	−40 dBc
	12.0000 GHz 2/3f	18.000 GHz		______	−35 dBc
	16.0000 GHz 2f	8.000 GHz		______	−40 dBc
	20.0000 GHz 2f	10.000 GHz		______	−40 dBc
	24.0000 GHz 2f	12.000 GHz		______	−40 dBc
4-11.	**NON-HARMONICALLY RELATED SPURIOUS SIGNALS (CW AND AM MODES)**				
	Carrier Frequency	Spurious Signal Frequency		Spurious Signal Level	
	2.0 to 6.6 GHz 3 000 MHz	______		______	−60 dBc
	______	______		______	−60 dBc
	______	______		______	−60 dBc
	______	______		______	−60 dBc
	______	______		______	−60 dBc
	______	______		______	−60 dBc
4-12.	**SINGLE-SIDEBAND PHASE NOISE**				
	1 kHz offset from carrier				
		6600 MHz		______	−60 dBc
		12 300 MHz		______	−60 dBc
		18 000 MHz		______	−60 dBc
4-13.	**RESIDUAL AM**				
	6.6 GHz			______	0.5%
	12.2 GHz			______	0.5%
	18.0 GHz			______	0.5%

Table 4-2. Performance Test Record (5 of 6)

Para. No.	Test	Results: Min.	Actual	Max.
4-14.	**AMPLITUDE MODULATION**			
	AM Rates			
	4.0 GHz ________	−3 dB	________	+3 dB
	6.7 GHz ________	−3 dB	________	+3 dB
	15.0 GHz ________	−3 dB	________	+3 dB
	AM Distortion			
	1 kHz Rate, 50% AM Depth 4.0 GHz		________	8%
	6.7 GHz		________	8%
	15.0 GHz		________	8%
4-15.	**FM FREQUENCY RESPONSE**			
	3 kHz	−3 dB	________	+3 dB
	30 kHz	−3 dB	________	+3 dB
	100 kHz		0 dB	
	300 kHz	−3 dB	________	+3 dB
	1000 kHz	−3 dB	________	+3 dB
	2000 kHz	−3 dB	________	+3 dB
4-16.	**INCIDENTAL AM**			
	2.0 GHz			
	5% AM Reference Level ________ Vrms			
	Incidental FM less than reference level		________ Vrms	
	6.7 GHz			
	5% AM Reference Level ________ Vrms			
	Incidental FM less than reference level		________ Vrms	
	12.4 GHz			
	5% AM Reference Level ________ Vrms			
	Incidental FM less than reference level		________ Vrms	
	18.0 GHz			
	5% AM Reference Level ________ Vrms			
	Incidental FM less than reference level		________ Vrms	
4-17.	**PULSE**			
	Overshoot and Ringing			
	2000.000 MHz at +8 dBm		________	20%
	6000.000 MHz at +8 dBm		________	20%
	6600.002 MHz at +8 dBm		________	20%
	6600.002 MHz at 0 dBm		________	20%
	6600.002 MHz at −10 dBm		________	20%
	6700.002 MHz at +8 dBm		________	20%
	6700.002 MHz at 0 dBm		________	20%
	6700.002 MHz at −10 dBm		________	20%

Table 4-2. Performance Test Record (3 of 6)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-17.	PULSE (cont'd)			
	Overshoot and Ringing (cont'd)			
	12290.002 MHz at +8 dBm		________	20%
	12290.002 MHz at 0 dBm		________	20%
	12290.002 MHz at −10 dBm		________	20%
	12300.003 MHz at +8 dBm		________	20%
	12300.003 MHz at 0 dBm		________	20%
	12300.003 MHz at −10 dBm		________	20%
	17990.003 MHz at +8 dBm		________	20%
	17990.003 MHz at 0 dBm		________	20%
	17990.003 MHz at −10 dBm		________	20%
	On-Off Ratio (dB below reference signal)			
	2.0 GHz	70	________	
	3.0 GHz	70	________	
	4.0 GHz	70	________	
	5.0 GHz	70	________	
	6.0 GHz	70	________	
	6.6 GHz	70	________	
4-18.	INTERNAL TIME BASE AGING RATE		________	1.5×10^{-9}/day

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

This section contains adjustments and checks that assure peak performance of the Signal Generator. This instrument should be readjusted after repair to assure performance. Allow a one hour warm-up prior to performing the adjustments. If the mains power cable is removed and reinstalled during an adjustment, be sure that the OVEN COLD status annunciator is off before proceeding with the adjustment.

Most adjustments are performed manually. However, several adjustments are performed with computer assistance using the adjustment software, HP Part Number 11726-10002, and the HP 85B as a controller.

The order in which the adjustments are made is critical. Prior to making any adjustments, refer to the paragraph titled Related Adjustments.

Determining the adjustments to be performed after a component failure and subsequent repair or a performance test failure is important. This will help keep the adjustment time to a minimum. After the repair and/or adjustment, performance tests are usually required to verify proper performance. Refer to the paragraph titled Related Adjustments.

5-2. SAFETY CONSIDERATIONS

This section contains information, cautions and warnings which must be followed for your protection and to avoid damage to the equipment.

WARNING

Maintenance described in this section is performed with power supplied to the instrument and with protective covers removed. Maintenance should be performed only by service trained personnel who are aware of the hazard involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.

A pin-to-pin voltage difference of 60 Vdc may be found on many of the Signal Generator's circuit board connectors. If a circuit board is placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

5-3. EQUIPMENT REQUIRED

Each adjustment procedure contains a list of required test equipment and accessories. The test equipment is identified by callouts in the test setup diagrams included with each procedure.

If substitutions must be made for the specified test equipment, refer to Table 1-3 for the minimum specifications. It is important that the test equipment meet the critical specifications listed in the table if the Signal Generator is to meet its performance requirements.

SRD Bias, YTM Tune, Flatness and ALC, and Pulse Amplitude Control adjustment procedures are automated. Automated adjustment programs are written for specific test equipment; therefore, substitute test equipment cannot be used.

Automated adjustments require a test cassette containing the programs (HP part number 11726-10002) and an HP 85B Controller plus the Advanced Programming ROM (00085-15005), the Plotter/Printer ROM (00085-15002), and the Matrix ROM (00085-15004). The test cassette is included in the 11726A Support Kit or it can be ordered separately from your nearest Hewlett-Packard office.

5-4. AUTOMATED ADJUSTMENT PROCEDURES

The adjustment software is a set of menu driven programs written in BASIC language. Adjustment programs are accessed via an executive program named "EXEC". Special function keys, which are enabled by software, select individual adjustment procedures and test routines from the executive program's main menu. Labels for enabled special function keys are displayed on the bottom two lines fo the controller's CRT screen.

AUTOMATED ADJUSTMENT PROCEDURES (cont'd)

To load the adjustment software, insert the tape cassette into the controller's tape drive, type the command LOAD "Autost" and then press END LINE. When the tape stops, press RUN. The calculator will then display the title screen (see Figure 5-1).

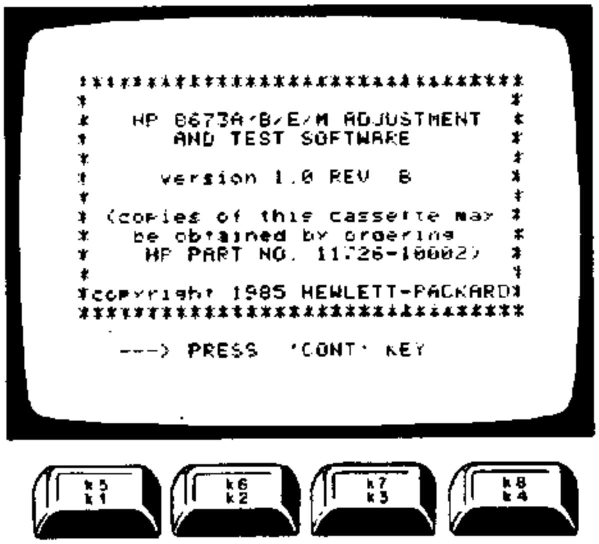


Figure 5-1. Title Screen

The title screen identifies the software version and casettes tape part number. Version 1.0 revision B or later is used to test the HP 8673E.

After the title screen is displayed, press the 'CONT' key. The "Autost" program will ask several hardware related questions, then test the HP Interface Bus for proper operation. In addition, the Signal Generator is preset. After the checks are completed the "EXEC" program will be loaded and run. The main menu of adjustments is displayed (see Figure 5-2).

NOTE

"Autost" may be bypassed if desired by initially loading "EXEC" program instead.

Press the special function key (K1 through K8) that corresponds to the adjustment or test that you want to perform. The appropriate program is loaded by the "EXEC" program and executed.

See Figure 5-3 for a flowchart of the adjustment

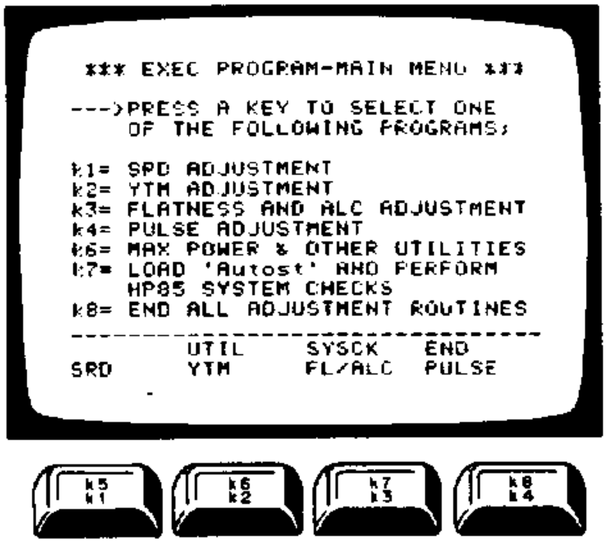


Figure 5-2. Main Menu

software. Included in the figure is a brief description of each item in the "EXEC" program's menu. Detailed descriptions of individual adjustments are included in the appropriate adjustment procedure.

5-5. FACTORY SELECTED COMPONENTS

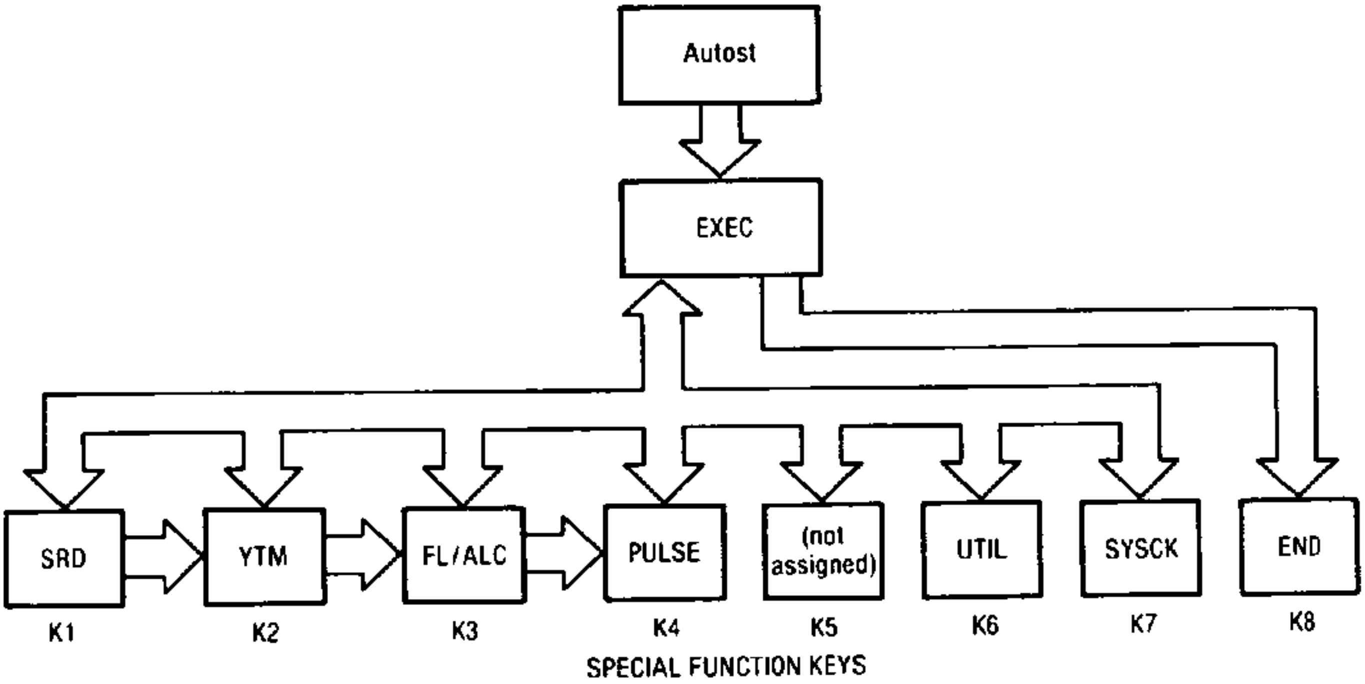
Factory selected components are identified on the schematics and parts list by an asterisk (*) that follows the reference designator. The nominal value of the component is shown. The manual change sheets will provide updated information pertaining to selected components. Table 5-1 lists the reference designator, the service sheet where the component is shown, the normal value range, and the criteria used for selecting a particular value.

5-6. RELATED ADJUSTMENTS

If all the adjustments are to be performed, they should be done in order of appearance in this manual.

In the event of a performance test or component failure, it must be determined if an individual adjustment procedure should be performed or if the instrument should be repaired. Tables 5-2 and 5-3 indicate the required action in either case.

After the instrument is repaired or adjusted, Performance Tests in Section IV must be performed to verify proper operation of the Signal Generator. Tables 5-2 and 5-3 can also be used as a guideline when repairing or adjusting the instrument.



Name	Description
Autost	Autostart program. Contains system hardware checks. Loads and runs EXEC program. Automatically loads and runs if the tape cassette is in the tape drive when power is applied to the controller.
EXEC	Executive program. Allows access to the individual adjustment procedures and test routines via special function keys, as selected by the user.
SRD	SRD Bias Adjustment. Accessed through EXEC.
YTM	YTM Tune Adjustment. Accessed through EXEC or SRD "Load Next Test" function.
FL/ALC	Flatness and ALC Adjustment. Accessed through EXEC or YTM "Load Next Test" function.
PULSE	Pulse Adjustments. Accessed through EXEC or FL/ALC "Load Next Test" function.
UTIL	Utility programs. Tests for maximum power, verification of HP-IB and management of power meter calibration factors.
SYSCK	Loads and executes Autost.
END	Terminates all adjustment programs. Accessed through EXEC.

Figure 5-3. Adjustment Software

Table 5-1. Factory Selected Components (1 of 2)

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A3A1A2C8 and A3A1A2L4	2	0 to 12.0 pF 0.22 to 6.8 μH	100 MHz VCXO Assembly. Centers the frequency adjustment range of A3A1A2C4 around 100 MHz. Refer to the Reference Loop (VCXO) Adjustment procedure.
A3A1A2R67, R68, and R69	2	Refer to Table in VCXO adjustment	100 MHz VCXO Assembly. Required change in attenuation necessary for a −10 dBm output level of the 400 MHz signal. Refer to the Reference Loop (VCXO) Adjustment procedure.
A3A1A5C38, R36, R40, and R41	5	R36: 82.5 or 56.2Ω R41: 100Ω or deleted R40: 51.1Ω or C38 at 27 pF	M/N Loop 5—45 MHz IF Output. If the power output from the IF OUT jack (A3A1A5J2) is less then −5 dBm at any frequency between 5 MHz to 45 MHz, replace R36 82.5Ω with a 56.2Ω resistor, R40 51.1Ω with C38 27 pF capacitor, and remove R41. Proper power output level is 0 ±5 dBm from 5 to 45 MHz. If this range cannot be met, service may be required.
A3A3R43	34	12 to 14.7 kΩ	Positive Regulator Assembly. Select so that pin 2 of V1 Power Up/Down Detector is 0.1 to 0.2V lower than the +5.2V Power Supply.
A3A7C48	13	3.9 to 5.6 pF	YTO/FM/Coil Driver Assembly. Selected for frequency response on the 100 kHz and lower FM deviation ranges. Use a test oscillator and spectrum analyzer. Set the test oscillator's controls so the spectrum analyzer's display of the first FM sidebands are 30 dB down from the carrier at 1 MHz. At 3.16 MHz the sidebands should be 40 dB down; at 10 MHz, 50 dB down. If the response is peaking (sidebands are too high), insert a smaller value capacitor. If the response is rolling off (sidebands are too low), insert a larger value capacitor.
A3A7R61, R65, and R75	13	Refer to table.	YTO/FM/Coil Driver Assembly. FM sensitivity is changed by replacing R61, R65 and R75 as a set. Connect test oscillator and AC voltmeter to the FM input of the Signal Generator. Connect the spectrum analyzer to the junction of A3A9J1 and A3A9J2. Set the Signal Generator to 10 MHz deviation range. Set the test oscillator's output level for the first carrier null (deviation approximately 240 kHz) at a 100 kHz rate. Measure the test oscillator FM drive voltage. The normal value is between 15.42 and 18.86 mV. Change R61, R65 and R75, using the values in the following table, to obtain the normal ac value. Voltage can be raised or lowered by the approximate increments shown in the table below.

Resistor	Nominal Value	Raise Voltmeter Reading		Lower Voltmeter Reading	
		+1 mV	+2.5 mV	−0.75 mV	−1.5 mV
R61	1.96 kΩ	1.78 kΩ	1.62 kΩ	1.96 kΩ	1.96 kΩ
R65	5.11 kΩ	6.19 kΩ	6.19 kΩ	4.64 kΩ	3.83 kΩ
R75	1.82 kΩ	1.78 kΩ	1.78 kΩ	1.96 kΩ	2.15 kΩ

Table 5-1. Factory Selected Components (2 of 2)

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A3A9A5C10	11	20—22 pF	Sampler Assembly. Centers YTO phase detector sampler response. Refer to YTO Loop Sampler Adjustment.
A3A9A5C22	11	120—150 pF	Selected for proper IF gain. Perform YTO Loop Sampler adjustments in this section.
A3A9R20	12	348Ω to 1.21 kΩ	YTO Loop Assembly. Sets YTO Loop gain crossover of 20 ±2 kHz. Refer to the YTO Loop Phase Detector Adjustment.

Table 5-2. Performance Test Failure and Required Action

Performance Test Failure	Required Action
Frequency Range and Resolution	Check phase lock loops. See BD 2, 3, and 4.
Output Level, High Level Accuracy and Flatness	Perform Flatness and ALC adjustment. Check output attenuator. See BD 5 and 6.
Low Level Accuracy	Check attenuator and attenuator driver. See to BD 5 and 6.
Harmonics, Subharmonics and Multiples	Perform YTM Tune and Flatness and ALC adjustments. Check YTM. See BD 5.
Non-Harmonically Related Spurious Signals (CW and AM Modes)	This problem can occur anywhere in the instrument. Isolate the defective component and make adjustments as required (see Table 5-3). NOTE: If the problem is in Band 1 (2.0 to 6.6 GHz), the output of the A3 RF Source section, W7, should be checked.
Power Line Related Spurious	Refer to Section VIII, Power Supply Schematics.
Single-Sideband Phase Noise	Perform 20/30 MHz (LFS) Loop Divider Bias, 160-240 MHz (20/30 MHz or LFS Loop) VCO Pretune, M/N Loop, YTO Driver, YTO Loop Sampler, YTO Loop Offset and FM Overmodulation, and FM Driver adjustments. Check the YTO Loop for phase lock to within 1 Hz resolution. NOTE: An efficient troubleshooting technique is to isolate the problem to one of the phase lock loops, if possible, and then perform the adjustment for that loop. See BD 2, 3 and 4.
AM Incidental Phase Modulation AM Rates (3 dB Bandwidth) Residual AM	 Repair AM, YTM, or ALC circuits. Perform AM Bandwidth adjustment. Repair AM, YTM or ALC circuits. See BD5 and BD6.
FM Frequency Response	Perform FM Driver and FM Accuracy and Overmodulation adjustments. See BD 4.
Residual FM	Perform FM Driver adjustments. See BD4.
Incidental AM	Repair or adjust the YTM and ALC circuits. See BD1, 5, 6 and 7.
Pulse	Repair or adjust YTM, ALC and pulse circuits. See BD 1, 5, 6 and 7.

Table 5-3. Post-Repair Adjustments (1 of 2)

Repaired Assembly	Adjustments
A1A2 — Detector Module Assembly	Flatness and ALC AM Bandwidth AM Accuracy and Meter
A1A3 — Functions Board Assembly	AM Accuracy and Meter FM Accuracy and Overmodulation
A1A4 — Pulse Driver Processing Board Assembly	Flatness and ALC Pulse Modulation Pulse Amplitude Control
A1A5 — DAC and Enable Board Assembly	Pulse Modulation Pulse Amplitude Control
A1A6 — Meter Board Assemby	AM Accuracy and Meter FM Accuracy and Overmodulation
A1A7 — YTM Driver Board Assembly	YTM Tune
A1A8 — SRD Bias Board Assembly	SRD Bias Flatness and ALC Pulse Modulation Pulse Amplitude Control
A1A9 — Preamp Assembly	Flatness and ALC AM Bandwidth AM Accuracy and Meter
A1A10 — YTM Assembly	SRD Bias YTM Tune Flatness and ALC AM Bandwidth AM Accuracy and Meter Pulse Modulation Pulse Amplitude Control
A1A11 — Power Amplifier Assembly	Power Clamp Flatness and ALC Pulse Modulation — Pulse Clamp and ALC Sample Pulse portions only
A1AT2 — Isolator	None
A1AT3 — Pulse Modulator	Pulse Modulation
A1CP1 — Bias Tee	Pulse Amplitude Control
A1CR1 — Crystal Detector	Flatness and ALC Pulse Modulation — ALC Sample Pulse portion only

Table 5-3. Post-Repair Adjustments (2 of 2)

Repaired Assembly	Adjustments
A1DC1 — Directional Coupler	Flatness and ALC Pulse Modulation — ALC Sample Pulse portion only
A1FL1 — High-Pass Filter	Pulse Modulation Pulse Amplitude Control
A2A3, A2A4, A2A5 — LFS Loop Circuits	20/30 MHz Loop Divider 160—240 MHz (20/30 MHz or LFS Loop) VCO Pretune LFS Loop Filter
A2A7 — I/O Assembly	Sweep Out and Blanking/Marker
A3A1, A3A3, A3A4 — Power Supplies	Power Supply
A3A1A1, A3A1A2 — Reference Loop Circuits	Reference Loop
A3A1A3, A3A1A4, A3A1A5 — M/N Loop Circuits	M/N Loop
A3A5 — DAC Assembly A3A6 — YTO Driver Assembly	YTO Pretune Digital-to-Analog Converter YTO Driver YTO Loop Sampler YTO Offset and FM Overmodulation YTO Loop Phase Detector
A3A7 — YTO FM Coil Driver Assembly	YTO Pretune Digital-to-Analog Converter YTO Driver YTO Loop Sampler YTO Offset and FM Overmodulation YTO Loop Phase Detector FM Driver
A3A9A3 — 2.0 to 6.6 GHz YTO Assembly	YTO Pretune Digital-to-Analog Converter YTO Driver YTO Loop Sampler YTO Offset and FM Overmodulation YTO Loop Phase Detector FM Driver FM Accuracy and Overmodulation

ADJUSTMENTS

5-7. POWER SUPPLY ADJUSTMENTS

Reference Service Sheets 33, 34, 35.

Description Adjust the +22 volt and +20 volt power supplies in the A3 Assembly to their required tolerance. Check the remaining supply voltages referenced to the +20 volt supply (+11V, +5.2V, −5.2V, −10V, and −40V).

Equipment Digital Voltmeter (DVM) .... HP 3456A or HP 3455A

Procedure

1. Set the Signal Generator's rear panel FREQ STANDARD INT/EXT switch to INT.
2. Connect the DVM input to A3A1TP1 on the Rectifier Assembly.
3. Adjust +22 ADJ (A3A1R2) for a DVM reading of +22.00 ±0.02 Vdc.
4. Connect the DVM input to A3A3TP5 on the Positive Regulator Assembly.
5. Set +20 ADJ (A3A3R50) for a DVM reading of +20.000 ±0.002 Vdc.
6. Check the power supplies shown in the following table. All voltages should be within tolerance.

Power Supply	Test Point	Power Supply Voltage (Vdc)	
		Min.	Max.
+11 Vdc	A3A3TP6	+9.9	+12.1
+5.2 Vdc	A3A3TP2	+5.1	+5.3
−5.2 Vdc	A3A4TP5	−5.1	−5.3
−10 Vdc	A3A4TP4	−9.8	−10.2
−40 Vdc	A3A4TP1	−39.00	−40.60

ADJUSTMENTS

5-8. 10 MHz REFERENCE OSCILLATOR ADJUSTMENT

Reference Service Sheet 1.

Description Connect the reference signal from the Signal Generator (10 MHz OUT) to the oscilloscope's vertical input. A frequency standard (with long term stability greater than 1×10^{-10}) is connected to the trigger input. Adjust the A3A8 Assembly's FREQ adjustment for a minimum drift rate.

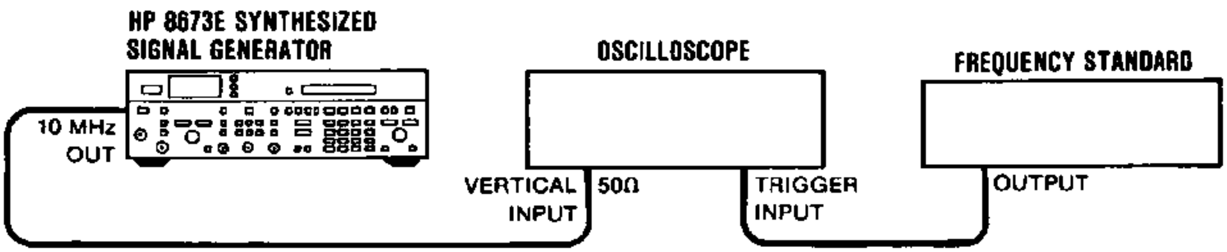


Figure 5-4. 10 MHz Reference Oscillator Adjustment Test Setup

Equipment

Frequency Standard .... HP 5065A
Oscilloscope .... HP 1980B

NOTE

Be sure the Signal Generator has had one hour to warm up before performing the adjustment. Verify that the OVEN COLD and NOT PHASE-LOCKED status annunciators are off. If necessary, refer to the troubleshooting information in Section VIII.

Procedure

1. Set the Signal Generator's rear panel FREQ STANDARD INT/EXT switch to the INT position.

2. Connect the equipment as shown in Figure 5-4. Set vertical input of oscilloscope for 50Ω input impedance.

3. Set the FREQ adjustment (on the A3A8 10 MHz Reference Oscillator Assembly) so the signal, as observed on the oscilloscope display, is not drifting.

4. Verify that in 10 seconds the display drifts less than 360°. A drift of 360° in 10 seconds corresponds to an adjustment accuracy of 1×10^{-18}. Adjustment accuracy is not specified for this instrument; the numbers shown are what can typically be obtained.

ADJUSTMENTS

5-9. REFERENCE LOOP (VCXO) ADJUSTMENT

Reference Service Sheet 2.

Description The open loop frequency and maximum power output of the 100 MHz VCXO is centered around 100 MHz. The output is set as close as practical to 100 MHz. The 400 MHz signal is adjusted for maximum 400 MHz output and minimum spurious signal output. An attenuator is selected to provide a 400 MHz output of −10 dBm.

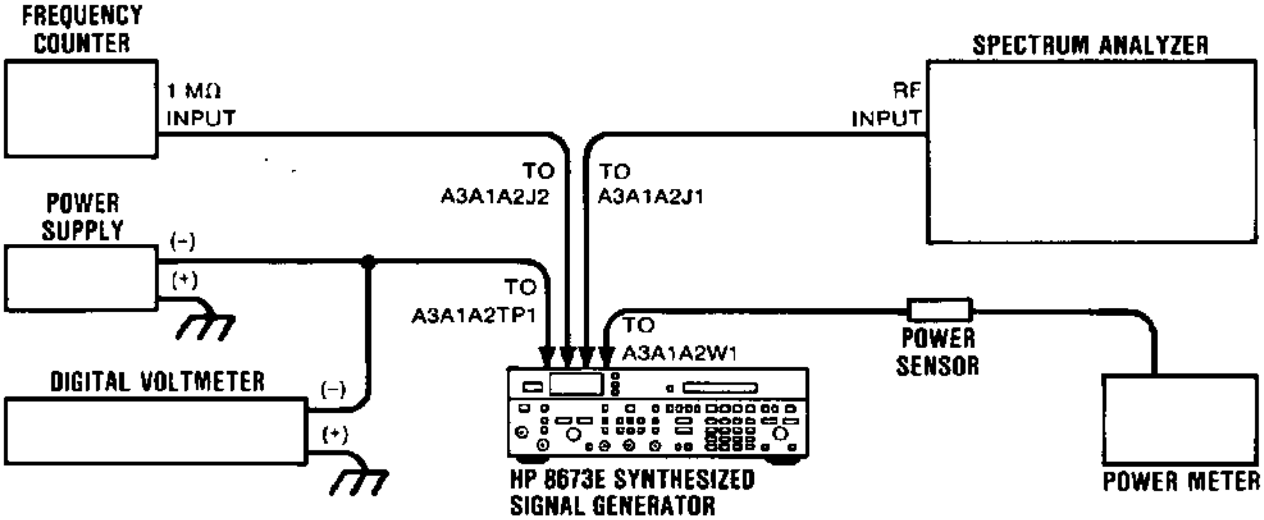


Figure 5-5. Reference Loop (VCXO) Adjustment Test Setup

Equipment

Frequency Counter	HP 5343A
Spectrum Analyzer	HP 8566B
Power Supply	HP 6200B
Power Meter	HP 436A
Power Sensor	HP 8481A
Digital Voltmeter (DVM)	HP 3456A or HP 3455A

Procedure

1. Connect the frequency counter to A3A1A2J2 in place of the termination and connect the spectrum analyzer to A3A1A2J1 in place of the gray-orange-white cable, as shown in Figure 5-5.

2. Set the output of the power supply to −8.00 ±0.01 Vdc. Connect the positive lead to ground and the negative lead to A3A1A2TP1, 100 MHz TUNE.

3. Tune A3A1A2C4, 100 MHz, for the maximum 100 MHz signal level as viewed on the spectrum analzyer display.

4. Tune A3A1A2C4 to increase the frequency (and decrease the amplitude) until the oscillation stops on the high frequency side; then tune A3A1A2C4 to start the oscillation. Continue to decrease the frequency until the oscillation stops. If the VCXO does not stop oscillating at the high end, decrease the value of A3A1A2C8 by 1 pF from its present value. If it does not stop at the low end, increase the value of A3A1A2C8 by 1 pF. If a change is necessary, repeat this step. If a value of

ADJUSTMENTS

5-9. REFERENCE LOOP (VCXO) ADJUSTMENT (cont'd)

Procedure (cont'd)

A3A1A2C8 cannot be found within the range of 0 to 12 pF, change A3A1A2L4. (The range of values for A3A1A2L4 is listed in step 7.) Then repeat this step.

5. Adjust A3A1A2C4 to obtain the maximum signal level as viewed on the spectrum analyzer display. Slowly tune to a higher frequency until the power drops by 1 dB. Record ΔF_1, that is, how far the 1 dB point is above 100 MHz. Use the frequency counter to make the measurements to 10 Hz resolution.

_______________ ΔF_1

6. Tune to a lower frequency until the power is decreased 1 dB on the other side of the peak. Record ΔF_2, that is, how far the 1 dB point is below 100 MHz.

_______________ ΔF_2

7. The VCXO centering about 100 MHz is correct if $0.5 \leq \frac{\Delta F_1}{\Delta F_2} \leq 2.$

If the ratio is less than 0.5, decrease A3A1A2L4 one value to increase the center frequency. If the ratio is greater than 2, increase A3A1A2L4 one value to decrease center frequency. Refer to the following table for the inductor values.

A3A1A2L4 Inductor Values

Value	HP Part Number
0.68 μH	9140-0141
0.56 μH	9100-2256
0.47 μH	9100-2255
0.39 μH	9100-2254
0.33 μH	9100-0368
0.27 μH	9100-2252
0.22 μH	9100-2251

8. If the inductor value is changed, repeat steps 3 through 7.

9. Adjust A3A1A2C4 to obtain a VCXO output of 100 MHz ±100 Hz.

10. Disconnect the spectrum analyzer from A3A1A2J1 and reconnect the gray-orange-white cable.

11. Disconnect the 400 MHz Output cable (gray-red-white cable) from A3A1A5J1 and connect the cable to the spectrum analyzer. Set the spectrum analyzer's controls for a center frequency of 500 MHz, frequency span per division 100 MHz, and vertical sensitivity per division 10 dB log. Adjust the 400 MHz A3A1A2C3, C2, and C1 adjustments in that order to obtain the maximum 400 MHz signal with the lowest harmonic levels possible.

ADJUSTMENTS

5-9. REFERENCE LOOP (VCXO) ADJUSTMENT (cont'd)

Procedure (cont'd)

12. Check the various harmonics of the 100 MHz signal relative to the 400 MHz signal level. The 200 and 800 MHz harmonics should be greater than 25 dB down; 100, 300, 500, 600, 700, and 900 MHz harmonics should be greater than 35 dB down. If necessary, repeat steps 11 and 12.

13. Disconnect the spectrum analyzer from the gray-red-white cable and connect the cable to the power meter.

14. Check the power meter reading. The power should be −10 to −13 dBm. If the power is incorrect, select the values of A3A1A2R67, R68, and R69 from the Attenuator Resistor Values Table to obtain the proper power level. The attenuation should always be 3 dB or greater.

Attenuator Resistor Values

Attenuation (dB)	Resistors (ohms)		
	R67	R68	R69
3	261	17.8	261
4	215	23.7	215
5	178	31.6	178
6	147	38.3	147
7	133	46.4	133
8	121	51.1	121
9	110	61.9	110

15. If the amount of attenuation is changed, recheck the harmonic levels.

16. Set the Signal Generator's LINE switch to STBY. Disconnect all test equipment except the DVM and reconnect all instrument cables.

17. Set the Signal Generator's LINE switch to ON. Verify that the dc voltage at A3A1A2TP1 is 8 ±1 Vdc. If the voltage is out of tolerance, repeat step 9 or check the 10 MHz Reference Adjustment.

18. Connect the frequency counter to the Signal Generator's RF OUTPUT connector.

19. Verify that the counter reading is within ±1 kHz of the Signal Generator's FREQUENCY MHz display at 2.0 and 6.6 GHz.

ADJUSTMENTS

5-10. M/N LOOP ADJUSTMENTS

Reference Service Sheet 4.

Description The M/N loop frequency is set to track tuning voltage across the frequency range. The output level is set and checked to ensure an adequate RF output level across the band.

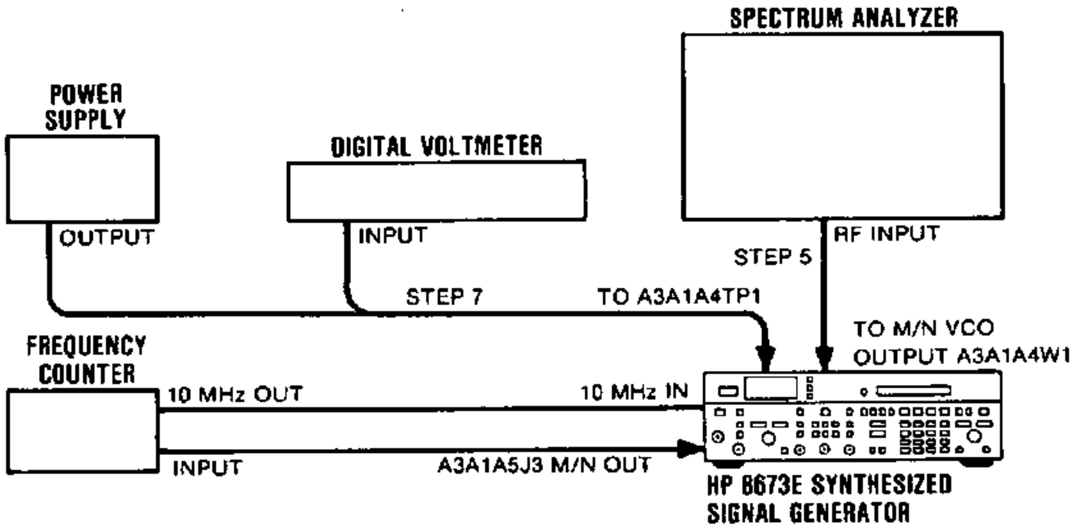


Figure 5-6. M/N Loop Adjustment Test Setup

Equipment

Digital Voltmeter (DVM) .... HP 3456A or HP 3455A
Frequency Counter .... HP 5343A
Spectrum Analyzer .... HP 8566B
Power Supply .... HP 6200B

Procedure

1. On the Signal Generator, key in RCL 0 and set the frequency to 6090.000 MHz. Set the FREQ STANDARD INT/EXT on the rear panel to INT.
2. Connect the equipment as shown in Figure 5-6.
3. Verify that the M/N output frequency is 197.419 MHz ±1 kHz.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

4. Set the LINE switch to STBY and disconnect the mains power cable. Remove the A3A1A4/A5 Assembly and place it on an extender board.
5. Connect the spectrum analyzer input to the M/N VCO output A3A1A4W1 (white coax).

CAUTION

Do not apply a positive voltage to A3A1A4TP1. A positive voltage will forward bias the VCO tuning diodes and may destroy them.

ADJUSTMENTS

5-10. M/N LOOP ADJUSTMENTS (cont'd)

Procedure (cont'd)

6. Connect the mains power cable and set the LINE switch to ON.

7. Set the power supply for −35.0 ±0.5 Vdc. Connect the positive output of the power supply to ground and connect the negative output to the A3A1A4TP1 TUNE.

NOTE

The adjustment screws for A3A1A4A1C1 and C5 are held in place by locknuts. After making the adjustment, tighten the locknuts and recheck the frequency and level.

8. Release the locknut for the PWR adjustment, A3A1A4A1C5. Adjust A3A1A4A1C5 for an output level of 0 ±2 dBm. Tighten the locknut.

9. Slowly reduce the dc voltage at A3A1A4TP1, TUNE, while monitoring the VCO output power on the spectrum analyzer. The output power should be greater than −2 dBm between 395 MHz (−35 Vdc) and 355 MHz (−2.3 Vdc).

10. Remove the power supply connection to A3A1A4TP1.

11. Set the LINE switch to STBY and disconnect the mains power cable. Remove A3A1A4/A5 from the extender board and reinstall the assembly in the Signal Generator.

12. Connect the mains power cable and set the LINE switch to ON. Verify that the frequency is still at 6090.000 MHz.

13. Set FREQ ADJ A3A1A4A1C1 for a voltage level of −35.0 ±0.5 Vdc, measured at A3A1A4TP1.

14. Tune the Signal Generator frequency to 2100.000 MHz. Verify that the M/N output frequency is 177.500 MHz and the tuning voltage is −2.4 ±0.7 Vdc.

15. Disconnect all test equipment from the Signal Generator and reconnect all instrument cables.

16. Connect the frequency counter to the Signal Generator's RF OUTPUT connector.

17. Verify that the counter reading is within ±1 kHz of the Signal Generator's FREQUENCY MHz display at 2.0 and 6.6 GHz.

ADJUSTMENTS

5-11. 20/30 MHz (LFS) LOOP DIVIDER BIAS ADJUSTMENT

Reference Service Sheet 6.

Description A substitute VCO feedback signal, derived from an external RF signal source, is monitored with an oscilloscope. The RF signal level is slowly reduced and the CLK BIAS ADJ is set to obtain a stable clock signal. The RF input is reduced to the minimum level that provides a stable signal.

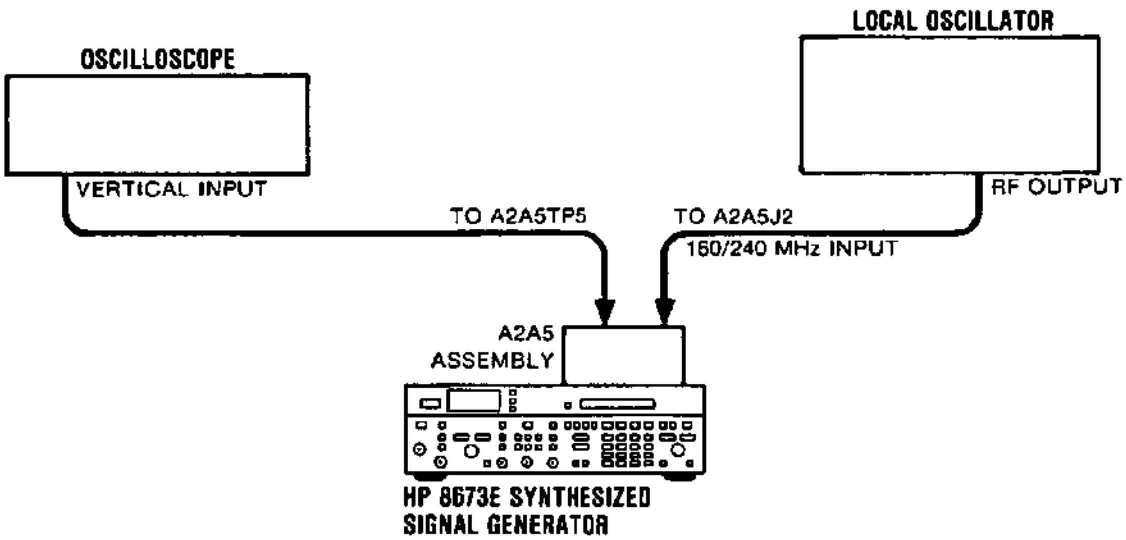


Figure 5-7. 20/30 MHz (LFS) Loop Divider Bias Adjustment Test Setup

Equipment

Oscilloscope .... HP 1980B
Local Oscillator .... HP 8340A

Procedure

1. Set the LINE switch to STBY.

2. Remove the screws that hold the A2A5 20/30 MHz Divider Assembly in place.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury is contacted.

3. Remove the A2A5 Assembly, place it on an extender board, and reinstall the assembly.

4. Set the LINE switch to ON.

5. Set the controls of the local oscillator for continuous wave output of −5 dBm at 240 MHz.

ADJUSTMENTS

5-11. 20/30 MHz (LFS) LOOP DIVIDER BIAS ADJUSTMENT (cont'd)

Procedure (cont'd)

6. Remove the red cable A2W2 from the 160/240 MHz INPUT, A2A5J1.
7. Connect the equipment as shown in Figure 5-7.
8. Center A2A5R4 (CLK BIAS ADJ).
9. Observe the 14—24 MHz clock signal on the oscilloscope display.
10. Adjust A2A5R4 to obtain a stable clock frequency.
11. Reduce the output level of the local oscillator while readjusting A2A5R4 to obtain a stable clock at the lowest possible signal.
12. Verify that a stable clock signal is obtained with an input signal of −10 dBm or less.
13. Disconnect the test equipment. Set the Signal Generator to STBY and reinstall A2A5 in its cavity. Reconnect cable A2W2 to A2A5J1.

ADJUSTMENTS

5-12. 160—240 MHz (20/30 MHz OR LFS LOOP) VCO PRETUNE

Reference Service Sheet 8.

Description If any of the 160—240 MHz oscillator components have been replaced, the low and high frequency limits of the oscillator must be checked to ensure proper operation. The oscillator coil is moved closer to or away from the circuit board in order to set the low and high frequency limits.

Equipment Frequency Counter .... HP 5343A

NOTE

This procedure need be performed only if major repair has been done to the oscillator.

Procedure

1. Set the LINE switch to STBY.
2. Remove the screws that hold the A2A3 VCO assembly in place.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

3. Remove the A2A3 assembly, place it on an extender board, and reinstall the assembly.
4. Remove the green cable A3W14 that is connected to the 20/30 MHz OUTPUT A2A3J1. Connect the frequency counter output to A2A3J1.
5. Set the LINE switch to ON.
6. Set A2A3S1 (FREQ TEST SWITCH) to the TEST HIGH FREQ position. The frequency should be greater than 30.5 MHz.
7. If the frequency is less than 30.4 MHz, the oscillator coil must be moved closer to the circuit board. The oscillator cover must be removed before adjusting the coil. Unsolder the four corners of the oscillator cover before removing it. Next, unsolder the oscillator coil leads, move the coil closer to the circuit board, and resolder the coil leads. Clip excess oscillator lead length on the circuit side of board if necessary.

NOTE

The oscillator coil is normally mounted parallel to the circuit board with the bottom threads approximately 1.3 mm (0.050 inch) above the board.

8. Replace the oscillator cover by temporarily soldering one corner of the cover. Then recheck the frequency.

5-12. 160—240 MHz (20/30 MHz OR LFS LOOP) VCO PRETUNE (cont'd)

Procedure (cont'd)

9. Set A2A3S1 to the TEST LOW FREQ position. Verify a frequency reading of less than 19.5 MHz. If necessary, set the LINE switch to STBY, remove the cover, reset the coil, replace the cover, and repeat steps 6 through 9.

10. Set A2A3S1 to the NORMAL position.

11. Replace the oscillator cover permanently by soldering all four corners. Do not solder the entire perimeter of the oscillator cover. The cover is for frequency stability, not for RFI leakage.

12. Set the LINE switch to STBY. Reinstall A2A3 in its cavity and reconnect the green cable to A2A3J1.

ADJUSTMENTS

5-13. LFS LOOP NOTCH FILTER ADJUSTMENT

Reference Service Sheet 7.

Description A 7985 Hz signal is passed through the 8 kHz notch filter. The adjustable components are set for the minimum signal transfer.

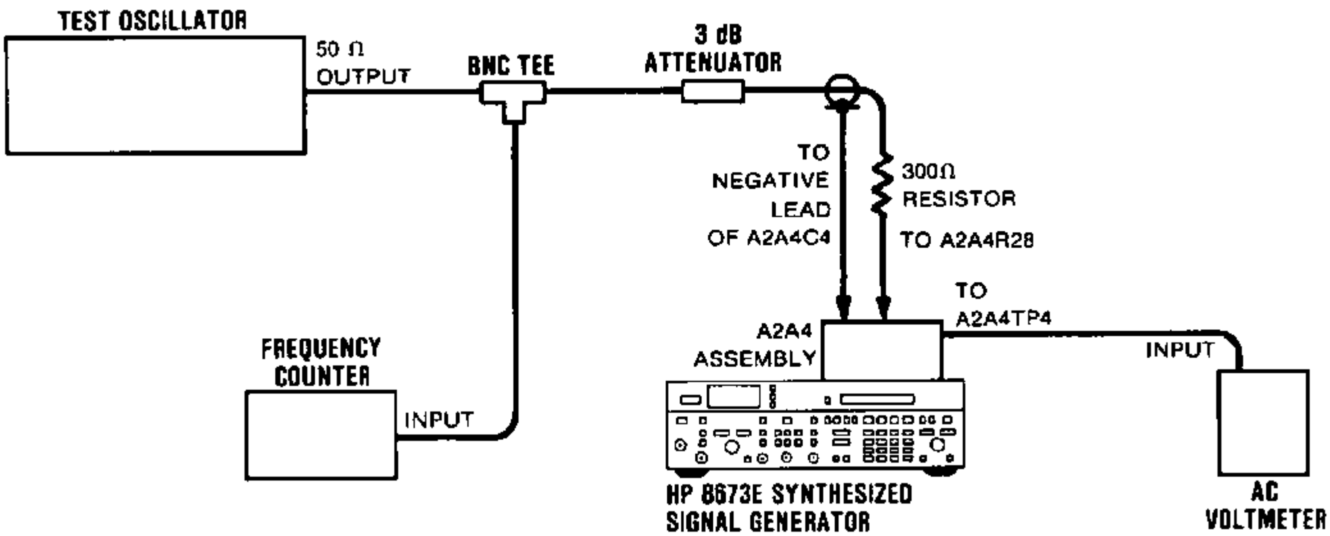


Figure 5-8. LFS Loop Notch Filter Adjustment Test Setup

Equipment

Test Oscillator	HP 3335A
Frequency Counter	HP 5343A
AC Voltmeter	HP 400E
3 dB Attenuator	HP 8491A Option 003

Procedure

1. Set the LINE switch to STBY.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

2. Remove the A2A4 20/30 Phase Detector Assembly.

3. Unsolder the input end (top) of A2A4R28 (refer to the component location diagram in Section VIII).

4. Install the circuit board on the extender board.

ADJUSTMENTS

5-13. LFS LOOP NOTCH FILTER ADJUSTMENT (cont'd)

Procedure (cont'd)

5. Connect the equipment as shown in Figure 5-8. The leads from the 3 dB attenuator should be as short as possible. Connect the ground wire to the negative side of A2A4C4.

6. Set the Signal Generator's LINE switch to ON.

7. Set the test oscillator's controls for 1 kHz and an AC voltmeter indication of +10 dBm.

8. Set the test oscillator as close to 7985 Hz as possible.

9. Adjust A2A4L3 and L4 to minimize the meter reading. The indication must be less than −50 dBm.

10. Detune the test oscillator away from 7985 Hz while monitoring the AC voltmeter reading. As the oscillator is detuned, the meter indication should increase.

11. Set the Signal Generator's LINE switch to STBY. Resolder A2A4R28 and reinstall the A2A4 assembly.

ADJUSTMENTS

5-14. YTO PRETUNE DIGITAL-TO-ANALOG CONVERTER ADJUSTMENT

Reference Service Sheet 9.

Description This adjustment sets the analog voltages with respect to the digital frequency tuning data. Adjustments are made at selected frequencies. Some of these frequencies are below the low frequency limit of the Signal Generator (2 GHz). These frequencies are selected by shorting test point pair A2A9TP1 and tuning to the specified frequencies.

Equipment Digital Voltmeter (DVM) .... HP 3456A or HP 3455A

Procedure

1. Key in RCL 0 on the Signal Generator and set the frequency to 4800.000 MHz.
2. Connect the DVM ground lead to the reference ground, A3A6TP5. (The ground lead remains connected here for the remainder of this procedure.)
3. Attach the DVM test lead to A3A5TP4. Set REF ADJ (Reference Buffer output) A3A5R13 for a DVM reading of −6.50 ±0.04 Vdc.
4. Check the output voltages of the Reference Buffers at A3A5TP1 (+10.75 ±0.25 Vdc) and A3A5TP2 (+10.00 ±0.15 Vdc). Make repairs if necessary.
5. Connect the DVM to the YTO Pretune Output, A3A5TP3.
6. Short test point pair A2A9TP1 with an alligator clip.
7. Adjust 1.6 GHz A3A5R4 (not 1.61) to obtain a DVM reading of −4.80 ±0.01 Vdc.
8. Remove the clip from test point pair A2A9TP1.
9. Adjust 4.8 GHz A3A5R3 to obtain a reading of −14.400 ±0.001 Vdc.
10. Tune to 4900.000 MHz and short the test point pair A2A9TP1.
11. Adjust 1.7 GHz A3A5R29 to obtain −5.100 ±0.001 Vdc.
12. Tune to 4800.000 MHz and repeat steps 7 through 11 until step 7 is within 0.01 Vdc and steps 9 through 11 are within 0.001 Vdc of the specified value.
13. Tune to 4810.000 MHz. Verify that the clip is connected to test point pair A2A9TP1.
14. Adjust 1.61 GHz A3A5R42 (not 1.6) to obtain a DVM reading of −4.830 ±0.001 Vdc.
15. Tune to 5000.000 MHz. Adjust 1.8 GHz A3A5R24 to obtain −5.400 ±0.001 Vdc.
16. Remove the alligator clip. Tune to 2000.000 MHz.
17. Adjust 2.0 GHz A3A5R22 to obtain −6.000 ±0.001 Vdc.
18. Tune to 2400.000 MHz. Adjust 2.4 GHz A3A5R20 to obtain −7.200 ±0.001 Vdc.

ADJUSTMENTS

5-14. YTO PRETUNE DIGITAL-TO-ANALOG CONVERTER ADJUSTMENT (cont'd)

Procedure (cont'd)

19. Tune to 3200.000 MHz. Adjust 3.2 GHz A3A5R18 to obtain −9.600 ±0.001 Vdc.

20. At each frequency listed in the table, check the YTO pretune voltage at A3A5TP3 with the clip attached to the test point pair A2A9TP1.

Signal Generator Frequency (GHz)	Voltage at A3A5TP3 (Vdc)
4.801	−4.803 ±0.001
4.802	−4.806 ±0.001
4.804	−4.812 ±0.001
4.808	−4.824 ±0.001
4.810	−4.830 ±0.001
4.820	−4.860 ±0.001
4.840	−4.920 ±0.001
4.880	−5.040 ±0.001

21. Tune to 4910.000 MHz and measure the voltage at A3A5TP3. The voltage should read −5.130 ±0.002 Vdc with the clip in place.

22. Remove the clip and measure the voltage at A3A5TP3. The voltage should now read −14.730 ±0.002 Vdc. If the voltage tolerances in steps 21 and 22 are not met, repeat this procedure starting from step 5. Then if the voltage tolerances cannot be met, refer to Section VIII for troubleshooting information.

ADJUSTMENTS

5-15. YTO DRIVER ADJUSTMENT

Reference Service Sheet 10.

Description The fundamental output of the Signal Generator is set to the maximum and minimum frequencies and the YTO driver's gain and offset currents are set to give specified YTO output frequencies.

Equipment Frequency Counter .... HP 5343A

NOTE

All boards must be installed in the instrument before these adjustments are made.

Procedure

1. On the Signal Generator, press RCL 0 and set the output level to 0 dBm.
2. Connect the frequency counter to the Signal Generator's RF OUTPUT connector.
3. Connect A3A6TP5 (GND) to A3A7TP2 (TUN VOLT) with a clip-on jumper wire. (This grounds the feedback voltage and opens the YTO phase lock loop.)
4. Tune the Signal Generator to 2000.000 MHz. Adjust A3A6R34, 2 GHz, to obtain 2000.0 ±0.1 MHz on the frequency counter. Wait until the drift is minimal (approximately 30 seconds) before making this adjustment.
5. Tune the Signal Generator to 6599.000 MHz. Adjust A3A6R25, which is labeled 6.199 GHz, to obtain 6599.0 ±0.1 MHz on the frequency counter. Wait until the drift is minimal (approximately 30 seconds) before making this adjustment.
6. Repeat steps 4 and 5 until the required tolerance is obtained at both frequencies.
7. Disconnect A3A6TP5 from A3A7TP2.
8. Verify that the counter reading is within ±1 kHz of the Signal Generator's FREQUENCY MHz display at 2.0 and 6.6 GHz.

ADJUSTMENTS

5-16. YTO LOOP SAMPLER ADJUSTMENTS

Reference Service Sheet 11.
Service Sheet A.

Description The sampler is driven by a sweep oscillator and the dc output is monitored with an oscilloscope. The sampler driver circuit is adjusted for maximum amplitude and flatness over the range of the M/N loop. The sampler's IF preamplifier is adjusted for correct level and the frequency response is checked.

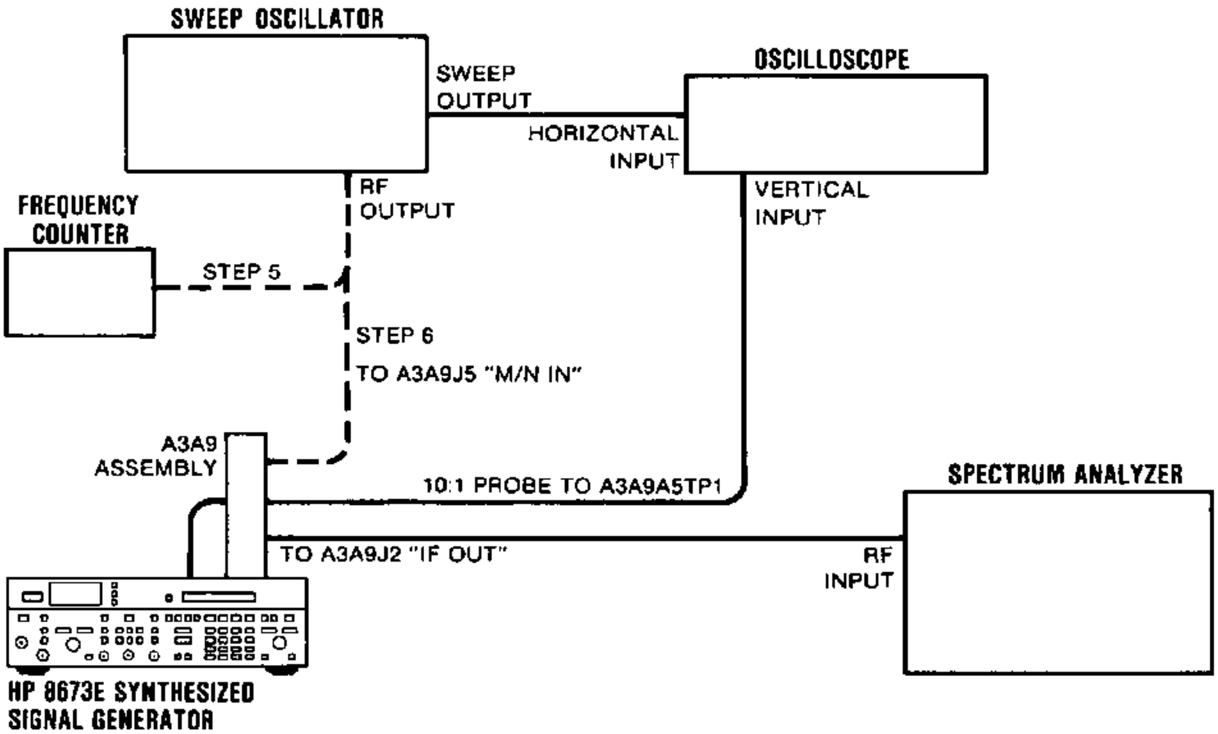


Figure 5-9. YTO Loop Sampler Adjustment Test Setup

Equipment

Oscilloscope	HP 1980B
Sweep Oscillator	HP 86222B/8620C or HP 8340A
Spectrum Analyzer	HP 8566B
Frequency Counter	HP 5343A
50Ω Termination	HP 909A Opt 012

NOTE

An HP 8481A Power Sensor can be used in place of the 50Ω termination.

ADJUSTMENTS

5-16. YTO LOOP SAMPLER ADJUSTMENTS (cont'd)

Procedure (cont'd)

1. Set the Signal Generator's LINE switch to STBY and disconnect the mains power cable.
2. Place the A3A9 Assembly into the service position. (Refer to Service Sheet A for disassembly procedures.)
3. Remove the right side cover of A3A9.
4. Connect a 50Ω termination to the A3A9A1 Directional Coupler output, which normally connects to A1W1.
5. Set the sweep oscillator's controls for a leveled output level of 0 dBm, center frequency range of 187.5 ±1.0 MHz (measured by frequency counter) and a sweep range of 200 MHz ±100 MHz.
6. Connect the equipment as shown in Figure 5-9. Connect the Signal Generator's mains power cord and set the LINE switch to ON.
7. Connect the sweep oscillator's RF output to the M/N LOOP SIGNAL connector, A3A9J5, in place of the white-orange cable.
8. Adjust A3A9A5C1 and C2 (with an insulated adjustment tool) to get an oscilloscope display similar to Figure 5-10. Tune for maximum negative voltage and flatness over the center two divisions. The minimum change from the reference level to the maximum negative voltage should be 0.4 volts. (Troubleshooting Note: If the minimum change is out of tolerance, A3A9A5Q3 and Q8 may have low gain, the YTO feedback signal feeding the RF port of the mixer may be low, or the sampler may be bad.)

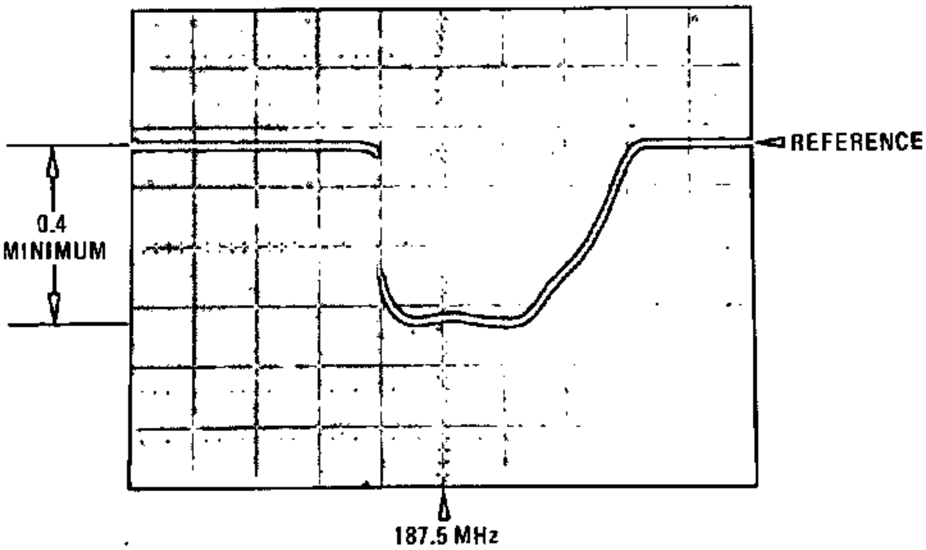


Figure 5-10. Sampler Frequency Response

5-16. YTO LOOP SAMPLER ADJUSTMENTS (cont'd)

Procedure (cont'd)

9. Short A3A7TP2 to ground to open the YTO phase-locked loop.
10. Tune to 2100 MHz and disconnect the gray cable from the phase detector output, A3A9J6. Remove the oscilloscope's probe from A3A9A5TP1.
11. Connect the spectrum analyzer's input directly to IF OUT, A3A9J2.
12. Set the sweep oscillator's controls for a center frequency of 177.5 ±1.0 MHz and set the sweep width to 10 MHz.
13. Connect the sweep oscillator's output to the M/N LOOP SIGNAL input A3A9J5.
14. Set the spectrum analyzer's controls for a 0 to 100 MHz frequency span. Set the other controls to display the swept IF signal. The fundamental, second and third harmonics should be visible at 30, 60, and 90 MHz. Tune the sweep oscillator slightly to align the signals on the display.
15. Adjust the A3A9A5R1, IF GAIN, so that the displayed IF signal at 30 MHz is +2 ±1 dBm. If the level is too low, or if the levels in the following step are not within the levels given, select a new value for C22. Values should be within the range of 120 to 150 pF, and 130 is usually the best value.
16. Slowly tune the sweep oscillator's center frequency from 174 to 181 MHz and observe the fundamental's output level. Verify that the allowable level variation is not exceeded or that the power does not drop below the stated level over the frequency range:
    a. from 6 to 20 MHz, −3 dBm minimum,
    b. from 20 to 30 MHz, +2 to +6 dBm,
    c. from 30 to 70 MHz, −10 dBm minimum.
17. Return the Signal Generator to normal operation as follows:
    a. Disconnect all test equipment.
    b. Reconnect the gray cable to A3A9J6 and the white-orange cable to A3A9J3.
    c. Reverse the instructions in step 4, 3, 2, and 1.
18. Connect the frequency counter to the Signal Generator's RF OUTPUT connector.
19. Verify that the counter reading is within ±1 kHz of the Signal Generator's FREQUENCY MHz display at 2.0 and 6.6 GHz.

ADJUSTMENTS

5-17. YTO LOOP OFFSET AND FM OVERMODULATION ADJUSTMENTS

Reference Service Sheet 12.

Description To operate the YTO loop phase detector in the linear region, the loop offset adjustment is set so that the foldover at the peak of the phase detector output signal just begins. The FM overmodulation adjustment is set to the fully clockwise position to disable the front panel FM OVERMOD status annunciator.

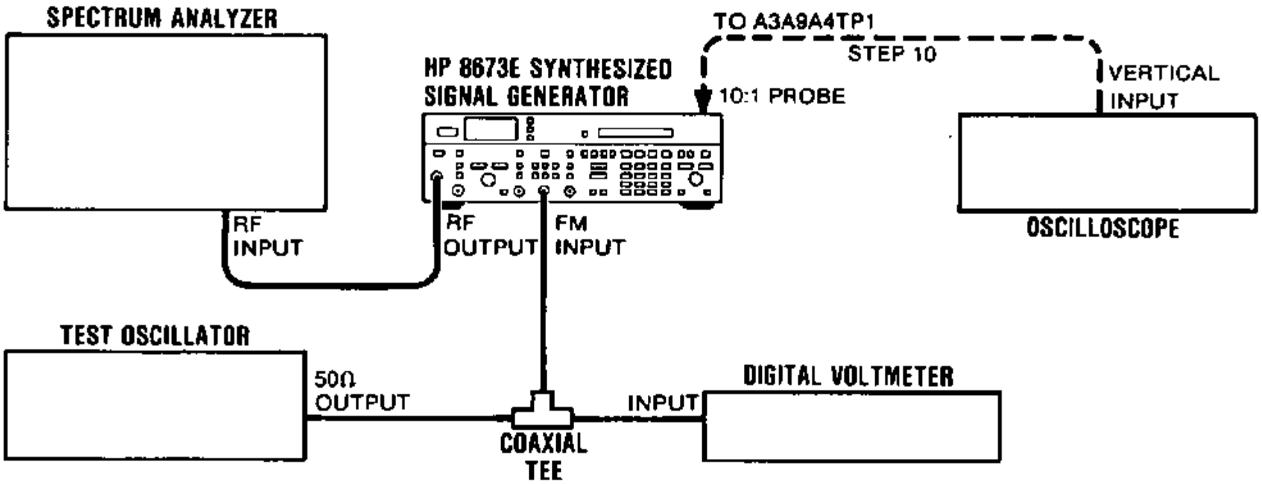


Figure 5-11. YTO Loop Offset and FM Overmodulation Adjustment Test Setup

Equipment

Oscilloscope .... HP 1980B
Spectrum Analyzer .... HP 8566B
Test Oscillator .... HP 3335A
Digital Voltmeter (DVM) .... HP 3456A or HP 3455A

Procedure

1. Set the Signal Generator's LINE switch to STBY and disconnect the mains power cord.
2. Place the A3A9 Assembly into the test position. (Refer to Sec. VIII disassembly procedures).
3. Remove the A3A9A4 cover.
4. Connect the equipment as shown in Figure 5-11. Connect the Signal Generator's mains power cord and set the LINE switch to ON.
5. On the Signal Generator, key in RCL 0 and then set FM DEVIATION to 3 MHz.
6. Tune the test oscillator to 100 kHz.
7. Adjust the spectrum analyzer's controls to display the carrier and the 100 kHz sidebands.

ADJUSTMENTS

5-17. YTO LOOP OFFSET AND FM OVERMODULATION ADJUSTMENTS (cont'd)

Procedure (cont'd)

8. Adjust the test oscillator's output level for the first carrier null as observed on the spectrum analyzer's display. Record the test oscillator's output level as measured with the voltmeter.

_____________ Vrms (V_1)

9. Divide the measured value by 2.4. Readjust the test oscillator's output level to the computed level, V_2.

$\frac{V_1}{2.4}$ _____________ (V_2)

10. Connect the oscilloscope to A3A9A4TP1 through a divide-by-ten probe. Adjust the oscilloscope's controls to view the 100 kHz signal.

11. Set the YTO loop offset adjustment A3A9A4R53, OFST, so the sinusoidal waveform just begins to fold over. See Figure 5-12.

NOTE

There may be two settings of A3A9A4R53 that give the proper offset. Use the position closer to the center of the adjustment range.

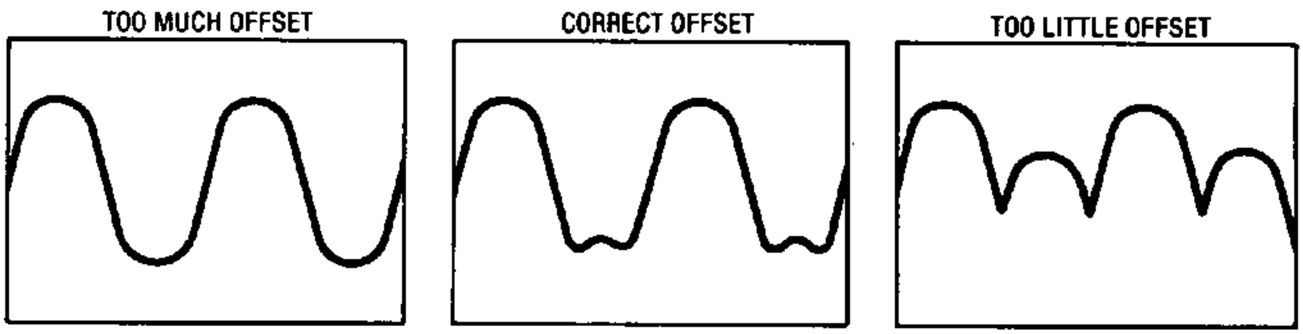


Figure 5-12. YTO Loop Offset Adjustment Waveforms

12. Disconnect the oscilloscope's probe.

13. Set the FM overmodulation adjustment A3A9A4R30, OMOD, to the full clockwise position. This disables the FM overmodulation circuit, to prevent erroneous indications.

14. Return the Signal Generator to normal operation by reversing the instructions in steps 4, 3, 2, and 1.

ADJUSTMENTS

5-18. YTO LOOP PHASE DETECTOR ADJUSTMENTS

Reference Service Sheet 12.

Description The gain crossover frequency of the YTO phase-locked loop is measured and adjusted using a low frequency spectrum analyzer and tracking generator.

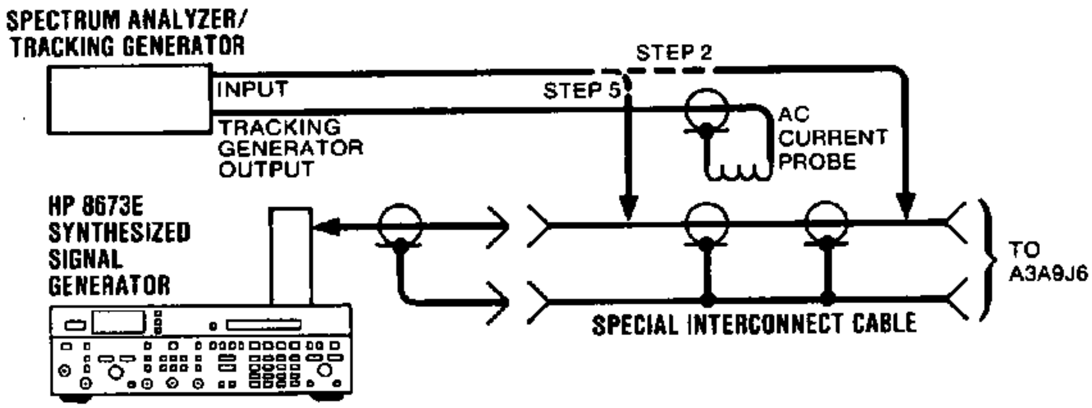


Figure 5-13. YTO Loop Phase Detector Adjustment Test Setup

Equipment

Spectrum Analyzer .... HP 8556A/8552B/141T
(with tracking generator)
AC Current Probe .... HP 1110B
Special Interconnect Cable .... (See Figure 5-14)

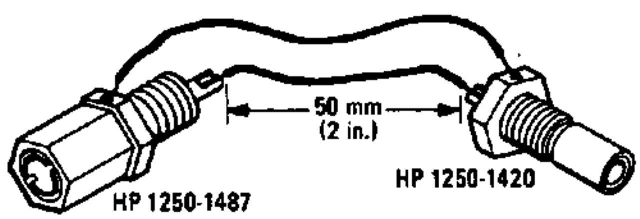


Figure 5-14. Special Interconnect Cable

ADJUSTMENTS

5-18. YTO LOOP PHASE DETECTOR ADJUSTMENTS (cont'd)

Procedure

1. Set the Signal Generator's RF OUTPUT switch to ON.
2. Connect the equipment as shown in Figure 5-13. The special interconnect cable is inserted between A3W16 (gray cable) and A3A9J6 (YTO TUNE 1).

NOTE

When clipping the current probe around the special cable's center conductor, do not allow the metal surface to come in contact with the center conductor connection of the SMA connectors.

3. Set the spectrum analyzer to scan from 0 to 50 kHz, vertical sensitivity per division to 2 dB, scan mode to single, and set the display's variable persistence to maximum.
4. Press the single sweep key on the spectrum analyzer.
5. Move the spectrum analyzer's input to the cable side (A3W16) of the special cable.
6. Press the single sweep key. Check that the gain-crossover frequency is 20 ±2 kHz. If the gain-crossover frequency is not correct, A3A9A4R20 must be changed to set the correct frequency; otherwise, this adjustment is complete. See Figure 5-15.

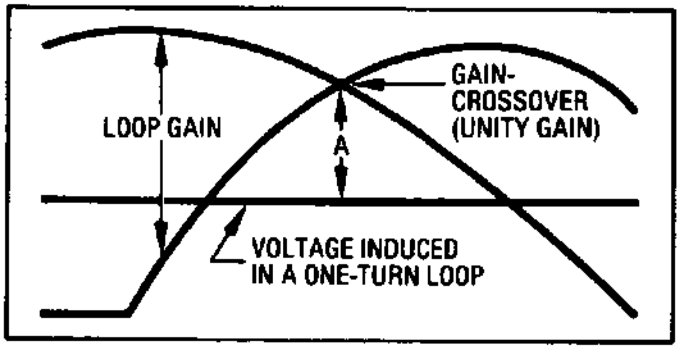


Figure 5-15. Spectrum Analyzer Display of Phase Locked Loop Gain

7. If A3A9A4R20 must be changed, perform the following steps:
   a. Set the LINE switch to STBY.
   b. Disconnect the mains power cord.
   c. Place the A3A9 Assembly in the test position. (Refer to Section VIII disassembly procedures.)

ADJUSTMENTS

5-18. YTO LOOP PHASE DETECTOR ADJUSTMENTS (cont'd)

Procedure (cont'd)

d. Remove the A3A9A4 cover.

e. Select the value of R20 using the following formula.

$$R2 = R1\left(\frac{F1}{20\ \text{kHz}}\right)$$

where R2 = required value for R20
R1 = present value of R20
F1 = measured frequency

for example, if
R1 = 619Ω
and F1 = 25 kHz
then

$$R2 = 619\left(\frac{25\ \text{kHz}}{20\ \text{kHz}}\right)$$

R2 = 773Ω or 750Ω (closest value)

8. Install R20, reconnect the mains power cord and set the LINE switch to ON. Recheck the gain-crossover frequency.

NOTE

The other loop parameters, phase margin and loop gain, may be checked if the loop does not operate correctly. Loop gain is checked at 1 kHz and should be approximately 40 dB. Phase margin is checked by disconnecting the input to the ac probe, shorting the input, and pressing the single sweep pushbutton. Phase margin should be approximately 45° and is calculated by the following expression:

$$\theta = \cos^{-1}\left(1 - \frac{10^{\left(\frac{A}{10}\right)}}{2}\right)$$

where θ = phase margin
and A = ratio (in dB) of the induced voltage to the gain-crossover. (Gain-crossover is the reference, therefore the ratio is negative.)

9. Return the Signal Generator to normal operation as follows:
   a. Set the LINE switch to STBY.
   b. Disconnect the mains power cord.
   c. Install the A3A9A4 cover.
   d. Return the A3A9 Assembly to its normal position.
   e. Install the top and bottom covers.

ADJUSTMENTS

5-19. FM DRIVER ADJUSTMENTS

Reference Service Sheet 13.

Description The dc offset of the FM integrator amplifier is set as close to zero volts as possible. Any FM signal present on the error signal line of the YTO phase-locked loop is nulled at both high and low FM driver sensitivities.

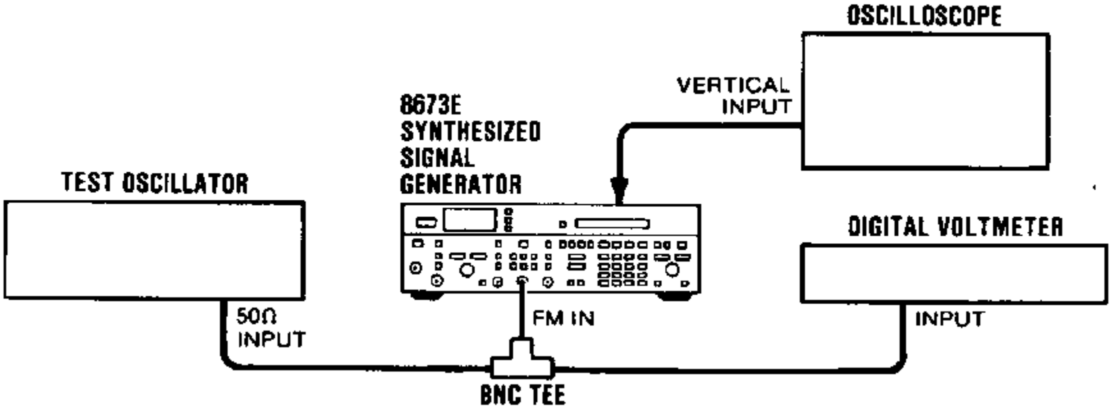


Figure 5-16. FM Driver Adjustment Test Setup

Equipment

Oscilloscope	HP 1980B
Test Oscillator	HP 3335A
Digital Voltmeter	HP 3456A or HP 3455A

Procedure

1. Key in RCL 0 on The Signal Generator and set FM DEVIATION to .1 MHz.
2. With the test oscillator disconnected, connect the oscilloscope to A3A7TP3.
3. Adjust A3A7R28, OFST (offset adjust), for 0.0 ±0.1 Vdc display on the oscilloscope.
4. Set the Signal Generator FM DEVIATION to 3 MHz.
5. Verify that the voltage at A3A7TP3 is 0 ±2 Vdc.
6. Connect the equipment as shown in 5-16.
7. Set the test oscillator to 5 MHz and adjust the oscillator's output for 1.5 mVrms as indicated on the digital voltmeter.
8. Connect the oscilloscope to A3A7TP2. The signal displayed on the oscilloscope will usually be less than 20 mV peak-to-peak.
9. Adjust A3A7R40, GAIN, to null any FM signal on the display.
10. Set the Signal Generator FM DEVIATION to .1 MHz, and adjust the test oscillator for a 0.15 output as indicated by the digital voltmeter.
11. Adjust A3A7R46, −40 GN (−40 gain), to null any FM signal on the display.

ADJUSTMENTS

5-20. FM ACCURACY AND OVERMODULATION ADJUSTMENTS

Reference Service Sheet 21.

Description The FM gain is set. The modulation drive is set to a level that causes FM deviation to equal a full scale meter reading. The meter drive adjustment is set accordingly. The modulation drive is then set to a level that causes overmodulation. The FM overmodulation adjustment is set to a position that just lights the front panel FM OVERMOD status annunicator.

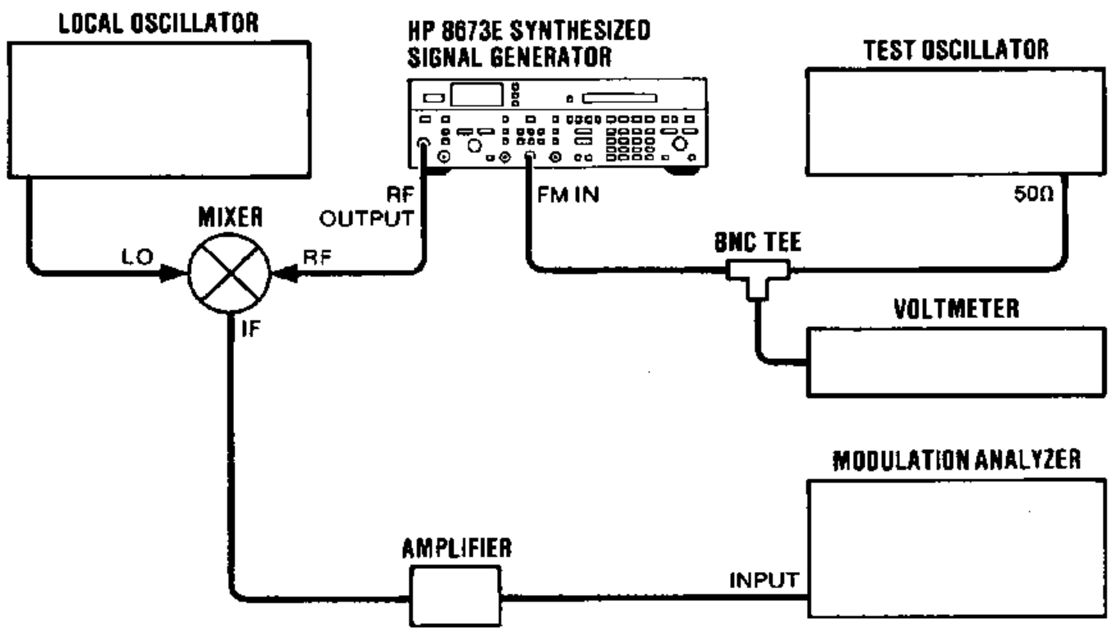


Figure 5-17. FM Accuracy and Overmodulation Adjustment Test Setup

Equipment

Digital Voltmeter	HP 3456A or HP 3455A
Modulation Analyzer	HP 8902A
Test Oscillator	HP 3335A
Preamplifier	HP 8447A
Mixer	RHG DMS1-18
Local Oscillator	HP 8340A

Procedure

1. Connect the equipment as shown in Figure 5-17.

2. On the Signal Generator press RCL 0. Set the instrument to the following conditions:

Frequency	15 GHz
Output Level	−20 dBm
Meter Scale	FM
FM Deviation	0.1 MHz

3. Set the local oscillator's frequency to 15.1 GHz at an output level of +7 dBm, with all modulation off.

ADJUSTMENTS

5-20. FM ACCURACY AND OVERMODULATION ADJUSTMENTS (cont'd)

Procedure (cont'd)

4. Set the test oscillator's frequency to 100 kHz and amplitude for a voltmeter reading of 0.7071 Vrms.

5. Adjust FM GAIN (A1A6R35) on the A1A6 Meter Assembly for a modulation analyzer reading of 100.0 ±0.1 kHz.

6. Adjust FM MTR (A1A6R70) for a full scale reading of 100 kHz on the Signal Generator's front panel meter.

7. Set the Signal Generator to the 0.03 MHz FM deviation range.

8. Verify that the Signal Generator's front panel meter agrees with the modulation analyzer (approximately 30 kHz).

9. Set the test oscillator's amplitude for a voltmeter reading of 0.7425 Vrms.

10. Set FM OMOD (A1A6R54) to the extreme clockwise position.

NOTE

Adjust FM OMOD as accurately as possible to avoid turning on the front panel FM OVERMOD status annunciator erroneously.

11. Adjust FM OMOD (A1A6R54) in a counterclockwise direction until the FM OVERMOD status annunciator on the Signal Generator's front panel just turns on.

ADJUSTMENTS

5-21. SRD BIAS ADJUSTMENT

Reference Service Sheet 19.

Description **Automated adjustment.** The YIG-Tuned Multiplier (YTM) multiplies the fundamental frequency of the YIG-Tuned Oscillator (2.0 to 6.6 GHz). Multiplication is achieved via the Step Recovery Diode (SRD) inside the YTM. The bias voltages on the SRD control the signal levels of the harmonics generated. Misadjusted bias voltages result in low harmonic levels, and thus low power out in the harmonic frequency bands (6.6—18 GHz). Extreme misadjustment can cause YTM spurious oscillations and poor pulse shape in pulse modulation mode.

The SRD bias adjustment procedure consists of setting both the source and gate bias voltages of the SRD bias FET. There are three source voltage adjustments; one for each frequency band. There are four gate voltage adjustments; two for each of the harmonic bands. The adjustment is performed as follows:

a. Source and gate dc bias voltage values are entered into the controller as shown in Figure 5-18. The bias voltages are listed on the YTM label located inside the Signal Generator near the A2A5 assembly on the A2 Controller chassis. The question mark (?) is used as a prompt to indicate when and where data should be entered.

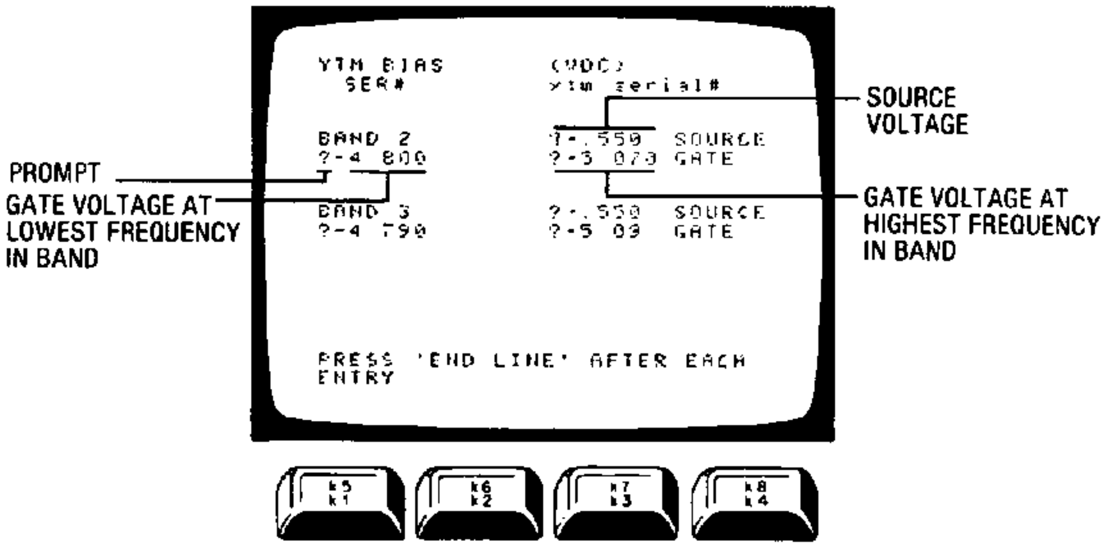


Figure 5-18. Format for Entering SRD Bias Voltages

b. Source voltages for each band are adjusted. Band 1 (2.0 to 6.6 GHz) source voltage is always set to 3.80 ±0.01 Vdc. Band 2 (6.6 to 12.3 GHz), band 3 (12.3 to 18.0 GHz) source voltages are set to within ±0.001 Vdc of the voltage listed on the YTM label. After the source voltages are adjusted, the results are printed.

c. Gate bias voltages are adjusted for bands 2 and 3. Four rectangles are drawn on the controller screen, each one representing an adjustment. The center of the rectangle

ADJUSTMENTS

5-21. SRD BIAS ADJUSTMENT (cont'd)

Description (cont'd)

represents the entered gate voltage. The flashing "X", which represents the error from the entered gate voltage, is adjusted to within one-half division of the rectangle center. See Figure 5-19.

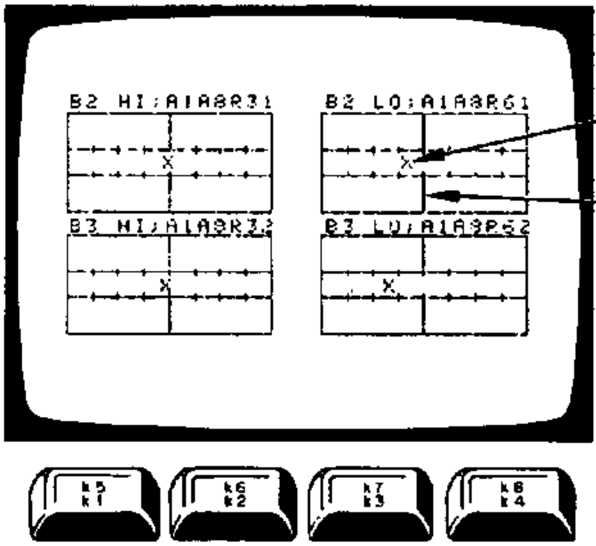


Figure 5-19. Gate Voltage Adjustment

After the gate voltages are adjusted, the results are printed.

NOTES

If a gate voltage cannot be adjusted, check the controller printout of the entered SRD bias voltages and verify that the gate voltages were entered correctly. The center of the rectangle represents the gate voltage that was entered into the controller.

Gate voltages can be checked manually by measuring dc voltage at the lowest and highest frequency of each band. These voltages should correspond to the voltages on the YTM label.

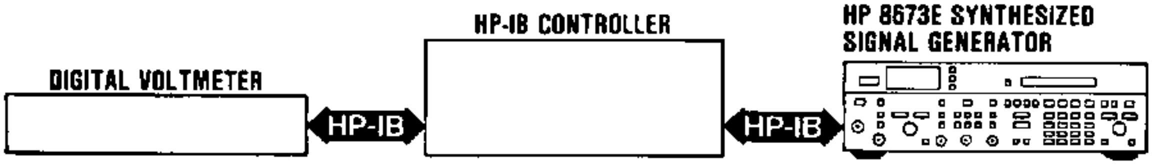


Figure 5-20. SRD Bias Adjustment Test Setup

ADJUSTMENTS

5-21. SRD BIAS ADJUSTMENT (cont'd)

Equipment

Digital Voltmeter	HP 3456A or HP 3455A
HP-IB Controller	HP 85B/00085-15002/00085-15004/ 00085-15005
Test Cassette	HP 11726-10002

Procedure

1. Connect the Signal Generator and voltmeter to the controller via the HP Interface Bus as shown in Figure 5-20.

2. Ensure that the Signal Generator's HP-IB address is set to 19 and that the voltmeter's HP-IB address is set to 22.

3. Load and run the test program "EXEC", if the Main Menu, Figure 5-2, is not presently displayed. Instructions can be found in the paragraph titled "Automated Adjustment Procedures" in this section.

4. After the program is loaded and the main menu is displayed, press k1 to run the SRD bias adjustment program.

5. Instructions for the remainder of the procedure will be displayed on the controller screen. The program will indicate when the SRD bias adjustment has been completed.

ADJUSTMENTS

5-22. YTM TUNE ADJUSTMENT

Reference Service Sheets 14, 16, 17, 20, and 22.

Description **Automated adjustment.** The YIG-Tuned Multiplier (YTM) is swept approximately 200 MHz above and below the Signal Generator's set RF output frequency. The YTM pass band is adjusted so that its center frequency tracks the desired YTM output frequency over its entire range.

If the YTM tuning is out of adjustment, the bandpass filter either attenuates the YIG Tuned Oscillator (YTO) signal more than normal, resulting in low output power, or insufficiently filters signal harmonics. In addition, a misaligned YTM can cause poor pulse shape in pulse modulation mode. The YTM tune adjustment should be performed whenever the YTM or associated circuitry has been repaired or whenever low output power or high harmonics exist.

The YTM tune adjustment is performed as follows:

a. Preliminary adjustments are made. These include setting the +12.4 voltage reference, setting the peaker DAC input bits low via the Special Function learn mode, adjusting "INT OS", disabling the power clamp circuit, and setting the front panel CAL control.

b. The oscilloscope display is calibrated to monitor the detected output of the YTM.

c. YTM tuning is adjusted by centering the YTM response peak on the oscilloscope display (see Figure 5-21). Adjustments are made at the highest and lowest frequency in each band. In addition, band 3 is adjusted at "breakpoint" to correct for tracking deviation at the higher frequencies.

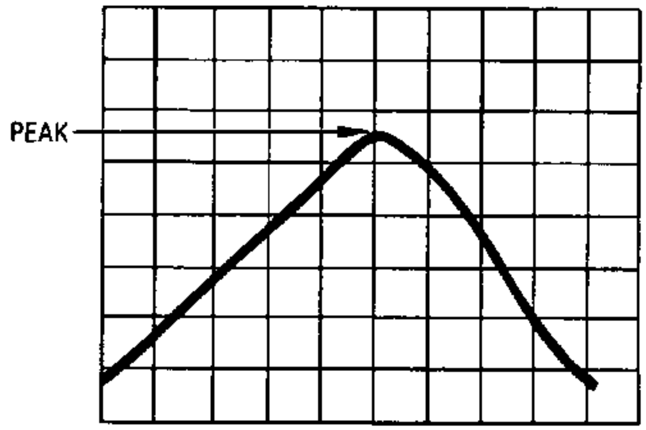


Figure 5-21. Optimum YTM Response

d. Each band is swept to check the YTM tracking response of its passband after adjustment.

ADJUSTMENTS

5-22. YTM TUNE ADJUSTMENT (cont'd)

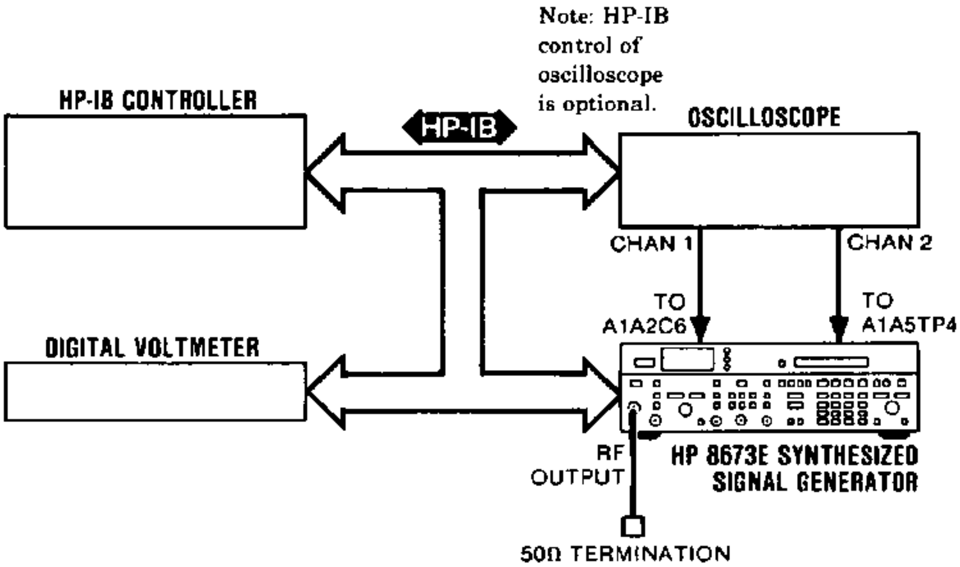


Figure 5-22. YTM Tune Adjustment Test Setup

Equipment

Digital Voltmeter	HP 3456A or HP 3455A
Oscilloscope	HP 1980B
50Ω Termination	HP 909A Opt. 012
HP-IB Controller	HP 85B/00085-15002/ 00085-15004/00085-15005
Test Cassette	HP 11726-10002

Procedure

1. Connect equipment as shown in Figure 5-22.
2. Ensure that the Signal Generator's HP-IB address is set to 19, that the voltmeter's HP-IB address is set to 22, and the oscilloscope's address is set to 07.

NOTE

The use of a remotely controlled oscilloscope is optional. The test will run with either a manual oscilloscope or a remotely controlled HP 1980B.

3. The YTM adjustment program can be loaded by either of two methods: a) by using the SRD adjustment program "Load next test" function or b) by loading and running the "EXEC" program to display the Main Menu, Figure 5-2.
4. After the "EXEC" program is loaded and the Main Menu is displayed, press k2 to run the YTM tune adjustment program.
5. Instructions for the remainder of the procedure will be displayed on the controller screen. The program will indicate when the YTM tune adjustment has been completed.

NOTE

Perform the procedure titled "Clamp Adjustment" after completing this adjustment.

ADJUSTMENTS

5-23. CLAMP ADJUSTMENT

Reference Service Sheet 20.

Description The power clamp circuit is used to limit power in band 1 (2.0 to 6.6 GHz) below the level where YIG-Tuned Multiplier (YTM) spurious oscillations (squegging) occur. Spurious oscillations vary with each YTM and with frequency, but generally occur at high power levels (>12 dBm) and at frequencies within band 1. The clamp level is adjusted to prevent spurious oscillations for all specified operating modes. The YTM is then checked for absence of squegging.

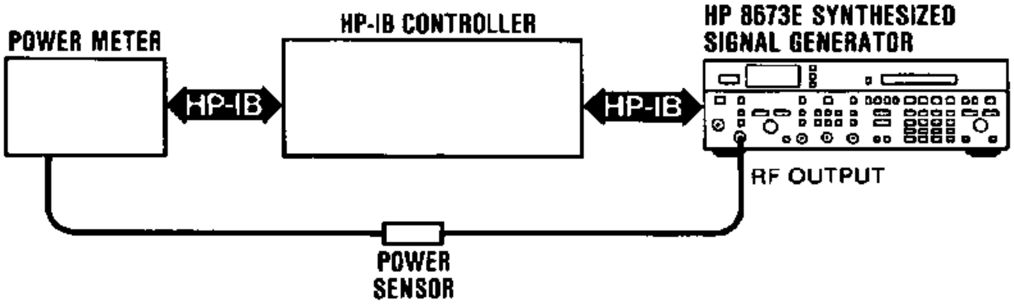


Figure 5-23. Power Clamp Adjustment Test Setup

Equipment

Power Meter	HP 436A
Power Sensor	HP 8481A
HP-IB Controller	HP 85B/00085-15002/ 00085-15004/00085-15005
Test Cassette	HP 11726-10002

Procedure

1. Calibrate the power meter to the power sensor.
2. Connect the equipment as shown in Figure 5-23. Ensure that the Signal Generator and Power Meter HP-IB addresses are set to 19 and 22 respectively.
3. Set CLAMP (A1A3R51) on the Function Assembly fully clockwise for maximum clamping effect.
4. On the Signal Generator, press RCL 0; set FREQUENCY to 6 GHz, LEVEL to 0 dBm, and ALC DIODE to on.
5. Set the CAL control on the Signal Generator's front panel fully clockwise.
6. Set the power meter's cal factor for 6 GHz correction.
7. Adjust CLAMP counterclockwise until the power meter reads +11.0 ±0.2 dBm.
8. Set Signal Generator to Internal ALC and +13 dBm output level.

ADJUSTMENTS

5-23. CLAMP ADJUSTMENT (cont'd)

Procedure (cont'd)

9. Set the Signal Generator's frequency increment to 50 MHz. Then, press the FREQ INCREMENT ⬇ key to tune down in frequency across band 1 (6.6 to 2.0 GHz) while observing the power meter reading. If the power changes suddenly by several dB while changing frequency, the Signal Generator has entered the spurious oscillation (squegging) mode. Decrease the clamp level in 0.5 dB increments at 6 GHz, each time setting the RF key to OFF momentarily and starting the CLAMP adjustment from its fully clockwise position. Repeat this step until no squegging exists.

NOTE

It should not be necessary to set the clamp level lower than +10 dBm.

10. Record this level below for use as a reference.

_____________ dBm

Checking the YTM Performance and Maximum Available Power

11. If the Main Menu, Figure 5-2, is not present on the controller screen, load and run the "EXEC" program. Instructions can be found in the paragraph titled "Automated Adjustment Procedures" in this section.

12. When the Main Menu, Figure 5-2, is displayed, press k6 to run the "Utilities" program. The Utility Menu, Figure 5-24, will be displayed.

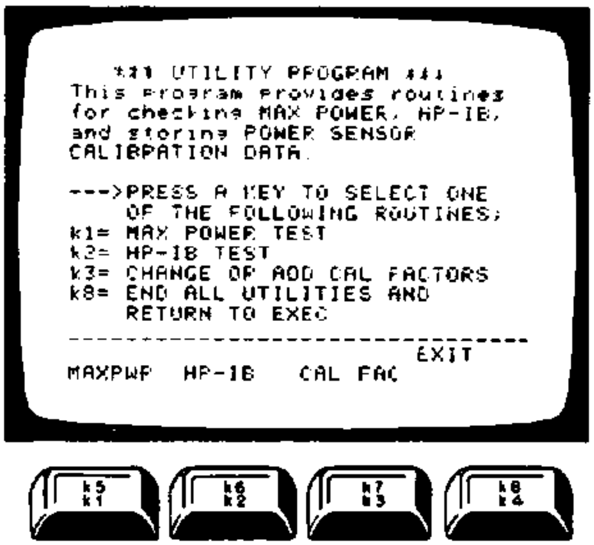


Figure 5-24. Utility Menu

ADJUSTMENTS

5-23. CLAMP ADJUSTMENT (cont'd)

Procedure (cont'd)

13. The maximum available unleveled power will be measured and plotted as in Figure 5-25. If maximum power is lower than the typical specs shown on the graph, then refer to Section VIII, BD5 for troubleshooting.

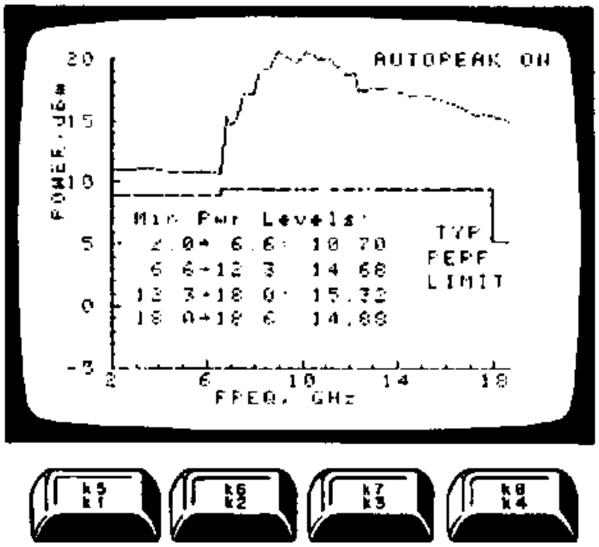


Figure 5-25. Maximum Power Plot

ADJUSTMENTS

5-24. FLATNESS AND ALC ADJUSTMENTS

Reference Service Sheets 14, 17, 19, 20 and 22.

Description **Automated adjustment.** The flatness adjustments compensate for power variations caused by RF output cables, the attenuator, the crystal detector, and the directional coupler. Misadjusted flatness can cause large variations in power level as frequency changes.

The ALC adjustments include centering the ALC loop error voltage within the unleveled detector range, adjusting the AM carrier level, and calibrating the ALC log amp curve. Misadjusted ALC can cause poor AM performance, high level accuracy errors and LVL meter errors.

Flatness. The flatness adjustment procedure is performed as follows:

a. The program runs a flatness plot of the Signal Generator, which is displayed on the controller screen.

b. The program calculates and draws the specification lines and calculates and displays the slope for each of the four flatness regions.

c. A copy of the flatness plot is printed. See Figure 5-26.

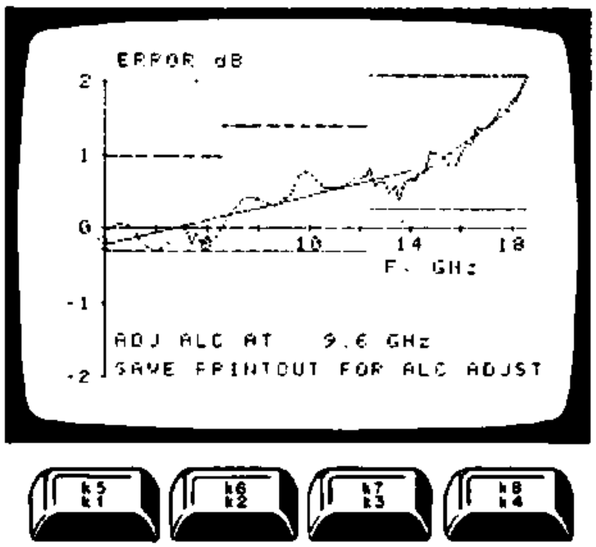


Figure 5-26. Typical Flatness Plot Before Adjustment

d. Three axes representing the slope adjustment for each flatness region, are drawn on the controller screen (see Figure 5-27). The center of each axis represents zero error (the optimum slope for that region). The "X" is adjusted as close as possible for zero error.

ADJUSTMENTS

5-24. FLATNESS AND ALC ADJUSTMENTS (cont'd)

Description (cont'd)

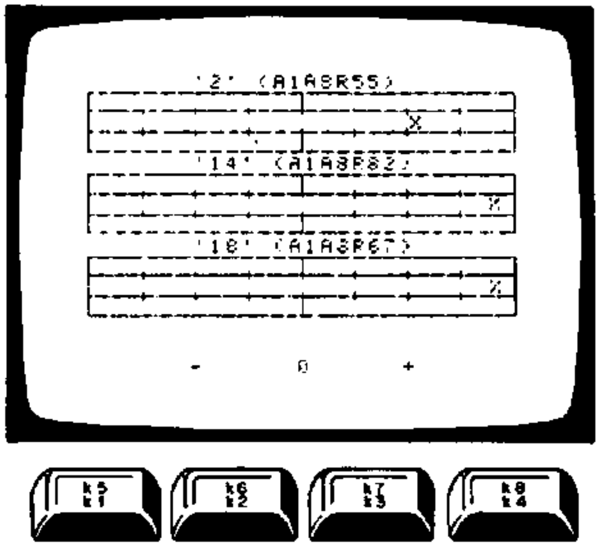


Figure 5-27. Flatness Adjustment Display

e. After the flatness adjustments are made, the controller will print a new flatness plot. Included on the plot is an ALC adjustment frequency that is used in the ALC portion of this adjustment procedure.

ALC. The ALC adjustment procedure is performed as follows:

a. The front panel meter's mechanical zero is set for a mechanical indication of exactly zero on the lower scale.

b. The ALC adjustment frequency, provided on the flatness plot printout, is entered into the controller.

c. The ALC loop error voltage is centered within the unleveled detector's window.

d. AM carrier level (with no modulation input) is set to the same power level as the CW level (AM off).

e. Vernier and meter circuits are adjusted.

f. The overrange adjustment is set to obtain the same RF level in and out of the overrange mode.

g. The internal ALC log amp is adjusted to produce an output voltage proportional to the log of the detected input power (in Watts) at all levels. This ensures that the proper output power level will be obtained across the full vernier range.

h. The external ALC log amp is adjusted to minimize dc offset and to center the operating range of the external leveling circuitry.

ADJUSTMENTS

5-24. FLATNESS AND ALC ADJUSTMENTS (cont'd)

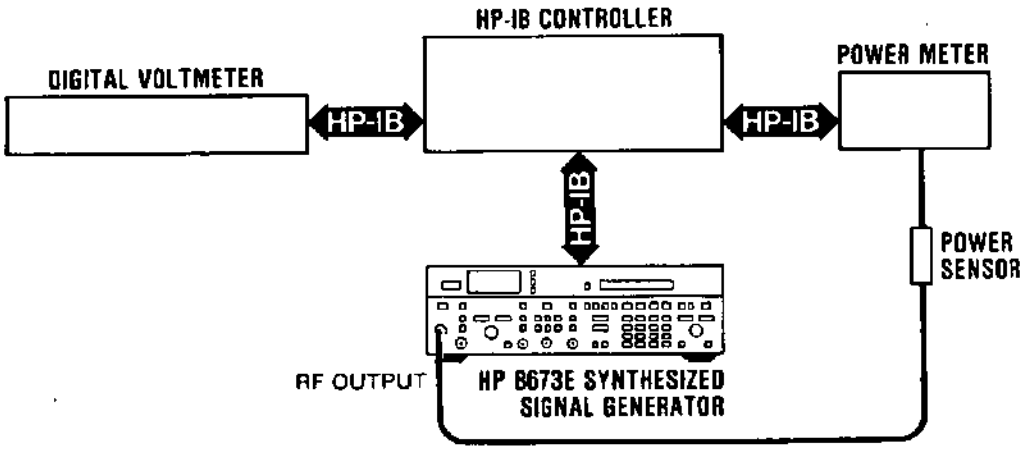


Figure 5-28. Flatness and ALC Adjustment Test Setup

Equipment

Power Meter	HP 436A
Power Sensor	HP 8481A
Digital Voltmeter	HP 3456A or HP 3455A
HP-IB Controller with Optional ROMs	HP 85B/00085-15002/00085-15004/ 00085-15005
Test Cassette	HP 11726-10002

Procedure (cont'd)

NOTE

If either flatness or ALC requires adjustment, both adjustments must be performed. Flatness should be adjusted first because it affects level accuracy at most frequencies.

1. Set the Signal Generator's HP-IB address to 19, set the voltmeter's HP-IB address to 22, and set the power meter's HP-IB address to 13.
2. Calibrate the power meter to the power sensor.
3. Connect the equipment as shown in Figure 5-28.
4. Key in RCL 0 and select AM meter mode.
5. Adjust the mechanical meter zero to give an indicator of zero on the lower scales.
6. Load the test program "EXEC" if the Main Menu, Figure 5-2, is not presently displayed. Instructions can be found in the paragraph titled "Automated Adjustment Procedures" in this section.
7. After the program is loaded and the Main Menu is displayed, press k3 to run the Flatness and ALC adjustment program.
8. Instructions for the remainder of the procedure will be displayed on the controller's screen. The program will indicate when the flatness and ALC adjustments are completed.

ADJUSTMENTS

5-25. AM BANDWIDTH ADJUSTMENT

Reference Service Sheet 14.

Description ALC loop gain is adjusted separately for each band to optimize ALC loop stability, level switching speed, and AM bandwidth. Each band is scanned in small steps to determine where maximum rolloff and peaking occur in the ALC response. The bandwidth is then adjusted to optimize the above three performance parameters.

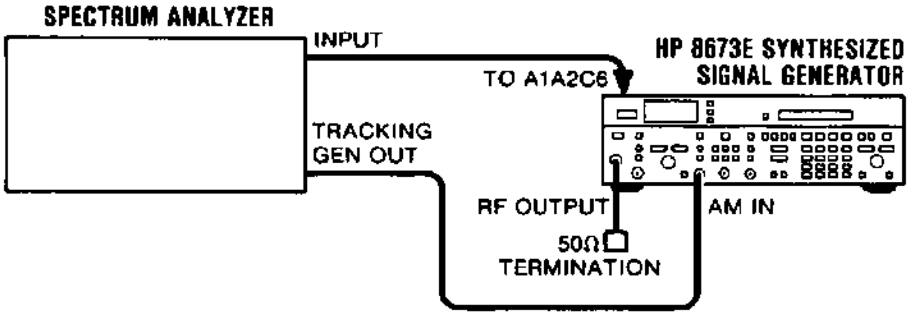


Figure 5-29. AM Bandwidth Adjustment Test Setup

Equipment

Spectrum Analyzer	HP 8556A/8552B/141T
50Ω Termination	HP 909A Opt. 012

Procedure

1. Connect the equipment as shown in Figure 5-29.

2. Key in RCL 0 and then set the Signal Generator to the following conditions:

Start Frequency	2 GHz
Stop Frequency	6.6 GHz
Step Size	10 MHz
Output Level	0 dBm
AM Mode	100%
Meter Scale	AM
AUTO PEAK	Off
NORMAL/BYPASS	NORMAL

3. Center the following adjustments: B1 (A1A2A1R61), B2 (A1A2A1R59) and B3 (A1A2A1R58).

4. Adjust the tracking generator level on the spectrum analyzer so that the Signal Generator's meter reads approximately 30% AM.

5. Change the Signal Generator's meter mode to LVL.

6. Set the spectrum analyzer's vertical sensitivity to 2 dB per division. Adjust the spectrum analyzer's log reference level and linear sensitivity to set the left portion of the displayed signal on a convenient CRT graticule line (two or three divisions from the top of the screen). This represents the reference level for determining AM roll-off.

7. Using the manual sweep mode, tune the Signal Generator from 2.0—6.6 GHz in 10 MHz steps to determine where the sharpest roll-off occurs in the AM response. This corresponds to the highest negative difference in level at the far right of the display (200 kHz) as compared to the reference at the left side (0 kHz).

ADJUSTMENTS

5-25. AM BANDWIDTH ADJUSTMENT (cont'd)

Procedure (cont'd)

8. When the sharpest roll-off frequency is found, vary the Signal Generator's output level from −10 to +8 dBm to determine at what level the sharpest roll-off occurs.

9. At the worst-case roll-off frequency and level, adjust B1 (A1A2A1R61) to set the AM roll-off to −3 dB at 200 kHz as displayed on the spectrum analyzer.

10. Vary the output level from −10 to +8 dBm to determine at what level the sharpest peaking occurs.

11. If this peaking level exceeds +2 dB with respect to 0 Hz, readjust B1 to obtain +2 dB.

12. Return to the frequency and level of maximum roll-off and verify that the roll-off does not exceed −3 dB at a 100 kHz rate.

NOTE

The other two bands (B2 and B3) are adjusted in a manner similar to band 1 (B1). Perform steps 13 through 17 for each adjustment listed in the table.

13. For each adjustment, tune the Signal Generator over the corresponding range listed in the Frequency Tuning column of the following table. Determine where the sharpest roll-off occurs in the AM response.

Adj Name	Reference Designation	Frequency Tuning (in 10 MHz steps)	Output Level
B2	A1A2A1R59	6610 to 12300 MHz	−10 to +5 dBm
B3	A1A2A1R58	12310 to 16000 MHz 16010 to 18600 MHz	−10 to +8 dBm −10 to +8 dBm

14. When the sharpest roll-off frequency is found, vary the Signal Generator's output level over the appropriate range listed in the Output Level column of the table.

15. At the worst-case roll-off frequency and level, set the appropriate adjustment for AM roll-off of −3 dB at 200 kHz as displayed on the spectrum analyzer.

16. Vary the output level over the range used in step 13 to determine at what level the sharpest peaking occurs.

17. If this peaking level exceeds +2 dB with respect to 0 Hz, readjust the adjustment for +2 dB.

18. Return to the frequency and level of maximum roll-off and verify that the roll-off does not exceed −3 dB at a 100 kHz rate.

ADJUSTMENTS

5-26. AM ACCURACY AND METER ADJUSTMENT

Reference Service Sheets 20 and 21.

Description The AM log amp is adjusted for calibrated AM depth accuracy and the AM meter circuit is adjusted for accurate indication of AM depth.

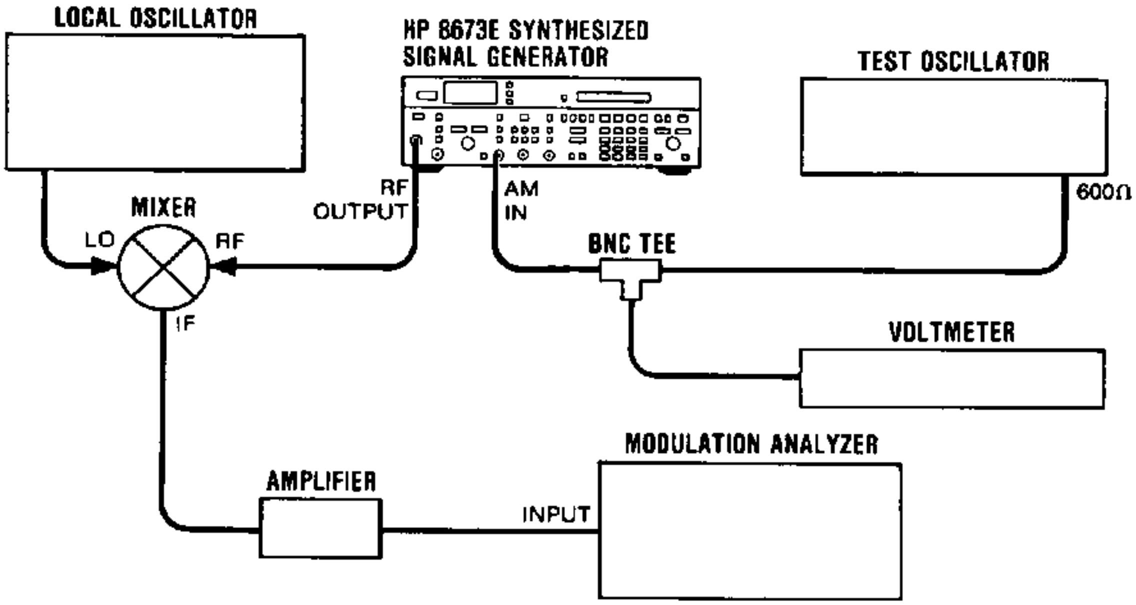


Figure 5-30. AM Accuracy and Meter Adjustment Test Setup

Equipment

Digital Voltmeter	HP 3456A or HP 3455A
Modulation Analyzer	HP 8902A
Amplifier	HP 8447A
Test Oscillator	HP 3335A
Mixer	RHG DMS1-18
Local Oscillator	HP 8340A

Procedure

1. Connect the equipment as shown in Figure 5-30.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

2. On the Signal Generator press RCL 0. Set the instrument to 2 GHz, −25 dBm output level, 100% AM, and AM meter scale.

3. Set the local oscillator to 2.07 GHz at +5 dBm.

4. Set the test oscillator's amplitude for a voltmeter reading of 0.5303 Vrms at 1 kHz.

5. Adjust AM CAL (A1A3R83) on the Function Assembly for a modulation analyzer reading of 73.00 ±0.01% AM depth.

ADJUSTMENTS

5-26. AM ACCURACY AND METER ADJUSTMENT (cont'd)

Procedure (cont'd)

NOTE

AM CAL is set to 73% AM instead of 75% AM to compensate for internal temperature variations. With the covers installed the actual 75% AM corresponds to the meter reading of 75% AM.

6. Adjust AM MTR (A1A6R84) on the meter assembly so that the signal generator's meter reads exactly 75% on the middle scale.

ADJUSTMENTS

5-27. PULSE MODULATION ADJUSTMENT

Reference Service Sheets 15, 17, and 22.

Description The pulse clamp circuitry is adjusted to the low level dynamic range of the internal ALC detector circuitry in pulse mode. This prevents excessively long response times at low duty cycles. The maximum output of the Pulse Amplitude Control (PAC) DAC is adjusted with all DAC bits set high. This affects the range and resolution of the YTM bias sensing that supplies the input to the pulse amplitude control (PAC) circuit. The YTM injected pulse width is adjusted to provide pre-biasing of the YTM step-recovery diode at the proper time. The series pulse width adjustment is set so as to not conflict with the shunt pulse. The relative timing between the series and shunt pulses is critical for proper modulation performance. The ALC sample pulse timing is adjusted to select the optimum time period for which the ALC loop is activated for pulse purposes. The ALC sample pulse fine adjustments are set to minimize the difference in power between CW (continuous wave) and pulse modes at minimum pulse width. The minimum pulse width indicator circuit is adjusted to turn on the ALC UNLEVELED status annunciator when the pulse width becomes less than 100 ns.

Equipment

Digital Voltmeter	HP 3456A or HP 3455A
Oscilloscope	HP 1980B
Pulse Generator	HP 8013B
HP-IB Controller	HP 85B/00085-15002/ 00085-15004/00085-15005
Crystal Detector	HP 08673-60083
Test Cassette	HP 11726-10002
Shunt Adapter	Fabricated Locally (see Figure 5-34)

Procedure

Pulse Clamp and PAC DAC Sensitivity Adjustments

1. Set the Signal Generator's HP-IB address to 19.

2. Connect the equipment as shown in Figure 5-31.

3. Load the test program "EXEC" if the Main Menu, Figure 5-2, is not presently displayed. Instructions can be found in the paragraph titled "Automated Adjustment Procedures" in this section.

4. After the program is loaded and the Main Menu is displayed, press k4 to run the "Pulse" adjustment program.

5. When the Pulse adjustment program appears press k1, DACSENS, to select the PAC DAC adjustment routine.

6. Instructions for the remainder of the procedure will be displayed on the controller's screen.

5-27. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

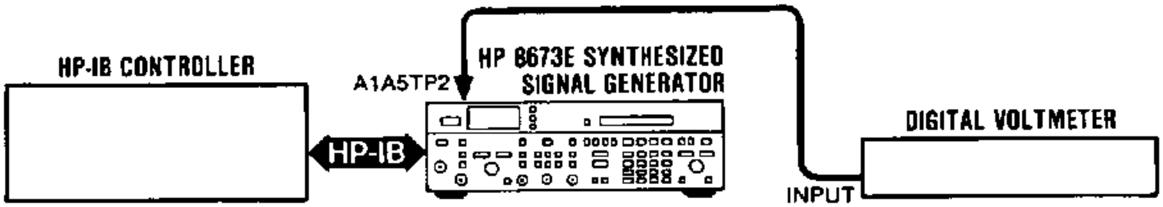


Figure 5-31. PAC DAC Adjustment Test Setup

YTM Injected Pulse Width Adjustment

NOTE

This adjustment is not critical and is being reserved for future options.

7. Set YPW (YTM PW A1A4R19) to the center of its range.

Series Pulse Width Adjustment

8. Connect the equipment as shown in Figure 5-32.

Procedure

9. Set the pulse generator to the following settings:

Pulse Period Range	20 ns — 1 μs
Pulse Delay Range	35 ns — 1 μs
Pulse Width Range	10 ns — 1 μs
Pulse Double/Norm	Norm
Output Norm/Compl	Norm
Amplitude Range	4 — 10 Vpk
Offset (μ Output)	Off
Int Load	Out

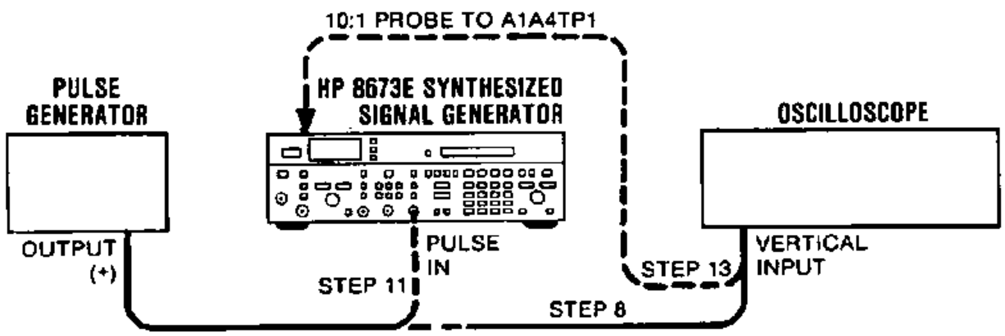


Figure 5-32. Series Pulse Width Adjustment Test Setup

ADJUSTMENTS

5-27. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

10. Set the oscilloscope's vertical input to DC coupled, 50 ohm impedance and adjust the pulse generator's amplitude for a 5V peak-to-peak signal, the pulse period to 1 μs, and the pulse width to approximately 200 ns using the waveform displayed on the oscilloscope.

11. Connect the output of the pulse generator to the PULSE IN connector on the Signal Generator.

12. Set the oscilloscope's input to AC mode, 1 MΩ impedance.

13. Connect the input of the oscilloscope to A1A4TP1 using a 10:1 high frequency probe.

14. Set the oscilloscope's vertical sensitivity to 0.1V per division.

15. On the Signal Generator, set the frequency to 6.6 GHz and select PULSE NORM mode.

16. Adjust the pulse generator's pulse delay to center the pulse waveform on the oscilloscope display.

17. Adjust SPW (SER P A1A4R25) to obtain the waveform shown in Figure 5-33.

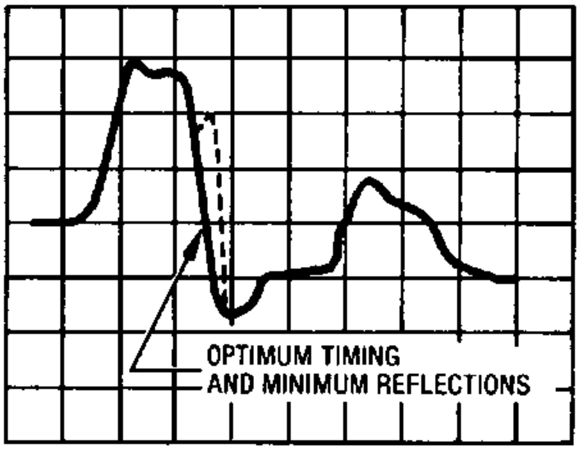


Figure 5-33. Series Pulse Width Waveform

ALC Sample Pulse Adjust

18. Set MPW (Min PW A1A4R9) fully clockwise.

19. Set the pulse generator's pulse period to 1 μs and the pulse width to 98 ns.

20. Connect a 10:1 high impedance probe from the channel 1 input of the oscilloscope to A1A4TP14 (SMPL).

ADJUSTMENTS

5-27. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

21. Set the Signal Generator's frequency to 6.6 GHz and PULSE NORM mode to on.

22. Set the oscilloscope to the following conditions:

Channel 1	Channel 2	Display Modes
2 V/Div dc coupled	.005 V/Div dc coupled 50Ω	Vert Disp: Alt Horiz Disp: Main Sweep Mode: Auto Main Trig: dc, ext Time/Div: 0.05 μs

23. Connect channel 2 to the shunt adapter (Figure 5-34) output as shown in Figure 5-35. The cable between the oscilloscope and the shunt adapter must not be longer than 24 inches.

NOTE

The shunt adapter can easily be fabricated using 2 BNC connectors and a 147 ohm resistor as shown below.

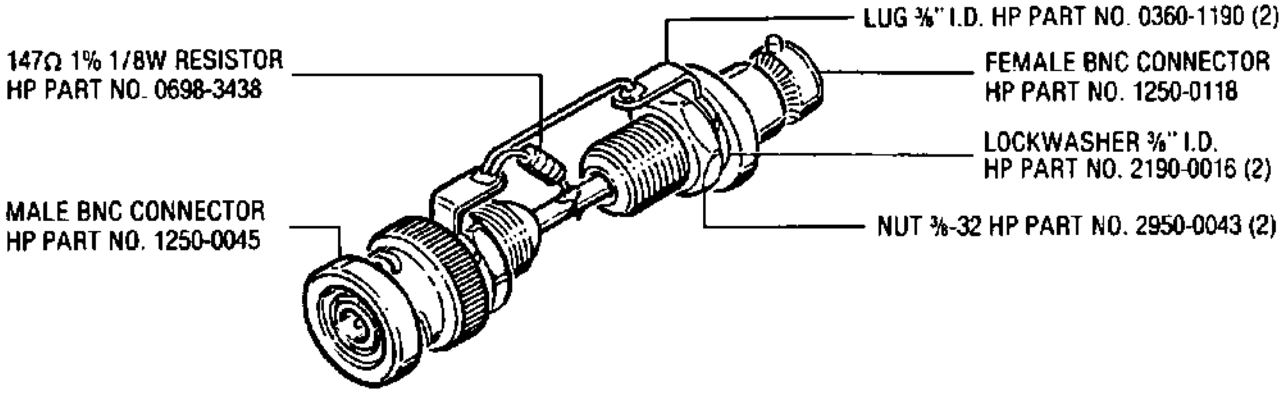


Figure 5-34. Pulse Shunt Adapter

24. Set the Signal Generator's output level to +10 dBm.

25. Adjust channel 2 vertical sensitivity for maximum vertical deflection.

26. On the pulse generator, set the pulse period to approximately 1 μs and the pulse width to 100 ±3 ns using the displayed RF detected pulse waveform on channel 2 of the oscilloscope.

27. Switch the Signal Generator between PULSE NORM and PULSE OFF modes.

ADJUSTMENTS

5-27. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

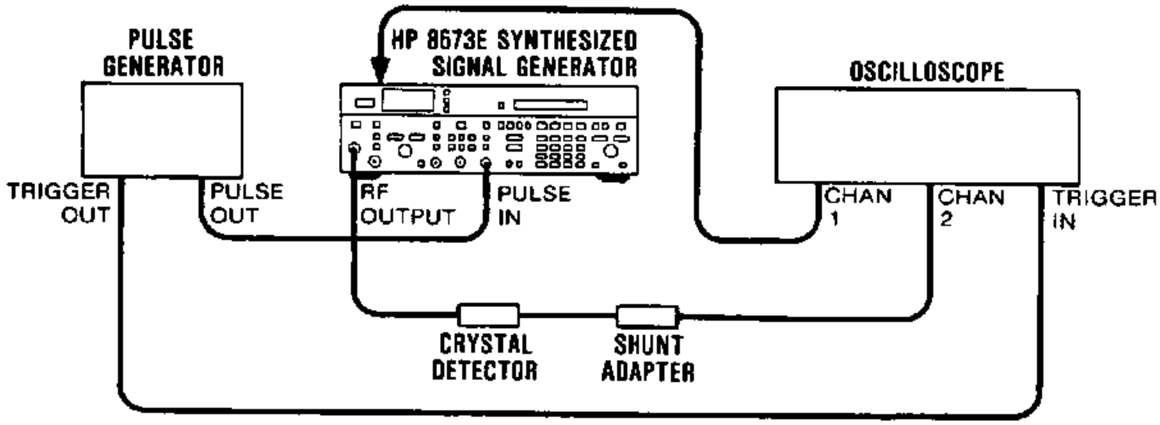


Figure 5-35. ALC Sample Pulse Adjustment Test Setup

28. Adjust TE (A1A4R43) to minimize the difference between PULSE OFF and PULSE NORM modes. The modes should be within ±1 dB of each other on the scope display. (Note: the display can be calibrated to show ±1 dB by using the output level vernier control and the HP 8673E LEVEL dBm display).
29. Set the Signal Generator's output level to −10 dBm or the lowest power out that will give at least 4 divisions of deflection on the oscilloscope's 1 mV/div range. Change oscilloscope channel 2 coupling to dc (switch out of 50Ω mode).

NOTE

The closer the adjustment point is to −10 dBm output power, the more accurate the measurement becomes as long as a four division deflection is maintained.

30. Readjust the oscilloscope's channel 2 vertical sensitivity for a display greater than 4 divisions.
31. Adjust LE (A1A4R52) to minimize the difference between PULSE OFF and PULSE NORM modes.
32. Repeat steps 24 through 31 until the error is minimized at both power levels. Remember to use dc 50Ω coupling when making the high output level adjustment.

NOTE

Try to adjust sample pulse as wide as possible while not sacrificing accuracy in order to do so. See Figure 5-36.

ADJUSTMENTS

5-27. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

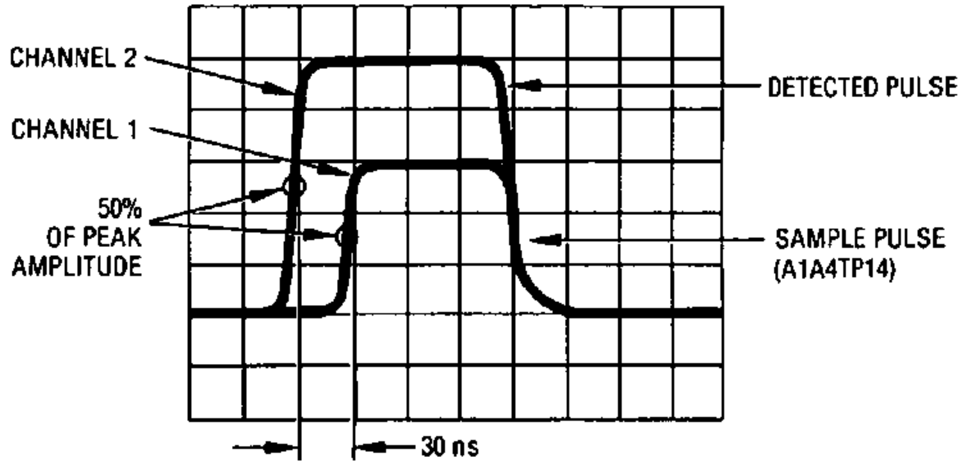


Figure 5-36. ALC Sample Pulse Waveform

Minimum Pulse Width Indicator Adjustment

33. Set the Signal Generator to PULSE NORM mode and output frequency to 6.6 GHz.

34. Set MPW (MIN PW A1A4R9) fully clockwise.

35. Set the pulse generator's pulse period to approximately 1 μs and the pulse width to 80 $\pm$3 ns using the oscilloscope display.

36. Adjust MPW (MIN PW A1A4R9) in a counterclockwise direction until the Signal Generator's front panel ALC UNLEVELED status annunciator just turns off.

37. Set the pulse generator's pulse width vernier fully clockwise, then slowly rotate it counterclockwise. The ALC UNLEVELED status annunciator should turn on after the pulse width narrows to less than 100 ns.

ADJUSTMENTS

5-28. PULSE AMPLITUDE CONTROL ADJUSTMENT

Reference Service Sheet 19

Description **Automated adjustment.** The amplitude of the YTM Bias pulse affects rise time, overshoot, and general pulse shape of the pulse modulated microwave carrier. This amplitude is controlled by the pulse amplitude control (PAC) voltage. To maintain good pulse shape over the Signal Generator's full frequency and output level range, the PAC voltage must be adjusted properly. The required PAC voltage will vary with both frequency and output level setting of the Signal Generator. The level of the PAC voltage in each harmonic frequency band is controlled by a slope and offset adjustment. The label for each adjustment is as follows:

Frequency:	Band 2	Band 3
Adjustment:	B2 OF	B3 OF
	B2 SL	B3 SL

Pulse Program Menu

The PAC voltage adjustment is computer assisted and runs on an HP 85B controller. To run the program, load the "Autost" file on the Test Cassette, HP Part No. 11726-10002. Press run when loaded. After the "EXEC" Program Main Menu is displayed, press the special function key k4, PULSE. This will load and run the Pulse adjustment routine. The following Pulse Program Menu will then be displayed.

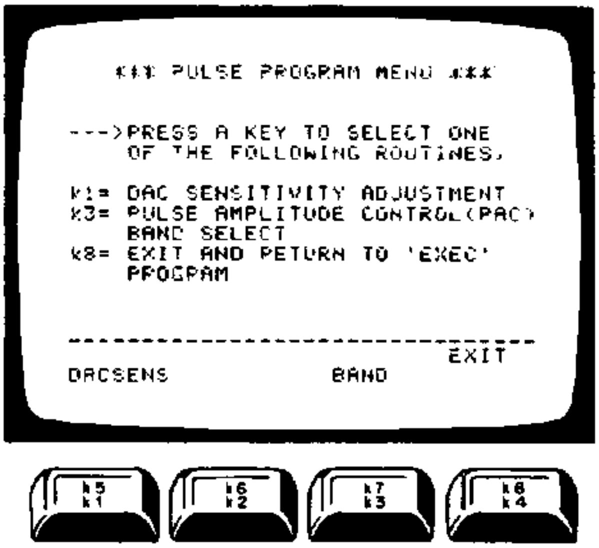


Figure 5-37. Pulse Program Menu

The user then selects k3, Band. After k3 is pressed a new menu (Figure 5-38) will be displayed.

5-28. PULSE AMPLITUDE CONTROL ADJUSTMENT (cont'd)

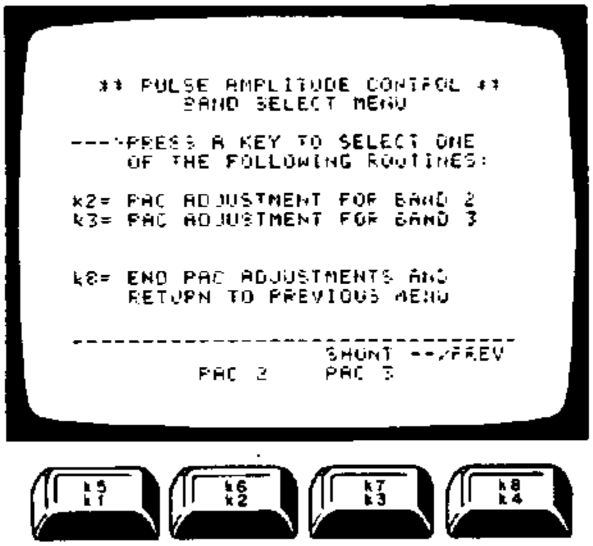


Figure 5-38. Pulse Amplitude Control Band Select Menu

The user can then select Bands 2 or 3 PAC adjustment. The adjustment procedure for each band is identical, therefore the following discussion for Band 2 applies to both bands.

Band 2 Adjustment

The user then selects k2, PAC 2, for the Band 2 adjustment. Key k3 is selected for Band 3 adjustment. The following PAC Adjustment Menu will then be displayed.

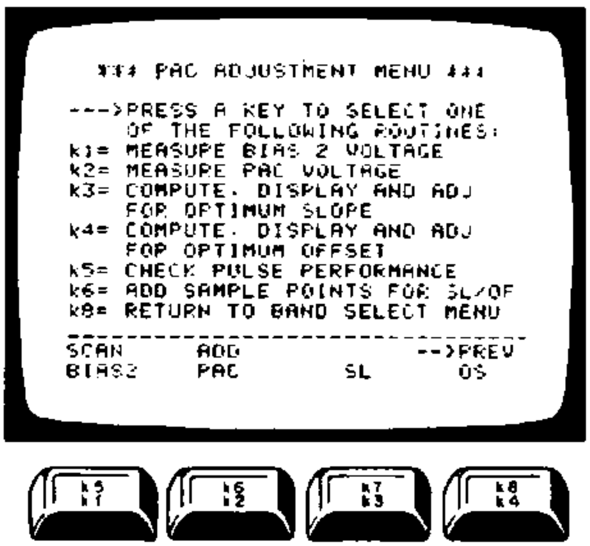


Figure 5-39. PAC Adjustment Menu

ADJUSTMENTS

5-28. PULSE AMPLITUDE CONTROL ADJUSTMENT (cont'd)

BIAS 2

The user then selects k1, BIAS 2. This routine will first set the Signal Generator to the highest frequency in the band (example 12.3 GHz for Band 2). Next it will measure and store the YTM Bias 2 voltage at two different output level vernier settings, −10 dBm and +8 dBm. These two Bias 2 voltage levels will be used later to calculate and plot the optimum settings for the PAC voltage slope and offset adjustments.

PAC

The user then selects k2, PAC. The controller will then set the Signal Generator to the PULSE NORM mode and the user will view the detected pulse modulated signal on the oscilloscope. The user then adjusts the PAC voltage using either B2 OF or B2 SL pots to obtain the optimum pulse shape. The pulse shape should be as flat as possible with minimum overshoot and rise time. The user can observe the PAC voltage change on the DVM while adjusting OF or SL pots.

The PAC voltage is adjusted initially at one frequency for two power level settings (for example, 12.3 GHz at −10 dBm and +8 dBm). The optimum PAC voltage found by the user for these two points is then measured and stored by the controller when the 'CONT' key is pressed.

The controller then uses these two PAC voltages to compute the optimum slope and offset settings for all frequency and output levels. The user will then be guided to these desired settings in the SL, k3 and OS, k4 routines. This will result in the most optimum PAC voltages providing the best possible pulse shape, at all instrument sampled frequency and output levels.

SL

The user then selects k3, SL. The controller switches the instrument between two output levels continuously and measures the PAC voltage at each level. It will then compute the real-time slope and display the slope error from the optimum computed slope. To observe the slope error, the user views the DVM and notes the reading during the time that the DVM is in "External Trigger Mode". All other readings must be ignored. The reading displayed will be a dimensionless number representing the slope error. The slope pot for that band is then adjusted for 0.00 ±0.005 on the DVM. If the error is negative, turn the pot clockwise to compensate. If the error is positive, turn the pot counterclockwise.

OS

The user then selects k4, OS. Again the DVM will continuously cycle and switch between internal and external trigger. Observe the reading during the DVM "External Trigger Mode" and adjust the OS pot for 0.00 ±0.001.

ADJUSTMENTS

5-28. PULSE AMPLITUDE CONTROL ADJUSTMENT (cont'd)

SCAN

The user must now check the adjustment at several frequencies and power levels. To do this the user can select k5, SCAN. When k5, SCAN, is selected the Pulse Scan Menu will be displayed. See Figure 5-40.

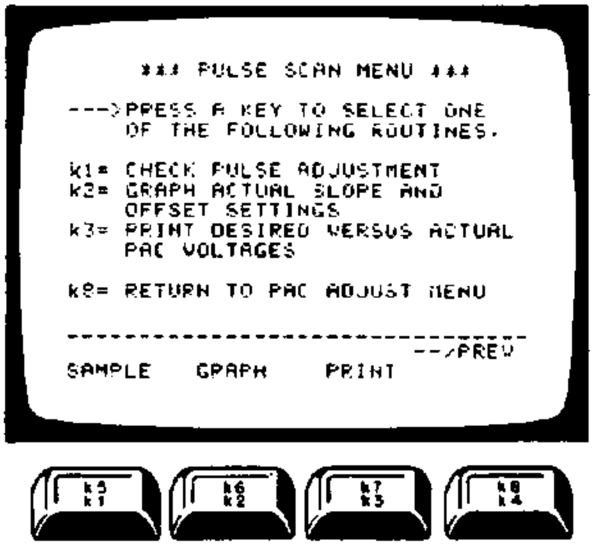


Figure 5-40. Pulse Scan Menu

SAMPLE

The user should select k1, SAMPLE, at this time. Sample is used to check selected frequency points. The controller will set the Signal Generator to various frequencies and power levels as the user checks for excessive overshoot and rise times.

GRAPH and PRINT Routines

Graph, k2 and Print, k3 can optionally be selected by the user to print actual data results of the adjustment. GRAPH prints a graph of Vbias2 versus Vpac. PRINT is used to print the desired versus actual PAC voltages. Examples of both printouts are shown on the next page. See Figures 5-41 and 5-42.

ADJUSTMENTS

5-28. PULSE AMPLITUDE CONTROL ADJUSTMENT (cont'd)

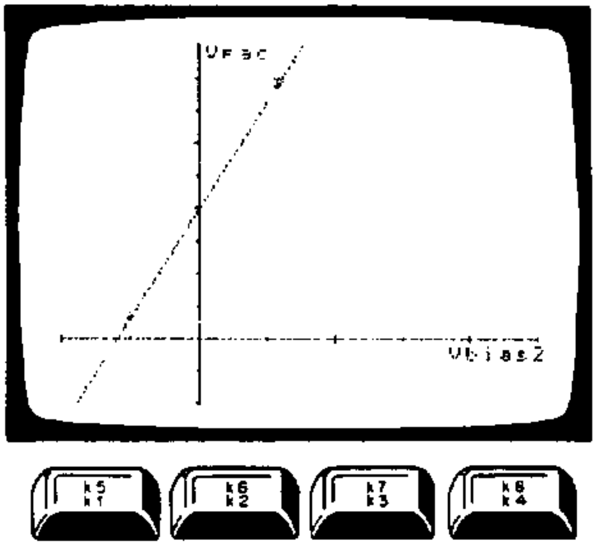


Figure 5-41. Graph Display

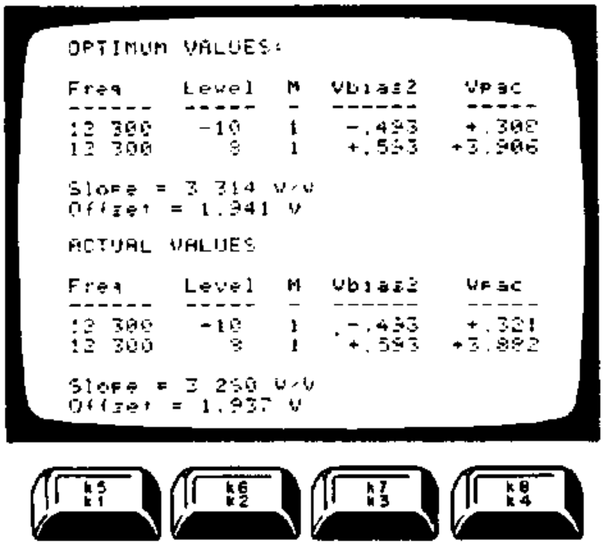


Figure 5-42. Print Display

Once the user is satisfied with the adjustment of the sampled points, it is then necessary to return the Signal Generator to local operation by pressing the LOCAL key and check all frequencies and power levels in Band 2. If points are found out of specification press k8, PREV and refer to ADD function, k6 below. If all points in Band 2 are within specification then press k8, PREV twice to return to the PAC Band Select Menu.

NOTE

Care should be taken when checking performance to the instrument specification with this test setup. High overshoot and ringing can be caused by SWR reflections in the test system. If this occurs, add additional attenuator pads to the output of the detector before the amplifier. This may alleviate problems.

ADD FUNCTION

The add function is selected if the user finds one or several frequencies or power levels that are out of specification while checking overall instrument pulse performance. By selecting k6, ADD, compromises in the optimum slope and offset adjustment settings can be made. The user will first enter the frequencies where out of spec performance was found. Bias 2 and PAC voltage data will then be entered for the new sampled points. The controller will then recompute the optimum slope and offset, taking into consideration all sampled data points. The PAC Adjustment Menu will then be displayed. The user then readjusts the recommended points using SL and OS key functions. The SCAN function is then used again to observe the performance of all sampled points. This iterative procedure is continued until all frequency and output level points are within specified performance. Normally this will be achieved in one iteration of the procedure.

ADJUSTMENTS

5-28. PULSE AMPLITUDE CONTROL ADJUSTMENTS (cont'd)

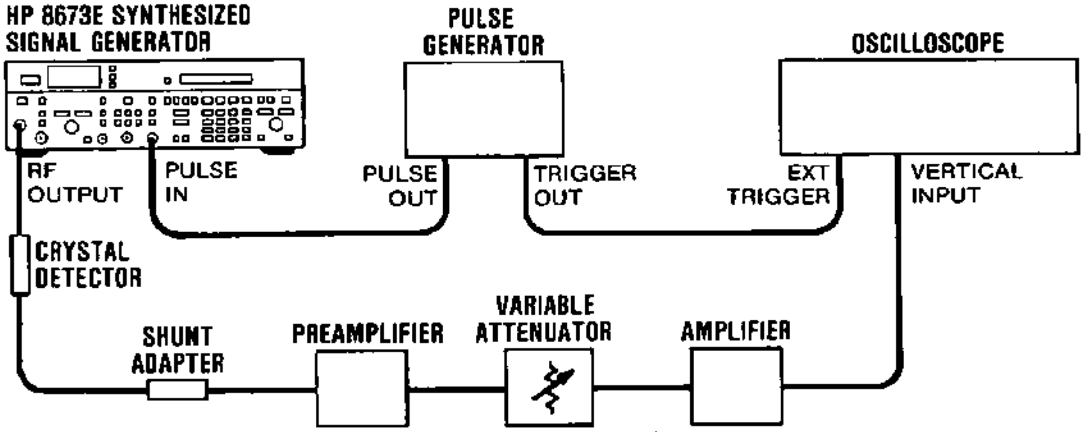


Figure 5-43. Pulse Amplitude Control Adjustment Test Setup

Equipment

Oscilloscope	HP 1980B
Pulse Generator	HP 8013B
Amplifiers	HP 8447F
Crystal Detector	HP 08673-60083
HP-IB Controller	HP 85B/00085-15005/ 00085-15002/00085-15004
Test Cassette	HP 11726-10002
Attenuator, Step	HP 8495B Option 1
Pulse Shunt Adapter	Fabricated Locally (see Figure 5-34)

Procedure

1. Set the Signal Generator's HP-IB address to 19.

2. Connect the equipment as shown in Figure 5-43.

3. Load the test program "EXEC" if the Main Menu is not presently displayed. Instructions can be found in the paragraph titled "Automated Adjustment Procedures" in this section.

4. After the "EXEC" program is loaded and the Main Menu is displayed, press K4 to run the "Pulse" adjustment.

ADJUSTMENTS

5-29. SWEEP OUT AND BLANKING/MARKER ADJUSTMENTS

Reference Service Sheets 26 and 31.

Description The ramp is adjusted for 0 to +10V and is available at the rear panel SWP OUT connector. The Z-axis intensity marker is adjusted to −5V and is available at the rear panel BLANKING/MARKER connector.

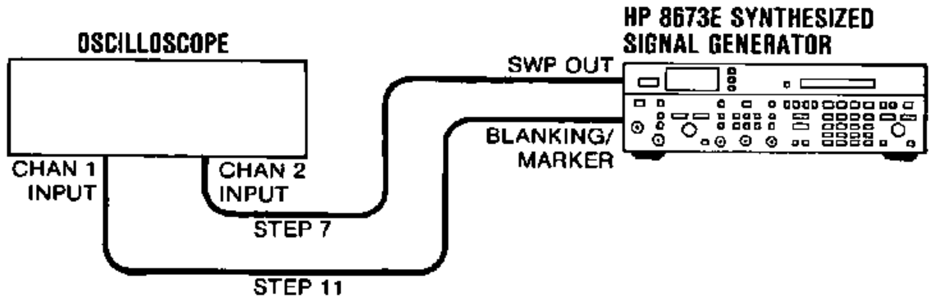


Figure 5-44. Sweep Out and Blanking/Marker Adjustments Test Setup

Equipment

Oscilloscope .... HP 1980B
MPU Test Board .... HP 11726-60001

NOTE

The MPU Test Board is part of the HP 11726A Support Kit or can be ordered separately from your nearest HP Sales office.

Procedure

1. Set the Signal Generator's LINE switch to STBY, then remove the top cover.
2. Connect the MPU test board to Microprocessor Assembly A2A8.
3. On the Microprocessor Assembly, short A2A8TP5 to the adjacent GND test point.
4. Set diagnostic switch A2A8S1, on the Microprocessor Assembly, to 4. (Diagnostic mode 4 enables testing of circuits on the A2A7 I/O Assembly.)
5. Set the LINE switch to ON.
6. Verify that the FREQUENCY MHz display shows 04-1, indicating that the diagnostic switch is correctly set to diagnostic mode 4.
7. Connect the Signal Generator to the oscilloscope's channel 2 input as shown in Figure 5-44.
8. Set the oscilloscope's trigger to channel 2 and set channel 2 vertical input for dc coupling. Adjust the oscilloscope for the display shown in Figure 5-45.

ADJUSTMENTS

5-29. SWEEP OUT AND BLANKING/MARKER ADJUSTMENTS (cont'd)

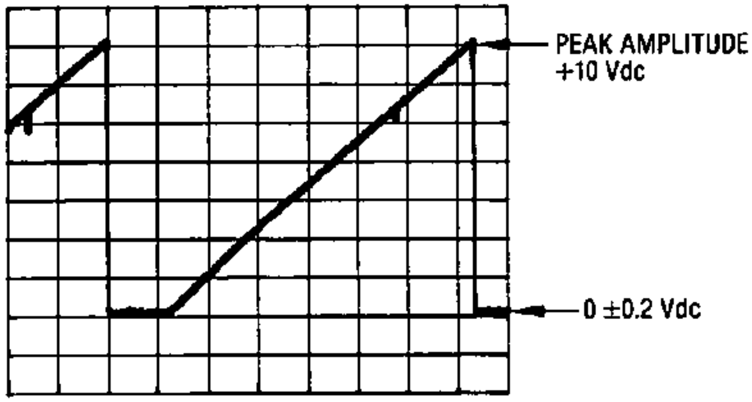


Figure 5-45. Sweep Out Waveform

Procedure (cont'd)

9. Set SWP (A2A7R34) for a +10V ramp peak-to-peak. Verify that the ramp contains no discontinuities.

10. Connect the rear panel BLANKING/MARKER BNC connector to channel 1 of the oscilloscope, leaving the trigger set to channel 2.

11. Using the GND on channel 1 of the oscilloscope, set a reference for normal output level (see Figure 5-46).

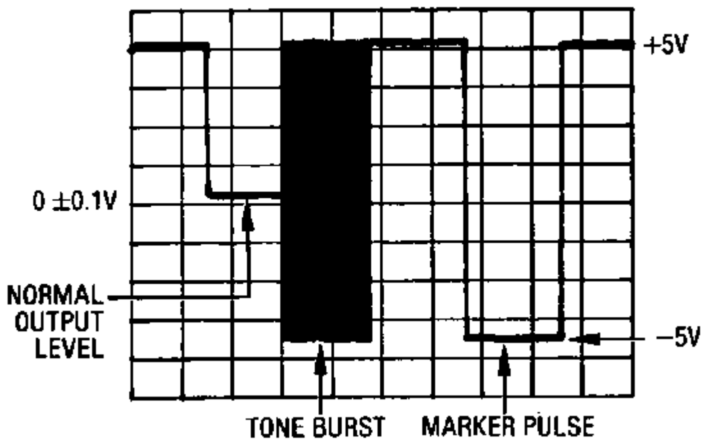


Figure 5-46. Marker Waveform

12. Switch channel 1 to dc coupling.

13. Adjust MKR (A2A7R50) for a marker pulse −5V below the reference.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

This section contains information for ordering parts. Table 6-1 lists exchange assemblies. Table 6-2 lists abbreviations used in the parts list and the manual. Table 6-3 lists all replaceable parts in reference designator order. Table 6-4 contains the names and addresses that correspond to the manufacturer's code numbers.

6-2. EXCHANGE ASSEMBLIES

Table 6-1 lists assemblies within the instrument that may be replaced on an exchange basis. Exchange, factory-repaired and tested assemblies are available only on a trade-in basis. Defective assemblies must be returned for credit. Assemblies required for spare parts stock must be ordered by the new assembly part number.

6-3. ABBREVIATIONS

Table 6-2 lists abbreviations used in the parts list, schematics, and throughout the manual. In some cases, two forms of the abbreviation are used, one all in capital letters, and one with partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-3. REPLACEABLE PARTS LIST

Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numerical order by reference designation.

c. Mechanical parts.

Information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. Part number check digit (CD).

c. The total quantity (Qty) for the entire instrument except for option assemblies.

d. The description of the part.

e. A typical manufacturer of the part in a five-digit code.

f. The manufacturer's number for the part.

The total quantity for each part is given only once — at the first appearance of the part number in the list for each major assembly.

NOTE

Total quantities for optional assemblies are totaled by assembly and not integrated into the standard list.

6-5. ORDERING INFORMATION

To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number (with the check digit), indicate the quantity required, and address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-6. SPARE PARTS KIT

Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard has a "Spare Parts Kit" available for this purpose. The kit consists of selected replaceable assemblies and components for this instrument. The contents of the kit and the "Recommended Spares" list are based on failure reports and repair data, and provides parts support for one year. A complimentary "Recommended Spares" list for this instrument may be obtained on request and the "Spare Parts Kit" may be ordered through the nearest Hewlett-Packard office.

Table 6-1. Part Numbers for Exchange Assemblies

Reference Designation	Description	Part Number*	
		Exchange Assy	New Assy
A1A9	Pre Amp Assembly	08673-67206	08673-67012
A10A11	Power Amp	08673-67205	08673-67011
A3A1A4	M/N VCO Assembly	86701-60071	86701-60029

*When ordering extra assemblies for spare parts stock, use new assembly part number only. Exchange orders require return of the defective part.

Table 6-2. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

- A . . . assembly
- AT . . attenuator; isolator; termination
- B . . . fan; motor
- BT . . . battery
- C . . . capacitor
- CP . . . coupler
- CR . . . diode; diode thyristor; varactor
- DC . . . directional coupler
- DL . . . delay line
- DS . . . annunciator; signaling device (audible or visual); lamp; LED
- E . . . miscellaneous electrical part
- F . . . fuse
- FL . . . filter
- H . . . hardware
- HY . . . circulator
- J . . . electrical connector (stationary portion); jack
- K . . . relay
- L . . . coil; inductor
- M . . . meter
- MP . . . miscellaneous mechanical part
- P . . . electrical connector (movable portion); plug
- Q . . . transistor: SCR; triode thyristor
- R . . . resistor
- RT . . . thermistor
- S . . . switch
- T . . . transformer
- TB . . . terminal board
- TC . . . thermocouple
- TP . . . test point
- U . . . integrated circuit; microcircuit
- V . . . electron tube
- VR . . . voltage regulator; breakdown diode
- W . . . cable; transmission path; wire
- X . . . socket
- Y . . . crystal unit (piezo-electric or quartz)
- Z . . . tuned cavity; tuned circuit

ABBREVIATIONS

- A . . . ampere
- ac . . . alternating current
- ACCESS . . . accessory
- ADJ . . . adjustment
- A/D . . . analog-to-digital
- AF . . . audio frequency
- AFC . . . automatic frequency control
- AGC . . . automatic gain control
- AL . . . aluminum
- ALC . . . automatic level control
- AM . . . amplitude modulation
- AMPL . . . amplifier
- APC . . . automatic phase control
- ASSY . . . assembly
- AUX . . . auxiliary
- avg . . . average
- AWG . . . American wire gauge
- BAL . . . balance
- BCD . . . binary coded decimal
- BD . . . board
- BE CU . . . beryllium copper
- BFO . . . beat frequency oscillator
- BH . . . binder head
- BKDN . . . breakdown
- BP . . . bandpass
- BPF . . . bandpass filter
- BRS . . . brass
- BWO . . . backward-wave oscillator
- CAL . . . calibrate
- ccw . . . counter-clockwise
- CER . . . ceramic
- CHAN . . . channel
- cm . . . centimeter
- CMO . . cabinet mount only
- COAX . . . coaxial
- COEF . . . coefficient
- COM . . . common
- COMP . . . composition
- COMPL . . . complete
- CONN . . . connector
- CP . . . cadmium plate
- CRT . . . cathode-ray tube
- CTL . . . complementary transistor logic
- CW . . . continuous wave
- cw . . . clockwise
- cm . . . centimeter
- D/A . . . digital-to-analog
- dB . . . decibel
- dBm . . . decibel referred to 1 mW
- dc . . . direct current
- deg . . degree (temperature interval or difference)
- . . .° . . . degree (plane angle)
- °C . . . degree Celsius (centigrade)
- °F . . . degree Fahrenheit
- °K . . . degree Kelvin
- DEPC . . deposited carbon
- DET . . . detector
- diam . . . diameter
- DIA . . . diameter (used in parts list)
- DIFF AMPL . . differential amplifier
- div . . . division
- DPDT . . . double-pole, double-throw
- DR . . . drive
- DSB . . . double sideband
- DTL . . . diode transistor logic
- DVM . . . digital voltmeter
- ECL . . . emitter coupled logic
- EMF . . electromotive force
- EDP . . . electronic data processing
- ELECT . . . electrolytic
- ENCAP . . . encapsulated
- EXT . . . external
- F . . . farad
- FET . . . field-effect transistor
- F/F . . . flip-flop
- FH . . . flat head
- FIL H . . . fillister head
- FM . . frequency modulation
- FP . . . front panel
- FREQ . . . frequency
- FXD . . . fixed
- g . . . gram
- GE . . . germanium
- GHz . . . gigahertz
- GL . . . glass
- GRD . . . ground(ed)
- H . . . henry
- h . . . hour
- HET . . . heterodyne
- HEX . . . hexagonal
- HD . . . head
- HDW . . . hardware
- HF . . . high frequency
- HG . . . mercury
- HI . . . high
- HP . . . Hewlett-Packard
- HPF . . . high pass filter
- HR . . . hour (used in parts list)
- HV . . . high voltage
- Hz . . . Hertz
- IC . . . integrated circuit
- ID . . . inside diameter
- IF . . . intermediate frequency
- IMPG . . . impregnated
- in . . . inch
- INCD . . . incandescent
- INCL . . . include(s)
- INP . . . input
- INS . . . insulation
- INT . . . internal
- kg . . . kilogram
- kHz . . . kilohertz
- kΩ . . . kilohm
- kV . . . kilovolt
- lb . . . pound
- LC . . . inductance-capacitance
- LED . . light-emitting diode
- LF . . . low frequency
- LG . . . long
- LH . . . left hand
- LIM . . . limit
- LIN . . . linear taper (used in parts list)
- lin . . . linear
- LK WASH . . . lock washer
- LO . . . low; local oscillator
- LOG . . . logarithmic taper (used in parts list)
- log . . . logrithm(ic)
- LPF . . . low pass filter
- LV . . . low voltage
- m . . . meter (distance)
- mA . . . milliampere
- MAX . . . maximum
- MΩ . . . megohm
- MEG . . . meg (10^6) (used in parts list)
- MET FLM . . . metal film
- MET OX . . metallic oxide
- MF . . . medium frequency; microfarad (used in parts list)
- MFR . . . manufacturer
- mg . . . milligram
- MHz . . . megahertz
- mH . . . millihenry
- mho . . . mho
- MIN . . . minimum
- min . . . minute (time)
- . . .' . . . minute (plane angle)
- MINAT . . . miniature
- mm . . . millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-2. Reference Designations and Abbreviations (cont'd)

MOD .... modulator
MOM ...... momentary
MOS .... metal-oxide semiconductor
ms .... millisecond
MTG .... mounting
MTR ... meter (indicating device)
mV .... millivolt
mVac ...... millivolt, ac
mVdc ...... millivolt, dc
mVpk .... millivolt, peak
mVp-p ... millivolt, peak-to-peak
mVrms .... millivolt, rms
mW .... milliwatt
MUX .... multiplex
MY .... mylar
μA .... microampere
μF .... microfarad
μH .... microhenry
μmho .... micromho
μs .... microsecond
μV .... microvolt
μVac ...... microvolt, ac
μVdc ..... microvolt, dc
μVpk ... microvolt, peak
μVp-p ... microvolt, peak-to-peak
μVrms .... microvolt, rms
μW .... microwatt
nA .... nanoampere
NC ...... no connection
N/C .... normally closed
NE .... neon
NEG .... negative
nF .... nanofarad
NI PL ...... nickel plate
N/O ..... normally open
NOM .... nominal
NORM .... normal
NPN ... negative-positive-negative
NPO .... negative-positive zero (zero temperature coefficient)
NRFR .. not recommended for field replacement
NSR ..... not separately replaceable
ns .... nanosecond
nW .... nanowatt
OBD ... order by description
OD ..... outside diameter
OH .... oval head
OP AMPL ... operational amplifier
OPT .... option
OSC .... oscillator
OX .... oxide
oz .... ounce
Ω .... ohm
P .... peak (used in parts list)
PAM .... pulse-amplitude modulation
PC ...... printed circuit
PCM .. pulse-code modulation; pulse-count modulation
PDM ..... pulse-duration modulation
pF .... picofarad
PH BRZ phosphor bronze
PHL .... Phillips
PIN ... positive-intrinsic-negative
PIV .... peak inverse voltage
pk .... peak
PL .... phase lock
PLO .... phase lock oscillator
PM .... phase modulation
PNP ... positive-negative-positive
P/O .... part of
POLY ...... polystyrene
PORC .... porcelain
POS .. positive; position(s) (used in parts list)
POSN .... position
POT ..... potentiometer
p-p .... peak-to-peak
PP ... peak-to-peak (used in parts list)
PPM ..... pulse-position modulation
PREAMPL ... preamplifier
PRF .... pulse-repetition frequency
PRR .... pulse repetition rate
ps .... picosecond
PT .... point
PTM .... pulse-time modulation
PWM .... pulse-width modulation
PWV ...... peak working voltage
RC .... resistance-capacitance
RECT .... rectifier
REF .... reference
REG .... regulated
REPL .... replaceable
RF ..... radio frequency
RFI .... radio frequency interference
RH .... round head; right hand
RLC .... resistance-inductance-capacitance
RMO ... rack mount only
rms .... root-mean-square
RND .... round
ROM .. read-only memory
R&P ..... rack and panel
RWV ... reverse working voltage
S ... scattering parameter
s .... second (time)
..." . second (plane angle)
S-B ..... slow-blow (fuse) (used in parts list)
SCR ... silicon controlled rectifier; screw
SE .... selenium
SECT .... sections
SEMICON ..... semiconductor
SHF ...... superhigh frequency
SI .... silicon
SIL .... silver
SL .... slide
SNR .. signal-to-noise ratio
SPDT ...... single-pole, double-throw
SPG .... spring
SR .... split ring
SPST ...... single-pole, single-throw
SSB ..... single sideband
SST ...... stainless steel
STL .... steel
SQ .... square
SWR .. standing-wave ratio
SYNC ...... synchronize
T .. timed (slow-blow fuse)
TA .... tantalum
TC .... temperature compensating
TD .... time delay
TERM .... terminal
TFT .. thin-film transistor
TGL .... toggle
THD .... thread
THRU .... through
TI .... titanium
TOL .... tolerance
TRIM .... trimmer
TSTR .... transistor
TTL .. transistor-transistor logic
TV .... television
TVI television interference
TWT .. traveling wave tube
U ..... micro (10^{-6}) (used in parts list)
UF ... microfarad (used in parts list)
UHF .. ultrahigh frequency
UNREG .... unregulated
V .... volt
VA .... voltampere
Vac .... volts, ac
VAR .... variable
VCO ... voltage-controlled oscillator
Vdc .... volts, dc
VDCW. . volts, dc, working (used in parts list)
V(F) ...... volts, filtered
VFO .. variable-frequency oscillator
VHF ...... very-high frequency
Vpk .... volts, peak
Vp-p .. volts, peak-to-peak
Vrms .... volts, rms
VSWR ... voltage standing wave ratio
VTO ...... voltage-tuned oscillator
VTVM .... vacuum-tube voltmeter
V(X) ..... volts, switched
W .... watt
W/ .... with
WIV .... working inverse voltage
WW .... wirewound
W/O .... without
YIG .. yttrium-iron-garnet
Z_o .... characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A1	08673-60104	6	1	ATTENUATOR DRIVER BOARD ASSEMBLY	28480	08673-60104
A1A1C1	0180-0291	3	18	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A1C2	0180-0197	8	15	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A1C3	0160-0572	1	2	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A1A1C4	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A1A1C5	0160-0576	5	50	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A1C6	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A1CR1				NOT ASSIGNED		
A1A1CR2	1901-0050	3	49	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR13	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR14	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR15	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR16	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR17	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR19				NOT ASSIGNED		
A1A1CR20	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR21	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR22	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR23	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR24	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR25	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR26	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1CR27				NOT ASSIGNED		
A1A1CR28				NOT ASSIGNED		
A1A1CR29	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A1Q1				NOT ASSIGNED		
A1A1Q2	1854-0810	2	30	TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A1R1	0698-3430	5	4	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A1A1R2	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A1A1R3				NOT ASSIGNED		
A1A1R4	0698-0083	8	28	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A1R5	0757-0288	1	4	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A1A1R6	0757-0289	2	5	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A1A1U1	1820-0535	7	6	IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A1U2	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A1U3	1820-1445	0	9	IC LCH TTL LS 4-BIT	01295	SN74LS375N
A1A1U4	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A1U5	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A1U6	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
A1A1U7	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A1U8	1820-0535	7		IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A1A2	08673-60116	0	1	DETECTOR MODULE ASSEMBLY	28480	08673-60116
A1A2C1	0160-4082	6	5	CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A1A2C2	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A1A2C3	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A1A2C4	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A1A2C5				NOT ASSIGNED		
A1A2C6	0160-6211	7	3	CAPACITOR-FDTHRU 10PF 20% 200V CER	28480	0160-6211
A1A2C7	0160-4082	6		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4082
A1A2C8	0160-6211	7		CAPACITOR-FDTHRU 10PF 20% 200V CER	28480	0160-6211
A1A2C9	0160-6211	7		CAPACITOR-FDTHRU 10PF 20% 200V CER	28480	0160-6211

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A2MP1	0360-0353	0	1	BRACKET-RTANG .406-LG X .343-LG .312-WD	28480	0360-0353
A1A2MP2	0520-0127	6	22	SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1A2MP3	0520-0163	0	4	SCREW-MACH 2-56 .188-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A1A2MP4	2190-0045	8	32	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0045
A1A2MP5	2190-0124	4	1	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A1A2MP6	2200-0103	2	7	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A1A2MP7	2360-0117	6	2	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1A2MP8	2950-0078	9	1	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A1A2MP9	3050-0006	6	1	WASHER-SHLDR NO. 10 .2-IN-ID .5-IN-OD	28480	3050-0006
A1A2MP10	3050-0062	4	1	WASHER-FL NM NO. 8 .188-IN-ID .438-IN-OD	28480	3050-0062
A1A2MP11	08673-00020	9	1	COVER-DETECTOR MODULE	28480	08673-00020
A1A2MP12	08673-00022	1	1	INSULATOR-DETECTOR HOUSING	28480	08673-00022
A1A2MP13	08673-00038	9	1	COVER-DETECTOR HOUSING (REAR)	28480	08673-00038
A1A2MP14	08673-20083	6	1	BUSHING	28480	08673-20083
A1A2MP15	08673-20147	3	1	DETECTOR HOUSING	28480	08673-20147
A1A2MP16	0520-0173	2	1	SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1A2A1	08673-60114	8	1	ALC BOARD ASSEMBLY	28480	08673-60114
A1A2A1C1	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A2A1C2	0180-0491	5	3	CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A1A2A1C3	0180-2620	6	3	CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A1A2A1C4	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A1A2A1C5	0160-3454	4	1	CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A1A2A1C6	0160-3879	7	15	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A1C7	0160-2209	5	1	CAPACITOR-FXD 360PF +-5% 300VDC MICA	28480	0160-2209
A1A2A1C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A1C9	0160-0161	4	2	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A1A2A1C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A1C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A1C12	0160-0163	6	1	CAPACITOR-FXD .033UF +-10% 200VDC POLYE	28480	0160-0163
A1A2A1C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A2A1C14	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A1A2A1C15	0160-0573	2	3	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A1A2A1C16	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A1A2A1C17	0160-0127	2	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A1A2A1C18	0160-4764	1	1	CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4764
A1A2A1C19	0160-0574	3	1	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A1A2A1C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A1CR1	1901-0040	1	12	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2A1CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2A1CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2A1CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A2A1J1	1250-1255	1	1	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1255
A1A2A1L1	9140-0144	0	6	INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A1A2A1L2	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A1A2A1L3	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A1A2A1MP1	1480-0073	6	11	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A1A2A1MP2	4040-0750	7	1	EXTR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
A1A2A1Q1	1855-0276	6	3	TRANSISTOR J-FET 2N4416A N-CHAN D-MODE	01295	2N4416A
A1A2A1Q2	1855-0253	9	4	TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	28480	1855-0253
A1A2A1Q3	1855-0276	6		TRANSISTOR J-FET 2N4416A N-CHAN D-MODE	01295	2N4416A
A1A2A1Q4	1854-0477	7	4	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A2A1Q5	1853-0322	9	4	TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A2A1Q6	1855-0276	6		TRANSISTOR J-FET 2N4416A N-CHAN D-MODE	01295	2N4416A
A1A2A1Q7	1853-0316	1	2	TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
A1A2A1Q8	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A2A1Q9	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A2A1Q10	1853-0529	8	1	TRANSISTOR-DUAL PNP PD=2.5W	28480	1853-0529
A1A2A1Q11	1853-0459	3	21	TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A2A1Q12	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A2A1Q13	1855-0253	9		TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	28480	1855-0253
A1A2A1Q14	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A2A1Q15	1855-0251	7	1	TRANSISTOR MOSFET N-CHAN E-MODE TO-39 SI	28480	1855-0251

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3 Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A2A1Q16	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A2A1R1	2100-3273	1	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A1A2A1R2	0698-7576	8	2	RESISTOR 217 .1% .125W F TC=0+-25	19701	MF4C1/8-T9-217R-B
A1A2A1R3	0757-0409	8	1	RESISTOR 274 1% .125W F TC=0+-100	24546	C4-1/8-T0-274R-F
A1A2A1R4	0698-7280	1	6	RESISTOR 68.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6812-F
A1A2A1R5	0698-7280	1		RESISTOR 68.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6812-F
A1A2A1R6	0698-7280	1		RESISTOR 68.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6812-F
A1A2A1R7	0698-5383	1	1	RESISTOR 11.5K 1% .125W F TC=0+-25	28480	0698-5383
A1A2A1R8	0698-7243	6	8	RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A1A2A1R9	0698-7222	1	4	RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-F
A1A2A1R10	0698-7280	1		RESISTOR 68.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6812-F
A1A2A1R11	0698-7280	1		RESISTOR 68.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6812-F
A1A2A1R12	0698-7260	7	23	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A2A1R13	0698-7277	6	12	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A2A1R14	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A2A1R15	0699-0784	8	1	RESISTOR 17.55K .1% .1W F TC=0+-15	28480	0699-0784
A1A2A1R16	0698-7576	8		RESISTOR 217 .1% .125W F TC=0+-25	19701	MF4C1/8-T9-217R-B
A1A2A1R17	0699-0994	2	1	RESISTOR-28.544K .1% .125W F TC=0+-25PPM	28480	0699-0994
A1A2A1R18	0699-0096	5	2	RESISTOR 12K .1% .1W F TC=0+-10	28480	0699-0096
A1A2A1R19	0699-0993	1	1	RESISTOR 46.4K .1% .125W F TC=0+-25PPM	28480	0699-0993
A1A2A1R20	0699-0992	0	1	RESISTOR 227.2 .1% .125W F TC=0+-25	28480	0699-0992
A1A2A1R21	0699-0991	9	1	RESISTOR-4.452K .1% .125W F TC=0+-25PPM	28480	0699-0991
A1A2A1R22	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A2A1R23	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A2A1R24				NOT ASSIGNED		
A1A2A1R25	0698-7234	5	1	RESISTOR 825 1% .05W F TC=0+-100	24546	C3-1/8-T0-825R-F
A1A2A1R26	0698-6329	7	2	RESISTOR 845 1% .125W F TC=0+-25	28480	0698-6329
A1A2A1R27	0698-7227	6	1	RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-F
A1A2A1R28	0698-7272	1	3	RESISTOR 31.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3162-F
A1A2A1R29	0698-8827	4	2	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A1A2A1R30	2100-3353	8	4	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A1A2A1R31	0698-7284	5	4	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A1A2A1R32	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A1A2A1R33	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A1A2A1R34	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A2A1R35	0757-0274	5	4	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A1A2A1R36	0757-0438	3	12	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A2A1R37	0698-7198	0	3	RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-26R1-F
A1A2A1R38	0698-7212	9	16	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A2A1R39	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A2A1R40	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A1A2A1R41	0698-7261	8	2	RESISTOR 11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1102-F
A1A2A1R42	0698-7188	8	16	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A2A1R43	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A2A1R44	0698-7224	3	3	RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A1A2A1R45	0757-0280	3	23	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A2A1R46	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A2A1R47	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A2A1R48	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A2A1R49	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A2A1R50	0698-3459	8	1	RESISTOR 383K 1% .125W F TC=0+-100	28480	0698-3459
A1A2A1R51	0698-7236	7	4	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A1A2A1R52	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A2A1R53	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A1A2A1R54	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A2A1R55	0757-0290	5	2	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A1A2A1R56	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A2A1R57	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A1A2A1R58	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A1A2A1R59	2100-3274	2	5	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A2A1R60	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A1A2A1R61	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A2A1R62	0698-7272	1		RESISTOR 31.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3162-F
A1A2A1R63	0698-7270	9	3	RESISTOR 26.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2612-F
A1A2A1R64	0698-7267	4	1	RESISTOR 19.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1962-F
A1A2A1R65	0698-7265	2	2	RESISTOR 16.2K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1622-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A2A1R66	0698-7282	3	1	RESISTOR 82.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-8252-F
A1A2A1R67	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A2A1R68	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A2A1R69	0698-7280	1		RESISTOR 68.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6812-F
A1A2A1R70	0757-0180	2	3	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A1A2A1R71	0698-7222	1		RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-F
A1A2A1R72	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A2A1R73	0757-0346	2	7	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1A2A1R74	0698-7252	7	3	RESISTOR 4.64K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4641-F
A1A2A1R75	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A1A2A1R76	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A2A1RT1	0837-0232	5	1	THERMISTOR-POS. TEMP. COEEF. 2.00K@25C	28480	0837-0232
A1A2A1TP1	0360-0535	0	32	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A2A1TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A2A1TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A2A1TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A2A1TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A2A1U1	1826-0601	0	2	IC OP AMP PRCN TO-99 PKG	06665	OP-16FJ
A1A2A1U2	1826-0496	9	1	IC MULTIPLXR 4-CHAN-ANLG DUAL 16-DIP-P	04713	MC14052BCP
A1A2A1U3	1826-0488	1	1	IC OP AMP WB TO-99 PKG	27014	LM218H
A1A2A1U4	1826-0601	0		IC OP AMP PRCN TO-99 PKG	06665	OP-16FJ
A1A2A1U5	1826-0720	4	1	IC SWITCH ANLG QUAD 16-DIP-C PKG	06665	SW-02FQ
A1A2A1VR1	1902-0951	5	4	DIODE-ZNR 5.1V 5% DO-35 PD=.4W TC=+.035%	28480	1902-0951
A1A2A2	08673-60031	8	1	DETECTOR BOARD ASSEMBLY	28480	08673-60031
A1A2A2C1	0180-2661	5	3	CAPACITOR-FXD 1UF+-10% 50VDC TA	25088	D1R0GS1A50K
A1A2A2C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A2C3	0180-2731	0	1	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	28480	0180-2731
A1A2A2C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A2C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A2C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A2C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A2A2C8	0180-2661	5		CAPACITOR-FXD 1UF+-10% 50VDC TA	25088	D1R0GS1A50K
A1A2A2C9	0160-2244	8	1	CAPACITOR-FXD 3PF +-.25PF 500VDC CER	28480	0160-2244
A1A2A2C10	0160-0174	9	1	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A1A2A2C11	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A2A2C12	0160-3877	5	4	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A1A2A2C13	0160-2256	2	1	CAPACITOR-FXD 9.1PF +-.25PF 500VDC CER	28480	0160-2256
A1A2A2C14	0160-2250	6	2	CAPACITOR-FXD 5.1PF +-.25PF 500VDC CER	28480	0160-2250
A1A2A2C15	0160-2250	6		CAPACITOR-FXD 5.1PF +-.25PF 500VDC CER	28480	0160-2250
A1A2A2CR1	1901-0539	3	21	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A2A2CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A2A2CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A2A2E1	9170-0962	3	5	CORE-SHIELDING BEAD	28480	9170-0962
A1A2A2E2	9170-0962	3		CORE-SHIELDING BEAD	28480	9170-0962
A1A2A2E3	9170-0962	3		CORE-SHIELDING BEAD	28480	9170-0962
A1A2A2E4	9170-0962	3		CORE-SHIELDING BEAD	28480	9170-0962
A1A2A2E5	9170-0962	3		CORE-SHIELDING BEAD	28480	9170-0962
A1A2A2J1	1250-1220	0	1	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
A1A2A2Q1	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A2A2Q2	1854-0345	8	3	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A1A2A2Q3	1855-0268	6	2	TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	17856	J309
A1A2A2Q4	1855-0268	6		TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	17856	J309
A1A2A2Q5	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A1A2A2Q6	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO 72 PD=200MW	04713	2N5179
A1A2A2Q7	1853-0405	9	9	TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A1A2A2Q8	1853-0075	9	1	TRANSISTOR-DUAL PNP PD=400MW	28480	1853-0075
A1A2A2Q9	1854-0475	5	2	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A1A2A2Q10	1853-0451	5	2	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A1A2A2Q11	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A1A2A2Q12	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A2A2Q13	1854-0295	7	1	TRANSISTOR DUAL NPN PD=400MW	28480	1854-0295

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A2A2R1	0811-3591	1	1	RESISTOR-0.2+-0.5% 1W WW F TC=+-90PPM/C	28480	0811-3591
A1A2A2R2	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A2A2R3	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A2A2R4	0698-7198	0		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-26R1-F
A1A2A2R5	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A2A2R6	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A2A2R7	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A2A2R8	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A2A2R9	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A2A2R10	0757-0419	0	4	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A1A2A2R11	0698-7244	7	7	RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2A2R12	2100-2039	5	2	RESISTOR-TRMR 20K 5% WW SIDE-ADJ 10-TRN	28480	2100-2039
A1A2A2R13	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A2A2R14	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2A2R15	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2A2R16	0698-7202	7	1	RESISTOR 38.3 1% .05W F TC=0+-100	24546	C3-1/8-T0-38R3-F
A1A2A2R17	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2A2R18	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2A2R19	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A2A2R20	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A1A2A2R21	2100-4090	2	2	RESISTOR-TRMR 1K 10% C SIDE-ADJ 25-TRN	28480	2100-4090
A1A2A2R22	0698-7272	1		RESISTOR 31.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3162-F
A1A2A2R23	0698-7229	8	2	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A1A2A2R24	0698-7203	8	1	RESISTOR 42.2 1% .05W F TC=0+-100	24546	C3-1/8-T0-42R2-F
A1A2A2R25	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A1A2A2R26	2100-4089	9	1	RESISTOR-TRMR 10 10% C SIDE-ADJ 25-TRN	28480	2100-4089
A1A2A2R27	0757-0459	8	2	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A1A2A2R28	0811-2031	2	1	RESISTOR 815 3% .25W PWW TC=+5900+-300	20940	143-1/4-815R-3
A1A2A2R29	2100-1922	3	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 22-TRN	32997	3059Y-1-502
A1A2A2R30	0698-7279	8	1	RESISTOR 61.9K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6192-F
A1A2A2R31				NOT ASSIGNED		
A1A2A2R32	0698-6320	8	2	RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A1A2A2R33	0698-7253	8	2	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A1A2A2R34	0698-7216	3	2	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A1A2A2R35	0757-0317	7	7	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1A2A2R36	0698-7249	2	1	RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-F
A1A2A2R37	0698-7253	8		RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A1A2A2R38	0698-7248	1	1	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A1A2A2R39	0699-0140	0	1	RESISTOR 524 .1% .1W F TC=0+-15	28480	0699-0140
A1A2A2R40	2100-4090	2		RESISTOR-TRMR 1K 10% C SIDE-ADJ 25-TRN	28480	2100-4090
A1A2A2R41	0698-8779	5	1	RESISTOR 280 .1% .1W F TC=0+-5	28480	0698-8779
A1A2A2R42	0698-6320	8		RESISTOR 5K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-5001-B
A1A2A2R43	0698-6329	7		RESISTOR 845 1% .125W F TC=0+-25	28480	0698-6329
A1A2A2R44	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A1A2A2RT1	0837-0124	4	1	THERMISTOR DISC 250-OHM TC=-4.4%/C-DEG	28480	0837-0124
A1A2A2TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A2A2TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A2A2U1	1826-0471	2	2	IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
A1A3	08673-60138	6	1	FUNCTION BOARD ASSEMBLY	28480	08673-60138
A1A3C1	0180-0374	3	2	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A1A3C2	0160-0570	9	17	CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A3C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A3C4	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2.
A1A3C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A3C6	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C8	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C9	0160-2207	3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A1A3C10	0140-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A1A3C11	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C12	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C13	0160-2265	3	3	CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2265
A1A3C14	0160-2200	6	1	CAPACITOR-FXD 43PF +-5% 300VDC MICA	28480	0160-2200
A1A3C15	0160-3878	6	6	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A3C16	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C18	0160-0155	6	1	CAPACITOR-FXD 3300PF +-10% 200VDC POLYE	28480	0160-0155
A1A3C19	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C20	0160-5652	8	2	CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-5652
A1A3C21	0160-4031	5	2	CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4031
A1A3C22	0160-5652	8		CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-5652
A1A3C23	0160-3876	4	4	CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A1A3C24	0160-2055	9	10	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A3C25	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C26	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C27	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C28	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C29	0160-2265	3		CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2265
A1A3C30	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C31	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C32	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A1A3C33	0160-4386	3	1	CAPACITOR-FXD 33PF +-5% 200VDC CER 0+-30	28480	0160-4386
A1A3C34	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A3C35	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C36	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3C37	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A3CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR5	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A3CR6	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A3CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3CR13	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A3L1	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A1A3L2	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A1A3L3	9140-0144	0		INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A1A3MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A1A3MP2	4040-0748	3	6	EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A1A3MP3	4040-0751	8	1	EXTR-PC BD ORN POLYC .062-BD-THKNS	28480	4040-0751
A1A3Q1	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A3Q2	1855-0327	8	1	TRANSISTOR J-FET 2N4416 N-CHAN D-MODE	01295	2N4416
A1A3Q3	1854-0830	6	1	TRANSISTOR-DUAL NPN PD=500MW	27014	LM394
A1A3Q4	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A3Q5	1854-0475	5		TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A1A3Q6	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A3Q7	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A3Q8	1855-0414	4	2	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A1A3Q9	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A3Q10	1855-0253	9		TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	28480	1855-0253
A1A3Q11	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A3Q12	1853-0322	9		TRANSISTOR PNP 2N2946A SI TO-46 PD=400MW	01295	2N2946A
A1A3Q13	1853-0316	1		TRANSISTOR-DUAL PNP PD=500MW	28480	1853-0316
A1A3Q14	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A3Q15	1855-0253	9		TRANSISTOR J-FET N-CHAN D-MODE TO-92 SI	28480	1855-0253
A1A3R1	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1A3R2	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A3R3	0698-8812	7	3	RESISTOR 1 1% .125W F TC=0+-100	28480	0698-8812
A1A3R4	0698-3101	7	1	RESISTOR 2.87K 1% .5W F TC=0+-100	28480	0698-3101
A1A3R5	0757-0421	4	2	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A1A3R6	0698-7261	8		RESISTOR 11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1102-F
A1A3R7	0757-0458	7	5	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1A3R8	0757-0442	9	14	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A3R9	0698-5808	5	1	RESISTOR 4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4001-F
A1A3R10	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A3R11	0757-0405	4	3	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A1A3R12	2100-2039	5		RESISTOR-TRMR 20K 5% WW SIDE-ADJ 10-TRN	28480	2100-2039
A1A3R13	0698-3447	4	4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A1A3R14	0698-3160	8	7	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A1A3R15	1810-0205	7	1	NETWORK-RES 8-SIP4.7K OHM X 7	01121	208A472
A1A3R16	0757-0431	6	1	RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A1A3R17	0698-7238	9	2	RESISTOR 1.21K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1211-F
A1A3R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A3R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A3R20	0698-7281	2	1	RESISTOR 75K 2% .05W F TC=0+-100	24546	C3-1/8-T0-7502-G
A1A3R21	0698-7262	9	1	RESISTOR 12.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1212-F
A1A3R22	0698-7254	9	2	RESISTOR 5.62K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5621-F
A1A3R23	0757-0441	8	5	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1A3R24	0698-4014	3	1	RESISTOR 787 1% .125W F TC=0+-100	24546	C4-1/8-T0-787R-F
A1A3R25	0698-3510	2	1	RESISTOR 453 1% .125W F TC=0+-100	24546	C4-1/8-T0-453R-F
A1A3R26	0698-4414	7	1	RESISTOR 158 1% .125W F TC=0+-100	24546	C4-1/8-T0-158R-F
A1A3R27	0698-7240	3	1	RESISTOR 1.47K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1471-F
A1A3R28	0698-3495	2	1	RESISTOR 866 1% .125W F TC=0+-100	24546	C4-1/8-T0-866R-F
A1A3R29	0698-3151	7	3	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A1A3R30	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1A3R31	2100-3351	6	2	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A1A3R32	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1A3R33	0698-7222	1		RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-F
A1A3R34	0698-7222	1		RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-F
A1A3R35	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1A3R36	0698-7244	7		RESISTOR 2.15K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2151-F
A1A3R37	0698-7254	9		RESISTOR 5.62K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5621-F
A1A3R38	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1A3R39	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A3R40	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A3R41	0757-0439	4	2	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A1A3R42	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A3R43	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A1A3R44	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A3R45	0698-3450	9	5	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A1A3R46	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A3R47	0698-3456	5	1	RESISTOR 287K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2873-F
A1A3R48	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A1A3R49	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A3R50	0757-0447	4	3	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A1A3R51	2100-3352	7	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A1A3R52	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1A3R53	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A3R54	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A3R55	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1A3R56	0698-7268	5	1	RESISTOR 21.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2152-F
A1A3R57	0698-3157	3	4	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A1A3R58	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A1A3R59	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A3R60	0698-3158	4	2	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A1A3R61	0698-7270	9		RESISTOR 26.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2612-F
A1A3R62	0698-7270	9		RESISTOR 26.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2612-F
A1A3R63	0698-3458	7	1	RESISTOR 348K 1% .125W F TC=0+-100	28480	0698-3458
A1A3R64	0698-3236	9	2	RESISTOR 15K .25% .125W F TC=0+-50	28480	0698-3236
A1A3R65	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A3R66	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A3R67	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A1A3R68	0698-7933	1	1	RESISTOR 3.83K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-3831-B
A1A3R69	0698-3445	2	1	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A1A3R70	0757-0401	0	13	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A3R71	0698-3236	9		RESISTOR 15K .25% .125W F TC=0+-50	28480	0698-3236
A1A3R72	2100-3109	2	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
A1A3R73	0698-7252	7		RESISTOR 4.64K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4641-F
A1A3R74	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A1A3R75	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A3R76	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A3R77	0698-7255	0	1	RESISTOR 6.19K 1% .05W F TC=0+-100	24546	C3-1/8-T0-6191-F
A1A3R78	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A3R79	0757-0402	1	2	RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A1A3R80	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A1A3R81	0698-8466	7	1	RESISTOR 842 .5% .125W F TC=0+-50	28480	0698-8466
A1A3R82	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1A3R83	2100-3350	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A1A3R84	0757-0465	6	3	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1A3R85	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A3R86	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A3R87	0757-0464	5	2	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A1A3R88	0698-8827	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A1A3R89	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A1A3R90	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A3R91	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A3R92	0698-7206	1	1	RESISTOR 56.2 1% .05W F TC=0+-100	24546	C3-1/8-T0-56R2-F
A1A3R93	0757-0394	0	2	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1A3R94	2100-3732	7	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	28480	2100-3732
A1A3R95	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A3R96	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A3R97	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A1A3RT1	0837-0295	0	1	THERMISTOR TUB WITH AXL LEADS 2.7K-OHM	28480	0837-0295
A1A3RT2				NOT ASSIGNED		
A1A3TP1	1251-0600	0	32	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A3TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A3TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A3TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A3U1	1826-0059	2	5	IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A3U2	1826-0800	9	1	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074ACN
A1A3U3	1826-0520	2	2	IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	01295	TL071BCP
A1A3U4	1826-0501	9	1	IC MULTIPLXR 2-CHAN-ANLG TRIPLE 16-DIP-P	04713	MC14053BCP
A1A3U5	1826-0413	2	4	IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	34371	HA2-2605-5
A1A3U6	1826-0413	2		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	34371	HA2-2605-5
A1A3U7	1820-0125	1	1	IC COMPARATOR GP DUAL TO-100 PKG	07263	711HC
A1A3U8	1826-0582	6	8	IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13201D
A1A3U9	1826-0413	2		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	34371	HA2-2605-5
A1A3U10	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
A1A3U11	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
A1A3U12	1826-0520	2		IC OP AMP LOW-BIAS-H-IMPD 8-DIP-P PKG	01295	TL071BCP
A1A3U13	1826-0413	2		IC OP AMP LOW-BIAS-H-IMPD TO-99 PKG	34371	HA2-2605-5
A1A3U14	1826-0471	2		IC OP AMP LOW-DRIFT TO-99 PKG	28480	1826-0471
A1A3U15	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A3VR1	1902-0951	5		DIODE-ZNR 5.1V 5% DO-35 PD=.4W TC=+.035%	28480	1902-0951
A1A3VR2	1902-0962	8	2	DIODE-ZNR 15V 5% DO-35 PD=.4W TC=+.087%	28480	1902-0962
A1A3VR3	1902-0961	7	1	DIODE-ZNR 13V 5% DO-35 PD=.4W TC=+.082%	28480	1902-0961
A1A3VR4	1902-0948	0	4	DIODE-ZNR 3.9V 5% DO-35 PD=.4W TC=-.012%	28480	1902-0948
A1A3VR5	1902-0948	0		DIODE-ZNR 3.9V 5% DO-35 PD=.4W TC=-.012%	28480	1902-0948
A1A3VR6	1902-0948	0		DIODE-ZNR 3.9V 5% DO-35 PD=.4W TC=-.012%	28480	1902-0948
A1A3VR7	1902-0951	5		DIODE-ZNR 5.1V 5% DO-35 PD=.4W TC=+.035%	28480	1902-0951
A1A3VR8	1902-0954	8	1	DIODE-ZNR 6.8V 5% DO-35 PD=.4W TC=+.057%	28480	1902-0954
A1A3VR9	1902-0950	4	1	DIODE-ZNR 4.7V 5% DO-35 PD=.4W TC=+.025%	28480	1902-0950
A1A4	08673-60137	5	1	BD AY PULSE DRVR	28480	08673-60137
A1A4C1	0180-0116	1	4	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A1A4C2	0180-1746	5	5	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1A4C3	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A1A4C4	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C5	0180-0229	7	2	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A4C6	0160-5910	1	5	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-5910
A1A4C7	0170-0040	9	1	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A1A4C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A4C9	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C10	0160-5910	1		CAPACITOR FXD .47UF +80-20% 25VDC CER	28480	0160-5910

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A4C11	0160-5910	1		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-5910
A1A4C12	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C15	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C16	0160-5910	1		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-5910
A1A4C17	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C18	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C19	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C20	0160-5910	1		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-5910
A1A4C21	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C22	0160-4031	5		CAPACITOR-FXD 330PF +-5% 100VDC CER	28480	0160-4031
A1A4C23	0160-4350	1	2	CAPACITOR-FXD 68PF +-5% 200VDC CER 0+-30	28480	0160-4350
A1A4C24	0160-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A1A4C25	0160-4387	4	3	CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A1A4C26	0160-4389	6	2	CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A1A4C27	0160-4350	1		CAPACITOR-FXD 68PF +-5% 200VDC CER 0+-30	28480	0160-4350
A1A4C28	0160-4520	7	1	CAPACITOR-FXD 11PF +-5% 200VDC CER 0+-30	28480	0160-4520
A1A4C29	0160-2257	3	3	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A1A4C30	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A1A4C31	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A1A4C32	0160-2266	4	2	CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A1A4C33	0160-3874	2	1	CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A1A4C34	0160-2257	3		CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A1A4C35	0160-2266	4		CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A1A4C36	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A1A4C37	0160-2259	5	1	CAPACITOR-FXD 12PF +-5% 500VDC CER 0+-30	28480	0160-2259
A1A4C38	0160-2199	2	1	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A1A4C39	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C40	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A4C41	0160-2257	3		CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A1A4C42	0160-4103	2	2	CAPACITOR-FXD 220PF +-5% 100VDC CER	72982	8121-M100-COG-221J
A1A4C43	0160-3875	3	4	CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A1A4C44	0160-2220	0	1	CAPACITOR-FXD 1200PF +-5% 300VDC MICA	28480	0160-2220
A1A4C45	0160-4829	9	1	CAPACITOR-FXD 680PF +-10% 100VDC CER	28480	0160-4829
A1A4C46	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A1A4C47	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A1A4C48	0160-2265	3		CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2265
A1A4C49	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A1A4CR1	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR2	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR3	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR4	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR5	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR6	1901-0179	7	1	DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A1A4CR7	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR8	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR9	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR10	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR11	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR12	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR13	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR14	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR15	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR16	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR17	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR18	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4CR19	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A1A4D1*	08673-80021	8	1	DELAY LINE 5NS	28480	08673-80021
A1A4D1*	08673-80023	0	1	DELAY LINE 5NS	28480	08673-80023
A1A4D2*	08673-80022	9	1	DELAY LINE 10NS	28480	08673-80022
A1A4D2*	08673-80024	1	1	DELAY LINE 10NS	28480	08673-80024
A1A4J1	1250-1377	8	2	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1377
A1A4J2	1250-0836	2	1	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0836
A1A4J3	1250-1377	8		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1377

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A4L1	9100-1618	1	2	INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A1A4L2	9100-1618	1		INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A1A4L3	9140-0142	8	1	INDUCTOR RF-CH-MLD 2.2UH 10% .105DX.26LG	28480	9140-0142
A1A4L4	9100-2261	2	1	INDUCTOR RF-CH-MLD 2.7UH 10% .105DX.26LG	28480	9100-2261
A1A4L5	9140-0158	6	1	INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A1A4MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A1A4MP2	4040-0748	3		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A1A4MP3	4040-0752	9	1	EXTR-PC BD YEL POLYC .062-BD-THKNS	28480	4040-0752
A1A4MP4	0340-1098	0	1	INSULATOR-IC B-NITRIDE	28480	0340-1098
A1A4Q1	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A1A4Q2	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A1A4Q3	1854-0809	9	8	TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A1A4Q4	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A1A4Q5	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A1A4Q6	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A1A4Q7	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A1A4Q8	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A1A4Q9	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A1A4Q10	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A1A4Q11	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A1A4Q12	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A1A4Q13	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A1A4Q14	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A4Q15	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
A1A4R1	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A1A4R2	0698-8812	7		RESISTOR 1 1% .125W F TC=0+-100	28480	0698-8812
A1A4R3	0698-8812	7		RESISTOR 1 1% .125W F TC=0+-100	28480	0698-8812
A1A4R4	0698-3429	2	1	RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A1A4R5	0757-1000	7	1	RESISTOR 51.1 1% .5W F TC=0+-100	28480	0757-1000
A1A4R6	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A4R7	1810-0204	6	1	NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A1A4R8	0757-0416	7	15	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R9	2100-3759	8	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	28480	2100-3759
A1A4R10	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R12	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A1A4R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R14	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R15	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A4R16	0698-3132	4	2	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1A4R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R18	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A1A4R19	2100-2413	9	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	30983	ET50X201
A1A4R20	0698-3444	1	2	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1A4R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R23	0757-0420	3	1	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1A4R24	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A1A4R25	2100-2574	3	4	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
A1A4R26	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A1A4R27	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R28	0698-3438	3	3	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A1A4R29	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R30	0698-3437	2	1	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A1A4R31	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A4R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A4R33	0757-0294	9	1	RESISTOR 17.8 1% .125W F TC=0+-100	19701	MF4C1/8-T0-17R8-F
A1A4R34	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R35	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R36	0757-1094	9	3	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A1A4R37	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A1A4R38	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R39	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R40	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A4R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R42	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A4R43	2100-3749	6	2	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	28480	2100-3749
A1A4R44	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R45	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R46	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R47	0764-0013	5	1	RESISTOR 56 5% 2W MO TC=0+-200	28480	0764-0013
A1A4R48	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A4R49	0698-3623	8	1	RESISTOR 130 5% 2W MO TC=0+-200	28480	0698-3623
A1A4R50	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R51	0698-8817	2	2	RESISTOR 2.61 1% .125W F TC=0+-100	28480	0698-8817
A1A4R52	2100-3749	6		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	28480	2100-3749
A1A4R53	0698-7242	5	1	RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-F
A1A4R54	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R55	0698-3440	7	1	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A1A4R56	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R57	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R58	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A4R59	0698-0082	7	1	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1A4R60	0698-3152	8	3	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A1A4R61	0698-0085	0	4	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1A4R62	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1A4R63	0698-3441	8	2	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1A4R64	0757-0428	1	2	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A1A4R65	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A1A4R66	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1A4TP1	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP2	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP3	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP4	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP5	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP6	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP7	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP8	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP9	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP10	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP11	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP12	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP13	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP14	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP15	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4TP16	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A4U1	1820-0694	9	1	IC GATE TTL S EXCL-OR QUAD 2-INP	01295	SN74S86N
A1A4U2	1820-0684	7	1	IC INV TTL S HEX 1-INP	01295	SN74S05N
A1A4U3	1820-1367	5	1	IC GATE TTL S AND QUAD 2-INP	01295	SN74S08N
A1A4U4	1820-0682	5	1	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S03N
A1A4U5	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A1A4U6	1820-0681	4	1	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
A1A4U7	1820-1797	5	1	IC DRVR TTL 2-INP	27014	DH0035CG
A1A4U8	1820-0683	6	1	IC INV TTL S HEX 1-INP	01295	SN74S04N
A1A4U9	1820-1729	3	1	IC LCH TTL LS COM CLEAR 8-BIT	01295	SN74LS259N
A1A4U10	1820-1423	4	1	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A1A4VR1	1902-0533	9	1	DIODE-ZNR 4.99V 2% DO-15 PD=1W TC=-.012%	28480	1902-0533
A1A4VR2	1902-0952	6	1	DIODE-ZNR 5.6V 5% DO-35 PD=.4W TC=+.046%	28480	1902-0952
A1A4VR3	1902-0551	1	1	DIODE-ZNR 6.2V 5% PD=1W IR=10UA	28480	1902-0551
A1A4VR4	1902-0948	0		DIODE-ZNR 3.9V 5% DO-35 PD=.4W TC=-.012%	28480	1902-0948
A1A5	08673-60028	3	1	DAC ENABLE BOARD ASSEMBLY	28480	08673-60028
A1A5C1	0160-4527	4	1	CAPACITOR-FXD 56PF +-5% 200VDC CER 0+-30	28480	0160-4527
A1A5C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A5C3	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A5C4	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A1A5C5	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A5C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A1A5C7	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A5C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A5C9	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A5C10	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A5C11	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A5C12	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A5C13	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A5C14	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A5C15	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A5C16				NOT ASSIGNED		
A1A5C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A1A5C18	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A1A5C19	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A1A5C20	0160-3872	0	1	CAPACITOR-FXD 2.2PF +-.25PF 200VDC CER	28480	0160-3872
A1A5C21	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A5C22	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A5C23	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A5C24	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A5C25	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A5C26	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A1A5CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A5CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A5CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A5MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A1A5MP2	4040-0748	3		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A1A5MP3	4040-0753	0	1	EXTR-PC BD GRN POLYC .062-BD-THKNS	28480	4040-0753
A1A5Q1	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A5Q2	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A5Q3	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A5Q4	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A5Q5	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A5Q6	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A5Q7	1855-0414	4		TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
A1A5Q8	1855-0420	2	2	TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A1A5Q9	1855-0420	2		TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
A1A5Q10	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A1A5Q11	1854-0637	1	2	TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A1A5Q12	1853-0314	9	3	TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A1A5Q13	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A5Q14	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A5R1	0698-3403	2	2	RESISTOR 348 1% .5W F TC=0+-100	28480	0698-3403
A1A5R2	0757-0444	1	4	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A1A5R3	0698-3403	2		RESISTOR 348 1% .5W F TC=0+-100	28480	0698-3403
A1A5R4	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1A5R5	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A5R6	0698-3153	9	3	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1A5R7	0757-0797	7	2	RESISTOR 90.9 1% .5W F TC=0+-100	28480	0757-0797
A1A5R8	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A1A5R9	2100-3103	6	12	RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A5R10	0698-0084	9	2	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A1A5R11	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A1A5R12	0811-3202	1	4	RESISTOR 30.615K .1% .05W PWW TC=0+-10	14140	1409-1/40-30615R-B
A1A5R13	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A5R14	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A5R15	0811-3377	1	1	RESISTOR 5.62K .1% .125W PWW TC=0+-10	28480	0811-3377
A1A5R16	0698-3156	2	7	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A1A5R17	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A1A5R18	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A5R19	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A5R20	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A5R21	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A5R22	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A5R23	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A5R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A5R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4 1/8-T0-1002-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A5R26	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A5R27	0698-3154	0	2	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1A5R28	0698-7284	5		RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-F
A1A5R29	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1A5R30	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A5R31	0811-3374	8	2	RESISTOR 23.7K .1% .05W PWW TC=0+-10	28480	0811-3374
A1A5R32	0811-3374	8		RESISTOR 23.7K .1% .05W PWW TC=0+-10	28480	0811-3374
A1A5R33	0698-7263	0	2	RESISTOR 13.3K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1332-F
A1A5R34	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A5R35	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1A5R36	0811-3202	1		RESISTOR 30.615K .1% .05W PWW TC=0+-10	14140	1409-1/40-30615R-B
A1A5R37	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A1A5R38	0698-3136	8	4	RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A1A5R39	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A1A5R40	0757-0459	8		RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A1A5R41	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1A5R42	0698-7198	0		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-26R1-F
A1A5R43	0698-7194	6	1	RESISTOR 17.8 1% .05W F TC=0+-100	24546	C3-1/8-T0-17R8-F
A1A5R44	0757-0199	3	2	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A1A5R45	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A1A5R46	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A5R47	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A5R48	0698-8061	8	1	RESISTOR 8.25K .1% .125W F TC=0+-25	19701	MF4C1/8-T9-8251-B
A1A5R49	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A1A5R50	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A1A5R51	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1A5R52	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1A5R53	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A1A5R54	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1A5R55	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A5R56	0757-0468	7	1	RESISTOR 110K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1103-F
A1A5R57	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1A5R58	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A5R59	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A1A5R60	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A5R61	0757-0395	1	1	RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-56R2-F
A1A5R62	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1A5R63	0698-3161	9	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A1A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A5U1	1826-0972	8	1	IC-DAC 10-BIT	28480	1826-0972
A1A5U2	1826-0798	6	2	IC CONV 8-B-D/A	18324	NE5018F
A1A5U3	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
A1A5U4	1826-0798	6		IC CONV 8-B-D/A	18324	NE5018F
A1A5U5	1826-0025	2	2	IC OP AMP LOW-DRIFT TO-99 PKG	27014	LM208AH
A1A5U6	1826-0217	4	4	IC OP AMP GP DUAL TO-99 PKG	07933	RC4558T
A1A5U7	1826-0026	3	1	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A1A5U8	1820-0495	8	1	IC DCDR TTL 4-TO-16-LINE 4-INP	01295	SN74154N
A1A5U9	1820-1917	1	1	IC BFR TTL LS LINE DRVR OCTL	01295	SN74LS240N
A1A5U10	1826-0191	3	1	IC COMPARATOR GP DUAL TO-100 PKG	27014	LM319H
A1A5U11	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A5U12	1820-1208	3	1	IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A1A6	08673-60029	4	1	METER BOARD ASSEMBLY	28480	08673-60029
A1A6C1	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6C2	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1A6C3	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6C4	0180-2207	5	5	CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A1A6C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A6C6	0180-2207	5		CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A1A6C7	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C9	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6C10	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A1A6C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C12	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A1A6C13	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C14	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6C15	0180-2619	3	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	25088	D22GS1B15K
A1A6C16	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A1A6C17	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1A6C18	0160-2252	8	1	CAPACITOR-FXD 6.2PF +-.25PF 500VDC CER	28480	0160-2252
A1A6C19	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C20	0160-3875	3		CAPACITOR-FXD 22PF +-5% 200VDC CER 0+-30	28480	0160-3875
A1A6C21	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C22	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1A6C23	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C24	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C25	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A6C26	0180-2206	4	2	CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A1A6C27	0180-2206	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9006B2
A1A6C28	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1A6C29	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6C30	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C31	0180-2207	5		CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A1A6C32	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A6C33	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A6CR1	1901-0535	9	6	DIODE-SM SIG SCHOTTKY	28480	1901-0535
A1A6CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR3	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A1A6CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A6CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A6CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR13	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A1A6CR14	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A1A6CR15	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A1A6CR16	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A1A6CR17	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A6CR18	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A6MP1	1200-0173	5	1	INSULATOR-XSTR DAP-GL	28480	1200-0173
A1A6MP2	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A1A6MP3	4040-0748	3		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A1A6MP4	4040-0754	1	1	EXTR-PC BD BLU POLYC .062-BD-THKNS	28480	4040-0754
A1A6Q1	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6Q2	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6Q3	1854-0610	0	5	TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A1A6Q4	1854-0610	0		TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A1A6Q5	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6Q6	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6Q7	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A1A6Q8	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6Q9	1854-0809	9		TRANSISTOR NPN 2N2369A SI TO-18 PD=360MW	28480	1854-0809
A1A6Q10	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6Q11	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6Q12	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6Q13	1854-0610	0		TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A1A6Q14	1854-0597	2	1	TRANSISTOR NPN 2N5943 SI TO-39 PD=1W	04713	2N5943
A1A6Q15	1854-0610	0		TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A6Q16	1854-0610	0		TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A1A6Q17	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A6Q18	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1A6Q19	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A6Q20	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6Q21	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A6R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A6R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A6R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A6R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A6R5	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A1A6R6	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A6R7	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A6R8	0757-0397	3	1	RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A1A6R9	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A1A6R10	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A6R11	0698-7205	0	4	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A1A6R12	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A6R13	0757-0389	3	1	RESISTOR 33.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-33R2-F
A1A6R14	0698-8651	2	1	RESISTOR 16.7 1% .05W F TC=0+-100	28480	0698-8651
A1A6R15	0698-5068	9	1	RESISTOR 50 1% .125W F TC=0+-25	28480	0698-5068
A1A6R16	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A6R17	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A1A6R18	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A6R19	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A6R20	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A6R21	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A6R22	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A6R23	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A1A6R24	0757-0418	9	3	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A1A6R25	0757-0797	7		RESISTOR 90.9 1% .5W F TC=0+-100	28480	0757-0797
A1A6R26	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1A6R27	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A1A6R28	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A6R29	0698-7209	4	1	RESISTOR 75 1% .05W F TC=0+-100	24546	C3-1/8-T0-75R0-F
A1A6R30	0757-0403	2	1	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A1A6R31	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A1A6R32	0698-7233	4	3	RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-F
A1A6R33	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A1A6R34	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A1A6R35	2100-2574	3		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
A1A6R36	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A6R37	0698-7241	4	1	RESISTOR 1.62K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1621-F
A1A6R38	0698-7238	9		RESISTOR 1.21K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1211-F
A1A6R39	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A1A6R40	0698-8816	1	1	RESISTOR 2.15 1% .125W F TC=0+-100	28480	0698-8816
A1A6R41	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A6R42	0698-7230	1	1	RESISTOR 562 1% .05W F TC=0+-100	24546	C3-1/8-T0-562R-F
A1A6R43	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A1A6R44	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A1A6R45	0698-8817	2		RESISTOR 2.61 1% .125W F TC=0+-100	28480	0698-8817
A1A6R46	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A1A6R47	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A1A6R48	0757-0378	0	1	RESISTOR 11 1% .125W F TC=0+-100	19701	MF4C1/8-T0-11R0-F
A1A6R49	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A6R50	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A6R51	0698-7251	6	1	RESISTOR 4.22K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4221-F
A1A6R52	0698-7263	0		RESISTOR 13.3K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1332-F
A1A6R53	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A1A6R54	2100-2632	4	1	RESISTOR-TRMR 100 10% C SIDE-ADJ 1-TRN	30983	ET50X101
A1A6R55	0698-7220	9	1	RESISTOR 215 1% .05W F TC=0+-100	24546	C3-1/8-T0-215R-F
A1A6R56	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A1A6R57	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A1A6R58	0698-7265	2		RESISTOR 16.2K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1622-F
A1A6R59	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A6R60	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A6R61	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A1A6R62	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A1A6R63	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1A6R64	0683-1055	5	1	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A1A6R65	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A6R66	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A6R67	0698-7288	9	1	RESISTOR 147K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1473-F
A1A6R68	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A6R69	0698-7233	4		RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-F
A1A6R70	2100-2574	3		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
A1A6R71	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A1A6R72	0757-0482	3	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A1A6R73	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A6R74	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A1A6R75	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A6R76	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A1A6R77	0698-7232	3	1	RESISTOR 681 1% .05W F TC=0+-100	24546	C3-1/8-T0-681R-F
A1A6R78	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A1A6R79	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A6R80	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A1A6R81	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A1A6R82	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A6R83	0698-7233	4		RESISTOR 750 1% .05W F TC=0+-100	24546	C3-1/8-T0-750R-F
A1A6R84	2100-2574	3		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
A1A6TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A6U1	1820-0919	1	1	IC COMPTR ECL A/D DUAL	04713	MC1650L
A1A6U2	1826-0256	1	1	IC COMPARATOR HS DUAL 14-DIP-P PKG	18324	NE522A
A1A6U3	1820-1374	4	2	IC SWITCH ANLG QUAD 16-DIP-P PKG	24355	AD7510DIJN
A1A6U4	1826-0582	6		IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13201D
A1A6U5	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
A1A6U6	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
A1A6U7	1820-1374	4		IC SWITCH ANLG QUAD 16-DIP-P PKG	24355	AD7510DIJN
A1A6VR1	1902-0962	8		DIODE-ZNR 15V 5% DO-35 PD=.4W TC=+.087%	28480	1902-0962
A1A6VR2	1902-0951	5		DIODE-ZNR 5.1V 5% DO-35 PD=.4W TC=+.035%	28480	1902-0951
A1A6VR3	1902-0957	1	1	DIODE-ZNR 9.1V 5% DO-35 PD=.4W TC=+.069%	28480	1902-0957
A1A7	08673-60032	9	1	YTM DRIVER BOARD ASSEMBLY	28480	08673-60032
A1A7C1	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A7C2	0180-2141	6	4	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1A7C3	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A7C4	0180-2141	6		CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1A7C5	0160-4103	2		CAPACITOR-FXD 220PF +-5% 100VDC CER	72982	8121-M100-COG-221J
A1A7C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A7C7	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A1A7C8	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A7C9	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A7C10	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A1A7C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A7C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A7C13	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A1A7C14	0160-3491	9	1	CAPACITOR-FXD .47UF +-20% 50VDC CER	28480	0160-3491
A1A7C15	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A7C16	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A1A7C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A7C18	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A1A7C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A7C20	0160-4387	4		CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A7C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A7C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A7CR1	1901-0376	6	7	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1A7CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A7CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A7CR4	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1A7CR5	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1A7CR6	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1A7CR7	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1A7CR8	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1A7CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A7MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A1A7MP2	4040-0748	3		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A1A7MP3	4040-0755	2	1	EXTR-PC BD VIO POLYC .062-BD-THKNS	28480	4040-0755
A1A7Q1	1853-0462	8	1	TRANSISTOR PNP 2N3635 SI TO-39 PD=1W	01295	2N3635
A1A7Q2	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A1A7Q3	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A7Q4	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A7Q5	1855-0020	8	3	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A1A7Q6	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A1A7Q7	1855-0020	8		TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A1A7Q8	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A7Q9	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A1A7Q10	1854-0712	3	1	TRANSISTOR-DUAL NPN PD=1.8W	28480	1854-0712
A1A7Q11	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A7Q12	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A7R1	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1A7R2	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A1A7R3	0698-3334	8	1	RESISTOR 178 1% .5W F TC=0+-100	28480	0698-3334
A1A7R4	0757-0814	9	1	RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A1A7R5	0811-2870	7	2	RESISTOR 1.96K 1% .05W PWW TC=0+-10	14140	1409-1/20-D-1961-F
A1A7R6	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A1A7R7	0811-3372	6	1	RESISTOR 1.71K 1% .05W PWW TC=0+-10	28480	0811-3372
A1A7R8	2100-3351	6		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A1A7R9	0811-3598	8	1	RESISTOR-18.5K 1% .125W TC=0+-2PPM/C	28480	0811-3598
A1A7R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A7R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A7R12	0757-0464	5		RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A1A7R13	0698-3439	4	1	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A1A7R14	2100-3152	5	1	RESISTOR-TRMR 5K 10% MF SIDE-ADJ 25-TRN	28480	2100-3152
A1A7R15	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A7R16	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1A7R17	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A7R18	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A7R19	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A7R20	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A7R21	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A7R22	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A7R23	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A7R24	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A1A7R25	0811-3373	7	3	RESISTOR 17.8K .1% .05W PWW TC=0+-10	28480	0811-3373
A1A7R26	0811-3373	7		RESISTOR 17.8K .1% .05W PWW TC=0+-10	28480	0811-3373
A1A7R27	0811-3373	7		RESISTOR 17.8K .1% .05W PWW TC=0+-10	28480	0811-3373
A1A7R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A7R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A7R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A7R31	0811-3369	1	2	RESISTOR 12K .1% .125W PWW TC=0+-10	28480	0811-3369
A1A7R32	0811-3359	9	4	RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A1A7R33	0811-3369	1		RESISTOR 12K .1% .125W PWW TC=0+-10	28480	0811-3369
A1A7R34	0757-0417	8	1	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A1A7R35	0811-3366	8	4	RESISTOR 5K .1% .05W PWW TC=0+-2	28480	0811-3366
A1A7R36	0811-3366	8		RESISTOR 5K .1% .05W PWW TC=0+-2	28480	0811-3366
A1A7R37	0811-3366	8		RESISTOR 5K .1% .05W PWW TC=0+-2	28480	0811-3366
A1A7R38	0811-3366	8		RESISTOR 5K .1% .05W PWW TC=0+-2	28480	0811-3366
A1A7R39	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1A7R40	0698-3162	0	1	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A7R41	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A1A7R42	0811-3368	0	1	RESISTOR 100K 1% .05W PWW TC=0+-10	28480	0811-3368
A1A7R43	0811-0648	3	2	RESISTOR 50K .01% .125W PWW TC=0+-10	28480	0811-0648
A1A7R44	0811-0648	3		RESISTOR 50K .01% .125W PWW TC=0+-10	28480	0811-0648
A1A7R45	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A7R46	0811-2870	7		RESISTOR 1.96K 1% .05W PWW TC=0+-10	14140	1409-1/20-D-1961-F
A1A7R47	0698-5446	7	1	RESISTOR 31.6K .25% .125W F TC=0+-50	28480	0698-5446
A1A7R48	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A7R49	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A1A7R50	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A7R51	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A7R52	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A7R53	0811-2675	0	2	RESISTOR 1K .02% .2W PWW TC=0+-10	14140	1283-1/20-D-1001-Q
A1A7R54	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A7R55	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1A7R56	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A1A7R57	0811-3202	1		RESISTOR 30.615K .1% .05W PWW TC=0+-10	14140	1409-1/40-30615R-B
A1A7R58	0811-3370	4	2	RESISTOR 20K 1% .05W PWW TC=0+-10	28480	0811-3370
A1A7R59	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A1A7R60	0811-3370	4		RESISTOR 20K 1% .05W PWW TC=0+-10	28480	0811-3370
A1A7R61	0811-3135	9	3	RESISTOR 10K .1% .125W PWW TC=0+-10	28480	0811-3135
A1A7R62	0811-3135	9		RESISTOR 10K .1% .125W PWW TC=0+-10	28480	0811-3135
A1A7R63	0811-3396	4	1	RESISTOR 11K 1% .05W PWW TC=0+-2	28480	0811-3396
A1A7R64	0811-3135	9		RESISTOR 10K .1% .125W PWW TC=0+-10	28480	0811-3135
A1A7R65	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A7R66	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A7R67	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A7R68	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A7R69	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A7R70	0811-2675	0		RESISTOR 1K .02% .2W PWW TC=0+-10	14140	1283-1/20-D-1001-Q
A1A7TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A7TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A7TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A7TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A7TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A7TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A7U1	1820-0223	0	7	IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A7U2	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A7U3	1826-0229	8	1	IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-05CJ
A1A7U4	1826-0582	6		IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13201D
A1A7U5	1826-0582	6		IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13201D
A1A7U6	1826-0582	6		IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13201D
A1A7U7	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A7U8	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A7U9	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A7U10	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A7U11	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A1A7VR1	1902-0958	2	1	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.075%	28480	1902-0958
A1A7VR2	1902-0680	7	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	24046	1N827
A1A7VR3	1902-0956	0	1	DIODE-ZNR 8.2V 5% DO-35 PD=.4W TC=+.065%	28480	1902-0956
A1A7VR4	1902-0965	1	1	DIODE-ZNR 20V 5% DO-35 PD=.4W TC=+.092%	28480	1902-0965
A1A8	08673-60033	0	1	SRD BIAS BOARD	28480	08673-60033
A1A8C1	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A8C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A8C3	0180-2141	6		CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1A8C4	0180-2141	6		CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1A8C5	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A8C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A8C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A8C8	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A8C9	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A1A8C10	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A8C11	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A1A8C12	0180-2661	5		CAPACITOR-FXD 1UF+-10% 50VDC TA	25088	D1R0GS1A50K
A1A8C13	0160-0571	0	5	CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A1A8C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A1A8C15	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A1A8C16	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A1A8C17	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A1A8C18	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A1A8C19	0160-0571	0		CAPACITOR-FXD 470PF +-20% 100VDC CER	28480	0160-0571
A1A8C20	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A1A8CR1	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A1A8L1	9140-0210	1	1	INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A1A8MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A1A8MP2	4040-0747	2	1	EXTR-PC BD GRA POLYC .062-BD-THKNS	28480	4040-0747
A1A8MP3	4040-0748	3		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A1A8Q1	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q2	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q3	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q4	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q5	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q6	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q7	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A1A8Q8	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q9	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q10	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q11	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A1A8Q12	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A8Q13	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A8Q14	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A1A8R1	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1A8R2	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A8R3	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A1A8R4	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1A8R5	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1A8R6	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1A8R7	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A8R8	0698-6360	6	3	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1A8R9	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A8R10	2100-3056	8	7	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A1A8R11	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A1A8R12	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A1A8R13	2100-3054	6	3	RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A1A8R14	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A1A8R15	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A1A8R16	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A8R17	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A8R18	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A8R19	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A1A8R20	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A1A8R21	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A1A8R22	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A8R23	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A8R24	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A8R25	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A8R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A8R27	0811-3202	1		RESISTOR 30.615K .1% .05W PWW TC=0+-10	14140	1409-1/40-30615R-B
A1A8R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A8R29	0811-3138	2	3	RESISTOR 25K .1% .125W PWW TC=0+-10	20940	114-1/16-2502-B
A1A8R30	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1A8R31	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A8R32	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A1A8R33	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A1A8R34	0811-3360	2	5	RESISTOR 25K .1% .05W PWW TC=0+-5	28480	0811-3360
A1A8R35	0811-3360	2		RESISTOR 25K .1% .05W PWW TC=0+-5	28480	0811-3360

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A8R36	0811-3138	2		RESISTOR 25K .1% .125W PWW TC=0+-10	20940	114-1/16-2502-B
A1A8R37	0811-3138	2		RESISTOR 25K .1% .125W PWW TC=0+-10	20940	114-1/16-2502-B
A1A8R38	0698-3150	6	2	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A1A8R39	0811-3360	2		RESISTOR 25K .1% .05W PWW TC=0+-5	28480	0811-3360
A1A8R40	0811-3360	2		RESISTOR 25K .1% .05W PWW TC=0+-5	28480	0811-3360
A1A8R41	0811-3360	2		RESISTOR 25K .1% .05W PWW TC=0+-5	28480	0811-3360
A1A8R42	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1A8R43	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A1A8R44	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A1A8R45	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A1A8R46	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A1A8R47	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A1A8R48	0698-3442	9	1	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A8R49	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A8R50	2100-3161	6	2	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	02111	43P203
A1A8R51	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A1A8R52	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A1A8R53	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A1A8R54	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1A8R55	2100-3094	4	2	RESISTOR-TRMR 100K 10% C SIDE-ADJ 17-TRN	02111	43P104
A1A8R56	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A1A8R57	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A1A8R58	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A1A8R59	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A1A8R60	0698-6358	2	1	RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A1A8R61	2100-3103	6		RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TRN	02111	43P103
A1A8R62	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A1A8R63	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A1A8R64	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A1A8R65	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A1A8R66	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1A8R67	2100-3161	6		RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	02111	43P203
A1A8R68	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A1A8R69	0811-3234	9	3	RESISTOR 10K 1% .05W PWW TC=0+-10	20940	140-1/20-1002-F
A1A8R70	0811-3234	9		RESISTOR 10K 1% .05W PWW TC=0+-10	20940	140-1/20-1002-F
A1A8R71	0811-3234	9		RESISTOR 10K 1% .05W PWW TC=0+-10	20940	140-1/20-1002-F
A1A8R72	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A1A8R73	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A1A8R74	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A1A8R75	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1A8R76	0698-8642	1	1	RESISTOR 56.2K .1% .125W F TC=0+-25	28480	0698-8642
A1A8R77	0698-6866	7	1	RESISTOR 2.182K .25% .125W F TC=0+-50	28480	0698-6866
A1A8R78	0699-0272	9	2	RESISTOR 75K .1% .125W F TC=0+-25	28480	0699-0272
A1A8R79	0698-6838	3	2	RESISTOR 3.88K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3881-D
A1A8R80	0699-0272	9		RESISTOR 75K .1% .125W F TC=0+-25	28480	0699-0272
A1A8R81	0698-6838	3		RESISTOR 3.88K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3881-D
A1A8R82	2100-3094	4		RESISTOR-TRMR 100K 10% C SIDE-ADJ 17-TRN	02111	43P104
A1A8R83	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A1A8R84	2100-3154	7	4	RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A1A8R85	2100-3154	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A1A8R86	2100-3154	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A1A8R87	2100-3154	7		RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A1A8R88	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1A8R89	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A1A8R90	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1A8R91	0698-6360	6		RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A1A8R92	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A1A8R93	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A1A8R94	0698-3260	9	1	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1A8R95	0699-0096	5		RESISTOR 12K .1% .1W F TC=0+-10	28480	0699-0096
A1A8R96	0698-8638	5	4	RESISTOR 3.16K .1% .125W F TC=0+-25	28480	0698-8638
A1A8R97	0698-8638	5		RESISTOR 3.16K .1% .125W F TC=0+-25	28480	0698-8638
A1A8R98	0698-8638	5		RESISTOR 3.16K .1% .125W F TC=0+-25	28480	0698-8638
A1A8R99	0698-8638	5		RESISTOR 3.16K .1% .125W F TC=0+-25	28480	0698-8638
A1A8R100	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A8R101	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A1A8R102	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A1A8R103	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A8R104	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A8R105	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A8TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A8TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A8TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A8TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1A8U1	1826-0217	4		IC OP AMP GP DUAL TO-99 PKG	07933	RC4558T
A1A8U2	1826-0582	6		IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13201D
A1A8U3	1826-0323	3	1	IC OP AMP GP QUAD 14-DIP-C PKG	28480	1826-0323
A1A8U4	1826-0582	6		IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13201D
A1A8U5	1820-1445	0		IC LCH TTL LS 4-BIT	01295	SN74LS375N
A1A8U6	1826-0582	6		IC SWITCH ANLG QUAD 16-DIP-C PKG	27014	LF13201D
A1A8U7	1826-0217	4		IC OP AMP GP DUAL TO-99 PKG	07933	RC4558T
A1A8U8	1826-0217	4		IC OP AMP GP DUAL TO-99 PKG	07933	RC4558T
A1A8U9	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A8VR1	1902-0554	4	2	DIODE-ZNR 10V 5% PD=1W IR=10UA	28480	1902-0554
A1A8VR2	1902-0579	3	1	DIODE-ZNR 5.1V 5% PD=1W IR=10UA	28480	1902-0579
A1A8VR3	1902-0554	4		DIODE-ZNR 10V 5% PD=1W IR=10UA	28480	1902-0554
A1A9	08673-67012	9	1	PREAMP ASSEMBLY	28480	08673-67012
	08673-67206	3	1	RESTORED 08673-67001	28480	08673-67206
A1A10	08673-67013	0	1	YTM ASSEMBLY(NON-FIELD REPAIRABLE PART)	28480	08673-67013
A1A10A1	08673-60027	2	1	YTM HEATER BOARD ASSEMBLY	28480	08673-60027
A1A10A1C1	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A1A10A1C2	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A1A10A1C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A10A1C4				NOT ASSIGNED		
A1A10A1C5	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A1A10A1C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A10A1C7	0180-2104	1	1	CAPACITOR-FXD 40UF+-20% 30VDC TA	06001	69F2143G7
A1A10A1C8	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A10A1C9	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A1A10A1CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1A10A1E1-			5			
A1A10A1E6	1251-3172	7	16	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A1A10A1J1	1250-0257	1	7	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A10A1J2	1200-0508	0	3	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0508
A1A10A1Q1	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A1A10A1R1	0698-7252	7		RESISTOR 4.64K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4641-F
A1A10A1R2	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10A1R3	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10A1R4	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A10A1R5	0698-7277	6		RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A1A10A1R6	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A1A10A1R7	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A1A10A1R8	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A10A1R9	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A1A10A1R10	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A1A10A1R11	0699-0068	1	1	RESISTOR-1.47M 1% .125W	28480	0699-0068
A1A10A1R12	0698-7237	8	1	RESISTOR 1.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1101-F
A1A10A1R13	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A1A10A1TP1-						
A1A10A1TP9	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A1A10A1U1	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A1A10A1U2	1826-0025	2		IC OP AMP LOW-DRIFT TO-99 PKG	27014	LM208AH

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A10A1VR1	1902-0176	6	1	DIODE-ZNR 47V 5% PD=1W IR=5UA	28480	1902-0176
A1A11	08673-67011	8	1	POWER AMP	28480	08673-67011
	08673-67205	2	1	RESTORED POWER AMP	28480	08673-67205
A1A12	08673-60136	4	1	MOTHERBOARD ASSEMBLY	28480	08673-60136
A1A12C1	0180-2207	5		CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A1A12C2	0180-2207	5		CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A1A12C3	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C4	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C5	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C6	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C7	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C8	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C9	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C10	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C11	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C12	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C13	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C14	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12C15	0160-0570	9		CAPACITOR-FXD 220PF +-20% 100VDC CER	20932	5024EM100RD221M
A1A12J1	1251-3905	4	1	CONNECTOR 20-PIN M RECTANGULAR	28480	1251-3905
A1A12J2	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A12J3	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A12J4	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A12J5	1200-0508	0		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0508
A1A12J6	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A12J7	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A12J8	1250-0257	1		CONNECTOR-RF SMB M PC 50-OHM	28480	1250-0257
A1A12J9	1200-0508	0		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0508
A1A12J10	1251-5649	7	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-5649
A1A12J11	1200-0812	9	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0812
A1A12J12	1251-5547	4	1	CONNECTOR 6-PIN M POST TYPE	28480	1251-5547
A1A12MP1	0380-0688	6	2	SPACER-RVT-ON .156-IN-LG .15-IN-ID	00000	ORDER BY DESCRIPTION
A1A12MP2	0590-0526	6	1	THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
A1A12XA1	1251-1626	2	1	CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1626
A1A12XA2	1251-2026	8	5	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A12XA3	1251-1365	6	2	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A1A12XA4	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A12XA5	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A1A12XA6	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A12XA7	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A12XA8	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A12XA9	1251-0472	4	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A1AT1	08672-60146	5	1	PROGRAMMABLE ATTENUATOR - 110 DB	28480	08672-60146
A1AT1W1				P/O A1AT1, NSR		
A1AT2	0960-0699	9	1	ISOLATOR	28480	0960-0699
A1AT3	0955-0160	8	1	PULSE MODULATOR	28480	0955-0160
A1AT4	0955-0163	1	1	COAXIAL ATTENUATOR	28480	0955-0163
A1CP1	11720-60002	8	1	BIAS TEE ASSEMBLY	28480	11720-60002
A1CR1	08673-60093	0	1	CRYSTAL DETECTOR ASSEMBLY	28480	08673-60093
A1DC1	0955-0101	7	1	COUPLER-DIRECTIONAL 2.0 TO 18.6 GHZ	28480	0955-0101
A1FL1	11720-60003	9	1	HIGH PASS FILTER ASSEMBLY	28480	11720-60003
A1MP1	0340-0614	4	1	INSULATOR-XSTR POLYI HD-ANDZ	28480	0340-0614
A1MP2	0400-0018	0	1	GROMMET-CHAN NCH .052-IN-THK-PNL	28480	0400-0018
A1MP3	0403-0194	9	4	GUIDE-PC BD BE-CU .062-BD-THKNS 3.5-LG	28480	0403-0194
A1MP4	0520-0155	0	8	SCREW-MACH 2-56 .125-IN-LG PAN-HD-POZI	28480	0520-0155
A1MP5	1200-0043	8	1	INSULATOR-XSTR ALUMINUM	28480	1200-0043
A1MP6				NOT ASSIGNED		
A1MP7	1251-4459	5	5	CLIP-CABLE PLUG RING-DUAL INLINE 14 CONT	28480	1251-4459
A1MP8	3050-0098	6	5	WASHER-FL MTLC NO. 2 .094-IN-ID	28480	3050-0098
A1MP9	2190-0019	6	20	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
A1MP10	2190-0045	8		WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0045

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1MP11	2200-0091	7	2	SCREW-MACH 4-40 .562-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1MP12	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A1MP13	2200-0111	2	3	SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1MP14	2200-0143	0	15	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	28480	2200-0143
A1MP15	2200-0167	9	3	SCREW-MACH 4-40 .375-IN-LG 82 DEG	28480	2200-0167
A1MP16	2200-0169	0	14	SCREW-MACH 4-40 .5-IN-LG 82 DEG	28480	2200-0169
A1MP17	2260-0002	6	1	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	28480	2260-0002
A1MP18	2360-0113	2	10	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1MP19	2360-0180	3	2	SCREW-MACH 6-32 .188-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A1MP20	2360-0195	0	2	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	28480	2360-0195
A1MP21	2360-0197	2	2	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0197
A1MP22	2360-0333	8	10	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
A1MP23	2420-0001	5	4	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
A1MP24	3050-0010	2	6	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
A1MP25	08673-20115	5	2	BUSHING, INSULATOR	28480	08673-20115
A1MP26	3050-0105	6	1	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
A1MP27	5040-0170	6	2	BOARD SUPPORT	28480	5040-0170
A1MP28	08673-00026	5	1	REAR SUPPORT	28480	08673-00026
A1MP29	08673-00027	6	1	SPACER-MICROCIRCUIT	28480	08673-00027
A1MP30	08673-00050	5	1	GUSSET-RF (LEFT)	28480	08673-00050
A1MP31	08673-00029	8	1	GUSSET-RF (RIGHT)	28480	08673-00029
A1MP32	08673-00055	0	1	SUPPORT-P.C. (FRONT)	28480	08673-00055
A1MP33	08673-00051	6	1	CHASSIS	28480	08673-00051
A1MP34	08673-00032	3	1	SUPPORT-P.C. (REAR)	28480	08673-00032
A1MP35	08673-00033	4	1	SUPPORT-ISOLATOR	28480	08673-00033
A1MP36	08673-00034	5	2	SHIELD-PULSE BOARD	28480	08673-00034
A1MP37	08673-00057	2	1	SUPPORT-COUPLER	28480	08673-00057
A1MP38	08673-20046	1	1	SHIELD-ISOLATOR	28480	08673-20046
A1MP39	08673-20063	2	1	BUSHING	28480	08673-20063
A1MP40				NOT ASSIGNED		
A1MP41				NOT ASSIGNED		
A1MP42	2200-0165	6	3	SCREW-MACH 4-40 .25-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A1MP43	08673-00047	0	1	SUPPORT, ATTENUATOR	28480	08673-00047
A1MP44	08673-20099	4	1	ATTENUATOR SHIELD	28480	08673-20099
A1MP45	0520-0128	7	3	SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1MP46	1251-4459	5		CLIP-CABLE PLUG RTNG-DUAL INLINE 14 CONT	28480	1251-4459
A1MP47	3050-0098	6		WASHER-FL MTLC NO. 2 .094-IN-ID	28480	3050-0098
A1MP48	2360-0117	6		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1Q1	1853-0344	5	1	TRANSISTOR PNP 2N5876 SI TO-3 PD=150W	04713	2N5876
A1R1	0811-3477	2	1	RESISTOR 25 1% 25W PW TC=0+-2	28480	0811-3477
A1W1	08673-20055	2	1	CABLE ASSEMBLY RF OUTPUT	28480	08673-20055
A1W2	08673-20128	0	1	CABLE ASSEMBLY-CPLR OUTPUT	28480	08673-20128
A1W3	08673-20168	8	1	CABLE ASSEMBLY-YTM OUTPUT	28480	08673-20168
A1W4	08673-20050	7	1	CABLE ASSEMBLY-POWER AMP INPUT	28480	08673-20050
A1W5	08673-20166	6	1	CABLE ASSEMBLY-YTM INPUT	28480	08673-20166
A1W6	08672-60071	5	1	CABLE, ASSY, 14 COND	28480	08672-60071
A1W7	08673-60069	2	1	CABLE ASSEMBLY-PULSE MOD	28480	08673-60069
A1W8	08673-60049	8	1	CABLE ASSEMBLY-YTM PULSE	28480	08673-60049
A1W9	08673-60048	7	1	CABLE ASSEMBLY-BIAS TEE	28480	08673-60048
A1W10	08673-20051	8	1	CABLE ASSEMBLY-POWER AMP OUTPUT	28480	08673-20051
A1W11	08673-20049	4	1	CABLE ASSEMBLY-PREAMP OUTPUT	28480	08673-20049
A1W12	08673-60093	2	1	CABLE ASSEMBLY-RIBBON 14-PIN	28480	08673-60093
A1W13	08673-60045	4	1	CABLE ASSEMBLY-ALC OUTPUT	28480	08673-60045

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A1	08673-60159	1	1	PANEL DRIVER BOARD ASSEMBLY	28480	08673-60159
A2A1C1	0180-1746	5	7	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2A1C2	0160-4389	6	2	CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A2A1C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2A1C4	0160-4389	6		CAPACITOR-FXD 100PF +-5PF 200VDC CER	28480	0160-4389
A2A1C5	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2A1C6	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2A1C7	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2A1C8	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2A1C9	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A2A1CR1	1901-0050	3	15	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A1CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A1CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A1L1	9100-3922	4	7	INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A2A1MP1	1480-0073	8	11	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A2A1MP2	4040-0748	3	5	EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A2A1MP3	4040-0749	4	2	EXTR-PC BD BRN POLYC .062-BD-THKNS	28480	4040-0749
A2A1R1	0698-3132	4	29	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R2	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R3	0698-3136	8	3	RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A2A1R4	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R5	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R6	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R7	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R8	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R9	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R10	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R11	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R12	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R13	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R14	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R15	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R16	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R17	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R18	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R19	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R20	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R21	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R22	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R23	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R24	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R25	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R26	0698-3438	3	2	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A2A1R27	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A2A1R28	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R29	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R30	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R31	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1R32	0698-3159	5	2	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A2A1R33	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A2A1R34	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A2A1R35	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A2A1R36	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2A1U1	1820-1202	7	4	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A2A1U2	1820-1423	4	2	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A2A1U3	1820-1201	6	5	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2A1U4	1820-1423	4		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A2A1U5	1820-1858	9	14	IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A1U6	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A1U7	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A1U8	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A1U9	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A1U10	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A1U11	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A1U12	1820-1740	8	2	IC DRVR TTL DSPL DRVR	27014	DS8863N
A2A1U13	1820-1740	8		IC DRVR TTL DSPL DRVR	27014	DS8863N
A2A1U14	1820-1216	3	8	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2A1U15	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2A2	08673-60004	5	1	KEY CODE BOARD ASSEMBLY	28480	08673-60004
A2A2C1	0180-0197	8	15	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A2C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A2C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A2C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A2C5	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A2C6	0160-3878	6	1	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A2A2C7	0160-0576	5	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2A2CR1	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A2CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A2DS1	1990-0678	8	7	LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0678
A2A2DS2	1990-0678	8		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0678
A2A2DS3	1990-0678	8		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0678
A2A2DS4	1990-0678	8		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0678
A2A2DS5	1990-0678	8		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0678
A2A2DS6	1990-0678	8		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0678
A2A2DS7	1990-0678	8		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	1990-0678
A2A2L1	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A2A2MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A2A2MP2	4040-0748	3		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A2A2MP3	4040-0750	7	1	EXTR-PC BD RED POLYC .062-BD-THKNS	28480	4040-0750
A2A2R1	1810-0280	8	7	NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A2A2R2	1810-0280	8		NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A2A2R3	1810-0280	8		NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A2A2R4	0757-0442	9	18	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A2R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A2R6	0757-0401	0	8	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A2R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A2R8	1810-0339	8	1	NETWORK-RES 8-SIP270.0 OHM X 7	01121	208A271
A2A2S1	3101-2170	8	1	SWITCH-PB SPDT MOM	28480	3101-2170
A2A2U1	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2A2U2	1820-1422	3	4	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2A2U3	1820-1199	1	6	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A2U4	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A2U5	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2A2U6	1820-1195	7	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A2A2U7	1820-1112	8	5	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A2U8	1820-1197	9	10	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A2U9	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A2U10	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A2U11	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A2A2U12	1820-1851	2	4	IC ENCDR TTL LS	01295	SN74LS148N
A2A2U13	1820-1851	2		IC ENCDR TTL LS	01295	SN74LS148N
A2A2U14	1820-1851	2		IC ENCDR TTL LS	01295	SN74LS148N
A2A2W1	8159-0005	0	1	RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A2A3	08672-60143	2	1	VCO ASSEMBLY- 160-240 MHZ	28480	08672-60143
A2A3C1	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C2	0160-0168	9	5	CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0168
A2A3C3	0160-3879	7	4	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A3C4	0180-0116	1	13	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A3C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A3C6	0160-2259	5	1	CAPACITOR-FXD 12PF +-5% 500VDC CER 0+-30	28480	0160-2259
A2A3C7	0160-0301	4	2	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A2A3C8	0160-0166	9		CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
A2A3C9	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C10	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C11	0160-0301	4		CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A2A3C12	0160-3456	6	16	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C13	0180-2211	1	1	CAPACITOR-FXD 5UF+50-10% 150VDC AL	56289	30D505F150CC2
A2A3C14	0180-2214	4	1	CAPACITOR-FXD 90UF+75-10% 16VDC AL	56289	30D906G016CC2
A2A3C15	0160-0166	9		CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0166
A2A3C16	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C17	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C18	0160-3466	8	4	CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A2A3C19	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C20	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C21	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C22	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C23	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C24	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C25	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C26	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C27	0160-2240	4	1	CAPACITOR-FXD 2PF +-.25PF 500VDC CER	28480	0160-2240
A2A3C28	0160-2262	0	2	CAPACITOR-FXD 16PF +-5% 500VDC CER 0+-30	28480	0160-2262
A2A3C29	0160-2262	0		CAPACITOR-FXD 16PF +-5% 500VDC CER 0+-30	28480	0160-2262
A2A3C30	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C31	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2A3C32	0140-0195	2	2	CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR
A2A3C33	0140-0195	2		CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR
A2A3CR1	0122-0085	1	4	DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	28480	0122-0085
A2A3CR2	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	28480	0122-0085
A2A3CR3	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	28480	0122-0085
A2A3CR4	0122-0085	1		DIODE-VVC 2.2PF 7% C3/C25-MIN=4.5	28480	0122-0085
A2A3J1	1250-0544	9	3	CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A2A3J2	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A2A3L1	9140-0180	4	1	INDUCTOR RF-CH-MLD 2.7UH 10%	28480	9140-0180
A2A3L2	9100-2583	1	2	INDUCTOR RF-CH-MLD 6.8MH 10%	28480	9100-2583
A2A3L3	9100-2583	1		INDUCTOR RF-CH-MLD 6.8MH 10%	28480	9100-2583
A2A3L4	9100-2249	6	1	INDUCTOR RF-CH-MLD 150NH 10% .105DX.26LG	28480	9100-2249
A2A3L5	9100-2891	4	1	INDUCTOR RF-CH-MLD 50NH 10% .105DX.26LG	28480	9100-2891
A2A3L6	9100-2248	5	2	INDUCTOR RF-CH-MLD 120NH 10% .105DX.26LG	28480	9100-2248
A2A3L7	9100-2254	3	1	INDUCTOR RF-CH-MLD 390NH 10% .105DX.26LG	28480	9100-2254
A2A3L8	9100-2248	5		INDUCTOR RF-CH-MLD 120NH 10% .105DX.26LG	28480	9100-2248
A2A3MP1	2190-0016	3	20	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
A2A3MP2	2200-0101	0	10	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2A3MP3	4330-0145	9	1	INSULATOR-BEAD GLASS	28480	4330-0145
A2A3MP4	08672-20135	8	1	COVER, VCO BD	28480	08672-20135
A2A3Q1	1855-0392	7	1	TRANSISTOR J-FET N-CHAN D-MODE TO-72 SI	28480	1855-0392
A2A3Q2	1854-0345	8	3	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A2A3Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A2A3Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A2A3Q5	1853-0020	4	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A2A3Q6	1853-0451	5	1	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A2A3R1	0757-0199	3	4	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A3R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A3R3	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A2A3R4	0757-0834	3	1	RESISTOR 5.62K 1% .5W F TC=0+-100	28480	0757-0834
A2A3R5	0757-0279	0	17	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A3R6	0757-0280	3	23	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A3R7	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A3R8	0757-0278	9	4	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A2A3R9	0757-0346	2	4	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A3R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A3R11	0698-3444	1	8	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A3R12	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A3R13	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A3R14	0757-0180	2	1	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A2A3R15	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A3R16	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A2A3R17	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A3R18	0698-3440	7	2	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A2A3R19	0757-0428	1	1	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A2A3R20	0698-3160	8	6	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2A3R21	0698-3452	1	1	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A2A3R22	0757-0123	3	1	RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A2A3R23	0757-0416	7	4	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A2A3R24	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A2A3R25	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A3R26	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A3R27	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A2A3R28	0757-0418	9	4	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A2A3R29	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A3R30	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A2A3R31	0698-0083	8	7	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A3R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A3R33	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A3R34	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A3S1	3101-1524	4	1	SWITCH-SL DP3T SUBMIN .5A 125VAC/DC PC	28480	3101-1524
A2A3T1	08672-80003	5	1	COIL-INDUCTOR	28480	08672-80003
A2A3U1	1820-1225	4	1	IC FF ECL D-M/S DUAL	04713	MC10231P
A2A3U2	1820-0794	0	1	IC FF ECL D-M/S	04713	MC1670L
A2A4	08672-60144	3	1	PHASE DETECTOR ASSEMBLY- 20/30	28480	08672-60144
A2A4C1	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A4C2	0160-0162	5	2	CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A2A4C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A4C4	0180-0141	2	1	CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A2A4C5	0160-3459	9	4	CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A2A4C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A4C7	0160-0161	4	2	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A2A4C8	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A2A4C9	0160-2290	4	2	CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A2A4C10	0160-2205	1	1	CAPACITOR-FXD 120PF +-5% 300VDC MICA	28480	0160-2205
A2A4C11	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A2A4C12	0160-2290	4		CAPACITOR-FXD .15UF +-10% 80VDC POLYE	28480	0160-2290
A2A4C13	0160-2207	3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A2A4C14	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A2A4C15	0160-3458	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3458
A2A4C16	0160-2055	9	15	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A4C17	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A2A4C18	0170-0040	9	2	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A2A4C19	0160-0168	9		CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0168
A2A4C20	0160-3661	5	2	CAPACITOR-FXD .1UF +-5% 50VDC MET-POLYC	28480	0160-3661
A2A4C21	0160-0168	9		CAPACITOR-FXD .068UF +-10% 200VDC POLYE	28480	0160-0168
A2A4C22	0160-3661	5		CAPACITOR-FXD .1UF +-5% 50VDC MET-POLYC	28480	0160-3661
A2A4CR1	1901-0535	9	4	DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4CR2	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4CR3	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4CR4	1901-0535	9		DIODE-SM SIG SCHOTTKY	28480	1901-0535
A2A4L1	9100-1629	4	2	INDUCTOR RF-CH-MLD 47UH 5% .166DX.385LG	28480	9100-1629
A2A4L2	9100-1629	4		INDUCTOR RF-CH-MLD 47UH 5% .166DX.385LG	28480	9100-1629
A2A4L3	08672-80002	4	2	INDUCTOR- 3.8 MH	28480	08672-80002
A2A4L4	08672-80002	4		INDUCTOR- 3.8 MH	28480	08672-80002
A2A4MP1	1205-0250	8	3	THERMAL LINK SGL TO-5/TO-39-CS	28480	1205-0250
A2A4MP2	08672-20136	9	1	COVER-PHASE DETECTOR	28480	08672-20136
A2A4MP3	1200-0081	4	2	INSULATOR-FLG-BSHG NYLON	28480	1200-0081
A2A4MP4	2200-0101	0		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2A4MP5	2200-0103	2	19	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A4Q1	1854-0712	3	1	TRANSISTOR-DUAL NPN PD=1.8W	28480	1854-0712
A2A4Q2	1854-0071	7	3	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A4R1	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A4R2	0698-3629	4	1	RESISTOR 270 5% 2W MO TC=0+-200	28480	0698-3629
A2A4R3	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A2A4R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A4R5	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A4R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A4R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A4R8	0757-0440	7	2	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A2A4R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A4R10	0757-0438	3	17	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A4R11	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A2A4R12	0757-0422	5	4	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A2A4R13	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A2A4R14	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A4R15	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2A4R16	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A4R17	0757-0462	3	2	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A2A4R18	0757-0458	7	6	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A4R19	0757-0462	3		RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A2A4R20	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A4R21	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A4R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A4R23	0757-0819	4	1	RESISTOR 909 1% .5W F TC=0+-100	28480	0757-0819
A2A4R24	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A4R25	0757-0424	7	1	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A2A4R26	0698-3443	0	1	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A2A4R27	0698-3153	9	1	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A2A4R28	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A4R29	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A2A4R30	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A2A4R31	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A2A4R32	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A4TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A4U1	1820-0429	8	2	IC V RGLTR TO-39	18324	LM309H
A2A4U2	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A4U3	1820-0281	0	1	IC FF TTL J-K M/S PULSE CLEAR DUAL	01295	SN74107N
A2A4U4	1820-0846	3	1	IC BFR TTL NON-INV QUAD 1-INP	27014	DM8094N
A2A4U5	1820-0223	0	1	IC OP AMP GP TO-99 PKG	3L585	CA301AT
A2A4U6	1820-1422	3		IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2A4U7	1820-1422	3		IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2A4U8	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A4VR1	1902-3234	3	1	DIODE-ZNR 19.6V 5% DO-35 PD=.4W	28480	1902-3234
A2A5	08672-60145	4	1	DIVIDER ASSEMBLY- 20/30	28480	08672-60145
A2A5C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C2	0180-0229	7	4	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5C3	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5C4	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	150D334X9035A2
A2A5C5	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A2A5C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C7	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A5C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A5C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A5C19	0160-3537	4	1	CAPACITOR-FXD 680PF +-5% 100VDC MICA	28480	0160-3537
A2A5C20	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A2A5CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2A5J1	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A2A5L1	9100-4078	3	2	INDUCTOR 650H 54%	28480	9100-4078
A2A5L2	9100-1618	1	1	INDUCTOR RF-CH-MLD 5.6UH 10%	28480	9100-1618
A2A5L3	9100-4078	3		INDUCTOR 650H 54%	28480	9100-4078
A2A5MP1	1205-0250	9		THERMAL LINK SGL TO-5/TO-39-CS	28480	1205-0250
A2A5MP2	08672-20134	7	1	COVER-DIVIDER	28480	08672-20134
A2A5MP3	1200-0081	4		INSULATOR-FLG-BSHG NYLON	28480	1200-0081
A2A5MP4	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
A2A5MP5	2200-0101	0		SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2A5MP6	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A2A5Q1	1854-0019	3	2	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A2A5R1	0698-3628	3	1	RESISTOR 220 5% 2W MO TC=0+-200	28480	0698-3628
A2A5R2	0757-0397	3	1	RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A2A5R3	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A5R4	2100-2413	9	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	30983	ET50X201
A2A5R5	0698-7216	3	16	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R6	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R7	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R8	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R11	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A5R12	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A2A5R13	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A5R14	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R15	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A5R16	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R17	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R18	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R19	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R20	0698-3157	3	1	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A2A5R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R23	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R24	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R25	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R26	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R27	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R29	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A2A5R30	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A2A5R31	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A2A5R32	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A5R34	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R35	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R36	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5R37	0698-7216	3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A2A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A5TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A5U1	1820-1251	6	5	IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U2	1820-1251	6		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U3	1820-1251	6		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U4	1820-0261	6	1	IC MV TTL MONOSTBL	01295	SN74121N
A2A5U5	1820-0686	9	1	IC GATE TTL S AND TPL 3-INP	01295	SN74S11N
A2A5U6	1820-0629	0	2	IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A2A5U7	1820-0629	0		IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A2A5U8	1820-1384	6	1	IC PRESCR ECL	52648	SP8641B
A2A5U9	1820-0429	8		IC V RGLTR TO-39	18324	LM309H
A2A5U10	1820-1251	6		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U11	1820-1251	6		IC CNTR TTL LS DECD ASYNCHRO	01295	SN74LS196N
A2A5U12	1820-0909	9	1	IC MULTR TTL	01295	SN74167N
A2A5U13	1820-0751	9	2	IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN74196N
A2A5U14	1820-0751	9		IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN74196N
A2A5U15	1820-0685	8	1	IC GATE TTL S NAND TPL 3-INP	01295	SN74S10N
A2A5U16	1820-0690	5	1	IC BFR TTL S NAND DUAL 4-INP	01295	SN74S40N
A2A6				NOT ASSIGNED		
A2A7	08673-60160	4	1	I/O BOARD ASSEMBLY	28480	08673-60160
A2A7C1	0180-2620	6	12	CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C2	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C3	0160-0572	1	3	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A2A7C4	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C5	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C6	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C7	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C8	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A2A7C9	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C10	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C11	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C12	0160-0174	9	1	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A2A7C13	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C14	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C15	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A2A7C16	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A2A7C17	0160-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A2A7C18	0160-0153	4	1	CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A2A7C19	0160-4103	2	2	CAPACITOR-FXD 220PF +-5% 100VDC CER	72982	8121-M100-COG-221J
A2A7C20	0160-0162	5		CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A2A7C21	0170-0040	9		CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A2A7C22	0160-4103	2		CAPACITOR-FXD 220PF +-5% 100VDC CER	72982	8121-M100-COG-221J
A2A7CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7CR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A2A7DS1	1990-0670	0	4	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A2A7DS2	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A2A7DS3	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A2A7DS4	1990-0670	0		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0670
A2A7L1	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A2A7MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A2A7MP2	4040-0748	3		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A2A7MP3	4040-0755	2	1	EXTR-PC BD VIO POLYC .062-BD-THKNS	28480	4040-0755

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A2A7Q1	1853-0281	9	5	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A2A7Q2	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A2A7Q3	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A2A7Q4	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A2A7Q5	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A2A7Q6	1854-0477	7	2	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2A7Q7	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A2A7Q8	1853-0314	9	1	TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A2A7R1	0757-0465	6	6	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A7R2	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R3	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R4	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A7R5	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R6	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2A7R7	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R8	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A7R9	0698-3442	9	4	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2A7R10	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A7R11	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2A7R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A7R13	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R14	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A7R15	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2A7R16	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A7R17	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2A7R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A7R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R20	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2A7R21	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A2A7R22	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R23	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A2A7R24	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R25	0757-0159	5	1	RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159
A2A7R26	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A7R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R28	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A7R29	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R30	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A7R31	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A7R32	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A7R33	1810-0280	8		NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A2A7R34	2100-3353	8	2	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A2A7R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A7R36	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A2A7R37	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A7R38	0757-0274	5	3	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A2A7R39	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A7R40	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A7R41	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A7R42	0698-3161	9	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A2A7R43	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A7R44	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A7R45	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A7R46	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A7R47	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A7R48	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A7R49	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A7R50	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A2A7R51	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A7R52	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A7R53	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A7R54	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A2A7R55	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A7R56	0757-0460	1	1	RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A2A7R57	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A2A7R58	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A2A7R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A7S1	3101-2747	5	1	8-POS AI DIP SW	28480	3101-2747
A2A7TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A7TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A7TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A7TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A7U1	1820-2079	8	1	IC GATE CMOS NOR DUAL 4-INP	04713	MC14002BCP
A2A7U2	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A2A7U3	1820-1422	3		IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2A7U4	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A7U5	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2A7U6	1820-0693	8	2	IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A2A7U7	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A7U8	1826-0600	9	2	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074ACN
A2A7U9	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A7U10	1820-1445	0	1	IC LCH TTL LS 4-BIT	01295	SN74LS375N
A2A7U11	1820-2081	2	2	IC NMOS	04713	MC68A21P
A2A7U12	1820-1759	9	19	IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A7U13	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A7U14	1826-0462	1	1	IC CONV 10-B-D/A 16-DIP-C PKG	04713	MC3410CL
A2A7U15	1820-0693	8		IC FF TTL S D-TYPE POS-EDGE-TRIG	01295	SN74S74N
A2A7U16	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A2A7U17	1820-1747	5	2	IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A7U18	1826-0600	9		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074ACN
A2A7U19	1820-1419	8	1	IC COMPTR TTL LS MAGTD 4-BIT	01295	SN74LS85N
A2A7U20	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A7U21	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A7U22	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A7U23	1826-0026	3	1	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A2A7U24	1820-1285	6	1	IC GATE TTL LS AND-OR-INV 4-INP	01295	SN74LS54N
A2A7U25	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A7U26	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A7VR1	1902-0962	8	1	DIODE-ZNR 15V 5% DO-35 PD=.4W TC=+.087%	28480	1902-0962
A2A7VR2	1902-0950	4	1	DIODE-ZNR 4.7V 5% DO-35 PD=.4W TC=+.025%	28480	1902-0950
A2A7XU11	1200-0654	7	4	SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A2A8	08673-60110	4	1	MICROPROCESSOR BOARD ASSEMBLY	28480	08673-60110
A2A8C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A8C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C7	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C8	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C9	0160-2255	1	1	CAPACITOR-FXD 8.2PF +-.25PF 500VDC CER	28480	0160-2255
A2A8C10	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A2A8C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2A8C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2A8CR1	1901-0028	5	1	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A2A8L1	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A2A8L2	9140-0179	1	1	INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A2A8MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A2A8MP2	4040-0747	2	1	EXTR-PC BD GRA POLYC .062-BD-THKNS	28480	4040-0747
A2A8MP3	4040-0748	3		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A2A8MP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A8Q1	1853-0393	4	1	TRANSISTOR PNP SI TO-18 PD=500MW	28480	1853-0393
A2A8Q2	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A2A8R1	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A8R2	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A8R3	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A8R4	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A2A8R5	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A8R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A8R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A8R8	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R9	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A2A8R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A8R11	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A8R12	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A8R13	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A8R14	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A2A8R15	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A8R16	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A8R17	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A8R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A8R19	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A8R20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A8R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A8R22	1810-0275	1	3	NETWORK-RES 10-SIP1.0K OHM X 9	01121	210A102
A2A8S1	3100-3364	2	1	SWITCH-ROTARY 16 PIN DIP 4PDT 16 POS	28480	3100-3364
A2A8TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A8TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A8TP2G	1251-0600	0	31	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A8TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A8TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A8TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A8TP5G	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A8U1	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A8U2	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2A8U3	08673-80018	3	1	ROM-PROGRAMMED	28480	08673-80018
A2A8U4	1820-1201	6		IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A2A8U5	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A2A8U6	1820-2240	5	1	IC MPU; CLK FREQ=1.5MHZ, W/INTNL CLK	28480	1820-2240
A2A8U7	1820-1203	8	1	IC GATE TTL LS AND TPL 3-INP	01295	SN74LS11N
A2A8U8	1820-2469	0	1	IC-MICROPROCESSOR	28480	1820-2469
A2A8U9	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A8U10	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A2A8U11	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A8U12	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A8U13	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2A8U14	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2A8U15	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A8U16	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A2A8U17	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A8U18	1820-1932	0	1	IC MV CMOS MONOSTBL RETRIG/RESET DUAL	04713	MC14538BCP
A2A8U19	1820-1747	5		IC GATE CMOS NAND QUAD 2-INP	04713	MC14011BCP
A2A8U20	1820-1746	4	2	IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A8U21	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2A8U22	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A8U23	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A8U24	1820-1851	2		IC ENCDR TTL LS	01295	SN74LS148N
A2A8U25	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A8U26	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A8U27	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A8U28	1820-2102	8	1	IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A2A8XU3	1200-0541	1	2	SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A2A8XU6	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A9	08673-60006	7	1	FREQUENCY/HP-IB BOARD ASSEMBLY	28480	08673-60006
A2A9C1	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A9C2	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A9C3	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A9L1	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A2A9MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A2A9MP2	4040-0748	3		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	4040-0748
A2A9MP3	4040-0756	3	1	EXTR-PC BD WHT POLYC .062-BD-THKNS	28480	4040-0756
A2A9Q1	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A9Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A9R1	1810-0275	1		NETWORK-RES 10-SIP1.0K OHM X 9	01121	210A102
A2A9R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A9R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A9R4	1810-0275	1		NETWORK-RES 10-SIP1.0K OHM X 9	01121	210A102
A2A9R5	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A2A9R6	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A2A9R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A9S1	3101-1856	5	1	SWITCH-SL 8-1A DIP-SLIDE-ASSY .1A 50VDC	28480	3101-1856
A2A9TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A9U1	1820-1955	7	5	IC ADDR CMOS FULL ADDER 4-BIT	3L585	CD4008BE
A2A9U2	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	3L585	CD4008BE
A2A9U3	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	3L585	CD4008BE
A2A9U4	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	3L585	CD4008BE
A2A9U5	1820-1955	7		IC ADDR CMOS FULL ADDER 4-BIT	3L585	CD4008BE
A2A9U6	1820-1208	3	2	IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A2A9U7	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A9U8	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2A9U9	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A2A9U10	1820-2549	7	1	IC-8291A P HPIB	28480	1820-2549
A2A9U11	1820-3431	8	1	IC TRANSCEIVER TTL S INSTR-BUS IEEE-488	28480	1820-3431
A2A9U12	1820-1746	4		IC BFR CMOS INV HEX	04713	MC14049UBCP
A2A9U13	1820-1976	2	2	IC BFR CMOS NON-INV HEX	3L585	CD4050BE
A2A9U14	1820-1976	2		IC BFR CMOS NON-INV HEX	3L585	CD4050BE
A2A9U15	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A9U16	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A9U17	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A9U18	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A2A9U19	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A9U20	1820-3513	7	2	IC TRANSCEIVER TTL S INSTR-BUS IEEE-488	28480	1820-3513
A2A9U21	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A9U22	1820-3513	7		IC TRANSCEIVER TTL S INSTR-BUS IEEE-488	28480	1820-3513
A2A9XU10	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A2A10	08673-60109	1	1	RAM BOARD ASSY	28480	08673-60109
A2A10C1	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A10C2	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A10C3	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A10C4	0160-3466	8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A2A10C5	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A10CR1	1901-0376	6	2	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2A10CR2	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2A10L1	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A2A10MP1	1480-0073	6		PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
A2A10R1	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A10R2	0698-8827	4	1	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827
A2A10S1	3101-2135	5	1	SWITCH-RKR DIP-RKR-ASSY DPDT .05A 30VDC	28480	3101-2135

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A10U1	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A10U2	1820-1206	1	1	IC GATE TTL LS NOR TPL 3-INP	01295	SN74LS27N
A2A10U3	1820-1730	6	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A2A10U4	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A10U5	08673-80001	4	1	EPROM	28480	08673-80001
A2A10U6	1818-1768	5	1	IC CMOS 16384 (16K) STAT RAM 150-NS 3-S	S0545	UPD446C-1(PER HP DWG)
A2A10U7	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2A10U8	1820-2075	4	1	IC TRANSCEIVER TTL LS BUS OCTL	28480	1820-2075
A2A10XU6	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A2A11	08673-60167	1	1	ROM BD ASSY	28480	08673-60167
A2A11C1	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A11C2	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A11C3	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A11C4	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A2A11J1	1251-5652	2	1	CONNECTOR 40-PIN M POST TYPE	28480	1251-5652
A2A11L1	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A2A11MP1	4040-0749	4		EXTR-PC BD BRN POLYC .062-BD-THKNS	28480	4040-0749
A2A11R1	1810-0280	8		NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A2A11R2	1810-0280	8		NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A2A11R3	1810-0280	8		NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A2A11U1	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A11U2	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A11U3	1820-1208	3		IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A2A11U4	1820-2081	2		IC NMOS	04713	MC68A21P
A2A11U5	08673-80051	4	1	PROGRAMMED ROM	28480	08673-80051
A2A11U6	08673-80052	5	1	PROGRAMMED ROM	28480	08673-80052
A2A11U7	08673-80053	6	1	PROGRAMMED ROM	28480	08673-80053
A2A11U8	08673-80014	9	1	PROGRAMMED ROM	28480	08673-80014
A2A11U9	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A11U10	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A11U11	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2A11U12	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A11U13	1820-1759	9		IC BFR TTL LS NON-INV OCTL	27014	DM81LS97N
A2A11XU4	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A2A11XU5	1200-0567	1	3	SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A2A11XU6	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A2A11XU7	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A2A11XU8A	1200-0607	0	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A2A11XU8B	1200-0798	8	1	SOCKET-IC 8-CONT DIP DIP-SLDR	28480	1200-0798
A2A12				NOT ASSIGNED		
A2A13	08673-60158	0	1	MOTHERBOARD ASSEMBLY	28480	08673-60158
A2A13C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A13C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2A13C3	0160-3877	5	16	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C4	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C5	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C6	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C7	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C8	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C9	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C10	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C11	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C12	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C13	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C14	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C15	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C16	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C17	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C18	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A2A13C19	0160-3873	1	4	CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A2A13C20	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2A13C21	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A2A13C22	0160-3873	1		CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A2A13J1	1250-1255	1	1	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1255
A2A13J2	1251-5722	7	1	CONNECTOR 50-PIN M POST TYPE	28480	1251-5722
A2A13J3	1251-5721	6	1	CONNECTOR 40-PIN M POST TYPE	28480	1251-5721
A2A13J4	1251-5720	5	1	CONNECTOR 34-PIN M POST TYPE	28480	1251-5720
A2A13J5	1251-5649	7	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-5649
A2A13MP1	0380-0817	3	2	SPACER-RVT-ON .095-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
A2A13MP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A2A13R1	0757-1000	7	1	RESISTOR 51.1 1% .5W F TC=0+-100	28480	0757-1000
A2A13W1	08673-20070	1	1	CABLE-SEMI RIGID	28480	08673-20070
A2A13XA1A	1251-2026	8	12	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA1B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA2	1251-1365	6	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A2A13XA3	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA4	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA5	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA6				NOT ASSIGNED		
A2A13XA6				NOT ASSIGNED		
A2A13XA7A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA7B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA7C	1251-2035	9	5	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A13XA8B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA8C	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A13XA9A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA9B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA9C	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A13XA10B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA10C	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A13XA11B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2A13XA11C	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2A14	08673-60013	6	1	REAR INTERCONNECT BOARD ASSEMBLY	28480	08673-60013
A2A14J1	1251-3025	9	1	CONNECTOR 34-PIN M RECTANGULAR	28480	1251-3025
A2A14MP1	0380-0339	4	1	STANDOFF-RVT-ON .25-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
A2A15	08673-60010	3	1	HP-IB CONNECTOR BOARD ASSEMBLY	28480	08673-60010
A2A15J1	1251-3283	1	1	CONNECTOR 24-PIN F MICRORIBBON	28480	1251-3283
A2A15MP1	0380-0643	3	2	STANDOFF-HEX .255-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
A2A15MP2	2190-0017	4	2	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
A2A15MP3	2190-0019	6	2	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
A2A15MP4	2200-0109	8	2	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2A15MP5	2260-0002	6	2	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	28480	2260-0002
A2A15MP6	3050-0139	6	2	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0139
A2A15MP7	1530-1098	4	1	CLEVIS 0.070-IN W SLT: 0.454-IN PIN CTR	00000	ORDER BY DESCRIPTION
A2A15XA1	1251-3403	7	1	CONNECTOR-PC EDGE 10-CONT/ROW 2-ROWS	28480	1251-3403
A2BT1	08672-60092	0	1	BATTERY PACK ASSEMBLY	28480	08672-60092
A2J1				NOT ASSIGNED		
A2J2	1250-0083	1	5	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A2J3	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A2J4	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A2J5	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A2J6	1251-0143	6	1	CONNECTOR 14-PIN F MICRO RIBBON	28480	1251-0143
A2J7	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A2MP1	0624-0268	6	48	SCREW-TPG 4-24 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2MP2				NOT ASSIGNED		
A2MP3	2190-0401	0	14	WASHER-FL NM NO. 4 .12-IN-ID .312-IN-OD	28480	2190-0401
A2MP4	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A2MP5	2360-0115	4	2	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2MP6	2360-0333	8	13	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
A2MP7	0624-0097	9	2	SCREW-TPG 4-40 .188-IN-LG PAN-HD-POZI	28480	0624-0097
A2MP8				NOT ASSIGNED		
A2MP9				NOT ASSIGNED		
A2MP10	3050-0010	2	2	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
A2MP11	7100-1266	3	1	CAN-SQUARE	28480	7100-1266
A2MP12	85660-00054	6	1	CLAMP BATTERY	28480	85660-00054
A2MP13	08672-20120	1	12	STEP WASHER	28480	08672-20120
A2MP14	08672-20142	7	1	AMPLIFIER HOUSING	28480	08672-20142
A2MP15	08672-20146	1	1	MOUNTING BLOCK	28480	08672-20146
A2MP16	08672-60029	3	1	BATTERY HOLDER ASSEMBLY	28480	08672-60029
A2MP17	08673-00062	9	1	SUPPORT-FRONT DCU	28480	08673-00062
A2MP18	08673-00005	0	1	GUSSET-RIGHT DCU	28480	08673-00005
A2MP19	08673-00006	1	1	GUSSET-CENTER DCU	28480	08673-00006
A2MP20	08673-00007	2	1	GUSSET-LEFT DCU	28480	08673-00007
A2MP21				NOT ASSIGNED		
A2MP22	0520-0129	8	2	SCREW-MACH 2-56 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2MP23	0610-0001	6	2	NUT-HEX-DBL-CHAM 2-56-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
A2MP24	1400-0249	0	3	CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
A2MP25	2190-0016	3		WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
A2MP26	2190-0045	8	2	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0045
A2MP27	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A2MP28	2950-0001	8	5	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A2MP29	08673-00008	3	1	PANEL-REAR DCU	28480	08673-00008
A2MP30				NOT ASSIGNED		
A2MP31	2510-0195	9	4	SCREW-MACH 8-32 .375-IN-LG 100 DEG	28480	2510-0195
A2MP32	2360-0229	1	1	SCREW-MACH 6-32 .562-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A2MP33	2190-0018	5	1	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
A2MP34	08673-40002	1	1	ABS INTERFACE PAD	28480	08673-40002
A2W1	08672-60030	6	1	CABLE ASSEMBLY-VCO OUTPUT	28480	08672-60030
A2W2	08673-60024	9	1	CABLE ASSEMBLY-34 CONDUCTOR S	28480	08673-60024

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1	08673-60133	1	1	RECTIFIER ASSEMBLY	28480	08673-60133
A3A1C1	0160-2055	9	51	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1C4	0160-4084	8	10	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A1C5	0180-0230	0	1	CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A3A1C6	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A1C7	0180-0197	8	18	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C8	0160-4005	3	2	CAPACITOR-FXD 1UF +-20% 100VDC CER	28480	0160-4005
A3A1C9	0160-4005	3		CAPACITOR-FXD 1UF +-20% 100VDC CER	28480	0160-4005
A3A1C10				NOT ASSIGNED		
A3A1C11				NOT ASSIGNED		
A3A1C12	0160-3638	6	1	CAPACITOR-FXD .22UF +80-20% 200VDC CER	28480	0160-3638
A3A1CR1	1901-0662	3	16	DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR2	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR3	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR4	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR5	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR6	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR7	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR8	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR9	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR10	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR11	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR12	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR13	1901-0765	7	2	DIODE-PWR RECT 1N5812 50V 20A 35NS DO-4	12969	1N5812
A3A1CR14	1901-0765	7		DIODE-PWR RECT 1N5812 50V 20A 35NS DO-4	12969	1N5812
A3A1CR15	1990-0487	7	4	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4584
A3A1CR16	1884-0018	5	6	THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A1CR17	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A1CR18	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A1DS1	1990-0487	7		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4584
A3A1F1	2110-0001	8	1	FUSE 1A 250V NTD 1.25X.25 UL	75915	312001
A3A1MP1				NOT ASSIGNED		
A3A1MP2	0590-0526	6	2	THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
A3A1MP3	1200-0081	4	25	INSULATOR-FLG-BSHG NYLON	28480	1200-0081
A3A1MP4	1251-2313	6	2	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A3A1MP5	2740-0003	5	2	NUT-HEX-W/LKWR 10-32-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
A3A1MP6	1251-0600	0	58	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1MP7	5000-9043	6	5	PIN-P.C. BOARD EXTRACTOR	28480	5000-9043
A3A1MP8	5040-6843	2	5	BOARD EXTRACTOR	28480	5040-6843
A3A1MP9	86701-00018	4	1	HEAT SINK	28480	86701-00018
A3A1MP10	2740-0003	5		NUT-HEX-W/LKWR 10-32-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
A3A1MP11	2200-0107	6	6	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A1R1	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A1R2	2100-3123	0	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A3A1R3	0757-0346	2	31	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1R4	0698-3444	1	8	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A1R5	0698-3447	4	5	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A3A1R6	0698-8818	3	3	RESISTOR 3.16 1% .125W F TC=0+-100	28480	0698-8818
A3A1R7	0698-8818	3		RESISTOR 3.16 1% .125W F TC=0+-100	28480	0698-8818
A3A1R8	0698-8818	3		RESISTOR 3.16 1% .125W F TC=0+-100	28480	0698-8818
A3A1U1	1826-0128	4	1	IC 7818 V RGLTR TO-3	04713	MC7818CK
A3A1VR1	1902-3263	8	1	DIODE-ZNR 24.9V 2% DO-35 PD=.4W	28480	1902-3263
A3A1VR2	1902-3404	9	2	DIODE-ZNR 82.5V 5% DO-7 PD=.4W TC=+.082%	28480	1902-3404
A3A1XF1	2110-0269	0	6	FUSEHOLDER-CLIP TYPE.250-FUSE	28480	2110-0269

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A1	86701-60021	5	1	REFERENCE PHASE DETECTOR ASSEMBLY	28480	86701-60021
A3A1A1C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C3	0180-1746	5	8	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1A1C4	0160-3879	7	31	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C5	0140-0190	7	2	CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3A1A1C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C8	0180-1848	6	1	CAPACITOR-FXD 2.2UF+-10% 35VDC TA	56289	150D225X9035B2
A3A1A1C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C12	0160-2199	2	7	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A1A1C13	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C14	0160-2204	0	6	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A1C15	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A1C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C23	0180-0553	0	2	CAPACITOR-FXD 22UF+-20% 25VDC TA	28480	0180-0553
A3A1A1C24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C26	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A1C27	0140-0193	0	6	CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A1A1C28	0180-0553	0		CAPACITOR-FXD 22UF+-20% 25VDC TA	28480	0180-0553
A3A1A1C29	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C30	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A1A1C31	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1A1C32	0170-0066	9	1	CAPACITOR-FXD .027UF +-10% 200VDC POLYE	28480	0170-0066
A3A1A1C33	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C34	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C35	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A1A1C36	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C37	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C38	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A1A1C39	0160-3454	4	25	CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A1C40	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1A1C41	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C42	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C43	0160-2206	2	1	CAPACITOR-FXD 160PF +-5% 300VDC MICA	28480	0160-2206
A3A1A1C44	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C45	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C46	0140-0210	2	3	CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A3A1A1C47	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C48	0140-0210	2		CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A3A1A1C49	0160-2201	7	1	CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A3A1A1C50	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C51	0140-0210	2		CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A3A1A1C52	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C53	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A1C54	0180-0183	2	1	CAPACITOR-FXD 10UF+75-10% 50VDC AL	56289	30D106G050CB2
A3A1A1C55	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1A1C56	0180-0229	7	3	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A3A1A1C57	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A1C58	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C59	0160-3878	6	34	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A1C60	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A1C61	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A1C62	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A1CR1	1901-0518	8	6	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR2	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR3	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR4	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR5	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1CR6	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3A1A1J1	1250-0544	9	8	CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A1J3	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A1J4	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A1J5	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A1J6	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A1L1	9140-0238	3	2	INDUCTOR RF-CH-MLD 82UH 5% .166DX.385LG	28480	9140-0238
A3A1A1L2	9140-0238	3		INDUCTOR RF-CH-MLD 82UH 5% .166DX.385LG	28480	9140-0238
A3A1A1L3	9140-0143	9	2	INDUCTOR RF-CH-MLD 3.3UH 10% .105DX.26LG	28480	9140-0143
A3A1A1L4	9140-0143	9		INDUCTOR RF-CH-MLD 3.3UH 10% .105DX.26LG	28480	9140-0143
A3A1A1L5	9100-2261	2	1	INDUCTOR RF-CH-MLD 2.7UH 10% .105DX.26LG	28480	9100-2261
A3A1A1L6	9140-0114	4	1	INDUCTOR RF-CH-MLD 10UH 10% .166DX.385LG	28480	9140-0114
A3A1A1L7	9100-2255	4	4	INDUCTOR RF-CH-MLD 470NH 10% .105DX.26LG	28480	9100-2255
A3A1A1L8	9100-0368	6	4	INDUCTOR RF-CH-MLD 330NH 10% .105DX.26LG	28480	9100-0368
A3A1A1L9	9100-2257	6	3	INDUCTOR RF-CH-MLD 820NH 10% .105DX.26LG	28480	9100-2257
A3A1A1L10	9100-2255	4		INDUCTOR RF-CH-MLD 470NH 10% .105DX.26LG	28480	9100-2255
A3A1A1L11	9100-2257	6		INDUCTOR RF-CH-MLD 820NH 10% .105DX.26LG	28480	9100-2257
A3A1A1L12	9100-2255	4		INDUCTOR RF-CH-MLD 470NH 10% .105DX.26LG	28480	9100-2255
A3A1A1L13	9100-2257	6		INDUCTOR RF-CH-MLD 820NH 10% .105DX.26LG	28480	9100-2257
A3A1A1L14	9100-2255	4		INDUCTOR RF-CH-MLD 470NH 10% .105DX.26LG	28480	9100-2255
A3A1A1L15	9100-2256	5	1	INDUCTOR RF-CH-MLD 560NH 10% .105DX.26LG	28480	9100-2256
A3A1A1MP1	1205-0250	9	1	THERMAL LINK SGL TO-5/TO-39-CS	28480	1205-0250
A3A1A1MP2	2190-0124	4	10	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A3A1A1MP3	2200-0103	2	27	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A3A1A1MP4	2950-0078	9	5	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A3A1A1MP5	6040-0239	9	1	LUBRICANT-GREASE SIL	05820	120
A3A1A1MP6	86701-20040	4	1	COVER-P.C. (PHASE LOCK)	28480	86701-20040
A3A1A1MP7	86701-40001	9	12	EXTRACTOR-P.C. BOARD	28480	86701-40001
A3A1A1MP8	2200-0139	4	18	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0139
A3A1A1MP9	2190-0019	6	41	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
A3A1A1Q1	1854-0019	3	3	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A3A1A1Q2	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A3A1A1Q3	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A3A1A1Q4	1855-0049	1	1	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
A3A1A1Q5	1853-0451	5	15	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A1Q6	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A1Q7	1853-0034	0	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A3A1A1R1	0757-0399	5	3	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1A1R2	0757-0417	8	1	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A3A1A1R3	0757-0416	7	19	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A1R4	0757-0401	0	26	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A1R5	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3A1A1R6	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A1R7	0757-0420	3	6	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A1A1R8	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A1R9	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1A1R10	0698-7222	1	2	RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-F
A3A1A1R11	0698-7219	6	7	RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A1R12	0757-0442	9	19	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R13	0698-3453	2	3	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A3A1A1R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R15	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A3A1A1R16	0757-0441	8	6	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A1A1R17	0698-3438	3	3	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A3A1A1R18	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R19	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R20	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A1R21	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A3A1A1R22	0698-3136	8	1	RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A3A1A1R23	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R24	0698-3154	0	12	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R25	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R26	0757-0280	3	23	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A1R27	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R28	0698-3450	9	3	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A3A1A1R29	0698-3449	6	2	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A3A1A1R30	0757-0444	1	2	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A3A1A1R31	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R32	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R33	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R34	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A1R35	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A1R36	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A3A1A1R37	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A3A1A1R38	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A1A1R39	0757-0440	7	5	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A1A1R40	0757-0394	0	16	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A1R41	0698-3446	3	2	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A3A1A1R42	0698-0085	0	7	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A1A1R43	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R45	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A1R46	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A1R47	0698-3453	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A3A1A1R48	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A1R49	0698-7285	6	1	RESISTOR 110K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1103-F
A3A1A1R50	0698-3157	3	6	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A1A1R51	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A1A1R52	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A1R53	0698-3440	7	8	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A1A1R54	0698-7234	5	1	RESISTOR 825 1% .05W F TC=0+-100	24546	C3-1/8-T0-825R-F
A3A1A1R55	0698-7257	2	1	RESISTOR 7.5K 1% .05W F TC=0+-100	24546	C3-1/8-T0-7501-F
A3A1A1R56	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A1R57	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A3A1A1R58	0698-7246	9	1	RESISTOR 2.61K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2611-F
A3A1A1R59	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A1A1R60	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A3A1A1R61	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A1R62	0757-1094	9	3	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3A1A1R63	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A1A1R64	0698-3132	4	4	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A3A1A1R65	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A1A1R66	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A1A1R67	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A1R68	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A1R69	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A1R70	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A1R71	0757-0274	5	1	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A3A1A1R72	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A3A1A1R73	0757-0317	7	2	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A3A1A1R74	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A3A1A1R75	0698-7236	7	4	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3A1A1T1	86701-60082	8	2	TRANSFORMER-RF	28480	86701-60082
A3A1A1T2	86701-60082	8		TRANSFORMER-RF	28480	86701-60082
A3A1A1TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A1U1	1821-0001	4	1	TRANSISTOR ARRAY 14-PIN PLSTC DIP	3L585	CA3046
A3A1A1U2	1820-0328	6	1	IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A3A1A1U3	1820-1383	5	1	IC CNTR ECL BCD POS-EDGE-TRIG	04713	MC10138L
A3A1A1U4	1820-0802	1	6	IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A1U5	1820-0223	0	6	IC OP AMP GP TO-99 PKG	3L585	CA301AT

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A1U6	1820-0429	8	1	IC V RGLTR TO-39	18324	LM309H
A3A1A1VR1	1902-3082	9	3	DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
A3A1A1VR2	1902-3256	9	1	DIODE-ZNR 23.7V 5% DO-35 PD=.4W	28480	1902-3256
A3A1A1W1	86701-60059	9	1	CABLE ASSEMBLY-GRAY/ORANGE/WHITE	28480	86701-60059
A3A1A2	86701-60020	4	1	100 MHZ VCXO ASSEMBLY	28480	86701-60020
A3A1A2C1	0121-0495	5	3	CAPACITOR-V TRMR-AIR 1.9-15.7PF 175V	74970	187-0309-125
A3A1A2C2	0121-0495	5		CAPACITOR-V TRMR-AIR 1.9-15.7PF 175V	74970	187-0309-125
A3A1A2C3	0121-0495	5		CAPACITOR-V TRMR-AIR 1.9-15.7PF 175V	74970	187-0309-125
A3A1A2C4	0121-0453	5	1	CAPACITOR-V TRMR-AIR 1.3-5.4PF 175V	74970	187-0303-125
A3A1A2C5	0180-0049	9	1	CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A3A1A2C6	0160-3456	6	3	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3A1A2C7	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C8*	0160-2259	5	1	CAPACITOR-FXD 12PF +-5% 500VDC CER 0+-30	28480	0160-2259
A3A1A2C9	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A1A2C10	0140-0191	8	1	CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300WV1CR
A3A1A2C11	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A2C12	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C13	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C14	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C15	0160-2261	9	8	CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C16	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C17	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C18	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C19	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C20	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C21	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C22	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C23	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C24	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C25	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C26	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C27	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C28	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C29	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C30	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C31	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C32	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C33	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A3A1A2C34	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C35	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C36	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C37	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C38	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C39	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C40	0160-2238	0	1	CAPACITOR-FXD 1.5PF +-.25PF 500VDC CER	28480	0160-2238
A3A1A2C41				NOT ASSIGNED		
A3A1A2C42	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C43	0180-0116	1	12	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A1A2C44	0160-2253	9	1	CAPACITOR-FXD 6.8PF +-.25PF 500VDC CER	28480	0160-2253
A3A1A2C45	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C46	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A2C47	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C48	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3A1A2C49	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3A1A2C50	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A1A2C51	0160-4299	7	11	CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A2C52	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C53	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C54	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C55	0160-3454	4		CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0160-3454
A3A1A2C56	0160-2437	1	13	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A2CR1	0122-0245	5	1	DIODE-VVC 1N5139 6.8PF 10%	01281	1N5139
A3A1A2CR2				NOT ASSIGNED		
A3A1A2CR3	1901-0539	3	2	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A3A1A2CR4	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A3A1A2J1	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A2J2	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A2J3	1250-0544	9		CONNECTOR-RF SM-SNP M SGL-HOLE-FR 50-OHM	28480	1250-0544
A3A1A2J4				PART OF A3A1A2W1		
A3A1A2L1				NOT ASSIGNED		
A3A1A2L2	9100-2249	6	3	INDUCTOR RF-CH-MLD 150NH 10% .105DX.26LG	28480	9100-2249
A3A1A2L3	9140-0158	6	2	INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A3A1A2L4*	9100-2254	3	3	INDUCTOR RF-CH-MLD 390NH 10% .105DX.26LG	28480	9100-2254
A3A1A2L5	9100-2538	6	1	INDUCTOR RF-CH-MLD 1UH 10% .161DX.385LG	28480	9100-2538
A3A1A2L6	9100-2251	0	5	INDUCTOR RF-CH-MLD 220NH 10% .105DX.26LG	28480	9100-2251
A3A1A2L7	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10% .105DX.26LG	28480	9100-2251
A3A1A2L8	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10% .105DX.26LG	28480	9100-2251
A3A1A2L9	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10% .105DX.26LG	28480	9100-2251
A3A1A2L10				PART OF ETCHED CIRCUIT BOARD		
A3A1A2L11				PART OF ETCHED CIRCUIT BOARD		
A3A1A2L12				PART OF ETCHED CIRCUIT BOARD		
A3A1A2L13				NOT ASSIGNED		
A3A1A2L14	9100-2247	4	2	INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A3A1A2L15	9100-2247	4		INDUCTOR RF-CH-MLD 100NH 10% .105DX.26LG	28480	9100-2247
A3A1A2MP1	2190-0019	8		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0018
A3A1A2MP2	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A3A1A2MP3	1200-0173	5	3	INSULATOR-XSTR DAP-GL	28480	1200-0173
A3A1A2MP4	2200-0139	4		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0139
A3A1A2MP5	86701-60073	7	1	SHIELD ASSEMBLY	28480	86701-60073
A3A1A2MP6	86701-20039	1	1	COVER- P.C. VCXO BOARD	28480	86701-20039
A3A1A2MP7	86701-40001	9		EXTRACTOR-P.C. BOARD	28480	86701-40001
A3A1A2MP8	1400-0401	6	1	CABLE TIE .75-DIA .094-WD NYL	28480	1400-0401
A3A1A2MP8	2580-0002	4	4	NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
A3A1A2Q1	1854-0345	8	16	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q5	1854-0247	9	5	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A1A2Q6	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q7	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q8	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q9	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2Q10	1854-0404	0	16	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A1A2Q11	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A2R1	0757-0279	0	5	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A1A2R2	0757-0419	0	4	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A3A1A2R3	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A1A2R4	0757-0422	5	8	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R5	0698-3155	1	9	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A1A2R6	0698-7224	3	6	RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A3A1A2R7	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A2R8	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A2R10	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R11	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R12	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R13	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R14	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R15	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R16	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R17	0698-3150	6	18	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R18	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R19	0698-7198	0	2	RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-26R1-F
A3A1A2R20	0698-3443	0	7	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A2R21	0698-3429	2	6	RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A1A2R22	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A3A1A2R23	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R24	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R25	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R26	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R27	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A1A2R28	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R29	0698-7198	0		RESISTOR 26.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-26R1-F
A3A1A2R30	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A3A1A2R31	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A1A2R32	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A3A1A2R33	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A3A1A2R34	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A1A2R35	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A3A1A2R36	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R37	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R38	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R39	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R40	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R41	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R42	0698-0084	9	7	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A1A2R43	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A1A2R44	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A1A2R45	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A1A2R46	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A1A2R47	0757-0439	4	3	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A3A1A2R48	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R49	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A1A2R50	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A3A1A2R51	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A2R52	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A2R53	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R54	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1A2R55	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A1A2R56	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R57	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R58	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R59	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A1A2R60	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A2R61	0698-3441	8	2	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A3A1A2R62	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A2R63				NOT ASSIGNED		
A3A1A2R64				NOT ASSIGNED		
A3A1A2R65				NOT ASSIGNED		
A3A1A2R66				NOT ASSIGNED		
A3A1A2R67*	0757-0402	1	3	RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3A1A2R68*	0757-0276	7	4	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A3A1A2R69*	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3A1A2T1	86701-60081	7	3	TRANSFORMER-RF, BLUE	28480	86701-60081
A3A1A2T2	86701-60081	7		TRANSFORMER-RF, BLUE	28480	86701-60081
A3A1A2T3	86701-60081	7		TRANSFORMER-RF, BLUE	28480	86701-60081
A3A1A2TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A2W1	86701-60031	7	1	CABLE ASSEMBLY-GRAY/RED/WHITE	28480	86701-60031
A3A1A2Y1	0410-1086	5	1	CRYSTAL-QUARTZ 100.00 MHZ HC-35/U-HLDR	28480	0410-1086
A3A1A3	86701-60077	1	1	M/N PHASE DETECTOR ASSEMBLY	28480	86701-60077
A3A1A3C1	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C2	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C3	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C4	0180-1731	8	5	CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A1A3C5	0160-0157	8	2	CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A3C6	0160-0161	4	4	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A3C7	0160-0157	8		CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A3A1A3C8	0160-3535	2	2	CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-3535
A3A1A3C9	0160-3535	2		CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-3535
A3A1A3C10	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A3C11	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C12	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C13	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C14	0160-2406	4	1	CAPACITOR-FXD .27UF +-10% 80VDC POLYE	28480	0160-2406
A3A1A3C15	0160-3877	5	2	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A3A1A3C16	0140-0196	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A3A1A3C17	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A3C18	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C19	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C20	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A3C21	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C22	0160-4299	7		CAPACITOR-FXD 2200PF +-20% 250VDC CER	56289	C067F251F222MS22-CDH
A3A1A3C23	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A3C24	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A3A1A3C25	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A3C26	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A3L1	9100-1641	0	7	INDUCTOR RF-CH-MLD 240UH 5% .166DX.385LG	28480	9100-1641
A3A1A3L2	9100-2259	8	2	INDUCTOR RF-CH-MLD 1.5UH 10% .105DX.26LG	28480	9100-2259
A3A1A3L3	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5% .166DX.385LG	28480	9100-1641
A3A1A3L4	9100-2562	6	2	INDUCTOR RF-CH-MLD 100UH 10% *	28480	9100-2562
A3A1A3L5	9100-2562	6		INDUCTOR RF-CH-MLD 100UH 10%	28480	9100-2562
A3A1A3MP1	0520-0128	7	2	SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A1A3MP2	0520-0175	4	1	SCREW-MACH 2-56 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A1A3MP3	0590-0533	5	1	THREADED INSERT-NUT 2-56 .06-IN-LG SST	28480	0590-0533
A3A1A3MP4	1205-0285	0	1	HEAT SINK SGL DIP	28480	1205-0285
A3A1A3MP5				NOT ASSIGNED		
A3A1A3MP6	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A3A1A3MP7	2200-0139	4		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0139
A3A1A3MP8	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A3A1A3MP9	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A3A1A3MP10	6040-0239	9		LUBRICANT-GREASE SIL	05820	120
A3A1A3MP11	86701-00032	2	1	BRACKET-HEAT SINK	28480	86701-00032
A3A1A3MP12	86701-00033	3	1	BRACKET-HS	28480	86701-00033
A3A1A3MP13	86701-20038	0	1	COVER-P.C. M/N DETECTOR	28480	86701-20038
A3A1A3MP14	86701-40001	9		EXTRACTOR-P.C. BOARD	28480	86701-40001
A3A1A3MP15	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
A3A1A3MP16	2190-0890	1	10	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0890
A3A1A3Q1	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A3Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A1A3R1	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A3R2	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A3R3				NOT ASSIGNED		
A3A1A3R4	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A3R5	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A3R6				NOT ASSIGNED		
A3A1A3R7	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A3R8	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A3R9	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3A1A3R10	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3A1A3R11	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A3R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A3R13	0698-3260	9	1	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A3A1A3R14	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A3R15	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A1A3R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1A3R17	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A3R18	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A3R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A3R20	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A3R21	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A3R22	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A3R23	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A3A1A3R24	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A3A1A3R25	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A1A3R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A3R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A3R28	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A1A3TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3TP11	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A3U1	1820-1344	8	2	IC PL LOOP 14-DIP-C PKG	04713	MC12040L
A3A1A3U2	1820-1225	4	2	IC FF ECL D-M/S DUAL	04713	MC10231P
A3A1A3U3	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U4	1820-0820	3	2	IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
A3A1A3U5	1810-0251	3	3	NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0251
A3A1A3U6	1810-0204	6	7	NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A3A1A3U7	1826-0092	3	4	IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A1A3U8	1820-0821	4	2	IC CNTR ECL BIN UP/DOWN SYNCHRO	04713	MC10136L
A3A1A3U9	1810-0204	6		NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A3A1A3U10	1810-0204	6		NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A3A1A3U11	1820-0806	5	2	IC GATE ECL OR-NOR DUAL 4-5-INP	04713	MC10109P
A3A1A3U12	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U13	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A3A1A3U14	1810-0251	3		NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0251
A3A1A3U15	1826-0059	2	1	IC OP AMP GP TO-99 PKG	01295	LM201AL
A3A1A3U16	1810-0204	6		NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A3A1A3U17	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3U18	1820-0820	3		IC FF ECL J-BAR K-BAR COM CLOCK DUAL	04713	MC10135L
A3A1A3U19	1820-0821	4		IC CNTR ECL BIN UP/DOWN SYNCHRO	04713	MC10136L
A3A1A3U20	1810-0204	6		NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A3A1A3U21	1810-0204	6		NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A3A1A3U22	1810-0251	3		NETWORK-RES 10-SIP MULTI-VALUE	28480	1810-0251
A3A1A3U23	1820-0806	5		IC GATE ECL OR-NOR DUAL 4-5-INP	04713	MC10109P
A3A1A3U24	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A1A3VR1	1902-3082	9		DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
A3A1A3W1	86701-60051	1	1	CABLE ASSEMBLY- WHITE/RED	28480	86701-60051
A3A1A3W2	86701-60060	2	1	CABLE ASSEMBLY-GRAY/WHITE	28480	86701-60060
A3A1A4	86701-60029	3	1	M/N VCO ASSEMBLY	28480	86701-60029
A3A1A4	86701-60071	5	1	M/N VCO ASSEMBLY (RESTORED 86701-60029)	28480	86701-60071
A3A1A4MP1	0362-0227	1	1	CONNECTOR-SGL CONT SKT 1.14-MM-BSC-SZ	28480	0362-0227
A3A1A4MP2	0520-0165	2	1	SCREW-MACH 2-56 .312-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A3A1A4MP3	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A3A1A4MP4	2200-0167	8	2	SCREW-MACH 4-40 .375-IN-LG 82 DEG	28480	2200-0167
A3A1A4A1				VCO RESONATOR ASSY (NSR)		
A3A1A4A2	86701-60027	1	1	BOARD ASSEMBLY-M/N VCO	28480	86701-60027
A3A1A4A2C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A4A2C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C5	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A1A4A2C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A4A2C8	0160-3873	1	1	CAPACITOR-FXD 4.7PF +-.5PF 200VDC CER	28480	0160-3873
A3A1A4A2C9	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A4A2C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A4A2C11	0180-2161	0	1	CAPACITOR-FXD .75UF+-10% 50VDC TA	56289	150D754X9050A2
A3A1A4A2L1	9140-0770	8	4	INDUCTOR RF-CH-MLD 50NH 10% 105DX.26LG	28480	9140-0770
A3A1A4A2L2	9140-0770	8		INDUCTOR RF-CH-MLD 50NH 10% 105DX.26LG	28480	9140-0770
A3A1A4A2L3	86701-20051	7	1	INDUCTOR	28480	86701-20051
A3A1A4A2L4	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A3A1A4A2Q1	1854-0610	0	1	TRANSISTOR NPN SI TO-46 FT=800MHZ	28480	1854-0610
A3A1A4A2Q2	1854-0686	0	1	TRANSISTOR NPN SI TO-72 PD=200MW FT=4GHZ	28480	1854-0686
A3A1A4A2R1	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A1A4A2R2	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A4A2R3	0698-7193	5	1	RESISTOR 16.2 1% .05W F TC=0+-100	24546	C3-1/8-T0-16R2-F
A3A1A4A2R4	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A1A4A2R5	0757-0428	1	6	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A1A4A2R6	0698-7262	9	1	RESISTOR 12.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1212-F
A3A1A4A2R7	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A1A4A2R8	0698-7254	9	1	RESISTOR 5.62K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5621-F
A3A1A4A2R9	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A4A2R10	0698-7265	2	1	RESISTOR 16.2K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1622-F
A3A1A4A2R11	0698-7250	5	1	RESISTOR 3.83K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3831-F
A3A1A4A2R12	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A1A4A2R13	0757-0400	9	1	RESISTOR 90.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-90R9-F
A3A1A4A2TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A4A2TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A4A2TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A4A2W1	86701-60058	9	1	CABLE ASSEMBLY-VCO OUTPUT	28480	86701-60058
A3A1A4A2W2	86701-20050	6	1	CABLE- S/R JUMPER	28480	86701-20050
A3A1A4A2MP1	0590-0526	6		THREADED INSERT-NUT 4-40 .065-IN-LG SST	28480	0590-0526
A3A1A4A2MP2	86701-20052	8	1	SPACER-INSULATOR	28480	86701-20052
A3A1A4A2MP3	1251-2313	6		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A3A1A5	86701-60065	7	1	M/N OUTPUT ASSEMBLY (INC. A3A1A4)	28480	86701-60065
A3A1A5C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C3	0160-2255	1	1	CAPACITOR-FXD 8.2PF +-.25PF 500VDC CER	28480	0160-2255
A3A1A5C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C6				NOT ASSIGNED		
A3A1A5C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C8	0140-0192	9	2	CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A3A1A5C9	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A3A1A5C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A5C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A5C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A5C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A1A5C14	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C15	0160-3451	1	8	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A1A5C16	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C18	0160-2257	3	1	CAPACITOR-FXD 10PF +-5% 500VDC CER 0+-60	28480	0160-2257
A3A1A5C19	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A1A5C20	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C21	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C22	0160-2266	4	1	CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A3A1A5C23				NOT ASSIGNED		
A3A1A5C24	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A5C25	0160-0153	4	1	CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A3A1A5C26	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A3A1A5C27	0160-3534	1	1	CAPACITOR-FXD 510PF +-5% 100VDC MICA	28480	0160-3534
A3A1A5C28	0160-0298	8	1	CAPACITOR-FXD 1500PF +-10% 200VDC POLYE	28480	0160-0298
A3A1A5C29	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A5C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A1A5C31	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1A5C32	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C33	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C34	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A1A5C35	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
***Indicates factory selected value**

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A5C36	0140-0192	9		CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A3A1A5C37	0160-4351	2	1	CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4351
A3A1A5C38*	0160-2306	3	1	CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0160-2306
A3A1A5J1	1250-0657	5	3	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0657
A3A1A5J2	1250-0657	5		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0657
A3A1A5J3	1250-0657	5		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0657
A3A1A5J4	1250-1255	1	1	CONNECTOR-RF SMB M PC 50-OHM	28480	1250-1255
A3A1A5L1	9140-0770	8		INDUCTOR RF-CH-MLD 50NH 10% .105DX.26LG	28480	9140-0770
A3A1A5L2	9135-0081	3	1	INDUCTOR RF-CH-MLD 68NH 5% .102DX.26LG	28480	9135-0081
A3A1A5L3				NOT ASSIGNED		
A3A1A5L4	9100-2248	5	2	INDUCTOR RF-CH-MLD 120NH 10% .105DX.26LG	28480	9100-2248
A3A1A5L5	9140-0771	9	2	INDUCTOR RF-CH-MLD 51NH 5% .102DX.26LG	28480	9140-0771
A3A1A5L6	9100-1635	2	1	INDUCTOR RF-CH-MLD 91UH 5% .166DX.385LG	28480	9100-1635
A3A1A5L7	9100-1634	1	1	INDUCTOR RF-CH-MLD 75UH 5% .166DX.385LG	28480	9100-1634
A3A1A5L8	9100-1620	5	4	INDUCTOR RF-CH-MLD 15UH 10% .166DX.385LG	28480	9100-1620
A3A1A5L9	9140-0210	1	1	INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A3A1A5L10	9140-0771	9		INDUCTOR RF-CH-MLD 51NH 5% .102DX.26LG	28480	9140-0771
A3A1A5L11	9100-2248	5		INDUCTOR RF-CH-MLD 120NH 10% .105DX.26LG	28480	9100-2248
A3A1A5MP1	0360-0452	0	1	TERMINAL-SLDR LUG PL-MTG FOR-#10-SCR	28480	0360-0452
A3A1A5MP2	2190-0009	4	1	WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
A3A1A5MP3	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A3A1A5MP4	2200-0101	0	1	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A1A5MP5	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A3A1A5MP6	2200-0167	8		SCREW-MACH 4-40 .375-IN-LG 82 DEG	28480	2200-0167
A3A1A5MP7	2580-0002	4		NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
A3A1A5MP8	86701-20056	2	1	COVER (BOTTOM)	28480	86701-20056
A3A1A5MP9	86701-00041	3	1	COVER (TOP)	28480	86701-00041
A3A1A5MP10	86701-40001	9		EXTRACTOR-P.C. BOARD	28480	86701-40001
A3A1A5MP11	86701-20037	9	1	COVER-P.C. M/N MOUNT	28480	86701-20037
A3A1A5MP12	86701-20057	3	1	SHIELD-HOUSING	28480	86701-20057
A3A1A5MP13	86701-00061	7	1	GROUND STRAP	28480	86701-00061
A3A1A5MP14	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
A3A1A5MP15	2200-0139	4		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0139
A3A1A5MP16	3050-0079	3	3	WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
A3A1A5MP17	2950-0078	9		NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A3A1A5Q1	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q2	1853-0015	7	2	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A3A1A5Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A1A5Q5	1854-0546	1	5	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5Q6	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5Q7	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5Q8	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5Q9	1854-0546	1		TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0546
A3A1A5R1	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R2	0698-7248	1	5	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R3	0698-7243	6	5	RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R4	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A5R5	0698-7223	2	3	RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-T0-287R-F
A3A1A5R6	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R7	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R8	0698-7203	8	1	RESISTOR 42.2 1% .05W F TC=0+-100	24546	C3-1/8-T0-42R2-F
A3A1A5R9	0698-7218	5	1	RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-F
A3A1A5R10	0698-7188	8	5	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R11	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A3A1A5R12	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-F
A3A1A5R13	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-F
A3A1A5R14	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R15	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A1A5R16	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T0-10R-F
A3A1A5R17	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R18	0698-7208	3	1	RESISTOR 68.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-68R1-F
A3A1A5R19	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A1A5R20	0698-7222	1		RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A5R21	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-TO-287R-F
A3A1A5R22	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-TO-10R-F
A3A1A5R23	0698-7229	8	3	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A3A1A5R24	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-TO-100R-F
A3A1A5R25	0698-7247	0	1	RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-TO-2871-F
A3A1A5R26	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-TO-1961-F
A3A1A5R27	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-TO-3161-F
A3A1A5R28	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-TO-511R-F
A3A1A5R29	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-TO-1961-F
A3A1A5R30	0698-7200	5	1	RESISTOR 31.6 1% .05W F TC=0+-100	24546	C3-1/8-TO-31R6-F
A3A1A5R31	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-TO-316R-F
A3A1A5R32	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-TO-10R-F
A3A1A5R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A3A1A5R34	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3161-F
A3A1A5R35				NOT ASSIGNED		
A3A1A5R36*	0698-7210	7	1	RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-TO-82R5-F
A3A1A5R37	0698-7223	2		RESISTOR 287 1% .05W F TC=0+-100	24546	C3-1/8-TO-287R-F
A3A1A5R38				NOT ASSIGNED		
A3A1A5R39	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-TO-3161-F
A3A1A5R40*	0698-7205	0	5	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A3A1A5R41*	0698-7212	9	12	RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-TO-100R-F
A3A1A5R42	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-TO-51R1-F
A3A1A5U1	0955-0063	0	1	MIXER-DOUBLE BALANCE	28480	0955-0063
A3A1A5U2	1820-2642	1	1	IC CNTR ECL BIN DUAL	28480	1820-2642
A3A1A5VR1	1902-3070	5	2	DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A3A1A5VR2	1902-3070	5		DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A3A1A5W1	86701-20055	1	1	JUMPER-COAX	28480	86701-20055
A3A1A6	86701-60022	6	1	M/N REFERENCE MOTHER BOARD ASSEMBLY	28480	86701-60022
A3A1A6C1	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C2	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C3	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C4	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C5	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C6	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C7	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C8	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C9	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C10	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C11	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6C12	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A3A1A6MP1	0360-1514	7	1	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3A1A6MP2	2190-0843	4	1	WASHER-LK INTL T NO. 8 .165-IN-ID	28480	2190-0843
A3A1A6MP3	2580-0002	4		NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
A3A1A6MP4	86701-00031	1	1	INSULATOR	28480	86701-00031
A3A1A6MP5	86701-00046	8	1	INSULATOR	28480	86701-00046
A3A1A6TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A6TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A6TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A6TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A6TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A6TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A1A6XA3A1A	5060-0112	8	2	CONNECTOR-15 CONTACTS	28480	5060-0112
A3A1A6XA3A1B	5060-0112	8		CONNECTOR-15 CONTACTS	28480	5060-0112
A3A1A6XA3A1A1	1251-4423	3	1	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-4423
A3A1A6XA3A1A2	1251-4174	1	2	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-4174
A3A1A6XA3A1A3	1251-2035	9	3	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A3A1A6XA3A1A5	1251-4174	1		CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-4174
A3A1A7MP1	5021-3208	7	2	HOUSING-REF BLK	28480	5021-3208
A3A1A7MP2	86701-00024	2	2	SCOOP, AIR	28480	86701-00024
A3A1A7MP3	86701-00029	7	2	BAFFLE, AIR, TOP	28480	86701-00029
A3A1A7MP4	86701-00030	0	2	BAFFLE, AIR, BOTTOM	28480	86701-00030
A3A1A7MP5	2200-0105	4	59	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A1A7MP6	85660-20090	2	4	STEP WASHER	28480	85660-20090
A3A1A7MP7	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A3A1A7MP8	0570-0632	3	1	SCREW-SPCL 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A2				NOT ASSIGNED		
A3A3	86701-60090	8	1	POSITIVE REGULATOR ASSEMBLY	28480	86701-60090
A3A3C1	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	150D334X9035A2
A3A3C2	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A3C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A3C4	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A3C5	0180-0228	6	11	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A3C6	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A3C7	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A3C8	0160-3460	2	5	CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A3C9	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A3C10	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A3C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A3C12	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A3C13	0160-0127	2	6	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A3C14	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A3C15	0160-4298	6	2	CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A3A3C16	0180-0491	5	3	CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A3A3CR1	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A3CR2	1884-0046	9	1	THYRISTOR-SCR VRRM=50	03508	C230F
A3A3CR3	1990-0487	7		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4584
A3A3CR4	1901-0033	2	21	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR8	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR9	1990-0404	8	5	LED-LAMP LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A3CR10	1990-0404	8		LED-LAMP LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A3CR11	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3CR12	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A3F1	2110-0036	9	1	FUSE 8A 250V NTD 1.25X.25 UL IEC	75915	312008
A3A3F2	2110-0003	0	1	FUSE 3A 250V NTD 1.25X.25 UL	75915	312003
A3A3MP1	0520-0128	7		SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A3MP2	2190-0014	1	1	WASHER-LK INTL T NO. 2 .089-IN-ID	28480	2190-0014
A3A3MP3	2190-0027	6	1	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0027
A3A3MP4	2950-0051	8	1	NUT-HEX-DBL-CHAM 1/4-28-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A3A3MP5	5000-9043	6		PIN-P.C. BOARD EXTRACTOR	28480	5000-9043
A3A3MP6	5040-6843	2		BOARD EXTRACTOR	28480	5040-6843
A3A3MP7	86701-20036	8	1	MOUNTING BLOCK-DIODE	28480	86701-20036
A3A3MP8	1200-0081	4		INSULATOR-FLG-BSHG NYLON	28480	1200-0081
A3A3Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A3Q3	1853-0012	4	3	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3A3Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q5	1854-0441	5	2	TRANSISTOR NPN SI PD=5.8W FT=800KHZ	28480	1854-0441
A3A3Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q7	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q8	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A3Q9	1854-0005	7	1	TRANSISTOR NPN 2N708 SI TO-18 PD=360MW	04713	2N708
A3A3Q10	1854-0039	7	1	TRANSISTOR NPN 2N3053S SI TO-39 PD=1W	3L585	2N3053S
A3A3R1	0757-0443	0	3	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3A3R2	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A3R3	0811-1659	8	1	RESISTOR .27 5% 2W PW TC=0+-800	75042	BWH2-27/100-J
A3A3R4	0757-0418	9	3	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3A3R5	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3A3R6	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A3R7	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R8	0698-3442	9	2	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A3A3R9	0698-8465	6	1	RESISTOR 7.15K .5% .125W F TC=0+-50	28480	0698-8465
A3A3R10	0698-6835	0	9	RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A3R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A3R12	0757-0278	9	4	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3A3R13	0683-0275	9	5	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3A3R14	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A3R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A3R16	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3A3R17	0698-3162	0	2	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A3A3R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A3R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A3R20	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A3R21	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A3A3R22	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A3R23	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3A3R24	0698-3629	4	1	RESISTOR 270 5% 2W MO TC=0+-200	28480	0698-3629
A3A3R25	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A3R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A3R27	0812-0019	4	3	RESISTOR .33 5% 3W PW TC=0+-90	28480	0812-0019
A3A3R28	0812-0019	4		RESISTOR .33 5% 3W PW TC=0+-90	28480	0812-0019
A3A3R29	0812-0019	4		RESISTOR .33 5% 3W PW TC=0+-90	28480	0812-0019
A3A3R30	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A3A3R31	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A3R32	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A3R33	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A3R34	0698-8466	7	1	RESISTOR 942 .5% .125W F TC=0+-50	28480	0698-8466
A3A3R35	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A3R36	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A3R37	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3A3R38	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A3R39	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A3R40	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A3R41	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R42	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3A3R43*	0698-3156	2	3	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3A3R44	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A3A3R45	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R46	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R47	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A3A3R48	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R49	0698-8464	5	2	RESISTOR 12.6K .5% .125W F TC=0+-50	28480	0698-8464
A3A3R50	2100-3095	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 17-TRN	02111	43P201
A3A3R51	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A3R52	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A3R53	0698-4405	6	1	RESISTOR 107 1% .125W F TC=0+-100	24546	C4-1/8-T0-107R-F
A3A3R54	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A3R55	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A3R56	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A3R57	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A3R58	0698-3634	1	1	RESISTOR 470 5% 2W MO TC=0+-200	28480	0698-3634
A3A3R59	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A3A3R60	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A3R61	0698-3631	8	1	RESISTOR 330 5% 2W MO TC=0+-200	28480	0698-3631
A3A3RT1	0837-0126	6	1	THERMISTOR DISC 1K-OHM TC=-4.4%/C-DEG	28480	0837-0126
A3A3TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A3U1	1826-0161	7	1	IC OP AMP GP QUAD 14-DIP-P PKG	04713	MLM324P
A3A3U2	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A3U3	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A3VR1	1902-3171	7	2	DIODE-ZNR 11V 5% DO-35 PD=.4W TC=+.062%	28480	1902-3171
A3A3VR2	1902-0686	3	2	DIODE-ZNR 6.2V 2% DO-7 PD=.4W TC=+.002%	04713	1N825
A3A3VR3	1902-3252	5	1	DIODE-ZNR 22.6V 2% DO-35 PD=.4W	28480	1902-3252
A3A3VR4	1902-0049	2	2	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A3A3VR5	1902-0686	3		DIODE-ZNR 6.2V 2% DO-7 PD=.4W TC=+.002%	04713	1N825
A3A3VR6	1902-3082	9		DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
A3A3XF1	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
A3A3XF2	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
A3A4	86701-60078	2	1	NEGATIVE REGULATOR ASSEMBLY	28480	86701-60078
A3A4C1	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A4C2	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A4C3	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A4C4	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A4C5	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A4C6	0160-2199	2		CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A3A4C7	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A4C8	0180-1731	8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A4C9	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A4C10	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A4C11	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A4C12	0160-0575	4	2	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3A4C13	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A4C14	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A4C15	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A4C16	0180-0100	3	1	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A3A4CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR2	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR3	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR4	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR8	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A4CR9	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A4CR10	1990-0404	8		LED-LAMP LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A4CR11	1990-0404	8		LED-LAMP LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A4CR12	1901-0662	3		DIODE-PWR RECT 100V 6A	04713	MR751
A3A4CR13	1990-0404	8		LED-LAMP LUM-INT=300UCD IF=50MA-MAX	28480	5082-4480
A3A4CR14	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A4CR15	1901-0743	1	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	01295	1N4004
A3A4CR16- A3A4CR24			11	NOT ASSIGNED		
A3A4CR25	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A4CR26	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A4CR27	1884-0018	5		THYRISTOR-SCR 2N4186 VRRM=200	04713	2N4186
A3A4F1	2110-0083	6	1	FUSE 2.5A 250V NTD 1.25X.25 UL	28480	2110-0083
A3A4F2	2110-0043	8	1	FUSE 1.5A 250V NTD 1.25X.25 UL	28480	2110-0043
A3A4F3	2110-0010	9	1	FUSE 5A 250V NTD 1.25X.25 UL	75915	312005
A3A4K1	0490-0916	6	1	RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-0916
A3A4MP1	5000-9043	6		PIN-P.C. BOARD EXTRACTOR	28480	5000-9043
A3A4MP2	5040-6843	2		BOARD EXTRACTOR	28480	5040-6843
A3A4MP3	1200-0081	4		INSULATOR-FLG-BSHG NYLON	28480	1200-0081
A3A4Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A4Q2	1854-0441	5		TRANSISTOR NPN SI PD=5.8W FT=800KHZ	28480	1854-0441
A3A4Q3	1853-0001	1	1	TRANSISTOR PNP SI TO-39 PD=600MW	28480	1853-0001
A3A4Q4	1853-0007	7	6	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A4Q5	1854-0271	9	1	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0271
A3A4Q6	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A4Q7	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A4R1	0812-0020	7	2	RESISTOR .39 5% 3W PW TC=0+-90	91637	CW2B1-3-T2-39/100-J
A3A4R2	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A4R3	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A4R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A4R5	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R6	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R7	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R8	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3A4R9	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A4R10	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A4R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A4R12	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A4R13	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A3A4R14	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A4R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A4R16	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A4R17	0811-1665	6	1	RESISTOR .82 5% 2W PW TC=0+-800	75042	BWH2-82/100-J
A3A4R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A4R19	0698-3449	6		RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A3A4R20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A4R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A4R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A4R23	0812-0020	7		RESISTOR .39 5% 3W PW TC=0+-90	91637	CW2B1-3-T2-39/100-J
A3A4R24	0698-8464	5		RESISTOR 12.6K .5% .125W F TC=0+-50	28480	0698-8464
A3A4R25	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R26	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R27	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3A4R28	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A4R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A4R30	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A4R31	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A4R32	0812-0066	1	3	RESISTOR .33 5% 2W PW TC=0+-800	75042	BWH2-33/100-J
A3A4R33	0812-0066	1		RESISTOR .33 5% 2W PW TC=0+-800	75042	BWH2-33/100-J
A3A4R34	0812-0066	1		RESISTOR .33 5% 2W PW TC=0+-800	75042	BWH2-33/100-J
A3A4R35	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A4R36	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A4R37	0698-6835	0		RESISTOR 3.16K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-3161-D
A3A4R38	0698-7050	3	1	RESISTOR 4.48K .5% .125W F TC=0+-50	28480	0698-7050
A3A4R39	0698-6853	2	1	RESISTOR 7.68K .5% .125W F TC=0+-50	24546	NC55-1/8-T2-7681-D
A3A4R40	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A3A4R41	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A4R42	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A3A4R43	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A4R44	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A4R45	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A4R46	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A4R47	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A4R48	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A4TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A4U1	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A4U2	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A4U3	1820-0223	0		IC OP AMP GP TO-99 PKG	3L585	CA301AT
A3A4VR1	1902-0025	4	2	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A3A4VR2	1902-3171	7		DIODE-ZNR 11V 5% DO-35 PD=.4W TC=+.062%	28480	1902-3171
A3A4VR3	1902-3330	0	1	DIODE-ZNR 44.2V 2% DO-35 PD=.4W	28480	1902-3330
A3A4VR4	1902-0049	2		DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A3A4XF1	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
A3A4XF2	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
A3A4XF3	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A5	86701-60015	7	1	DAC ASSY (DIGITAL-TO-ANALOG CONVERTER)	28480	86701-60015
A3A5C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C2	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A5C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C4	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A3A5C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C6	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A5C7	0180-1731	8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A5C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C9	0180-1731	8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A5C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A5C11	0180-2141	6	1	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A3A5C12	0160-0160	3	1	CAPACITOR-FXD 8200PF +-10% 200VDC POLYE	28480	0160-0160
A3A5L1	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5% .166DX.385LG	28480	9100-1641
A3A5L2	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5% .166DX.385LG	28480	9100-1641
A3A5L3	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5% .166DX.385LG	28480	9100-1641
A3A5MP1	5000-9043	6		PIN-P.C. BOARD EXTRACTOR	28480	5000-9043
A3A5MP2	5040-6843	2		EXTRACTOR- P.C. BOARD	28480	5040-6843
A3A5Q1	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A5Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q3	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A5Q5	1854-0712	3	3	TRANSISTOR-DUAL NPN PD=1.8W	28480	1854-0712
A3A5Q6	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q7	1854-0474	4	1	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A3A5Q8	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A5Q9	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q10	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5Q11	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A5Q12	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A5R1	0811-3404	5	1	RESISTOR 3.55K .1% .05W PWW TC=0+-5	28480	0811-3404
A3A5R2	0811-3358	8	1	RESISTOR 7.2K .1% .05W PWW TC=0+-5	28480	0811-3358
A3A5R3	2100-1654	8	2	RESISTOR-TRMR 100 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-101
A3A5R4	2100-1448	8	1	RESISTOR-TRMR 200 5% WW SIDE-ADJ 22-TRN	32997	3057Y-1-201
A3A5R5	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A3A5R6	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A5R7	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A3A5R8	0757-0290	5	3	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3A5R9	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A5R10	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R11	0811-3357	7	2	RESISTOR 6.25K .1% .05W PWW TC=0+-5	28480	0811-3357
A3A5R12	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R13	2100-1657	1	1	RESISTOR-TRMR 1K 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-102
A3A5R14	0811-3359	9	5	RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R15	0811-3357	7		RESISTOR 6.25K .1% .05W PWW TC=0+-5	28480	0811-3357
A3A5R16	0699-0271	8	1	RESISTOR 715 .1% .125W F TC=0+-25	28480	0699-0271
A3A5R17	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R18	2100-1654	8		RESISTOR-TRMR 100 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-101
A3A5R19	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R20	2100-1656	0	4	RESISTOR-TRMR 500 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-501
A3A5R21	0811-3360	2	1	RESISTOR 25K .1% .05W PWW TC=0+-5	28480	0811-3360
A3A5R22	2100-1656	0		RESISTOR-TRMR 500 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-501
A3A5R23	0811-3361	3	1	RESISTOR 50K .1% .05W PWW TC=0+-5	28480	0811-3361
A3A5R24	2100-1658	2	1	RESISTOR-TRMR 2K 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-202
A3A5R25	0811-2919	5	1	RESISTOR 100K .1% .125W PWW TC=0+-5	54294	SP70-1/16-C-1003-B
A3A5R26	0811-2037	8	1	RESISTOR 2.4K 1% .25W PWW TC=0+-10	20940	143-D-2401-F
A3A5R27	0811-3235	0	1	RESISTOR 7.5K 1% .05W PWW TC=0+-10	20940	140-1/20-7501-F
A3A5R28	0698-6358	2	1	RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-6358
A3A5R29	2100-1656	0		RESISTOR-TRMR 500 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-501
A3A5R30	0811-1185	5	1	RESISTOR 10K .01% .05W PWW TC=0+-10	20940	140-1/20-1002-T
A3A5R31	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R32	0811-3138	2	1	RESISTOR 25K .1% .125W PWW TC=0+-10	20940	114-1/16-2502-B
A3A5R33	0811-0647	2	1	RESISTOR 50K .1% .125W PWW TC=0+-10	28480	0811-0647
A3A5R34	0698-8319	9	1	RESISTOR 10K 1% .1W F TC=0+-10	19701	5023Z1/8-T13-1002-F
A3A5R35	0811-3362	4	1	RESISTOR 825 .1% .05W PWW TC=0+-10	28480	0811-3362

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A5R36	0698-3193	7	1	RESISTOR 10K .25% .125W F TC=0+-50	28480	0698-3193
A3A5R37	0811-3359	9		RESISTOR 12.5K .1% .05W PWW TC=0+-5	28480	0811-3359
A3A5R38	0698-3235	8	1	RESISTOR 25K .25% .125W F TC=0+-50	03888	PME55-1/8-T2-2502-C
A3A5R39	0698-3220	1	1	RESISTOR 50K .25% .125W F TC=0+-50	28480	0698-3220
A3A5R40	0698-3190	4	1	RESISTOR 100K .25% .125W F TC=0+-50	28480	0698-3190
A3A5R41	0698-3237	0	1	RESISTOR 5K .25% .125W F TC=0+-50	28480	0698-3237
A3A5R42	2100-1656	0		RESISTOR-TRMR 500 5% WW SIDE-ADJ 22-TRN	32997	3057P-1-501
A3A5R43	0811-2895	6	1	RESISTOR 422 .1% .2W PWW TC=0+-10	14140	1350-1/16-L3-422R-B
A3A5R44	0698-3153	9	3	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3A5R45	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A5R46	0757-0458	7	9	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A5R47	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R48	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R49	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A5R50	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A5R51	0811-3356	6	1	RESISTOR 5.9K .1% .125W PWW TC=0+-5	28480	0811-3356
A3A5R52	0698-6360	6	1	RESISTOR 10K .1% .125W F TC=0+-25	28480	0698-6360
A3A5R53	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A5R54	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A5R55	0811-3325	9	1	RESISTOR 312 .1% .125W PWW TC=0+-10	28480	0811-3325
A3A5R56	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A5R57	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A5R58	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3A5R59	0698-3456	5	1	RESISTOR 287K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2873-F
A3A5R60	0698-3454	3	1	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A3A5R61	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A5U1	1826-0092	3		IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A5U2	1826-0013	8	3	IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A3A5U3	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A3A5U4	1826-0013	8		IC OP AMP LOW-NOISE TO-99 PKG	06665	SSS741CJ
A3A5U5	1901-1011	8	3	DIODE-ARRAY VF DIFF=5MV	28480	1901-1011
A3A5U6	1901-1011	8		DIODE-ARRAY VF DIFF=5MV	28480	1901-1011
A3A5U7	1901-1011	8		DIODE-ARRAY VF DIFF=5MV	28480	1901-1011
A3A5U8	1820-0668	7	3	IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A3A5U9	1820-0668	7		IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A3A5U10	1820-0668	7		IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A3A5VR1	1902-0692	1	1	DIODE-ZNR 6.3V 1% DO-7 PD=.4W TC=+.001%	28480	1902-0692
A3A5VR2	1902-0244	9	1	DIODE-ZNR 30V 5% PD=1W IR=5UA	28480	1902-0244
A3A6	86701-60016	8	1	YTO DRIVER ASSEMBLY	28480	86701-60016
A3A6C1	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C2	0180-1731	8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A3A6C3	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A6C4	0160-0574	3	6	CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A6C5	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A6C6	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C7	0180-2139	2	1	CAPACITOR-FXD 10UF+-20% 60VDC TA	06001	69F177G7
A3A6C8	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C9	0160-3452	2	1	CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3452
A3A6C10	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A3A6C11	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C12	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C13	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A6C14	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A6C15	0180-1748	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A6C16	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C17	0160-3460	2		CAPACITOR-FXD .05UF +80-20% 100VDC CER	28480	0160-3460
A3A6C18	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3A6C19	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A6CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR2	1901-0040	1	18	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A6CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A6CR4				NOT ASSIGNED		
A3A6CR5	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR6	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR7	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A6CR9	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A3A6CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A6MP1	1205-0085	8	1	HEAT SINK TO-66-CS	28480	1205-0085
A3A6MP2	5000-9043	6		PIN-P.C. BOARD EXTRACTOR	28480	5000-9043
A3A6MP3	5040-6843	2		BOARD EXTRACTOR	28480	5040-6843
A3A6MP4	2200-0107	6		SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A6MP5				NOT ASSIGNED		
A3A6MP6	2190-0003	8	4	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0003
A3A6MP7	2260-0001	5	4	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
A3A6Q1	1854-0237	7	1	TRANSISTOR NPN SI TO-66 PD=20W FT=10MHZ	28480	1854-0237
A3A6Q2	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A6Q3	1854-0022	8	2	TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A3A6Q4	1854-0232	2	1	TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
A3A6Q5	1853-0038	4	1	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A3A6Q6	1853-0404	8	1	TRANSISTOR PNP SI PD=500MW FT=1.6GHZ	01295	A5T4260
A3A6Q7	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A6Q8	1854-0022	8		TRANSISTOR NPN SI TO-39 PD=700MW	07263	S17843
A3A6Q9	1854-0712	3		TRANSISTOR-DUAL NPN PD=1.8W	28480	1854-0712
A3A6Q10	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A3A6Q11	1853-0050	0	2	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0050
A3A6Q12	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3A6Q13	1853-0050	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0050
A3A6R1				NOT ASSIGNED		
A3A6R2				NOT ASSIGNED		
A3A6R3	0757-0456	5	1	RESISTOR 43.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4322-F
A3A6R4	0698-4492	1	1	RESISTOR 32.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3242-F
A3A6R5	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A6R6	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A6R7	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A6R8	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A6R9	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A6R10	0757-0465	6	4	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3A6R11	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A6R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A6R13	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A6R14	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A6R15	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A6R16	0811-3440	9	1	RESISTOR 125 1% 25W PW TC=0+-2	28480	0811-3440
A3A6R17	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3A6R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A6R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A6R20	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A6R21	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A6R22	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3A6R23	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A6R24	0811-2936	5	1	RESISTOR 15 .1% .5W PWW TC=0+-5	14140	1251-1/4-C-15R-B
A3A6R25	2100-0635	3	2	RESISTOR-TRMR 2K 10% C SIDE-ADJ 20-TRN	28480	2100-0635
A3A6R26	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A6R27	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A6R28	0757-0467	8	2	RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3A6R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A6R30	0698-8025	4	1	RESISTOR 1.91K .25% .125W F TC=0+-50	19701	MF4C1/8-T2-1911-C
A3A6R31	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A3A6R32	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A6R33	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A6R34	2100-0635	3		RESISTOR-TRMR 2K 10% C SIDE-ADJ 20-TRN	28480	2100-0635
A3A6R35	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A6R36	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A3A6R37	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A6R38	0698-5673	2	1	RESISTOR 3.9K 1% .125W F TC=0+-25	28480	0698-5673
A3A6R39	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A6R40	0698-8420	3	1	RESISTOR 4.22K 1% .125W F TC=0+-25	19701	MF4C1/8-T9-4221-F
A3A6R41	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A6R42	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A6TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A6U1	1826-0092	3		IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A6VR1	1902-0680	7	1	DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	24046	1N827
A3A6VR2	1902-3404	9		DIODE-ZNR 82.5V 5% DO-7 PD=.4W TC=+.082%	28480	1902-3404
A3A6VR3	1902-3323	1	1	DIODE-ZNR 42.2V 5% DO-35 PD=.4W TC=+.08%	28480	1902-3323
A3A6VR4	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A3A7	08673-60017	9	1	FM DRIVER ASSEMBLY	28480	08673-60017
A3A7C1	0160-0578	7	4	CAPACITOR-FXD .047UF +-1% 50VDC	28480	0160-0578
A3A7C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C3	0160-0578	7		CAPACITOR-FXD .047UF +-1% 50VDC	28480	0160-0578
A3A7C4	0160-0573	2	1	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0160-0573
A3A7C5	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A7C6	0160-3874	2	4	CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3A7C7	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A3A7C8	0160-4298	6		CAPACITOR-FXD 4700PF +-20% 250VDC CER	56289	C067F251H472MS22-CDH
A3A7C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A7C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C11	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A7C12	0160-0174	9	1	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3A7C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C14	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A3A7C15	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A7C16	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A7C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C18	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A7C19*	0160-0134	1	1	CAPACITOR-FXD 220PF +-5% 300VDC MICA	28480	0160-0134
A3A7C20	0160-3533	0	1	CAPACITOR-FXD 470PF +-5% 300VDC MICA	28480	0160-3533
A3A7C21	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A7C22	0160-0158	9	1	CAPACITOR-FXD 5600PF +-10% 200VDC POLYE	28480	0160-0158
A3A7C23	0180-1719	2	1	CAPACITOR-FXD 22UF+-10% 25VDC TA	06001	69F1466B
A3A7C24	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C25	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C26	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A7C27	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C28	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A7C29	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A7C30	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A7C31	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C32	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C33	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A7C34	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A7C35	0180-0234	4	1	CAPACITOR-FXD 33UF+-20% 75VDC TA	06001	69F28667
A3A7C36	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A7C37	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C38	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C39	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A3A7C40	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C41	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A7C42	0160-2202	8	1	CAPACITOR-FXD 75PF +-5% 300VDC MICA	28480	0160-2202
A3A7C43	0140-0194	1	2	CAPACITOR-FXD 110PF +-5% 300VDC MICA	72136	DM15F111J0300WV1CR
A3A7C44	0160-3872	0	1	CAPACITOR-FXD 2.2PF +-.25PF 200VDC CER	28480	0160-3872
A3A7C45	0160-0578	7		CAPACITOR-FXD .047UF +-1% 50VDC	28480	0160-0578

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A7C46	0160-0576	7		CAPACITOR-FXD .047UF +-1% 50VDC	28480	0160-0576
A3A7C47	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A7C48*	0160-2248	2	1	CAPACITOR-FXD 4.3PF +-.25PF 500VDC CER	28480	0160-2248
A3A7C49	0160-3491	9	1	CAPACITOR-FXD .47UF +-20% 50VDC CER	28480	0160-3491
A3A7C50	0160-3874	2		CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3A7CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A7K1	0490-0564	0	2	RELAY-REED 1C 350MA 70VAC 5VDC-COIL 10VA	28480	0490-0564
A3A7K2	0490-0564	0		RELAY-REED 1C 350MA 70VAC 5VDC-COIL 10VA	28480	0490-0564
A3A7L1	9100-2259	8		INDUCTOR RF-CH-MLD 1.5UH 10% .105DX.26LG	28480	9100-2259
A3A7MP1	1205-0011	0	2	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A3A7MP2	1205-0037	0	2	HEAT SINK TO-18-CS	28480	1205-0037
A3A7MP3	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A3A7Q1	1854-0013	7	1	TRANSISTOR NPN 2N2218A SI TO-5 PD=800MW	04713	2N2218A
A3A7Q2	1853-0012	4		TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	01295	2N2904A
A3A7Q3	1854-0401	7	1	TRANSISTOR NPN SI TO-72 PD=200MW	28480	1854-0401
A3A7Q4	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A7Q5	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A7Q6	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A7Q7	1854-0023	9	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A3A7Q8	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A7Q9	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A7Q10	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A7Q11	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A7Q12	1855-0020	8	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A3A7Q13	1853-0281	9	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A3A7Q14	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A7Q15	1855-0417	7	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0417
A3A7R1	0757-0447	4	2	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A3A7R2	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A7R3	0757-0443	0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3A7R4	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3A7R5	0698-7277	6	1	RESISTOR 51.1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5112-F
A3A7R6	0698-7258	3	1	RESISTOR 8.25K 1% .05W F TC=0+-100	24546	C3-1/8-T0-8251-F
A3A7R7	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A7R8	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3A7R9	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A3A7R10	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A7R11	0698-3432	7	1	RESISTOR 26.1 1% .125W F TC=0+-100	03888	PME55-1/8-T0-26R1-F
A3A7R12				NOT ASSIGNED		
A3A7R13	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A3A7R14				NOT ASSIGNED		
A3A7R15	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R16	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R17	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R18	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R19	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R20	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R21	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3A7R22	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A7R23	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A3A7R24	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A3A7R25				NOT ASSIGNED		
A3A7R26	0698-7278	5	2	RESISTOR 46.4K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4642-F
A3A7R27	0698-7278	5		RESISTOR 46.4K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4642-F
A3A7R28	2100-3353	8	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A3A7R29	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A7R30	0683-1555	0	2	RESISTOR 1.5M 5% .25W FC TC=-900/+1100	01121	CB1555

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A7R31	0698-4414	7	2	RESISTOR 158 1% .125W F TC=0+-100	24546	C4-1/8-T0-158R-F
A3A7R32	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A7R33	0698-7271	0	1	RESISTOR 28.7K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2872-F
A3A7R34	0698-7283	4	1	RESISTOR 90.9K 1% .05W F TC=0+-100	24546	C3-1/8-T0-9092-F
A3A7R35	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A7R36	0698-7272	1	1	RESISTOR 31.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3162-F
A3A7R37	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A7R38	0757-0316	6	1	RESISTOR 42.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A3A7R39	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A7R40	2100-3354	9	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 1-TRN	28480	2100-3354
A3A7R41	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A7R42	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A3A7R43	0698-3152	8	2	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A3A7R44	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-F
A3A7R45	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A7R46	2100-3350	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A3A7R47	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A7R48	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R49	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A7R50	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R51	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R52	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A7R53	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A7R54	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A7R55	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A3A7R56	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3A7R57	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A7R58	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A7R59	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3A7R60	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A3A7R61*	0698-0083	8	14	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A7R62	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A3A7R63	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A3A7R64				NOT ASSIGNED		
A3A7R65*	0757-0438	3	21	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A7R66	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A3A7R67*	0698-3437	2	1	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A3A7R68	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A3A7R69	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A3A7R70	0757-0424	7	4	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3A7R71	0686-1525	0	1	RESISTOR 1.5K 5% .5W CC TC=0+647	01121	EB1525
A3A7R72	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A7R73	0757-0802	5	2	RESISTOR 162 1% .5W F TC=0+-100	28480	0757-0802
A3A7R74	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A7R75*	0698-6113	7	1	RESISTOR 1.82K .25% .125W F TC=0+-100	28480	0698-6113
A3A7R76				NOT ASSIGNED		
A3A7R77	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A7R78	0757-0802	5		RESISTOR 162 1% .5W F TC=0+-100	28480	0757-0802
A3A7R79	0698-3452	1	1	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A3A7R80	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A7R81	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A3A7R82	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A3A7R83	0683-1555	0		RESISTOR 1.5M 5% .25W FC TC=-900/+1100	01121	CB1555
A3A7R84	0698-4414	7		RESISTOR 158 1% .125W F TC=0+-100	24546	C4-1/8-T0-158R-F
A3A7R85	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A7R86	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A7TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A7TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A7TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A7TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A7TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A7U1	1826-0261	8	1	IC OP AMP LOW-NOISE TO-99 PKG	28480	1826-0261
A3A7U2	1826-0081	0	1	IC OP AMP WB TO-99 PKG	27014	LM318H
A3A7U3	1826-0044	5	2	IC OP AMP GP DUAL 14-DIP-C PKG	07263	UA739DC

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A8	10811-60116	3	1	10 MHZ REF OSC	28480	10811-60116
A3A9C1	0160-3036	8	6	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C2	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C3	0160-4748	1	3	CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4748
A3A9C4	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C5	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C6	0160-4748	1		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4748
A3A9C7	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9C8	0160-4748	1		CAPACITOR-FDTHRU 1000PF 20% 200V CER	28480	0160-4748
A3A9C9	0160-3036	8		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-3036
A3A9J1	1250-0691	7	6	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J2	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J3	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J4	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J5	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9J6	1250-0691	7		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0691
A3A9MP1	0520-0247	1	2	SCREW-MACH 2-56 .625-IN-LG PAN-HD-POZI	28480	0520-0247
A3A9MP2	1250-1142	5	1	WASHER-LK INTL T 1/2 IN .26-IN-ID	28480	1250-1142
A3A9MP3	1250-1143	6	1	NUT-RF CONN,SERIES SMA,HEX,1/4-36 THRD	16179	1707
A3A9MP4	1400-0024	9	1	CLAMP-CABLE .25-DIA .5-WD NYL	28480	1400-0024
A3A9MP5	1251-4459	5	1	CLIP-CABLE PLUG RTNG-DUAL INLINE 14 CONT	28480	1251-4459
A3A9MP6	2190-0018	5	25	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
A3A9MP7	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
A3A9MP8	3050-0105	6	7	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
A3A9MP9	86701-00058	2	1	DECK-YTO PHASE LOCK	28480	86701-00058
A3A9MP10	86701-00010	6	1	COVER-SAMPLER	28480	86701-00010
A3A9MP11	86701-00011	7	1	COVER-PHASE LOCK	28480	86701-00011
A3A9MP12	86701-00054	8	1	SPACER-SAMPLER	28480	86701-00054
A3A9MP13	86701-20009	5	1	HOUSING-CASTING	28480	86701-20009
A3A9MP14	86701-40001	9		EXTRACTOR-P.C. BOARD	28480	86701-40001
A3A9MP15	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A3A9MP16	2200-0138	3	5	SCREW-MACH 4-40 .188-IN-LG 100 DEG	28480	2200-0138
A3A9MP17	2200-0149	6	3	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A9MP18	2360-0115	4	18	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3A9MP19	2360-0197	2	13	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0197
A3A9MP20	3050-0010	2	7	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
A3A9MP21	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
A3A9MP22	2190-0124	4		WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
A3A9MP23	6960-0016	0	4	PLUG-HOLE TR-HD FOR .125-D-HOLE NYL	28480	6960-0016
A3A9U1	86701-67001	5	1	SAMPLER-2-6.5 GHZ	28480	86701-67001
A3A9W1	86701-20064	2	1	CABLE ASSEMBLY- YTO OUTPUT	28480	86701-20064
A3A9W2	86701-20066	4	1	CABLE ASSEMBLY- ATTENUATOR OUTPUT	28480	86701-20066
A3A9W3	86701-20065	3	1	CABLE ASSEMBLY- FILTER INPUT	28480	86701-20065
A3A9W4	86701-60052	2	1	CABLE ASSEMBLY- COAX, BLACK	28480	86701-60052
A3A9A1	0955-0098	1	2	DIRECTIONAL COUPLER ASSEMBLY	28480	0955-0098
A3A9A2	08673-60089	6	1	YTO INTERCONNECT ASSEMBLY	28480	08673-60089
A3A9A2J1	1250-0543	8	1	CONNECTOR-RF SM-SNP M PC 50-OHM	28480	1250-0543
A3A9A2MP1	3050-0079	3		WASHER-FL NM NO. 2 .094-IN-ID .188-IN-OD	28480	3050-0079
A3A9A2W1	86701-60010	2	1	CABLE ASSY-YTO LOOP RIBBON	28480	86701-60010
A3A9A2W2	86701-60009	9	1	CABLE ASSY-YTO LOOP RIBBON	28480	86701-60009
A3A9A3	5086-7366	2	1	2.0-6.6 GHZ YTO ASSEMBLY	28480	5086-7366
A3A9A4	86701-60024	8	1	YTO PHASE DETECTOR ASSEMBLY	28480	86701-60024
A3A9A4C1	0160-2307	4	2	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A3A9A4C2	0160-2307	4		CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A3A9A4C3	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C4	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A9A4C6	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C7				NOT ASSIGNED		
A3A9A4C8				NOT ASSIGNED		
A3A9A4C9	0160-3538	5	2	CAPACITOR-FXD 750PF +-5% 100VDC MICA	28480	0160-3538
A3A9A4C10	0160-3538	5		CAPACITOR-FXD 750PF +-5% 100VDC MICA	28480	0160-3538
A3A9A4C11	0160-0165	8	1	CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A3A9A4C12	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A3A9A4C13	0160-3874	2		CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3A9A4C14	0160-2453	1	1	CAPACITOR-FXD .22UF +-10% 80VDC POLYE	28480	0160-2453
A3A9A4C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A4C16	0160-0168	1	1	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A3A9A4C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A4C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A4C19	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A9A4C20	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A9A4C21	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A9A4C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A4C23	0160-3874	2		CAPACITOR-FXD 10PF +-.5PF 200VDC CER	28480	0160-3874
A3A9A4C24	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C25	0140-0190	7		CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A3A9A4C26	0160-3490	8	1	CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-3490
A3A9A4C27	0160-0574	3		CAPACITOR-FXD .022UF +-20% 100VDC CER	28480	0160-0574
A3A9A4C28	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A9A4C29	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A9A4C30	0160-2200	6	1	CAPACITOR-FXD 43PF +-5% 300VDC MICA	28480	0160-2200
A3A9A4C31	0160-2264	2	1	CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A3A9A4C32	0140-0194	1		CAPACITOR-FXD 110PF +-5% 300VDC MICA	72136	DM15F111J0300WV1CR
A3A9A4C33	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3A9A4CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR3				NOT ASSIGNED		
A3A9A4CR4				NOT ASSIGNED		
A3A9A4CR5	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3A9A4CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR8				NOT ASSIGNED		
A3A9A4CR9				NOT ASSIGNED		
A3A9A4CR10				NOT ASSIGNED		
A3A9A4CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3A9A4CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A9A4J1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4J2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4J3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4J4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4J5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4J6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A4L1	9100-2254	3		INDUCTOR RF-CH-MLD 390NH 10% .105DX.26LG	28480	9100-2254
A3A9A4L2	9100-1620	5		INDUCTOR RF-CH-MLD 15UH 10% .166DX.385LG	28480	9100-1620
A3A9A4L3	9100-1620	5		INDUCTOR RF-CH-MLD 15UH 10% .166DX.385LG	28480	9100-1620
A3A9A4L4	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5% .166DX.385LG	28480	9100-1641
A3A9A4L5	9100-1620	5		INDUCTOR RF-CH-MLD 15UH 10% .166DX.385LG	28480	9100-1620
A3A9A4L6	9100-1641	0		INDUCTOR RF-CH-MLD 240UH 5% .166DX.385LG	28480	9100-1641
A3A9A4L7	9100-0368	6		INDUCTOR RF-CH-MLD 330NH 10% .105DX.26LG	28480	9100-0368
A3A9A4L8	9140-0179	1	2	INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3A9A4L9	9100-2254	3		INDUCTOR RF-CH-MLD 390NH 10% .105DX.26LG	28480	9100-2254
A3A9A4L10	9100-0368	6		INDUCTOR RF-CH-MLD 330NH 10% .105DX.26LG	28480	9100-0368
A3A9A4L11	9140-0179	1		INDUCTOR RF-CH-MLD 22UH 10% .166DX.385LG	28480	9140-0179
A3A9A4MP1	3050-0079	3		WASHER-FL NM NO. 2 .094-IN-ID .198-IN-OD	28480	3050-0079
A3A9A4Q1	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3A9A4Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A3A9A4Q3	1855-0395	0	1	TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	17856	FN2645
A3A9A4Q4	1854-0712	3		TRANSISTOR-DUAL NPN PD=1.8W	28480	1854-0712
A3A9A4Q5	1854-0404	0		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A9A4R1	0698-7288	9	1	RESISTOR 147K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1473-F
A3A9A4R2	0757-0464	5	1	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A3A9A4R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A9A4R4	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A9A4R5	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A9A4R6	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A9A4R7	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A9A4R8	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A9A4R9	0698-7219	6		RESISTOR 196 1% .05W F TC=0+-100	24546	C3-1/8-T0-196R-F
A3A9A4R10	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A9A4R11	0698-3429	2		RESISTOR 19.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R6-F
A3A9A4R12	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A9A4R13	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A9A4R14	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A9A4R15	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A3A9A4R16	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A4R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A4R18	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A9A4R19	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A9A4R20*	0757-0421	4	8	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A9A4R21	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3A9A4R22	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A3A9A4R23				NOT ASSIGNED		
A3A9A4R24	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A9A4R25	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A9A4R26	0698-4020	1	1	RESISTOR 9.53K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9531-F
A3A9A4R27	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A9A4R28	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A9A4R29	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A9A4R30	2100-3212	8	1	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A3A9A4R31	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A9A4R32	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3A9A4R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A9A4R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A9A4R35	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A9A4R36	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3A9A4R37	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A9A4R38	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A3A9A4R39	0757-0467	8		RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3A9A4R40				NOT ASSIGNED		
A3A9A4R41				NOT ASSIGNED		
A3A9A4R42				NOT ASSIGNED		
A3A9A4R43	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A3A9A4R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A9A4R45	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A3A9A4R46	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A3A9A4R47	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A9A4R48	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-F
A3A9A4R49	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A3A9A4R50	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A9A4R51	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A9A4R52	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A9A4R53	2100-3211	7	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	28480	2100-3211
A3A9A4R54	0698-7245	8	1	RESISTOR 2.37K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2371-F
A3A9A4R55	0698-7242	5	1	RESISTOR 1.78K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1781-F
A3A9A4R56	0698-7253	8	1	RESISTOR 5.11K 1% .05W F TC=0+-100	24546	C3-1/8-T0-5111-F
A3A9A4R57	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A3A9A4R58	0698-3451	0	1	RESISTOR 133K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1333-F
A3A9A4U1	1826-0092	3		IC OP AMP GP DUAL TO-99 PKG	28480	1826-0092
A3A9A4U2	1826-0026	3	1	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A3A9A4U3	1826-0044	5		IC OP AMP GP DUAL 14-DIP-C PKG	07263	UA739DC
A3A9A4U4	1820-1423	4	1	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A3A9A4U5	1820-1344	8		IC PL LOOP 14-DIP-C PKG	04713	MC12040L

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A9A4U6	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A3A9A4U7	1820-0817	8	2	IC FF ECL D-M/S DUAL	04713	MC10131P
A3A9A4U8	1810-0204	6		NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A3A9A4U9	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A3A9A4VR1	1902-1260	1	2	DIODE-ZNR 1N5525C 6.2V 2% DO-7 PD=.4W	04713	1N5525C
A3A9A4VR2	1902-1260	1		DIODE-ZNR 1N5525C 6.2V 2% DO-7 PD=.4W	04713	1N5525C
A3A9A4VR3	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
A3A9A4VR4	1902-3104	6	1	DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A3A9A5	86701-60089	5	1	SAMPLER ASSEMBLY (DOES NOT INCLUDE A3A9U1 SAMPLER)	28480	86701-60089
A3A9A5C1	0121-0046	2	2	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304322 9/35PF N650
A3A9A5C2	0121-0046	2		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304322 9/35PF N650
A3A9A5C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A9A5C4	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A3A9A5C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C6	0160-2150	5	1	CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A3A9A5C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A9A5C9	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A9A5C10	0160-2265	3	1	CAPACITOR-FXD 22PF +-5% 500VDC CER 0+-30	28480	0160-2265
A3A9A5C11	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A9A5C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C13	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A3A9A5C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A5C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C18	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3A9A5C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A5C20	0160-0939	4	1	CAPACITOR-FXD 430PF +-5% 300VDC MICA	28480	0160-0939
A3A9A5C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C22*	0140-0196	3	2	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A3A9A5C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C24	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A9A5C25	0140-0193	0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A3A9A5C26	0160-2308	5	1	CAPACITOR-FXD 36PF +-5% 300VDC MICA	28480	0160-2308
A3A9A5C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C29	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A5C30	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A5C31	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3A9A5C32	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3A9A5J1	1251-3172	7	3	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A3A9A5J2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A5L1				NSR, PART OF CIRCUIT BOARD		
A3A9A5L2	9140-0144	0	1	INDUCTOR RF-CH-MLD 4.7UH 10% .105DX.26LG	28480	9140-0144
A3A9A5L3	9100-1623	8	1	INDUCTOR RF-CH-MLD 27UH 5% .166DX.385LG	28480	9100-1623
A3A9A5L4	9100-2251	0		INDUCTOR RF-CH-MLD 220NH 10% .105DX.26LG	28480	9100-2251
A3A9A5L5	9100-2258	7	2	INDUCTOR RF-CH-MLD 1.2UH 10% .105DX.26LG	28480	9100-2258
A3A9A5L6	9100-2258	7		INDUCTOR RF-CH-MLD 1.2UH 10% .105DX.26LG	28480	9100-2258
A3A9A5L7	9140-0770	8		INDUCTOR RF-CH-MLD 50NH 10% 105DX.26LG	28480	9140-0770
A3A9A5L8				NSR, PART OF CIRCUIT BOARD		
A3A9A5L9				NSR, PART OF CIRCUIT BOARD		
A3A9A5L10	9140-0539	7	1	INDUCTOR RF-CH-MLD 3UH 5% .105DX.26LG	28480	9140-0539
A3A9A5L11	9100-0368	5		INDUCTOR RF-CH-MLD 330NH 10% .105DX.26LG	28480	9100-0368
A3A9A5L12	9100-2249	6		INDUCTOR RF-CH-MLD 150NH 10% .105DX.26LG	28480	9100-2249
A3A9A5L13	9100-2250	9	1	INDUCTOR RF-CH-MLD 180NH 10% .105DX.26LG	28480	9100-2250
A3A9A5L14	9100-2249	6		INDUCTOR RF-CH-MLD 150NH 10% .105DX.26LG	28480	9100-2249
A3A9A5MP1	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A3A9A5MP2	1205-0037	0		HEAT SINK TO-18-CS	28480	1205-0037
A3A9A5MP3				NOT ASSIGNED		
A3A9A5MP4	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A9A5Q1	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A9A5Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A9A5Q3	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A9A5Q4	1855-0235	7	1	TRANSISTOR J-FET N-CHAN D-MODE TO-52 SI	28480	1855-0235
A3A9A5Q5	1853-0015	7		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A3A9A5Q6	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A9A5Q7	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A3A9A5Q8	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A3A9A5R1	2100-3383	4	1	RESISTOR-TRMR 50 10% C TOP-ADJ 1-TRN	28480	2100-3383
A3A9A5R2	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A9A5R3	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A3A9A5R4	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A3A9A5R5	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3A9A5R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A5R7	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3A9A5R8	0757-0796	6	1	RESISTOR 82.5 1% .5W F TC=0+-100	28480	0757-0796
A3A9A5R9	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A9A5R10	0698-3457	6	1	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A3A9A5R11	0757-0470	3	1	RESISTOR 162K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1623-F
A3A9A5R12				NOT ASSIGNED		
A3A9A5R13	0698-7216	3	1	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-F
A3A9A5R14				NOT ASSIGNED		
A3A9A5R15	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3A9A5R16	0757-0398	4	1	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3A9A5R17	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3A9A5R18	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A3A9A5R19	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A9A5R20	0698-7224	3		RESISTOR 316 1% .05W F TC=0+-100	24546	C3-1/8-T0-316R-F
A3A9A5R21	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A9A5R22	0698-7195	7	1	RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-T0-19R6-F
A3A9A5R23	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3A9A5R24	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A3A9A5R25	0698-0082	7	2	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A3A9A5R26	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A5R27	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A9A5R28	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A3A9A5R29	0698-7212	9		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-F
A3A9A5R30	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A9A5R31	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3A9A5R32	0698-3439	4	2	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A3A9A5R33	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3A9A5R34	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3A9A5R35	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A3A9A5R36	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A9A5R37	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A9A5R38	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A3A9A5R39	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A3A9A5R40	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A9A5R41	0698-7196	8	1	RESISTOR 21.5 1% .05W F TC=0+-100	24546	C3-1/8-T0-21R5-F
A3A9A5TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A3A9A6	0955-0090	3	2	ATTENUATOR ASSEMBLY- 150B	28480	0955-0090
A3A9A7	9135-0111	0	1	6.2 GHZ LOW PASS FILTER ASSEMBLY	28480	9135-0111
A3A10	08673-60161	5	1	MOTHERBOARD ASSEMBLY	28480	08673-60161
A3A10C1-A3A10C4				NOT ASSIGNED		
A3A10C5	0160-5492	4	1	CAPACITOR-FXD MP 1UF +-10%; 400WVDC	28480	0160-5492
A3A10CR1	1901-0159	3	1	DIODE-PWR RECT 400V 750MA DO-41	28480	1901-0159
A3A10CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A3A10CR3	1990-0517	4	1	LED-LAMP LUM-INT=3MCD IF=20MA-MAX BVR=5V	28480	5082-4855

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A10J1	1200-0812	9	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0812
A3A10J2	1251-3905	4	1	CONNECTOR 20-PIN M RECTANGULAR	28480	1251-3905
A3A10J3	1253-0473	9	1	CONNECTOR ASSEMBLY, 5-PIN	28480	1253-0473
A3A10J4	1251-0555	4	1	CONNECTOR-PC EDGE 30-CONT/ROW 2-ROWS	28480	1251-0555
A3A10K1	0490-0618	5	1	RELAY 2C 24VDC-COIL 5A 115VAC	28480	0490-0618
A3A10MP1	0380-0076	6	2	SPACER-RVT-ON .5-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
A3A10MP2	0380-0076	6		SPACER-RVT-ON .5-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
A3A10MP3	0380-0659	1	1	SPACER-RVT-ON .375-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
A3A10MP4	0380-0884	4	1	STANDOFF-RVT-ON .156-IN-LG 4-40THD	00000	ORDER BY DESCRIPTION
A3A10MP5	0590-0343	5	1	THREADED INSERT-NUT 4-40 .062-IN-LG	28480	0590-0343
A3A10MP6	0380-0677	3	1	SPACER-RVT-ON .156-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
A3A10MP7	1400-0249	0	10	CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
A3A10MP8	1400-0619	8	1	CABLE CLAMP-HFCL .312-DIA .5-WD	28480	1400-0619
A3A10MP9	2190-0012	9	1	WASHER-LK EXT T NO. 10 .195-IN-ID	28480	2190-0012
A3A10MP10	2200-0141	8	4	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	28480	2200-0141
A3A10MP11	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
A3A10R1				NOT ASSIGNED		
A3A10R2	0687-3321	0	1	RESISTOR 3.3K 10% .5W CC TC=0+647	01121	EB3321
A3A10R3	0683-7515	4	1	RESISTOR 750 5% .25W FC TC=-400/+600	01121	CB7515
A3A10R4	0686-7525	2	1	RESISTOR 7.5K 5% .5W CC TC=0+647	01121	EB7525
A3A10R5	0683-2225	3	1	RESISTOR 2.2K 5% .25W FC TC=-400/+700	01121	CB2225
A3A10R6	0811-1669	0	1	RESISTOR 1.8 5% 2W PW TC=0+-400	75042	BWH2-1R8-J
A3A10XA3A2	1251-2026	8	4	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A3A10XA3A3	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A3A10XA3A4	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A3A10XA3A5	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A3A10XA3A6	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A3A10XA3A7	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A3A11	0960-0443	1	1	LINE MODULE-FILTERED	28480	0960-0443
A3AT1	86701-60066	8	2	TERMINATION- 50 OHM	28480	86701-60066
A3AT2	86701-60066	8		TERMINATION- 50 OHM	28480	86701-60066
A3AT3	0955-0090	3		ATTEN, COAXIAL	28480	0955-0090
A3AT4	0955-0098	1		COUPLER, 2-8.4GHZ	28480	0955-0098
A3B1	3160-0298	1	1	FAN-SKL 72-CFM 115V 50/60/400-HZ	28480	3160-0298
A3C1	0180-0452	8	1	CAPACITOR-FXD .013F+75-10% 25VDC AL	28480	0180-0452
A3C2	0180-0454	0	1	CAPACITOR-FXD 4200UF+75-10% 75VDC AL	28480	0180-0454
A3C3	0180-0453	9	1	CAPACITOR-FXD 8700UF+75-10% 40VDC AL	28480	0180-0453
A3C4	0180-2798	9	1	CAPACITOR-FXD .03F+100-10% 20VDC AL	28480	0180-2798
A3C5	0160-4065	5	1	CAPACITOR-FXD .1UF +-20% 250VAC(RMS)	28480	0160-4065
A3F1	2110-0055	2	1	FUSE 4A 250V NTD 1.25X.25 UL (FOR 100/120V OPERATION)	75915	312004
A3F1	2110-0002	9	1	FUSE 2A 250V NTD 1.25X.25 UL (FOR 220/240V OPERATION)	75915	312002
A3J1- A3J5				NOT ASSIGNED		
A3J6				NOT ASSIGNED		
A3J7				P/O A3W7, NSR		
A3J8				P/O A3W5, NSR		
A3J9				P/O A3W2, NSR		
A3J10				P/O A3W13, NSR		
A3MP1	0360-0268	6	1	TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	28480	0360-0268
A3MP2	0400-0001	1	1	GROMMET-RND .562-IN-ID .75-IN-GRV-OD	28480	0400-0001
A3MP3	0400-0005	5	1	GROMMET-RND .438-IN-ID .562-IN-GRV-OD	28480	0400-0005
A3MP4	0400-0018	0	1	GROMMET-CHAN NCH .052-IN-THK-PNL	28480	0400-0018
A3MP5	0403-0265	5	1	GUIDE-PC BD BLK NYL .078-BD-THKNS 3-LG	32559	E-300
A3MP6	2190-0010	7	9	WASHER-LK EXT T NO. 8 .168-IN-ID	28480	2190-0010
A3MP7	2200-0139	4		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0139
A3MP8	2200-0147	4	2	SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	28480	2200-0147
A3MP9	2200-0155	4	4	SCREW-MACH 4-40 1-IN-LG PAN-HD-POZI	28480	2200-0155
A3MP10	2360-0113	2	6	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3MP11	2360-0180	3	5	SCREW-MACH 6-32 .188-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A3MP12	1400-0510	8	1	CLAMP-CABLE .15-DIA .62-WD NYL	28480	1400-0510
A3MP13	1400-0618	7	1	CABLE CLAMP-HFCL .125-DIA .5-WD	28480	1400-0618
A3MP14	2360-0195	0	2	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	28480	2360-0195
A3MP15	1400-0673	4	1	CLAMP-CABLE 2-DIA .5-WD SST	28480	1400-0673
A3MP16	1520-0065	2	1	SHOCK MOUNT .5-EFF-HGT 8-LB-LOAD-CAP	28480	1520-0065
A3MP17	1520-0094	7	1	SHOCK MOUNT .45-EFF-HGT 1-LB-LOAD-CAP	28480	1520-0094
A3MP18	2360-0333	8	7	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
A3MP19	2360-0334	9	2	SCREW-MACH 6-32 .312-IN-LG 100 DEG	28480	2360-0334
A3MP20	2190-0011	8	8	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
A3MP21	2190-0017	4	8	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
A3MP22	2190-0018	5		WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
A3MP23	2190-0019	6		WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
A3MP24	2360-0459	9	1	SCREW-MACH 6-32 .375-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A3MP25	2190-0102	8	4	WASHER-LK INTL T 15/32 IN .472-IN-ID	28480	2190-0102
A3MP26	2420-0001	5	3	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
A3MP27	2420-0003	7	4	NUT-HEX-DBL-CHAM 6-32-THD .094-IN-THK	28480	2420-0003
A3MP28				NOT ASSIGNED		
A3MP29	2200-0141	6		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	28480	2200-0141
A3MP30	3050-0105	6		WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
A3MP31	3050-0010	2		WASHER-FL MTLC NO. 8 .147-IN-ID	28480	3050-0010
A3MP32	2360-0115	4		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP33				NOT ASSIGNED		
A3MP34	6960-0001	3	1	PLUG-HOLE DOME-HD FOR .375-D-HOLE STL	28480	6960-0001
A3MP35	2360-0197	2		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0197
A3MP36	2360-0219	9	2	SCREW-MACH 6-32 1.375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP37				NOT ASSIGNED		
A3MP38	0515-1331	5	12	SCREW-METRIC SPECIALTY M4 X 0.7 THD; 6	28480	0515-1331
A3MP39	0515-0896	5	4	SCREW-MACH M4 X 0.7 10MM-LG	28480	0515-0896
A3MP40	2580-0002	4		NUT-HEX-DBL-CHAM 8-32-THD .085-IN-THK	28480	2580-0002
A3MP41	2680-0129	8	6	SCREW-MACH 10-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP42	2950-0035	8	1	NUT-HEX-DBL-CHAM 15/32-32-THD	00000	ORDER BY DESCRIPTION
A3MP43	5001-8232	5	1	GUSSET, SIDE	28480	5001-8232
A3MP44	5021-5803	2	1	FRAME-FRONT	28480	5021-5803
A3MP45	5021-5883	8	1	STRUT CORNER	28480	5021-5883
A3MP46	08673-00013	0	1	CHASSIS M/F	28480	08673-00013
A3MP47				NOT ASSIGNED		
A3MP48	0515-1055	0	4	SCREW-MACH M4 X 0.7 6MM-LG 90-DEG-FLH-HD	28480	0515-1055
A3MP49	08673-00015	2	1	REAR PANEL M/F	28480	08673-00015
A3MP50	08673-00023	2	1	CHASSIS CONT MOD	28480	08673-00023
A3MP51	08673-00046	9	1	SUPPORT, RECT. BD. BOARD	28480	08673-00046
A3MP52	08673-20036	9	2	HEAT SINK 'A'	28480	08673-20036
A3MP53	08673-20037	0	2	HEAT SINK 'B'	28480	08673-20037
A3MP54	08673-20042	7	1	HEAT SINK	28480	08673-20042
A3MP55	08673-20067	6	1	FRAME SUPPORT	28480	08673-20067
A3MP56	86701-00016	2	1	SUPPORT-CAPACITOR	28480	86701-00016
A3MP57	86701-00017	3	1	DISK- FAN SHIELD	28480	86701-00017
A3MP58	86701-00007	1	1	GUARD FAN	28480	86701-00007
A3MP59	2200-0115	6	1	SCREW-MACH 4-40 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP60-A3MP65				NOT ASSIGNED		
A3MP66	86701-00062	8	1	STRUT ASSEMBLY (LEFT)	28480	86701-00062
A3MP67	86701-00063	9	1	STRUT ASSEMBLY (RIGHT)	28480	86701-00063
A3MP68	86701-00042	4	1	SUPPORT-MOUNT (BOTTOM)	28480	86701-00042
A3MP69	86701-00043	5	1	SUPPORT-MOUNT (TOP)	28480	86701-00043
A3MP70	86701-00044	6	2	SNUBBER	28480	86701-00044
A3MP71	86701-20002	8	1	COWLING FAN	28480	86701-20002
A3MP72				NOT ASSIGNED		
A3MP73				NOT ASSIGNED		
A3MP74	86701-20005	1	1	GUIDE-P.C. BOARD (REAR)	28480	86701-20005
A3MP75	86701-20006	2	1	GUIDE-P.C. BOARD (FRONT)	28480	86701-20006
A3MP76	86701-20092	6	1	FRAME-MOD (REAR)	28480	86701-20092
A3MP77				NOT ASSIGNED		
A3MP78	1200-0147	3	16	INSULATOR-FLG-BSHG NYLON	28480	1200-0147
A3MP79-A3MP82				NOT ASSIGNED		

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3MP83	1400-0249	0		CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
A3MP84	2200-0103	2		SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
A3MP85	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP86	2200-0138	3		SCREW-MACH 4-40 .188-IN-LG 100 DEG	28480	2200-0138
A3MP87	2200-0149	6		SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP88				NOT ASSIGNED		
A3MP89	2360-0207	5	9	SCREW-MACH 6-32 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP90	6960-0016	0		PLUG-HOLE TR-HD FOR .125-D-HOLE NYL	28480	6960-0016
A3MP91	5021-3208	7		HOUSING-REF BLK	28480	5021-3208
A3MP92				NOT ASSIGNED		
A3MP93	08673-00014	1	1	DIVIDER CENTER	28480	08673-00014
A3MP94				NOT ASSIGNED		
A3MP95				NOT ASSIGNED		
A3MP96	86701-00024	2		SCOOP AIR	28480	86701-00024
A3MP97	86701-00028	6	1	SPRING FLAT	28480	86701-00028
A3MP98	86701-00029	7		BAFFLE AIR TOP	28480	86701-00029
A3MP99	86701-00030	0		BAFFLE AIR BOTTOM	28480	86701-00030
A3MP100	86701-00044	6		SNUBBER	28480	86701-00044
A3MP101- A3MP104				NOT ASSIGNED		
A3MP105	2190-0010	7		WASHER-LK EXT T NO. 8 .168-IN-ID	28480	2190-0010
A3MP106	1200-0147	3		INSULATOR-FLG-BSHG NYLON	28480	1200-0147
A3MP107	2200-0153	2	8	SCREW-MACH 4-40 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP108	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP109	2200-0117	8	1	SCREW-MACH 4-40 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A3MP110				NOT ASSIGNED		
A3MP111	3050-0139	6	1	WASHER-FL MTLC NO. 8 .172-IN-ID	28480	3050-0139
A3Q1	1854-0618	8	2	TRANSISTOR NPN SI DARL TO-3 PD=150W	04713	MJ3000
A3Q2	1854-0294	6	1	TRANSISTOR NPN SI TO-3 PD=115W FT=500KHZ	28480	1854-0294
A3Q3	1854-0618	8		TRANSISTOR NPN SI DARL TO-3 PD=150W	04713	MJ3000
A3Q4	1854-0679	1	1	TRANSISTOR NPN 2N5885 SI TO-3 PD=200W	04713	2N5885
A3T1	9100-2653	6	1	TRANSFORMER	28480	9100-2653
A3W1	86701-60046	4	1	CABLE ASSY A1 M/B TO YTO FM IN (BRN)	28480	86701-60046
A3W2	86701-60007	7	1	CABLE ASSY-FREQ. STD. OUTPUT(GRAY/VIO)	28480	86701-60007
A3W3	86701-60063	5	1	CABLE ASSY-FREQ. REF. (GRAY)	28480	86701-60063
A3W4	86701-60039	5	1	CABLE ASSY-YTM TUNE (YELLOW)	28480	86701-60039
A3W5	86701-60005	5	1	CABLE ASSY-10 MHZ OUTPUT (GRAY/BLUE)	28480	86701-60005
A3W6	86701-60049	7	1	CABLE ASSY-10 MHZ OUTPUT (BLUE)	28480	86701-60049
A3W7	86701-60004	4	1	CABLE ASSY-100 MHZ OUTPUT (GRAY/GREEN)	28480	86701-60004
A3W8	86701-60053	3	1	CABLE ASSY-M/N OUTPUT (WHITE/ORANGE)	28480	86701-60053
A3W9- A3W12				NOT ASSIGNED		
A3W13	86701-60006	6	1	CABLE ASSY-FREQ. STD. INPUT (GRAY/BLACK)	28480	86701-60006
A3W14	86701-60056	6	1	CABLE ASSY-20/30 MHZ OUTPUT (GREEN)	28480	86701-60056
A3W15	86701-60033	9	1	CABLE ASSY (VIO) A3 M/B TO A3A9A2 YTO	28480	86701-60033
A3W16	86701-60055	5	1	CABLE ASSY (GRAY) A3 M/B TO A3A9 YTO TUN	28480	86701-60055
A3W17	86701-60054	4	1	CABLE ASSY (WHITE) A3 M/B TO A3A9 IFM IN	28480	86701-60054

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A1	08673-60128	4	1	FRONT PANEL BOARD ASSEMBLY (DOES NOT INCLUDE A4R1, R2, A4DS1-14, A4DS16, A4M1, A4U1)	28480	08673-60128
A4A1	08673-60157	9	1	FRONT PANEL BOARD ASSEMBLY (INCLUDES ALL BUT A4M1)	28480	08673-60157
A4A1C1	0180-3311	4	1	CAPACITOR ELECTROLYTIC 6.8UF +-20% 50V	28480	0180-3311
A4A1DS1-A4A1DS14				NOT ASSIGNED		
A4A1DS15-A4A1DS37	1990-0665	3	23	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A4A1DS38	1990-0486	6	4	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A4A1DS39	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A4A1DS40	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A4A1DS41	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A4A1DS42	2140-0092	0	5	LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A4A1DS43	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A4A1DS44	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A4A1DS45	2140-0253	5	2	LAMP-INCAND 6839 28VDC 24MA T-1-BULB	1F556	6839
A4A1DS46	2140-0253	5		LAMP-INCAND 6839 28VDC 24MA T-1-BULB	1F556	6839
A4A1DS47	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A4A1DS48	2140-0092	0		LAMP-INCAND 685 5VDC 60MA T-1-BULB	00115	685 TIP END
A4A1J1	1251-3119	2	1	CONNECTOR 20-PIN M RECTANGULAR	28480	1251-3119
A4A1J2	1251-4737	2	1	CONNECTOR 50-PIN M RECTANGULAR	28480	1251-4737
A4A1J3	1251-5721	8	1	CONNECTOR 40-PIN M POST TYPE	28480	1251-5721
A4A1J4	1251-4666	8	1	CONNECTOR-SGL CONT PIN .03-IN-BSC-SZ RND	28480	1251-4666
A4A1MP1	0361-0064	2	7	EYELET-RLD-FLG .059-OD .125-LG .006-THK	28480	0361-0064
A4A1MP2	1200-1177	1	2	SOCKET-STRP 16-CONT DIP DIP-SLDR	28480	1200-1177
A4A1MP3	1200-0874	3	4	SOCKET-STRP 22-CONT SIP DIP-SLDR	28480	1200-0874
A4A1MP4	1251-0600	0	2	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A4A1MP5				NOT ASSIGNED		
A4A1MP6	0361-1160	1	7	RIVET	28480	0361-1160
A4A1MP7	0360-0270	0	2	TERMINAL-SLDR LUG LK-MTG FOR-#10-SCR	28480	0360-0270
A4A1MP8	2190-0016	3	4	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
A4A1MP9	2190-0067	4	1	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0067
A4A1MP10	2950-0001	8	3	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A4A1MP11	2950-0072	3	1	NUT-HEX-DBL-CHAM 1/4-32-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
A4A1R1	2100-2590	3	1	RESISTOR-VAR CONTROL CCP 10K 10% 10CW	28480	2100-2590
A4A1R2	2100-4065	1	1	RESISTOR-VAR CONTROL CP 10K 10% LIN	28480	2100-4065
A4A1R3	0757-0401	0	1	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A1R4	0757-0417	8	1	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A4A1S1	5060-9436	7	58	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0819	2	1	KEY CAP-HALF, SKY GRAY "0"	28480	5041-0819
A4A1S2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0811	4	1	KEY CAP-HALF, SKY GRAY "1"	28480	5041-0811
A4A1S3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0812	5	1	KEY CAP-HALF, SKY GRAY "2"	28480	5041-0812
A4A1S4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0813	6	1	KEY CAP-HALF, SKY GRAY "3"	28480	5041-0813
A4A1S5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0814	7	1	KEY CAP-HALF, SKY GRAY "4"	28480	5041-0814
A4A1S6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0815	8	1	KEY CAP-HALF, SKY GRAY "5"	28480	5041-0815
A4A1S7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0816	9	2	KEY CAP-HALF, SKY GRAY "6"	28480	5041-0816
A4A1S8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0817	0	1	KEY CAP-HALF, SKY GRAY "7"	28480	5041-0817
A4A1S9	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0818	1	1	KEY CAP-HALF, SKY GRAY "8"	28480	5041-0818
A4A1S10	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0816	9		KEY CAP-HALF, SKY GRAY "6"	28480	5041-0816
A4A1S11	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0122	0	8	KEY CAP-QUARTER, JADE GRAY (BLANK)	28480	5041-0122
A4A1S12	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0128	6	4	KEY CAP-HALF, JADE GRAY (ILLUMINATED)	28480	5041-0128

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A1S13	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0122	0		KEY CAP-QUARTER, JADE GRAY (BLANK)	28480	5041-0122
A4A1S14	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0123	1	3	KEY CAP-HALF, JADE GRAY (BLANK)	28480	5041-0123
A4A1S15	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0128	6		KEY CAP-HALF, JADE GRAY (ILLUMINATED)	28480	5041-0128
A4A1S16	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0123	1		KEY CAP-HALF, JADE GRAY (BLANK)	28480	5041-0123
A4A1S17	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0122	0		KEY CAP-QUARTER, JADE GRAY (BLANK)	28480	5041-0122
A4A1S18	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1829	6	4	KEY CAP-QUARTER, SHORT DB, UP ARROW	28480	5041-1829
A4A1S19	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1829	6		KEY CAP-QUARTER, SHORT DB, DOWN ARROW	28480	5041-1829
A4A1S20	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6	14	KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S21	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1919	5	1	KEY CAP-QUARTER "STEPS ms"	28480	5041-1919
A4A1S22	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1920	8	1	KEY CAP-QUARTER "<-----"	28480	5041-1920
A4A1S23	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0808	9	1	KEY CAP-HALF, SKY GRAY "DECIMAL"	28480	5041-0808
A4A1S24	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0127	5	1	KEY CAP-QUARTER, SHORT DB (ILLUMINATED)	28480	5041-0127
A4A1S25	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0128	6		KEY CAP-HALF, JADE GRAY (ILLUMINATED)	28480	5041-0128
A4A1S26	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1829	6		KEY CAP-QUARTER, SHORT DB, UP ARROW	28480	5041-1829
A4A1S27	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S28	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S29	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1829	6		KEY CAP-QUARTER, SHORT DB, DOWN ARROW	28480	5041-1829
A4A1S30	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S31	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0122	0		KEY CAP-QUARTER, JADE GRAY (BLANK)	28480	5041-0122
A4A1S32	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0122	0		KEY CAP-QUARTER, JADE GRAY (BLANK)	28480	5041-0122
A4A1S33	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S34	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1827	4	1	KEY CAP-QUARTER, SHORT DB "FREQUENCY"	28480	5041-1827
A4A1S35	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1828	5	1	KEY CAP-QUARTER, SHORT DB "FREQ INCR"	28480	5041-1828
A4A1S36	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S37	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1917	3	1	KEY CAP-QUARTER "STO"	28480	5041-1917
A4A1S38	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1918	4	1	KEY CAP-QUARTER "RCL"	28480	5041-1918
A4A1S39	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0122	0		KEY CAP-QUARTER, JADE GRAY (BLANK)	28480	5041-0122
A4A1S40	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0384	6	4	KEY CAP-QUARTER, SKY GRAY (ILLUMINATED)	28480	5041-0384
A4A1S41	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0384	6		KEY CAP-QUARTER, SKY GRAY (ILLUMINATED)	28480	5041-0384
A4A1S42	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0123	1		KEY CAP-HALF, JADE GRAY (BLANK)	28480	5041-0123
A4A1S43	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0384	6		KEY CAP-QUARTER, SKY GRAY (ILLUMINATED)	28480	5041-0384
A4A1S44	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0122	0		KEY CAP-QUARTER, JADE GRAY (BLANK)	28480	5041-0122
A4A1S45	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0384	6		KEY CAP-QUARTER, SKY GRAY (ILLUMINATED)	28480	5041-0384

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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A1S46	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S47	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S48	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S49	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S50	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S51	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S52	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S53	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0285	6		KEY CAP-QUARTER, LITE GRAY (ILLUMINATED)	28480	5041-0285
A4A1S54	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0128	6		KEY CAP-HALF, JADE GRAY (ILLUMINATED)	28480	5041-0128
A4A1S55	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0122	0		KEY CAP-QUARTER, JADE GRAY (BLANK)	28480	5041-0122
A4A1S56	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1921	9	1	KEY CAP-QUARTER 'GHZ'	28480	5041-1921
A4A1S57	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1922	0	1	KEY CAP-QUARTER 'MHZ'	28480	5041-1922
A4A1S58	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-1923	1	1	KEY CAP-QUARTER 'KHZ'	28480	5041-1923
A4A1XDS1- A4A1XDS41				NOT ASSIGNED		
A4A1XDS42- A4A1XDS49	86290-00034	6	14	LAMP CONTACT	28480	86290-00034
A4DS1	1990-0821	3	1	DISPLAY (+-)	28480	1990-0821
A4DS2	1990-0822	4	14	DISPLAY-NUMERIC	28480	1990-0822
A4DS3	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS4	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS5	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS6	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS7	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS8	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS9	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS10	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS11	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS12	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS13	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS14	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS15	1990-0892	8	1	MATCHED DISPLAY SET, A4DS1-A4DS14, A4DS16	28480	1990-0892
A4DS16	1990-0822	4		DISPLAY-NUMERIC	28480	1990-0822
A4DS17- A4DS41				NOT ASSIGNED		
A4J1	11729-60030	1	1	OUTPUT CONNECTOR ASSEMBLY	28480	11729-60030
A4J2				P/O A4W1, NSR		
A4J3				P/O A4W2, NSR		
A4J4				P/O A4W3, NSR		
A4J5				P/O A4W4, NSR		
A4M1	1120-0585	3	1	METER 2.50-IN; 1 MA FSD; TAUT BAND; LIN	28480	1120-0585
A4MP1				NOT ASSIGNED		
A4MP2	0370-3023	8	2	KNOB3/4 JGK .25-IN-ID	28480	0370-3023
A4MP3	0510-1148	2	4	RETAINER-PUSH ON KB-TO-SHFT EXT	28480	0510-1148
A4MP4	0590-1649	6	4	NUT-KNRLD-R 15/32-32-THD .08-IN-THK	28480	0590-1649
A4MP5				NOT ASSIGNED		
A4MP6	2190-0019	6	3	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
A4MP7	2190-0890	1	1	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0890
A4MP8				NOT ASSIGNED		
A4MP9	2200-0105	4	18	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A4MP10	2200-0143	0	2	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	28480	2200-0143

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4MP11	2200-0164	6	2	SCREW-MACH 4-40 .188-IN-LG UNCT 82 DEG	00000	ORDER BY DESCRIPTION
A4MP12	2200-0166	7	18	SCREW-MACH 4-40 .312-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A4MP13	2740-0001	3	2	NUT-HEX-DBL-CHAM 10-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
A4MP14				NOT ASSIGNED		
A4MP15				NOT ASSIGNED		
A4MP16				NOT ASSIGNED		
A4MP17	5040-6928	4	1	DIVIDER STRIP	28480	5040-6928
A4MP18	5041-1418	9	1	ROCKER	28480	5041-1418
A4MP19				NOT ASSIGNED		
A4MP20	3050-0161	4	1	WASHER-SPR WAVY 1/4 IN .265-IN-ID	28480	3050-0161
A4MP21	08672-20037	9	4	SUPPORT-FRONT PANEL	28480	08672-20037
A4MP22	08672-20056	2	1	PAD-L.E.D.	28480	08672-20056
A4MP23	08672-20057	3	1	HEAT SINK-L.E.D.	28480	08672-20057
A4MP24	08672-40006	4	7	HOUSING-LAMP (LONG)	28480	08672-40006
A4MP25	08672-40008	6	7	BAR LIGHT (LONG)	28480	08672-40008
A4MP26	08672-40010	0	7	PLUG LIGHT	28480	08672-40010
A4MP27	08673-00064	1	1	PANEL (FRONT)	28480	08673-00064
A4MP28	08673-00067	4	1	PANEL-SUB (FRONT)	28480	08673-00067
A4MP29	08673-00017	4	1	SPACER-METER	28480	08673-00017
A4MP30	08673-20016	5	1	HEAT SINK-L.E.D.	28480	08673-20016
A4MP31	08673-20018	7	4	SUPPORT (BOTTOM)	28480	08673-20018
A4MP32	00310-48801	0	4	WASHER-SHOULDERED	28480	00310-48801
A4MP33	2950-0030	3	4	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A4MP34				NOT ASSIGNED		
A4MP35	08640-40044	2	1	SCREW-METER ZERO	28480	08640-40044
A4MP36	08673-80025	2	3	WASHER ASSY	28480	08673-80025
A4MP37	08673-20087	0	1	WASHER, SHLDR MOD	28480	08673-20087
A4MP38	08662-20039	9	1	HEAT SINK-SINGLE L.E.D.	28480	08662-20039
A4MP39	08662-20038	8	1	PAD-SINGLE L.E.D.	28480	08662-20038
A4R1	0698-3430	5	1	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A4S1	3101-2080	9	1	SWITCH-LINE DPDT (LINE)	28480	3101-2080
A4U1	0960-0683	1	1	ROTARY PULSE GENERATOR INPUT POWER: 5VDC	28480	0960-0683
A4W1	08673-60036	3	1	CABLE ASSEMBLY-ALC	28480	08673-60036
A4W2	08673-60037	4	1	CABLE ASSEMBLY-AM INPUT	28480	08673-60037
A4W3	08673-60038	5	1	CABLE ASSEMBLY-FM INPUT	28480	08673-60038
A4W4	08673-60039	6	1	CABLE ASSEMBLY-PULSE INPUT	28480	08673-60039

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS/MISCELLANEOUS PARTS		
MP1	0361-0316	7	2	RIVET-BLIND	28480	0361-0316
MP2	0570-0034	9	5	SCREW-MACH 4-40 .25-IN-LG RD-HD-SLT	00000	ORDER BY DESCRIPTION
MP3	0570-0632	3	4	SCREW-SPCL 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP4	0624-0268	6	24	SCREW-TPG 4-24 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP5	1400-0082	9	2	CLAMP-CABLE .125-DIA .375-WD NYL	28480	1400-0082
MP6	1460-0553	5	7	STAMPING-BE-CU CLIP-WINDOW	28480	1460-0553
MP7				NOT ASSIGNED		
MP8	2190-0018	5	4	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP9	2190-0019	6	6	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
MP10	2200-0103	2	6	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0103
MP11	2200-0105	4	24	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP12	2200-0138	3	19	SCREW-MACH 4-40 .188-IN-LG 100 DEG	28480	2200-0138
MP13	2200-0141	8	2	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	28480	2200-0141
MP14	2200-0145	2	4	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP15	2200-0151	0	2	SCREW-MACH 4-40 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP16	2360-0113	2	1	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP17	2360-0115	4	2	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP18	2360-0117	6	5	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP19	0515-1232	5	4	SCREW-MACH M3.5 X 0.6 8MM-LG PAN-HD	28480	0515-1232
MP20	2360-0197	2	1	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0197
MP21	2360-0229	1	3	SCREW-MACH 6-32 .562-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP22	2360-0333	8	11	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
MP23	2360-0334	9	2	SCREW-MACH 6-32 .312-IN-LG 100 DEG	28480	2360-0334
MP24	2420-0001	5	2	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
MP25	0515-1132	4	4	SCREW-MACH M5 X 0.8 10MM-LG	28480	0515-1132
MP26	3030-0152	1	2	SCREW-SET 4-40 .312-IN-LG SMALL CUP-PT	28480	3030-0152
MP27	3050-0010	2	2	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
MP28	3050-0105	6	6	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
MP29	5040-7201	8	4	FOOT (STANDARD)	28480	5040-7201
MP30	5040-7202	9	1	TRIM, TOP	28480	5040-7202
MP31	5041-6819	4	2	HANDLE, CAP-FRONT	28480	5041-6819
MP32	5041-6820	7	2	HANDLE, CAP-REAR	28480	5041-6820
MP33	5040-7221	2	4	STANDOFF, REAR PANEL	28480	5040-7221
MP34	5041-1829	6	2	KEY/QTR SHORT DB	28480	5041-1829
MP35				NOT ASSIGNED		
MP36				NOT ASSIGNED		
MP37	5060-9805	4	2	STRAP HANDLE 21 IN	28480	5060-9805
MP38	5061-9436	9	1	TOP COVER 21 IN.	28480	5061-9436
MP39	5061-9448	3	1	COVER BOTTOM 21 IN	28480	5061-9448
MP40				NOT ASSIGNED		
MP41				NOT ASSIGNED		
MP42	5061-9689	4	1	HDL KIT FRONT (OPTION 909 ONLY)	28480	5061-9689
MP43	5061-2034	9	1	INFO TRAY KIT (DOES NOT INCL. INFO CARD)	28480	5061-2034
MP44				NOT ASSIGNED		
MP45	08672-20120	1	12	STEPWASHER	28480	08672-20120
MP46	08673-00009	4	1	COVER, DCU	28480	08673-00009
MP47				NOT ASSIGNED		
MP48				NOT ASSIGNED		
MP49	08673-00058	3	1	COVER, RF SECTION	28480	08673-00058
MP50	08673-20064	3	1	INSULATOR, M/B	28480	08673-20064
MP51	08673-20169	9	1	WINDOW FRONT "E"	28480	08673-20169
MP52	08673-20132	6	1	SHIELD RFI	28480	08673-20132
MP53				NOT ASSIGNED		
MP54				NOT ASSIGNED		
MP55				NOT ASSIGNED		
MP56	85660-20090	2	4	STEPWASHER	28480	85660-20090
MP57	86701-00022	0	1	COVER GUARD	28480	86701-00022
MP58	5060-9938	4	2	SIDE COVER	28480	5060-9938
MP59				NOT ASSIGNED		
MP60				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP61	1460-1345	5	2	TILT STAND SST	28480	1460-1345
MP62	5001-0439	8	2	TRIM SIDE FRT FRAME	28480	5001-0439
MP63-MP66				NOT ASSIGNED		
MP67	0515-1245	0	1	SCREW-SPCL M3.5 X 0.6 12MM-LG	28480	0515-1245
MP68	0510-0043	4	1	RETAINER-RING E-R EXT .141-IN-DIA STL	28480	0510-0043
MP69				NOT ASSIGNED		
MP70	08673-80062	7	1	INFO CARD	28480	08673-80062
W1	08672-60057	7	1	CABLE ASSY 20 COND	28480	08672-60057
W2	08673-60023	8	1	CABLE ASSY 50 COND	28480	08673-60023
W3	08673-60022	7	1	CABLE ASSY 40 COND	28480	08673-60022
W4	08673-60092	1	1	CABLE ASSY RBN 16 PN	28480	08673-60092
W5	08673-60086	3	1	CABLE ASSY CNTR IFCE	28480	08673-60086
W6	8120-1378	1	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT	28480	8120-1378
W7	08673-20048	3	1	CABLE ASSY, YTO-PREAMP	28480	08673-20048
W8	5060-9462	9	1	HP-IB ADAPTER	28480	5060-9462
W9-W50				NOT ASSIGNED		
	08673-60097	6	1	KIT EXTENDER BD	28480	08673-60097
	08673-90052	6	1	MANUAL OPER-SERV	28480	08673-90052
				ACCESSORY PARTS		
	1250-1250	6	1	ADAPTER-COAX STR M-N F-SMA	28480	1250-1250

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-4. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address		Zip Code
50545	NIPPON ELECTRIC CO	TOKYO	JP	
00000	ANY SATISFACTORY SUPPLIER			
00115	ACE GLASS INC	VINELAND	NJ	08360
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01281	TRW INC SEMICONDUCTOR DIV	LAWNDALE	CA	90260
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
02111	SPECTROL ELECTRONICS CORP	CITY OF IND	CA	91745
03508	GE CO SEMICONDUCTOR PROD DEPT	AUBURN	NY	13201
03888	K D I PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
05820	WAKEFIELD ENGINEERING INC	WAKEFIELD	MA	01880
06001	MEPCO ELECTRA CORP	COLUMBIA	SC	29063
06383	PANDUIT CORP	TINLEY PARK	IL	60477
06665	PRECISION MONOLITHICS INC	SANTA CLARA	CA	95050
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW	CA	94042
07933	RAYTHEON CO SEMICONDUCTOR DIV HQ	MOUNTAIN VIEW	CA	94040
1F556	PRECISION LAMP INC	COTATI	CA	94040
12969	UNITRODE CORP	WATERTOWN	MA	02172
14140	EDISON ELEK DIV MCGRAW-EDISON	MANCHESTER	NH	03130
16179	OMNI SPECTRA INC	FARMINGTON	MI	03054
17856	SILICONIX INC	SANTA CLARA	CA	95054
18324	SIGNETICS CORP	SUNNYVALE	CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
20932	EMCON DIV ITW	SAN DIEGO	CA	92129
20940	MICRO-OHM CORP	EL MONTE	CA	91731
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD	MA	01880
24355	ANALOG DEVICES INC	NORWOOD	MA	02062
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
25088	SIEMENS CORP	ISELIN	NJ	08830
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
3L585	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	
30983	MEPCO/ELECTRA CORP	SAN DIEGO	CA	92121
32559	BIVAR INC	SANTA ANA	CA	92705
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE	CA	92507
34371	HARRIS SEMICON DIV HARRIS-INTERTYPE	MELBOURNE	FL	32901
52648	PLESSEY SEMICONDUCTORS	SANTA ANA	CA	92705
52763	STETTNER ELECTRONICS INC	CHATTANOOGA	TN	13035
54294	SHALLCROSS INC	SELMA	NC	27576
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
72136	ELECTRO MOTIVE CORP	FLORENCE	SC	06226
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE	PA	16512
74970	JOHNSON E F CO	WASECA	MN	56093
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA	PA	19108
75915	LITTELFUSE INC	DES PLAINES	IL	60016
91637	DALE ELECTRONICS INC	COLUMBUS	NE	68601

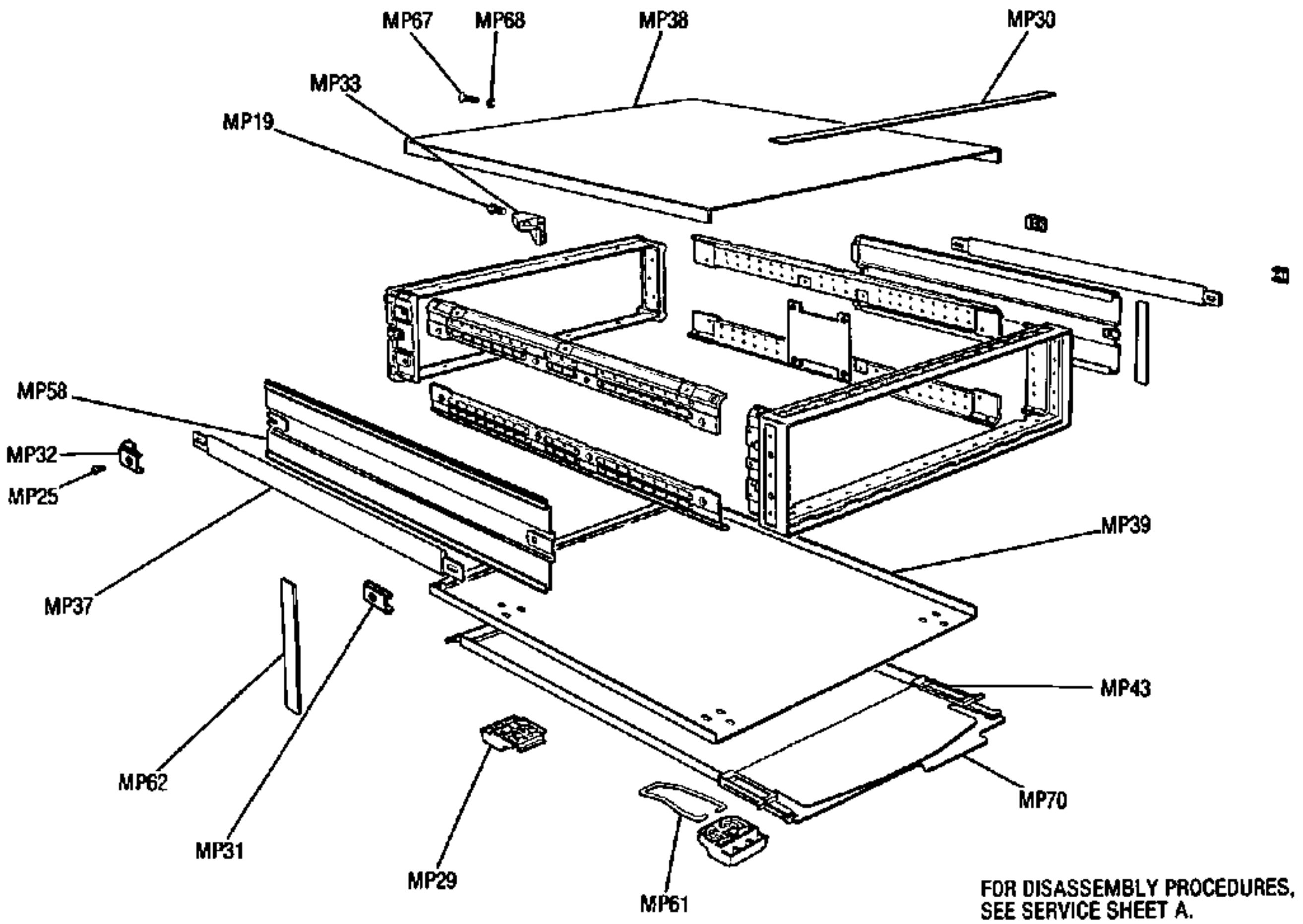
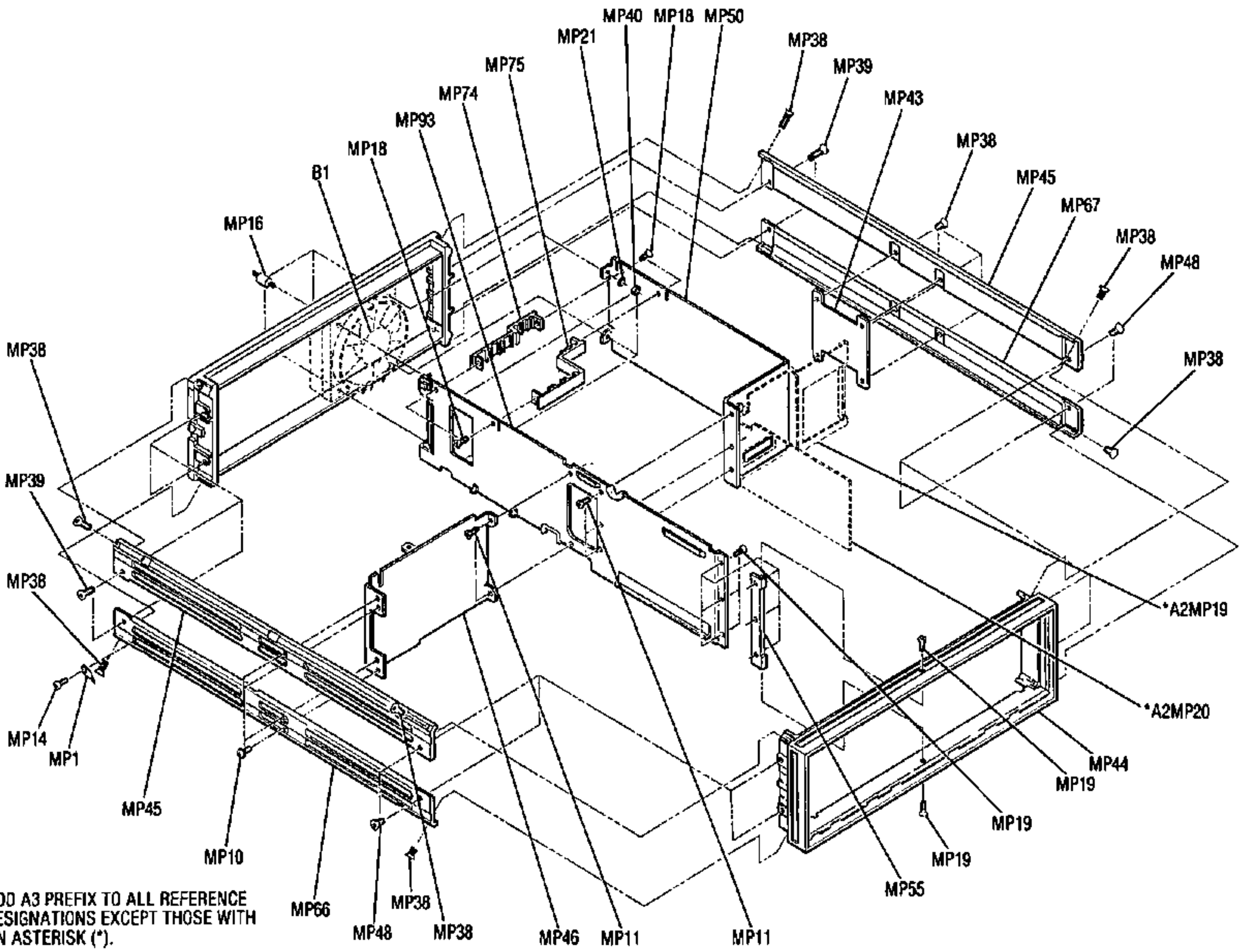


Figure 6-1. Cabinet Illustrated Parts Breakdown



ADD A3 PREFIX TO ALL REFERENCE DESIGNATIONS EXCEPT THOSE WITH AN ASTERISK (*).

SOME CABINET PARTS AND ASSOCIATED HARDWARE MAY BE ENGLISH OR METRIC. REFER TO SERIAL NUMBER RELATED CHANGES IN THE MANUAL CHANGES SUPPLEMENT FOR YOUR INSTRUMENT.

Figure 6-2. Cabinet and Frame Illustrated Parts Breakdown

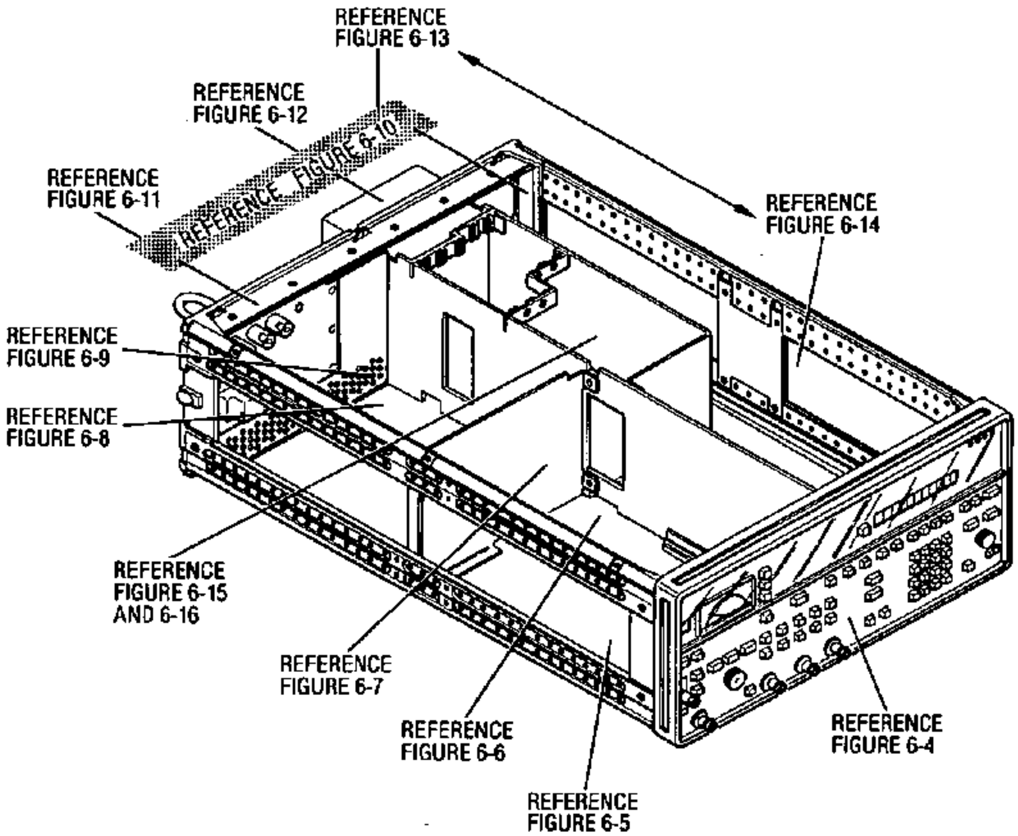


Figure 6-3. Overall Illustrated Parts Breakdown

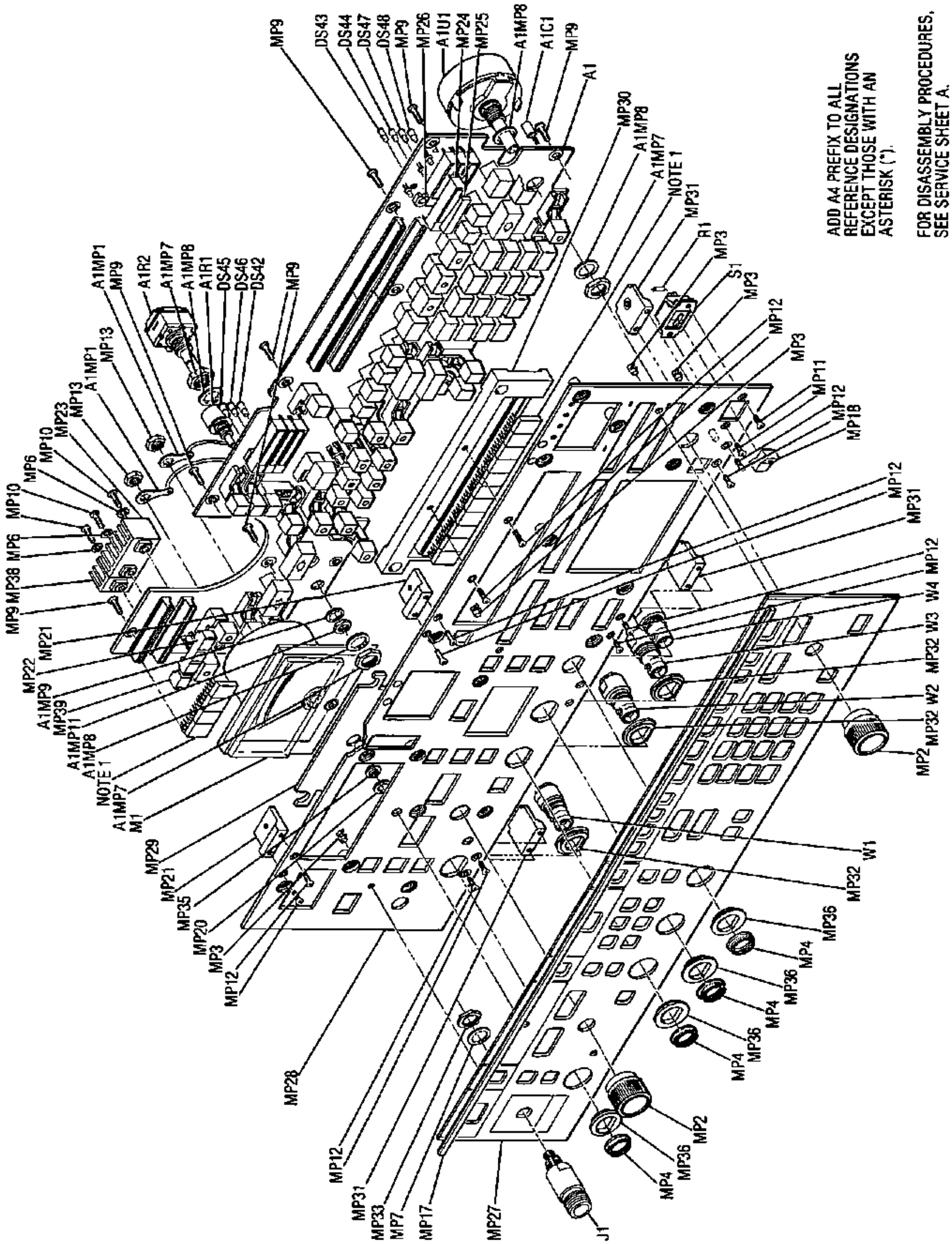


Figure 6-4. A4 Front Panel Illustrated Parts Breakdown

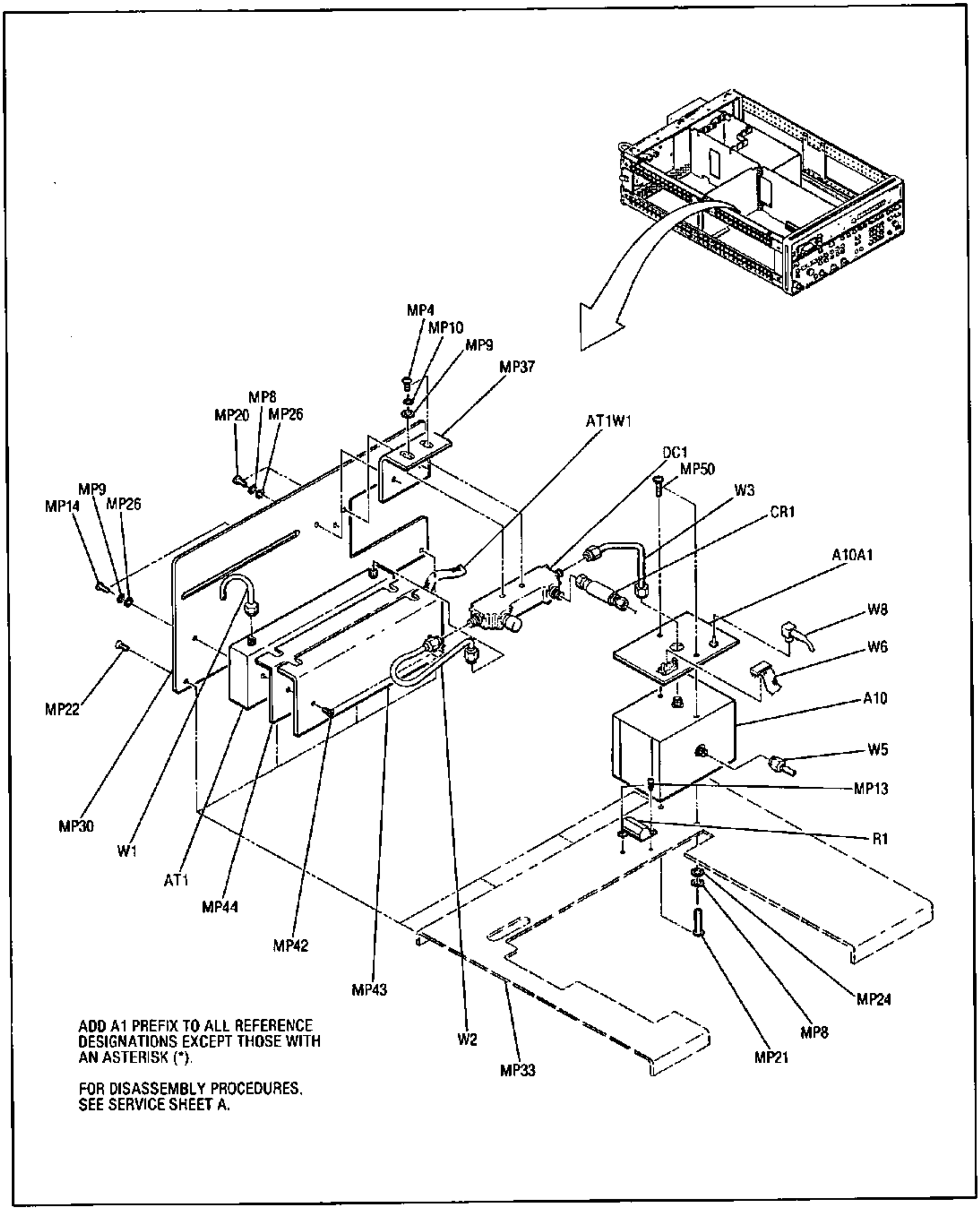


Figure 6-5. A1 Microwave Circuits Illustrated Parts Breakdown

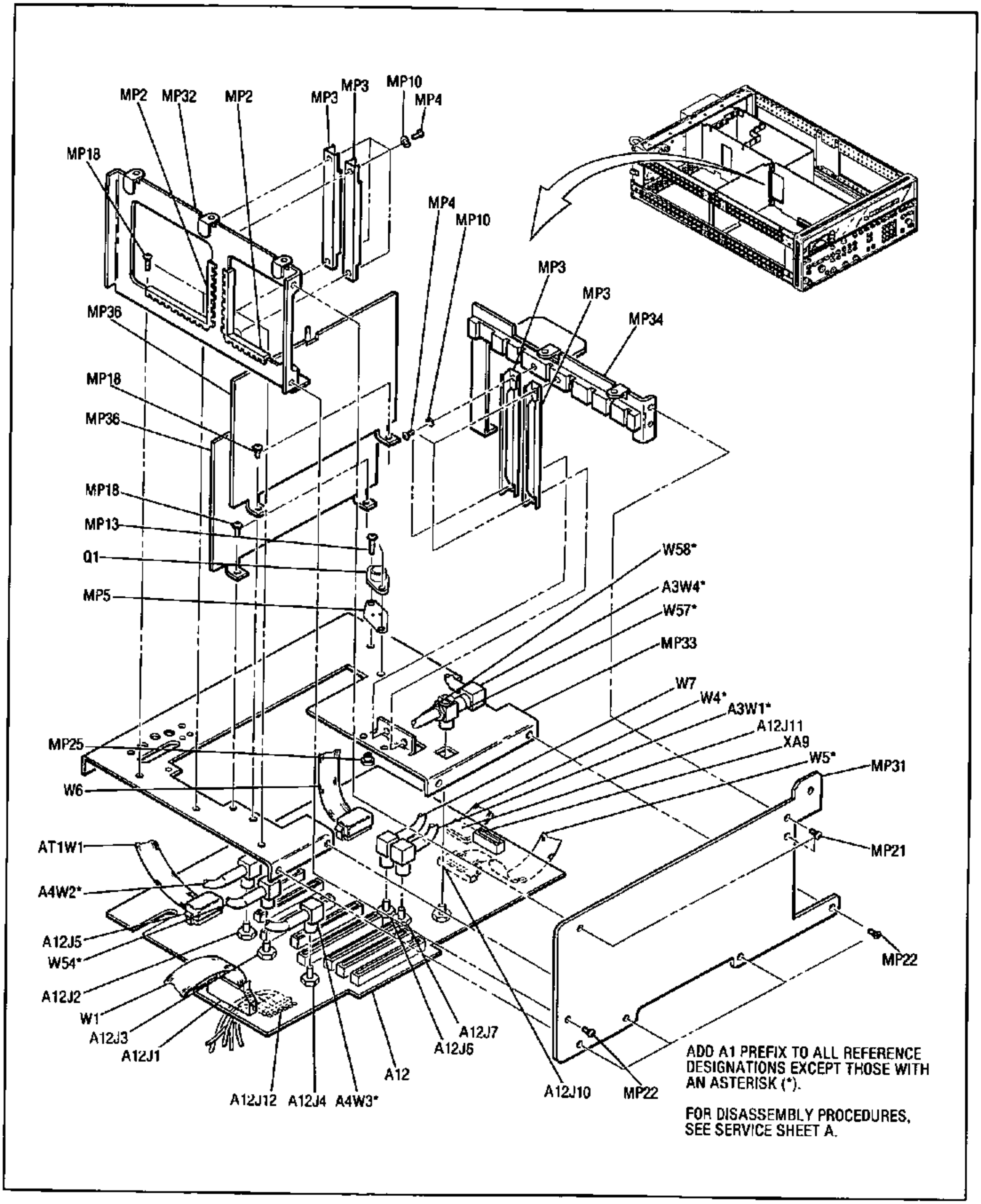
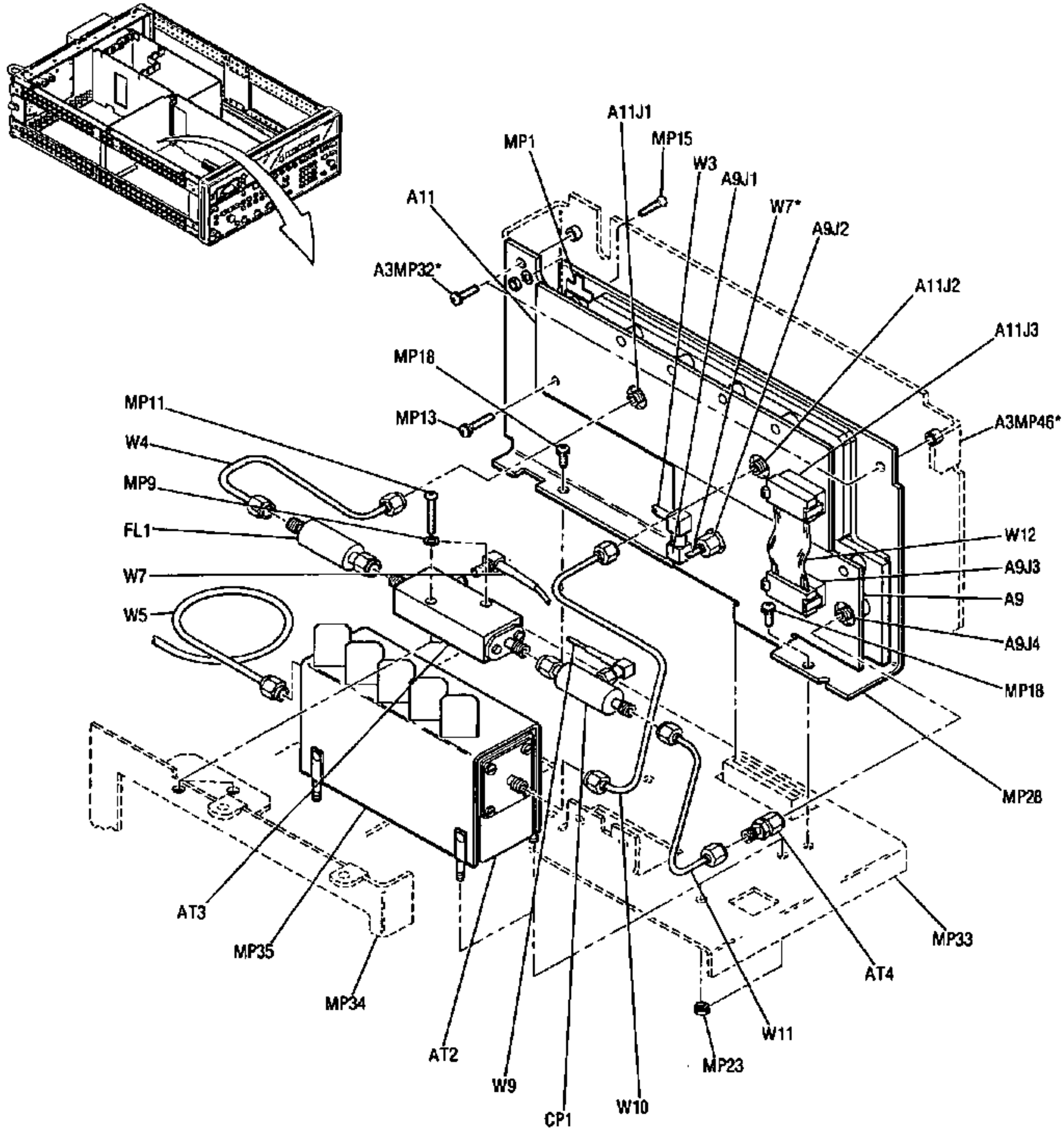


Figure 6-6. A1 Card Cage Illustrated Parts Breakdown



ADD A1 PREFIX TO ALL REFERENCE DESIGNATIONS EXCEPT THOSE WITH AN ASTERISK (*).

FOR DISASSEMBLY PROCEDURES, SEE SERVICE SHEET A.

Figure 6-7. A1 Pulse Circuits Illustrated Parts Breakdown

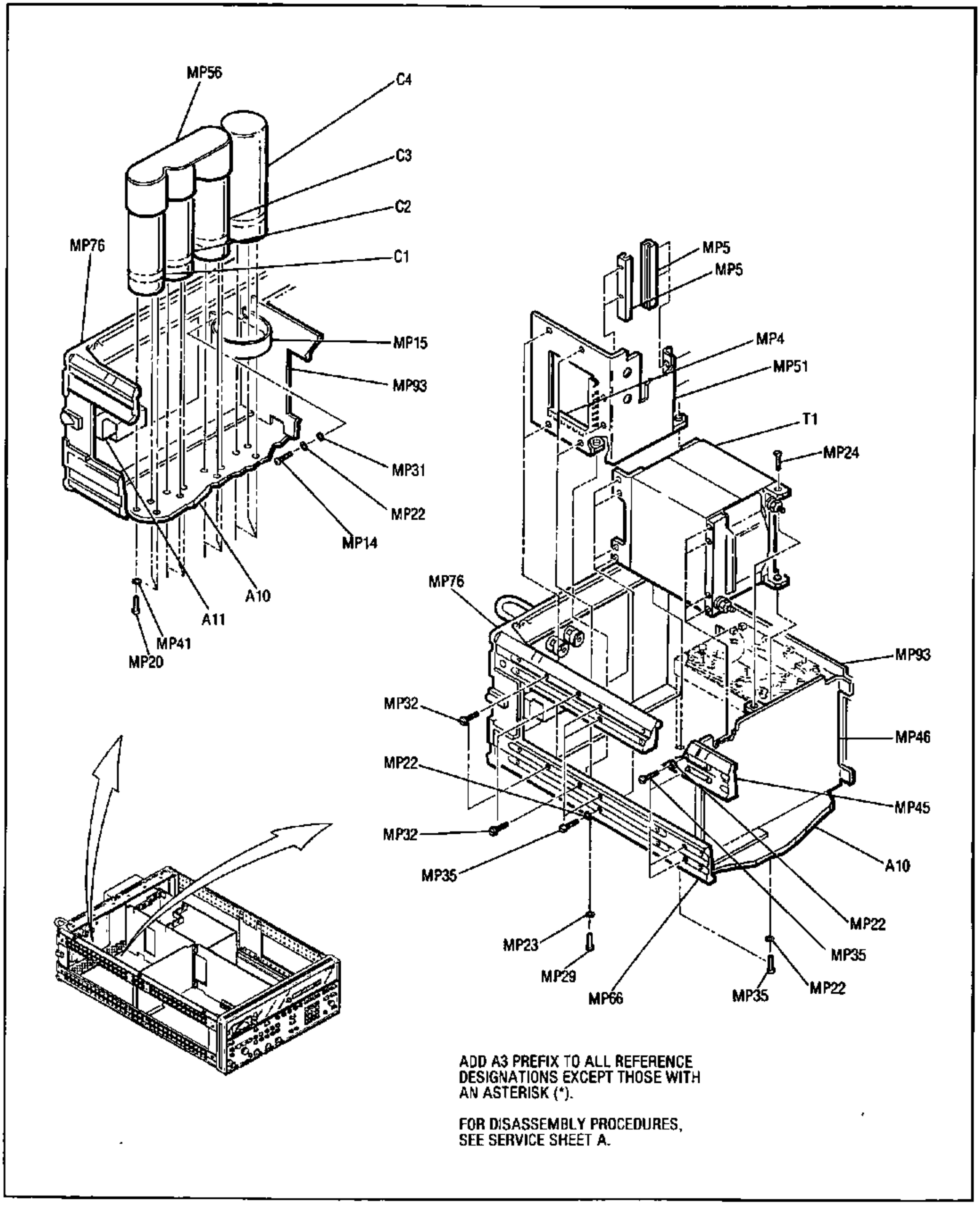


Figure 6-8. A3 Power Supply and RF Source Illustrated Parts Breakdown

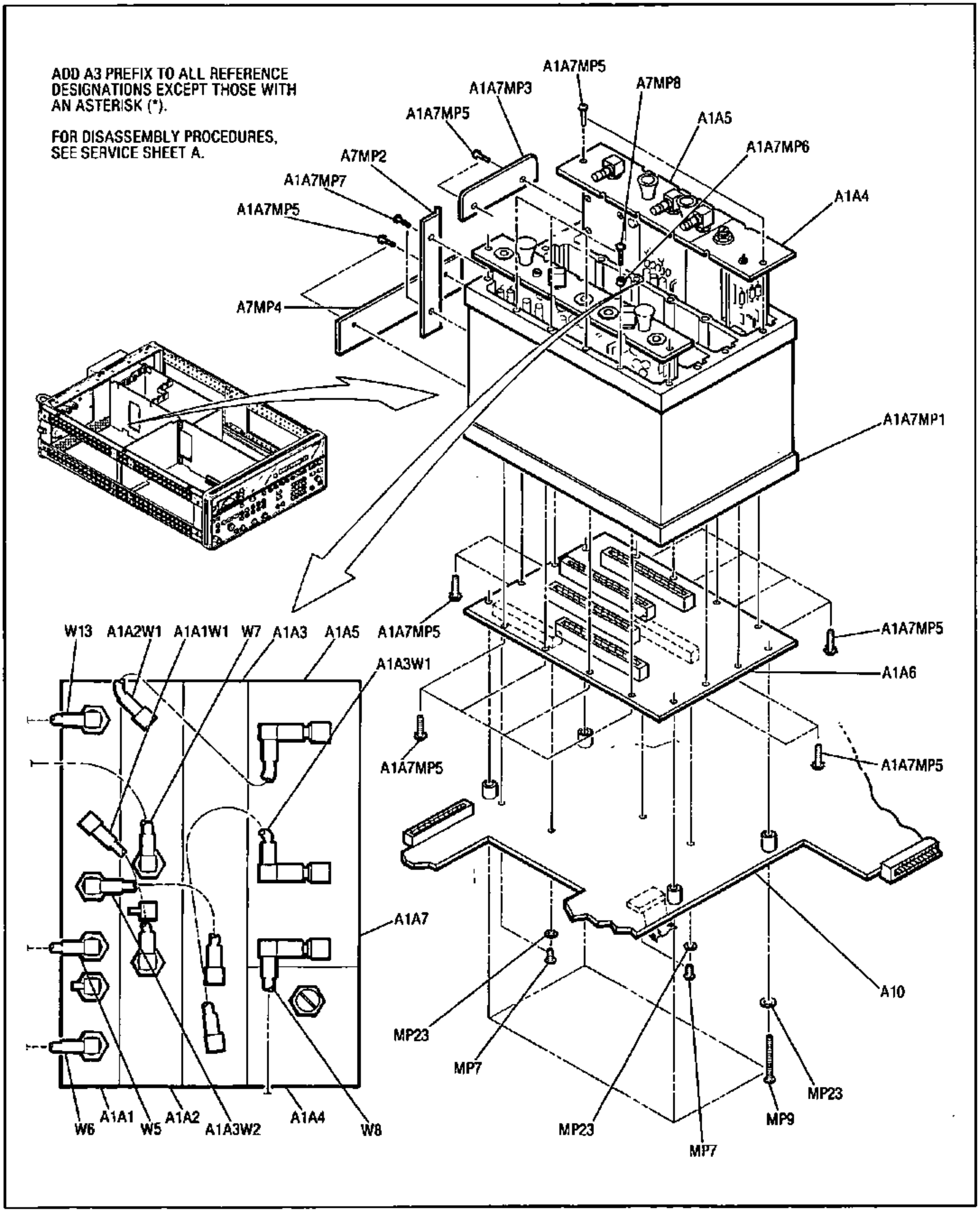


Figure 6-9. A3 RF Source Illustrated Parts Breakdown

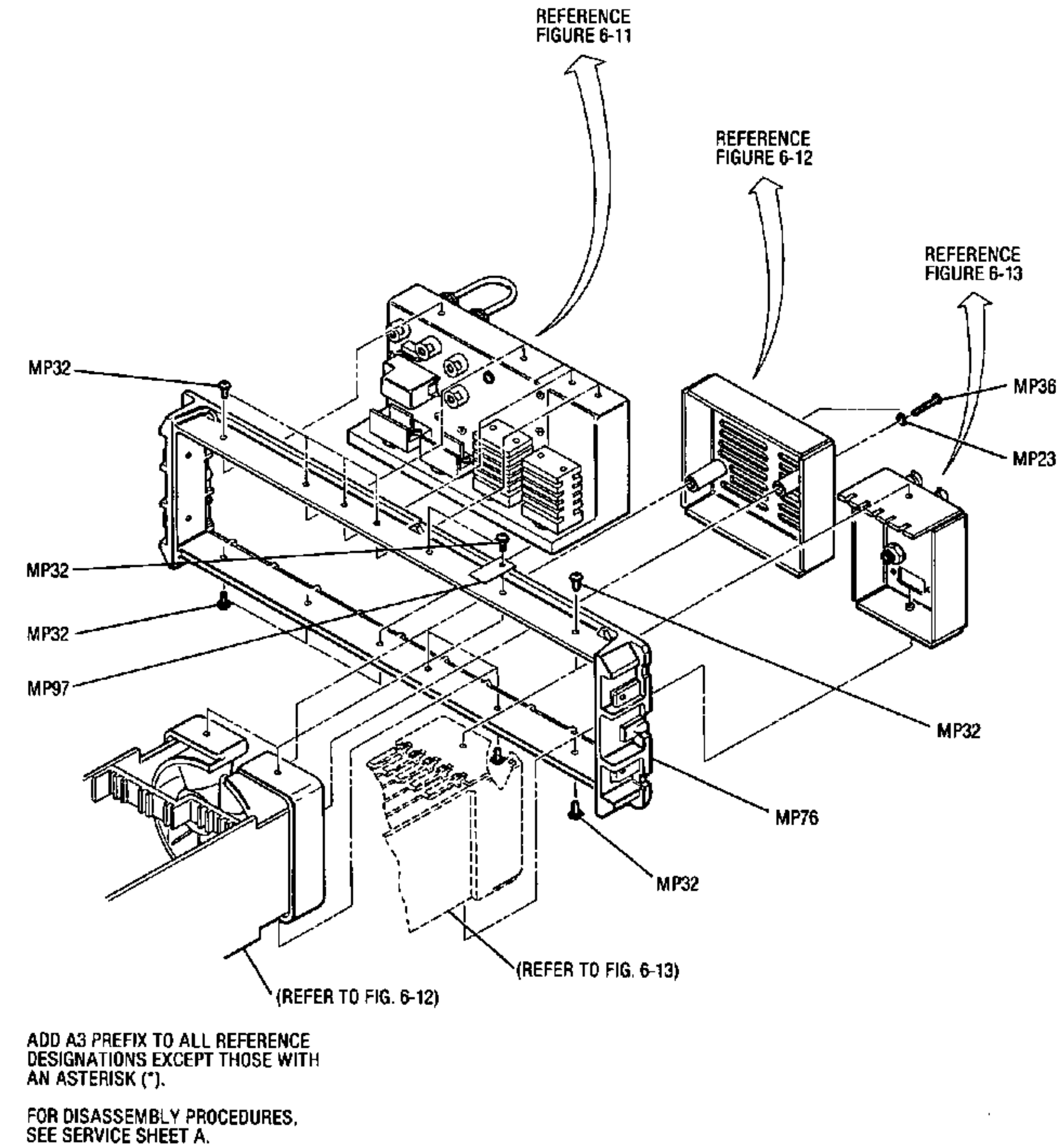
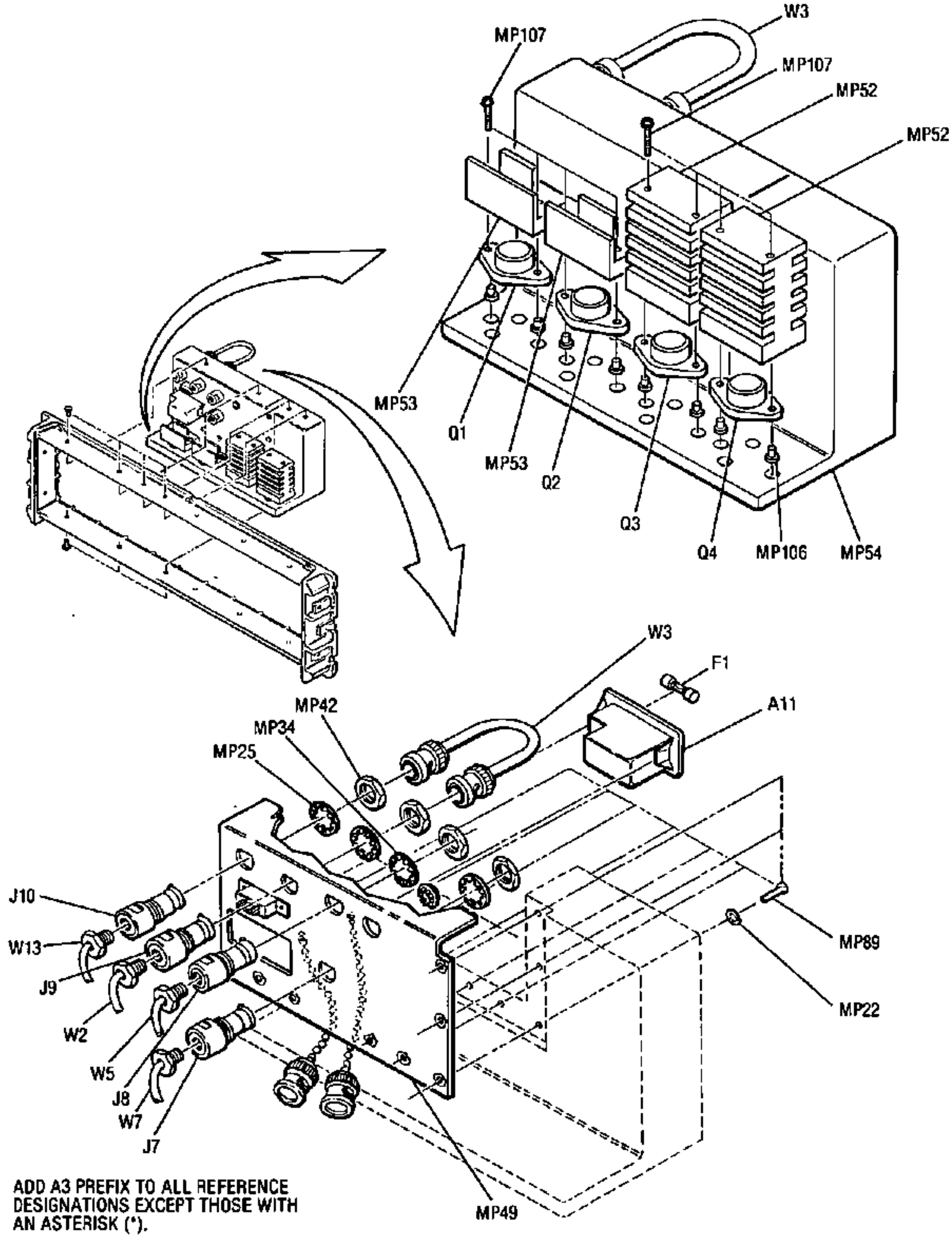


Figure 6-10. A3 Rear Panel Illustrated Parts Breakdown



ADD A3 PREFIX TO ALL REFERENCE DESIGNATIONS EXCEPT THOSE WITH AN ASTERISK (*).

FOR DISASSEMBLY PROCEDURES, SEE SERVICE SHEET A.

Figure 6-11. A3 Power Supply and Rear Panel Illustrated Parts Breakdown

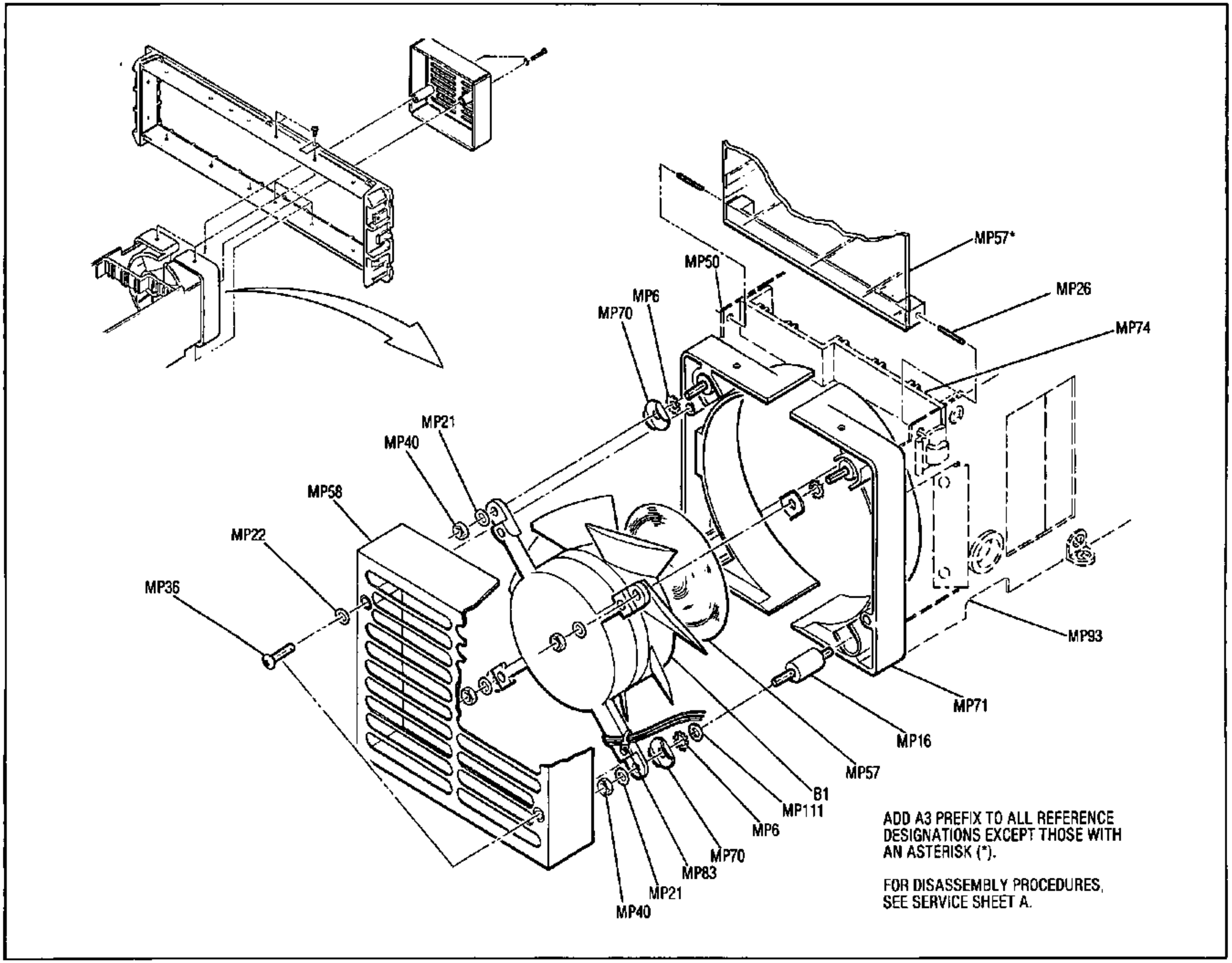


Figure 6-12. A3 Fan Assembly Illustrated Parts Breakdown

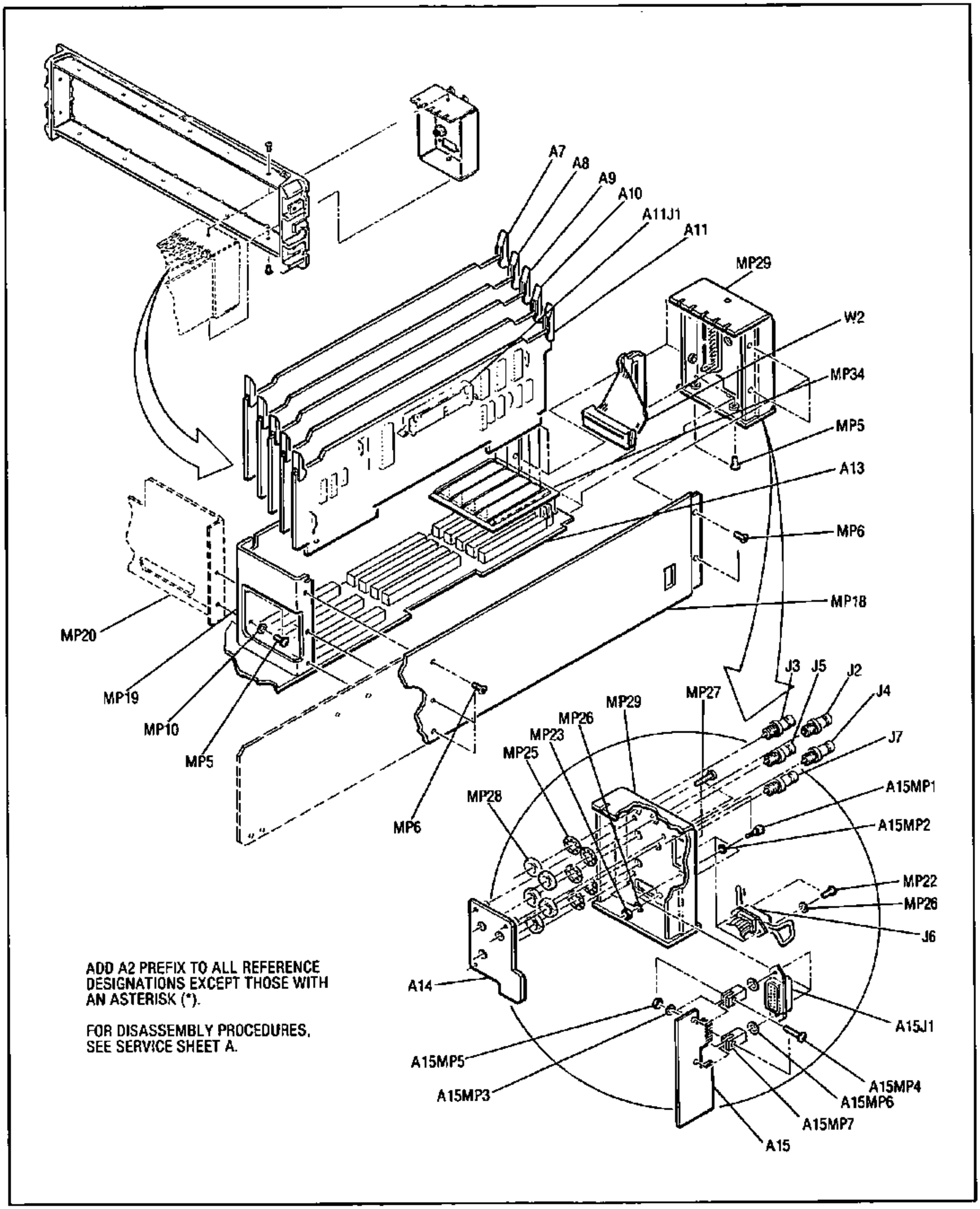


Figure 6-13. P/O A2 Controller Assembly and Rear Panel Illustrated Parts Breakdown

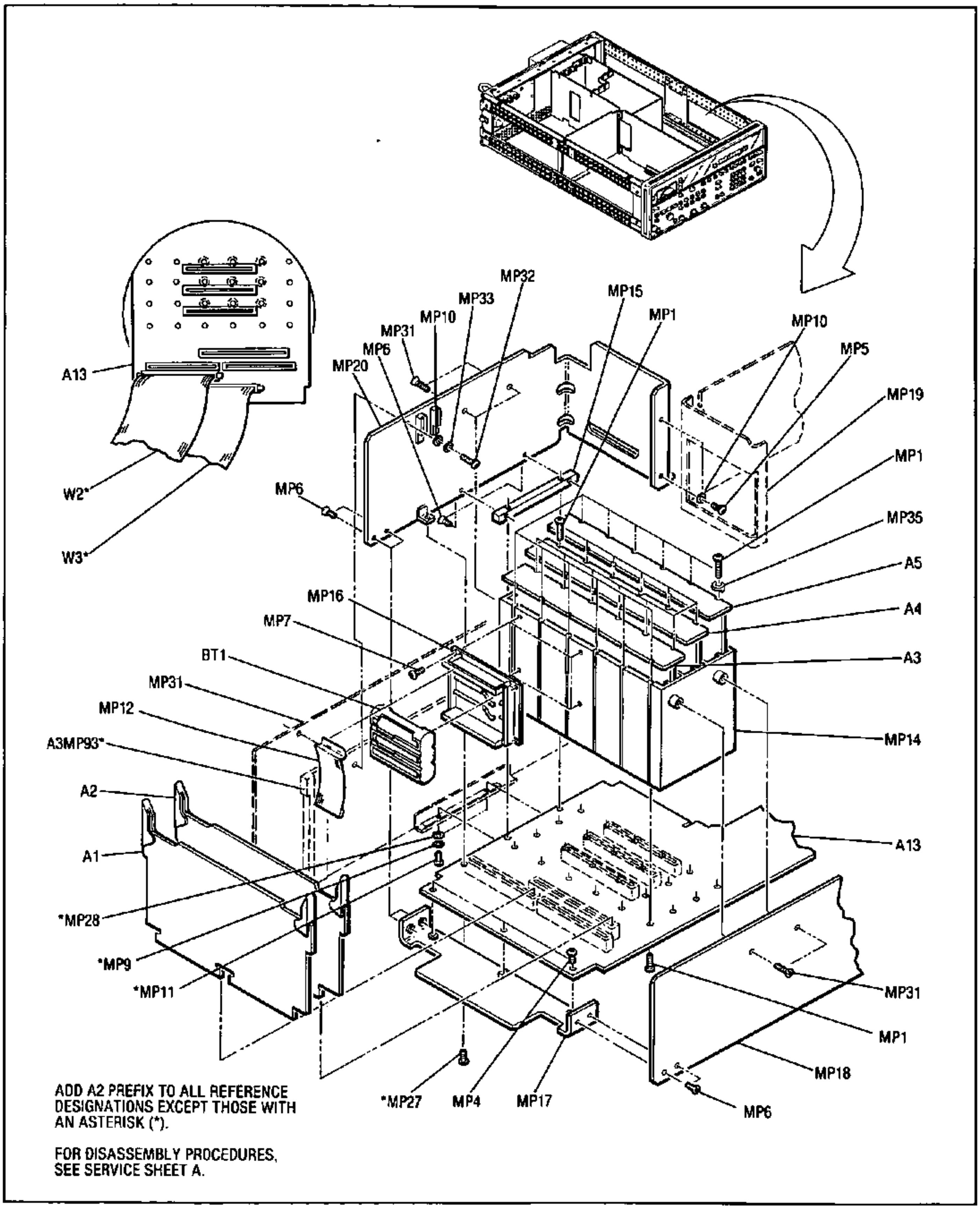
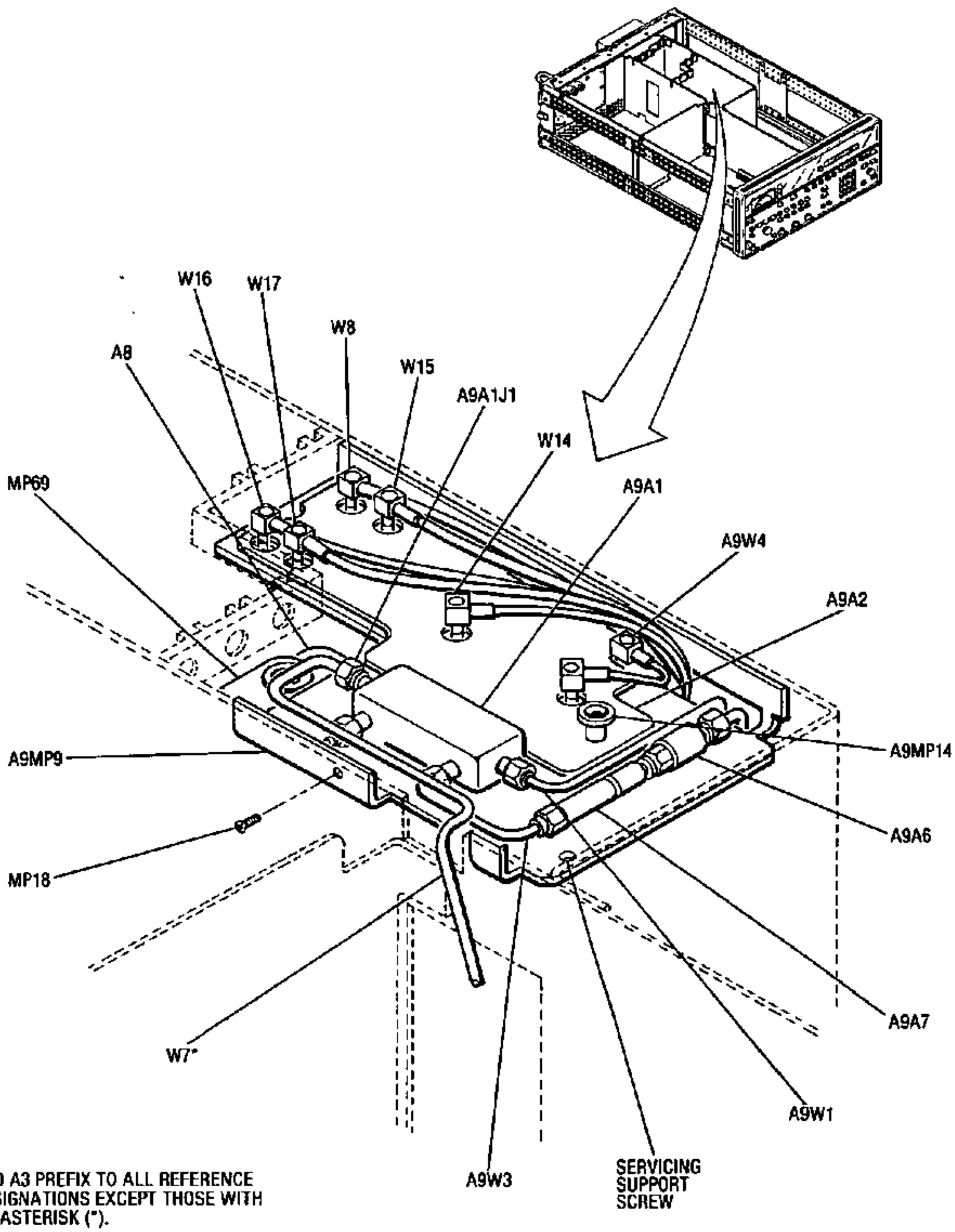


Figure 6-14. P/O A2 Controller Assembly Illustrated Parts Breakdown



ADD A3 PREFIX TO ALL REFERENCE DESIGNATIONS EXCEPT THOSE WITH AN ASTERISK (*).

FOR DISASSEMBLY PROCEDURES, SEE SERVICE SHEET A.

Figure 6-15. A3A9 YTO Loop Illustrated Parts Breakdown

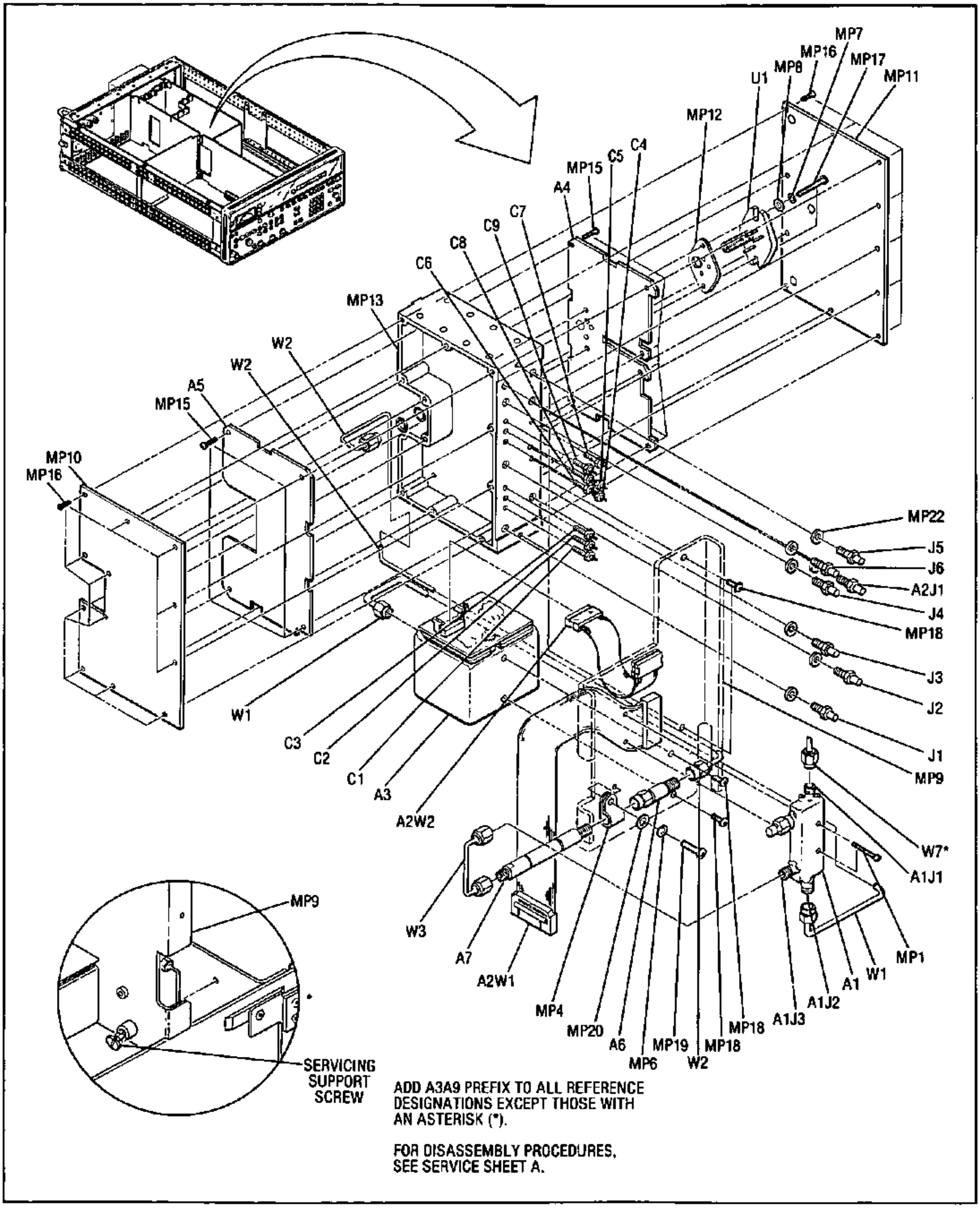


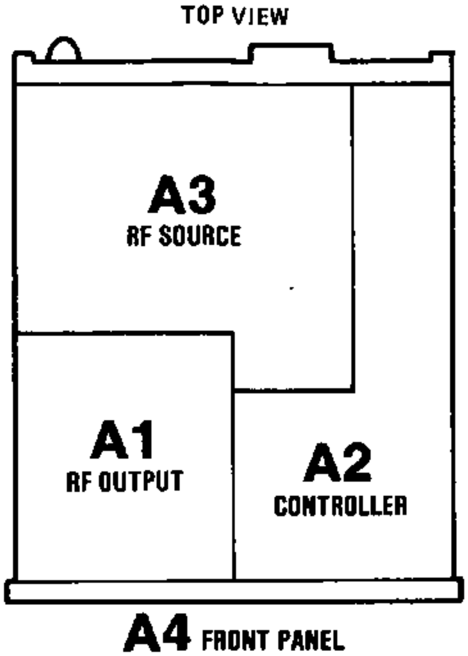
Figure 6-16. A3A9 YTO and Reference Oscillator Illustrated Parts Breakdown

VII Manual Changes

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

This section normally contains information for adapting this manual to instruments for which the content does not apply directly. Since this manual does apply directly to instruments having serial numbers listed on the title page, no change information is given here. Refer to INSTRUMENTS COVERED BY MANUAL in Section I for additional important information about serial number coverage.



MAJOR ASSEMBLIES

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Attenuator Driver Board Assembly	18
A1A2	Detector Module Assembly	14,17
A1A2A1	ALC Board Assembly	14,17
A1A2A2	Detector Board Assembly	17
A1A3	Function Board Assembly	20
A1A4	Pulse Driver Board Assembly	15
A1A5	DAC and Enable Board Assembly	22
A1A6	Meter Board Assembly	21
A1A7	YTM Driver Board Assembly	16
A1A8	SRD Bias Board Assembly	19
A1A9	Preamp Assembly	14,16
A1A10	YTM Assembly	16
A1A10A1	YIG Heater Control Assembly	16
A1A11	Power Amplifier Assembly	16
A1A12	Motherboard Assembly	14-16,18-22, 30,31
A1A13	Terminal Strip	15
A1A14	Amp Bias Board Assembly	17
A2A1	Panel Driver Board Assembly	25
A2A2	Key Code Board Assembly	24
A2A3	VCO Assembly	8
A2A4	Phase Detector Assembly	7
A2A5	Divider Assembly 20/30	6
A2A6	Not Assigned	
A2A7	I/O Board Assembly	30,31
A2A8	Microprocessor Board Assembly	26
A2A9	Frequency/HP-IB Board Assembly	29
A2A10	RAM Board Assembly	28
A2A11	ROM Board Assembly	27
A2A12	Not Assigned	
A2A13	Motherboard Assembly	6-8,10,20-32
A2A14	Rear Interconnect Board Assembly	24,29,31
A2A15	HP-IB Connector Board Assembly	29
A3A1	Rectifier Assembly	33
A3A1A1	Reference Phase Detector Assembly	1,2
A3A1A2	100 MHZ VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator	4
A3A1A4A2	VCO Board Assembly	4
A3A1A5	M/N Output Assembly	5
A3A1A6	M/N Reference Motherboard Assembly	1-3,5
A3A1A7	Reference Housing Assembly	
A3A2	Not Assigned	
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	DAC Assembly	9
A3A6	YTO Driver Assembly	10
A3A7	FM Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Sampler Assembly	11
A3A9A6	Attenuator Assembly	13
A3A9A7	6.2 GHz Low Pass Filter	13
A3A10	Motherboard Assembly	1,3,4,6,10, 12-14,21-23, 26,29-31, 33-35
A4A1	Front Panel Board Assembly	20,22,23,32

SECTION VIII
SERVICE

8-1. INTRODUCTION

This section contains information for troubleshooting and repairing the Signal Generator. Included are block diagrams, schematic diagrams, principles of operation, and procedures for troubleshooting, repair, disassembly, and reassembly.

8-2. FAILURE MODES AND SERVICE STRATEGY

8-3. General

Instrument problems usually fall into four general categories: turn-on errors, operator errors, instrument performance out of specification and catastrophic failures. The troubleshooting strategy is different for each catagory.

8-4. Turn-on Errors

An error message displayed on the front panel when the Signal Generator is turned on indicates that the built-in diagnostic routine has detected some problem. Turn the instrument off and on again. If the error repeats, do one of the following:

a. Press Recall 0. If operation seems to be normal, the instrument may be useable with limited functions.

b. Go to Service Sheet BD1 to begin troubleshooting.

8-5. Operator Errors

Apparent failures often result from operator errors and may take one of three forms: invalid entry (message codes 01-09), "soft errors" that result from incorrect combinations of sweep entries (message codes 10-16), and HP-IB errors (message codes 20-24). Refer to Table 3-7 or the Pullout Card for additional information on these errors.

8-6. Instrument Performance Out of Specification

Two levels of testing can be performed to verify that the instrument is operating normally and within specification. The first level of testing is the Abbreviated Performance Tests in Section IV, Part 1 of this manual. These tests involve the least amount of time and can reveal much about overall operation. For a complete test, perform the full Performance Tests in Section IV Part 2. The specifications are listed in Table 1-1.

If a parameter is only slightly out of limits, it can often be brought into specification by an adjustment. The procedures for all adjustments are in Section V. A cross-reference table for performance tests and adjustment procedures is also included. If the adjustment fails to bring the parameter into specification, use the troubleshooting procedures starting on Service Sheet BD1.

8-7. Catastrophic Failures

When a catastrophic failure occurs, begin troubleshooting on Service Sheet BD1. The information there is used to quickly isolate the problem to one of the major functional sections of the instrument. Troubleshooting catastrophic failures in the Signal Generator is structured into three levels:

a. The overall troubleshooting level, where problems are isolated to the power supply or one of the functional sections. This level of troubleshooting is supported by Service Sheet BD1, which includes diagrams, theory of operation, and troubleshooting information.

b. The functional level of troubleshooting isolates the malfunction to a circuit or circuit board. This level of troubleshooting is supported by Service Sheets BD2 through BD9, which include diagrams, theory of operation, and troubleshooting information.

c. Circuit level troubleshooting isolates the problem to a stage within the circuits shown on the schematic. This level of troubleshooting is supported by Service Sheets 1-35, which include circuit level block diagrams, schematics, theory of operation, and troubleshooting information. It is expected that further troubleshooting, to the component level, depends on the skill and experience of the troubleshooter.

8-8. SERVICE SHEETS

The foldout pages in the last part of this section are the service sheets. They consist of block diagrams, circuit schematic diagrams, supplemental diagrams, troubleshooting information, internal views, and disassembly procedures.

8-9. MANUAL BACKDATING(†)

A dagger (†) by an item of service information means that the information is different for instruments with serial number prefixes lower than the one shown on the manual's title page. Table 7-1, Manual Changes by Serial Number lists the backdating changes and their related serial number prefix. The backdating changes are contained in Section VII.

8-10. MANUAL UPDATING (Manual Changes Supplement)

Production changes to the instrument made after the publication date of this manual are indicated by a change in the serial number prefix. Changes to this manual are identified by serial number prefix on the Manual Changes supplement. Errors are also noted in the ERRATA portion of the Manual Changes supplement.

Keep this manual up to date by periodically requesting the latest supplement from your Hewlett-Packard office.

8-11. SAFETY CONSIDERATIONS

8-12. Before Applying Power

Verify that the instrument is set to match the available line voltage and that the correct fuse is installed. An uninterrupted safety earth ground must be provided from the main power source to the instrument input wiring terminals, power cable, or supplied power cable set.

8-13. Warnings and Cautions

Pay attention to WARNINGS and CAUTIONS. They must be followed for your protection and to avoid damage to the equipment.

WARNINGS

Maintenance described herein is performed with power supplied to the instrument and with protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power supplied, the power should be removed.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between this instrument and any other equipment used in conjunction with it prior to energizing any of the units.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure that the common terminal is connected to neutral (that is, the grounded side of the mains supply).

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

CAUTION

Do not disconnect or remove any boards in the Signal Generator unless the instrument is turned off or unplugged. Some boards contain devices that can be damaged if the board is removed when the power is on. Several components, including MOS devices, can be damaged by electrostatic dischage. Use conductive foam and grounding straps when servicing is required on sensitive components. Use care when unplugging ICs from high-grip sockets.

8-14. After Service Safety Checks

Visually inspect interior of instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy the cause of any such condition.

Using a suitable ohmmeter, check resistance from instrument enclosure to ground pin on power cable plug. The reading must be less than one ohm. Flex the power cable while making this measurement to determine whether intermittent discontinuities exist.

Check any indicated front or rear panel ground terminals that are marked, using the above procedures.

Check resistance from instrument enclosure to line and neutral (tied together) with the power switch on and the power source disconnected. The minimum acceptable resistance is two megohms. Replace any component that results in a failure.

Check line fuse to verify that a correctly rated fuse is installed.

8-15. RECOMMENDED TEST EQUIPMENT

Test equipment and accessories required to maintain the Signal Generator are listed in Table 1-3, Recommended Test Equipment. Equipment other than that listed may be used if it meets the critical specifications listed in the table.

8-16. SERVICE TOOLS, AIDS, AND INFORMATION

8-17. Service Accessories

HP 11726-10002	Adjustment Cassette
HP 11726-60004	Super Extender 3 Test Board
HP 11726-60001	MPU Test Connector
HP 11726-60002	3-Connector Extender Board
HP 08672-60117	30-pin Extender Board
HP 08672-60020	36-pin Extender Board (2 req.)
HP 05342-60035	48-pin Extender Board
HP 5060-0258	24-pin Extender Board
HP 8120-1578	Cable Assembly
HP 1250-1158	Female SMA to Female SMA Adapter
HP 11611-60056	Cable Assembly
HP 1250-1237	Male SMB to Female BNC Adapter
HP 1250-1391	SMB Tee
HP 08673-60123	Test Connector
HP 86730-60051	Extender Cable
HP 1250-1250	Type N Male to Female SMA Adapter (2 required)

8-18. Service Functions

The Service Functions listed in Table 8-1 are used in the adjustment procedures in Section V, and in Power-up checks. They can be executed manually or via HP-IB control. Service Functions are activated manually by entering the proper service number from the front panel and then pressing the switch located on the top of the Keycode Board (A2A2). In remote, these functions can be activated by programming a data message with the service number followed by the program code "SV."

8-19. Signature Analysis

Signature analysis is a simple means of verifying the operation of digital circuitry. When properly used, signature analysis can detect extremely subtle hardware faults. Signatures must identically match those given in the signature tables.

8-20. Pozidriv Screwdrivers

Many screws in the Signal Generator appear to be Phillips type, but are not. To avoid damage to the screw head slots, Pozidriv screwdrivers should be used. HP 8710-0899 is the No. 1 Pozidriv. HP 8710-0900 is the No. 2 Pozidriv.

8-21. Tuning Tools

For adjustments requiring non-metalic tuning tools, use the HP 8710-0033 blade tuning tool or the HP 8710-1010 (JFD Model No. 5284) hex tuning tool. For other adjustments an ordinary small screwdriver or suitable tool is sufficient. No matter which tool is used, never force any adjustment control. This is especially critical when adjusting variable inductors or capacitors.

8-22. Heat Staking Tools

The front panel pushbutton switches have small plastic posts protruding from the back. These posts fit through holes in the front panel printed circuit board and are melted down to hold the switch in place. This process is known as heat staking. The heat staking tool is a standard soldering iron with a special tip attached.

Refer to the paragraph entitled Replacement of Key Cap and Pushbutton Switches under REPAIR AND REPLACEMENT in this section for the heat staking procedure.

Table 8-1. Schematic Diagram Notes (1 of 8)

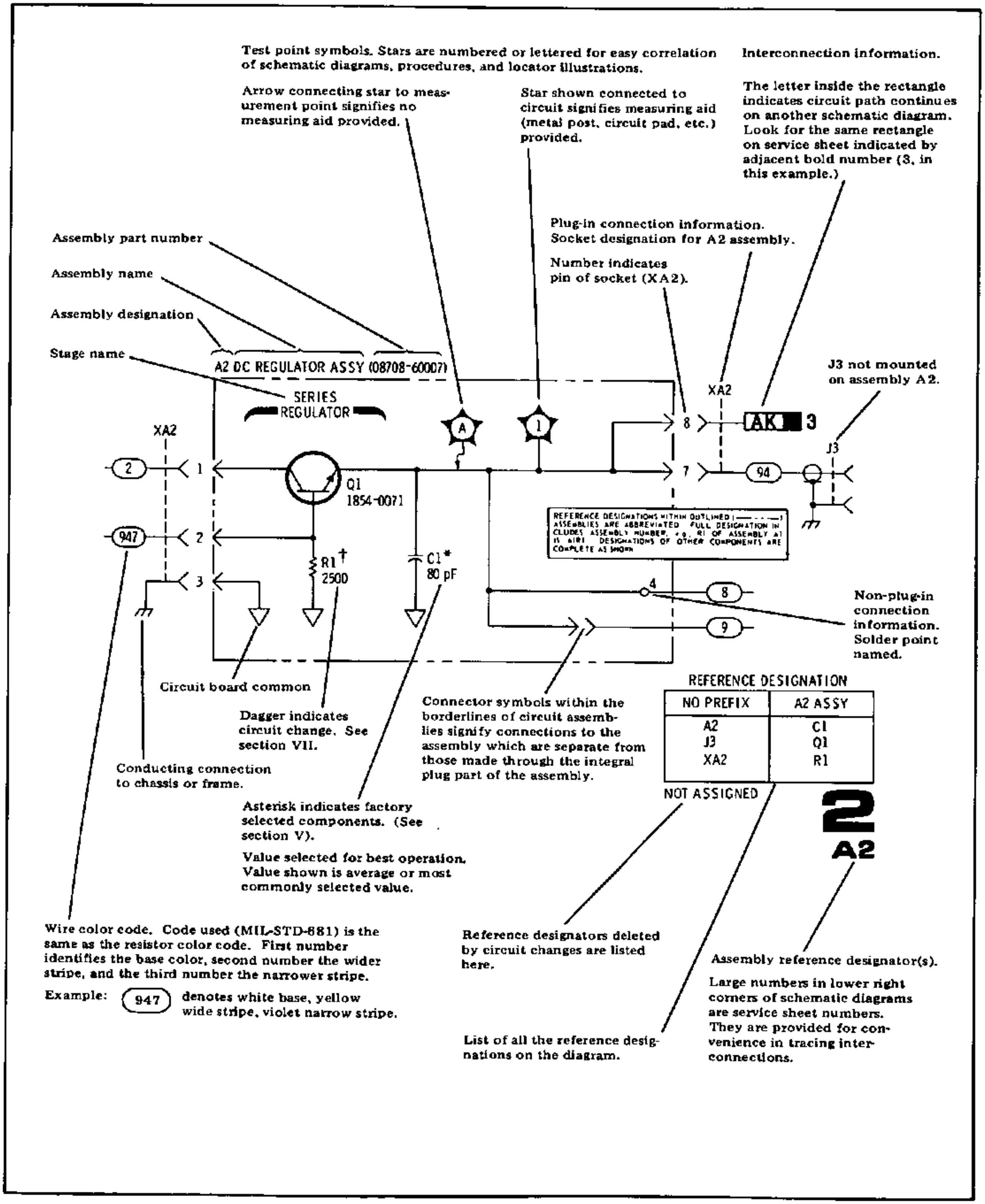


Table 8-1. Schematic Diagram Notes (2 of 8)

SCHEMATIC DIAGRAM NOTES

*	Asterisk denotes a factory-selected value. Value shown is typical.
†	Dagger indicates circuit change. See Section VII.
	Tool-aided adjustment. ○ Manual control.
	Encloses front-panel designation.
	Encloses rear-panel designation.
	Circuit assembly borderline.
	Other assembly borderline.
	Heavy line with arrows indicates path and direction of main signal.
	Heavy dashed line with arrows indicates path and direction of main feedback.
	Indicates stripline (i.e., RF transmission line above ground).
CW	Wiper moves toward cw with clockwise rotation of control (as viewed from shaft or knob).
1	Numbered Test Point measurement aid provided.
	Encloses wire or cable color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider stripe, and the third number identifies the narrower stripe, e.g., denotes white base, yellow wide stripe, violet narrow stripe.
	A direct conducting connection to earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea, or land vehicle).
	A conducting connection to a chassis or frame.
	Common connections. All like-designation points are connected.
AK 12	Letters = off-page connection, e.g., AK Number = Service Sheet number for off-page connection, e.g., 12
1 THIS PAGE	Number (only) = on-page connection.

Table 8-1. Schematic Diagram Notes (3 of 8)

SCHEMATIC DIAGRAM NOTES

Indicates multiple paths represented by only one line. Letters or names identify individual paths. Numbers indicate number of paths represented by the line.

Coaxial or shielded cable.

Relay. Contact moves in direction of arrow when energized.

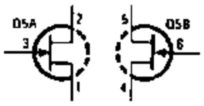
Indicates a pushbutton switch with a momentary (ON) position.

Indicates a PIN diode.

Indicates a current regulation diode.

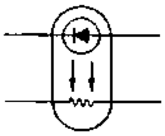
Indicates a voltage regulation diode.

Indicates a Schottky (hot-carrier) diode.



Multiple transistors in a single package—physical location of the pins is shown in package outline on schematic.

Identification of logic families as shown (in this case, ECL).

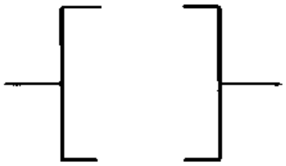


Indicates an opto-isolator of a LED and a photoresistor packaged together. The resistance of the photoresistor is a function of the current flowing through the LED.

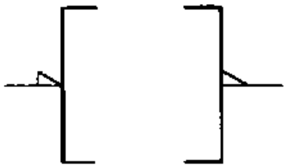
Table 8-1. Schematic Diagram Notes (4 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

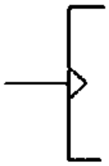
Input and Output Indicators



Implied Indicator—Absence of polarity indicator (see below) implies that the active state is a relative high voltage level. Absence of negation indicator (see below) implies that the active state is a relative high voltage level at the input or output.

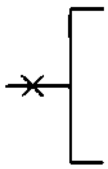


Polarity Indicator—The active state is a relatively low voltage level.

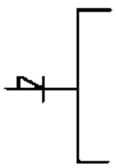


Dynamic Indicator—The active state is a transition from a relative low to a relative high voltage level.

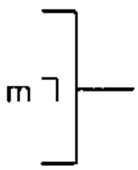
Inhibit Input—Input that, when active, inhibits (blocks) the active state outputs of a digital device.



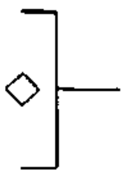
Analog Input—Input that is a continuous signal function (e.g., a sine wave).



Polarity Indicator used with Inhibit Indicator—Indicates that the relatively low level signal inhibits (blocks) the active state outputs of a digital device.



Output Delay—Binary output changes state only after the referenced input (m) returns to its inactive state (m should be replaced by appropriate dependency or function symbols).



Open Collector Output—Output that must form part of a distributed connection.

Table 8-1. Schematic Diagram Notes (5 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Input and Output Indicators (Cont'd)

3-STATE	Three-state Output—Indicates outputs that can have a high impedance (disconnect) state in addition to the normal binary logic states.

Combinational Logic Symbols and Functions

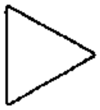
&	AND—All inputs must be active for the output to be active.
≥1	OR—One or more inputs being active will cause the output to be active.
≥m	Logic Threshold—m or more inputs being active will cause the output to be active (replace m with a number).
=1	EXCLUSIVE OR—Output will be active when one (and only one) input is active.
=m	m and only m—Output will be active when m (and only m) inputs are active (replace m with a number).
=	Logic Identity—Output will be active only when all or none of the inputs are active (i.e., when all inputs are identical, output will be active).
	Amplifier—The output will be active only when the input is active (can be used with polarity or logic indicator at input or output to signify inversion).
X/Y	Signal Level Converter—Input level(s) are different than output level(s).
⟷	Bilateral Switch—Binary controlled switch which acts as an on/off switch to analog or binary signals flowing in both directions. Dependency notation should be used to indicate affecting/affected inputs and outputs. Note: amplifier symbol (with dependency notation) should be read to indicate unilateral switching.
X→Y	Coder—Input code (X) is converted to output code (Y) per weighted values or a table.
(Functional Labels)	The following labels are to be used as necessary to ensure rapid identification of device function.
MUX	Multiplexer—The output is dependent only on the selected input.
DEMUX	Demultiplexer—Only the selected output is a function of the input.
CPU	Central Processing Unit
PIO	Peripheral Input/Output
SMI	Static Memory Interface

Table 8-1. Schematic Diagram Notes (6 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions

1 	Monostable—Single shot multivibrator. Output becomes active when the input becomes active. Output remains active (even if the input becomes inactive) for a period of time that is characteristic of the device and/or circuit.
G 	Oscillator—The output is a uniform repetitive signal which alternates between the high and low state values. If an input is shown, then the output will be active if and only if the input is in the active state.
FF	Flip-Flop—Binary element with two stable states, set and reset. When the flip-flop is set, its outputs will be in their active states. When the flip-flop is reset, its outputs will be in their inactive states.
T	Toggle Input—When active, causes the flip-flop to change states.
S	Set Input—When active, causes the flip-flop to set.
R	Reset Input—When active, causes the flip-flop to reset.
J	J Input—Analogous to set input.
K	K Input—Analogous to reset input.
D	Data Input—Always enabled by another input (generally a C input—see Dependency Notation). When the D input is dependency-enabled, a high level at D will set the flip-flop; a low level will reset the flip-flop. Note: strictly speaking, D inputs have no active or inactive states—they are just enabled or disabled.
m	Count-Up Input—When active, increments the contents (count) of a counter by "m" counts (m is replaced with a number).
−m	Count-Down Input—When active, decrements the contents (count) of a counter by "m" counts (m is replaced with a number).
→m	Shift Right (Down) Input—When active, causes the contents of a shift register to shift to the right or down "m" places (m is replaced with a number).
←m	Shift Left (Up) Input—When active, causes the contents of a shift register to shift to the left or up "m" places (m is replaced with a number).

NOTE

For the four functions shown above, if m is one, it is omitted.

(Functional Labels)	The following functional labels are to be used as necessary in symbol build-ups to ensure rapid identification of device function.

Table 8-1. Schematic Diagram Notes (7 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Sequential Logic Functions (Cont'd)

mCNTR	Counter—Array of flip-flops connected to form a counter with modulus m (m is replaced with a number that indicates the number of states: 5 CNTR, 10 CNTR, etc.).
REG	Register—Array of unconnected flip-flops that form a simple register or latch.
SREG	Shift Register—Array of flip-flops that form a register with internal connections that permit shifting the contents from flip-flop to flip-flop.
ROM	Read Only Memory—Addressable memory with read-out capability only.
RAM	Random Access Memory—Addressable memory with read-in and read-out capability.

Dependency Notation

mAm	Address Dependency—Binary affecting inputs of affected outputs. The m prefix is replaced with a number that differentiates between several address inputs, indicates dependency, or indicates demultiplexing and multiplexing of address inputs and outputs. The m suffix indicates the number of cells that can be addressed.
Gm	Gate (AND) Dependency—Binary affecting input with an AND relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or letter (the identifier).
Cm	Control Dependency—Binary affecting input used where more than a simple AND relationship exists between the C input and the affected inputs and outputs (used only with D-type flip-flops).
Vm	OR Dependency—Binary affecting input with an OR relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or the letter (the identifier).
Fm	Free Dependency—Binary affecting input acting as a connect switch when active and a disconnect when inactive. Used to control the 3-state behavior of a 3-state device.

NOTE

The identifier (m) is omitted if it is one—that is, when there is only one dependency relationship of that kind in a particular device. When this is done, the dependency indicator itself (G, C, F, or V) is used to prefix or suffix the affected (dependent) input or output.

Table 8-1. Schematic Diagram Notes (8 of 8)

DIGITAL SYMBOLOGY REFERENCE INFORMATION

Miscellaneous

⎎	Schmitt Trigger — Input characterized by hysteresis; one threshold for positive going signals and a second threshold for negative going signals.
Active	Active State — A binary physical or logical state that corresponds to the true of an input, an output, or a function. The opposite of the inactive state.
Enable	Enabled Condition — A logical state that occurs when dependency conditions are satisfied. Although not explicitly stated in the definitions listed above, functions are assumed to be enabled when their behavior is described. A convenient way to think of it as follows: A function becomes active when: • it is enabled (dependency conditions — if any — are satisfied) • and its external stimulus (e.g., voltage level) enters the active state.

Table 8-2. Service Functions

Service Number	Function
1	Performs a test of the RAM circuit. While the test is being performed, the FREQUENCY MHz display indicats 00. If a display other than 00 is present, that number indicates which part(s) of the RAM failed. Refer to Service Sheet BD8 for an explanation of the error codes.
2	Performs a checksum test of the microprocessor ROM. Refer to Service Sheet BD8 for an explanation of the error codes.
3	Disables the YTM AUTO PEAK tuning function and sweeps the YTM over a limited range so the tuning curve can be examined.
4	Disables the YTM AUTO PEAK tuning function and centers the YTM peak tuning DAC.
6	Stores the start and stop frequencies in storage registers 1 through 4. These frequencies can be recalled by pressing RCL1, RCL2, RCL3, or RCL4. This function can be used when performing individual band tests or adjustments.
7	Tests pulse modulation video feedthrough.
8	Not used.
9	Not used.
10	Not used.
11	Displays setting of configuration switch A2A7S1 (W1—W7).
33	Not used.
34	Not used.
35	Not used.
36	Inhibits YTM peaking.
37	Re-enables peaking.

8-23. Hardware

The Signal Generator has a mixture of Unified National (inch) and metric screws. The metric screws are defined in Industrial Fasteners publication (IFI 500) and are identified in the replaceable parts list as M (metric). Metric screws have a shiny silver appearance and are used throughout the instrument. The Unified National screws have a dull steel-gray appearance. Do not use a metric screw in a Unified National nut; thread damage will result.

8-24. Assembly Locations

Assemblies in the Signal Generator are numbered in groups, both by function and by location. Refer to lettered service sheet(s) for identification of assemblies. In addition, each tab has major assembly location figures. Also, each tab has a table listing the Service Sheets where each major assembly is found.

8-25. Parts and Cable Locations

The location of individual components mounted on printed circuit boards or other assemblies are shown near the schematic diagram. The part reference designator is the assembly designator plus the part designator. For example, A2A3R9 is R9 on the A2A3 assembly. For specific component descriptions and ordering information, refer to Table 6-3, Replaceable Parts, in Section VI. Chassis and frame parts, as well as mechanical parts (MP) and cables (W), are identified on illustrated parts breakdowns (IPB) in Section VI, or in this section on the lettered diagrams.

8-26. Test Points and Adjustment Locations

Most test points and adjustments are indicated on circuit board assemblies. Test points and adjustments can also be found on the component locator figure near the assembly's schematic diagram. Test points identified on block diagrams are also shown on the lettered service sheets following the schematic diagram foldouts.

8-27. Service Aids on Printed Circuit Boards

Service aids on printed circuit boards include test points, indicator lights, some reference designations, adjustment names, and assembly part numbers.

8-28. Other Service Documents

Service Notes, Manual Change Supplements, and other service literature are available through Hewlett-Packard. For further information, contact your nearest Hewlett-Packard office.

8-29. REPAIR AND REPLACEMENT

8-30. After Repair Adjustment Procedure

After repairs are made, adjustments may be needed to assure optimum performance. Refer to Table 5-3, Post Repair Adjustments in Section V of this volume to determine what, if any, adjustments are needed after any repair is made.

8-31. Disassembly and Reassembly Procedures

Disassembly and reassembly procedures begin on Service Sheet A. Top and bottom cover removal procedures are described there and also in the following paragraph.

8-32. Top and Bottom Cover Removal

1. Place the instrument with the appropriate cover up.
2. Remove the appropriate rear panel standoffs MP33.
3. Loosen the captive screw securing the cover to the frame.
4. Slide the cover to the rear and remove.
5. For replacement, follow the above steps in the inverse order.

8-33. Front Panel Key Cap Replacement

If key cap replacement is necessary, removing the front panel key cap can be done in one of two ways. If the front panel has been removed, as described on the lettered service sheet diagrams, use a small flat blade screwdriver to press on the switch side of the key cap while working it from side-to-side with your fingers. Removing the key cap without opening the instrument is done as follows. Grasp the key cap firmly with pliers. Work it from side-to-side while pulling away from the panel.

NOTE

The pliers may damage the key cap unless the jaws are covered with a protective material.

Be sure the key cap is aligned properly before snapping into place. Note that the key cap has 8 possible postions (see Figure 8-1).

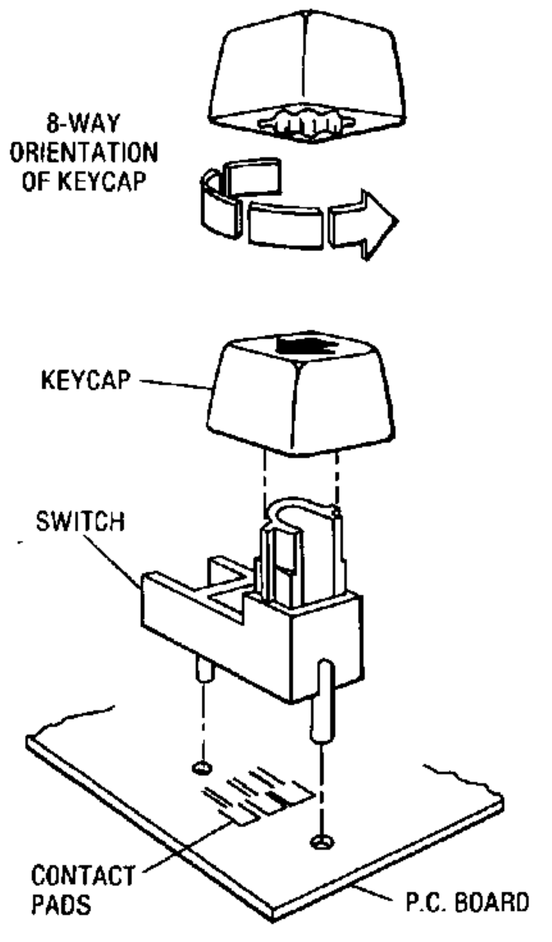


Figure 8-1. Front Panel Pushbutton Switch Assembly

8-34. Front Panel Switch Replacement.

NOTE

The front panel switch traces and contacts are specially cleaned at the factory.

Front Panel Switch Replacement (cont'd)

NOTE (cont'd)

Do not handle or attempt to clean them. Wear linen gloves when making any repairs.

The front panel switches have a very high cycle life. However, if one becomes faulty and needs replacement, follow the procedure outlined below:

1. Remove the front panel by referring to the disassembly procedure in Service Sheet A following the schematic foldouts.

2. Remove the key cap as indicated above.

3. Remove the switch by chipping away the melted plastic tabs at the circuit side of the keyboard that hold the switch in place.

NOTE

The following operation should be done in a well ventilated area. If the heat staking tip is too hot, the plastic will vaporize and emit fumes. However, these fumes are non-toxic.

4. For reliable operation, the switch must be mounted tightly against the printed circuit board. To facilitate the heat staking operation, specially molded support anvils (HP 5040-6881) can be ordered. See Figure 8-2.

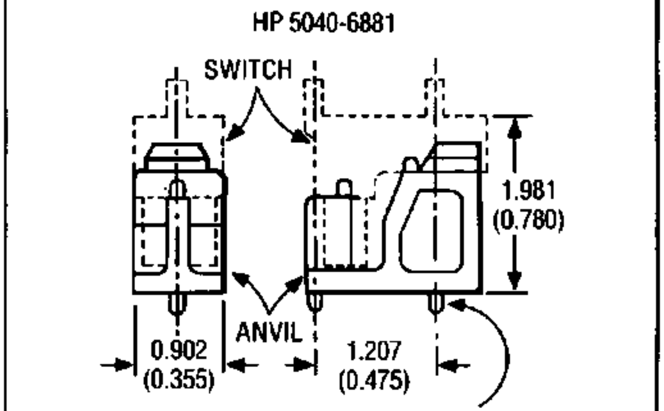


Figure 8-2. Pushbutton Switch Support Anvil

NOTE

Do not disturb the assembly for at least 10 seconds after heat staking.

If not enough heat is applied, the plastic will tend to stick to the tip of the iron.

If too much heat is applied, the plastic will fume profusely, the plastic post will be irregularly shaped, and the plastic will be permanently discolored.

If the staking tool is worn or flaked, it will cause a misshaped plastic post and/or a contamination deposit on the surface.

5. To ensure proper switch assembly, verify that the switch is pushed firmly against the circuit board and, with the hot (440°C or 825°F) staking tip (see Figure 8-3) push down on each of the two posts on the switch. Each post should take about one second to stake. With the proper cycle, the post should turn a darker color and, in about ten seconds, return to its original bright red color. The correctly staked post should have a smooth round rivet-like top. See Figure 8-4.

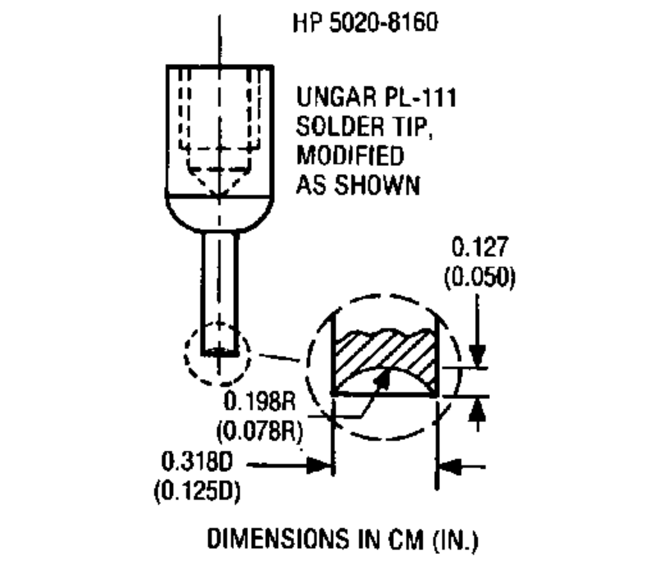


Figure 8-3. Heat Staking Tip

8-35. Etched Circuits (Printed Circuit Boards)

The etched circuit boards in the Signal Generator have plated through holes which make a

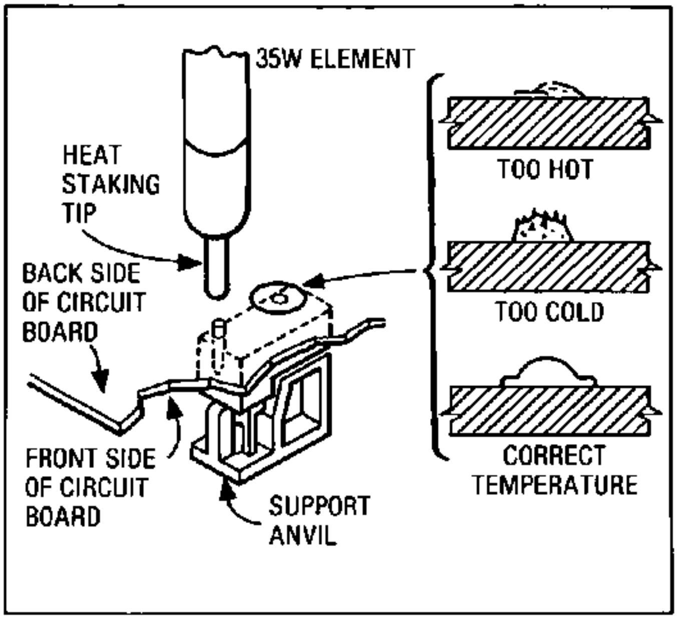


Figure 8-4. Typical Assembly for Heat Staking Operation

Etched Circuits (Printed Circuit Boards) (cont'd)

solder path through to both sides of the insulating material. Soldering can be done from either side of the board with equally good results. When soldering to any circuit board, keep in mind the following recommendations:

1. Avoid unnecessary component unsoldering and soldering. Excessive replacement can result in damage to the circuit board and/or adjacent components.
2. Do not use a high power soldering iron on etched circuit boards. A 35-watt soldering iron is recommended. Excessive heat may lift a conductor or damage the board.

CAUTION

Do not use a sharp metal object such as an awl or twist drill in the following step. Sharp objects may damage the plated through conductor.

3. Use a suction device or wooden toothpick to remove solder from component mounting holes. When using a suction device make sure that equipment is properly grounded to prevent electrostatic discharge from damaging MOS devices. Refer to Table 8-3, Etched Circuit Soldering Equipment, for information on available tools for working on etched circuit boards.

8-36. Electrostatic Discharge (ESD) Precautions

Electrostatic discharge (ESD) can cause damage to certain devices in the Signal Generator. The damage can range from slight degradation of a parameter to catastrophic failures.

MOS, CMOS, and other static sensitive devices are used in this instrument. They are prone to damage from both static electricity and transient signals. They must be handled carefully. When working on the Signal Generator, keep in mind the following recommendations to avoid damaging these sensitive components.

1. Use a static-free work station with a pad of conductive rubber or similar material.
2. Do not remove any board unless the Signal Generator has been turned off or unplugged.
3. After removing boards from the Signal Generator, be sure that they are placed on a conductive surface to guard against ESD damage. Do not stack boards.
4. When removing a MOS or CMOS device from a high grip socket, be careful not to damage it. Avoid removing devices from these sockets with pullers. Instead, use a small screwdriver to pry the device up from one end, slowly pulling it up one pair of pins at a time.
5. Once a MOS or CMOS device has been removed from an assembly, immediately stick it into a pad of conductive foam or other suitable holding medium.
6. When replacing a MOS or CMOS device, ground the foam on which it resides to the instrument before removing it. If a device requires soldering, make sure that the assembly is lying on a pad of conductive material, and that the pad, soldering iron tip, and personnel, are grounded to the assembly. Apply as little heat as possible.
7. Before turning the instrument off, remove any large ac sources that may be driving MOS switches.

8-37. Module Exchange Program

Table 6-1 lists assemblies that are available on an exchange basis. Refer to the table, and the

Table 8-3. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended	HP Part No.
Soldering Tool	Soldering, Heat Staking	Wattage: 35W Tip Temp.: 390—440°C (735—825°F)	Ungar No. 135 Ungar Division Eldon Ind. Corp. Compton, CA 90220	8690-0167
Soldering Tip	Soldering, Unsoldering	*Shape: Chisel	*Ungar PL113	8690-0007
Soldering Tip	Heat Staking	Shape: Cupped	HP 5020-8160 or modified Ungar PL11	5020-8160
De-Solder Aid	To remove molten solder from connection	Suction Device	Soldapullt by Edsyn Co., Van Nuys, CA 91406	8690-0060
Rosin (flux) Solvent	To remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board.	Freon TF	8500-0232
Solder	Component replacement, Circuit Board repair wiring	Rosin (flux core, high tin content (63/37 tin/lead), 18 gauge (AWG) 0.040 in. diameter preferred.		8090-0607

*For working on circuit boards; for general purpose work, use No. 555 Handle (8690-0261) and No. 4037 Heating Unit 47½ — 56½ W (HP 8690-0006); tip temperature of 850 — 900°F; and Ungar No. PL113 ⅛" chisel tip.

Module Exchange Program (cont'd)
EXCHANGE ASSEMBLIES paragraph in Section VI for further information.

8-38. Non-Repairable Assemblies

The following assemblies are not factory repairable and must be discarded.
A1CP1 Bias Tee
A1AT2 Isolator
A1AT3 Pulse Modulator
A1AT4 Attenuator, 2 dB
A1CR1 Crystal Detector
A1FL1 High Pass Filter
A2A1 Rotary Pulse Generator
A3A9A1 Directional Coupler
A3A9A6 Attenuator
A3A9A7 Low Pass Filter
A3A9U1 Sampler

8-39. Factory Selected Components (*)

Some component values are selected at the factory to provide optimum compatibility with associated components. These components are identified on individual schematics and the replaceable parts list by an asterisk (*). Refer to Table 5-1, Factory Selected Components, for the selection procedures.

8-40. CLEANING

8-41. Cleaning Intervals

Hewlett-Packard recommends a 6-month interval between cleaning for some parts of the Generator and a 12-month interval for other parts. However, cleaning intervals are mostly dependent upon where the Generator is used. The Generator should be cleaned more often if it is used in a dusty or very humid area.

8-42. Cleaning Solution

Hewlett-Packard recommends using either of two cleaning solutions on printed circuit (pc) board edge connectors. For best cleaning results, we recommend an ammonium hydroxide solution (NH_4OH, 29.5% NH_3 by weight). However, using concentrated solutions of ammonia requires using gloves, eye goggles, and proper ventilation. The second recommendation is an 80:20 solution of isopropyl alcohol and water (IPA/H_2O). This should serve as a satisfactory cleaner where one would rather not use ammonium hydroxide.

8-43. Top Cover Removal and Replacement

1. At the rear corners of the top cover, remove the two plastic standoffs.
2. At the center-rear of the top cover, loosen the captive screw securing the cover to the frame.
3. Slide the cover to the rear and remove it.
4. When the cleaning is completed, position the cover on top of the Generator and gently slide it as far forward as possible.
5. Secure the cover to the frame by tightening the captive screw at the center-rear of the cover.
6. Replace the two plastic standoffs to the rear corners of the Generator.

8-44. 6-Month Cleaning

WARNING

Before cleaning, make sure the Generator is disconnected from the power source This is to eliminate the possiblity of electrical shock.

CAUTION

In procedures that call for a vacuum cleaner to remove dust, do not use a blower or compressed air. Doing so will cause the dust to be transferred throughout the Generator.

Fan.

1. At the rear of the Generator, remove two screws and lock washers that secure the fan cover.
2. Remove the fan cover.
3. Using a vacuum cleaner and a soft-bristle brush, remove dust from the fan and its cover.
4. Replace the fan cover.

Vents.

1. Locate the ventilation holes at the rear of the Generator (in the lower right corner as viewed from the rear).
2. Using a vacuum cleaner and a soft-bristle brush, remove dust from the ventilation holes.

Power Supply Filter Capacitors.

1. Inside the Generator, locate the power supply filter capacitor area (just forward and to the right of the fan as viewed from the rear).
2. Using a vacuum cleaner and a soft-bristle brush, remove dust from the entire area.

Area in Front of Fan.

1. Locate the hinged plastic cover just forward of the fan.
2. Raise the plastic cover into its upright position.
3. Using the plastic-loop pc board extractors, remove all of the boards.

NOTE

As you remove each board, locate its silkscreened reference designation. (The reference designations are A3A3, A3A4, A3A5, A3A6, and A3A7.) When you return the boards, you can identify the proper slot by matching reference designations on the pc board, the mother board, and the plastic cover.

4. Using a vacuum cleaner and a soft-bristle brush, remove dust from the fan and the entire area forward of it.

6-Month Cleaning (cont'd)

5. Using a vacuum cleaner and a soft-bristle brush, remove dust from each of the pc boards.

CAUTION

In the next step, do not let the cleaning solution touch circuit portions of the pc board. This could cause residual flux on solder connections to liquify and contaminate the edge connectors.

6. Using a lint-free cloth saturated with cleaning solution, rub each pc board edge connector 3 or 4 times to remove any foreign material.

7. Rinse the pc board edge connectors with deionized water and wipe them dry.

NOTE

Before returning the pc boards to their their normal places, it is a good idea to inspect them for heat damage. The pc boards that are mounted directly in front of the fan, produce relatively high amounts of heat. Heat discoloration of the pc board material can be a sign that the fan is not working properly.

8. Carefully insert the pc boards into their guides and mother board connectors. (The component side of each pc board faces right when viewed from the rear of the Generator.)

9. Lower the hinged plastic cover into its normal position.

8-45. 12-Month Cleaning

WARNING

Before cleaning, make sure the Generator is disconnected from the power source. This is to eliminate the possiblity of electrical shock.

CAUTION

In procedures that call for a vacuum cleaner to remove dust, do not use a blower or compressed air. Doing so will cause the dust to be transferred throughout the Generator.

Digital Control Unit (DCU) Area.

1. Just forward and to the left of the fan (as viewed from the rear), locate the long aluminum cover over the DCU assembly.

2. Remove the screw and lock washer located at the rear of the cover.

3. Remove the cover by sliding it to the rear and up.

NOTE

Before removing any pc board, notice that each board in the DCU has a unique set of color coded plastic extractors. At the forward end, these extractors match the colors of the guides on the aluminum frame. At the rear, the first four extractors are black; the fifth extractor, on the A2A11 ROM Assembly, is brown.

4. Remove all five pc boards. To remove each board, grasp both of its extractors. Then, by pulling up on the extractors, the board will gently pry itself from its mother board connectors.

CAUTION

In the next step, do not use a vacuum cleaner to remove dust from the A2 Assembly pc boards. The boards have static sensitive devices that can be damaged by a vacuum cleaner.

5. Using a soft-bristle brush only, remove dust from the pc boards.

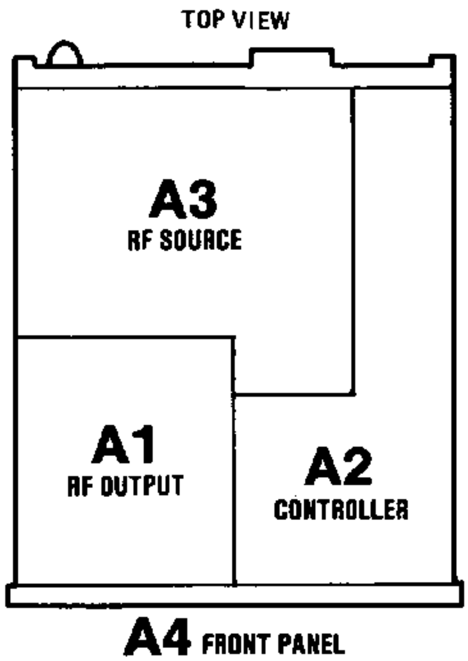
6. Using a vacuum cleaner and a soft-bristle brush, remove dust from the entire DCU area (especially from the mother board connectors).

CAUTION

In the next step, do not let the cleaning solution touch circuit portions of the pc board. This could cause residual flux on solder connections to liquify and contaminate the edge connectors.

7. Using a lint-free cloth saturated with cleaning solution, rub each pc board edge connector 3 or 4 times to remove any foreign material.

8. Rinse the pc board edge connectors with deionized water and wipe them dry.



MAJOR ASSEMBLIES

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Attenuator Driver Board Assembly	18
A1A2	Detector Module Assembly	14,17
A1A2A1	ALC Board Assembly	14,17
A1A2A2	Detector Board Assembly	17
A1A3	Function Board Assembly	20
A1A4	Pulse Driver Board Assembly	15
A1A5	DAC and Enable Board Assembly	22
A1A6	Meter Board Assembly	21
A1A7	YTM Driver Board Assembly	16
A1A8	SRD Bias Board Assembly	19
A1A9	Preamp Assembly	14,16
A1A10	YTM Assembly	16
A1A10A1	YIG Heater Control Assembly	16
A1A11	Power Amplifier Assembly	16
A1A12	Motherboard Assembly	14-16,18-22, 30,31
A1A13	Terminal Strip	15
A1A14	Amp Bias Board Assembly	17
A2A1	Panel Driver Board Assembly	25
A2A2	Key Code Board Assembly	24
A2A3	VCO Assembly	8
A2A4	Phase Detector Assembly	7
A2A5	Divider Assembly 20/30	6
A2A6	Not Assigned	
A2A7	I/O Board Assembly	30,31
A2A8	Microprocessor Board Assembly	26
A2A9	Frequency/HP-IB Board Assembly	29
A2A10	RAM Board Assembly	28
A2A11	ROM Board Assembly	27
A2A12	Not Assigned	
A2A13	Motherboard Assembly	6-8,10,20-32
A2A14	Rear Interconnect Board Assembly	24,29,31
A2A15	HP-IB Connector Board Assembly	29
A3A1	Rectifier Assembly	33
A3A1A1	Reference Phase Detector Assembly	1,2
A3A1A2	100 MHZ VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator	4
A3A1A4A2	VCO Board Assembly	4
A3A1A5	M/N Output Assembly	5
A3A1A6	M/N Reference Motherboard Assembly	1-3,5
A3A1A7	Reference Housing Assembly	
A3A2	Not Assigned	
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	DAC Assembly	9
A3A6	YTO Driver Assembly	10
A3A7	FM Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Sampler Assembly	11
A3A9A6	Attenuator Assembly	13
A3A9A7	6.2 GHz Low Pass Filter	13
A3A10	Motherboard Assembly	1,3,4,6,10, 12-14,21-23, 26,29-31, 33-35
A4A1	Front Panel Board Assembly	20,22,23,32

12-Month Cleaning (cont'd)

CAUTION

The next step requires care to ensure that pc board edge connectors are properly aligned with the mother board connectors. When properly aligned, the pc board will press snuggly into the mother board connectors. However, if they are not properly aligned, pressure on the pc board can damage the mother board and its connector.

9. Carefully insert the pc boards into their guides and mother board connectors. Ensure that the extractors match the colors on their plastic guides.
10. Install the DCU cover by tilting its front-end down and into the locking slots provided for the cover's front tabs. Then, lower the cover into place and secure it with its screw and lock washer.

Battery, Contacts.

1. Locate the battery pack in the general area of the forward-right corner of the Generator (as viewed from the front).
2. Remove pc boards A2A1 and A2A2. To remove each board, grasp both of its extractors. Then, by pulling up on the extractors, the board will gently pry itself from its mother board connector(s).
3. With your fingers, remove the spring retaining clip that holds the battery pack in its plastic holder.

CAUTION

In the next two steps, be careful not to bend the spring-contacts in the battery holder.

4. Using a lint-free cloth saturated with cleaning solution, rub each contact on the battery pack and holder 3 or 4 times to remove any foreign matter.
5. Using a lint-free cloth saturated with deionized water, rinse the contacts. Then wipe them dry.
6. Position the battery pack so that its contacts are on the right side and facing to the rear. Place the battery pack into its holder.

NOTE

The next step refers to the top and bottom of the spring retaining clip. The bottom of the clip is identified by a single bend of metal; the top is identified by a double bend.

7. Slip the bottom end of the spring retaining clip under the bottom lip of the plastic battery holder. Snap the top end of the clip over the top of the holder.

CAUTION

In the next step, do not let the cleaning solution touch circuit portions of the pc board. This could cause residual flux on solder connections to liquify and contaminate the edge connectors.

8. Using a lint-free cloth saturated with cleaning solution, rub each pc board edge connector 3 or 4 times to remove any foreign material.
9. Rinse the pc board edge connectors with deionized water and wipe them dry.
10. Carefully insert the pc boards into their guides and mother board connectors. Ensure that the extractors match the colors of their plastic guides.

8-46. SCHEMATIC SYMBOLOGY

8-47. Basic Logic Symbology

The logic symbols used in this manual are based on the American National Standards Institute (ANSI) Y32.14-1973, "Graphic Symbols for Logic Diagrams (Two State Devices)." A summary of this symbology is provided to aid in interpreting these symbols.

Power supply and ground connections are not shown on the symbols. This information is tabulated on the right margins of the service sheets.

Gates and Qualifiers. This section includes a brief description of the basic logic symbols used on the service sheets, a summary of indicator symbols, a discussion of contiguous blocks, control blocks, and dependency notation, and a summary of symbology for some of the more complex devices.

Qualifiers are that portion of a device symbol that denotes the logic function. For example, "&" denotes the AND function. See Figure 8-5 for a

Basic Logic Symbology (cont'd)

summary of the basic logic symbols and their qualifiers.

Indicator Symbols. Indicator symbols identify the active state of a device's input or output, as shown in Figure 8-6.

Contiguous Blocks. Two symbols may share a common boundary, parallel or perpendicular to the direction of the signal flow. Note that in the examples shown in Figure 8-7, there is generally no logic connection across a horizontal line, but there is always an implied logic connection across a vertical line. Notable exceptions to this rule are the horizontal lines beneath control blocks and between sections of shift registers and counters (dividers).

Dependency Notation. Dependency notation simplifies symbols for complex integrated circuit elements by defining the relationship between inputs and outputs without actually showing all the elements and connections involved (see Figures 8-8 through 8-10). The following examples use the letter A for address, C for control, G for AND, V for OR, and F for free dependencies. The dependent input or output is labeled with a number that is either prefixed (e.g.,1X) or subscripted (e.g.,X_1). They both mean the same thing. Note that many times a controlled line may already be labeled with a number that indicates input or output weighting (for example, in a coder). In this case, the controlling or gating input will be labeled with a letter.

Common Control Block. The control block is used in conjunction with an array of related symbols in order to group common logic lines. Figure 8-11 shows how the control block is usually represented. Figure 8-12 shows a quad D-type flip-flop with reset. This can be redrawn as shown in Figure 8-13. Note that the representation shown in Figure 8-13 can be used when the flip-flops are functionally scattered around the schematic (i.e., not used as a quad unit).

8-48. Complex Device Symbology

Figures for complex device symbology show how the basic symbols can be combined to illustrate the behavior of fairly complex devices.

Shift Register. The shift register (see Figure 8-14) control block shows common inputs to a bidirectional shift register. Notice that ">m" means shift the contents to the right or down by "m" units. And "<m" means shift the contents to the left or up by "m" units. Note: If m=1, then "m" may be omitted. Inputs "a" and "b" are each single IC pins that have two functions. Input "a" enables one of the inputs to the top D-type flip-flop (1D) and also shifts the register contents down "m" units. Input "b" enables one of the inputs to the bottom flip-flop (2D), and also shifts the register contents up "m" units. Input "c" loads all four flip-flops in parallel (3D). Input "d" is a common reset. The output delay indicator is used because these are master-slave flip-flops.

AND-OR Selector. The selector control block simplifies the AND portion of a quad AND-OR select gate (see Figure 8-15). When G1 is high, the data presented at the "1" inputs is gated through. When G2 is high, the data presented at the "2" inputs is gated through.

UP-DOWN Counter. The counter control block shows common inputs to a Presettable Decade UP-DOWN Counter (see Figure 8-16). Notice that "+m" means count up (increment the count) by "m"; "−m" means count down by "m."' Note: if m=1, then "m" may be omitted. Since the D-type flip-flops are master-slave, the output delay indicator is used. The "=9, +1" and "=0, −1" notation defines when the carry and borrow outputs are generated. They also define it as a decade counter; a binary counter would have the carry indicated with "=15, +1." Flip-flop weighting is indicated in parentheses. Input "C1" allows all four "D1" flip-flops to be preset in parallel.

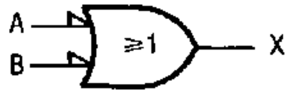
Quad D-Type Latch. The register control block illustrates a quad D-type latch (see Figure 8-17). There is a common active-low reset (R), and a common edge triggered control input (C). Since there is only one dependency relationship, the controlling input is not numbered and the controlled functions (D) are subscripted with a C.

AND GATE

A	B	X
H	H	H
H	L	L
L	H	L
L	L	L

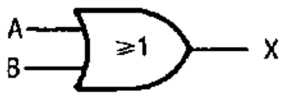
NAND GATE

OR GATE WITH INVERTED INPUTS



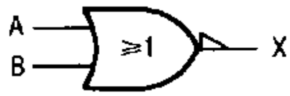
A	B	X
H	H	L
H	L	H
L	H	H
L	L	H

OR GATE



A	B	X
H	H	H
H	L	H
L	H	H
L	L	L

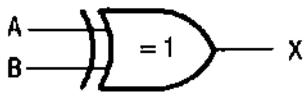
NOR GATE



AND GATE WITH INVERTED INPUTS

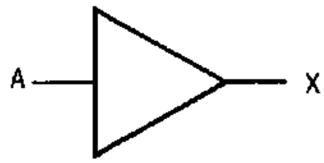
A	B	X
H	H	L
H	L	L
L	H	L
L	L	H

EXCLUSIVE-OR GATE

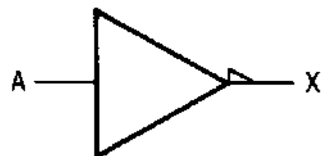


A	B	X
H	H	L
H	L	H
L	H	H
L	L	L

BUFFER



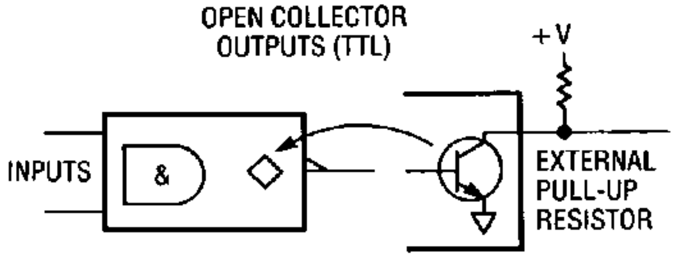
A	X
H	H
L	L



INVERTER

A	X
H	L
L	H

OPEN COLLECTOR OUTPUTS (TTL)



OPEN EMITTER OUTPUTS (ECL)

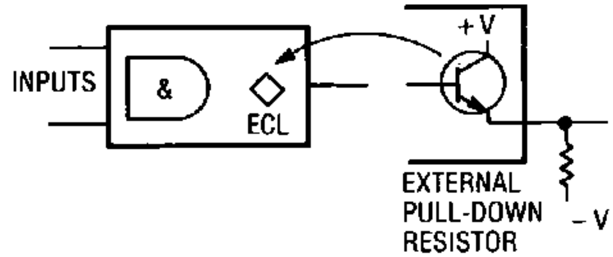


Figure 8-5. Basic Logic Symbols and Qualifiers

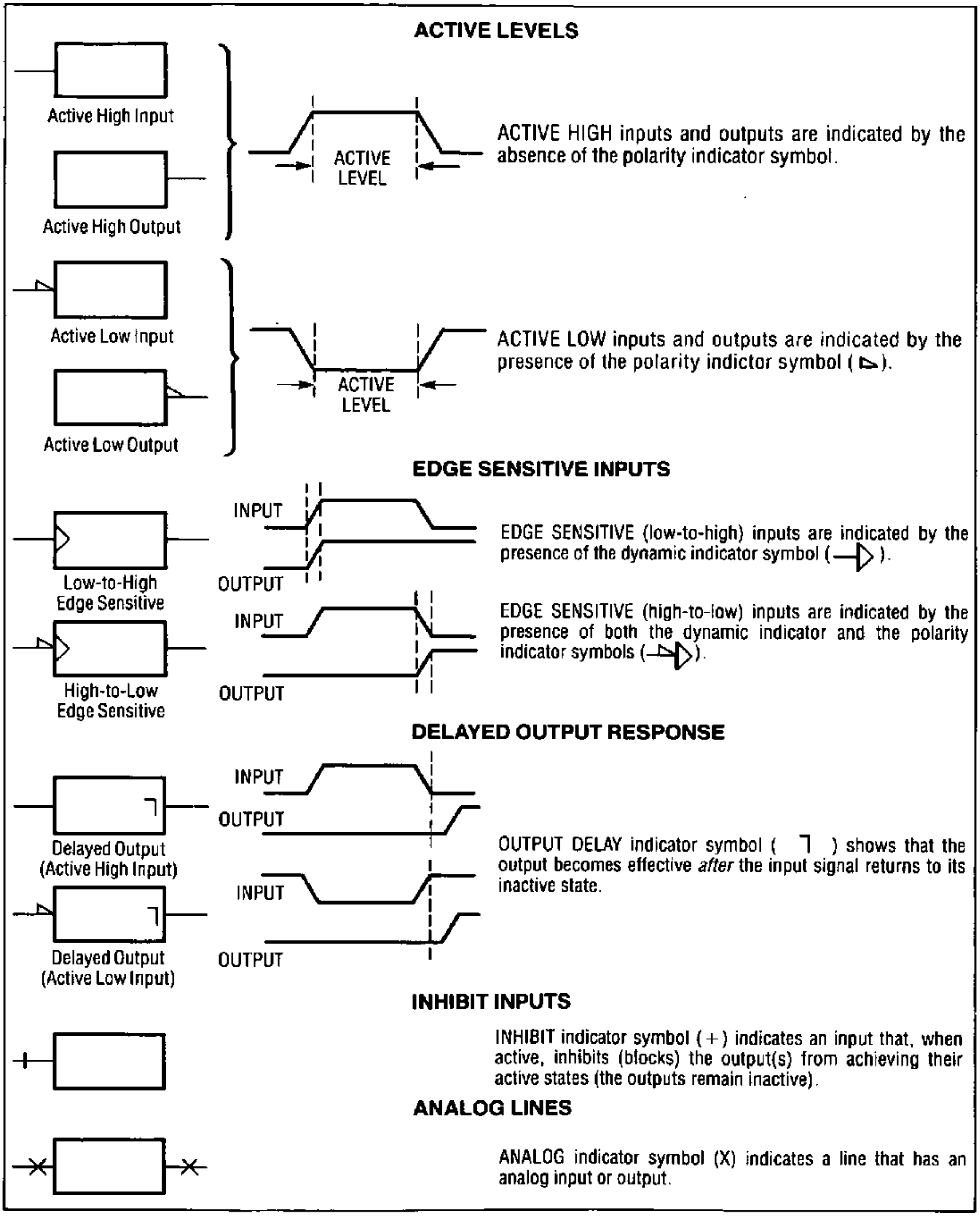


Figure 8-6. Indicator Symbols

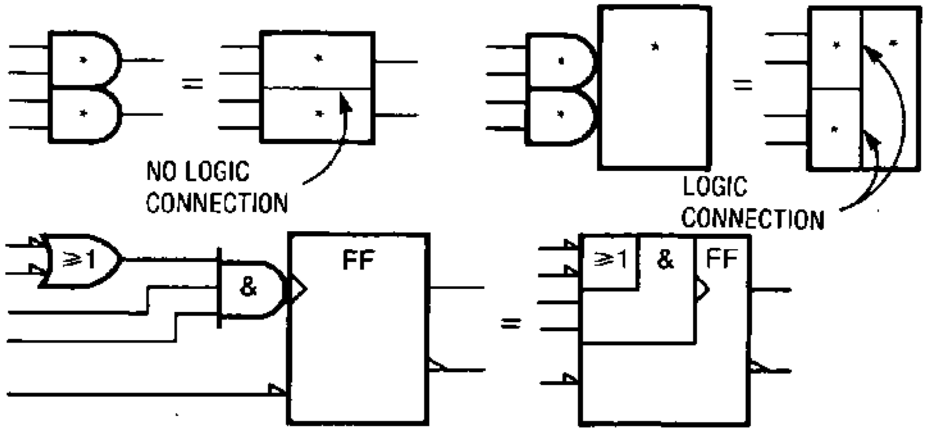
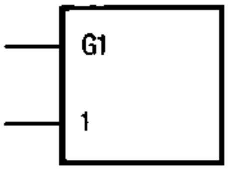
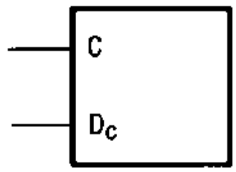


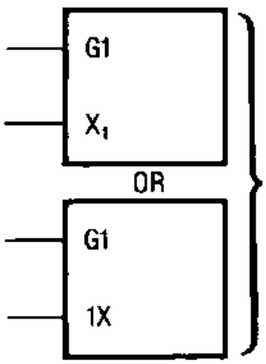
Figure 8-7. Contiguous Blocks



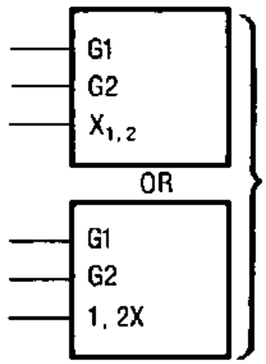
The input that controls or gates other inputs is labeled with a C or a G, followed by an identifying number.
The controlled or gated input or output is labeled with the same number. In this example, 1 is controlled by G1.



If a particular device has only one gating or control input, then the identifying number may be eliminated and the relationship shown with a subscript.

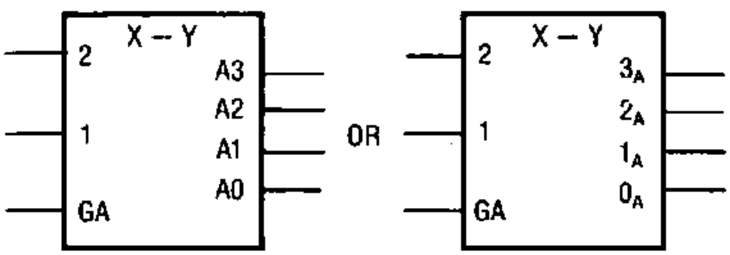


When the controlled or gated input or output already has a functional label (X is used here), that label will be prefixed or subscripted by the identifying number.



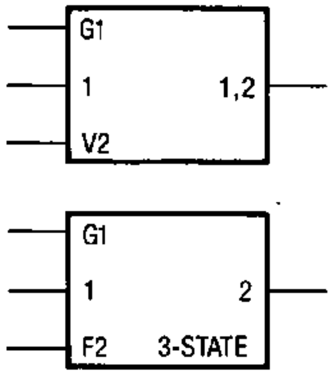
If the input or output is affected by more than one gate or control input, then the identifying numbers of each gate or control input will appear in the prefix or subscript, separated by commas. In this example, X is controlled by G1 and G2.

Figure 8-8. AND Dependency Notation



When GA is active, the active address line (0 through 3) is the decoded value of the 1 and 2 binary inputs. When the controlled address lines have a functional value, that value will be prefixed or subscripted by the identifying letter.

Figure 8-9. Address Dependency Notation



When a V input is active, the output will be in its active state. With the V input inactive, the device functions as if the V input doesn't exist.

When an F input is active, the output is enabled to function normally. When an F input is inactive, the output becomes a high impedance, effectively removing that device from the circuit.

The 3-STATE label is sometimes used with the free dependency notation.

Figure 8-10. OR and Free Dependency Notation

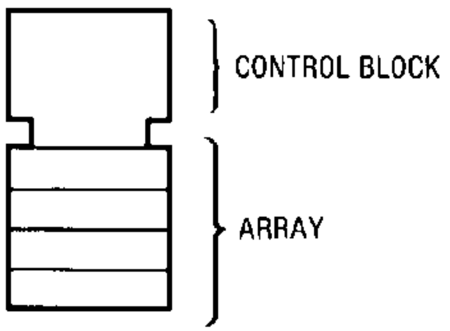


Figure 8-11. Common Control Block

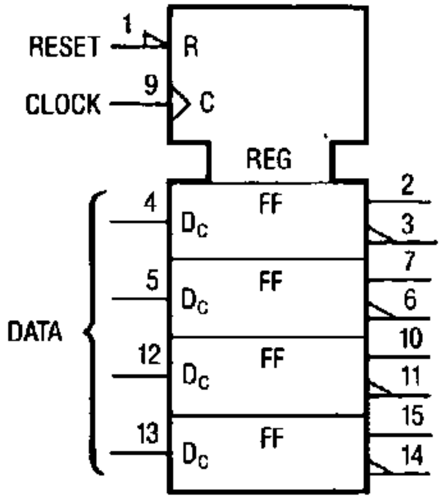


Figure 8-12. Quad D-Type Latch (Combined)

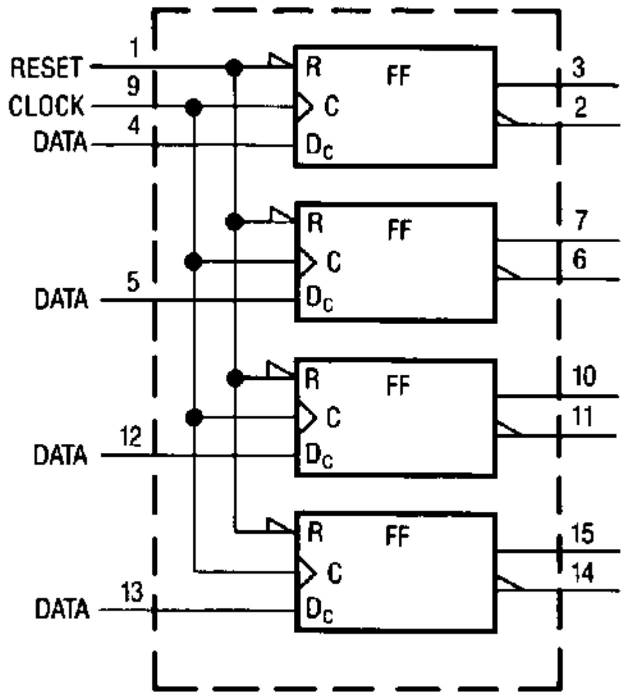


Figure 8-13. Quad D-Type Latch (Individual)

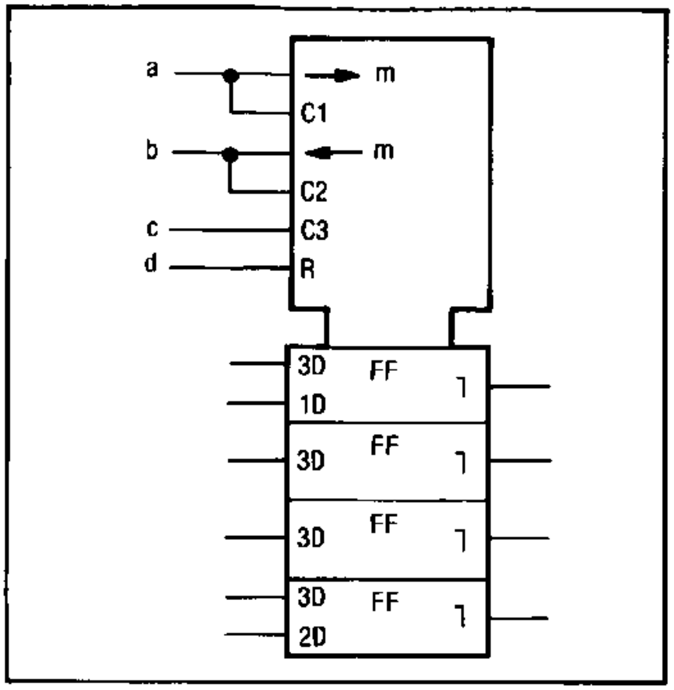


Figure 8-14. Shift Register

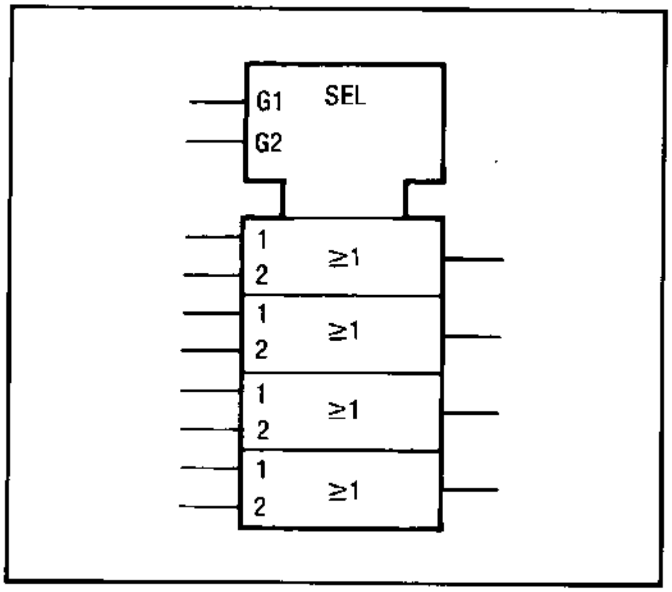


Figure 8-15. AND-OR Selector

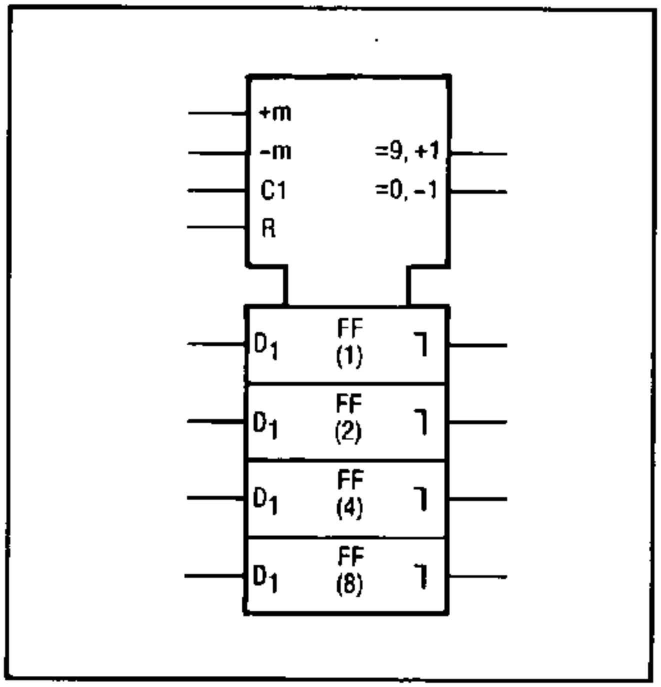


Figure 8-16. UP-DOWN Counter

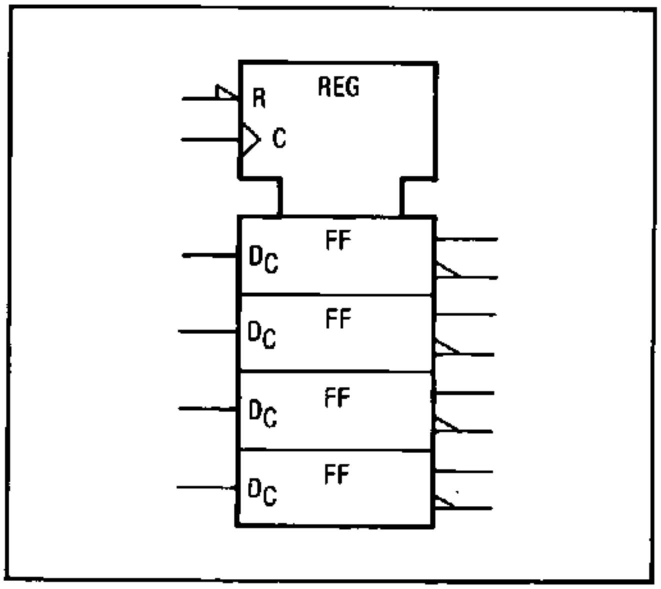


Figure 8-17. Quad D-Type Latch

BLOCK DIAGRAM 1

OVERALL BLOCK DIAGRAM AND TROUBLESHOOTING

REFERENCES

Servicing Strategy	Beginning of Section VIII
Operator's Checks	Section III
Disassembly Procedures	Service Sheet A
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V

PRINCIPLES OF OPERATION

Major Mechanical Assemblies

The HP 8673E Signal Generator consists of four major mechanical assemblies as listed below:

- A1 RF Output Assembly
- A2 Controller Assembly
- A3 RF Source Assembly
- A4 Front Panel Assembly

These assemblies are shown in Figure 8-18 with their associated subsystems. Each is discussed briefly below:

A1 RF Output Assembly. This assembly multiplies the output of the RF Source Assembly, amplifies it, and provides the selected output attenuation. Automatic Leveling Control (ALC), AM and pulse modulation take place in this assembly. The subsystems of the RF Ouput Assembly are:

- Microwave Signal Path Circuits
- ALC/AM Circuits
- Pulse Modulation Circuits

A2 Controller Assembly. This assembly contains the Digital Control Unit (DCU) that controls the entire operation of the Signal Generator. It also contains part of the RF Phase Locked Loops subsystem.

A3 RF Source Assembly. This Assembly generates all the reference frequencies used in the Signal Generator. It uses some of these reference signals plus control signals from the DCU to generate the baseband signal of 2.0—6.6 GHz. This baseband signal is applied to the RF Output Assembly. The RF Source Assembly also handles frequency modulation. Subsystems are:

- Time Base Reference
- Part of the RF Phase Lock Loops
- YIG Tuned Oscillator (YTO)

A4 Front Panel Assembly. This assembly is the user interface to the HP 8673E. It contains the keys, indicators, and annunciators that are connected to the DCU. It is part of the digital control unit subsystem.

Functional Description

Functionally, the HP 8673E can be divided into eight electrical subsystems. These are listed below with the physical assemblies of which they are a part:

- Time Base Reference A3
- RF Phase Locked Loops A2 and A3
- YIG Tuned Oscillator (YTO) Summing Loop A3
- Microwave Signal Path A1
- Automatic Level Control (ALC) A1
- Pulse Modulation A1
- Digital Control Unit A2 and A4
- Power Supplies A3

These subsystems are illustrated in the simplified block diagram of Figure 8-19, and in the more detailed block diagram of BD1. Each block of BD1 is further expanded in the block diagram indicated in the lower right hand corner of each block. The following discussion is referenced to Figure 8-19 and to BD1. A more detailed discussion of each block is found with block diagrams BD2—BD9.

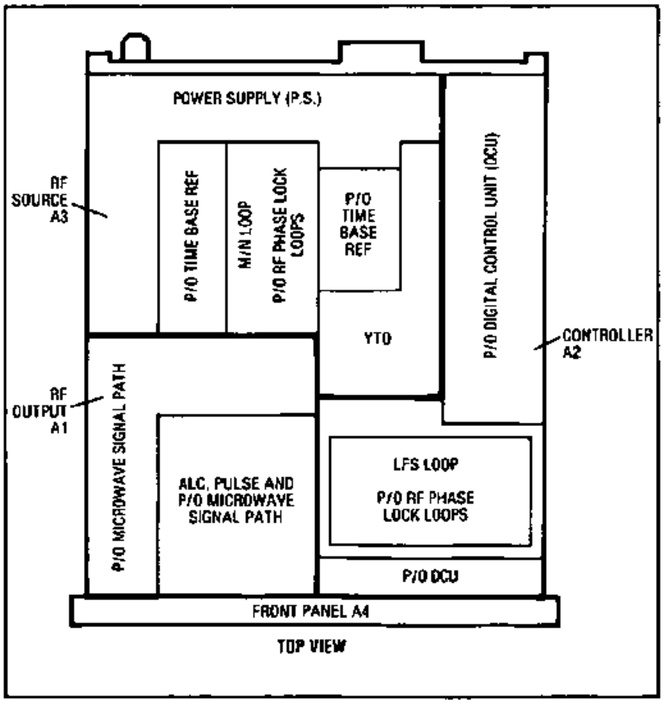


Figure 8-18. HP 8673E Assemblies and Subassemblies

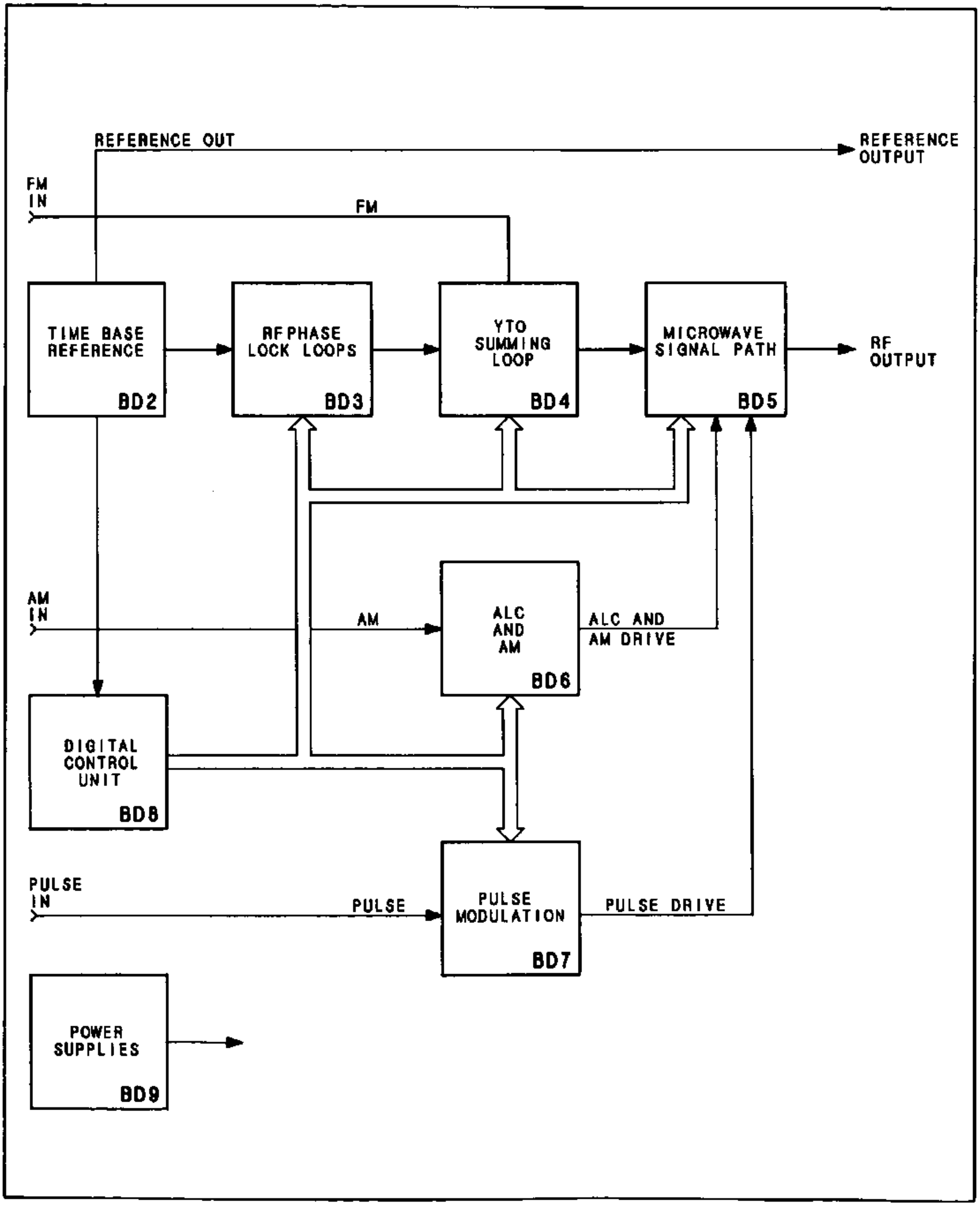


Figure 8-19. HP 8673E Simplified Block Diagram

SERVICE SHEET BD1 (cont'd)

Time Base Reference. This subsystem generates the reference frequencies for the Signal Generator. It consists of the following:

- 10-MHz Reference Oscillator
- Reference Loop

The 10-MHz Reference Oscillator is a temperature controlled, crystal oscillator that generates the basic 10-MHz reference signal. Provision is also made for use of an external 5 or 10 MHz reference signal. The Reference Loop also contains a 100-MHz voltage-controlled crystal oscillator (VCXO) that is phase locked to the internal 10-MHz Reference Oscillator, or to an external 5 or 10 MHz reference.

In the Reference Loop, the 100 MHz signal from the VCXO is divided and multiplied to produce reference frequencies for the RF Phase Locked Loops, and for the DCU. A 10 MHz and 100 MHz reference signal is also available at a rear-panel BNC connector.

RF Phase Locked Loops. These loops are phase locked to the Timebase Reference. Under control of the Digital Control Unit (DCU), they generate the signals that control the YIG Tuned Oscillator (YTO) Summing Loop. The RF Phase Locked Loops subsystem contains the following:

- Low Frequency Source (LFS) Loop
- M/N Loop

The LFS Loop generates a 20—30 MHz control signal. This signal is controlled by the DCU to tune the YTO in 1-kHz steps. This controls the least significant four digits in the front panel FREQUENCY MHz display. The M/N Loop generates a 177—197.5 MHz control signal that is controlled by the DCU to tune the YTO in 10-MHz steps. This controls the 10-MHz and higher digits of the front panel FREQUENCY MHz display. The RF Phase Locked Loops subsystem is located in RF Source Assembly A3 (M/N Loop), and Controller Assembly A2 (LFS Loop).

YIG Tuned Oscillator (YTO) Summing Loop. This subsystem generates the baseband or Band 1 frequencies (2—6.6 GHz.) under control of the DCU, and signals from the RF Phase Locked Loops subsystem.

The YTO Summing Loop consists of the YTO Loop and a Digital-to-Analog Converter (DAC). The DAC, under control of digital signals from the DCU, pretunes the YTO to within ±50 MHz of the desired YTO frequency. For fine tuning to the desired frequency, the YTO loop is phase locked to the 20—30 MHz and 177—197.5 MHz outputs of the LFS and M/N loops. Frequency modulation (FM) also takes place in the YTO Summing Loop. The YTO subsystem is located in RF Source Assembly A3.

Microwave Signal Path. This subsystem receives the baseband frequencies from the YTO Summing Loop and, under DCU control, multiplies this signal to generate the final desired output frequency. The Microwave Signal Path also performs the following functions:

- Automatic Level Control
- AM and pulse modulation
- Attenuation

For Automatic Level Control, the Microwave Signal path output is sampled, detected and routed to the Automatic Level Control (ALC) subassembly which sends a signal to the ALC modulator (in the Microwave Signal Path) to control signal level. Amplitude modulation also comes from the ALC subassembly. The pulse modulation signal comes from the Pulse Modulation subassembly.

The DCU controls the output attenuation based on the front panel RANGE inputs. The Microwave Signal Path is located in RF Output Assembly A1.

Automatic Level Control. This subassembly has two functions:

- Leveling the Signal Generator RF output
- Amplitude modulating the Signal Generator RF output

To level the RF signal, the ALC monitors the output level, either from the internal coupler and detector or from an external reference. If the level starts to change, the ALC changes the drive to the ALC modulator in the Microwave Signal Path to counteract the change, and the level stays constant. The front panel VERNIER control adjusts the ALC level to adjust the output level within a 15 dB range.

The AM input is added directly to the ALC/AM modulator drive signal after passing through correction circuitry in the ALC subsystem. The

SERVICE SHEET BD1 (cont'd)

ALC subsystem is located in RF Output Assembly A1.

Pulse Modulation. This subsystem includes circuits that control the pulse modulator in the Microwave Signal Path. It also generates the YTM injected pulse that compensates for YTM SRD bias which is lost between pulses in pulse mode. This subsystem is located in RF Output Assembly A1.

Digital Control Unit. This is the brain of the Signal Generator. It receives data from the front panel keys (local mode) or from HP-IB (remote mode). After receiving the input data, the DCU processes it and sends it to the various assemblies to control frequency, power level, modulation levels and modes, and other operating modes. The controller also runs diagnostics and monitors operating conditions. If a problem is detected, the controller activates the appropriate annunciators on the front panel. The Digital Control Unit subsystem is located in Controller Assembly A2.

Power Supplies. The Signal Generator contains negative and positive voltage regulators that provide the DC voltages required for operation. The +22V regulator is turned on whenever main power is applied to the Signal Generator. The remaining regulators are not turned on until the Front Panel LINE switch is set to ON. The power supplies are located in RF Source Assembly A3.

TROUBLESHOOTING PROCEDURES

General

If the instrument is not operating properly in the local mode, use the following Overall Level Procedure to isolate the problem to one of the eight subsystems. The appropriate Functional Level Procedures (associated with BD2—BD9) and Circuit Level Procedures (associated with Service Sheets 1—35) should then be followed to isolate the problem to the defective assembly within the subsystem, and then to the defective component within the defective assembly.

Once the defective component has been replaced, run the Overall Level Procedure again to check for other possible defects.

When the Overall Level Procedure can be run with no failures, run the Abbreviated Performance Tests in Section IV, Part 1 before putting the unit back into service.

Overall Level Procedure

The Overall Level Procedure consists of the following:

1. Turn-On Check (√1)
2. Power Supply Checks (√2)
3. Front Panel Checks (√3)
4. Baseband (2—6.6 GHz) Checks (√4), (√5), and (√6)
   a. YTO Frequency Check (√4)
      Reference Loop Check (√4a)
      LFS Loop Check (√4b)
      M/N Loop Check (√4c)
   b. YTO Power Check (√5)
   c. YTO FM Check (√6)
5. Output Level Check (√7)
6. ALC/AM Check (√8)
7. Pulse Modulation Check (√9)

These checks should be run in sequence because each step assumes that previous steps have been run with no errors. Also, because of the interrelationship of the various elements of the Signal Generator, it is difficult to determine which element is at fault without running the checks in order.

Equipment

Frequency Counter	HP 5343A
Spectrum Analyzer	HP 8556A/8552B/ 141T
Test Oscillator	HP 3335A
Digital Voltmeter	HP 3456A or 3455A
Power Meter	HP 436A
Oscilloscope	HP 1980B
HP 8673A/B Adjustment Cassette	HP P/N 11726-10002
HP-IB Controller	HP 85B/82937A/ 82936A 00085-15002, 4, 5

SERVICE SHEET BD1 (cont'd)

Turn-On Check (√1)

1. Set LINE switch to STBY. Remove all external cables from the front and rear panels of the Signal Generator, including the primary power cable.
2. Set the rear panel FREQ STANDARD INT/EXT switch to INT and connect the jumper (A3W3) between A3J9 and A3J10.
3. After the primary power cable has been disconnected from the signal generator for at least one minute, reconnect it, and check for the following indications:
   - Front panel STANDBY annunciator ON
   - Front Panel OVEN COLD annunciator ON
   - Fan OFF.

   All of the above indications are controlled by the +22V supply which is on when the unit is in STBY.

   If the above indications are correct, proceed with Step 6. If any of the above indications are incorrect, proceed with with Step 4.
4. Remove the top cover and observe the +22V indicator (see BD1 for location).

   If the +22V indicator is on and the STANDBY and/or OVEN COLD annunciators are OFF, check the associated incandescent bulb and proceed with Step 6.

   If the indicator is off, proceed with Step 5.
5. Observe the Primary "ON" Indicator.

   If this indicator is ON, the +22V regulator is probably defective. Go to BD9 to further isolate the problem.

   If the indicator is off, check that the fuse is not open and that the Voltage Selection Card is properly installed. See Section II.

   NOTE

   An improper voltage selection can cause all supplies to be on, but too low in voltage. This is indicated by very dimly lit front panel displays.

   If necessary repair or adjustments have been completed, repeat steps 1 through 5.
6. Leave the LINE switch set to STBY until the OVEN COLD annunciator turns off. This should occur within 15 minutes or less depending on how long the Signal Generator was disconnected from main power.

   Once the OVEN COLD annunciator turns off, set the LINE switch to ON.

   NOTE

   The OVEN COLD annunciator may flicker on and off temporarily just as the oven stabilization temperature is reached. This is normal.

   The FREQUENCY MHZ display should show a frequency between 2 and 18.0 GHz.

   If the FREQUENCY MHz display is not as indicated, proceed with Step 7 to check the power supply voltages. If the voltages check out, go to BD8 to troubleshoot the DCU.

   If everything is normal at this point, proceed with Step 7 to confirm proper operating voltages before proceeding with the remaining checks.

Power Supply Checks. (√2)

7. An improper operating voltage can manifest itself in unpredictable ways. Therefore, check the operating voltages before proceeding with the remaining overall level checks. Proceed as follows:

   Remove the top cover and check the voltages at the following test points. Test point locations are given on BD1.

Test Point	Voltage
BD1 A3A3TP1	+22±0.2 Vdc
BD1 A3A3TP6	+11±1.1 Vdc
BD1 A3A3TP5	+20±0.002 Vdc
BD1 A3A3TP2	+5.2±0.1 Vdc
BD1 A3A4TP5	−5.2±0.05 Vdc
BD1 A3A4TP1	−40.0 −0.6, +1.0 Vdc
BD1 A3A4TP4	−10.0±0.2 Vdc

If any voltage is incorrect, proceed to Power Supply adjustments in Section V and attempt to adjust the faulty output to the correct voltage.

If the voltage cannot be adjusted, proceed to BD9 to isolate the power supply fault.

If any adjustments or repairs are required, repeat this procedure from Step 1 after making the appropriate adjustments or repairs.

SERVICE SHEET BD1 (cont'd)

Power Supply Checks (cont'd)

If all voltages are correct, proceed with Step 8.

Front Panel Checks (✓8)

8. Press RCL 0 to initialize the Signal Generator to a known state (see Step 11). Turn the line switch to STB then to ON. This ensures that no false errors will occur in the following steps.

9. Observe the MESSAGE key on the Signal Generator front panel.

   If the MESSAGE key is flashing, depress and hold it and read the error message in the FREQUENCY MHz display. This display will be a two-digit Error Message Number. Refer to Table 3-7 for a description of each Error Message Number and action to take for each. If the message key is not flashing, proceed with Step 10.

   NOTE

   Occasionally, transient conditions occur that cause a false error indication. If an error condition occurs, repeat the condition that caused the error. If the error repeats, it is probably a real error.

   If the message key is on but not flashing, a soft error is indicated, that is, you hit the wrong button. Depress and hold the MESSAGE key as above and refer to Table 3-7 to learn the nature of the problem.

10. Observe the Signal Generator front panel status annunciators.

    If any of the following status annunciators are on, a hardware problem is indicated. Refer to the list of Status Annunciators below and take the indicated action.

    - OVEN COLD
    - ALC UNLEVELED
    - NOT ϕ LOCKED

    The remaining Status Annunciators indicate operating modes. See Table 8-4 for a description of all Status Annunciators.

    If no Status Annunciators are on, proceed with Step 11.

OVEN COLD

Indicates that the reference oven in the A3 assembly is faulty or is in the warm-up stage. If the Signal Generator has just been connected to the power mains, this annunciator should turn off within 15 minutes. Otherwise, a fault is indicated. Proceed to BD2 to isolate the problem.

ALC UNLEVELED

Indicates that the Automatic Level control circuit is not providing a leveled output. This could be caused by several different problems, including low power output from the YIG Tuned Multiplier (YTM). To isolate the problem, proceed with Step 14 of this procedure.

NOT ϕ LOCKED

Indicates that one or more of the phase lock loops in the Signal Generator are not locked. To further isolate the problem, look at the Phase Lock indicators on A2A7. Remember that the phase locked loops are chained together, that is, the YTO loop is phase locked to the outputs of the M/N and LFS loops which are phase locked to the REF loop output. If more than one Phase Lock indicator is off, check the first loop in the chain. For example, if all Phase Lock indicators are off, check the reference loop first.

For REF loop problems go to BD2.

For M/N or LFS loop problems go to BD3.

For YTO problems go to BD4.

LSN or TLK

If one of these annunciators is lighted when the Signal Generator is first turned on, check the HP-IB address by pressing the LOCAL key. If the HP-IB address is set to 49, the LSN annunciator will be lighted. HP-IB address 50 will light the TLK annunciator. These two addresses are reserved for a master/slave mode of operation described in Section III. To change the address back to the factory selected HP-IB address, enter 19 from the numeric keypad and then press the STO and then LOCAL key. The LSN and TLK annunciators should now be off and pressing the LOCAL key should display "19" in the FREQUENCY MHz display.

SERVICE SHEET BD1 (cont'd)

Table 8-4. Front Panel Status Annunciators

Annunciator		Purpose
Name	Location	
STANDBY	A4	Indicates that the LINE switch is set to STBY.
OVEN COLD	A4	Monitors the reference oven in the A3 Assembly. Indicates oven temperature is not stable or is in the warm-up stage.
OUT OF RANGE	A4	Lights only when a combination of ΔF and FREQUENCY would cause the upper or lower limit of a frequency sweep to be out of range.
EXT REFERENCE	A4	Indicates that the rear panel FREQ REF switch is set to EXT.
ALC UNLEVLED	A4	Indicates that the ALC (leveling) circuit is not providing a leveled output or that an attempt was made to program the instrument to a power level below its range.
NOT PHASE LOCKED	A4	Indicates that one or more of the loops is not phase-locked. Refer to Phase Lock Loop Status Annunciators on A2A7.
FM OVERMOD	A4	Indicates that the maximum combination of FM rate, and deviation has been exceeded.
RMT	A4	Indicates that the instrument is in remote mode.
LSN	A4	Indicates that the instrument is addressed to listen.
TLK	A4	Indicates that the instrument is addressed to talk.
SRQ	A4	Indicates that the instrument is issuing the Require Service Message.

11. The front panel should now be set to the following conditions.

    RF OUTPUT to ON
    ALC INTERNAL to ON
    LEVEL dBm between −67 and −83 dBm
    AUTO PEAK to ON
    MTR LVL to ON
    AM, FM, and PULSE Modulation to OFF
    FREQUENCY to 3000.000 MHz
    FREQ INCR to 1.000 MHz
    START to 2000.000 MHz
    STOP to 4000.00 MHz
    ΔF to 2000.000 MHz
    MKRS to OFF (initialized to 3,6,9,12, and 15 GHz)
    SWEEP MODE to OFF
    STEP to 100 steps (20.000 MHz)
    DWELL to 20 ms
    TUNE knob to ON

12. Press STO 1 then RCL 1 and observe the MESSAGE key. If the MESSAGE key is flashing, an error is indicated, proceed as directed in Step 9.

The following steps check the two-way communication lines between the Front Panel and the DCU. The first test checks that the DCU can light all the front panel indicators that are controlled by the DCU (all except OVEN COLD and STANDBY). The remaining tests check that the Front Panel keys communicate with the DCU.

13. Set up the front panel indicator test as follows:

    a. Set LINE switch to STBY.

    b. Connect the MPU Test Connector (HP Part Number 11726-60001) to the connectors on top of Microprocessor Assembly A2A8.

    c. Set the diagnostic switch to "1" and install a shorting clip between A2A8TP5 and A2A8TPGND.

    d. Set the LINE switch to ON and verify that all indicators and annunciators (except OVEN COLD and STANDBY, these are hardware controlled) are turned on and the displays indicate the following:

SERVICE SHEET BD1 (cont'd)

Front Panel Checks (cont'd)

RANGE dBm +110.0
FREQUENCY MHz .1.0.1.0.1.0.1.0.1.0.1

In addition, verify that the AUTO SWEEP key LED is blinking.

If any of the above indications are incorrect, proceed to the troubleshooting procedures associated with BD8 to isolate the problem.

The following checks verify that the DCU is receiving inputs from the front-panel keys. If any indication cannot be verified, proceed to BD8 to isolate the problem.

14. MTR Key Checks

a. Set the LINE switch to STBY, then remove the DCU test connector and the shorting clip.

b. Set the LINE switch to ON, press RCL 0, and set the OUTPUT LEVEL meter to midrange using the VERNIER control.

Verify that the LVL key LED is on.

c. Press the AM key and verify that:
The meter drops to zero
The LVL key LED turns off
The AM key LED turns on

d. Press the FM key and verify that:
The meter does not change
The AM key LED turns off
The FM key LED turns on

e. Press the LVL key and verify that:
The meter returns to midrange
The FM key LED turns off
The LVL key LED turns on

15. Press and hold the MESSAGE key and verify that the FREQUENCY MHz display shows 00 (the MESSAGE key LED will not light). Release the MESSAGE key and verify that the FREQUENCY MHz display returns to 3000.000.

16. RF OUTPUT ON/OFF key check.

a. Press RF OUTPUT ON/OFF key and verify that:

The RF OUTPUT key LED turns off
The meter drops to zero
The ALC UNLEVELED and NOT ϕ LOCKED annunciators turn on

b. Press RF OUTPUT ON/OFF key again and verify that the display returns to normal.

17. ALC Key Checks

a. Press ALC DIODE key and verify that:

The INTERNAL key LED turns off
The DIODE key LED turns on
The OUTPUT LEVEL meter drops to zero
The ALC UNLEVELED annunciator turns on

b. Press ALC PWR MTR key and verify that:
The INTERNAL key LED stays off
The DIODE key LED turns off
The PWR MTR key LED turns on
The ALC UNLEVELED annunciator stays on
The OUTPUT LEVEL meter remains at zero

c. Press ALC INTERNAL key and verify that:

The PWR MTR key LED turns off
The INTERNAL key LED turns on
The ALC UNLEVELED annunciator turns off
The OUTPUT LEVEL meter returns to midrange

18. RANGE Key Checks

a. Press the RANGE (down arrow) key repeatedly and verify that the LEVEL dBm display decreases in increments of 10 dB, to a minimum of −120 dBm, each time the RANGE (down arrow) key is pressed.

b. Press the RANGE (up arrow) key repeatedly and verify that the LEVEL dBm display increases in increments of 10 dB, to a maximum of +10 dBm, each time the RANGE (up arrow) key is pressed.

c. Press RCL 0 to return LEVEL dBm to −70.

19. AUTO PEAK Key Checks

a. Press the AUTO PEAK key and verify that the AUTO PEAK key LED turns off.

b. Press the AUTO PEAK key again and verify that the AUTO PEAK key LED turns on.

SERVICE SHEET BD1 (cont'd)

Front Panel Checks (cont'd)

20. AM Key Checks

a. Press the 30% key and verify that its LED turns on.

b. Press the 100% key and verify that its LED turns on and the 30% key LED turns off.

c. Press the OFF key and verify that the 100% key LED turns off.

21. FM DEVIATION MHz Key Checks

a. Press the .03 key and verify that its LED turns on.

b. Press the .1 key and verify that its LED turns on and the .03 key LED turns off.

c. Press the .3 key and verify that its LED turns on and that the .1 key LED turns off.

d. Press the 1 key and verify that its LED turns on and the .3 key LED turns off.

e. Press the 3 key and verify that its LED turns on and the 1 key LED turns off.

f. Press the 10 key and verify that its LED turns on, the 3 key LED turns off and the NOT ϕ LOCKED annunciator turns on.

g. Press the OFF key and verify that the 10 key LED and the NOT ϕ LOCKED annunciator turn off.

22. PULSE Key Checks

a. Press the AUTO PEAK key to turn off its LED.

b. Press the NORM key and verify the following:

The AUTO PEAK key LED turns on
The OUTPUT LEVEL meter immediately starts climbing slowly toward maximum deflection.
The ALC UNLEVELED annunciator turns on.

c. Press the AUTO PEAK key to turn off its LED.

d. Press the COMPL key and verify the following:

The AUTO PEAK key LED turns on
The OUTPUT LEVEL meter returns to midrange
The ALC UNLEVELED annunciator goes off

e. Press the PULSE OFF key and verify that the PULSE COMPL key LED goes off, and the AUTO PEAK key LED stays on.

23. SWEEP FREQ Key Checks

a. Press RCL 0 then press and hold the START key and verify that the FREQUENCY MHz display indicates 2000.000.

b. Press and hold the STOP key and verify that the FREQUENCY Mhz display indicates 4000.000.

c. Press and hold the ΔF key and verify that the FREQUENCY MHz display indicates 2000.000.

d. Press and hold the MKR key and verify that the FREQUENCY MHz display goes blank.

24. SWEEP MODE Key Checks

a. Press the AUTO key and verify the following:

AUTO key LED turns on
FREQUENCY MHz display indicates 2000 4000

b. Press the OFF key and verify the following:

AUTO key LED turns off
FREQUENCY MHz display returns to 3000.000

c. Press the MANUAL key and verify the following:

The MANUAL key LED turns on
The FREQUENCY MHz display indicates 2000.00

d. Press the FREQ INCREMENT (down arrow) key and verify that the FREQUENCY MHz display does not change.

e. Press the FREQ INCREMENT (up arrow) key and verify that the FREQUENCY MHz display increases by 20 MHz each time it is pressed.

SERVICE SHEET BD1 (cont'd)

Front Panel Checks (cont'd)

f. Press the FREQ INCREMENT (down arrow) key to return the FREQUENCY MHz display to 2000.00, then turn the TUNE control counterclockwise. Verify that the FREQUENCY MHz display does not change.

g. Turn the TUNE control clockwise and verify that the FREQUENCY MHz display increases in 20 MHz steps.

h. Press the OFF key and verify that the MANUAL key LED turns off.

i. Press the SINGLE key and verify that the SINGLE key LED turns on and the FREQUENCY MHz display indicates 2000.000.

j. Press the SINGLE key again and verify the the FRQUENCY MHz display indicates a single sweep of the frequency from 2000.00 to 4000.00 and returns to 2000.00.

k. Press the OFF key and verify that the SINGLE key LED turns off and the FREQUENCY MHz display returns to 3000.000.

25. SWEEP RATE Key Checks

a. Press and hold the STEP key and verify that the FREQUENCY MHz display indicates 100 20.000.

b. Press and hold the DWELL key and verify that the FREQUENCY MHz display indicates 20 ms.

26. LOCAL Key Check

a. Press the following keys in the order given:

9 STO LOCAL. Then press and hold the LOCAL key. Verify that the FREQUENCY MHz display indicates 9.

b. Press the following keys in the order given:

1 9 STO LOCAL. Then press and hold the LOCAL key. Verify that FREQUENCY MHz display indicates 19.

27. Numeric Key Checks

a. Press the following keys in the order given: ., 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Verify that the FREQUENCY MHz display indicates .0123456789.

b. Press the delete (left arrow) key 11 times and verify that, starting at the right side of the FREQUENCY MHz display, one numeral is blanked each time the delete key is pressed, and that the display returns to 3000.000 after the decimal point is blanked.

28. FREQUENCY Key Checks

a. Press the following keys in sequence: FREQUENCY, 5, 0, 0, 0, 0, 0, 0, kHz. Verify that the FREQUENCY MHz display indicates 5000.000.

b. Press the following keys in sequence: FREQUENCY, 5, 0, 0, 0, MHz. Verify that the FREQUENCY MHz display indicates 5000.000.

c. Press the following keys in sequency: FREQENCY, 5, GHz. Verify that the FREQUENCY MHz display indicates 5000.000.

29. FREQ INCR Key Checks

a. Press RCL 0 to put the Signal Generator to 3000.00 MHz.

b. Press the following keys in sequence: FREQ INCR, 1, kHz.

c. Press the FREQ INCREMENT (up arrow) key several times and verify that the FREQUENCY MHz display increases by 1 kHz each time it is pressed.

d. Press the following keys in sequence: FREQ INCR, 1, MHz.

e. Press the FREQ INCREMENT (up arrow) key several times and verify that the FREQUENCY MHz display increases by 1 MHz each time the key is pressed.

f. Press the following keys in sequence: FREQ INCR, 1, GHz.

g. Press the FREQ INCREMENT (up arrow) key several times and verify that the FREQUENCY MHz display increases by 1 GHz each time it is pressed.

SERVICE SHEET BD1 (cont'd)

Front Panel Checks (cont'd)

30. STEPS/ms Key Check

a. Press the following keys in sequence: SWEEP RATE STEP, 1, 5, STEP/ms.

b. Press STEP/ms and verify that the FREQUENCY MHz display indicates 15 133.333.

c. Press the following keys in sequence: SWEEP RATE DWELL, 1, 5, STEP/ms.

d. Press STEP/ms and verify that the FREQUENCY MHz display indicates 15 ms.

31. TUNE ON/OFF Key Check

a. Press the TUNE ON/OFF key and verify that its LED turns off.

b. Rotate the TUNE knob clockwise and counterclockwise and verify that the FREQUENCY MHz display does not change.

c. Press the TUNE ON/OFF key and verify that its LED turns on.

d. Rotate the TUNE knob clockwise and counterclockwise and verify that the FREQUENCY MHz display increases and then decreases.

32. If all of the above Front Panel Checks were performed with no failures, proceed with the Base Band Checks beginning with Step 33.

Base Band Checks (√4), (√5), (√8)

YTO Frequency Check (√4)

33. Disconnect the semi-rigid coax from the output of coupler A3A1A1J1 (BD1 TPH), and connect the frequency counter in its place (frequency counter should be connected as in Figure 8-20). Refer to BD1, top and bottom view drawings for test point locations.

34. Set FREQ to 2.000000 GHz and FREQ INCR to 111.111 MHz.

35. Tune the Signal Generator from 2.000000 GHz to 6.600000 GHz. in 111.111 MHz steps.

The frequency on the counter should agree with the FREQ MHz display ±1 count.

If the frequency is not correct, proceed with REFERENCE LOOP CHECK, Step 36. Otherwise, proceed with step 42, YTO Power Checks.

Reference Loop Checks (√4a)

36. With frequency counter connected as in Figure 8-20, measure the frequency at the following test points:

Test Point	Frequency
TPA	100 MHz
TPB	10 MHz
TPD	10 MHz
TPE	400 MHz
TPC	20 MHz

If any of the above frequencies are not correct within ±1 count, proceed to BD2 to isolate the problem.

If the frequencies are correct proceed with Step 37, LFS Loop Check.

LFS Loop Checks (√4b)

37. Disconnect the green cable from A2A3J1 (BD1 TPF) and connect the counter in its place.

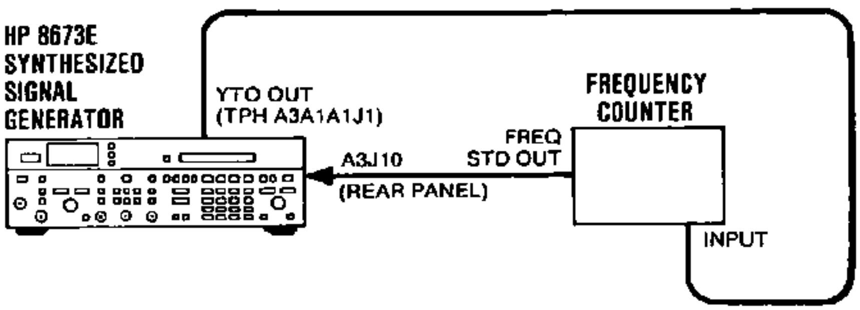


Figure 8-20. HP 8673E Baseband Frequency Test Setup

SERVICE SHEET BD1 (cont'd)

Base Band Checks (cont'd)

38. Set FREQ to 2.000000 GHz and FREQ INCR to 1.111 MHz. Step through the frequencies shown below and ensure that the counter reading agrees ±1 count:

Signal Generator Frequency	Frequency Counter Reading
2.000000 GHz	30.000000 MHz
2.001111 GHz	28.889000 MHz
2.002222 GHz	27.778000 MHz
2.003333 GHz	26.667000 MHz
2.004444 GHz	25.556000 MHz
2.005555 GHz	24.445000 MHz
2.006666 GHz	23.334000 MHz
2.007777 GHz	22.223000 MHz
2.008888 GHz	21.112000 MHz
2.009999 GHz	20.001000 MHz

If the frequencies are correct, proceed with Step 39, M/N Loop Check.

If one or more of the frequencies are incorrect, proceed to BD3 to isolate the problem in the LFS loop.

M/N Loop Checks ✓4c

39. Reconnect the green cable to A2A3J1 and disconnect the white/orange cable from A3A1A5J3 (TPG).

40. Connect the frequency counter to A3A1A5J3. Set FREQ to 2.100000 GHz and FREQ INCR to 210 MHz.

41. Step through the frequencies shown below and check corresponding frequency counter reading for each frequency.

The counter reading should agree ±1 count.

Signal Generator Frequency	Frequency Counter Reading
2.100000 GHz	177.500000 MHz
2.310000 GHz	180.000000 MHz
2.520000 GHz	182.142857 MHz
2.730000 GHz	184.000000 MHz
2.940000 GHz	185.625000 MHz
3.150000 GHz	187.058824 MHz
3.360000 GHz	188.333333 MHz
3.570000 GHz	189.473684 MHz
3.780000 GHz	190.500000 MHz
3.990000 GHz	191.428571 MHz
4.200000 GHz	192.272727 MHz
4.410000 GHz	193.043478 MHz
4.620000 GHz	194.750000 MHz
4.830000 GHz	195.400000 MHz
5.040000 GHz	195.000000 MHz
5.250000 GHz	195.555556 MHz
5.460000 GHz	196.071429 MHz
5.670000 GHz	196.551724 MHz
5.880000 GHz	197.000000 MHz
6.090000 GHz	197.419355 MHz
6.300000 GHz	191.818182 MHz
6.510000 GHz	192.352941 MHz

If the frequencies are correct, the problem is in the YTO loop. Proceed to BD4 to isolate.

If any frequency is not correct, proceed to BD3 to isolate the problem in the M/N loop.

When the problem has been corrected, repeat the procedure from Step 1.

YTO Power Checks ✓5

Initial conditions: FREQ set to 2.000000 GHz FREQ INCR set to 111.111 MHz

42. Disconnect the frequency counter and connect the power meter to BD1 TPH.

43. Tune the Signal Generator from 2.000000 GHz to 6.500000 GHz, in 111.111 MHz steps and record the power level for each step.

Power should be greater than +14 dBm for all frequencies.

If the power is low at any or all points, proceed to BD4 to isolate the problem. Otherwise, proceed to Step 44.

YTO/FM Checks ✓8

44. Press AM OFF and verify that both AM % LEDs are off.

45. Press FM DEVIATION MHz .3 and MTR FM pushbuttons and verify both LEDs light.

SERVICE SHEET BD1 (cont'd)

YTO/FM Checks (cont'd)

Connect the test equipment as shown in Figure 8-21.

46. Set the test oscillator to 100 kHz and adjust the output level of the test oscillator to obtain the first carrier null (modulation index = 2.404). Verify the voltage applied is 0.567±0.049 Vrms and the front panel meter indicates 240 ±30 kHz.

If the voltage applied is incorrect proceed to BD4 to further isolate the problem.

If only the front panel meter indication is incorrect, the problem is most likely in the metering control assembly (Service Sheet 21).

If both indications are correct, the FM circuits are probably working properly. If any doubt exists perform the FM adjustment procedures in Section V. Otherwise, proceed with Step 47, Output Level Check.

Output Level Checks (√7)

47. Connect the test equipment as shown in Figure 8-22.
48. Press RCL 0 then ALC DIODE. Verify that the RF OUTPUT, and ALC DIODE indicators, and the ALC UNLEVELED annunciator are on.
49. Insert HP 8673A/B adjustment cassette P/N 11726-10002 REV. B or higher, into the HP-85.
50. Load and run the program "EXEC." A more complete description of this software is given in the Adjustment Procedures, Section V, of this manual.
51. From the main menu select K6=MAX POWER & OTHER UTILITIES.
52. From the MAX POWER & UTILITY menu select K1= MAX Power Test.
53. Select AUTO PEAKER ON when asked by the program. The program will now run the plot.

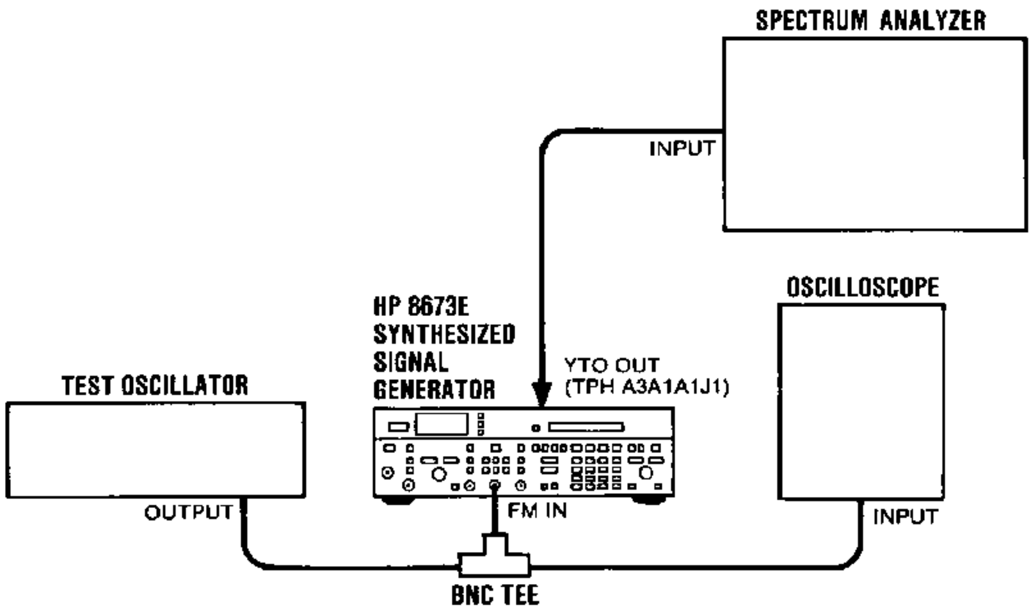


Figure 8-21. HP 8673E FM Test Setup

SERVICE SHEET BD1 (cont'd)

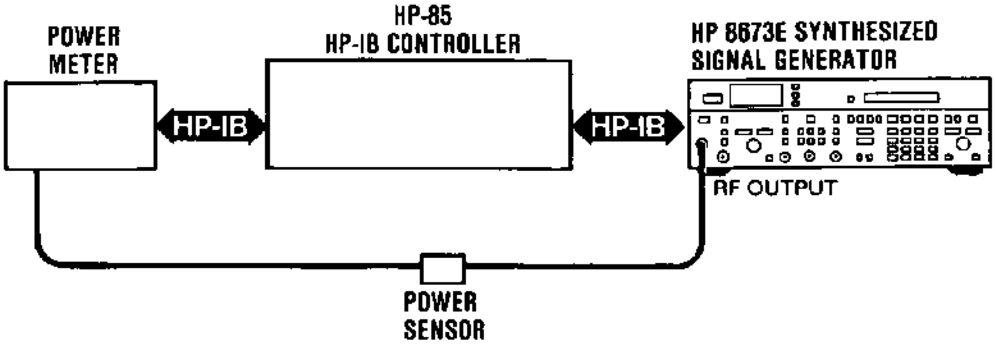


Figure 8-22. HP 8673E Power Output Test Setup

Output Level Checks (cont'd)

54. Compare the plot taken in Step 53 with the corresponding plot in Figure 8-23. There are three possible results:

a. The plot taken in Step 53 is essentially the same as the corresponding plot in Figure 8-23. If this is the case proceed with AM/ALC CHECK beginning with Step 55.

b. The power at one or more of the frequencies in the plot taken in Step 53 drops significantly below the Typical Performance limit line. This would indicate an output power problem. Proceed to BD5 to further isolate the problem.

NOTE

BD5 troubleshooting includes procedures to isolate the problem to BD6 or BD7.

c. The power at one or more of the frequencies in the plot taken in Step 53 is significantly lower than the power for the corresponding frequency in Figure 8-23, but not below the Typical Performance limit line. This would not necessarily indicate an output power problem but could affect AM and/or ALC operation. Proceed with AM/ALC CHECK beginning with Step 55.

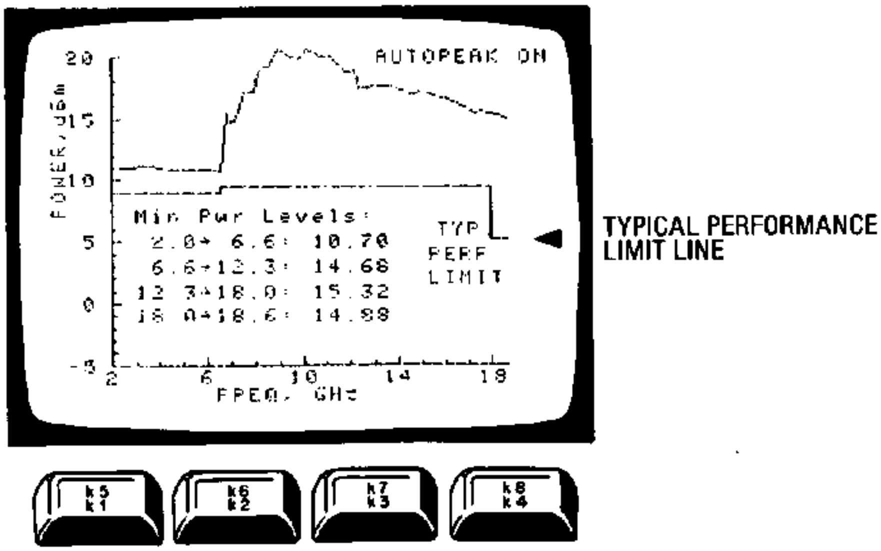


Figure 8-23. HP 8673E Power Plot

SERVICE SHEET BD1 (cont'd)

Output Level Checks (cont'd)

ALC/AM Check. (√9)

55. Press RCL 0, then connect 10 kHz at 0.707 Vrms to the AM IN connector. Press the AM 30% and MTR AM keys and verify that their LEDs turn on. Connect the Spectrum Analyzer to the RF OUTPUT connector. Set the Signal Generator output power level to −10 dBm.

    The Front Panel meter should indicate 30% ±3% and the first sidebands displayed on the spectrum analyzer should be about 16.5 dB below the carrier.

    If both readings are correct, continue with Step 56.

    If either or both indications are incorrect, proceed to BD6 to further isolate the problem.

56. Press the AM 100% key and verify that its LED turns on. Adjust the input voltage to obtain sidebands 12 dB below the carrier level.

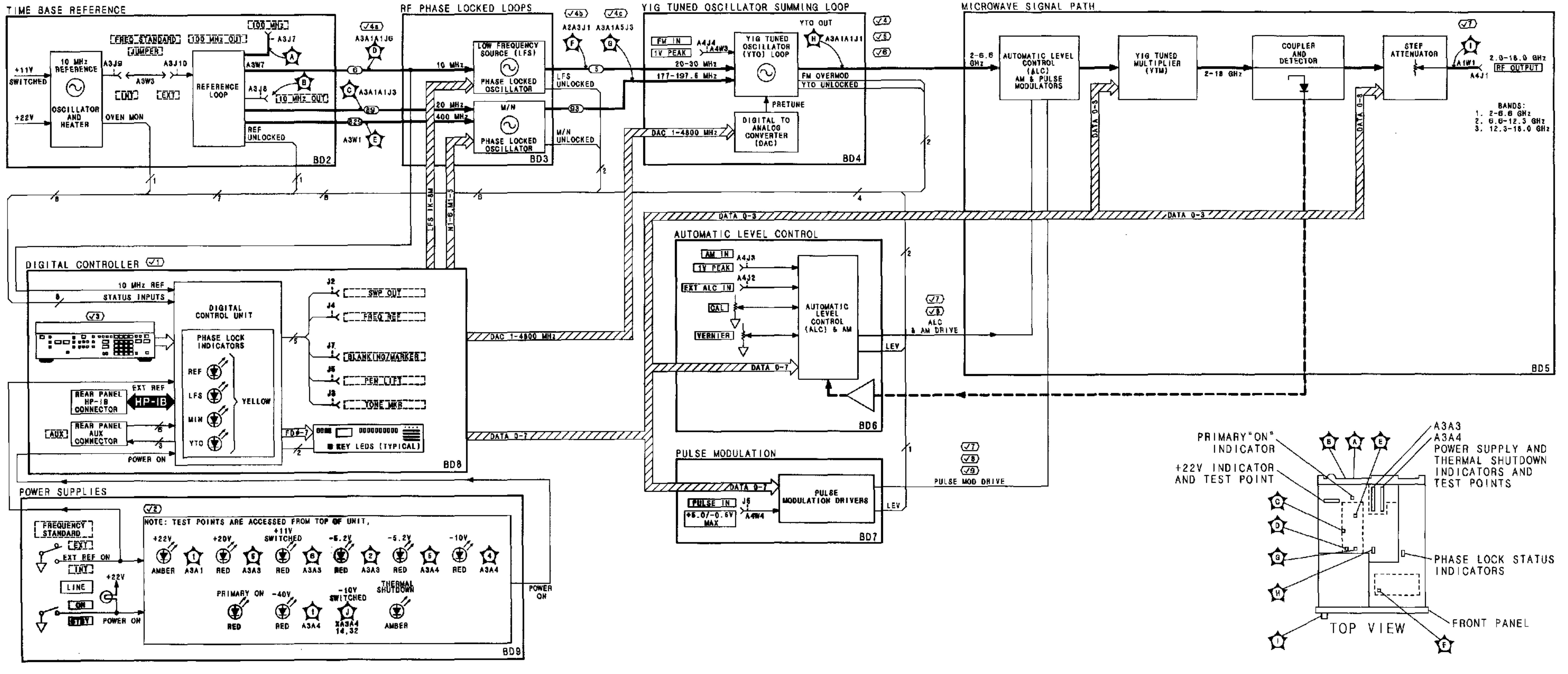
    The input voltage should be 0.354±0.018 Vrms and the Front Panel meter should indicate between 40% and 60%.

    If both indications are correct, the AM circuits are probably working properly. If any doubt exists, perform the AM adjustment procedure in Section V. Otherwise proceed with Pulse Modulation Checks.

    If either or both indications are incorrect, proceed to BD6 to further isolate the problem.

Pulse Modulation Checks. (√9)

If the HP 8673E has a pulse modulation problem, and if the unit passes all of the above checks, the problem is in the pulse modulation board. Proceed to BD7 to isolate the problem.



BD1

Figure 8-24. HP 8673E Overall Troubleshooting, Block Diagram

SERVICE SHEET BD2
TIME BASE REFERENCE

REFERENCES

- Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
- Disassembly Procedures .... Service Sheet A
- Interior Views .... Service Sheet B
- Replaceable Parts List .... Section VI
- Illustrated Parts Breakdown (IPB) .... Section VI
- Post Repair Adjustments .... Section V

PRINCIPLES OF OPERATION

The Time Base Reference generates precise time base reference signals of 10, 20, 100 and 400 MHz. These frequencies are generated from an internal, 10 MHz crystal oscillator, or from an external 5 or 10 MHz oscillator. The 10, 20, and 400 MHz time base reference signals are used as references for the M/N Loop, the Low Frequency Source (LFS) Loop, and the Digital Controller. The 100 MHz signal is available on the rear panel.

The Time Base Reference consists of two sections:

- Reference Loop Phase Detector, Service Sheet 1
- Reference Loop Oscillator and Frequency Multiplier, Service Sheet 2

The Reference Loop Oscillator and Frequency Mulitplier section contains a 100 MHz voltage controlled crystal oscillator (VCXO) that is phase locked to the 10 MHz Reference Oscillator by phase lock circuits in the Reference Loop Phase Detector. The 100 MHz output from the VCXO goes three places:

- It is fed back to the Reference Phase Detector where it is divided by 10 (÷5 and ÷2) and compared to the 10 MHz Reference Oscillator output to generate the Tune Voltage that keeps the 100 MHz VCXO phase locked to the 10 MHz reference. The output of the ÷5 circuit is buffered to become the internal 20 MHz reference and the output of the ÷2 circuit is routed to three separate buffers to become the three internal 10 MHz references.
- It is routed to the quadrupler to produce the 400 MHz reference output.
- It is routed to the rear panel as the 100 MHz reference.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet BD1 has been used to isolate a malfunction to the Time Base Reference BD2. The following troubleshooting procedure can be used to further isolate the problem to one of the following:

10 MHz Reference Oscillator
Reference Phase Detector
100 MHz VCXO

Test Equipment Required

Frequency Counter	HP 5343A
Variable Power Supply	HP 6200B
Digital Voltmeter	HP 3456A
Spectrum Analyzer	HP 8556B

Troubleshooting Procedure

This procedure is divided into two checks, as follows:

Reference Oscillator Check (√1)
100 MHz VCXO Check (√2)

If the reference Oscillator and the 100 MHz VCXO are operating normally, then, by default, the problem must be with the Reference Phase Detector.

Reference Oscillator Check (√1)

1. Remove the gray jumper (8) from A3J9 on the rear panel and connect the spectrum analyzer in its place.

   The spectrum analyzer should show a 10 MHz ±30 Hz signal at a power level of at least +8 dBm.

   If the frequency or power is incorrect, the reference oscillator is defective and should be replaced.

Overall Block Diagram and Troubleshooting SERVICE SHEET BD1

SERVICE SHEET BD2 (cont'd)

Reference Oscillator Check (√1) (cont'd)

If the frequency and power are correct, remove the spectrum analyzer, replace the jumper, and proceed with 100 MHz VCXO Check (√2) beginning with Step 2.

100 MHz VCXO Check (√2)

2. Remove A3A1A1. This opens the reference phase lock loop and allows testing of the 100 MHZ VCXO.

3. Remove the grey/orange/white (839) cable from A2A1A2J1 and connect the spectrum analyzer in its place.

4. Using the DVM, set variable power supply for −8.0 volts and turn power supply off. Connect the power supply positive lead to chassis ground and the negative lead to A3A1A2TP1.

   CAUTION

   Do not connect a positive voltage at this point. To do so would damage the 100 MHz VCXO.

5. Turn the power supply on and observe the spectrum analyzer.

   The frequency should be 100 MHz ±1 MHz at a power level of at least +3 dBm.

   If a signal is present but the frequency and/or power is not as indicated, go to the Reference Loop VCXO Adjustment procedure in Section V and attempt to adjust the 100 MHz VCXO.

   If there is no signal or if the 100 MHz VCXO cannot be properly adjusted, either the 100 MHz VCXO or the 100 MHz Buffer is defective, go to Service Sheet 2.

   If the signal is as indicated, leave the power supply connected to TP1, replace the gray/orange/white (839) cable and proceed with Step 6.

6. Connect the spectrum analyzer to rear panel connector A3J7.

   The spectrum analyzer display should show a 100±1 MHz signal at a power level of at least 0 dBm.

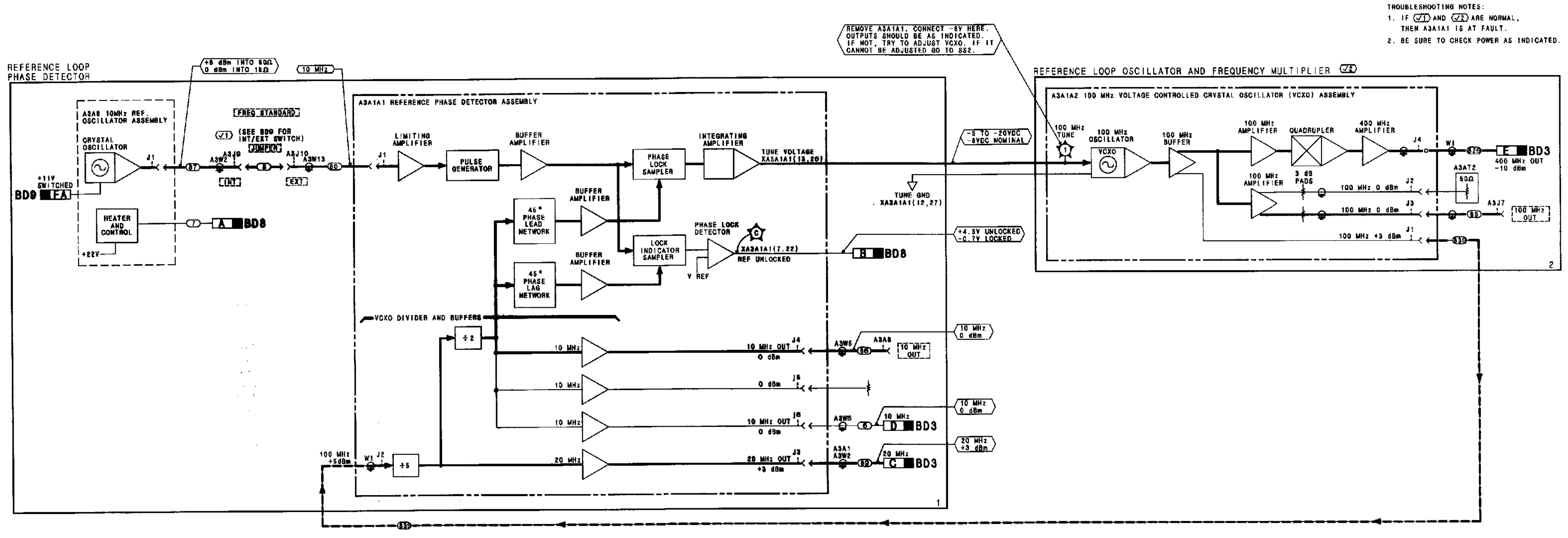
   If the signal is not as indicated, the 100 MHz amplifier is defective. Go to Service Sheet 2. Otherwise, continue with Step 8.

7. Remove the gray/red/white (829) cable from A3A1A5J1 and connect it to the spectrum analyzer.

   The spectrum analyzer should show a 400 ±4 MHz signal at a power level of at least −10 dBm.

   If the indication is not correct, the quadrupler or associated circuitry is defective. Go to Service Sheet 2.

   If the indication is correct, A3A1A2 is operating normally. If the Reference Oscillator is operating normally per (√1), the problem is in Reference Phase Detector A3A1A1. Replace the gray/red/white (829) cable, remove the power supply from TP1, and go to Service Sheet 1.



BD2

Figure 8-25. HP 8673E Time Base Reference, Block Diagram

SERVICE SHEET BD3
RF PHASE LOCKED LOOPS

REFERENCES

PRINCIPLES OF OPERATION

General

The RF Phase Locked Loops, under control of the Digital Control Unit (DCU), control the YTO output frequency. Two RF Phase Locked Loops are used to accomplish this:

- The Low Frequency Source (LFS) Loop, which controls YTO frequencies of 9.999 MHz and less in 1 kHz steps, and
- The M/N Loop, which controls YTO frequencies of 10 MHz to 6.6 GHz in 10 MHz steps.

Each is discussed separately below.

Low Frequency Source (LFS) Loop

The LFS loop synthesizes the 1 MHz, 100 kHz, 10 kHz and 1 kHz digits in the YTO output frequency. This is done by generating an output signal whose frequency varies from 20.001 MHz to 30.000 MHz. To do this the DCU decodes the four least significant bits of the selected frequency and sends it to the LFS loop as the 16-bit, LFS 1K—8M signal. This signal controls the LFS loop output frequency which is then used as a reference input signal to the YTO. The LFS Loop output frequency is given by the following equation:

$$f_{LFS} = 30 - \mathbf{x.xxx}\ \text{MHz}$$

where:

f_{LFS} = the LFS Loop output frequency, and x.xxx signifies the four least significant digits of the YTO frequency.

The YTO frequency can be calculated from the Signal Generator output frequency by using the following formulas for each band:

Band 1 $f_{YTO}=f_{OUT}$

Band 2 $f_{YTO}=f_{OUT}/2$

Band 3 $f_{YTO}=f_{OUT}/3$

Band 4 $f_{YTO}=f_{OUT}/4$

where:

f_{YTO} = the YTO output frequency, and
f_{OUT} = the Signal Generator Output frequency.

SERVICE SHEET BD3 (cont'd)

The LFS Loop consists of:

- 20/30 MHz Divider,
- 20/30 Phase Detector,
- 160—240 MHz VCO

Inputs to the 20/30 MHz Divider are the 10-MHz reference signal from the Reference Loop in A3, and 16 bits of digital information (LFS 1K—8M) from the Frequency Output-HP-IB assembly. A 160—240 MHz feedback signal, from the 160—240 MHz VCO Assembly portion of the Low Frequency Source, is also input to the 20/30 MHz Divider Assembly.

The divide by 10/11 prescaler output, in conjunction with a programmable divider, generates a nominal 80 kHz output when the LFS loop is phase locked. In the Phase Detector Assembly, this signal is compared to the 80 kHz reference signal (10 MHz divided by 125) to generate a pulse whose width is determined by the phase difference between the two signals. This pulse is integrated to obtain a dc tuning voltage, which will always drive the VCO frequency in the correct direction to maintain phase lock. If the loop unlocks, a one shot multivibrator is continuously retriggered and the NOT PHASE LOCKED status annunciator will light.

The 160-240 VCO Assembly contains a voltage controlled oscillator that is controlled by the TUNE OUT signal from the 20/30 Phase Detector. It is tuned, based on the LFS 1K—8M inputs, in discrete steps from 160.008 MHz to 240 MHz. The oscillator output has two paths. One is a filtered feedback path to the 20/30 MHz Divider Assembly. In the other path the signal is divided by eight and filtered to obtain a relatively clean signal between 20.001 MHz and 30.000 MHz. This signal goes to the YTO Loop in A3.

M/N LOOP

The M/N Loop consists of the M/N Phase Detector, the M/N VCO and M/N Output, and generates a 177 to 197.5 MHz signal at +3 dBm. This signal controls the four most significant digits of the YTO frequency. The loop is phase locked to the 400 MHz and 20 MHz reference signals from the Reference Loop. Two binary numbers (M and N), generated by the DCU, are used to control the M/N Loop frequency. The DCU generates the M and N numbers by decoding the most significant digits (10 MHz to 10 GHz) of the selected front panel frequencies. The ratio of M/N determines the M/N OUT frequency.

For each valid M/N OUT frequency change, a 10 MHz step occurs in the YTO output. This step complements the LFS Loop whose tuning range is 10 MHz in 1 kHz steps. Together, the M/N Loop, YTO pretuning, and the LFS Loop, tune the YTO from 2000.000 to 6599.999 MHz in 1 kHz steps.

Phase offsets between divider outputs are constant when the M/N Loop is phase locked. If the M/N Loop unlocks, the front panel NOT PHASE LOCKED status annunciator turns on.

SERVICE SHEET BD3 (cont'd)

The relationship between M/N loop output frequency and the M and N numbers is shown by the equation

$$f_{M/N} = [200-10(M/N)]\ \text{MHz}$$

where:

$f_{M/N}$ = M/N frequency out
M = M number
N = N number

Table 8-5 lists the M and N numbers, M/N output frequencies and YTO frequencies.

Time Base Reference Block Diagram SERVICE SHEET BD2

Table 8-5. Listing of all M and N Numbers and Resulting Frequencies (1 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
2000	17	11	184.545455	2530	24	14	182.857143
2010	16	11	185.454545	2540	23	14	183.571429
2020	15	11	186.363636	2550	22	14	184.285714
2030	14	11	187.272727	2560	21	14	185.000000
2040	13	11	188.181818	2570	20	14	185.714286
2050	12	11	189.090909	2580	19	14	186.428571
2060	11	11	190.000000	2590	18	14	187.142857
2070	10	11	190.909091	2600	17	14	187.857143
2080	9	11	191.818182	2610	16	14	188.571429
2090	8	11	192.727273	2620	15	14	189.285714
2100	27	12	177.500000	2630	14	14	190.000000
2110	26	12	178.333333	2640	13	14	190.714286
2120	25	12	179.166667	2650	12	14	191.428571
2130	24	12	180.000000	2660	11	14	192.142857
2140	23	12	180.833333	2670	10	14	192.857143
2150	22	12	181.666667	2680	9	14	193.571429
2160	21	12	182.500000	2690	8	14	194.285714
2170	20	12	183.333333	2700	27	15	182.000000
2180	19	12	184.166667	2710	26	15	182.666667
2190	18	12	185.000000	2720	25	15	183.333333
2200	17	12	185.833333	2730	24	15	184.000000
2210	16	12	186.666667	2740	23	15	184.666667
2220	15	12	187.500000	2750	22	15	185.333333
2230	14	12	188.333333	2760	21	15	186.000000
2240	13	12	189.166667	2770	20	15	186.666667
2250	12	12	190.000000	2780	19	15	187.333333
2260	11	12	190.833333	2790	18	15	188.000000
2270	10	12	191.666667	2800	17	15	188.666667
2280	9	12	192.500000	2810	16	15	189.333333
2290	8	12	193.333333	2820	15	15	190.000000
2300	27	13	179.230769	2830	14	15	190.666667
2310	26	13	180.000000	2840	13	15	191.333333
2320	25	13	180.769231	2850	12	15	192.000000
2330	24	13	181.538462	2860	11	15	192.666667
2340	23	13	182.307692	2870	10	15	193.333333
2350	22	13	183.076923	2880	9	15	194.000000
2360	21	13	183.846154	2890	8	15	194.666667
2370	20	13	184.615385	2900	27	16	183.125000
2380	19	13	185.384615	2910	26	16	183.750000
2390	18	13	186.153846	2920	25	16	184.375000
2400	17	13	186.923077	2930	24	16	185.000000
2410	16	13	187.692308	2940	23	16	185.625000
2420	15	13	188.461538	2950	22	16	186.250000
2430	14	13	189.230769	2960	21	16	186.875000
2440	13	13	190.000000	2970	20	16	187.500000
2450	12	13	190.769231	2980	19	16	188.125000
2460	11	13	191.538462	2990	18	16	188.750000
2470	10	13	192.307692	3000	17	16	189.375000
2480	9	13	193.076923	3010	16	16	190.000000
2490	8	13	193.846154	3020	15	16	190.625000
2500	27	14	180.714286	3030	14	16	191.250000
2510	26	14	181.428571	3040	13	16	191.875000
2520	25	14	182.142857	3050	12	16	192.500000

Table 8-5. Listing of all M and N Numbers and Resulting Frequencies (2 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
3060	11	16	193.125000	3590	18	19	190.526316
3070	10	16	193.750000	3600	17	19	191.052632
3080	9	16	194.375000	3610	16	19	191.578947
3090	8	16	195.000000	3620	15	19	192.105263
3100	27	17	184.117647	3630	14	19	192.631579
3110	26	17	184.705882	3640	13	19	193.157895
3120	25	17	185.294118	3650	12	19	193.684211
3130	24	17	185.882353	3660	11	19	194.210526
3140	23	17	186.470588	3670	10	19	194.736842
3150	22	17	187.058824	3680	9	19	195.263158
3160	21	17	187.647059	3690	8	19	195.789474
3170	20	17	188.235294	3700	27	20	186.500000
3180	19	17	188.823529	3710	26	20	187.000000
3190	18	17	189.411765	3720	25	20	187.500000
3200	17	17	190.000000	3730	24	20	188.000000
3210	16	17	190.588235	3740	23	20	188.500000
3220	15	17	191.176471	3750	22	20	189.000000
3230	14	17	191.764706	3760	21	20	189.500000
3240	13	17	192.352941	3770	20	20	190.000000
3250	12	17	192.941176	3780	19	20	190.500000
3260	11	17	193.529412	3790	18	20	191.000000
3270	10	17	194.117647	3800	17	20	191.500000
3280	9	17	194.705882	3810	16	20	192.000000
3290	8	17	195.294118	3820	15	20	192.500000
3300	27	18	185.000000	3830	14	20	193.000000
3310	26	18	185.555556	3840	13	20	193.500000
3320	25	18	186.111111	3850	12	20	194.000000
3330	24	18	186.666667	3860	11	20	194.500000
3340	23	18	187.222222	3870	10	20	195.000000
3350	22	18	187.777778	3880	9	20	195.500000
3360	21	18	188.333333	3890	8	20	196.000000
3370	20	18	188.888889	3900	27	21	187.142857
3380	19	18	189.444444	3910	26	21	187.619048
3390	18	18	190.000000	3920	25	21	188.095238
3400	17	18	190.555556	3930	24	21	188.571429
3410	16	18	191.111111	3940	23	21	189.047619
3420	15	18	191.666667	3950	22	21	189.523810
3430	14	18	192.222222	3960	21	21	190.000000
3440	13	18	192.777778	3970	20	21	190.476190
3450	12	18	193.333333	3980	19	21	190.952381
3460	11	18	193.888889	3990	18	21	191.428571
3470	10	18	194.444444	4000	17	21	191.904762
3480	9	18	195.000000	4010	16	21	192.380952
3490	8	18	195.555556	4020	15	21	192.857143
3500	27	19	185.789474	4030	14	21	193.333333
3510	26	19	186.315789	4040	13	21	193.809524
3520	25	19	186.842105	4050	12	21	194.285714
3530	24	19	187.368421	4060	11	21	194.761905
3540	23	19	187.894737	4070	10	21	195.238095
3550	22	19	188.421053	4080	9	21	195.714286
3560	21	19	188.947368	4090	8	21	196.190476
3570	20	19	189.473684	4100	27	22	187.727273
3580	19	19	190.000000	4110	26	22	188.181818

Table 8-5. Listing of all M and N Numbers and Resulting Frequencies (3 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
4120	25	22	188.636364	4650	12	24	195.000000
4130	24	22	189.090909	4660	11	24	195.416667
4140	23	22	189.545455	4670	10	24	195.833333
4150	22	22	190.000000	4680	9	24	196.250000
4160	21	22	190.454545	4690	8	24	196.666667
4170	20	22	190.909091	4700	27	25	189.200000
4180	19	22	191.363636	4710	26	25	189.600000
4190	18	22	191.818182	4720	25	25	190.000000
4200	17	22	192.272727	4730	24	25	190.400000
4210	16	22	192.727273	4740	23	25	190.800000
4220	15	22	193.181818	4750	22	25	191.200000
4230	14	22	193.636364	4760	21	25	191.600000
4240	13	22	194.090909	4770	20	25	192.000000
4250	12	22	194.545455	4780	19	25	192.400000
4260	11	22	195.000000	4790	18	25	192.800000
4270	10	22	195.454545	4800	17	25	193.200000
4280	9	22	195.909091	4810	16	25	193.600000
4290	8	22	196.363636	4820	15	25	194.000000
4300	27	23	188.260870	4830	14	25	194.400000
4310	26	23	188.695652	4840	13	25	194.800000
4320	25	23	189.130435	4850	12	25	195.200000
4330	24	23	189.565217	4860	11	25	195.600000
4340	23	23	190.000000	4870	10	25	196.000000
4350	22	23	190.434783	4880	9	25	196.400000
4360	21	23	190.869565	4890	8	25	196.800000
4370	20	23	191.304348	4900	27	26	189.615385
4380	19	23	191.739130	4910	26	26	190.000000
4390	18	23	192.173913	4920	25	26	190.384615
4400	17	23	192.608696	4930	24	26	190.769231
4410	16	23	193.043478	4940	23	26	191.153846
4420	15	23	193.478261	4950	22	26	191.538462
4430	14	23	193.913043	4960	21	26	191.923077
4440	13	23	194.347826	4970	20	26	192.307692
4450	12	23	194.782609	4980	19	26	192.692308
4460	11	23	195.217391	4990	18	26	193.076923
4470	10	23	195.652174	5000	17	26	193.461538
4480	9	23	196.086957	5010	16	26	193.846154
4490	8	23	196.521739	5020	15	26	194.230769
4500	27	24	188.750000	5030	14	26	194.615385
4510	26	24	189.166667	5040	13	26	195.000000
4520	25	24	189.583333	5050	12	26	195.384615
4530	24	24	190.000000	5060	11	26	195.769231
4540	23	24	190.416667	5070	10	26	196.153846
4550	22	24	190.833333	5080	9	26	196.538462
4560	21	24	191.250000	5090	8	26	196.923077
4570	20	24	191.666667	5100	27	27	190.000000
4580	19	24	192.083333	5110	26	27	190.370370
4590	18	24	192.500000	5120	25	27	190.740741
4600	17	24	192.916667	5130	24	27	191.111111
4610	16	24	193.333333	5140	23	27	191.481481
4620	15	24	193.750000	5150	22	27	191.851852
4630	14	24	194.166667	5160	21	27	192.222222
4640	13	24	194.583333	5170	20	27	192.592593

Table 8-5. Listing of all M and N Numbers and Resulting Frequencies (4 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
5180	19	27	192.962963	5710	26	30	191.333333
5190	18	27	193.333333	5720	25	30	191.666667
5200	17	27	193.703704	5730	24	30	192.000000
5210	16	27	194.074074	5740	23	30	192.333333
5220	15	27	194.444444	5750	22	30	192.666667
5230	14	27	194.814815	5760	21	30	193.000000
5240	13	27	195.185185	5770	20	30	193.333333
5250	12	27	195.555556	5780	19	30	193.666667
5260	11	27	195.925926	5790	18	30	194.000000
5270	10	27	196.296296	5800	17	30	194.333333
5280	9	27	196.666667	5810	16	30	194.666667
5290	8	27	197.037037	5820	15	30	195.000000
5300	27	28	190.357143	5830	14	30	195.333333
5310	26	28	190.714286	5840	13	30	195.666667
5320	25	28	191.071429	5850	12	30	196.000000
5330	24	28	191.428571	5860	11	30	196.333333
5340	23	28	191.785714	5870	10	30	196.666667
5350	22	28	192.142857	5880	9	30	197.000000
5360	21	28	192.500000	5890	8	30	197.333333
5370	20	28	192.857143	5900	27	31	191.290323
5380	19	28	193.214286	5910	26	31	191.612903
5390	18	28	193.571429	5920	25	31	191.935484
5400	17	28	193.928571	5930	24	31	192.258065
5410	16	28	194.285714	5940	23	31	192.580645
5420	15	28	194.642857	5950	22	31	192.903226
5430	14	28	195.000000	5960	21	31	193.225806
5440	13	28	195.357143	5970	20	31	193.548387
5450	12	28	195.714286	5980	19	31	193.870968
5460	11	28	196.071429	5990	18	31	194.193548
5470	10	28	196.428571	6000	17	31	194.516129
5480	9	28	196.785714	6010	16	31	194.838710
5490	8	28	197.142857	6020	15	31	195.161290
5500	27	29	190.689655	6030	14	31	195.483871
5510	26	29	191.034483	6040	13	31	195.806452
5520	25	29	191.379310	6050	12	31	196.129032
5530	24	29	191.724138	6060	11	31	196.451613
5540	23	29	192.068966	6070	10	31	196.774194
5550	22	29	192.413793	6080	9	31	197.096774
5560	21	29	192.758621	6090	8	31	197.419355
5570	20	29	193.103448	6100	27	32	191.562500
5580	19	29	193.448276	6110	26	32	191.875000
5590	18	29	193.793103	6120	25	32	192.187500
5600	17	29	194.137931	6130	24	32	192.500000
5610	16	29	194.482759	6140	23	32	192.812500
5620	15	29	194.827586	6150	22	32	193.125000
5630	14	29	195.172414	6160	21	32	193.437500
5640	13	29	195.517241	6170	20	32	193.750000
5650	12	29	195.862069	6180	19	32	194.062500
5660	11	29	196.206897	6190	18	32	194.375000
5670	10	29	196.551724				
5680	9	29	196.896552				
5690	8	29	197.241379				
5700	27	30	191.000000				

Table 8-5. Listing of all M and N Numbers and Resulting Frequencies (5 of 5)

Freq. MHz	M	N	M/N MHz	Freq. MHz	M	N	M/N MHz
6200	17	32	194.687500	6400	17	33	194.848485
6210	16	32	195.000000	6410	16	33	195.151515
6220	15	32	195.312500	6420	15	33	195.454545
6230	14	32	195.625000	6430	14	33	195.757576
6240	13	32	195.937500	6440	13	33	196.060606
6250	12	32	196.250000	6450	12	33	196.363636
6260	11	32	196.562500	6460	11	33	196.666667
6270	10	32	196.875000	6470	10	33	196.969697
6280	9	32	197.187500	6480	9	33	197.272727
6290	8	32	197.500000	6490	8	33	197.575758
6300	27	33	191.818182	6500	27	34	192.058824
6310	26	33	192.121212	6510	26	34	192.352941
6320	25	33	192.424242	6520	25	34	192.647059
6330	24	33	192.727273	6530	24	34	192.941176
6340	23	33	193.030303	6540	23	34	193.235294
6350	22	33	193.333333	6550	22	34	193.529412
6360	21	33	193.636364	6560	21	34	193.823529
6370	20	33	193.939394	6570	20	34	194.117647
6380	19	33	194.242424	6580	19	34	194.411765
6390	18	33	194.545455	6590	18	34	194.705882

SERVICE SHEET BD3 (cont'd)

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet BD1 was used to isolate the problem to either or both of the following:

- Low Frequency Source (LFS) Loop
- M/N Loop

The following troubleshooting procedures can be used to further isolate the problem to one of the following subassemblies:

LFS Loop
20/30 Divider
20/30 Phase Detector
VCO 160—240 MHz

M/N Loop
M/N Phase Detector
M/N VCO
M/N Output

Test Equipment Required

Frequency Counter .... HP 5343A
Oscilloscope ....HP 1980B
Digital Voltmeter ......HP 3456A

The following procedures are divided into ten checks, as follows:

LFS Loop Checks

10 MHz Reference Check (√1)
20/30 Divider Check (√2)
160—240 MHz VCO Check (√3)
20/30 Phase Detector Check (√4)

M/N Loop Checks

20 MHz Reference Check (√5)
400 MHz Reference Check (√6)
M/N Phase Detector Checks (√7)
200 kHz Filter Check (√8)
M/N VCO Checks (√9)
M/N Output Checks (√10)

LFS Loop Checks.

10 MHz Reference Check (√1)

1. Remove blue cable (6) from J1 of A2A13 motherboard and connect it to the counter.

   The frequency should be 10 MHz ±30 Hz.

   If the frequency is correct, proceed with Step 2.

   If the frequency is not correct, the Reference Loop is faulty. Proceed to Service Sheet 2 to troubleshoot the Reference Loop.

20/30 Divider Check (√2)

2. Replace the blue cable on A2A13J1 and connect the oscilloscope to A2A5TP2, 80 kHz REF.

   The waveform should be as shown in Figure 8-26.

   If the waveform is as shown, proceed with step 3.

   If the waveform is not as shown, the divide by 125 divider chain on A2A5 is faulty. Proceed to Service Sheet 6 for troubleshooting.

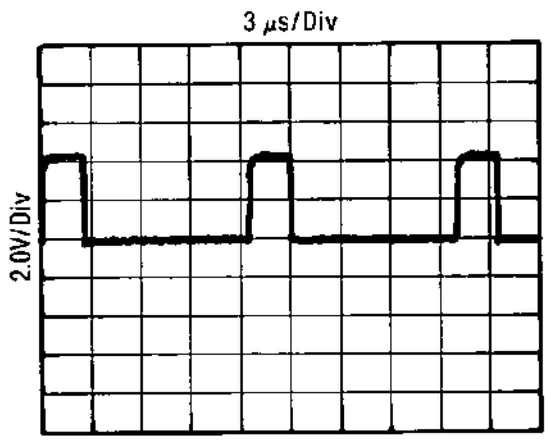


Figure 8-26. 80 kHz Reference. A2A5TP2

3. Remove A2A3, set the Test Switch to TEST HIGH FREQ, and replace A2A3. This opens the LFS loop by placing a fixed voltage on the VCO input.

4. Press RCL 0 and connect the oscilloscope to A2A5TP3. The waveform should be as shown in Figure 8-27.

   If the waveform is as shown, proceed with Step 9. If the waveform is not as shown, proceed with Step 5 to see if the problem is with 20/30 Divider A2A5 or with faulty inputs from the DCU.

SERVICE SHEET BD3 (cont'd)

Table 8-6. LFS 1K—8M Inputs

Freq. GHz	XA2A5-															
	11	12	13	14	15	16	17	18	29	30	31	32	33	34	35	36
3.339999	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
3.336666	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0

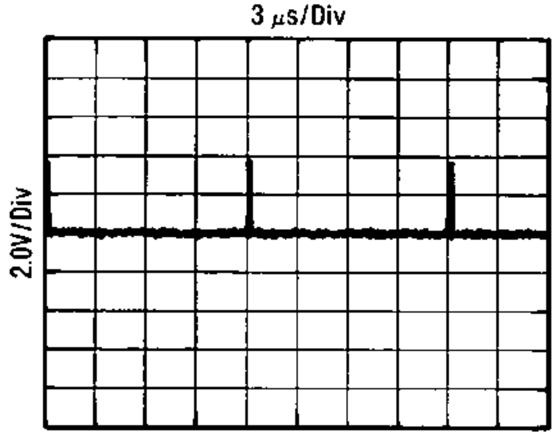


Figure 8-27. A2A5TP3, A2A3 Test Switch HIGH

5. Remove A2A5 and replace it on an extender board.

6. Set the Signal Generator to the Frequencies shown in Table 8-6, and check the input pins for the logic levels given.

   If all the input pins are correct, then 20/30 Divider A2A5 is defective. Go to Service Sheet 6 to isolate the problem.

   If any of the pins are incorrect, the appropriate output pins on Frequency Output-HP-IB Card A2A9 should be checked to insure that the problem is not on the mother board. Proceed with Step 7.

7. Remove A2A9 and replace it on the special extender card (P/N 11726-60002). (Two 36 pin and one 30 pin extender card may be used if the special card is not available.)

8. Set the Signal Generator to the frequencies shown in Table 8-7 and check the input pins for the logic levels given.

   If all the pins are correct, there is a problem in the motherboard between A2A9 and A2A5.

   If any of the pins are incorrect, the problem is in A2A9. Proceed to Service Sheet 29 to isolate the problem.

160-240 MHz VCO Check (✓3)

Initial Conditions: A2A3 Test Switch set to TEST HIGH FREQ.

9. Disconnect the red cable (2) from A2A3J2 160-240 MHz OUTPUT (TPA) and connect the frequency counter in its place.

   The frequency should be greater than 240 MHz.

   If the frequency is correct, proceed with step 10.

   If the frequency is not correct, A2A3 is faulty, go to Service Sheet 8 to isolate the problem.

Table 8-7. LFS 1K—8M Outputs

Freq. GHz	XA9B-										XA9A-					
	2	3	4	5	6	11	20	21	22	23	21	22	31	32	33	34
3.339999	0	0	1	0	1	1	1	0	0	1	1	0	1	0	0	1
3.336666	1	1	0	1	0	0	0	1	1	0	0	1	0	1	1	0

SERVICE SHEET BD3 (cont'd)

10. Remove A2A3, set the Test Switch to TEST LO FREQ, and replace A2A3, then recheck the counter display.

    The frequency should be less than 160 MHz.

    If the frequency is correct, reconnect the red cable (2) to A2A3J2 and proceed with step 11.

    If the frequency is not correct, A2A3 is faulty, go to Service Sheet 8 to isolate the problem.

11. Disconnect the green cable (5) from A2A3J1 (TPG) and connect the frequency counter in its place.

    The frequency should be less then 20 MHz.

    If the frequency is correct, proceed with Step 12.

    If the frequency is not correct, A2A3 is faulty. Go to Service Sheet 8 to troubleshoot.

12. Remove A2A3, set the Test Switch to TEST HIGH FREQ, and replace A2A3, then recheck the counter display.

    The frequency should be greater than 30 MHz.

    If the frequency is correct, reconnect the green cable and proceed with 20/30 Phase Detector Check (✓4) beginning with Step 13.

    If the frequency is not correct, A2A3 is faulty. Go to Service Sheet 8 to troubleshoot.

20/30 Phase Detector Checks (✓4)

Initial conditions: A2A3 Test Switch to TEST LO FREQ.

13. Connect the DVM to TP4 of A2A4.

    The voltage should be less than +4V.

    If the voltage is correct, proceed with Step 14. If the voltage is not correct, A2A4 is faulty, go to Service Sheet 7 to troubleshoot.

14. Remove A2A3, set the Test Switch to TEST HIGH FREQ, and replace A2A3, then recheck the DVM indication.

    The voltage should be more than 14 volts.

    If the voltage is correct, the LFS Loop is working normally. Remove A2A3, set the Test Switch to NORMAL, replace A2A3, and proceed with M/N Troubleshooting.

    If the voltage is not correct, A2A4 is faulty, go to Service Sheet 7 to troubleshoot.

M/N Troubleshooting.

20 MHz Reference Check (✓5)

1. Set Signal Generator for external reference and connect the frequency standard output from the frequency counter to A3J10 on the Signal Generator's rear panel.

2. Disconnect the grey/white (89) cable from A3A1A1J3 20 MHz OUT (TPF) and connect the counter in its place.

   The frequency should be 20 MHz ±one count.

   If the frequency is not correct, the problem is in Reference Phase Detector A3A1A1. Proceed to Service Sheet 2 to isolate the problem.

   If the frequency is correct, replace the grey/white cable (89) and proceed with Step 3.

400 MHz Reference Check (✓6)

Initial Conditions: Frequency counter connected to Signal Generator as in Step 1.

3. Remove the gray/red/white (829) cable from A3A1A5J1 400 MHz IN (TPD) and connect the cable to the counter.

4. The frequency should be 400 MHz ± one count.

   If the frequency is not correct, Reference Phase Detector A3A1A1 is at fault. Go to Service Sheet 2 to isolate the problem.

   If the frequency is correct, replace the gray/red/white cable and proceed with Step 5.

M/N Phase Detector Checks (✓7)

5. Disconnect white/red cable (92) from A3A1A5J2 IF OUT (TPE).

6. Place A3A1A3 on an extender card and connect DVM to A3A1A3TP5.

   The voltage should be approximately −0.5V.

   If the voltage is correct, proceed with step 7.

   If the voltage is not correct, proceed with Step 9 to check the M and N inputs to A3A1A3.

SERVICE SHEET BD3 (cont'd)

7. Remove the gray/white (89) cable from the 20 MHz OUT connector of A3A1A1 and connect the white/red cable (92), (previously disconnected from the IF OUT connector of A3A1A5) in its place.

8. Connect the DVM to A3A1A3TP5. The voltage should be approximately −38V.

   If the voltage is correct, proceed with (✓8) 200 kHz Filter Check, beginning with Step 11.

   If the voltage is not correct, proceed with Step 9 to see if the problem is on the Frequency Output-HP-IB board or the Mother Board.

9. Set the Signal Generator to each frequency shown in Table 8-8 and check for the corresponding logic level on each A3A1A3 input pin shown.

Table 8-8. M1—M6 and N1—N5 Inputs

Freq. GHz	XA3A1A3-										
	8	9	10	13	14	15	23	24	25	28	29
6.590	0	0	0	0	0	1	1	1	0	1	0
5.640	1	1	1	1	1	0	0	0	1	0	1

   If all of the pins are correct, A3A1A3 is defective, proceed to Service Sheet 3 to isolate the problem.

   If any of the pins are incorrect, proceed with Step 10 to see if the problem is with the I/O card or the mother board.

10. Set the Signal Generator to each frequency shown in Table 8-9 and check for the corresponding logic level on each output pin shown.

Table 8-9. M1—M6 and N1—N5 Outputs

Freq. GHz	XA9A-										
	1	2	3	4	5	6	7	8	9	10	11
6.590	1	0	0	0	1	0	1	0	0	1	0
5.640	0	1	1	1	0	1	0	1	1	0	1

   If all the pins are correct, there is a problem with the Mother Board.

   If any of the pins are not correct, the problem is on Frequency Output-HB-IB card A2A9. Go to Service Sheet 29 to isolate the problem.

200 kHz Filter Check (✓8)

Initial Conditions: White/red cable (92) connected to 20 MHz OUT connector of A3A1A1.

11. Connect DVM to A3A1A4 TP1.

    The voltage should be approximately −38V.

    If the voltage is correct, proceed with Step 12.

    If the voltage is not correct, The Low Pass Filter on A3A1A5 is defective, proceed to Service Sheet 3 to troubleshoot.

M/N VCO Checks (✓9)

Initial Conditions: White/red cable (92) connected to 20 MHz OUT connector of A3A1A1.

12. Place A3A1A5 on an extender board and disconnect the white cable (9) from the M/N VCO from A3A1A5J4 (TPB).

13. Connect the white cable to the spectrum analyzer.

    The frequency should be approximately 396 MHz at a power level of at least 0 dBm.

    If the frequency and power are correct, leave the white cable connected to the spectrum analyzer and proceed with step 14.

    If the frequency and/or power is not correct, the VCO is either defective or requires adjustment. Proceed to the VCO adjustment procedure in Section V and attempt to adjust the VCO. If it cannot be adjusted, replace it.

14. Disconnect the white/red cable (92) from the 20 MHz OUT connector of A3A1A1 and connect the gray/white cable (89) in its place.

    The frequency should be approximately 342 MHz at a power level of at least 0 dBm.

    If the frequency and power are correct, reconnect the white cable to A3A1A5J4 and proceed with M/N Output (✓10) check beginning with Step 15.

    If the frequency and/or power is not correct, the M/N VCO is either defective or requires

SERVICE SHEET BD3 (cont'd)

adjustment. Proceed to the M/N VCO adjustment procedure in Section V and attempt to adjust the M/N VCO. If it cannot be adjusted, replace it.

M/N Output Checks (√10)

15. Disconnect the white/orange (92) cable from A3A1A5J3 M/N OUT (TPC) and connect the counter in its place.

    The frequency should be approximately 171 MHz.

    If the frequency is correct, reconnect the white/orange cable to M/N out and proceed with step 16.

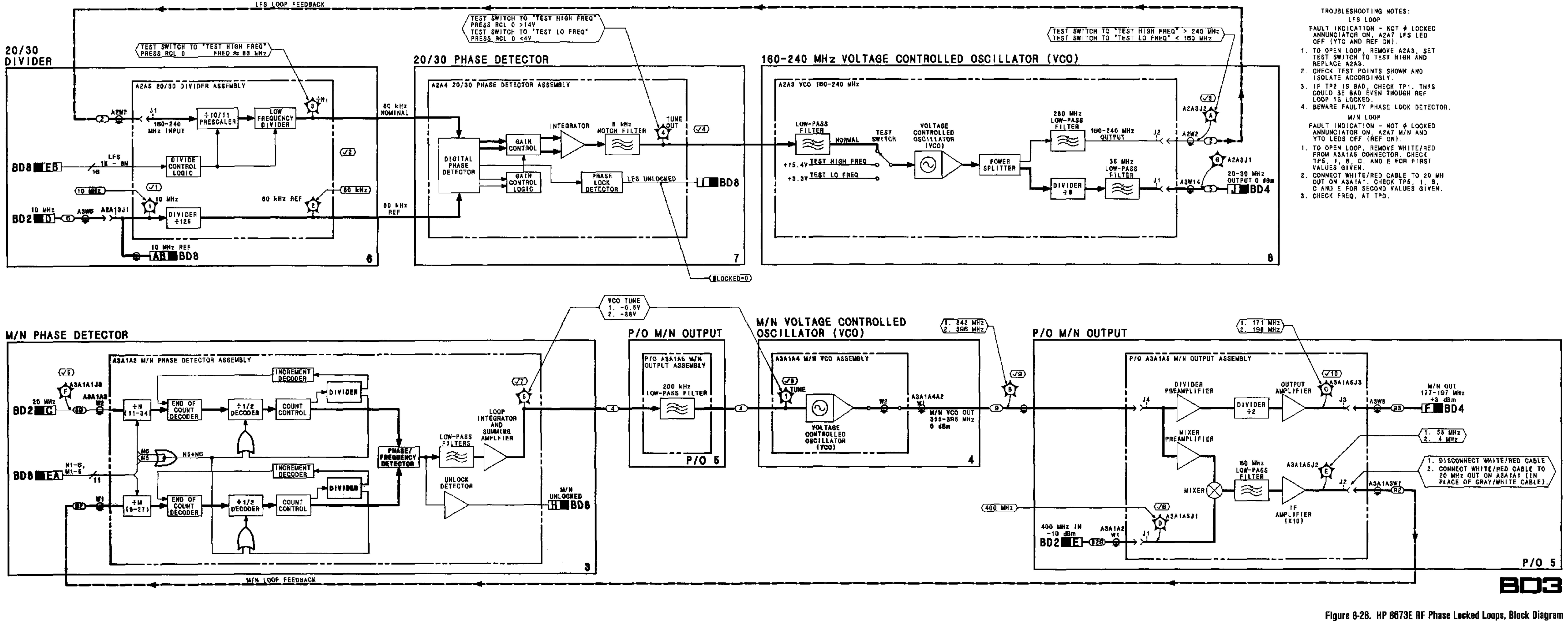
    If the frequency is not correct, A3A1A5 is defective, proceed to Service Sheet 5 to troubleshoot.

16. Connect the counter to A3A1A5J2 IF OUT (TPE).

    The frequency should be approximately 58 MHz.

    If the frequency is correct, the M/N loop is functioning normally.

    If the frequency is not correct, A3A1A5 is faulty. Proceed to Service Sheet 5 to troubleshoot.



TROUBLESHOOTING NOTES:

LFS LOOP

FAULT INDICATION - NOT φ LOCKED ANNUNCIATOR ON, A2A7 LFS LED OFF (YTO AND REF ON).

1. TO OPEN LOOP, REMOVE A2A3, SET TEST SWITCH TO TEST HIGH AND REPLACE A2A3.
2. CHECK TEST POINTS SHOWN AND ISOLATE ACCORDINGLY.
3. IF TP2 IS BAD, CHECK TP1. THIS COULD BE BAD EVEN THOUGH REF LOOP IS LOCKED.
4. BEWARE FAULTY PHASE LOCK DETECTOR.

M/N LOOP

FAULT INDICATION - NOT φ LOCKED ANNUNCIATOR ON, A2A7 M/N AND YTO LEDS OFF (REF ON).

1. TO OPEN LOOP, REMOVE WHITE/RED FROM A3A1A5 CONNECTOR. CHECK TP5, I, B, C, AND E FOR FIRST VALUES GIVEN.
2. CONNECT WHITE/RED CABLE TO 20 MH OUT ON A3A1A1. CHECK TP6, 1, B, C AND E FOR SECOND VALUES GIVEN.
3. CHECK FREQ. AT TPD.

Figure 8-28. HP 8673E RF Phase Locked Loops, Block Diagram

SERVICE SHEET BD4
YTO SUMMING LOOP

REFERENCES

PRINCIPLES OF OPERATION

General

The YTO Summing Loop generates the Signal Generator's baseband frequencies from 2.0—6.6 GHz. The baseband signal is multiplied, to produce the other Signal Generator frequencies.

The YTO Summing Loop consists of the following:

- Digital to Analog Converter (DAC), Service Sheet 9
- YIG Tuned Oscillator (YTO) Driver, Service Sheet 10
- YTO Loop
  - Sampler, Service Sheet 11
  - YTO Phase Detector, Service Sheet 12
- YTO/FM Coil Driver, Service Sheet 13
- FM Subsystem
  - Meter Board, P/O Service Sheet 21
  - P/O DAC and Enable, P/O Service Sheet 22
  - P/O YTO Phase Detector Assembly, Service Sheet 12
  - P/O YTO/FM Coil Driver, Service Sheet 13

Each is discussed separately below.

Digital to Analog Converter

The Digital to Analog Converter (DAC) receives the DAC 1—4800 MHz signal from the DCU to tune the YTO to within 50 MHz of the selected frequency. The DAC output, YTO PRETUNE, is routed to the YIG Tuned Oscillator Driver.

Yig Tuned Oscillator (YTO) Driver

This circuit receives the YTO PRETUNE signal from the DAC and the YTO TUNE 2 signal from the YTO/FM Coil Driver, sums the two and routes them to the YTO Assembly. The 100 MHz low pass filter routes only the DC and low frequency (less than 100 Hz) components of the YTO TUNE 2 signal to the YTO.

YTO Loop

Sampler. This circuit receives the M/N Loop output and the sampled output of the YTO. The M/N output is applied to a harmonic generator. The output of the harmonic generator is then mixed with the YTO sampled output. Since the YTO has been pretuned to within 50 MHz of the desired frequency, one of the IF frequencies from the mixer will be close to the 20—30 MHz signal from the LFS Loop. This IF signal is routed to the YTO Phase Detector.

YTO Phase Detector. This circuit receives the 20—30 MHz signal from the LFS Loop and the selected IF signal from the Sampler. These two signals are

SERVICE SHEET BD4 (cont'd)

compared in a phase/frequency detector. Each output of the phase/frequency detector corresponds to an error in the YTO frequency. One output is used to indicate the YTO frequency is too low and the other output indicates the YTO frequency is too high. An incorrect YTO frequency will produce a pulse on the phase/frequency detector output corresponding to the YTO frequency being too high or too low. The width of the pulse is proportional to the phase error between the two inputs to the phase/frequency detector.

The differential amplifier combines the two phase/frequency detector outputs to generate a single error signal for the Loop Integrators. When the YTO frequency is correct, there is no error signal at the input to the Loop Integrators so the YTO Tune 1 signal does not change. When the YTO frequency is too high or too low, the error signal at the input of the Loop Integrators causes the output of the Loop Integrators to increase or decrease until the error signal returns to zero.

The FM elements of the YTO phase detector are discussed under FM subsystem below.

YTO/FM Coil Driver

This circuit receives the YTO Tune 1 signal from the YTO Phase Detector, amplifies it and routes it to a crossover network consisting of a 100 Hz high pass filter in the YTO/FM Coil Driver Assembly and a 100 Hz low pass filter in the YTO Driver Assembly. The FM signal (100 Hz to 2 MHz) is routed to the FM coil of the YTO, and the YTO tuning signal (YTO TUNE 2 plus YTO PRETUNE) is routed to the YTO main coil. The FM elements of this circuit are discussed under FM Subsystem below.

FM Subsystem

Metering Control. This circuit receives the FM input directly from the front panel, and control signals from the DCU. The FM signal is first applied to the FM Band Select circuit and the FM Metering Circuit. The FM Band select circuit adjusts the FM signal level for the frequency band that has been selected. The FM Metering Circuit converts the FM signal to a dc level that is proportional to the level of the FM input signal. This level is routed to the front panel meter, through the Meter Selection Switch, and to the FM Overmod Circuit that drives the FM OM signal active if the input signal level is too high. The FM Overmod circuit also receives an input from the overmodulation detector in the YTO Summing Loop.

The output of the FM Band Select circuit is applied to the FM Amplifier whose gain is controlled by the DCU through the FM Range Select circuit.

YTO/FM Coil Driver. In the YTO/FM Coil Driver, the FM Signal from the Metering Control takes two paths: one is through a 0/40 dB attenuator and an FM amplifier and shaping network to the FM Coil Driver. The second path is through an integrator and a 0/40 db attenuator to the Loop Integrator in the YTO Phase Detector. The first path directly modulates the YTO. The second path cancels the

SERVICE SHEET BD4 (cont'd)

error signal produced by the phase/frequency so that FM can occur with the bandwidth of the YTO Summing Loop.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheet 1 was used to isolate a YTO Summing Loop malfunction. The following troubleshooting information can be used to further isolate the problem to one of the following YTO Summing Loop assemblies:

- Digital to Analog Converter Assembly
- YTO Driver Assembly
- YTO/FM Coil Driver Assembly
- Sampler Assembly
- YTO Phase Detector Assembly
- Meter Board Assembly

Test Equipment Required:

Frequency Counter .... HP 5343A
Digital Voltmeter .... HP 3456A
Oscilloscope .... HP 1980B

Troubleshooting Procedures

The following procedures are divided into ten checks as follows:

YTO Summing Loop Checks
- YTO Check (✓1)
- DAC Check (✓2)
- YTO Driver Check (unlocked) (✓3)
- Sampler Input Check (✓4)
- Sampler Output Check (✓5)
- YTO Phase Detector Check (✓6)
- Coil Driver Check (✓7)
- YTO Driver Check (locked) (✓8)

FM Checks
- FM Amplifier Check (✓9)
- FM 40 Check (✓10)

YTO Loop Checks.

YTO Check

1. Press RCL 0 and ground A3A6TP1. This opens the YTO loop to facilitate troubleshooting.

2. Disconnect the cable from J1 of directional coupler A3A9A1 (TPA) and connect the frequency counter in its place.

SERVICE SHEET BD4 (cont'd)

The frequency should be 3000.000±20 MHz.

If the frequency is correct proceed with Step 7.

If the frequency is not correct, continue with Step 3.

DAC Check (✓2)

3. Connect the DVM to A3A5TP3 and set the Signal Generator to 2.000 GHz and then to 6.599 GHz and record the DVM indication for each frequency. The voltages should be as follows:

   2.000 GHz −6.00V
   6.599 GHz −19.8V

   If the voltages are correct, proceed with Step 7.

   If the voltages are not correct, A3A5 is either faulty or needs adjustment, or the DAC 1—4800 MHz input from the DCU is faulty. Proceed with Step 4 to check the DAC inputs.

4. Set the Signal Generator to the frequencies shown in Table 8-10 and check the input pins for the indicated logic level.

Table 8-10. DAC 1—4800 MHz Inputs

Freq. GHz	XA3A5-													
	7	8	9	10	11	12	13	25	26	27	28	29	30	31
5.698	1	0	1	0	0	0	1	0	0	0	1	0	0	0
3.977	0	1	0	1	1	1	0	1	1	1	0	1	1	1

   If all the input levels are as indicated, then DAC A3A5 is defective. Go to Service Sheet 9 to isolate the problem.

   If any of the levels are not as indicated, proceed with Step 5 to check the output pins on Frequency Output-HP-IB A2A9 to ensure that the problem is not on the mother board.

5. Remove Frequency Output-HP-IB card A2A9 and replace it on the special extender card (P/N 11726-60002).

6. Set the Signal Generator to the frequencies shown in Table 8-11 and check the output pins for the logic levels given.

Table 8-11. DAC 1—4800 MHz Outputs

Freq. GHz	XA9A-													
	23	24	25	26	27	28	29	30	31	32	33	34	35	36
5.688	0	1	0	0	0	1	0	1	0	0	0	1	0	0
3.977	1	0	1	1	1	0	1	0	1	1	1	0	1	1

SERVICE SHEET BD4 (cont'd)

   If all the levels are as indicated, there is a problem on the mother board between A2A9 and A3A5.

   If any of the levels are not as indicated, the problem is in A2A9. Proceed to Service Sheet 29 to isolate the problem.

YTO Driver Check (unlocked) (✓3)

7. Connect the DVM to A3A6TP2 and set the Signal Generator to 2.000 GHz and then to 6.599 GHz and record the DVM indication for each frequency.

   The voltages should be as follows:
   2.0 GHz −37.5 Vdc±10%
   6.599 GHz −32.0Vdc±10%

   If the voltages are correct, the YTO Assembly or the directional coupler is defective. Proceed to Service Sheet 13 for troubleshooting.

   If the voltages are not correct, the YTO Driver Assembly is defective or requires adjustment. Perform the YTO Driver Adjustments in Section V. If A3A6 cannot be properly adjusted, proceed to Service Sheet 10 for troubleshooting.

Sampler Input Check (✓4)

8. Disconnect semirigid coaxial cable A3A9W2 from attenuator A3A9A6 (TPB) and connect the frequency counter in its place.

   The frequency should be within ±20 MHz of the frequency displayed on the front panel.

   If the frequency is correct, proceed with Step 9.

   If frequency is not correct, either directional coupler A3A9A1, low pass filter A3A9A7 or attenuator A3A9A6 is defective. Proceed to Service Sheet 13 to troubleshoot.

Sampler Output Check (✓5)

9. Reconnect A3A9W2, then disconnect the black cable (A3A9W4) from A3A9J2 (TPE) and connect the counter in its place. Press RCL 0.

   The frequency should be greater than 30 MHz.

   If the frequency is correct, replace the black cable and proceed with Step 11.

   If the frequency is not correct, proceed with Step 10.

10. Disconnect the white/orange cable from M/N IN connector A3A9J5 (TPC) and connect the cable to the counter.

   The frequency should be 189.375 MHz±1 count. If the frequency is correct, the Sampler Assembly is faulty. Go to Service Sheet 11 for troubleshooting.

RF Phase Locked Loops BLock Diagram SERVICE SHEET BD3

SERVICE SHEET BD4 (cont'd)

   If the frequency is not correct, the M/N Loop is defective. Go to BD3 for troubleshooting.

11. Disconnect the green cable from 20—30 MHz connector A3A9J3 (TPD), and connect the cable to the counter.

   The frequency should be 30.000 MHz±1 count.

   If the frequency is correct, leave the green cable disconnected and continue with Step 12.

   If the frequency is not correct, the LFS Loop is defective. Proceed to BD3 for troubleshooting.

YTO Phase Detector Check (✓6)

12. Remove ground from A3A6TP1 and connect DVM to A3A7TP2.

   The voltage should be greater than +5V.

   If the voltage is correct, continue with Step 13.

   If the voltage is not correct, A3A9A4 is defective, proceed to Service Sheet 12 for troubleshooting.

13. Disconnect the black cable from A3A9J1 and recheck the DVM indication.

   The voltage should be less than −5V.

   If the voltage is correct, proceed with Step 14.

   If the voltage is not correct, A3A9A4 is defective, proceed to Service Sheet 12 for troubleshooting.

Coil Driver Check (✓7)

Initial Conditions: Green cable disconnected from A3A9J3 (TPD); black cable disconnected from A3A9J1 (TPE)

14. Connect DVM to A3A6TP1.

   The voltage should be less than −5.3V. If the voltage is correct, proceed with Step 15.

   If the voltage is not correct, the phase lock amplifier of A3A7 is defective. Proceed to Service Sheet 13 for troubleshooting.

15. Reconnect the black cable to A3A9J1 (TPE) and recheck the DVM indication.

   The voltage should be greater than 6.7V.

   If the voltage is correct, proceed with Step 16.

   If the voltage is not correct, the phase lock amplifier of A3A7 is defective. Proceed to Service Sheet 13 for troubleshooting.

YTO Driver Check (locked) (✓8)

Initial Conditions: Green cable disconnected from A3A9J3 (TPD); black cable connected to A3A9J1 (TPE).

15. Connect DVM to A3A6 TP2. Reconnect the green cable to A3A9J3 and record the DVM indication. Disconnect the green cable from A3A9J3 and record the new DVM indication.

   The DVM indication should increase by about 0.02 volts when the cable is removed.

   If the voltage change is correct, reconnect the green cable to A3A9J3 (TPD), disconnect the black cable from A3A9J3 (TPE) and proceed with Step 16.

   If the voltage change is not correct, A3A6 is defective or requires readjustment. Perform the YTO Driver Adjustment procedure in Section V. If A3A6 cannot be adjusted, proceed to Service Sheet 10 for troubleshooting.

16. Connect the DVM to A3A6TP2. Reconnect the black cable to A3A9J3 (TPE) and record the DVM indication. Disconnect the black cable from A3A9J3 (TPE) and record the new DVM indication.

   The DVM indication should decrease by about 0.02 volts when the cable is removed.

   If the voltage change is as indicated, replace the black cable and proceed with FM Checks beginning with Step 17.

   If the voltage change is not as indicated, A3A6 is defective or requires readjustment. Perform the YTO Driver Adjustment procedure in Section V. If A3A6 cannot be adjusted, proceed to Service Sheet 10 for troubleshooting.

FM Checks.

FM Amplifier Check (✓9)

17. On front panel press RCL 0 and set FM deviation to 10 MHz.

18. Connect the test equipment as shown in Figure 8-29.

19. Set the test oscillator for 10 MHz at an output level of 0V.

SERVICE SHEET BD4 (cont'd)

20. Connect oscilloscope to A3A7TP5.

21. Adjust the Test Oscillator output level for 1V peak display on the oscilloscope.

    If the Test Oscillator output level cannot be adjusted to produce the indicated oscilloscope display, the FM amplifier in A1A6 is defective. Proceed to Service Sheet 21 for troubleshooting.

    Otherwise, continue with Step 22.

22. Press the following keys in sequence and check for the corresponding signal level on the oscilloscope:

KEYS	SIGNAL LEVEL
3	0.3 V peak
1	0.1 V peak
.3	0.03 V peak

If any or all of the above indications are incorrect, the gain control of the FM amplifier is defective. Proceed to Service Sheet 21 for troubleshooting.

Otherwise, continue with Step 23.

FM 40 Check (✓10)

23. Remove A1A5 and install it on an extender board. Connect the DVM to XA5-7 (TPF) and observe the voltage, then press the FM DEVIATION MHz .1 key.

    The voltage should jump from zero volts to +4.5 volts.

    If the voltage does not change as indicated, the logic latch or associated circuitry on A1A5 is defective. Go to Service Sheet 22.

    If the voltage does change as indicated, and if the indications in steps 21 and 22 are correct, the FM circuitry of A3A7 is at fault. Go to Service Sheet 13.

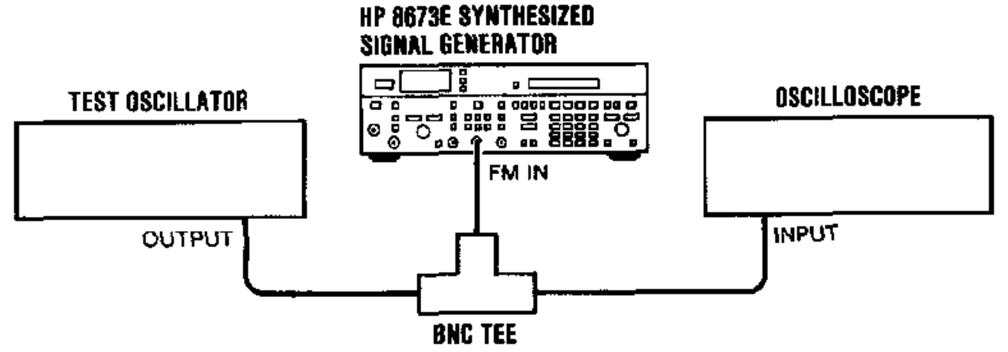
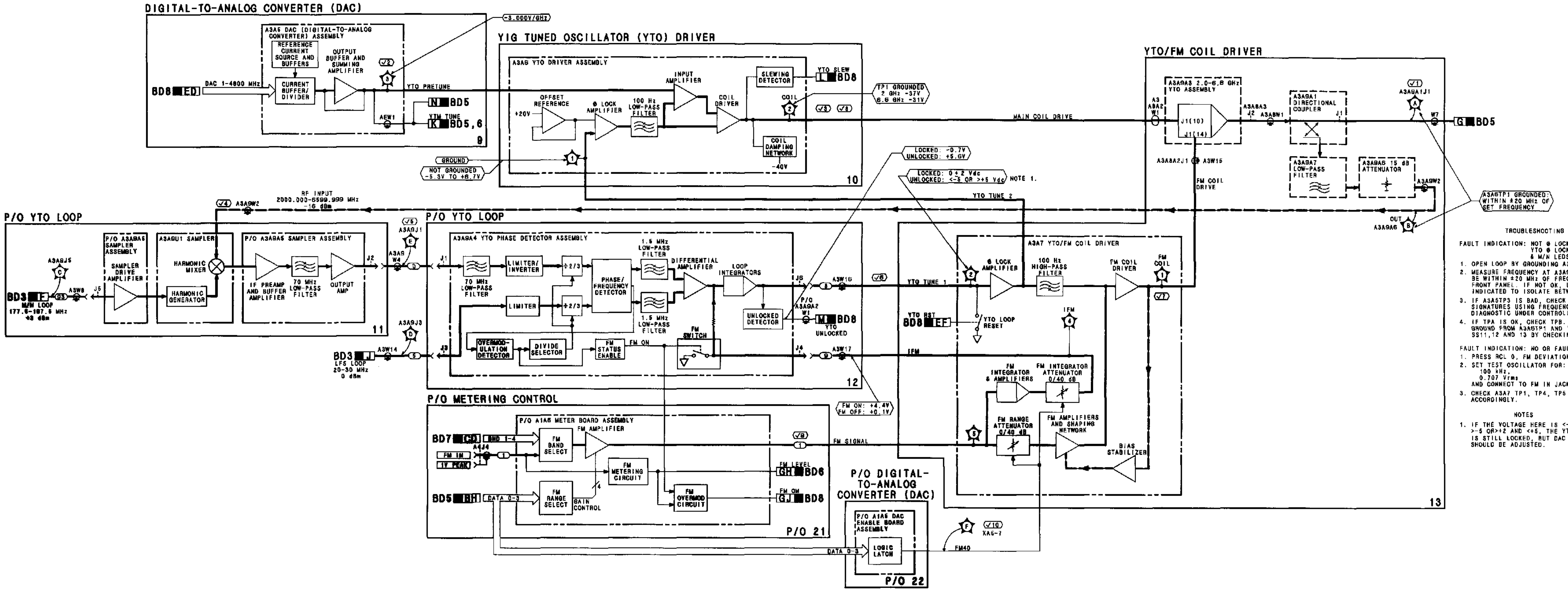


Figure 8-29. FM Amplifier Check, Initial Test Setup



TROUBLESHOOTING NOTES:

FAULT INDICATION: NOT Φ LOCKED ANNUNCIATOR ON
YTO Φ LOCK LED OFF (REF, LFS & M/N LEDS ON).

1. OPEN LOOP BY GROUNDING A3A6 TP1.
2. MEASURE FREQUENCY AT A3A9A1J1. SHOULD BE WITHIN ±20 MHz OF FREQUENCY SET ON FRONT PANEL. IF NOT OK, USE TEST POINTS INDICATED TO ISOLATE BETWEEN SS9,10 AND 13.
3. IF A3A5TP3 IS BAD, CHECK DAC 1-4800 SIGNATURES USING FREQUENCY OUTPUT DIAGNOSTIC UNDER CONTROLLER TROUBLESHOOTING.
4. IF TPA IS OK, CHECK TPB. IF OK, REMOVE GROUND FROM A3A6TP1 AND ISOLATE BETWEEN SS11,12 AND 13 BY CHECKING TEST POINTS.

FAULT INDICATION: NO OR FAULTY FM.

1. PRESS RCL 0, FM DEVIATION MHz .1
2. SET TEST OSCILLATOR FOR:
   100 kHz,
   0.707 Vrms
   AND CONNECT TO FM IN JACK.
3. CHECK A3A7 TP1, TP4, TP5 AND ISOLATE FAULT ACCORDINGLY.

NOTES

1. IF THE VOLTAGE HERE IS <-2 AND >-5 OR>+2 AND <+5, THE YTO IS STILL LOCKED, BUT DAC A3A5 SHOULD BE ADJUSTED.

BD4

Figure 8-30. HP 8673E YTO Summing Loop, Block Diagram

SERVICE SHEET BD5

MICROWAVE SIGNAL PATH

REFERENCES

PRINCIPLES OF OPERATION

General

The Microwave Signal Path multiplies the 2—6.6 GHz YTO output to 2—18 GHz.

The Microwave Signal Path is functionally divided into the following assemblies

- ALC Modulator, part of the Detector/ALC Assembly, Service Sheet 14
- Pulse Modulator, part of the Pulse Driver Processing Assembly, Service Sheet 15
- Peaker Digital to Analog Converter (DAC), part of the DAC and Enable Assembly, Service Sheet 22
- Step Recovery Diode (SRD) Assembly, Service Sheet 19
- YIG Tuned Multiplier (YTM) Driver Assembly, Service Sheet 16
- Detector Amplifier Circuits Assembly, Service Sheet 17
- Attenuator Driver Assembly, Service Sheet 18

The ALC modulator is driven by the ALC circuits to maintain the RF output signal at a constant level. This is discussed more fully under ALC operation, Service Sheet BD6.

The Pulse Modulator is driven by the pulse modulation circuits to pulse modulate the RF signal. This is discussed more fully under pulse modulation operation, Service Sheet BD7.

The Peaker DAC is used by the DCU to peak the YTM output signal for optimum performance. The YTMs YIG filter is adjusted so that the RF signal is centered in the passband of the filter to maximize available power and minimize the effects of the narrow passband on modulation.

Step Recovery Diode Control changes the SRD bias of the YTM Assembly, under DCU control, to adjust for different bias requirements at different frequencies.

In band 1, the step recovery diode (SRD) is forward biased to a low impedance to allow the input signal to pass through the filter. No significant harmonic generation occurs. In the multiplying bands (2—3) the SRD is biased to act as a charge controlled switch. This biasing produces a very narrow, harmonically rich pulse when the diode switches from forward to reverse bias. The pulse width is determined by the circuit inductance and the diode capacitance. Narrow pulsewidths of 40 ps are required to obtain high conversion efficiency to 18.0 GHz. The proper timing of the switching action is controlled by the dc voltage bias level. The YIG tuned filter in the YTM selects the desired harmonic from the harmonically rich pulse to recover the desired multiple of the input frequency.

SERVICE SHEET BD5 (cont'd)

Optimum RF conversion efficiency requires that the appropriate dc bias levels be established for the SRD. These bias levels are achieved using a variable resistance FET to control the self bias conditions of the SRD. A blocking capacitor prevents the dc current from flowing through the driving source. The resistance of the FET is controlled by varying the gate voltage.

The Step Recovery Diode Control assembly also provides, under DCU control, frequency band adjustment signals to the YIG Driver Board.

YIG Tuned Multiplier

The YIG Tuned Multiplier (YTM) is a broadband multiplier with an input frequency range of 2.0 to 6.625 GHz and an output frequency range of 2.0 to 18.0 GHz. This range is divided into three bands which correspond to the frequency multiplication factors of 1 through 3. The three bands and their input and output frequency ranges are listed in Table 8-12.

Table 8-12. Band Numbers and Frequencies

Band	Input Frequency Range (GHz)	Output Frequency Range (GHz)
1	2.0 to 6.6	2.0 to 6.6
2	>3.3 to 6.15	>6.6 to 12.3
3	>4.1 to 6.2	>12.3 to 18.6

The YTM is a standard step recovery diode (SRD) multiplier that produces a harmonic rich comb spectrum (see Figure 8-31). The input frequency from the YIG tuned oscillator (YTO) is tunable. The output frequency is chosen by selecting a single harmonic component through the YIG filter. The multiplier is inherently broadband in that the comb spectrum, generated by the SRD, extends from the input frequency to an upper limit above 30 GHz. The required output frequency is obtained by tuning the YIG filter to a specific harmonic. The YIG filter suppresses all other frequencies. An input low pass filter prevents the output signal from being absorbed by the driving source.

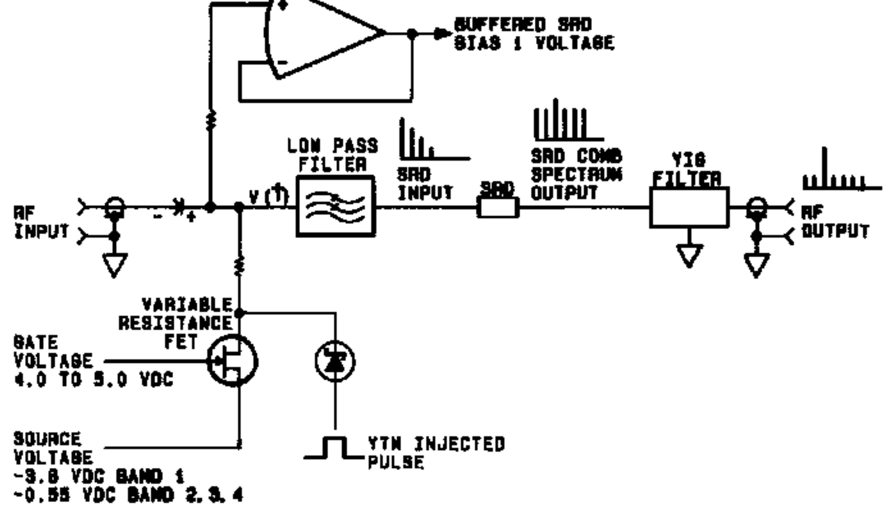


Figure 8-31. YTM Simplified Block Diagram

SERVICE SHEET BD5 (cont'd)

The Attenuator Driver Assembly decodes inputs from the DCU to control the output attenuator. The signals from the DCU are based on the front panel RANGE settings.

TROUBLESHOOTING

General

It is assumed that the troubleshooting procedures associated with BD1 have been used to isolate a problem to the Microwave Signal Path, illustrated on BD5.

The following procedure is designed to:

1. Check the microwave signal path of the Signal Generator, and
2. Isolate any problems encountered.

Some of the following steps may be skipped, but only if you have experience with the HP 8673E, and with these procedures. For anyone lacking this experience, all steps should be performed.

Troubleshooting

Power Meter	HP 436A
Digital Voltmeter	HP 3456A
Oscilloscope	HP 1980B
HP 8673E Adjustment Cassette	HP 11726—10002 REV B or higher
HP-IB Controller	HP 85B/82937A/82936A/ 00085-15002, 4, 5

Troubleshooting Hints

Squegging. Squegging is an unstable YTM output caused by too much power being applied to the YTF input. See Figure 8-32 for an example of squegging. This condition can occur in Band 1 because the RF signal itself (rather than some harmonic of the RF signal) is applied to the YTF. To prevent squegging in Band 1, the RF signal is clamped to a safe power level before it is applied to the YTF. Thererefore, if squegging occurs, first try to readjust the clamp circuit.

Programmable Attenuator. When the power plots are run using the HP 8673E adjustment cassette, the programmable attenuator is set for zero attenuation. Therefore, if you seem to be having power problems but the plots are normal, suspect the programmable attenuator.

Troubleshooting Procedure

The troubleshooting procedure is divided into the following checks:

Baseband Power Check ⟨√1⟩
YTM Output Power Check ⟨√2⟩
Final Output Power Check ⟨√3⟩
Programmable Attenuator Check ⟨√4⟩

SERVICE SHEET BD5 (cont'd)

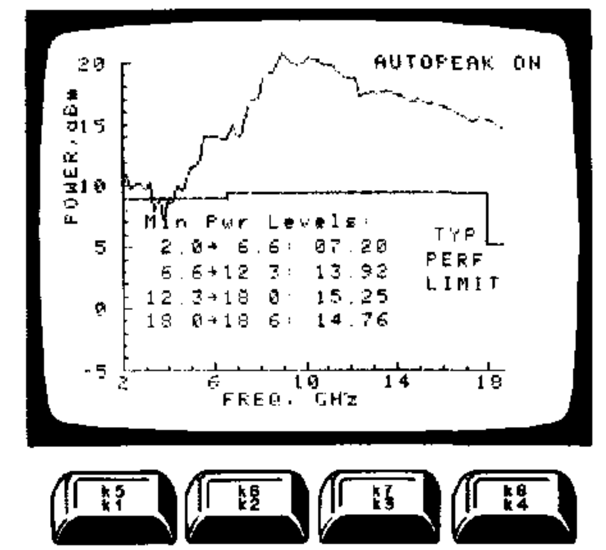


Figure 8-32. Squegging

If a check is faulty, procedures are provided to isolate the problem to a service sheet.

Baseband Power Check. ⟨√1⟩

NOTE

The maximum power plot described under YTM Output Power Check ⟨√2⟩ can be used in this check also.

1. Remove cable A1W4 from A1FL1 (See Figure 8-33).
2. Connect power meter to the output of A1FL1.
3. Set the Signal Generator frequency to 2.000000 GHz and the frequency increment to 100 MHz.
4. Tune from 2.0 to 6.59999 GHz while observing the power meter.

   Power should not drop below +11.5 dBm at any frequency.

   If the power is good proceed with Step 10, YTM Output Power Check.

   If the power is not good proceed with Step 5.
5. To measure power at TPB, remove cable A1W11 from Bias Tee A1CP1, See Figure 8-33, (removal of the cable can be facilitated by first removing circuit boards A1A7 and A1A8).
6. Connect cable to power meter.
7. Tune from 2.0 to 6.59999 GHz while observing power meter.

   The power should not drop below +12 dBm for any frequency.

   If the power is as indicated, the problem is in the Bias Tee, Pulse Modulator or Filter; go to Service Sheet 15.

   If the power is not as indicated, proceed with Step 8.

YTO Loop Block Diagram SERVICE SHEET BD4

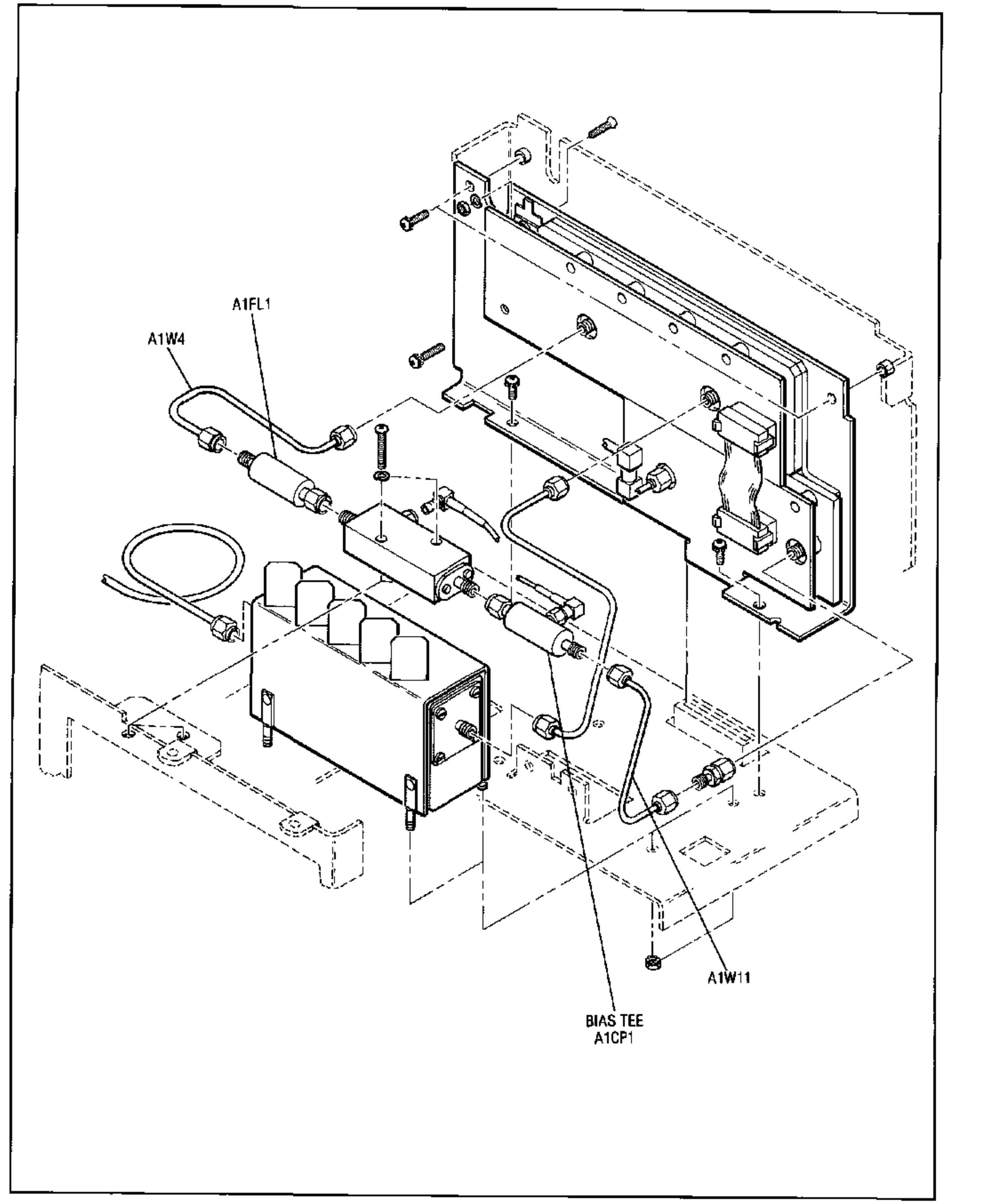


Figure 8-33. Pulse/YTM Driver Assembly Parts Locations

SERVICE SHEET BD5 (cont'd)

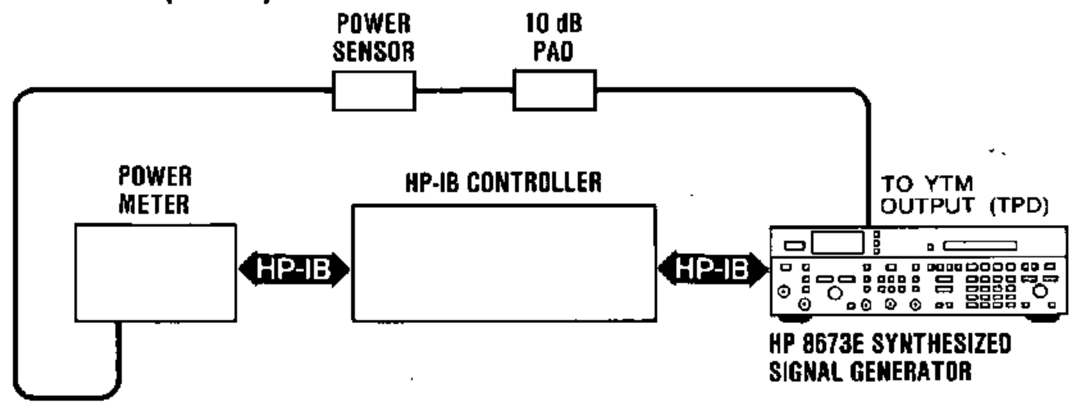


Figure 8-34. YTM Power Output Power Check Test Setup

8. To check power at TPA, remove cable W7 from the OUTPUT connector of directional coupler A3A9A1 and connect the power meter in its place.
9. Tune from 2.0 to 6.5999 GHz while observing the power meter.

   The power should not drop below +10 dBm for any frequency.

   If the power is OK, Detector/ALC Assembly A1A2 is defective, go to Service Sheet 14.

   If the power is low at any frequency, the YTO is defective, go to Service Sheet 13.

YTM Output Power Check (✓2)

10. To measure power at TPD, connect the equipment as shown in Figure 8-34.
11. To connect the power sensor to the YTM Output, remove the cable from the YTM Output and connect the 10 dB pad to the YTM output. Then connect the cable from the power sensor to the 10 dB pad.
12. Place the HP 8673A/B Adjustment cassette into the HP-IB controller then load and run "EXEC"
13. Select MAX POWER & OTHER UTILITIES then MAX POWER TEST.
14. Run a 2 to 18.0 GHz power plot.

    Compare the plot against the plot shown in Figure 8-35. For frequencies above 6.6 GHz the power should match the plot in the figure.

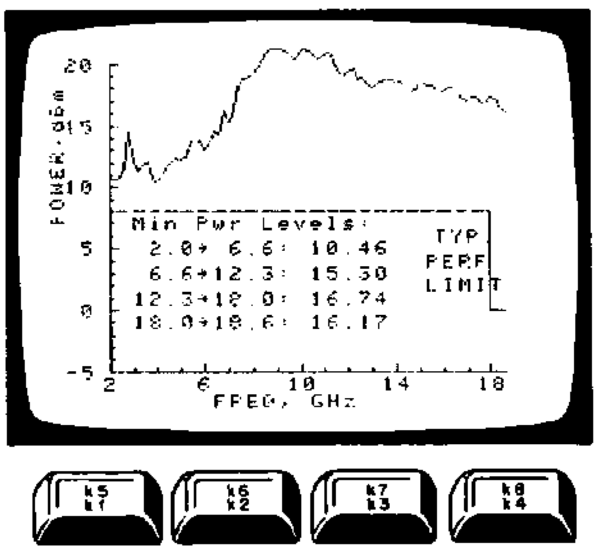


Figure 8-35. YTM Power Output Plot

SERVICE SHEET BD5 (cont'd)

If the power is above the typical limits shown on the plot, proceed with Final Output Power check beginning with Step 22.

If the power is below the typical limit at any or all frequencies, proceed with SRD Bias Board checks beginning with Step 15.

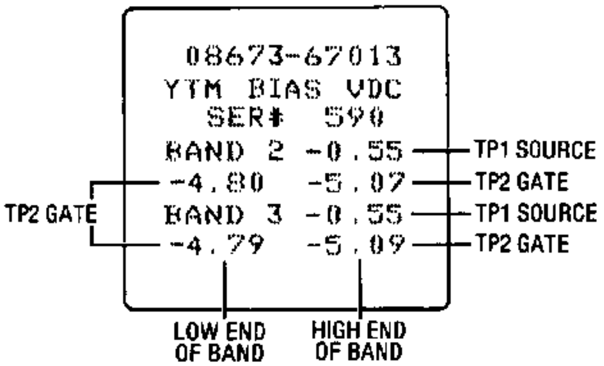
SRD Bias Board Checks (✓2a) (✓2b)

In the following steps the inputs and outputs of SRD Bias Board A1A8 are checked.

15. Refer to the SRD BIAS label on the front of the A2 bulkhead (See Figure 8-36). Using a DVM, check the voltages at test points 1 and 2 of A1A8 against this label. On the label, the voltage listed to the right of the band number is the source bias voltage (TP1) which does not vary across the band. The voltage below the band number is the Gate Bias voltage at the low end of the band, and the remaining voltage is the Gate Bias voltage at the high end of the band.

    If the voltages are not as shown on the label, ±1mV, proceed to Section V and attempt to adjust them.

    If they cannot be adjusted, proceed to Service Sheet 19 to isolate the problem on the SRD Bias Board. Otherwise, proceed with Step 16.



NOTE
If only two digits are printed to the right of the decimal point (as in −4.80), the unprinted third digit is zero (thus, −4.800).

Figure 8-36. YTM Bias Label

16. Remove SRD Bias Board A1A8 and replace it on a 36 pin extender card. Using a DVM, measure the voltages at TPF (XA8 pins 17, 18, and 35) for bands 2 and 3.

    The indication should be as shown in Table 8-13.

Table 8-13. SRD Bias Voltages

Signal	XA8-	Band		
		1	2	34
G2	17	L	H	L
G3	18	L	L	H

L≈−29V
H≈−1V

If any indication is abnormal, proceed to Service Sheet 19 to isolate the problem.

Otherwise, proceed with Step 17.

17. Connect DVM to TPK (XA8-10).

18. Set the Signal Generator to the following frequencies and check for the corresponding voltage.

Frequency (GHZ)	Voltage
2.0	−6 ±0.1V
4.0	−12 ±0.1V
6.0	−18 ±0.1V

If the voltages are incorrect there is a problem with the digital to analog converter. Go to Service Sheet 9.

If this and all previous measurements on A1A8 are correct, A1A8 is functioning normally. Proceed with Peaker DAC check beginning with step 19.

Peaker DAC Check.

19. On Microprocessor Board A2A8 set diagnostic switch to position 5, and install the MPU Test Board (P/N 11726-60001) on the top of Microprocessor Board A2A8.

20. Install a shorting clip between A2A8TP5 and A2A8TPGND.

CAUTION

Do not leave the Signal Generator in this mode for more than a few minutes at a time. To do so would cause excessive wear to several relays that are heavily exercised in this mode.

21. Connect oscilloscope to TP4 on A1A5.

SERVICE SHEET BD5 (cont'd)

The oscilloscope display should show a waveform similar to the one in Figure 8-39.

If the waveform is incorrect, there is a problem with the DAC & Enable board. Go to Service Sheet 22.

If the waveform is correct and if all of SRD Bias Board A1A8 checks were correct, the problem is with power amplifier A1A11, Isolator A1A12, YTM assembly A1A10 or YIG Driver Board A1A7. Proceed to Service Sheet 16 to isolate the problem.

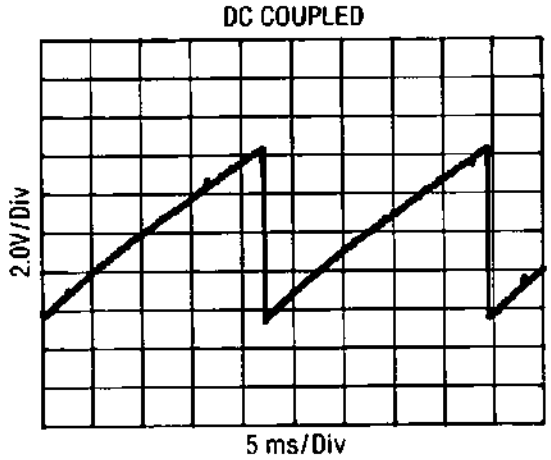


Figure 8-37. Peaker DAC Ramp Output

Final Output Power Check (✓3)

This procedure checks for problems in the directional coupler. A power plot from 2 to 18 GHz is run to isolate between the directional coupler and the programmable attenuator.

22. Connect equipment as shown in Figure 8-38.

23. With the HP 8673A/B Adjustment Cassette still installed, (see Step 12) run a 2 to 18 GHz power plot, then compare the plot to the one shown in Figure 8-39.

    If the plot just run is substantially the same as that shown in Figure 8-39, the Programmable Attenuator is faulty. Proceed to Service Sheet 18 to isolate the problem.

    If the plot just run is not substantially the same as that in Figure 8-39 (the power drops below the spec line at one or more points) the directional coupler is attenuating the signal.

Programmable Output Attenuator Check (✓4)

All the power plots run through the HP-IB controller set this attenuator for zero attenuation. Therefore, if you seem to be having power problems but the plots are OK, it is possible that the programmable attenuator is defective. To thoroughly check this attenuator perform the Low Level accuracy portion of the OUTPUT LEVEL test in Performance Tests in Section IV.

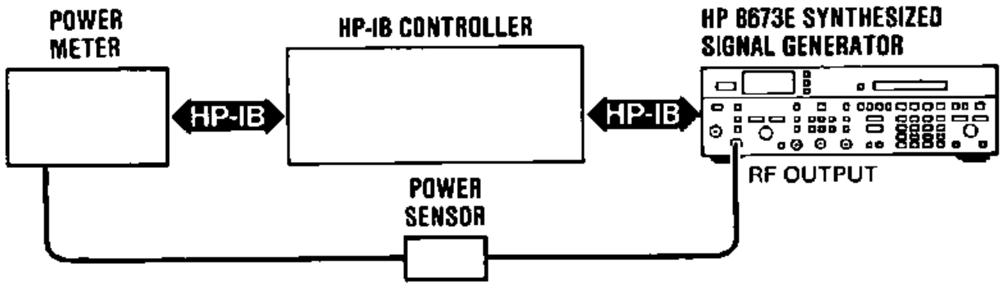


Figure 8-38. Final Output Power Check Test Setup

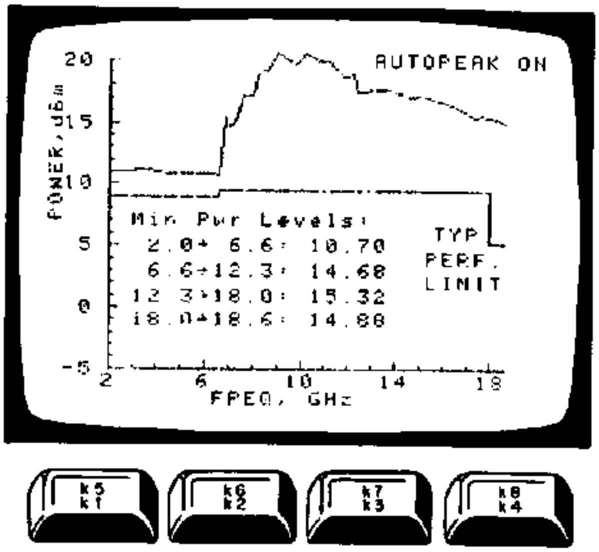
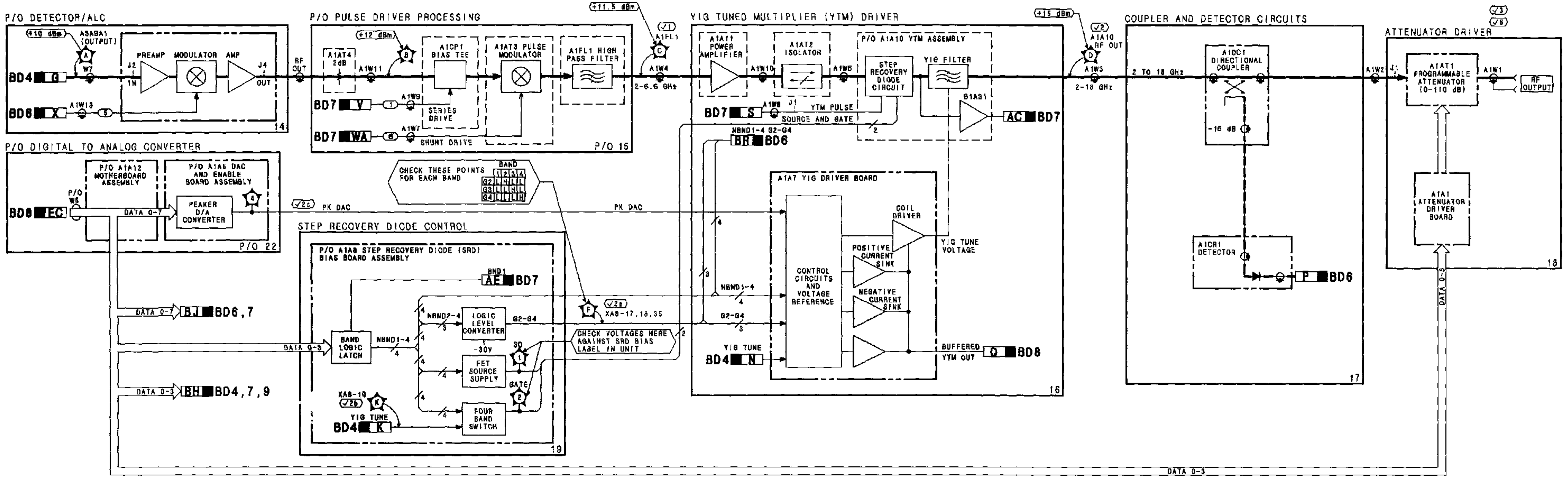


Figure 8-39. Power Output Plot



TROUBLESHOOTING NOTES:

FAULT INDICATION: NO OR LOW POWER, ALL BANDS.
1. MEASURE POWER AT TEST POINTS IN MICROWAVE CHAIN UNTIL LOW POWER IS FOUND.
2. IF POWER LOW AT TPD (OK AT TPA, B, AND C), CHECK A1A8 TP1 AND TP2 AND TPF TO ISOLATE BETWEEN SERVICE SHEETS 19 AND 16.

FAULT INDICATION: NO OR LOW POWER CERTAIN BAND(S) ONLY
1. CHECK A1A8 TEST POINTS FIRST. IF THEY ARE OK, GO TO SERVICE SHEET 16.

FAULT INDICATION: AUTO PEAK DOES NOT WORK.
1. CHECK OPERATION OF PEAKER DAC (A1A5 IF PROBLEM IS >2 GHz, A5A5 IF <2 GHz).

BD5

Figure 8-40. HP 8673E Microwave Signal Path, Block Diagram

SERVICE SHEET BD6
ALC LOOP

REFERENCES

PRINCIPLES OF OPERATION

The primary functions of the ALC loop are to provide accurately calibrated output power and wideband linear AM capability. In addition, an extenal ALC input makes it possible to level the power actually delivered to a remote load.

To accurately control the output power of the Signal Generator in the internal ALC mode, a portion of the RF output is fed to the detector by means of a broad band directional coupler. The logarithmically amplified detector output is summed with the reference voltage at the ALC summing junction. The summing junction is the input to the integrator. The output of the integrator is routed through an exponentiator and applied to the ALC modulator to control the RF output power. The AM signal is summed into the summing junction during AM operation.

During internal ALC operation in the local mode, the active inputs to the Reference Amplifier on ALC Board A1A2A1 are:

- F Correct
- ALC reference

The F Correct input compensates for the variations of RF power with increasing frequency due to losses in the detector, the coupler, the attenuator and connecting hardware.

The ALC Reference input is the reference voltage from the front panel VERNIER control. The output of the Reference amplifier is summed with the other active inputs at the ALC summing junction.

The detector output is directly proportional to the output power in watts. To make the detector output proportional to output power in dB, the detector output is routed through a logarithmic amplifier prior to being applied to the ALC summing junction. This conversion provides a linear reference voltage to control power out in dB.

During AM operation the AM input signal is routed through a log amplifier prior to being applied to the ALC summing junction. This provides linear, calibrated AM independent of RF output level and modulation depth.

External ALC operation is essentially the same as internal ALC. Note, however that the EXT ALC signal is routed through an absolute value amplifier prior to being applied to the log amplifier. The output of this amplifier is negative regardless of the input polarity. This allows any type of external reference, regardless of polarity, to be used and still get the necessary negative input required by the ALC circuitry.

SERVICE SHEET BD6 (cont'd)

In external ALC, the detector output is ac coupled into the external ALC summing junction. This serves the dual function of speeding up the external ALC response and of stabilizing the external ALC loop. When operating in band 1 in external ALC, a clamp circuit limits the power applied to the YTM to prevent spurious response.

TROUBLESHOOTING

General

It is assumed that the troubleshooting procedures associated with BD1 and BD5 have been used to isolate a problem to the ALC circuits on BD6. The following procedures can be used to further isolate the problem to one of the following assemblies.

DAC and Enable Board Assembly—Service Sheet 22
Function Board Assembly—Service Sheet 20
YIG Driver Board Assembly—Service Sheet 16
SRD Bias Board Assembly—Service Sheet 19
ALC Board Assembly—Service Sheet 14
Detector Board Assembly—Service Sheet 17

Test Equipment

Oscilloscope .... HP 1980B
Digital Voltmeter (DVM) .... HP 3456A
Test Oscillator .... HP 3335A
Variable Power Supply .... HP 6200B
Power Meter .... HP 436A
Power Sensor .... HP 8481A

Troubleshooting Procedure

The following troubleshooting procedure is divided into the following checks:

F CORRECT Check (✓1)
ALC Reference Check (✓2)
Detector Check (✓3)
ALC Modulator Drive Check (✓4)
LVL Meter Check (✓5)

Troubleshooting Hints

AM and External ALC Problems

If the unit has AM or external ALC problems, and the internal ALC circuits are working properly (see ALC Key Check (✓9), Step 17 and Output Level Check (✓7), of BD1) the problem is with Function Board A1A3, Service Sheet 20.

ALC in Remote Mode. If the ALC reference level cannot be controlled in remote mode (but works normally in local mode) the problem is with the Level Control DAC, Local/Remote Switch, or the Level Comparator on the DAC & Enable Board, Service Sheet 22.

Level Meter. If the ALC and AM circuits seem to be working normally, but the level meter does not track the VERNIER control and/or does not track AM input level changes, proceed directly to the Level Meter Checks beginning with Step 15.

Internal ALC Checks

This procedure first checks the F CORRECT and ALC REF inputs to the ALC Board and provides troubleshooting procedures to isolate any problems encountered.

Next the ALC loop feedback is removed by disconnecting the detector from the Detector Board input. A variable DC voltage is then applied to this input. TPB and TPC are then checked to isolate the problem to the Detector Board, the ALC Board or the ALC/AM Modulator.

F CORRECT Checks. (✓1)

1. Remove A1A8 and replace it on a 36 pin extender card. Set the Signal Generator frequency to 2.0 GHz, and then to 6.5 GHz. Check the voltage at XA8-15 (TPA) at each frequency.

   The voltages should be as shown below:

Frequency	Voltage
2.0 GHz	−0.003 ±0.002V
6.5 GHz	+0.2 ±0.1V

   If the voltages are correct, proceed with Step 3.

   If the voltages are not correct, proceed with Step 2.

2. Connect the DVM to A1A7TP2 and set the Signal Generator frequency to 2.0 GHz then to 6.5 GHz and observe the voltage at each frequency.

   The voltages should be as shown below.

Frequency	Voltage
2.0 GHz	−1.8V
6.5 GHz	−3.5V

   If the voltages are as shown, A1A8 is at fault, proceed to Service Sheet 19 to isolate the problem.

   If the voltages are not as shown, A1A7 is at fault, proceed to Service Sheet 16 to isolate the problem.

ALC Reference Checks. (✓2)

A. Local ALC Reference Check

3. Connect the DVM to A1A5TP10, ALC REF, and turn the Vernier control fully CW then fully CCW while observing the DVM.

   The voltages should be as follows:

Vernier Position	Voltage
fully CW	0.0V
fully CCW	−7.5V (typical)

   If the voltages are as shown, A1A5 is working normally, proceed with Step 4.

   If the voltages are not as shown, proceed with Step 5.

B. Remote ALC Reference Check

4. Connect the DVM to A1A5TP8 and turn the Vernier control fully CW then fully CCW while observing the DVM.

   The voltages should be as follows:

Vernier Position	Voltage
fully CW	0.0V
fully CCW	+ 5.8 (typical)

   If the voltages are as shown, A1A5 is working normally, proceed with Step 6.

   If the voltages are not as shown, proceed with Step 5.

5. Connect the signature analyzer as directed in paragraphs 5 and 6, DAC and Enable Board A1A5 Test of BD8. Verify the signatures of the input signals NSTRB, address lines BA0—3, data lines DATA0—7 as shown in Table 8-40 of BD8.

   If the signatures are not correct, go to BD8 for troubleshooting.

   If the signatures are correct, A1A5 is defective. Go to Service Sheet 22 for troubleshooting.

Detector Checks (✓3)

6. Remove Detector/ALC Assembly A1A2, remove the cover from the back of A1A2A1 and replace the assembly.

7. If the ALC problem occurs at certain frequencies only, set the Signal Generator to one of these frequencies, otherwise set it to any frequency. Set the output power to 0 dBm or less.

8. Connect the DVM to the center conductor of A1A2A2J1 on the back of A1A2A2, then turn the VERNIER control fully counterclockwise.

   The voltage should be as indicated below:

Vernier Position	Voltage
CCW	0.002V
CW	0.033V

   If the voltage is as indicated in both cases, the coupler and detector are functioning normally, proceed with Step 11 to check Detector Board Assembly A1A2A2.

   If either of the voltages is not as indicated, proceed with Step 9 to isolate the problem.

9. With the Signal Generator still set to the frequency set in Step 7, remove cable A1W2 from the output of coupler A1DC1 and connect the power meter in its place. Record the power meter reading.

10. Remove Detector A1CR1 from the −16 dB port of the coupler and connect the power meter in its place. Do not reconnect A1W2 at this time.

    The power should be 16 dB below the power recorded in Step 9.

    If the power is correct, Detector A1CR1 is defective.

    If the power is not as indicated, coupler A1DC1 is defective.

11. Press RCL 0 and turn RF power off. Adjust A1A2A2R12 (INT OS) for a voltage reading at A1A2C6 (TPB) of −0.92V.

12. Remove detector A1CR1 from A1A2A2J1.

13. Set variable power supply to zero volts and connect the positive output to the center conductor of A1A2A2J1 and the negative output to ground.

14. Turn RF OUTPUT ON and turn VERNIER fully ccw.

15. Connect DVM to A1A2AC6 (TPB) and gradually increase the power supply output voltage while observing the DVM.

    The voltage at TPB should vary as shown below.

Power Supply Voltage	TPB Voltage
0.005	−0.09V
0.010	+0.01V
0.015	+0.07V
0.020	+0.10V

    If the voltages are correct, the Detector Board is operating normally, proceed with step 16.

    If the voltages are not correct, the A1A2A2 Detector Board is at fault. Proceed to Service Sheet 17 to isolate the problem.

ALC Modulator Drive Checks. (✓4)

16. Remove A1A2 and replace it on a 36 pin extender card.

SERVICE SHEET BD6 (cont'd)

17. Remove the cable from A1A2A1J1 (TPC) and connect a tee in its place.

18. Connect a 50 ohm load and the DVM to the remaining legs of the tee.

19. With the power supply still connected to A1A2A2J1, set the voltage to zero and gradually increase it. The voltage at TPC should vary as shown below:

Power Supply Voltage	TPC Voltage
0.000	<−3.0V
0.0075	≈+0.9V
0.0225	≈+9.0V

    If the voltages are correct, the ALC modulator is at fault. Replace it.

    If the voltages are not correct, Detector/ALC board A1A2A1 is at fault. Go to Service Sheet 14 to isolate the problem.

LVL and AM Meter Checks.

These procedures are used if the ALC circuitry seems to be working normally (eg. ALC UNLEVELED not on, output level varies with VERNIER) but the meter does not respond at all or responds improperly to the VERNIER control or to variations in AM input levels.

For LVL meter faults the problem could be one of the following:

Defective error amp on A1A2A1, Service Sheet 14
Defective meter level circuit on A1A3, Service Sheet 20
Defective FET switch on A1A6, Service Sheet 21

For AM meter faults the problem could be:

Defective AM metering circuit or FET switch on A1A6, Service Sheet 21

LVL Meter Checks. (✓5)

20. Remove A1A2 and replace it on a 36 pin extender board.

21. Connect DVM to A1A2A1TP5, and, while observing the DVM, press the front panel RF OUTPUT key to turn off its LED.

    The DVM should initially indicate +0.15 volts then drop to about −4.5 volts when RF OUTPUT is pressed, and immediately begin increasing toward zero volts.

    If the DVM indication is normal, proceed with Step 22.

    If the DVM indication is not normal, the Error Amplifier is defective. Go to Service Sheet 14 to isolate the problem.

(✓5a)

22. Remove A1A3 and replace it on a 44 pin extender board.

23. Connect the DVM to XA3-11 (TPN) and observe the DVM display while turning the VERNIER control from full CW to full CCW.

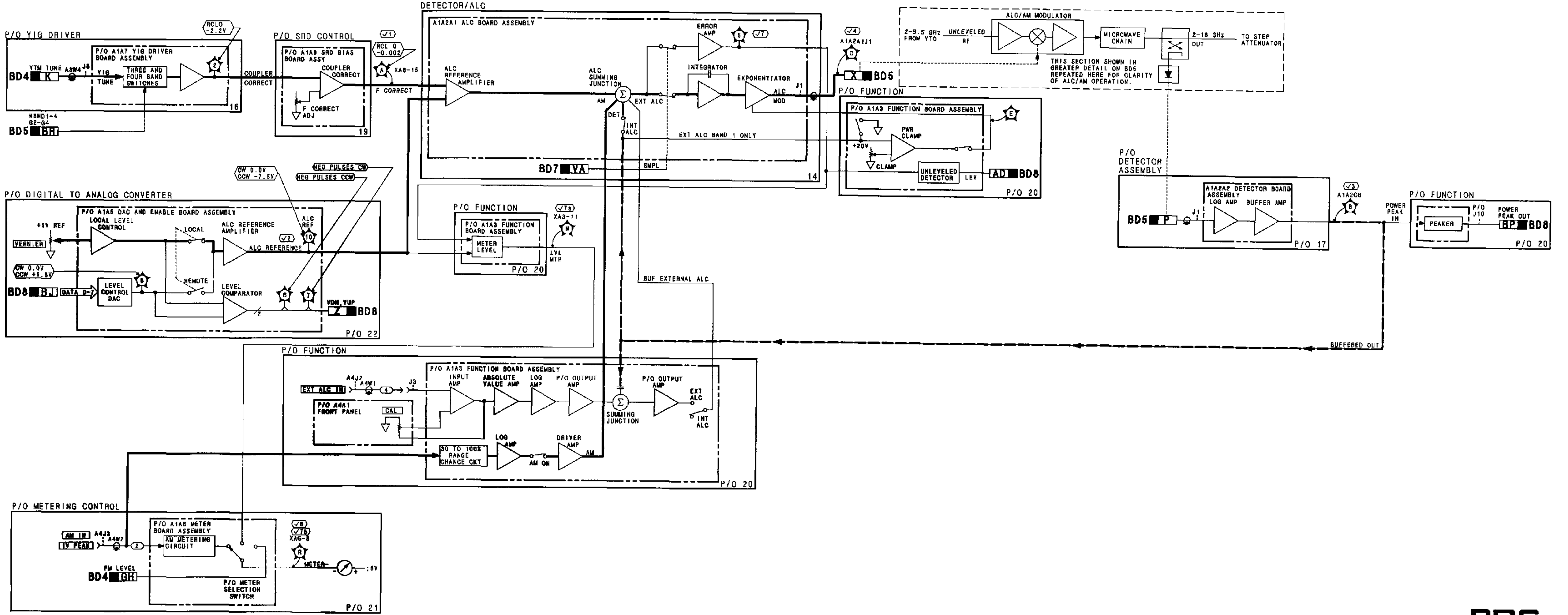
    The voltage at the two extreme points should be as follows:

Vernier	TPN Voltage
Fully CW	3.5V
Fully CCW	9.0V

    If the voltages are as indicated, A1A6 is defective; go to Service Sheet 21 to isolate the problem.

    If the voltages are not as indicated, the meter level circuit is defective, go to Service Sheet 20 to isolate the problem.

Microwave Signal Path
Block Diagram
SERVICE SHEET BD5



BD6

Figure 8-41. HP 8673E ALC Loop, Block Diagram

SERVICE SHEET BD7
PULSE MODULATION

REFERENCES

PRINCIPLES OF OPERATION

The pulse modulation circuits provide pulse modulation in the 2—18 GHz frequency range.

To achieve the typical risetime of <50 ns in bands 2—3, a YTM injected pulse is used to speed up the step recover diode self bias response time. Band 1 does not require the YTM injected pulse to meet this specification because the YTM internal step recovery diode is forward biased in this band.

The series and shunt pulse drivers on the Pulse Driver Processing board turn the RF signal on and off by controlling the series and shunt diodes in the pulse modulator. To turn the RF signal off, the shunt diodes in the pulse modulator are turned on and the series diode is turned off. In this configuration, the RF signal is directed to ground through a 50 ohm resistor and the shunt diodes. To turn the RF signal on, the shunt diodes are turned off and the series diode is turned on. In this configuration, the RF bypasses the 50 ohm resistor through the series diode and is routed through the modulator. The timing of the series and shunt pulses controlling the pulse modulator is critical.

The pulse driver board also generates the YTM injected pulse. This pulse is necessary because between RF pulses the step recovery diode loses part of its bias. If the RF pulse from the pulse modulator is applied to the YTM in this condition, the pulse risetime would suffer. The YTM injected pulse is applied to the step recovery diode 50 ns before the the RF pulse arrives. Thus the YTM is properly biased when the RF pulse arrives, and the pulse risetime is degraded only by the bandwidth of the YIG filter in the YTM.

The YTM injected pulse amplitude must be varied with changes in RF power and frequency. For example, the required amplitude can change significantly if the frequency is changed by more than 50 MHz or if the power is changed by 0.4 dB or more.

To maintain the correct amplitude of the YTM injected pulse, the controller compares the steady-state step recovery diode BIAS 1 voltage to the BIAS 2 voltage generated by the pulse amplitude control (PAC) DAC and adjusts the PAC DAC to make the two equal.

The output of the PAC DAC drives an amplifier that provides a slope and an offset voltage adjustment for each band. The dc output voltage of this amplifier controls the peak amplitude of the YTM injected pulse. The slope and offset adjustments are used to optimize the YTM pulse peak amplitude for bands 2 and 3 at all output vernier levels.

Also included in the pulse modulation system is an ALC sample and hold circuit. This circuit is used during pulse modulation (in conjunction with the ALC loop

SERVICE SHEET BD7 (cont'd)

previously discussed) to maintain the correct peak pulse power level. During each pulse, the sample gate driver turns the FET Sample Switches on. Thus, during pulse modulation operation, the ALC loop is operating only when the RF pulse is present. The integrating capacitor in the ALC integrator holds the proper dc leveling voltage during the time that the RF pulse is absent. The parameters of the sample gate pulse are adjusted for minimum error in pulse level accuracy. See Figure 8-42.

A minimum pulse width detector is included to light the ALC UNLEVELED annunciator if the pulse width is too narrow. The typical peak level accuracy at 100 ns pulse width is ±2 dB relative to the CW level. Pulse widths of less than 80 ns are available if unleveled power output is acceptable. The maximum pulse repetition frequency for specified level accuracy is 1 MHz.

TROUBLESHOOTING

General

It is assumed that the troubleshooting procedures associated with Service Sheets BD1 and BD5 were used to isolate the problem to the pulse modulation circuitry. The following procedures may be used to further isolate the problem to one of the following.

- A1 Pulse Driver Processing Assembly — Service Sheet 15
- DAC and Enable Assembly — Service Sheet 22
- SRD Control Assembly — Service Sheet 19
- Bias Tee/Pulse Modulator — Service Sheet 15

Troubleshooting Hints

Pulse modulation can be divided into two modes of operation, each with its own failure modes:

Band 1 (2—6.6 GHz). In this band, the frequency is not multiplied, therefore the SRD is forward biased and no YTM injection pulse is required. In this band there are three failure modes:

1. The Signal Generator works in CW mode but there is no pulse output. This indicates a complete failure in one of the pulse modulation circuits, probably the shunt pulse generator.
2. Inaccurate power levels. If the power level is correct in CW mode, the problem is most likely in the sample gate circuit or the sample and hold circuit on the ALC board.
3. Incorrect operation at minimum pulse width. Performing the adjustment procedures will usually correct this problem.

Bands 2—3 (6.6—18 GHz). In these bands the frequency is multiplied and the YTM injection pulse is critical to proper operation, especially at the high end of each band. There are four failure modes in these bands. The first three are the same as the Band 1 failure modes, the fourth is:

4. Poor pulse shape. This problem can usually be corrected by performing the pulse modulation adjustment procedures in

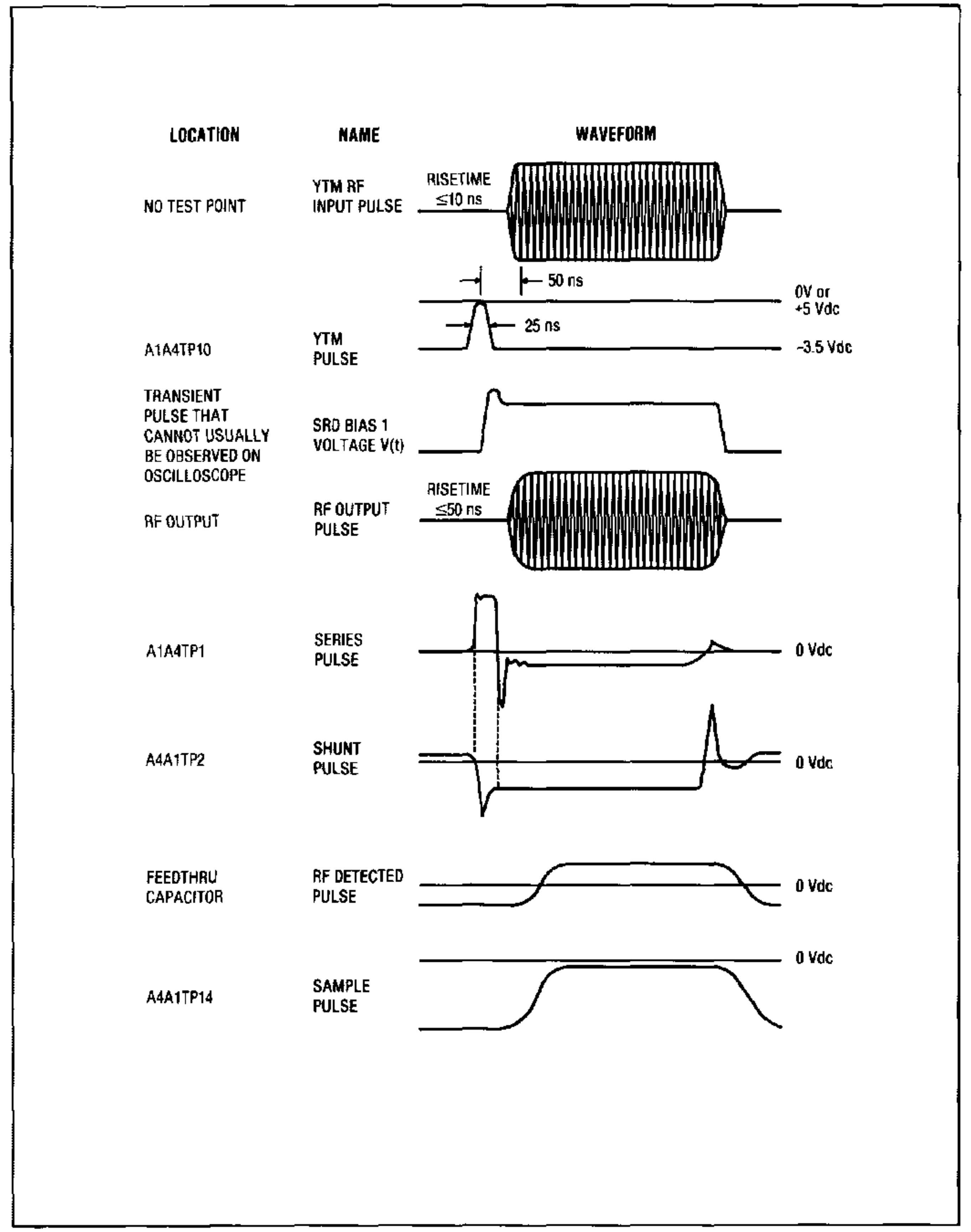


Figure 8-42. Pulse Modulation Waveforms

ALC Loop Block Diagram SERVICE SHEET BD6

SERVICE SHEET BD7 (cont'd)

Section V. If adjustment does not correct the problem, the YTM pulse circuitry must be checked.

Troubleshooting Procedures

The following procedure is divided into checks as follows:

Initial Checks

Band 1 Checks

- Shunt Pulse Check (√1)
- Series Pulse Check (√2)
- Bias Tee/Pulse Modulator Check (√3)
- Sample Gate Check (√4)
- Level Check (√5)

Band 2 and 3 Checks

- YTM Pulse Check (√6)
- PAC DAC Check (√7)
- PAC Check (√8)

Perform the initial checks first to determine the nature of the pulse modulation failure, then proceed to the indicated procedure.

SERVICE SHEET BD7 (cont'd)

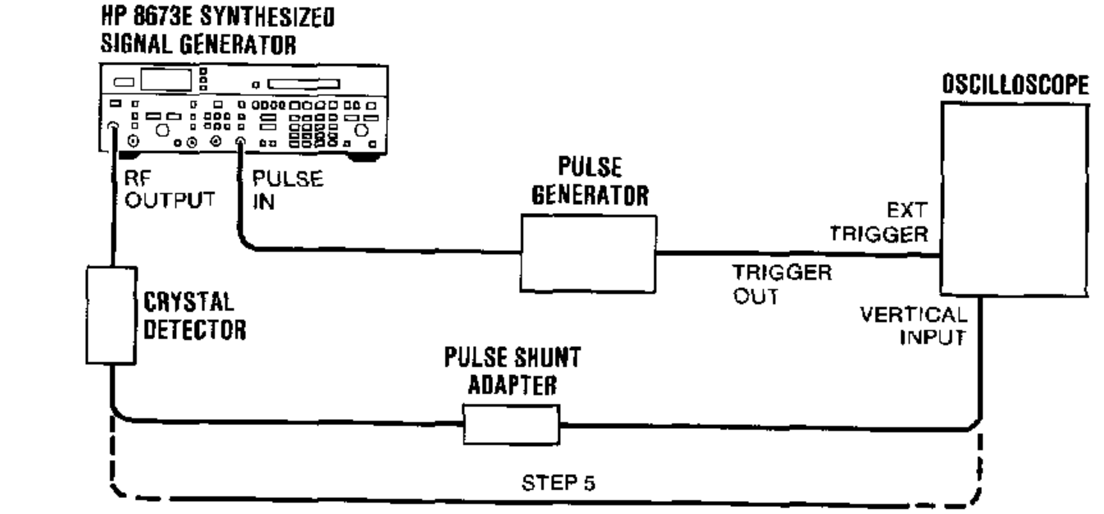


Figure 8-43. Pulse Modulation Initial Check Test Setup

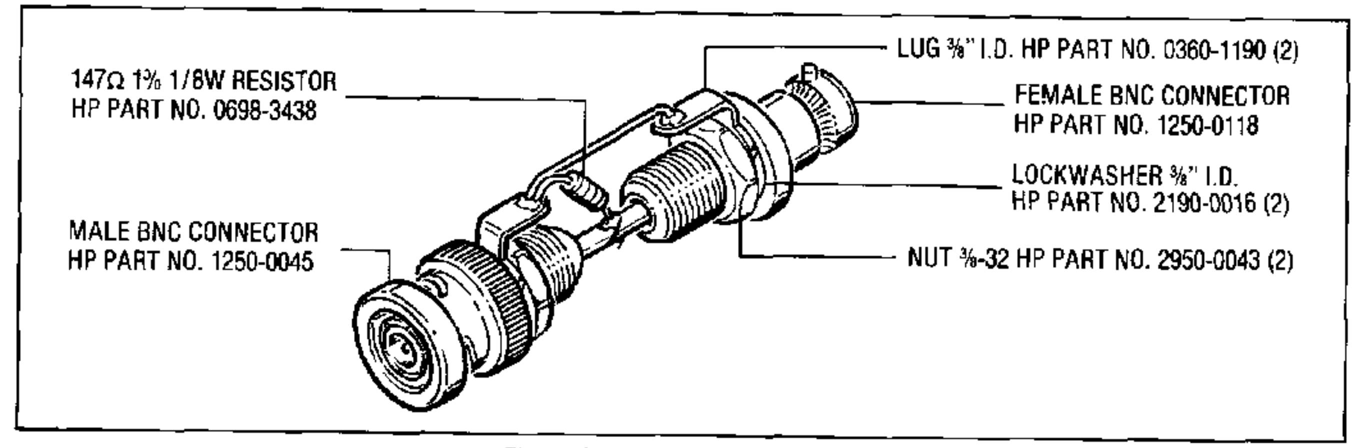


Figure 8-44. Pulse Shunt Adapter

Initial Checks. The purpose of these initial checks is to determine the failure mode of the unit under test. Once the failure mode is determined, the reader will be referred to the appropriate troubleshooting procedures.

1. Connect the equipment as shown in Figure 8-43. The shunt adapter can easily be fabricated using 2 BNC connectors and a 147 ohm resistor as shown in Figure 8-44.
2. Set the pulse generator for a 1 MHz pulse rate with a pulse width of 300 ns and pulse height of 3 volts peak. Set the variable attenuator for 10 dB attenuation.
3. On the Signal Generator press RCL O and PULSE NORM. Set Output Level to 0 dBm.
4. Observe the detected pulse on the oscilloscope.

   If the pulse is absent or seriously distorted, there is a problem with the shunt or series pulse circuits, go to (√1) Shunt Pulse Check and/or (√2) Series Pulse Check under Band 1 Checks.

   If the detected pulse looks good, go to Step 5.
5. Bypass the Pulse Shunt Adapter as shown in Figure 8-43. Adjust the oscilloscope vertical position and sensitivity controls so that the pulse base line is one division from the bottom graticule line and approximately 5 divisions high in peak amplitude. (The Signal Generator output level may have to be increased to +8 dBm.)
6. Switch Signal Generator to CW mode.

SERVICE SHEET BD7 (cont'd)

Adjust the oscilloscope vertical sensitivity for a display 5 divisions above the pulse base line. The peak of the CW signal is now the CW peak reference level.

NOTE

Do not touch the vertical position controls after the reference pulse base line has been set.

7. Switch back to PULSE NORM.

8. Without touching the vertical sensitivity controls, measure the difference between the CW peak reference level and the average peak pulse level excluding any over/undershoot.

   The difference should be within +0.61 −0.45 division on the oscilloscope.

   If the difference is not in the range indicated, proceed with ✓4 Sample Gate Check, Step 20. Otherwise, proceed with Step 9.

9. Reduce the pulse width from the pulse generator to 100 ns and repeat Steps 5 through 7.

   If the difference is not as indicated in Step 8, proceed with Sample Gate Check ✓4, Step 20. Otherwise, proceed with Step 10.

10. Set the pulse from the pulse generator to 300 ns.

11. Set the Signal Generator to each of the frequencies shown below, and for each frequency check the detected pulse rise time, fall time, and overshoot and ringing.

    Frequencies

    12.0 GHz
    18.0 GHz

    In each case the rise and fall time should be less than 50 ns, and the overshoot and ringing should be less than 20%.

    If the rise and fall time and overshoot and ringing are not as indicated, go to the Pulse Amplitude Control Adjustment in Section V and perform the indicated adjustments. If the adjustments cannot be made, or if they do not correct the problem, proceed with ✓5 YTM Pulse Check, Step 24.

Shunt Pulse Check. ✓1

12. Connect test equipment as shown in Figure 8-45.

13. Set the pulse generator for 1 pulse per microsecond (1 MHz PRF) and a pulse width of 200 ns.

14. Connect channel 1 of the oscilloscope to A1A4TP3 and Channel 2 to A1A4TP2. Set Channel 1 display at top of screen. Set oscilloscope controls as shown in Figure 8-46 and compare the display to the figure.

    If both channels are incorrect or absent entirely, the problem is most likely in the input control section of A1A4. Go to Step 15 to check input.

    If Channel 1 (TP3) is ok but channel 2 (TP2) is not correct, the problem is in the Shunt Pulse Delay and driver section of A1A4. Go to Service Sheet 15 to further isolate the problem.

    If both channels are correct, go to Step 18, Series Pulse Check.

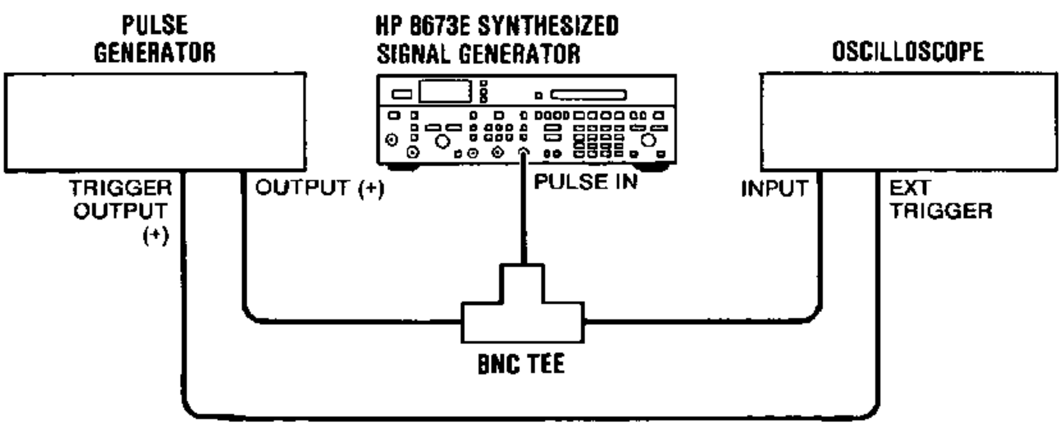


Figure 8-45. Pulse Modulation Check Setup

SERVICE SHEET BD7 (cont'd)

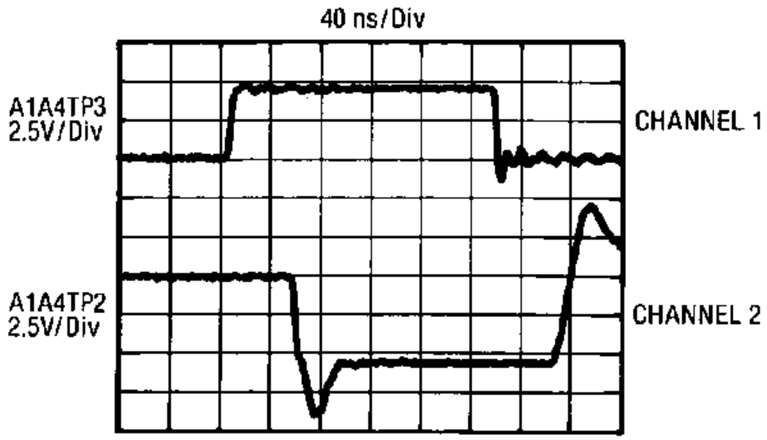


Figure 8-46. Pulse Driver Board Input and Shunt Pulses

15. Connect the oscilloscope to A1A4TP7. The oscilloscope should show a 200 ns pulse width and PRF of 1 MHz.

    If the display is correct, proceed with Step 16. If the display is not correct, the problem is between the pulse input connector and A1A4.

16. Remove A1A4 and replace it on a 36 pin extender board.

17. Connect the DVM to XA4-26 (TPB). The DVM should show a TTL logic high.

    If the DVM indication is not correct, there is a problem with the logic latch or associated circuitry on the DAC and Enable Board. Go to Service Sheet 22 to isolate the problem.

    If the indication is correct, there is a problem in the input control or addressable data latch on the pulse driver board. Go to Service Sheet 15 to isolate the problem.

Series Pulse Checks. ⟨✓2⟩

18. Connect Channel 1 of the oscilloscope to A1A4TP3 and Channel 2 of the oscilloscope to A1A4TP1. Adjust the oscilloscope as shown in Figure 8-47 then compare the oscilloscope display to the figure.

    If the oscilloscope display is not as shown in the figure, there is a problem in the Series Pulse Delay and one shot circuit. Go to Service Sheet 15 to isolate the problem.

    If the oscilloscope display is as shown in the figure, proceed with Step 19, Bias Tee/Pulse Modulator Check

Bias Tee/Pulse Modulator Check. ⟨✓3⟩

19. Set Both LINE switches to OFF then remove the bias tee A1CP1 (see Figure 8-48). Using the DVM, measure the resistance between:

Port	Resistance
Output port and TEE	0.1 ±0.05 ohms
Input port and TEE	open
Input port and output port	open

If the resistances are not as shown above, the bias tee is defective and should be replaced.

If the resistances are as shown above, pulse modulator A1AT3 is defective and should be replaced.

Sample Gate Checks. ⟨✓4⟩
If the pulse level accuracy is correct with a 300 ns pulse but fails with a 100 ns pulse, adjustment of the leading and trailing edge (L.E. and T.E.) one shots may be all that is necessary. Proceed to the ALC Sample Pulse Adjustment procedure in Section V. If this adjustment does not correct the problem, proceed with Step 22.

If the pulse level accuracy is not within specification with a 300 ns pulse, either the Sample Pulse circuitry is defective or the Sample and hold circuitry on the ALC board is defective. Proceed with Step 20 below.

20. Connect channel 1 of the oscilloscope to A1A4TP3 and Channel 2 to A1A4TP14. Adjust the oscilloscope as shown in Figure 8-49 and compare the oscilloscope display to the figure.

SERVICE SHEET BD7 (cont'd)

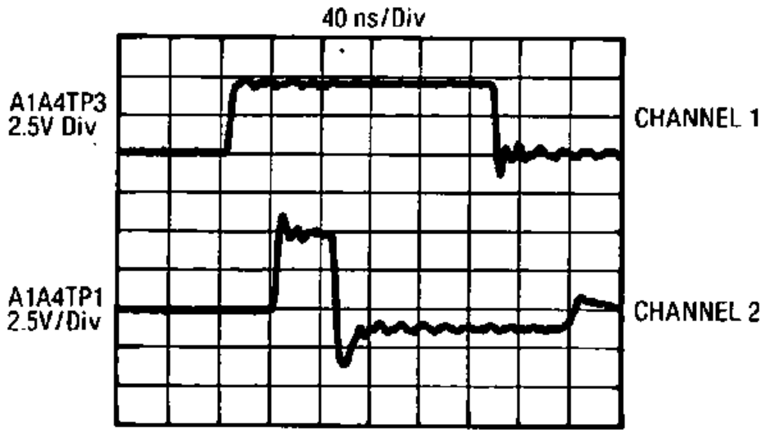


Figure 8-47. Pulse Driver Board Input and Series Pulses

If the oscilloscope display is not like the figure, the Sample Gate circuitry is defective. Go to Service Sheet 15 to isolate the problem.

If the oscilloscope display is like the figure, the fault is probably in the Sample and Hold circuitry of the ALC Board. Go to Service Sheet 14 to isolate the problem.

Level Check. (√5)
This check is to see if the minimum Pulse Width Detector of A1A4 is working normally.

21. Set the pulse generator for a pulse width of 300 ns.

22. Connect the DVM to A1A4TP5.

    The DVM should indicate a TTL logic high (>3V).

    If the DVM indication is not correct, the minimum Pulse Width Detector is defective. Go to Service Sheet 15 to isolate the problem. If the DVM indication is correct, proceed with Step 23.

23. Gradually reduce the pulse width to 50 ns while observing the DVM display.

    The DVM display should suddenly drop to 0 volts after the pulse width is reduced to 80 ns but before it reaches 50 ns.

    If the indication is not normal, go to the Minimum Pulse Width Indicator Adjustment in Section V. If the adjustment does not correct the problem go to Service Sheet 15 to isolate the problem.

    If the indication is normal, the minimum pulse width detector is working normally.

Band 2—3 Checks

Pulse modulation in the high bands (above 6.6 GHz) requires that a YTM pulse be injected into the YTM to compensate for bias lost when the pulse is off. Without a properly adjusted YTM pulse, the pulse modulation specification cannot be met.

It is assumed that pulse modulation in the high bands does not meet the rise time, fall time and/or overshoot and ringing specs, and that an attempt has been made to correct this fault by performing the Pulse Amplitude Control adjustments in Section V. This step is absolutely critical and cannot be bypassed.

The following procedures check the circuits that control the YTM pulse in order to isolate the fault to a service sheet.

YTM Pulse Check. (√6)

24. Remove SRD Bias Board A1A8 and replace it with a 36 pin extender board (do not install A1A8 on the extender board).

25. Set the variable power supply voltage to 0 volts, then connect the positive output to XA8-16 and ground to XA8-1 or XA8-19.

26. Set the pulse generator for a 300 ns pulse and the Signal Generator to 10 GHz.

27. Connect the oscilloscope to A1A4TP10 (YTM PUL).

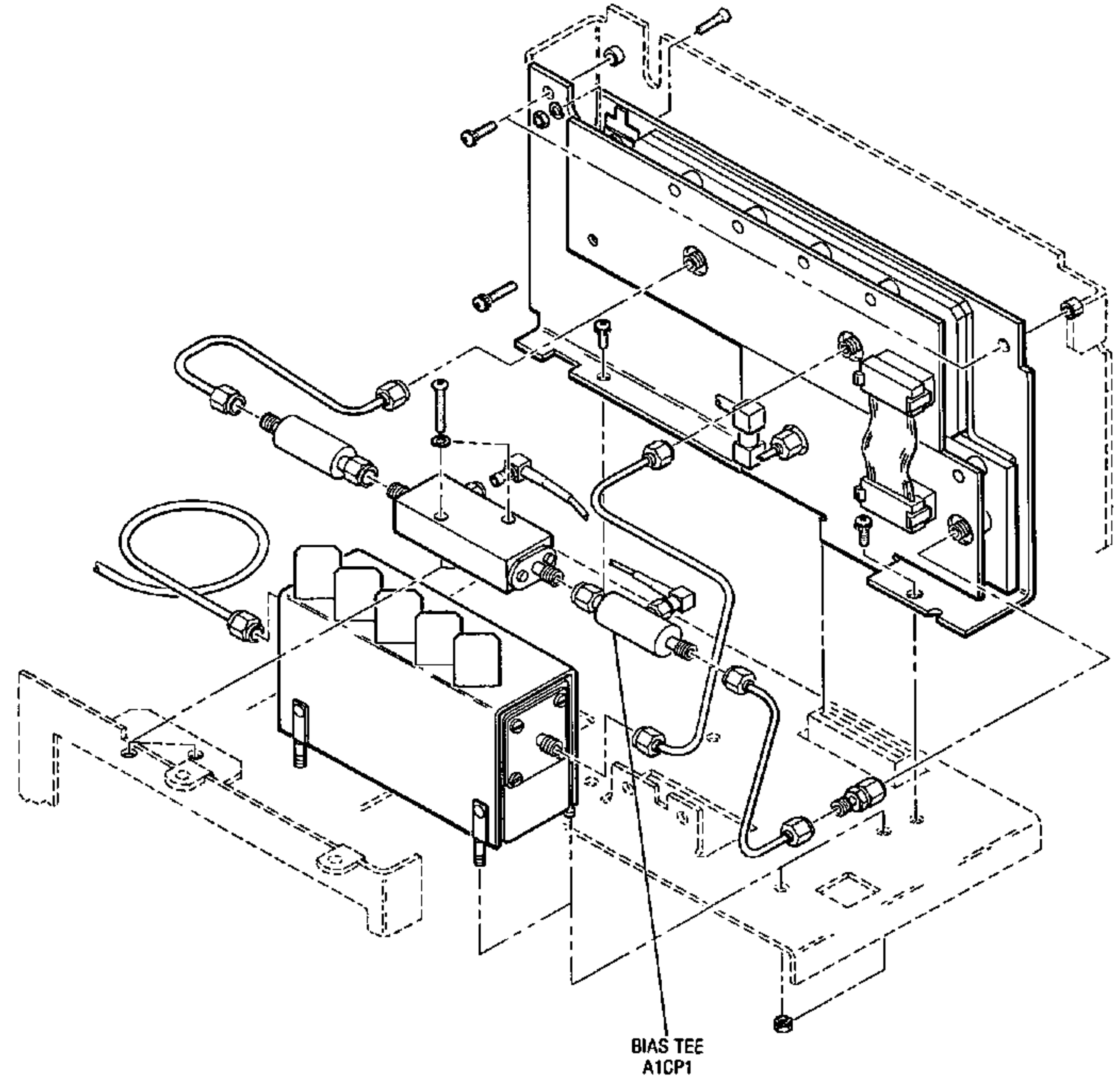


Figure 8-48. Bias Tee

SERVICE SHEET BD7 (cont'd)

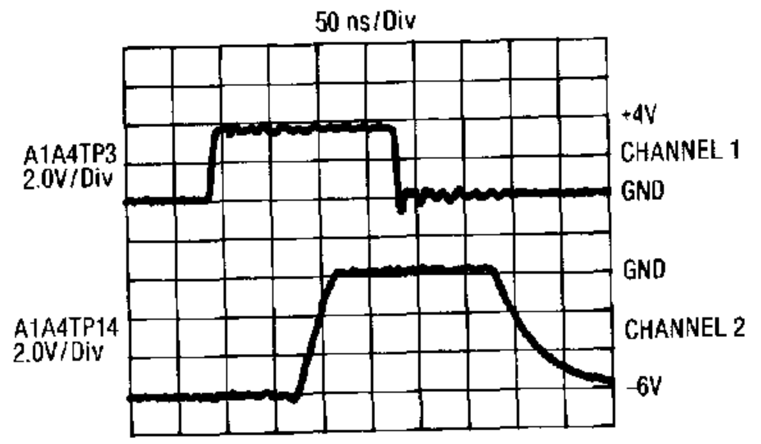


Figure 8-49. Pulse Driver Board Input Pulse and Sample Pulse

28. While observing the oscilloscope display, gradually increase the power supply voltage (maximum +10V).

    The peak amplitude of the YTM pulse on the oscilloscope display should be equal to the power supply output voltage at all levels.

    If the YTM pulse peak level does not track the power supply voltage, or is absent altogether, the YTM Pulse one shot is defective. Go to Service Sheet 15 to isolate the problem. If the YTM pulse peak level does track the power supply voltage, proceed with Step 31.

PAC DAC Check. (√7)

29. Remove A1A5 and replace it on a 44 pin extender board.
30. Set both channels of the oscilloscope for 0.5 volt per division and DC input.
31. Connect channel 1 of the oscilloscope to A1A5 U7-3 (TPA) and Channel 2 to A1A5TP2.
32. Set the Signal Generator to 6.7 GHz and FREQ INCR to 100 MHz and gradually increase the frequency to 12 GHz while observing the oscilloscope display.

    The Channel 1 and Channel 2 displays should track each other up the display as the frequency is increased.

    If the two signals do not track, there is a problem with the Pulse Amplitude Control (PAC) DAC or the comparator on DAC and Enable Board A1A5. Go to Service Sheet 22 to isolate the problem.

    If the two signals track, proceed with Step 35.

PAC Check (√8)

35. Install A1A8 on the extender board installed in Step 26, and set the following potentiometers to their maximum CW setting:

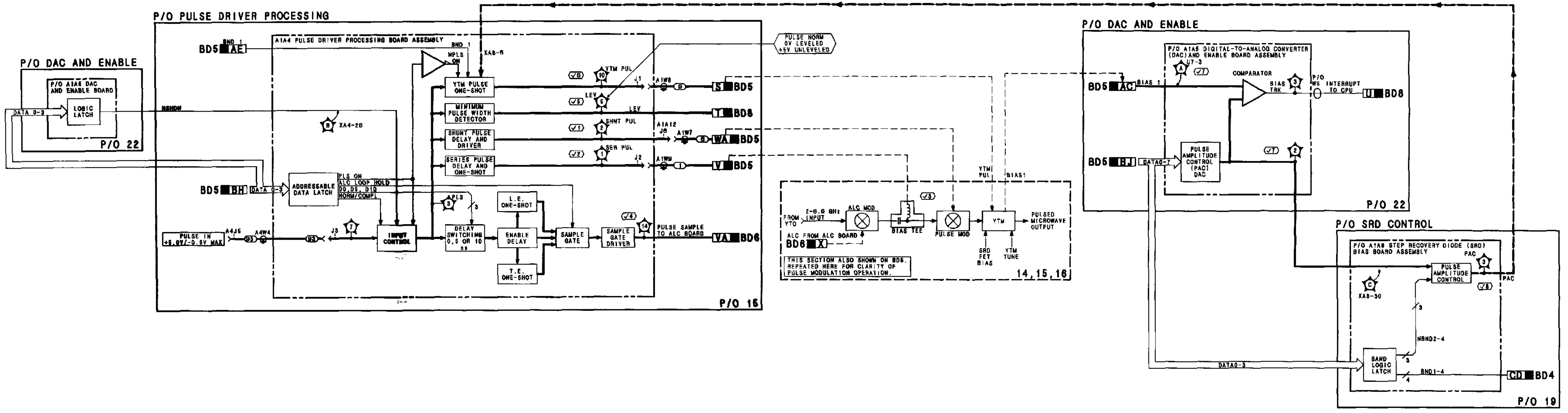
    A1A8R10 (B2 SL)
    A1A8R11 (B3 SL)
    A1A8R12 (B4 SL)
    A1A8R13 (B2 OF)
    A1A8R14 (B3 OF)
    A1A8R15 (B4 OF)

34. Connect the DVM to XA8-30 (TPC) and adjust the Signal Generator frequency to obtain the following voltages at XA8-30 (TPC) then check for the corresponding voltages at A1A8TP3.

XA8-30 (TPC) Voltage	A1A8TP3 Voltage
4	2
8	5
12	9

If any of the voltages at A1A8TP3 were incorrect, the Pulse Amplitude Control Circuit of A1A8 is defective, go to Service Sheet 19 to isolate the problem.

If the voltage at A1A8TP3 was correct, the YTM is defective and should be replaced.



BD7

Figure 8-50. HP 8673E Pulse Modulation, Block Diagram

SERVICE SHEET BD8

DIGITAL CONTROL UNIT BLOCK DIAGRAM

REFERENCES

PRINCIPLES OF OPERATION

The Digital Control Unit (DCU) consists of the following:

1. A Digital Controller consisting of a Microprocessor Assembly A2A8, a ROM - Converter Assembly A2A11, a RAM Assembly A2A10.

2. A Control Section consisting of a Frequency Output/HP-IB Assembly A2A9, an Input/Output Assembly A2A7, a Key Code Assembly A2A2, a Panel Driver Assembly A2A1 and a Front Panel Assembly A4.

The function of the Digital Control Unit is to control the operation of the Signal Generator. The DCU responds to data inputs from the Signal Generator's front panel as well as data and instructions from the rear panel AUX connector and the HP-IB bus. The DCU communicates with the A3 RF Source Assembly, the A1 RF Output Assembly, and the A4 Front Panel Assembly.

The Microprocessor Assembly continually executes programs stored in ROM (Read Only Memory) and uses the RAM (Random Access Memory) to store front panel information and intermediate data calculations. In order to preserve the information stored in RAM when power is removed from the instruments, a battery back up system is used to maintain power to the RAM.

The Microprocessor Assembly communicates with other assemblies via a bidirectional data bus, an address bus and various control lines. Information is sent and received on the data bus, the address bus controls where the information is coming from or being sent to and the control lines provide a means of controlling data flow and communication between the Microprocessor Assembly and other assemblies.

DIGITAL CONTROLLER (A2A8, A2A10, A2A11)

The Digital Controller is responsible for generating and processing data for the phase locked loops, ALC circuitry and pulse circuitry. The programs that enable the Controller to accomplish these functions are stored in Read Only Memory in the ROM/Converter Assembly. These programs are also called firmware and are not lost when the ROM is not powered.

The RAM Assembly A2A10 is used by the Microprocessor to store frequency values, front panel settings (including the data for the RCL 1-9 function), intermediate numerical values needed by the Microprocessor Assembly and return addresses when sub-routines are executed.

SERVICE SHEET BD8 (cont'd)

Control Section (A2A9,A2A7,A2A2,A2A1,A4)

The Control Section is the interface between the Digital Controller and the instrument. The Control Section can be divided into two smaller assemblies:

1. An internal interface consisting of Frequency Output/HP-IB A2A9 (only the frequency output portion) and Input/Output Assembly A2A7.

2. An external interface consisting of a Key Code Assembly A2A2, Panel Driver A2A1, Front Panel Assembly A4 and Frequency Output/HP-IB A2A9 (only the HP-IB portion).

The internal interface actually controls the instrument operation. The Frequency Output/HP-IB Assembly receives frequency data from the Digital Controller and generates the data needed by the YTO, M/N and LFS phase locked loops. This data is used differently by each phase locked loop. The data lines to the YTO phase locked loop are used to pretune the YTO frequency so that the YTO will not phase lock to the wrong frequency.

The data sent to the M/N phase locked loop is used to tune the M/N VCO to a specific frequency that will allow a harmonic of the M/N phase locked loop output to generate a 20-30 MHz difference frequency when mixed with the YTO phase locked loop output.

The data that go to the LFS phase locked loop are used to set the LFS phase locked loop to a frequency between 20 and 30 MHz with a resolution of 1 KHz.

The Input/Output Assembly A2A7 enables the Microprocessor Assembly to read the status of various circuits, output data to circuits and allows data to be read from the Key Code Assembly A2A2.

The external interface allows external inputs to be read by the Microprocessor Assembly. The external inputs can come from the HP-IB bus (in remote mode), the front panel keys or the AUX connector on the back panel of the instrument. The results of the entry are displayed on the Front Panel A4 display. The Microprocessor Assembly communicates directly with the Panel Driver Assembly A1A1 and the Front Panel A4 display to display the current control settings.

The Key Code Assembly A2A2 accepts inputs from the Front Panel A4 keys and encodes the information. When a key is pressed, a key down (KDN-L) signal is generated by the Key Code Assembly which tells the Digital Controller section of the DCU that a key has been pressed. The Microprocessor Assembly then reads the input from the Key Code Assembly via the Input/Output Assembly. When the data is read, an acknowledgement signal is sent to the Key Code Assembly that resets the circuit and allows another entry to be made. The Key Code Assembly also processes inputs from the AUX connector in the same manner as a front panel key input.

SERVICE SHEET BD8 (cont'd)

Inputs in remote mode are processed in the HP-IB portion of the Frequency Output/HP-IB Assembly A2A9. The HP-IB circuits contain eight registers (status registers) that can be read by the Digital Controller section of the DCU and eight registers (control registers) that the Digital Controller section can write data into. All communications with the HP-IB bus are done via the HP-IB circuits on the Frequency Output/HP-IB Assembly A2A9.

TROUBLESHOOTING

General

CAUTIONS

MOS and CMOS ICs can be damaged by static charges and circuit transients. Do not remove any A2 Controller assembly from the Signal Generator while power is applied. Discharge the board and replacement IC to the same potential. (Use a conductive pad, HP part Number 4208-0094). When unplugging ICs, place the board on a conductive pad. When the IC is unplugged, insert it into the pad also.

The A2A7 I/O Assembly uses the +22 Vdc power supply which is not switched. Therefore, disconnect the power cord before removing or installing A2A7.

Several ICs in the A2 Controller Assembly are held in high-grip sockets. Both the socket and the IC can be damaged if an attempt is made to remove the IC with an IC extraction tool. The recommended procedure is to first ground the tip of a small blade-type screwdriver. Then slide the tip between the IC and the socket and slowly pry up the IC one set of pins at a time on alternate ends until the IC is loose.

If the Signal Generator powers up correctly it is a strong indication that the DCU is operating correctly. In most cases, the two most common indications, of a Digital Control Unit failure are that the instrument fails to power up correctly or that the instrument behaves erratically. Erratic behavior is generally indicated by an unexpected front panel display or incorrect responses to valid keyboard entries.

In addition, keep the following points in mind when troubleshooting the Digital Control Unit:

1. The edge connectors of all assemblies must be clean and properly seated in the motherboard connectors.

2. The proper operation of the clock circuits for the Digital Control Unit is critical.

3. The Digital Control Unit operation depends on a long sequence of instructions and events. Even a single bit of information that

SERVICE SHEET BD8 (cont'd)

is incorrect can change an entire sequence.

4. Data on the buses is often unstable or meaningless because of multiplexing or switching transients. A signature analyzer can determine when the data is valid but other test instruments such as a logic probe or an oscilloscope cannot differentiate between stable data and transients. These other instruments, however, can still be used to examine qualitative factors such as general bus activity, logic levels, waveform timing and bus conflicts.

5. The bus structure makes it possible to connect many devices to the same node. Finding a single bad device on a multi-device node can be extremely difficult.

Equipment

Signature Analyzer/Multimeter .... HP 5006A/5005A/B
Digital Voltmeter .... HP 3456A

Troubleshooting Procedure

To facilitate troubleshooting the Digital Control Unit, each type of failure has a specific troubleshooting procedure associated with it. The types of failures are categorized as:

1. Power-up Failures

2. Front Panel Display, Annunciator and Switch Failures

3. Data Problems for Internal Circuitry

Power-Up Failures

When the instrument is first turned on, a series of tests are performed to check internal operation. If any of these self-diagnostic tests find a failure, a message will be displayed and can be observed by pressing the front panel MESSAGE key. Table 8-14 lists the error message numbers and the procedure to be followed to locate the source of the failure.

Front Panel Display, Annunciator and Switch Failures

A simplified block diagram of the front panel keys and display circuitry is shown in Figure 8-51. Faults in the front panel keys or Key Code circuitry can be isolated using the keyboard status indicators on the Key Code Assembly A2A2 and the front panel keys.

Press the function keys listed in Table 8-15 and verify that the pattern of lighted keyboard status indicators on the Key Code Board are as indicated. If the pattern does not change or changes only once, check KDN-L and KACK-L signals on the Key Code Assembly.

If a pattern is incorrect, press the alternate keys to isolate the problem to a row or column fault.

SERVICE SHEET BD8 (cont'd)

Table 8-14. Power-Up Tests and Error Messages

Error Message Number	Test	Fault Location Procedure
90	AUTO PEAK MALFUNCTION	Refer to Service Sheet 20
92	RECALL CHECKSUM ERROR	Repeat the STORE and RECALL that caused the error. If error persists, perform RAM Verification (A2A10).
95	LOSS OF DATA ON POWER UP	Reapply power. If trouble persists, check battery and replace if necessary. Re-enter data and restart.
96	MEMORY TEST FAILURE	Reapply power. If trouble persists, perform RAM Verification (A2A10) and, if necessary, ROM Diagnostic (A2A11) and ROM Assembly Check (A2A11).
97	ROM TEST FAILURE	Reapply power. If trouble persists, perform ROM tests
98	RAM TEST FAILURE	Same as 92 above.
99	RAM NOT FUNCTIONAL AT POWER UP.	Same as 98 above.

Pulse Modulation Block Diagram SERVICE SHEET BD7

SERVICE SHEET BD8 (cont'd)

Table 8-15. Key Code Patterns

Function Key	Key-Code Pattern							Input Pair Verified		IF Key-Code Pattern Incorrect	
	K6	K5	K4	K3	K2	K1	K0	Row	Column	Key to be Depressed to Verify Row	Key to be Depressed to Verify Column
1		L	L				L	KR1	C3L	9	2
ΔF		L	L	L		L		KR2	C3H	2	9
TUNE	L				L			KR3	C4L	3	LOCAL
ALC INT	L			L				KR0	C4H	0	RF ON/OFF
FREQ INCR	L		L		L			KR4	C5L	4	START
PULSE OFF	L		L	L	L		L	KR5	C5H	5	FM3
FM3	L	L			L	L		KR6	C66	6	FM1
SERVICE SWITCH	L	L		L	L	L	L	KR7	C6H	7	SINGLE

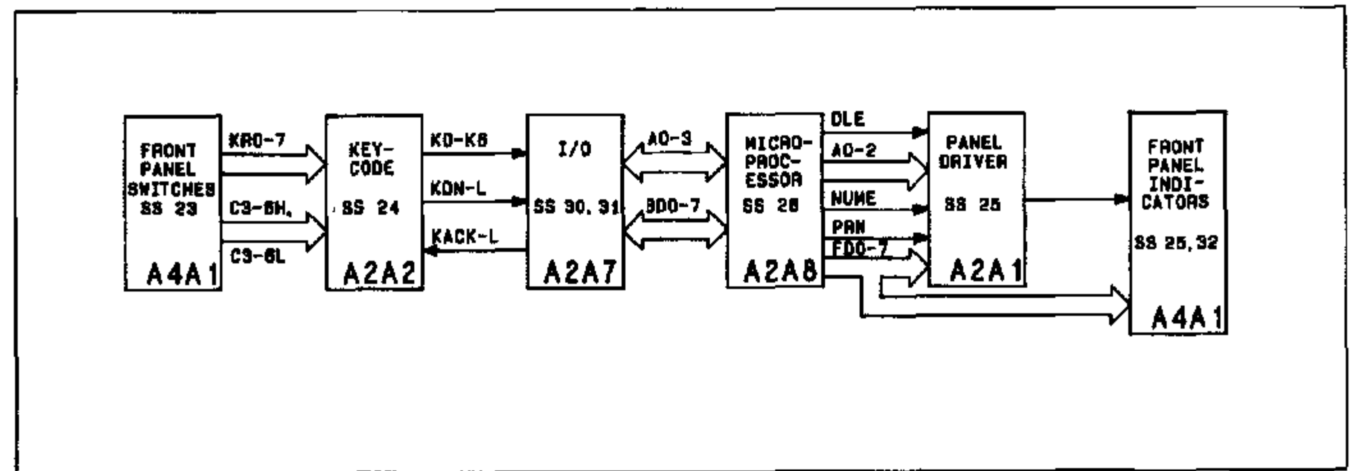


Figure 8-51. Front Panel Keyboard and Indicator Block Diagram

Front Panel Display, Annunciator and Switch Failures (cont'd)

Table 8-16 shows the required signal conditions between circuit elements for proper operation of the instrument. Examination of Table 8-16 reveals that functioning of circuitry and interconnects can be verified by depressing alternate keys which use the same circuitry and/or interconnects as the one under investigation. As an example, suppose the Auto key is depressed and the corresponding front panel LED is not lit and the function not performed. Depress any key but the numeral keys to verify the enable signals DLE and PRW from the microprocessor to the Panel Driver. Depress the Manual key to verify the address bit A2. By depressing the RF ON/OFF key, the data bit FD4 can be verified. No failures found when the alternate keys are depressed, indicates the fault of the AUTO function to be located on the Front Panel Circuit Card. A failure, if found when the alternate keys are depressed, is then located to be between the Key Code Circuit Card output and the Front Panel Card. By performing the Front Panel Display and Driver Diagnostic, a fault condition between the output of the Microprocessor and A2A8 and the Front Panel may be determined. Faults which occur between the output of the Key-Code Circuit Card and the output of the Micropro-

SERVICE SHEET 8 (cont'd)

Table 8-16. Signal Conditions for Front Panel Keyboard to Front Panel Indicators Operation (1 of 2)

Function	Front Panel Output																Key-Code Output							μP Output to Panel Driver														Panel Driver Output
	KR0	KR1	KR2	KR3	KR4	KR5	KR6	KR7	C3L	C3H	C4L	C4H	C5L	C5H	C6L	C6H	K6	K5	K4	K3	K2	K2	K0	NUME	DLE	PRW	A0	A1	A2	FD0	FD1	FD2	FD3	FD4	FD5	FD6	FD7	
0	L								L									L	L																			
1		L							L									L	L				L															
2			L						L									L	L			L																
3				L					L									L	L			L	L															
4					L				L									L	L		L																	
5						L			L									L	L		L		L															
6							L		L									L	L		L	L																
7								L	L									L	L		L	L	L															
8	L									L								L	L	L																		
9		L								L								L	L	L			L															
ΔF			L							L								L	L	L		L								NOT APPLICABLE								
AUTO				L						L								L	L	L		L	L		H	L			L					L				DL3-4
MKR					L					L								L	L	L	L									NOT APPLICABLE								
SWEEP OFF						L				L								L	L	L	L		L							NOT APPLICABLE								
MANUAL							L			L								L	L	L	L	L		H	L			L							L			DK3-5
UNUSED								L		L								L	L	L	L	L	L							NOT APPLICABLE								
LOCAL	L										L						L													NOT APPLICABLE								
DWELL		L									L						L						L							NOT APPLICABLE								
FREQ INCR DW			L								L						L					L								NOT APPLICABLE								
FREQ INCR UP				L							L						L					L	L							NOT APPLICABLE								
TUNE ON/OFF					L						L						L				L					L	L	L									L	DL4-6
STEPS						L					L						L				L		L							NOT APPLICABLE								
←							L				L						L				L	L								NOT APPLICABLE								
.								L			L						L				L	L	L							NOT APPLICABLE								
ALC INT	L											L					L			L							L	L	L	L								DL1-0
RF ON/OFF		L										L					L			L			L			L		L	L				L					DL1-4
UNUSED			L									L					L			L		L								NOT APPLICABLE								
RANGE				L								L					L			L		L	L							NOT APPLICABLE								
DIODE					L							L					L			L	L					L		L	L		L							DL1-1
PWR METER						L						L					L			L	L		L			L		L	L			L						DL1-2
RANGE							L					L					L			L	L	L								NOT APPLICABLE								
AUTO PK								L				L					L			L	L	L	L			L		L	L				L					DL1-3
START	L												L				L		L											NOT APPLICABLE								
STOP		L											L				L		L				L							NOT APPLICABLE								
NORM			L										L				L		L			L				L	L		L	L								DL2-0
FREQUENCY				L									L				L		L			L	L							NOT APPLICABLE								

Table 8-16. Signal Conditions for Front Panel Keyboard to Front Panel Indicators Operation (2 of 2)

Function	Front Panel Output																Key-Code Output							μP Output to Panel Driver														Panel Driver Output
	KR0	KR1	KR2	KR3	KR4	KR5	KR6	KR7	C3L	C3H	C4L	C4H	C5L	C5H	C6L	C6H	K6	K5	K4	K3	K2	K2	K0	NUME	DLE	PRW	A0	A1	A2	FD0	FD1	FD2	FD3	FD4	FD5	FD6	FD7	
FREQ INCR					L								L				L		L		L									NOT APPLICABLE								
COMPL						L							L				L		L		L		L			L	L		L		L							DL2-1
STO							L						L				L		L		L	L								NOT APPLICABLE								
RCL								L					L				L		L		L	L	L							NOT APPLICABLE								
AM OFF	L													L			L		L	L										NOT APPLICABLE								
MTR AM		L												L			L		L	L			L			L	L	L			L							DL4-1
MTR FM			L											L			L		L	L		L					L	L	L				L					DL4-2
FM OFF				L										L			L		L	L		L	L							NOT APPLICABLE								
MESSAGE KEY					L									L			L		L	L	L					L	L	L							L			DL4-4
PULSE OFF						L								L			L		L	L	L		L							NOT APPLICABLE								
UNUSED							L							L			L		L	L	L	L								NOT APPLICABLE								
MTR L V L								L						L			L		L	L	L	L	L			L	L	L		L								DL4-0
FM .3	L														L			L	L							L	L		L					L				DL2-4
FM .1		L													L			L	L				L			L	L		L				L					DL2-3
FM .03			L												L			L	L			L				L	L		L			L						DL2-2
AM 30%				L											L			L	L			L	L			L		L	L							L		DL1-6
AM 100%					L										L			L	L		L					L		L	L								L	DL1-7
FM 1						L									L			L	L		L		L			L	L		L						L			DL2-5
FM 3							L								L			L	L		L	L				L	L		L							L		DL2-6
FM 10								L							L			L	L		L	L	L			L	L		L								L	DL2-7
SINGLE	L															L	L	L	L	L						L			L							L		DL3-6
STEP		L														L	L	L	L	L										NOT APPLICABLE								
GHz			L													L	L	L	L	L		L								NOT APPLICABLE								
MHz				L												L	L	L	L	L		L	L							NOT APPLICABLE								
UNUSED					L											L	L	L	L	L	L									NOT APPLICABLE								
UNUSED						L										L	L	L	L	L	L		L							NOT APPLICABLE								
kHz							L									L	L	L	L	L	L	L								NOT APPLICABLE								
SERVICE SWITCH								L								L	L	L	L	L	L	L	L							NOT APPLICABLE								
NOT ϕ LOCKED												NOT APPLICABLE												L	H	L	L	L	L	L								DL0-0
ALC UNLEVELED												NOT APPLICABLE												L	H	L	L	L	L		L							DL0-1
FM OVERMOD												NOT APPLICABLE												L	H	L	L	L	L			L						DL0-2
EXTERNAL REF												NOT APPLICABLE												L	H	L	L	L	L						L			DL0-3
OUT OF RANGE												NOT APPLICABLE												L	H	L	L	L	L							L		DL0-6

SERVICE SHEET BD8 (cont'd)

Front Panel Display, Annunciator and Switch Failures (cont'd)

cessor Circuit Card may be caused by any of the assemblies on the data bus, therefore, the fault location procedure consists of performing the Diagnostic Tests in the order in which they are listed.

Faulty Data to M/N Phase Detector, LFS Loop DAC or 20/30 Divider

Figure 8-52 shows the circuitry involved in the generation of frequency information to the M/N ϕ Detector Circuit Card A3A1A3, the DAC Circuit Card A3A5, and the 20/30 Divider Circuit Card A2A5. It is assumed that the front panel to the Key-Code Circuit Card A2A2 has already been verified. If not, this should be done using the procedures delineated herein. Fault Location should then follow the controller signature analysis troubleshooting procedures in the order in which they are listed.

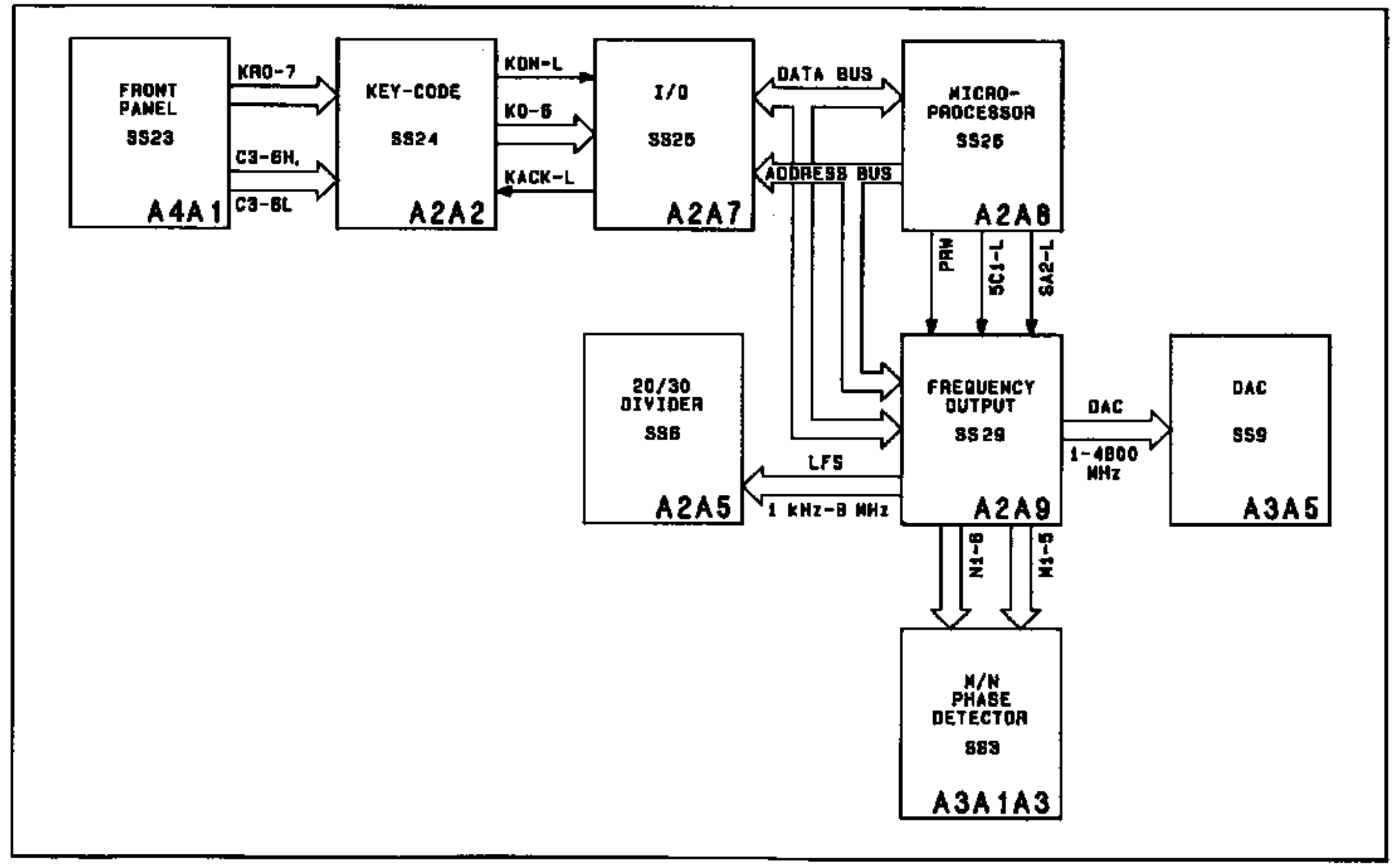


Figure 8-52. M/N Phase Detector, DAC and 20/30 Divider and Front Panel Interface Block Diagram

Signal Conditions for Front Panel Keyboard to Front Panel Indicators Operations

SERVICE SHEET BD8 (cont'd) DIAGNOSTIC TEST PROCEDURES

General

The diagnostic test procedures use the controller as a custom function generator to stimulate the digital circuitry in the Signal Generator. Except for the MPU Free Run Diagnostic, the microprocessor is controlled by the diagnostic ROM. This ROM contains special routines that stimulate the circuit under test. It is connected to the controller by the MPU test connector. Shorting A2A8TP5 to the adjacent GND testpoint prevents the microprocessor from reading data from anything except diagnostic switch A2A8S1 and diagnostic ROM A2A8U3. The front panel FREQUENCY MHz display indicates the switch setting followed by "-1". In this setting, the microprocessor repeatedly loops through a sequence of instructions so that "digital signatures" can be taken to verify proper performance or to locate defective components. When the shorting clip is removed from A2A8TP5, in certain tests the microprocessor reads data from the circuit under test and displays a test indication on the front panel.

The signature analyzer is a special counter circuit. It monitors the pulses present on its test probe at each clock pulse, between the start and stop signals. For most of these diagnostic tests, the clock lead is connected to the microprocessor clock. The start and stop leads are connected to the most significant address line, A15. This address line is not used in most of the Signal Generator address decoding circuits. Programming in the diagnostic ROM causes the microprocessor to jump between two address blocks to signal the beginning and end of the test period to the signature analyzer. This eliminates the requirement for a special circuit to generate the signature analyzer start and stop clock.

Signature analysis examines the stream of logic 0's and 1's at the node being probed. A change of the position of even one pulse out of a long stream causes a new signature to be displayed. There is no quantitative information in the value of a signature. A signature is either correct or incorrect. If a signature is incorrect, probe other points to determine whether the circuit driving that node is faulty or is receiving faulty inputs from another circuit.

In the following procedures, do not install an assembly until directed to do so by the procedure. It is possible to obtain a wrong signature in one procedure that is caused by an assembly that should not be installed at that time.

The following diagnostic tests are built into the Signal Generator to aid in troubleshooting the Controller:

a. The MPU Free Run Diagnostic. This test is run before the individual diagnostics controlled by the Diagnostic Switch (A2A8S1) are activated. It checks the MPU kernel (A2A8) to establish that the minimum operating circuits required to run the other diagnostics are functional.

b. Other tests. See Table 8-17.

Table 8-17. Diagnostic Tests

Diagnostic Switch Position (A2A8S1)	Test
0	MPU Timer and IRQ Encoder (A2A8)
1	Front Panel Display and Driver (A2A1)
2	HP-IB (A2A9)
3	Frequency Latches and M/N Encoder (A2A9)
4	I/O Assembly (A2A7)
5	Output Section (A2A9)
6	ROM, continuous with errors displayed (A2A11)
7	ROM, halt on first error (A2A11)
8	RAM, halt on first error or after first pass (A2A10)
9	RAM, halt on first error (A2A10)
A	RAM Divide-by-Three Circuit (A2A10)
B	Date code for diagnostic ROM (A2A8U3)

In addition, a typical program and procedure for an HP-IB talk-only diagnostic is presented after the built-in diagnostic procedures.

NOTE

To ensure that the required circuits are operational, perform the diagnostic tests in the order they are presented. If an error condition is indicated, check the related schematic to determine the faulty component. Perform the Diagnostic ROM Date Code Check first to determine if the signatures listed in the diagnostics are valid. The date codes for the diagnostic ROM (A2A8U3) must match that listed in the procedure for the listed signatures to be valid.

SERVICE SHEET BD8 (cont'd)
Diagnostic ROM Date Code Check

CAUTION

When taking signatures, it is possible to alter the diagnostic program by inadvertently shorting pins together with the probe. When this occurs, false signatures may be obtained. The diagnostic program can be returned to normal by setting the LINE switch to STBY and back to ON.

NOTE

If the date code checks procedure cannot be run, try to perform the MPU free run diagnostic to determine if at least the MPU kernal circuits are working. If the signatures are correct, continue performing the diagnostics until an error is found. However, if the procedures can be run but the date codes are incorrect, it is possible to run the diagnostics with the following restriction:

Any signature that matches a signature in the following procedures is a good indication that the associated circuits are working properly (but it is not an absolute check).

1. Set LINE switch to STBY.

CAUTION

If the A2A8 Microprocessor Assembly is not on an extender, care must be taken when installing the MPU test connector. Because of the width of the connector it is possible to damage adjustment resistors on the A2A7 I/O Assembly.

2. Connect the MPU test connector (HP Part Number 11726-60001) to the test connectors on top of the A2A8 Microprocessor Assembly.

3. Set diagnostic switch to B and install a shorting clip between A2A8TP5 and the adjacent TP GND.

4. Set LINE switch to ON.

5. Verify the FREQUENCY MHz display indicates 2324 11-1.

MPU Free Run Diagnostic (A2A8)

In this test, the controller cycles through all combinations of the 16 address lines attempting to read data or instructions. However, the data actually reaching the controller should always be from A2A8U9, the test switch buffer. This setup allows verification of the address decoder circuits and part of the functions internal to microprocessor A2A8U6.

1. Set the LINE switch to STBY, remove the power cord, and remove all circuit board assemblies from the A2 Controller Assembly except A2A1, A2A3, A2A4, and A2A5.

2. Install the A2A8 Microprocessor Assembly in the A2 Controller on an extender.

3. Install a shorting clip between A2A8TP5 and the adjacent TP GND.

4. Remove the MPU test connector from the A2A8 Assembly.

5. Connect the signature analyzer as follows:

Signature Analyzer Timing Pod	A2A8 Microprocessor
START	TP4
STOP	TP4
CLOCK	TP3
GND	TP GND

6. Set the signature analyzer pushbuttons as follows:

   START—OUT (positive edge)
   STOP—IN (negative edge)
   CLOCK—IN (negative edge)
   HOLD—OUT (not activated)
   SELF-TEST—OUT (not activated)

7. Reconnect the power cord, then Set the LINE switch to ON.

8. Use the signature analyzer probe to verify clocking activity on A2A8TP3.

9. Verify the signature is 0001. This signature indicates the free run mode is running correctly. If this signature is incorrect, make sure

SERVICE SHEET BD8 (cont'd)
MPU Free Run Diagnostic (cont'd)

the signature analyzer is properly connected and the START, STOP, and CLOCK pushbuttons are in the correct positions (see steps 5 and 6). Be very sure that the equipment is correctly setup because any deviation can cause a different verification signature.

10. The signatures listed in Table 8-18 verify the operation of the MPU, the address lines, and the address decoders.

11. The signatures listed in Table 8-19 verify the operation of the Diagnostic ROM (U3).

Table 8-18. MPU Address Line and Address Decoder Signatures

PIN NO.	SIGNATURE	MNEMONIC
A2A8B 8	HAP7	A11
11	0001	A15
12	CCCC	A1
14	3827	A13
15	5P18	SA3-L
16	3C96	A12
18	5H21	A3
29	5555	A0
30	F488	SCO-L
32	956C	SB4-L
33	2828	SA2-L
34	755U	A14
35	7F7F	A2
36	0AFA	A4
A2A8C 1	1293	A10
2	HPP0	A9
3	2H70	A8
4	52F8	A6
17	U68U	SC1-L
18	HC89	A7
20	04P6	SC2-L
22	UPFH	A5
29	16HH	DLE
30	CHOH	NUME

12. If any of the signatures are incorrect, the signatures listed in Table 8-20 can be used to aid in the isolation of the faulty part.

Table 8-19. Diagnostic ROM (U3) Signatures

PIN NO.	SIGNATURE	MNEMONIC
A2A8J1-3	8C25	DB-A4
4	FCPP	DB-A7
5	FAPC	DB-A3
6	78P0	DB-A2
9	2395	DB-A5
10	PC1A	DB-A6
11	FAPC	DB-A8
12	C5AA	DB-A1

Table 8-20. MPU Signatures

PIN NO.	SIGNATURE	MNEMONIC
U3-9	C5AA	DB-A1
10	78P0	DB-A2
11	FAPC	DB-A3
13	8C25	DB-A4
14	2395	DB-A5
15	PC1A	DB-A6
16	FCPP	DB-A7
17	FAPC	DB-A8
U6-9	5555	BA0
10	CCCC	BA1
11	7F7F	BA2
12	5H21	BA3
13	OAFA	BA4
14	UPFH	BA5
15	52F8	BA6
16	HC89	BA7
17	2H70	BA8
18	HPP0	BA9
19	1293	BA10
20	HAP7	BA11
22	3C96	BA12
23	3827	BA13
24	755U	BA14
25	0001	BA15

SERVICE SHEET BD8 (cont'd)

Table 8-20. MPU Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
U6-28	0000	D5
29	0001	D4
30	0001	D3
31	0000	D2
32	0001	D1
33	0001	D0
U7-3	5919	
4	UPFH	
6	OPHU	
8	C479	
9	9840	
10	8P4P	
11	A277	
U8-10	5555	A1
11	CCCC	A2
12	7F7F	A0
15	A277	C50
U12-8	5P19	
U13-4	HPPO	SB4-L
U14-13	04P6	SC2-L
14	U68U	SC1-L
15	F488	SC0-L
U15-3	160U	
8	0PHP	
9	0PHU	
11	160P	
U15-12	8P4P	
13	9840	
U16-3	C479	
U17-4	ACH0	
12	C478	
13	C479	
U21-9	A277	
10	9840	
11	8P4P	
12	5P18	SA3-L
13	2828	SA2-L
15	3APF	
U22-2	CCCC	BA1
3	CCCC	A1
4	5555	BA0
5	5555	A0
6	0001	BA15
7	0001	A15
U22-8	HAP7	BA11
9	HAP7	A11
11	3827	A13
12	3827	BA13
13	755U	A14
14	755U	BA14
15	3C96	A12
16	3C96	BA12
U22-17	7F7F	A2
18	7F7F	BA2
U23-2	HC89	BA7
3	HC89	A7
4	1293	A10
5	1293	A10
6	0AFA	BA4
7	0AFA	A4
8	5H21	BA3
9	5H21	A3
11	HPP0	A9
12	HPP0	BA9
U23-13	2H70	A8
14	2H70	BA8
15	52F8	A6
16	52F8	B-A6
17	UPFH	A5
18	UPFH	BA5
U25-1	0PHP	
11	0PHP	BD0
U26-2	0PHP	BD9
XA2A8B-8	HAP7	A11
11	0001	A15
12	CCCC	A1
14	3827	A13
15	5P18	SA3-L
XA2A8B-16	3C96	A12
18	5H21	A3
29	5555	A0
30	F488	SC0-L
32	956C	SB4-L
33	2828	SA2-L
34	755U	A14
35	7F7F	A2
36	0AFA	A4

SERVICE SHEET BD8 (cont'd)

Table 8-20. MPU Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
XA2A8C-1	1293	A10
2	HPP0	A9
3	2H70	A8
4	52F8	A6
17	U68U	SC1-L
18	HC89	A7
20	04P6	SC2-L
22	UPFH	A5
29	16HH	DLE
30	CH0H	NUME
XA2A8J1-3	8C25	DB-A4
4	FCPP	DB-A7
5	FAPC	DB-A8
6	78P0	DB-A2
9	2395	DB-A5
10	PC1A	DB-A6
11	FAPC	DB-A8
12	C5AA	DB-A1

MPU Timer and IRQ Encoder Diagnostic (A2A8)

In this diagnostic, the controller turns timer A2A8U8 on and off. The timer generates inputs to interrupt priority encoder A2A8U24. This diagnostic also verifies operation of the data bus on Microprocessor Assembly A2A8.

1. Set the LINE switch to STBY.
2. Connect the MPU test connector (HP Part Number 11726-60001) to the test connectors on top of the A2A8 Microprocessor Assembly.

NOTE

Always check the front panel indications and the verification signature for each diagnostic. If they are not correct, reset diagnostic switch A2A8S1. The switch might not make firm contact when switching positions.

3. Set diagnostic switch A2A8S1 to 0.

NOTE

Steps 4 and 5 require that the A2A1 Front Panel Driver be installed. This assumes that A2A1 is operational. If it is suspected of malfunctioning, continue the test if the displayed information is erratic. Note however, that a display of 15-1 or 02-1 is a strong indication that diagnostic switch A2A8S1 is not positioned correctly.

4. Set the LINE switch to ON. Verify that the FREQUENCY MHz display indicates 00-1.
5. Remove the short from A2A8TP5. Verify that the FREQUENCY MHz display indicates 00.
6. Touch the logic probe to +5V and verify the signature is 6FC9.
7. The signatures listed in Table 8-21 verify the operation of the timing and interrupt circuits.
8. If any of the signatures are incorrect, the signatures listed in Table 8-22 can be used to aid in the isolation of the faulty part.

Table 8-21. Timing, Interrupt and Buffered Data Circuits Signatures

PIN NO.	SIGNATURE	MNEMONIC
A2A8B 6	2256	VMA
7	6FC9	IRQA-L
24	6FC9	IRQB-L
25	6FC9	IRQIB-L
27	F637	PRW
A2A8C 5	6700	BD2
6	AA8P	E-PIA
7	6FC9	PHE-H
8	98P1	BD4
9	2U5F	BD6
15	7H31	BD0
19	AA8P	E-HPIB
21	P054	BD1
23	810P	BD3
24	944C	BD5
25	2U5F	BD7

Table 8-22. MPU Timer and IRQ Encoder Signatures

PIN NO.	SIGNATURE	MNEMONIC
U8-10	7758	A1
11	5CPA	A2
12	42C3	A0
13	F637	PRW
16	9U10	
17	AA8P	E-HPIB

SERVICE SHEET BD8 (cont'd)

Table 8-22. MPU Timer and IRQ Encoder Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
18	P9C7	D7
19	AAU1	D6
20	9CPP	D5
21	25AF	D4
22	HFP0	D3
23	5HU3	D2
24	FUF0	D1
25	8593	D0
U24-1	CCAU	
2	6FC9	IRQA-L
3	6FC9	IRQIB-L
6	CCAU	
7	6FC9	
9	6FC9	
12	6FC9	VTI-L
13	6FC9	IRQB-L
14	CCAU	IRQ
U25-1	3316	
11	7H31	BD0
13	P054	BD1
14	6FC9	
U25-15	81OP	BD3
16	6FC9	
17	6700	BD2
XA2A8B-7	6FC9	IRQA-L
8	592A	A11
11	6FC9	A15
12	5CPA	A1
14	0000	A13
16	H347	A12
18	5U90	A3
24	6FC9	IRQB-L
25	6FC9	IRQIB-L
29	7758	A0
34	0000	A14
35	42C3	A2
36	44H4	A4
XA2A8C-1	5UAU	A10
2	0000	A9
3	H5PU	A8
XA2A8C-4	2F4P	A6
5	6700	BD2
6	AA8P	E-PIA
8	98P1	BD4
9	2U5F	BD6
10	6FC9	VTI-L
16	7H31	BD0
21	P054	BD1
22	C1U5	A5
23	810P	BD3
24	944C	BD5
25	2U5F	BD7

Front Panel Display and Driver Diagnostic (A2A1)

In this test, the controller turns all indicators and annunciators on and off so rapidly that only a logic probe or signature analyzer can detect the change. If the signatures are correct, the controller can probably select any required front panel display.

1. Set the LINE switch to STBY.
2. Install the A2A1 Front Panel Driver Assembly, if not previously installed.
3. Install a shorting clip between A2A8TP5 and TP GND and MPU Connector on A2A8.
4. Set diagnostic switch A2A8S1 to position 1.
5. Set LINE switch to ON.
6. Touch the logic probe to +5V and verify the signature is CA4A.
7. Verify that all indicators and annunciators except OVEN COLD and STANDBY are lit and the displays indicate the following:

   RANGE dBm +110.0

   FREQUENCY MHz .1.0.1.0.1.0.1.0.1.0.1

   In addition, the AUTO SWEEP key light is blinking.
8. If the front panel display differs from step 7, place A2A1 on an extender board. The signatures listed in Table 8-23 verify the operation of the frequency data circuits. The signatures listed in Table 8-24 can be used to aid in the isolation of faulty parts.

SERVICE SHEET BD8 (cont'd)

Table 8-23. Frequency Data Signatures

PIN NO.	SIGNATURE	MNEMONIC
A2A1A-34	U5P4	FD0
36	PCFP	FD5
A2A1B-4	932C	FD6
19	A3H2	FD1
25	U92H	FD2
26	H886	FD7
27	2599	FD3
28	0977	DLE
29	3U2F	NUME
31	0371	FD4

Table 8-24. Front Panel Driver Assembly Signatures

PIN NO.	SIGNATURE	MNEMONIC
U1-2	9691	BDL3-1
3	9691	BDL3-4
6	2FHC	
9	2FHC	
U3-4	CA4A	
5	07PF	BDL4-4
U4-1	HA9P	BDL4-5
U5-1	8F11	PRW
2	548H	
3	A3H2	FD1
4	0371	FD4
6	0798	
7	U5P4	FD0
8	PCFP	FD5
11	4UP2	U5-11
13	H886	FD7
14	932C	FD6
16	9H89	
17	2599	FD3
18	U92H	FD2
19	2UF3	
U6-1	8F11	PRW
2	965F	
3	A3H2	FD1
4	0371	FD4
5	672F	
6	5624	
7	U5P4	FD0
8	PCFP	FDS
11	C1PA	U6-11
12	9453	
13	H886	FD7
14	932C	FD6
15	FFA9	
16	A381	
17	2599	FD3
18	U92H	FD2
19	98C1	
U7-1	8F11	PRW
2	8F05	
3	A3H2	FD1
4	0371	FD4
5	FP43	
6	47CF	
7	U5P4	
8	PCFP	FD5
9	U72U	
U7-11	U1F9	U7-11
12	F68C	
13	H886	FD7
14	932C	FD6
15	9886	
16	FA45	
17	2599	FD3
18	U92H	FD2
19	774P	
U8-1	8F11	PRW
3	A3H2	FD1
4	0371	FD4
5	9691	
7	U5P4	FD0
8	PCFP	FD5
9	9751	
11	P31P	U8-11
13	H886	FD7
14	932C	FD6
15	0CF6	
17	2599	FD3
18	U92H	FD2
U9-1	8F11	PRN
2	F842	
3	A3H2	FD1
4	0371	FD4

SERVICE SHEET BD8 (cont'd)

Table 8-24. Front Panel Driver Assembly Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
U9-5	07PF	
6	8F99	FD0
7	U5P4	FD0
8	PCFP	FD5
9	HA9P	
11	F024	U9-11
12	5F35	
13	H886	FD7
14	932C	FD6
15	8P77	
17	2599	FD3
18	U92H	FD2
19	P611	
U10-1	8F11	PRW
2	30F8	
3	A3H2	FD1
4	0371	FD4
5	0HC5	
6	9C3P	DL5-0
7	U5P4	FD0
8	PCFP	FD5
9	47C2	
11	2P78	U10-11
12	9CA4	
13	H886	FD7
14	932C	FD6
15	0C5C	
16	69H7	
17	2599	FD3
18	U92H	FD2
19	0149	
U11-1	8F11	PRW
2	H774	
3	A3H2	FD1
4	0371	FD4
5	C8U9	U13-5
6	49H7	U13-18
7	U5P4	FD0
8	PCFP	FD5
9	5PFF	U13-8
11	C94F	U11-11
12	0HA6	U12-9
13	H886	FD7
14	932C	FD6
15	37H0	U13-6
16	UU7P	U12-3
17	2599	FD3
18	U92H	FD2
19	F111	U12-17
U12-2	CA4A	U12-2
3	UU7P	U12-3
8	0HA6	U12-8
17	F111	U12-17
U13-6	37H0	U13-6
8	5PFF	U13-8
U14-1	PA88	A0
2	FP44	A1
3	HH57	A2
4	8F11	PRW
9	4UP2	U5-11
10	2P78	U10-11
11	FO24	U9-11
12	P31P	U8-11
13	U1F9	U7-11
14	C1PA	U6-11
15	C94F	U11-11
U15-1	PA88	A0
2	FP44	A1
3	HH57	A2
4	8F11	PRW
6	3U2F	NUME
9	UAPU	A-L
10	1UC3	F10-L
11	50A7	F89-L
12	6861	F67-L
13	HP11	F45-L
14	FFHF	F23-L
15	4A31	F01-L
P1A-18	0HC5	DL5-4
20	UAPU	A-L
22	CA4A	DL5-5
25	CA4A	DL5-6
28	5F35	DL4-7
34	U5P4	FD0
36	PCFP	FD5
P18-1	30F8	DL5-1
4	932C	FD6
5	CA4A	+5V
6	0000	GND

SERVICE SHEET BD8 (cont'd)

Table 8-24. Front Panel Driver Assembly Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
A2A18-14	HP11	F45-L
15	FFHF	F23-L
16	4A31	F01-L
17	6861	F67-L
18	9C3P	DL5-0
19	A3H2	FD1
P1B-23	CA4A	+5V
24	0000	GND
25	U92H	FD2
26	H886	FD7
27	2599	FD3
28	0977	DLE
29	3U2F	NUME
30	1UC3	F10-L
31	0371	FD4
32	50A7	F89-L
33	PA88	A0
34	8F11	PRW
35	HH57	A2
36	FP44	A1

RAM Verification (A2A10)

In this diagnostic, the controller writes and verifies data on RAM Assembly A2A10. The FREQUENCY MHz display gives pass or fail indications.

1. Set LINE switch to STBY.
2. Install the MPU test connector (HP Part Number 11726-60001) to the test connectors on top of A2A8 Microprocessor Assembly.
3. Connect the signature analyzer as shown under MPU Free Run Diagnostic (A2A8) paragraph 5.
4. Install a shorting clip between A2A8TP5 and TP GND.
5. Verify test switch A2A10S1 is set to NORM. Install the RAM assembly (A2A10).
6. Set diagnostic switch A2A8S1 to position 8.
7. Set LINE switch to ON.
8. Verify the FREQUENCY MHz display indicates 08-1. Remove the shorting clip.
9. Touch the logic probe to +5V and verify the signature flickers between 0003 and 0001.
10. Verify the following on the front panel:
    a. The right side of the FREQUENCY MHz display cycles between 08 and 0800.
    b. The RANGE dBm display indicates 0.
    c. All red LEDs and all white annunciators, except OVEN COLD and STBY, cycle on and off.
11. If an error is detected, the displays stop cycling and an error code is displayed.

Divide-By-Three Diagnostic (P/O A2A10)

1. Verify conditions are as in paragraphs 1 through 4 of RAM Verification (A2A10) above.
2. Install the RAM Assembly (A2A10) on an extender.
3. Set diagnostic switch A2A8S1 to position A and both switches of NORM/TEST switch A2A10S1 to TEST position.
4. Set LINE switch to ON.
5. Verify the FREQUENCY MHz display indicates 10-1.
6. Touch the RESET probe to +5V and verify the signature is U45H.
7. The signatures listed in Table 8-25 verify the operation of the divide-by-three circuits.
8. If any of the signatures are incorrect, the signatures listed in Table 8-26 can be used to isolate the faulty part.

Table 8-25. Divide-by-Three Circuit Signatures

PIN NO.	SIGNATURE	MNEMONIC
A2A10B 27	CC55	PRW
29	4UOH	A0
33	PPA7	SA2-L
A2A10C 11	U45H	PHE-H
13	PPA7	BD6
16	H9A2	BD0
22	6820	BD2
23	3248	BD1
24	8698	A5
25	C4UU	BD3
26	3CP7	BD4
27	8C35	BD5
28	PPA7	BD7

SERVICE SHEET BD8 (cont'd)

Table 8-26. RAM Assembly Diagnostic

PIN NO.	SIGNATURE	MNEMONIC
U1-1	0000	
2	U45H	PHE-H
3	U45H	
4	4U08	
5	U45H	PHE-H
6	CC55	
8	U45H	
9	42U2	VMA
10	0000	
U2-1	70C7	A12
2	84PA	A11
3	U45H	A15
4	0000	A14
5	0000	A13
6	0000	
8	4U08	
11	CC55	PRW
U3-1	U4HF	
2	5A6P	
3	H9A2	BD0
4	3248	BD1
5	AP83	
6	H564	
7	U032	BD2
8	C4UU	BD3
9	3149	
U3-11	CCH4	
12	A0P8	
13	5FH2	BD4
14	0U19	
15	0000	
U4-1	A1AU	
2	0U19	
3	PPA7	BD7
4	0U19	
5	PPA7	BD6
6	0U19	
7	8C35	BD5
8	5FH2	
9	3CP7	BD4
11	C4UU	BD3
12	0U19	

PIN NO.	SIGNATURE	MNEMONIC
13	U032	BD2
14	AUU1	
15	3248	BD1
16	572H	
17	H9A2	BD0
18	09A5	
U5-3	0000	
4	A0P8	
5	3149	
6	H564	
U5-7	AP83	
8	5A6P	
9	09A5	
10	572H	
11	AUU1	
13	0U19	
14	5FH2	
15	0U19	
16	0U19	
17	0U19	
U6-1	0000	A7
2	70C7	A6
3	8698	A5
4	4A48	A4
5	A9P9	A3
6	63CC	A2
7	2PFF	A1
8	4U0H	A0
18	U45H	
19	70C7	A10
20	4U08	
21	CC55	
22	70C7	A9
23	0000	A8
U7-1	4U0H	A0
2	CC55	PRW
3	U45H	PHE-H
5	PPA7	SA2-L
6	8698	A5
10	CCH4	
11	U4HF	
XA2A10B-4	84PA	A11
6	42U2	VMA

SERVICE SHEET BD8 (cont'd)

Table 8-26. RAM Assembly Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
XA2A10B-11	U45H	A15
12	2PFF	A1
14	0000	A13
16	70C7	A12
18	A9P9	A3
27	CC55	PRW
29	4U0H	A0
33	PPA7	SA2-L
34	0000	A14
35	63CC	A2
36	4A48	A4
XA2A10C-1	70C7	A10
2	70C7	A9
3	0000	A8
4	70C7	A6
11	U45H	PHE-H
13	PPA7	BD6
16	H9A2	BD0
19	0000	A7
XA2A10C-22	6820	BD2
23	3248	BD1
24	8698	A5
25	C4UU	BD3
26	5FH2	BD4
27	8C35	BD5
28	PPA7	BD7

Divide-By-Three Diagnostic (P/O A2A10) (cont'd)

9. Set the LINE switch to STBY.
10. Set NORM/TEST switch A2A10S1 to NORM position.
11. Remove the RAM assembly from the extender and install it in the instrument.

ROM Diagnostic (A2A11)

This diagnostic verifies the correct checksum in the ROM. A similar diagnostic is run every time the Signal Generator is turned on. In this test, the backup copy of the program (in the diagnostic ROM) is used. In addition, the diagnostic ROM checksum is tested.

1. Set LINE switch to STBY.
2. Install the ROM Assembly (A2A11). If not already installed, install the RAM assembly A2A10.
3. Install a shorting clip between A2A8TP5 and TP GND.
4. Install the MPU test connector to the test connectors on top of A2A8 Microprocessor Assembly.
5. Set diagnostic switch A2A8S1 to position 6.
6. Verify the signature analyzer is connected as shown under MPU Free Run Diagnostic (A2A8) paragraph 5.

NOTE

Position 7 is similar to position 6. The only difference is that in position 7 the ROM diagnostic halts on the first error. Use switch position 7 for detecting intermittent problems. Position 6 resumes testing after each error to detect multiple errors.

7. Set LINE switch to ON.
8. Verify the FREQUENCY MHz display indicates 06-1. Remove the shorting clip from A2A8TP5.
9. Verify the FREQUENCY MHz display indicates 0600. If no errors are detected, 00 blinks on and off. If an error is detected, the last two digits of the displayed number indicate which ROM failed. Multiple failures are indicated by a succesion of error numbers. The error numbers and the corresponding failed ROM are shown in Table 8-27.

Table 8-27. ROM Error Codes

Error Code	Defective ROM
06 — 01	A2A11U5
06 — 02	A2A11U6
06 — 03	A2A11U7
06 — 04	A2A8U3

ROM Assembly Check (A2A11)

This diagnostic checks the interconnections between the ROM Assembly (A2A11) and the microprocessor assembly

SERVICE SHEET BD8 (cont'd)

1. Set LINE switch to STBY.
2. Install A2A11 on an extender and install test connector, 08673-60123, and extender cable, 08673-60021, on A2A11J1.
3. Set A2A8S1 to position C.
4. Install shorting clip between A2A8TP5 and TP GND.
5. Set LINE switch to ON.
6. Verify the FREQUENCY MHz display indicates 12-1.
7. Remove shorting clip from TP GND.
8. Frequency MHz display should indicate 1200 if no faults are present. If the indication is 1201 a fault has occurred which probably is in the connections between the microprocessor assembly and A2A11U4. If the indication is 1203, a fault has occurred which is probably in the interconnections of the data lines or buffers. If the indication is 1202, a fault has occurred which is probably associated with A2A11U4 and its interconnections.
9. If any of the displays show a fault has occurred, the signatures shown in Table 8-28 can be used to aid in the isolation of the failed part.
10. Replace the shorting clip and proceed to take the signatures listed in Table 8-28.

Table 8-28. ROM and Converter Signatures

PIN NO.	SIGNATURE	MNEMONIC
U4-21	27PF	PRW
25	6163	E-HPIB
26	4074	D7
27	64FA	D6
28	2960	D5
29	F3UU	D4
30	C274	D3
31	7484	D2
32	7222	D1
33	3C7U	D0
34	468U	RESET-L
35	P672	BA1
36	C496	8A0
38	468U	NMI-L
U5-2	2FF0	BA12
3	PH75	BA7
4	4C02	BA6
5	HF5P	BA5
6	U6AC	BA4
7	2176	BA3
8	49C0	BA2
9	P672	BA1
10	C496	BA0
11	3C7U	D0
12	7222	D1
U5-13	7484	D2
15	C274	D3
16	F3UU	D4
17	2960	D5

SERVICE SHEET BD8 (cont'd)

Table 8-28. ROM and Converter Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
U5-18	64FA	D6
19	4074	D7
21	2FF0	BA10
23	5002	BA11
24	2FF0	BA9
25	3A4H	BA8
U6-2	2FF0	BA12
3	PH75	BA7
4	4C02	BA6
5	HF5P	BA5
6	U6AC	BA4
7	2176	BA3
8	49C0	BA2
9	P672	BA1
10	C496	BA0
11	3C7U	D0
U6-12	7222	D1
13	7484	D2
15	C274	D3
16	F3UU	D4
17	2960	D5
18	64FA	D6
19	4074	D7
21	2FF0	BA10
23	5002	BA11
24	2FF0	BA9
25	3A4H	BA8
U7-2	2FF0	BA12
3	PH75	BA7
4	4C02	BA6
5	HF5P	BA5
6	U6AC	BA4
7	2176	BA3
8	49C0	BA2
9	P672	BA1
10	C496	BA0
11	3C7U	D0
12	7222	D1
13	7484	D2
15	C274	D3
16	F3UU	D4
17	2960	D5
18	64FA	D6
U7-19	4074	D7
21	2FF0	BA10
23	5002	BA11
24	2FF0	BA9
U7-25	3A4H	BA8
U8-1	C1A5	
2	3A4H	BA14
3	3A4H	BA13
4	2FF0	BA10
5	5002	BA11
6	2FF0	BA12
7	HF5P	BA5
8	2FF0	BA9
9	4C02	BA6
10	3A4H	BA8
11	PH75	BA7
U9-2	C1A5	VMA
3	C1A5	BVMA
4	5002	A11
5	5002	BA11
6	C496	A0
7	C496	BA
8	P672	A1
9	P672	BA1
11	49C0	BA2
12	49C0	A2
13	2FF0	BA12
14	2FF0	A12
15	3A4H	BA13
16	3A4H	A13
17	3A4H	BA14
18	3A4H	A14
U10-2	3A4H	A8
3	3A4H	BA8
4	2FF0	A9
5	2FF0	BA9
6	2FF0	A10
7	2FF0	BA10
8	PH75	A7
9	PH75	BA7
11	4C02	BA6
12	4C02	A6

SERVICE SHEET BD8 (cont'd)

Table 8-28. ROM and Converter Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
U10-13	HF5P	BA5
14	HF5P	A5
15	U6AC	BA4
16	U6AC	A4
17	2176	BA3
18	2176	A3
XA11A-4	5002	A11
6	C1A5	VMA
12	P672	A1
13	468U	NM1-L
14	3A4H	A13
16	2FF0	A12
18	2176	A3
26	468U	RESET-L
XA11A-27	27PF	PRW
29	C496	A0
34	3A4H	A14
35	49C0	A2
36	U6AC	A4
XA11C-1	2FF0	A10
2	2FF0	A9
3	3A4H	A8
4	4C02	A6
13	8CH6	BD6
16	H463	BD0
17	6163	E-HPIB
19	PH75	A7
22	CA9H	BD2
23	9H3P	BD1
24	HF5P	A5
25	5H68	BD3
26	2FP3	BD4
27	P779	BD5
28	68C6	BD7

Frequency Output Diagnostic (A2A9)

This diagnostic verifies proper operation of the frequency latches and M and N encoder circuits. A special connection to the signature analyzer clock is needed because some of these circuits are too slow to generate stable signatures with the controller clock.

NOTE

In addition to this diagnostic, the operation of the frequency output section of the A2A9 Assembly can be checked using the special extender (HP Part Number 11726-60003). Note that all boards must be installed in the instrument if the special extender is being used. Refer to Table 8-5 for listings of the M/N numbers and the related frequencies.

1. Set LINE switch to STBY.
2. Verify that A2A1, A2A3, A2A4, A2A5 and A2A8 are the only circuit board assemblies of the A2 Controller that are installed.
3. Install the Frequency Output-HP-IB Assembly (A2A9) on an extender. Do not use the special extender (HP Part Number 11726-60003) as this extender may cause different signatures to be displayed.
4. Set the diagnostic switch A2A8S1 to position 3.
5. Connect the signature analyzer as follows:

Signature Analyzer Lead	Terminal
START	A2A8TP4
STOP	A2A8TP4
CLOCK	A2A9TP2
GND	A2A8TP GND

6. Set the signature analyzer pushbuttons as follows:
   START—OUT (positive edge)
   STOP—IN (negative edge)
   CLOCK—IN (negative edge)
   SELF-TEST—OUT (not activated)
7. Install a shorting clip between A2A8TP5 and TP GND.
8. Connect the MPU test connector to the test connectors on the top of the A2A8 Microprocessor asssembly.
9. Set LINE switch to ON and verify the FREQUENCY MHz display indicates 03-1.
10. Press the logic probe RESET and verify the signature is A52A.

SERVICE SHEET BD8 (cont'd)

Frequency Output Diagnostic (A2A9) (cont'd)

11. The signatures listed in Table 8-29 verify the operation of the output lines of the frequency output section of A2A9. If an incorrect output line signature is found, check the input line signatures listed in Table 8-30.

12. If incorrect signatures show a fault has occurred, the signatures of Table 8-31 can be used to isolate the source of the fault.

Table 8-29. Frequency Diagnostic Output Lines Signatures

PIN NO.	SIGNATURE	MNEMONIC
A2A9A 1	413H	M5
2	0FP0	M3
3	P101	M4
4	7378	M1
5	994A	M2
6	0H32	N5
7	95H0	N6
8	5AFU	N3
9	F813	N4
10	6876	N2
11	693P	N1
21	1H63	800K
22	758P	200K
23	UA07	DAC3200
24	468C	DAC800
25	C253	DAC400
26	H6F1	DAC200
27	1AH5	DAC100
28	1U41	DAC80
29	839U	DAC20
30	PH1A	DAC4800
31	0PC1	1 MHZ
32	8758	2 MHZ
33	F3AF	4 MHZ
34	61H6	8 MHZ
35	H652	DAC 10 MHz
36	912C	DAC 40 MHz
A2A9B 2	C1HP	20K
3	58PU	40K
4	63CH	10K
5	3AF7	400K
6	PC1H	100K
11	AF77	80K
20	3CHU	1K
21	8PU7	4K
22	1HPU	2K
23	F77C	8K
25	A52A	IRQ1B-L

Table 8-30. Frequency Diagnostic Input Lines Signatures

PIN NO.	SIGNATURE	MNEMONIC
A2A9B 12	A52A	A1
16	A52A	A2
26	A52A	RESET-L
27	0000	PRW
29	0000	A0
33	0000	SA2-L
34	A52A	E-HPIB
35	0000	SC1-L
36	0000	A4
A2A9C 5	0000	BD2
6	A52A	BD1
8	A52A	BD4
9	A52A	BD6
16	A52A	BD0
23	0000	BD3
24	0000	BD5
25	0000	BD7

Table 8-31. Frequency Output — HP-IB Assembly Diagnostic

PIN NO.	SIGNATURE	MNEMONIC
U1-2	H46U	
3	872F	
4	A52A	
5	F680	
6	H46U	
7	92P4	
10	468C	
11	UA07	
12	4830	
U2-1	UA07	
3	468C	
5	C253	
7	H6F1	
9	1AH5	
10	693P	
11	6876	

SERVICE SHEET BD8 (cont'd)

Table 8-31. Frequency Output — HP-IB Assembly Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
U2-12	5AFU	
13	F813	
14	P028	
U3-1	PH1A	
2	CUUU	
3	1UF3	
5	P101	
6	1AH5	
7	5PUP	
10	442C	
11	P417	
13	0H32	
14	95H0	
U4-3	1U41	
4	CUUU	
5	912C	
7	839U	
9	1AH5	
10	3F60	
11	A95A	
12	5PUP	
13	P101	
14	1UF3	
15	1AH5	
U5-2	0H80	
3	8UF3	
4	F794	
5	PH44	
6	0H80	
7	HC41	
10	H6F1	
U5-11	C253	
12	93P4	
13	F680	
14	872F	
15	F794	
XA9A-1	413H	M5
2	0FP0	M3
3	P101	M4
4	7378	M1
5	994A	M2

PIN NO.	SIGNATURE	MNEMONIC
XA9A-6	0H32	N5
7	95H0	N6
8	5AFU	N3
9	F813	N4
10	6876	N2
11	693P	N1
21	1H63	800K
22	758P	200K
23	UA07	DAC 3200 MHz
24	468C	DAC 800 MHz
25	C253	DAC 400 MHz
26	H6F1	DAC 200 MHz
27	1AH5	DAC 100 MHz
28	1U41	DAC 80 MHz
29	839U	DAC 20 MHz
30	PH1A	DAC 4800 MHz
XA9A-31	OPC1	DAC 1 MHz
32	8758	DAC 2 MHz
33	F3AF	DAC 4 MHz
34	61H6	DAC 8 MHz
35	H652	DAC 10 MHz
36	912C	DAC 40 MHz
XA9B-2	C1HP	20K
3	58PU	40K
4	63CH	10K
5	3AF7	400K
6	PC1H	100K
11	AF77	80K
12	A52A	A1
16	A52A	A2
20	3CHU	1K
21	8PU7	4K
22	1HPU	2K
23	F77C	8K
25	A52A	IRQ1B-L
29	0000	A0
33	0000	SA2-L
35	0000	SC1-L
36	0000	A4
XA9C-5	0000	BD2
6	A52A	BD1
8	A52A	BD4
XA9C-9	A52A	BD6
16	A52A	BD0
23	0000	BD3
24	0000	BD5
25	0000	BD7

SERVICE SHEET BD8 (cont'd)

HP-IB Diagnostic (A2A9)

This diagnostic verifies that most of the HP-IB circuits are nominally working. It does not verify that the Signal Generator can listen or respond to some of the signals that are tested in the Operator's Checks in Section III. The front panel HP-IB status indicators are not programmed for this diagnostic.

NOTE

In addition to this diagnostic, there are two other methods to check the HP-IB. The first is to perform the Remote Operator's Check in Section III and troubleshoot the specific lines that do not respond correctly. (Affected lines are identified in Section III text that describes each of the tested messages.) The other is to perform the External Controller HP-IB Diagnostic Procedure that is located after these diagnostics. It is sometimes more convenient to use more than one method to isolate a fault.

1. Set LINE switch to STBY.
2. Set HP-IB address switch A2A9S1 to 0011 0011. This is the factory setting for the switch and is required to run this diagnostic correctly.
3. Disconnect HP-IB connector on rear panel.
4. Install a shorting clip between A2A8TP5 and TP GND and the MPU connector on top of A2A8.
5. Set diagnostic switch A2A8S1 to position 2.
6. Connect the clock input of the signature analyzer to A2A8TP3.
7. Set LINE switch to ON and verify the FREQUENCY MHz display indicates 02-1.
8. Remove the shorting clip from A2A8TP5 and verify the FREQUENCY MHz indicates 00110011 (the setting of A2A9S1).
9. Set the LINE switch to STBY. Install a shorting clip between A2A8TP5 and TP GND. Set LINE switch to ON.
10. Press the logic probe RESET and verify the signature is CA25.
11. The signatures listed in Table 8-32 verify the operation of the output lines of the HP-IB section of A2A9. If one or more of the signatures are incorrect, check the input lines signatures listed in Table 8-33.

Table 8-32. HP-IB Diagnostic Output Lines Signatures

CONNECTOR	SIGNATURE	MNEMONIC
A2A9B 14	7CH9	DIO6
A2A9C 7	CA25	EOI
11	CU22	DIO1
12	F8U4	DIO2
13	8888	DIO3
14	U21P	DIO4
15	U890	DIO5
17	4A65	DIO7
18	FUFH	DIO8
19	CA25	ATN
20	CA25	SRQ
26	CA25	REN
27	CA25	IFC
28	CA25	NRFD
29	CA25	NDAC
30	CA25	DAV

Table 8-33. HP-IB Diagnostic Input Lines Signatures

CONNECTOR	SIGNATURE	MNEMONIC
A2A9B 12	P4AC	A1
15	3F76	SA3-L
16	P270	A2
26	CA25	RESET-L
27	0UF9	PRW
29	3C25	A0
33	CU0U	SA2-L
34	C5PF	E-HPIB
35	CH1A	SC1-L
36	PU59	A4
A2A9C 5	H8F1	BD2
6	6P92	BD1
8	9509	BD4
9	45H1	BD6
16	A40F	BD0
23	15FU	BD3
24	U5C7	BD5
25	6FH1	BD7

12. If any incorrect signatures occur, Table 8-34 can be used to isolate the source of the fault.

SERVICE SHEET BD8 (cont'd)

13. Remove the A2A9 Assembly from the extender and install it in the instrument.

NOTE

If necessary, return the HP-IB address switch to its previous setting.

Table 8-34. HP-IB Diagnostic Signatures

CONNECTOR	SIGNATURE	MNEMONIC
U6-8	0UF9	
10	0UF9	PRW
11	3FU7	
13	3F76	SA3-L
U7-1	CA25	RESET-L
2	CA25	RESET-L
3	0000	
4	86H2	
5	C5PF	
6	0UF9	
8	891C	
9	0UF9	PRW
10	86H2	
11	CA25	
12	0UF9	PRW
13	C5PF	E-HPIB
U8-1	3C25	A0
2	P4AC	A1
3	P270	A2
4	CH1A	SC1-L
5	CU0U	SA2-L
12	A52A	80B
13	A52A	80A
14	A52A	809
15	A52A	808
U9-1	PU59	A4
2	557F	
5	C5PF	E-HPIB
6	0UF9	
10	C5PF	
11	0UF9	
12	86H2	
13	3FU7	
U10-1	7FH7	
2	7FH7	
3	C5PF	E-HPIB
4	0000	
8	3FU7	
9	CA25	
10	0UF9	
U10-12	CA73	
13	FU7P	
14	92A9	
15	9U8F	
16	FC36	
17	5763	
18	7C58	
19	3171	
21	3C25	
22	P4AC	
23	P270	A4
24	CA25	IFC
25	CA25	REN
26	CA25	ATN
27	CA25	SRQ
28	CU22	IB1
29	F8U4	IB2
30	8888	IB3
31	U21P	IB4
32	U890	IB5
33	7CH9	IB6
34	4A65	IB7
35	FUFH	IB8
36	FUFH	IB8
37	CA25	NRFD
38	CA25	NDAC
39	CA25	E01
U11-1	7FH7	
2	CU22	DI01
3	F8U4	DI02
4	8888	DI03
5	U21P	DI04
6	U890	DI05
7	7CH9	DI06
8	4A65	DI07
9	FUFH	DI08
10	7FH7	

HP-IB Diagnostic — Talk Only Mode

In this test, the controller reads the address switch on top of the A2A8 Microprocessor Assembly and displays the switch setting on the FREQUENCY MHz display. It then puts the instrument into the

SERVICE SHEET BD8 (cont'd)

talk only mode and transmits data on the HP-IB. All 8 bit values from 0 to 255 are sent continuously. This data can be read and analyzed by an external controller.

1. Set the LINE switch to STBY.
2. Set test switch A2A8S1 on the Microprocessor Assembly to position 2.
3. Connect the MPU test connector (HP Part Number 11726-60001) to the test connectors on top of the A2A8 assembly.
4. Install a shorting clip between A2A8TP5 and the adjacent TP GND.
5. Set the LINE switch to ON.
6. Remove the short from A2A8TP5. Verify the FREQUENCY MHz display indicates the HP-IB address switch setting. If a Signal Generator addressing problem is suspected, change the address switch to several positions and check that each setting appears in the FREQUENCY MHz display as it is changed.

NOTE

Disregard the front panel HP-IB annunciators for this diagnostic.

7. Figure 8-54 is a sample program for the HP 9825A (HPL) or the HP 85 (BASIC) computing controllers. It reads the data the Signal Generator is sending on the HP-IB and checks that it is correct. Connect the HP-IB cable to the Signal Generator and run the program. If operation is normal, the controller display will contain "PASSED".
8. If the program is running for more than about 5 seconds on the HP 9825A or more than 20 seconds on the HP 85F, it is likely that the program is not reading data but is waiting because the Signal Generator is not "handshaking" properly. In this case the program will stay hung-up and the problem is most likely the HP-IB interface (A2A9U10) or transceiver (A2A9U22). Check the "handshaking" lines to find the cause.
9. If the data is read but is not correct, an error printout occurs. A sample error printout is shown in Figure 8-53. The 8 bit data bytes received are on the left and their decimal equivalent are on the right. The data goes from 0 to 255 and repeats. The controller starts reading anywhere in the cycle and reads 256 values. After reading all the values, the data is analyzed and data values near where the error was detected are printed. Analyzing the printout can often detect a bit stuck high or low. The sample printout in Figure 8-53 shows the DIO7 line stuck in the one state.

ERROR		ERROR	
BINARY	DECIMAL	BINARY	DECIMAL
11111010	250	(Cont'd)	(Cont'd)
11111011	251	01000101	69
11111100	252	01000110	70
11111101	253	01000111	71
11111110	254	01001000	72
11111111	255	01001001	73
01000000	64	01001010	74
01000001	65	01001011	75
01000010	66	01001100	76
01000011	67	01001101	77
01000100	68	01001110	78

Figure 8-53. Sample Error Printout

I/O Assembly Talk-Around Diagnostic (A2A7)

1. Install the I/O Assembly on an extender.
2. Set the Options Configuration Switches A2A7S1 to the OFF position.
3. Install the MPU Connector on top of A2A8 and a shorting clip between A2A8TP5 and TP GND.
4. Set the diagnostic switch A2A8S1 to 4.
5. Connect the power cord and set the LINE switch to ON.
6. Table 8-37 can be used to isolate the source of the malfunction. A recommended procedure is to first, verify the signatures at the edge connectors and second, locate the malfunction associated with the faulty line.
7. Disconnect the power cord.
8. Disconnect the MPU test connector, the shorting clip and the signature analyzer from A2A8.
9. Restore the Options Configuration Switches so that switches C, E and G are closed.
10. Install A2A7 in the instrument.

DESCRIPTION	SAMPLE PROGRAMS: HP 9825A (HPL)	SAMPLE PROGRAMS: HP 85F (BASIC)

Reserve space in memory for arrays A and A$.
Display "PROGRAM RUNNING" (BASIC only).
	`0: dim A[300],A$[8];fxd 0`	`10 OPTION BASE 1`
		`20 DIM A(300),A$[8]`
		`25 DISP "PROGRAM RUNNING"`

Reads 300 values from the HP-IB into array A.	`1: for I=1 to 300`
	`2: rdb(700)→A[I]`
	`3: next I`
		`30 FOR I=1 TO 300`
		`40 ENTER 700 USING "#,B" ; A(I)`
		`60 NEXT I`

Display "ALMOST DONE" (BASIC only). Check that each reading increases by 1. When the reading is 0, the sequence starts over.	`4: for J=1 to 256`
	`5: if A[J+1]=0;gto +2`
	`6: if A[J]+1#A[J+1];gto "error"`
	`7: next J`
		`65 DISP "ALMOST DONE"`
		`70 FOR J=1 TO 256`
		`90 IF A(J+1)=0 THEN 110`
		`100 IF A(J)+1<>A(J+1) THEN 140`
		`110 NEXT J`

Print or display "Passed" or "Error".	`8: prt "PASSED";stp`
	`9: "error":`
	`10: prt "ERROR"`
		`120 DISP "PASSED"`
		`130 STOP`
		`140 PRINT "ERROR"`

If an error was detected, start printing 5 readings before the error occurred.	`11: J-5→K` `12: if K<1;1→K`	`150 K=J-5` `160 IF K<1 THEN K=1`
Print 20 readings.	`13: for L=K to K+20`	`170 FOR L=K TO K+20`

Convert the numeric value of the reading to binary and store in string array A$.	`14: A[L]→V`
	`15: for M=1 to 8`
	`16: 2^(8-M)→B`
	`17: "0"→A$[M,M]`
	`18: if V>=B;"1"→A$[M,M];V-B→V`
	`19: next M`
		`180 V=A(L)`
		`190 FOR M=1 TO 8`
		`200 B=2^(8-M)`
		`210 A$[M,M]="0"`
		`220 IF V<B THEN 250`
		`230 A$[M,M]="1"`
		`240 V=V-B`
		`250 NEXT M`

Print the reading in Binary (Array A$) and decimal form.	`20: prt A$,A[L]` `21: next L`	`260 PRINT A$,A(L)` `270 NEXT L`
	`22: stp`	`280 END`

Figure 8-54. HP 9825A and HP 85F Sample Program Listing

SERVICE SHEET BD8 (cont'd)

Table 8-35. I/O Assembly Diagnostic Signatures (1 of 5)

PIN NO.	SIGNATURE	MNEMONIC
U1-1	0000	
2	H6A6	LFS UNLOCKED
3	0000	M/N UNLOCKED
4	H6A6	TP2
5	0000	REF UNLOCKED
7	0000	GND
14	H6A6	+5V
U2-1	P604	A3
2	5659	
3	1F3F	
4	5659	
5	P604	A3
6	CUPH	
7	0000	GND
8	8U97	CB2
9	H6A6	
10	5931	
11	289U	
12	1F3F	
13	3485	PRW
14	H6A6	+5V
U3-1	0000	GND
2	0000	GND
3	289U	
5	H6A6	+5V
6	5931	
7	0000	GND
9	H6A6	+5V
11	0000	GND
14	H6A6	+5V
U4-1	289U	
7	0000	GND
8	H6A6	
9	0000	VUP
10	H6A6	VDN
14	H6A6	+5V
U5-1	75U2	A0
2	224H	A1
3	P198	
4	C380	SA2-L
5	F9FU	SC2-L

PIN NO.	SIGNATURE	MNEMONIC
U5-6	H6A6	+5V
7	0A90	817
8	0000	GND
9	H6A6	816
13	7810	812
14	PA05	811
15	HP14	810
16	H6A6	+5V
U6-1	0U42	
2	H6A6	+5V
3	P223	E-PIA
4	H6A6	TP3
5	0U42	
6	H9P4	
7	0000	GND
9	H6A6	NSTRB
10	H6A6	STRB DIS
11	P223	E-P1A
12	0U42	
13	H6A6	+5V
14	H6A6	+5V
U7-1	3485	PRW
2	1C8F	
3	U0U9	BD0
4	UP98	BD1
5	8UUC	
6	98U5	
8	43AA	BD3
9	7058	END SWP
10	0000	GND
11	7810	812
12	44A1	TRIGGER OUTPUT
13	8UP7	BD4
14	0A71	BD5
15	1O1F	
17	1A8A	BD6
19	3UCA	
20	H6A6	+5V
U9-1	UP39	
2	289U	
7	0000	GND
8	H6A6	
9	0000	LEV UNLOCK
12	H6A6	

SERVICE SHEET BD8 (cont'd)

Table 8-35. I/O Assembly Diagnostic Signatures (2 of 5)

PIN NO.	SIGNATURE	MNEMONIC
U9-13	0000	
14	H6A6	+5V
U10-1	0000	FM OM
3	0000	P82
4	UNSTABLE	CB2
5	H6A6	PB0
7	H6A6	UNLOCK
8	0000	GND
9	H6A6	
11	H6A6	PB1
12	UNSTABLE	CB2
13	0000	P83
15	0000	EXT REF
16	H6A6	+5V
U11-1	0000	GND
2	H6A6	K0
3	H6A6	K1
4	H6A6	K2
5	H6A6	K3
6	H6A6	K4
7	H6A6	K5
8	H6A6	K6
9	0000	GND
10	H6A6	PB0
11	H6A6	PB1
12	0000	PB2
13	0000	PB3
14	U004	PB4
15	06UU	PB5
16	9HA2	PB6
17	37P6	PB7
18	H6A6	CB1
19	UNSTABLE	CB2
20	H6A6	+5V
21	3485	PRW
22	7568	VMA
23	80UU	SA3-L
24	P604	A3
25	P223	E-PIA
26	3CHH	D7
27	H7A3	D6
28	A67U	D5
29	05H2	D4

PIN NO.	SIGNATURE	MNEMONIC
U11-30	UU91	D4
31	13U5	D2
33	144U	D0
34	H6A6	RESET-L
35	224H	A1
36	75U2	A0
37	H6A6	IRQB-L
38	H6A6	IRQA-L
39	9638	KACK-L
40	H6A6	KDN-L
U12-1	CUPH	
2	U0U9	BD0
3	144U	D0
4	UP98	BD1
5	C670	D1
7	13U5	D2
8	43AA	BD3
9	UU91	D3
10	0000	GND
11	43AA	BD3
12	UU91	D3
14	13U5	D2
15	22AP	BD1
16	C670	D1
17	U0U9	BD0
18	144U	D0
19	1F3F	
20	H6A6	+5V
U13-1	CUPH	
2	8UP7	BD4
3	05H2	D4
4	0A71	BD5
5	A67U	D5
6	1A8A	BD6
7	H7A3	D6
9	3CHH	D7
10	0000	GND
12	3CHH	D7
13	1A8A	BD6
14	H7A3	D6
15	0A71	BD5
16	A67U	D5
17	8UP7	BD4
18	05H2	D4

SERVICE SHEET BD8 (cont'd)

Table 8-35. I/O Assembly Diagnostic Signatures (3 of 5)

PIN NO.	SIGNATURE	MNEMONIC
U12-19	1F3F	
20	H6A6	+5V
U14-1	0000	
2	0000	GND
3	0000	
4	25PF	
5	3960	
6	C172	
7	P825	
8	9P79	
9	93FF	
10	59CC	
11	6677	
12	04U8	
13	85AA	
14	H6A6	+5V
15	0000	GND
U15-2	U0U9	BD0
3	PA05	811
5	3960	
7	0000	GND
9	25PF	
11	PA05	811
12	22AP	BD1
14	H6A6	+5V
U16-2	4P43	BA1
4	224H	A1
5	75U2	A0
7	U6F2	BA0
8	0000	GND
9	0U42	
10	0606	BA3
12	P604	A3
13	P198	A2
15	12FF	BA2
16	H6A6	+5V
U19-1	0000	PB3
2	0000	GND
3	H6A6	+5V
4	0000	GND
6	UP39	
8	0000	GND
9	H6A6	PB0

PIN NO.	SIGNATURE	MNEMONIC
U19-10	U004	PB4
11	H6A6	PB1
12	06UU	PB5
13	9HA2	PB6
14	0000	PB2
15	37PC	PB7
16	H6A6	+5V
U20-1	0A90	817
2	H6A6	VDN
3	U0U9	BD0
4	0000	VUP
5	22AP	BD1
8	H6A6	STOP SWEEP
9	43AA	BD3
10	0000	GND
11	8UP7	BD4
12	0000	BIAS TRK
13	0A71	BD5
14	H6A6	CB1
15	1A8A	BD6
16	8U97	CB2
19	0A90	817
20	H6A6	+5V
U21-1	0000	GND
2	2143	DATA 7
4	1A8A	BD6
5	0070	DATA 6
6	59AP	DATA 5
7	0A71	BD5
8	8UP7	BD4
9	9142	DATA 4
10	0000	GND
11	0U42	
12	67FH	DATA 0
13	U0U9	BD0
14	AP	BD1
15	P5AA	DATA 1
16	91CU	DATA 2
18	43AA	BD3
19	A3A3	DATA 3
20	H6A6	+5V
U22-1	0000	GND
2	59CC	
3	43AA	BD3

SERVICE SHEET BD8 (cont'd)

Table 8-35. I/O Assembly Diagnostic Signatures (4 of 5)

PIN NO.	SIGNATURE	MNEMONIC
U22-5	6677	
6	04U8	
7	22AP	BD1
8	U0U9	BD0
9	85AA	
10	0000	GND
11	HP14	810
12	93FF	
13	8UP7	BD4
14	0A71	BD5
15	9P79	
16	P825	
17	1A8A	BD6
19	C172	
20	H6A6	+5V
U24-1	0000	GND
2	0000	GND
3	3485	PRW
4	3485	PRW
5	3485	PRW
6	H9P4	
7	0000	GND
8	0000	
9	1P3C	SC0-L
10	A453	SC1-L
11	A453	SC1-L
12	0U42	SB4-L
13	0U42	SB4-L
14	H6A6	+5V
U26-1	H6A6	816
2	H6A6	S1H
3	U0U9	BD0
4	H6A6	S1F
5	22AP	BD1
6	H6A6	S1D
8	H6A6	S1B
9	43AA	BD3
10	0000	GND
11	8UP7	BD4
12	H6A6	S1A
13	0A71	BD5
14	H6A6	S1C
15	1A8A	BD6
16	H6A6	S1E
18	H6A6	S1G
19	H6A6	816
U26-20	H6A6	+5V
XA7A-1	0000	M/N UNLOCKED
2	0000	EXT REF OVEN
4	H6A6	MONITOR LFS
7	H6A6	UNLOCKED
8	H6A6	K0
9	H6A6	K2
10	H6A6	K4
11	H6A6	K6
12	0000	VUP
13	H6A6	KDN-L
15	2143	DATA 7
16	59AP	DATA 5
17	A3A3	DATA 3
18	P5AA	DATA 1
20	0000	REF UNLOCKED
22	0000	BIAS TRK
26	9638	KACK-L
27	H6A6	K1
28	H6A6	K3
29	H6A6	K4
30	0000	BUFFERED YIG OUT
31	0000LEV	
32	0000	FM OM
33	0070	DATA 6
34	9142	DATA 4
35	91CU	DATA 2
36	67FH	DATA 0
XA7B-1	H6A6	+5V
2	46F2	BA0
3	0000	GND
4	H6A6	OVEN OK
5	H6A6	NSTRB
6	7568	VMA
7	H6A6	IRQA-L
8	H6A6	VDN
10	0000	GND
12	224H	A1
15	80UU	SA3-L
18	P604	A3
19	H6A6	+5V
20	12FF	BA2
22	0606	BA3

SERVICE SHEET BD8 (cont'd)

Table 8-35. I/O Assembly Diagnostic Signatures (5 of 5)

PIN NO.	SIGNATURE	MNEMONIC
XA7B-23	4P43	BA1
24	H6A6	IRQB-L
26	H6A6	RESET-L
27	3485	PRW
28	0000	GND
29	75U2	A0
30	1P3C	SC0-L
31	0000	SB4-L
35	P198	A2
XA7C-2	A453	SC1-L
4	F9FU	SC2-L
5	22AP	BD1

PIN NO.	SIGNATURE	MNEMONIC
XA7C-7	8UP7	BD4
8	1A8A	BD6
9	0000	VTI-L
12	4P53	PEN LIFT TRIGGER
13	U4A1	OUTPUT
14	H6A6	STOP SWEEP
16	U0U9	BD0
20	P223	E-PIA
21	H6A6	BD3
22	0A71	BDS
29	7058	END SWP

Table 8-36. Key Code Patterns

Function Key	Key-Code Pattern							Input Pair Verified		IF Key-Code Pattern Incorrect	
	K6	K5	K4	K3	K2	K1	K0	Row	Column	Key to be Depressed to Verify Row	Key to be Depressed to Verify Column
1		L	L				L	KR1	C3L	9	2
ΔF		L	L	L		L		KR2	C3H	2	9
TUNE	L				L			KR3	C4L	3	LOCAL
ALC INT	L			L				KR0	C4H	0	RF ON/OFF
FREQ DECR	L		L		L			KR4	C5L	4	START
PULSE OFF	L		L	L	L		L	KR5	C5H	5	FM3
FM3	L	L			L	L		KR6	C66	6	FM1
SERVICE FUNC.	L	L		L	L	L	L	KR7	C6H	7	SINGLE

Key Code Assembly (A2A2) Checks

1. Set LINE switch to STBY.
2. Install the A2A2 Key-Code Assembly in the instrument.
3. Set LINE switch to ON.
4. Verify all seven keyboard status indicators on top of the Key-Code Assembly are lit when no front panel keys are pressed.
5. Depress the keys indicated in Table 8-36 and verify the indicator pattern.
6. If a pattern of Step 5 cannot be verified, install the Key-Code Assembly on an extender card, replace in the instrument and check the appropriate input pair.
7. If, after the second key is depressed, no further keys when depressed will cause instrument changes, check to see that KACK-L at XA2-24 goes low after a key is depressed. If KACK-L does go low or is low after a key is depressed, there is a fault in the input to the Key Code Card. If KACK-L does not go low, then there is a fault in the I/O Assembly A2A7.

SERVICE SHEET BD8 (cont'd)

DAC and Enable Assembly (A1A5)

This test verifies performance of the digital portions of the DAC and Enable Board Assembly. The three DACs on the board are programmed in ramps covering their full output range. An oscilloscope can be used to verify monotonicity and adjustment of their output voltages.

1. Set the line switch to STBY and disconnect the power cord.
2. Set Diagnostic Switch (A2A8S1) to position 5.
3. Connect the MPU connector (HP Part No. 11726-60001) to the test connectors on top of the A2A8 assembly.
4. Install a shorting clip between A2A8TP5 and the adjacent TP GND.
5. Install power cord and set line switch to ON.
6. Verify the FREQUENCY MHz display indicates 05-1.
7. Touch the signature probe to +5V and verify the signature is C37F.
8. Table 8-37 lists the signatures for the DAC and Enable Board Assembly.

Table 8-37. DAC and Enable Diagnostic Signatures

PIN NO.	SIGNATURE	MNEMONIC
U1-1	0000	GND
2	8958	DATA 0
3	U194	DATA 1
4	9F1C	DATA 2
5	39P1	DATA 3
6	H551	DATA 4
7	6H90	DATA 5
8	71A2	DATA 6
9	8F48	DATA 7
10	8958	DATA 0
11	U194	DATA 1
12	2079	NEN12
13	A90C	NEN13
14	C37F	
15	C37F	
16	0000	GND
17	C37F	
U1-19	0000	−15V
20	5P61	
21	C37F	+5V
22	0000	
23	0000	
24	0000	GND
U2-1	0000	GND
2	8958	DATA 0
3	U194	DATA 1
4	9F1C	DATA 2
5	39P1	DATA 3
6	H551	DATA 4
7	6H90	DATA 5
8	71A2	DATA 6
9	8F48	DATA 7
10	1603	NEN10
12	C37F	
13	C37F	
14	C37F	
15	0000	
16	0000	
17	0000	−15V
18	UNSTABLE	PK DAC
19	C37F	+15V
20	0000	
21	0000	
22	0000	GND
U3-1	8958	DATA 0
2	075P	LOCAL
3	C422	REMOTE
4	HA66	EN11
5	9A20	FM40
7	U194	DATA 1
8	0000	GND
9	9F1C	DATA 2
11	A7PC	
12	HA66	EN11
14	40U2	NSHDN
15	39P1	DATA 3
16	C37F	+5
U4-1	0000	GND
2	8958	DATA 0
3	U194	DATA 1
4	9F1C	DATA 2

SERVICE SHEET BD8 (cont'd)

Table 8-37. DAC and Enable Diagnostic Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
U4-5	39P1	DATA 3
6	H551	DATA 4
7	6H90	DATA 5
8	71A2	DATA 6
9	8F48	DATA 7
10	U2FP	NEN9
12	0000	
13	C37F	+5V REF
14	C375	+5V REF
16	0000	
17	0000	−15V
18	252P	TP8
19	C37F	+15V
20	0000	
21	0000	
22	0000	GND
U8-1	1641	NEN1
2	AC53	NEN2
3	3065	NEN3
4	U867	NEN4
5	CAFA	NEN5
6	8C64	NEN6
7	A5CU	NEN7
8	802P	NEN8
9	U2FP	NEN9
10	1603	NEN10
11	691A	NEN11
12	0000	GND
13	2079	NEN12
14	A90C	NEN13
18	658A	NSTRB
19	0000	GND
20	1H0F	BA3
21	PAH6	BA2
22	PU34	BA1
23	1PP5	BA0
24	C37F	+5V
U9-1	0000	GND
2	1641	NEN1
3	182U	EN2
4	3065	NEN3
5	4C1C	EN4
6	CAFA	NEN5
7	3818	EN6
8	A5CU	NEN7
9	3352	EN8
10	0000	GND
11	802P	NEN8
12	16F3	EN7
13	8C64	NEN6
14	09C6	EN5
15	U867	NEN4
16	8319	EN3
17	AC53	NEN2
18	A53H	EN1
19	0000	GND
20	C37F	+5V
U12-1	P281	
2	C422	REMOTE
5	C422	REMOTE
7	0000	GND
8	C37F	
9	C37F	
10	C37F	
11	C37F	
12	C37F	
13	C37F	
14	C37F	+5V
XA5-1	0000	GND
2	C37F	+5V
6	0000	GND
7	9A20	FM40
8	C37F	PWR UP
9	0000	ALC REF
10	0000	ALC REF GND
11	A53H	EN1
12	182U	EN2
13	8319	EN3
14	4C1C	EN4
15	09C6	EN5
16	3818	EN6
17	16F3	EN7
18	3352	EN8
19	0000	B1A51
20	40U2	NSHDN
22	C37F	+5V REF
23	0000	GND
24	C37F	+5V

SERVICE SHEET BD8 (cont'd)

Table 8-37. DAC and Enable Diagnostic Signatures (cont'd)

PIN NO.	SIGNATURE	MNEMONIC
XA5-28	658A	NSTRB
29	1PP5	BA0
30	PU34	BA1
31	PAH6	BA2
32	1H0F	BA3
33	H9CF	RF ON
35	8958	DATA 0
36	U194	DATA 1
37	951C	DATA 2
38	39P1	DATA 3
39	H551	DATA 4
40	6H90	DATA 5
41	71A2	DATA 6
42	8F48	DATA 7
43	910U	BIAS 2

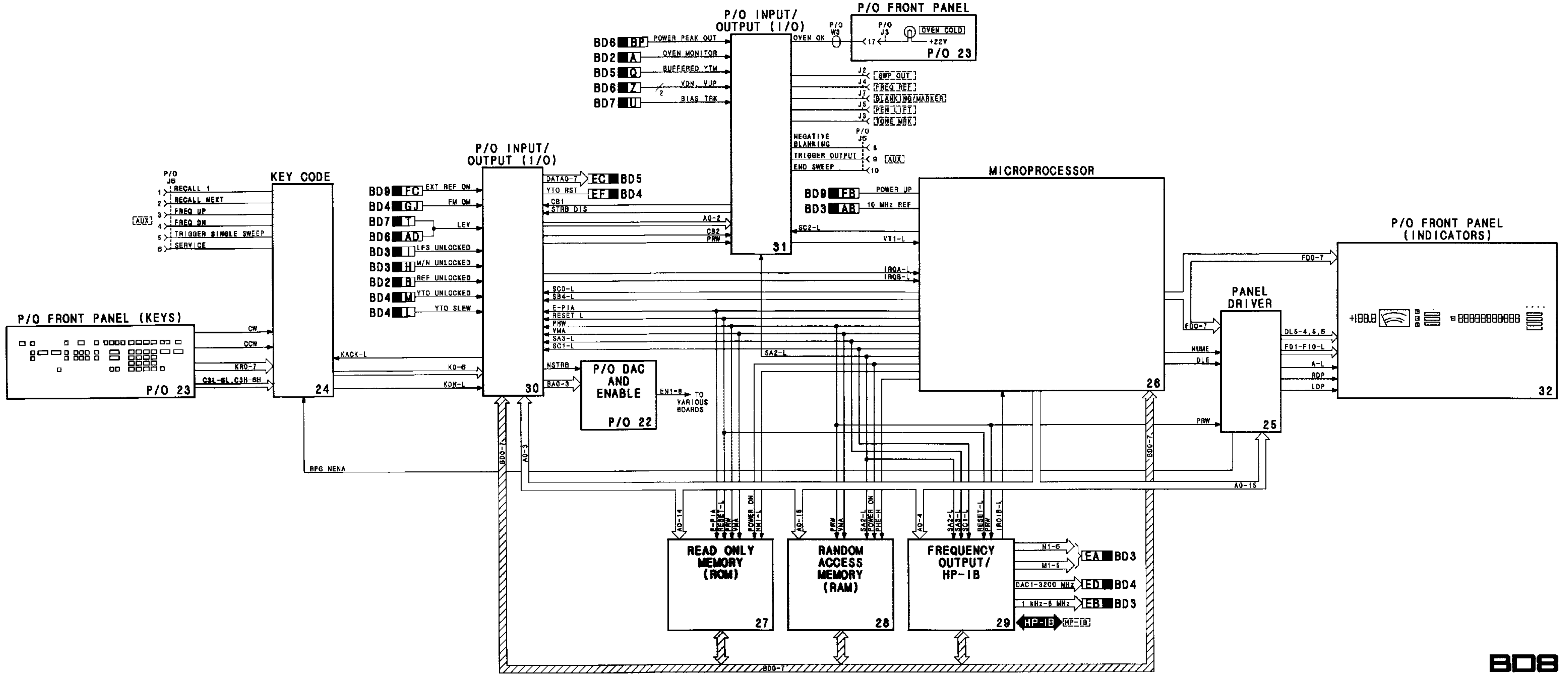


Figure 8-55. HP 8673E Controller Assembly, Block Diagram

SERVICE SHEET BD9
POWER SUPPLIES

REFERENCES

- Overall Block Diagram and Troubleshooting, BD1 ...... Service Sheet BD1
- Disassembly Procedures ...... Service Sheet A
- Interior Views ...... Service Sheets B
- Replaceable Parts List ...... Section VI
- Illustrated Parts Breakdown (IPB) ...... Section VI
- Post Repair Adjustments ...... Section V

PRINCIPLES OF OPERATION

Power supplies in A3 RF Source Assembly generate all dc operating voltages for the instrument. Voltages provided are as follows:

+22 Vdc
+20 Vdc
+10 Vdc
+5.2 Vdc
−5.2 Vdc
−10 Vdc
−40 Vdc

The power supply section consists of four parts:

- Mainframe Components
- Rectifier Assembly A3A1
- Positive Regulator Assembly A3A3
- Negative Regulator Assembly A3A4

Mainframe components consist of the input filter, power transformer, series pass transistors, filter capacitors, fan and power-on relay. These components serve to filter and regulate input power. The relay applies ac to the fan when instrument ac line is ON. An indicator, located on the motherboard on the bottom of the instrument, is turned on whenever ac voltages are present on the A3 motherboard.

Rectifier Assembly A3A1 rectifies all ac secondary voltage inputs to the power supplies. Unregulated dc is then routed to the appropriate regulator assemblies. Regulated +22 Vdc is generated on this assembly.

Positive Regulator Assembly A3A3 contains the +20 Vdc regulator, its overvoltage protection circuit, the front panel shutdown circuit, 10 MHz oscillator power supply, power up/down detector, the +5.2 Vdc regulator and its overvoltage protection circuit. The oscillator power supply is controlled by the rear panel INT/EXT switch.

Negative Regulator Assembly, A3A4, contains the −10 Vdc regulator, −5.2 Vdc Regulator, Switched −10 Vdc output and the −40 Vdc regulator and its associated overvoltage protection circuits.

TROUBLESHOOTING

General

It is assumed that the troubleshooting procedures associated with BD1 have been used to isolate a problem to one of the power supplies. The following troubleshooting

SERVICE SHEET BD9 (cont'd)

procedures can be used to further isolate the problem to one of the following:

Front Panel Assembly — Service Sheet 23
Rectifier Assembly — Service Sheet 33
Positive Regulator Assembly — Service Sheet 34
Negative Regulator Assembly — Service Sheet 35

Test Equipment Required

Digital Voltmeter ...... HP 3456A

Procedures

The following procedures are divided into checks as follows:

Rectifier Assembly Check
+22 Volt Check (✓1)

Positive Regulator Assembly Checks
+20 Volt Check (✓2)
+5.2 Volt Check (✓3)
+11 Volt Switched Check (✓4)

Negative Regulator Assembly Checks
−10 Volt Check (✓5)
−5.2 Volt Check (✓6)
−40 Volt Check (✓7)
−10 Volt Check (✓8)

Rectifier Assembly Checks. Rectifier Assembly A3A1 provides a regulated +22 volts as well as the unregulated voltages for the Positive and Negative Regulators. This procedure checks the +22 Volt regulated output.

+22 Volt Checks (✓1)

1. Connect the DVM to A3A1TP1.

The DVM should indicate +22 ±0.02 Vdc

If the indication is incorrect, attempt to adjust the voltage to +22.00 volts using A3A1R2.

If the indication is correct, or if the voltage can be adjusted to +22.00 volts, proceed with the next check.

If the indication is incorrect and cannot be adjusted to +22.00 volts, the Rectifier Assembly is defective. Go to Service Sheet 33 to isolate the problem.

Positive Regulator Assembly. Positive Regulator Assembly A3A3 provides the following voltages:

+20 Vdc
+5.2 Vdc
+11 Vdc Switched

Each is checked separately.

SERVICE SHEET BD9 (cont'd)

+20 Volt Check (✓2)

2. Connect DVM to A3A3TP5.

   The DVM should indicate +20 ±0.002 Vdc.

   If the indication is not correct, attempt to adjust the voltage to +20.000 Vdc using A3A3R50.

   If the voltage is correct, or if it can be adjusted, proceed with Step 4.

   If the voltage cannot be adjusted, proceed with Step 3 to isolate the problem.

3. Connect DVM to A3A3TP4.

   The DVM should indicate between 27 and 33 Vdc.

   If the DVM indication is not correct, the Rectifier Assembly is defective. Go to Service Sheet 33 to isolate the problem.

   If the DVM indication is correct, the +20 Volt Regulator is defective. Go to Service Sheet 34 to isolate the problem.

+5.2 Volt Check (✓3)

4. Connect the DVM to A3A3TP2.

   The DVM should indicate +5.2 ±0.01 Vdc.

   If the DVM indication is correct, proceed with Step 6.

   If the DVM indication is not correct, proceed with Step 5.

5. Connect DVM to A3A3TP1.

   The DVM should indicate between 10 and 15 Vdc.

   If the DVM indication is correct, the +5.2 Volt Regulator is defective. Go to Service Sheet 34 to isolate the problem.

   If the DVM indication is not correct, the Rectifier Assembly is defective. Go to Service Sheet 33 to isolate the problem.

+11 Volts Switched (✓4)

6. Ensure that the rear panel INT/EXT switch is set to INT.
7. Connect the DVM to A3A3TP6.

   The DVM should indicate +11 ±1.1 Vdc.

   If the DVM indication is correct, proceed with Step 11.

   If the DVM indication is not correct, proceed with Step 8.

8. Remove A3A3 and replace it on a 36 pin extender board.
9. Using the DVM, check for continuity (0 ohms) between XA3A3-18 (TPA) and ground.

   If there is continuity, the Oscillator Power Supply is defective. Go to Service Sheet 34 to isolate the problem.

   If there is no continuity, Switch A3S1 or the wiring to it is defective.

SERVICE SHEET BD9 (cont'd)

Negative Regulator Assembly. Negative Regulator Assembly A3A4 provides the following voltages:

−10 Volts
−5.2 Volts
−40 Volts

Each is checked separately.

−10 Volt Check (✓5)

10. Connect the DVM to A3A4TP4.

    The DVM should indicate −10 ±0.2 Vdc.

    If the DVM indication is correct, proceed with Step 12.

    If the DVM indication is not correct, proceed with Step 11.

11. Leave the DVM connected to A3A4TP4 but connect the DVM common lead to A3A4TP3.

    The DVM should indicate between −15 and −22 volts.

    If the indication is correct, the −10 Volt Regulator is defective. Go to Service Sheet 35 to isolate the problem.

    If the indication is not correct, the Rectifier Assembly is defective. Go to Service Sheet 33 to isolate the problem.

−5.2 Volt Check (✓6)

12. Connect the DVM to A3A4TP5 with COMMON lead to ground.

    The DVM should indicate −5.2 ±0.05 Vdc.

    If the indication is correct, proceed with Step 13.

    If the indication is not correct, the −5.2 volt regulator is defective, go to Service Sheet 35 to isolate the problem.

−40 Volt Check (✓7)

13. Connect the DVM to A3A4TP1 with the COMMON lead to ground.

    The DVM should indicate −39.0 to − 41.6 Vdc.

    If the DVM indication is correct, proceed with Step 15.

    If the DVM indication is not correct, proceed with Step 14.

14. Remove the DVM COMMON lead from ground and connect it to A3A4TP2.

    The DVM should indicate between −48 and −63 Vdc.

SERVICE SHEET BD9 (cont'd)

If the indication is correct, the −40 volt regulator is defective. Go to Service Sheet 35 to isolate the problem.

If the indication is not correct, the Rectifier Assembly is defective. Go to Service Sheet 33

−10 Volt Switched Check (✓5)

15. Remove Negative Regulator A3A4 and replace it on and extender board.
16. Connect the DVM to XA3A4-14 or -32 (TPD), and observe that the DVM reads −10 volts.
17. While observing the DVM, press the front panel RF OUTPUT ON/OFF key (key indicator off).

    The DVM indication should drop from −10 volts to zero volt when the RF OUTPUT ON/OFF key is pressed.

    If the voltage does drop to zero, proceed with Step 18.

    If the voltage does not drop to zero, proceed with Step 20.

18. Press the front panel RF OUTPUT ON/OFF key (key indicator on) and observe that the DVM indication returns to −10 volts.
19. While observing the DVM, short A3A3TP2 to ground.

    The DVM indication should drop to zero volt.

    If the voltage does drop to zero, proceed with Step 24.

    If the voltage does not drop to zero, proceed with Step 22.

20. Press the front panel RF OUTPUT ON/OFF key (key indicator on).

SERVICE SHEET BD9 (cont'd)

21. Connect the DVM to XA3A4-18 (TPC), and, while observing the DVM, press the front panel RF OUTPUT ON/OFF key (key indicator off).

    The DVM indication should drop from +5 volts to zero volt when the key is pressed.

    If the voltage does drop, relay A3A4K1 or associated components are defective. Go to Service Sheet 35 to isolate the problem.

    If the voltage does not drop, there is a problem with the logic latch, the switch or associated circuitry on DAC and ENABLE board A1A5. Go to Service Sheet 22 to isolate the problem.

22. Remove the ground from A3A3TP2, connect the DVM to XA3A4-18 (TPC), and, while observing the DVM, ground A3A3TP2.

    The voltage should drop from +5 volts to zero volts when A3A3TP2 is grounded.

    If the indication is incorrect, relay A3A4K1 is defective. Go to Service Sheet 35 to isolate the problem.

    If the indication is correct, proceed with Step 23.

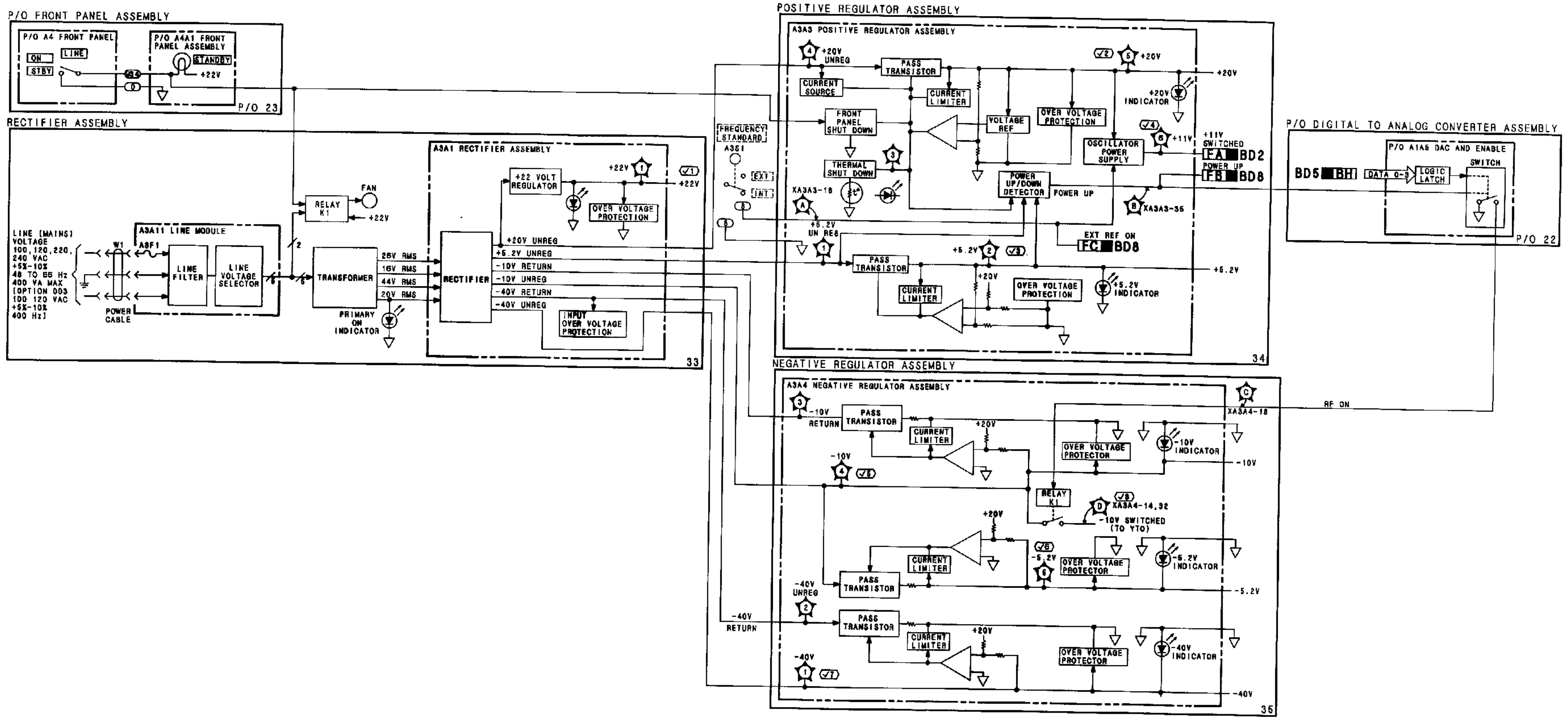
23. Remove the ground from A3A3TP2, connect the DVM to XA3A3-35 (TPB), then, while observing the DVM, ground A3A3TP2.

    The voltage should drop from +5 volts to zero volts when A3A3TP2 is grounded.

    If the indication is correct, there is a problem with the switch or associated components on DAC and Enable Board A1A5. Go to Service Sheet 22 to isolate the problem.

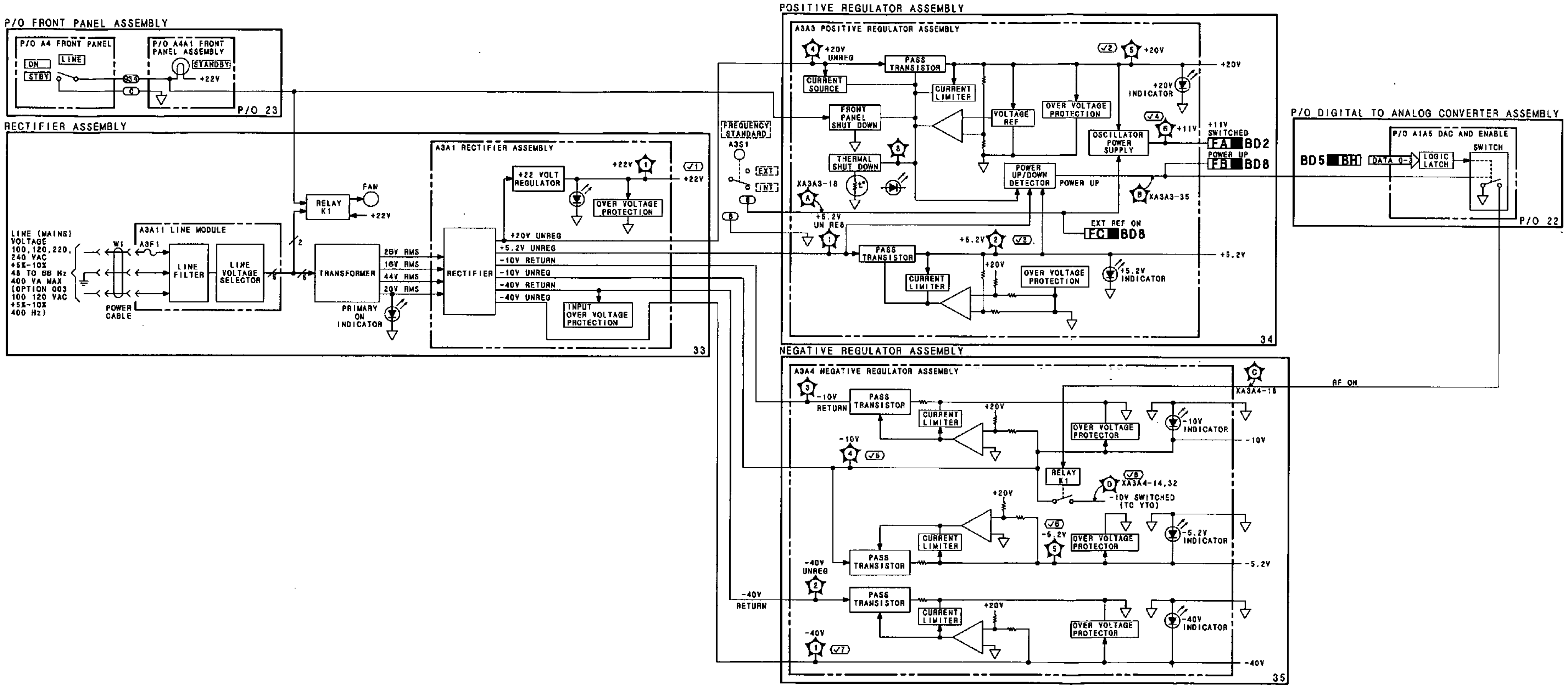
    If the indication is not correct, there is a problem with the Power Up/Down Detector on Positive Regulator A3A3. Go to Service Sheet 34 to isolate the problem.

Digital Control Unit Block Diagram SERVICE SHEET BD8



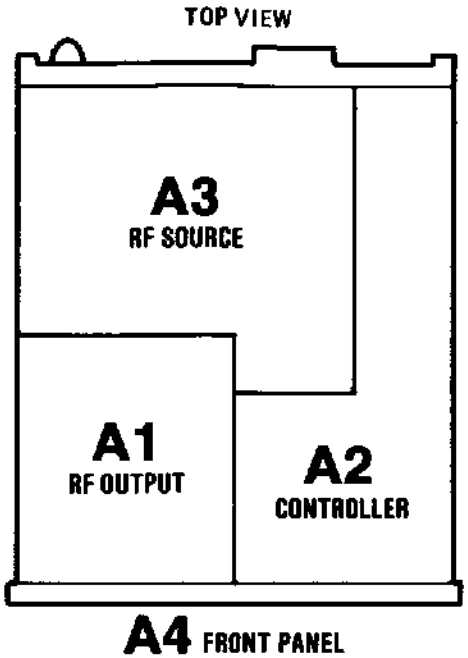
BD9

Figure 8-56. HP 8673E Power Supply Block Diagram



BD9

Figure 8-56. HP 8673E Power Supply Block Diagram



MAJOR ASSEMBLIES

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Attenuator Driver Board Assembly	18
A1A2	Detector Module Assembly	14,17
A1A2A1	ALC Board Assembly	14,17
A1A2A2	Detector Board Assembly	17
A1A3	Function Board Assembly	20
A1A4	Pulse Driver Board Assembly	15
A1A5	DAC and Enable Board Assembly	22
A1A6	Meter Board Assembly	21
A1A7	YTM Driver Board Assembly	16
A1A8	SRD Bias Board Assembly	19
A1A9	Preamp Assembly	14,16
A1A10	YTM Assembly	16
A1A10A1	YIG Heater Control Assembly	16
A1A11	Power Amplifier Assembly	16
A1A12	Motherboard Assembly	14-16,18-22, 30,31
A1A13	Terminal Strip	15
A1A14	Amp Bias Board Assembly	17
A2A1	Panel Driver Board Assembly	25
A2A2	Key Code Board Assembly	24
A2A3	VCO Assembly	8
A2A4	Phase Detector Assembly	7
A2A5	Divider Assembly 20/30	6
A2A6	Not Assigned	
A2A7	I/O Board Assembly	30,31
A2A8	Microprocessor Board Assembly	26
A2A9	Frequency/HP-IB Board Assembly	29
A2A10	RAM Board Assembly	28
A2A11	ROM Board Assembly	27
A2A12	Not Assigned	
A2A13	Motherboard Assembly	6-8,10,20-32
A2A14	Rear Interconnect Board Assembly	24,29,31
A2A15	HP-IB Connector Board Assembly	29
A3A1	Rectifier Assembly	33
A3A1A1	Reference Phase Detector Assembly	1,2
A3A1A2	100 MHZ VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator	4
A3A1A4A2	VCO Board Assembly	4
A3A1A5	M/N Output Assembly	5
A3A1A6	M/N Reference Motherboard Assembly	1-3,5
A3A1A7	Reference Housing Assembly	
A3A2	Not Assigned	
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	DAC Assembly	9
A3A6	YTO Driver Assembly	10
A3A7	FM Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Sampler Assembly	11
A3A9A6	Attenuator Assembly	13
A3A9A7	6.2 GHz Low Pass Filter	13
A3A10	Motherboard Assembly	1,3,4,6,10, 12-14,21-23, 26,29-31, 33-35
A4A1	Front Panel Board Assembly	20,22,23,32

SERVICE SHEET 1

REFERENCE PHASE DETECTOR ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

The Reference Loop Phase Detector is part of the Time Base Reference. It contains Reference Oscillator A3A8 and Reference Phase Detector A3A1A1. The Reference Oscillator is the frequency reference for the Signal Generator. The Reference Phase Detector is used to phase lock the output of a 100 MHz Voltage Controlled Crystal Oscillator (VCXO) to the output of the Reference Oscillator in order to generate the 10, 20, and 400 MHz reference frequencies required by the Signal Generator.

The Reference Phase detector divides the input from the 100 MHz VCXO down to 10 MHz and compares this 10 MHz frequency to the output of the 10 MHz Reference Oscillator. Any difference between the two frequencies will change the TUNE VOLTAGE signal to keep the two 10 MHz frequencies equal by tuning the 100 MHz VCXO. The 10 and 20 MHz reference frequency outputs are derived from the 100 MHz VCXO using frequency division.

A3A8 10 MHz Reference Oscillator

The following discussion refers to the Schematic Diagram of Service Sheet 1. The Reference Oscillator is a highly stable, temperature controlled, crystal oscillator. Its operating temperature is controlled by an internal heater control unit. The heater control unit, and the heater it controls, are powered by the +22 volt regulator that is on any time the Signal Generator is connected to the power mains. The crystal oscillator is powered by the +11 volt switched supply which is controlled by the rear panel INT/EXT switch.

A3A1A1 Reference Phase Detector Assembly

The Reference Phase Detector Assembly compares the output frequencies of the VCXO and the Reference Oscillator and generates a TUNE VOLTAGE output to fine tune the VCXO. The output of the 10 MHz Reference Oscillator is applied to a Limiting Amplifier consisting of a differential input stage followed by a voltage follower stage. The Limiting Amplifier is powered by an on board +5V Regulator. This isolates the Limiting Amplifier from any transients that may be on the +5.2 volt power supply.

The output of the Limiting Amplifier is a sine wave at TTL levels. This signal is applied to a Pulse Generator consisting of U2A, U2B, U2C and U2D. The Pulse Generator converts the sine wave to a series of narrow pulses that are buffered by the Buffer Amplifier to provide sufficient drive for the two sampling circuits, Phase Lock Sampler and Lock Indicator Sampler.

The second input to the Phase Lock Sampler is a 10 MHz frequency derived from the 100 MHz frequency output of the 100 MHz VCXO. The 100 MHz frequency is divided by 10 in U3A and U3B then phase shifted 45 degrees by Q1 and associated components. The phase shifting of the divided frequency ensures that the two inputs to the Phase Lock Sampler have the proper phase relationship.

The output of the Phase Lock Sampler is applied to the Integrating Amplifier consisting of Q4, Q5, and Q6. This circuit changes the TUNE VOLTAGE based on the error voltage produced by the Phase Lock Sampler circuit. The Tune Voltage is applied to the 100 MHz VCXO to tune the 100 MHz output so that the two 10 MHz frequencies present at the input to the Phase Lock Sampler are equal in frequency.

The second sampler, the Lock Indicator Sampler, outputs zero volts when the Reference loop is phase locked and a positive voltage when phase lock is lost. Phase Lock Detector U5 compares the output of the Lock Indicator Sampler to a −0.4 volt reference and outputs a negative voltage when the loop is phase locked and a positive voltage when it is unlocked. Zener diode VR1 clamps the output voltage swing of U5 to −0.7 volts and +4.6 volts.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD2 was used to isolate a malfunction to the Reference Phase

SERVICE SHEET 1 (cont'd)

Detector Assembly. The following information allows further isolation to the defective component on Service Sheet 1.

Test Equipment

Oscilloscope .... HP 1980A/B
Digital Voltmeter (DVM) .... HP 3456A

Troubleshooting Procedures

The following procedures are divided into the following sections:

- Phase Lock Detector
- VCXO Divider and Buffers
- Phase Lock Chain

The procedures in the Phase Lock Detector section should be used if the Reference Loop seems to be phase-locked but the REF phase lock indicator on A2A7 is off. The procedures in the VCXO Divider and Buffers section should be used if the Reference Loop is phase-locked but the 10 MHz and/or 20 MHz frequency reference(s) are incorrect. If the Reference Loop is not phase-locked, use the procedures in the Phase Lock Chain section.

Phase Lock Detector.

1. Connect the DVM to the negative terminal of C13 (same as U5 pin 3) and observe the DVM reading.

   The DVM should read approximately −1.3 volts.

   If the DVM indication is correct, check U5 and associated components.

   If the DVM indication is not correct, proceed with Step 2.

2. Connect the oscilloscope probe to the collector (case) of Q2. Verify that the signal observed is 10 MHz (100 ns period) with a peak-to-peak amplitude of 2.9 volts.

   If the signal is correct, check CR5, CR6 and associated components.

   If the signal is not correct, check Q2 and associated components.

VCXO Driver and Buffers. For problems with the 20 MHz reference, proceed with Step 3. For problems with the 10 MHz reference proceed with Step 4.

3. Connect the oscilloscope probe to U3 pin 2. Verify that the signal is 20 MHz (50 ns period) with a peak-to-peak amplitude of 1.9 volts.

   If the signal is correct, check U4B and associated components.

   If the signal is not correct, U3 is defective.

4. Connect the oscilloscope probe to U3 pin 15 and verify that the signal is 10 MHz (100 ns period) with a peak-to-peak amplitude of 1.0 volt.

   If the signal is correct, check the appropriate section of U4 and associated components.

   If the signal is not correct, U3 is defective.

Phase Lock Chain.

5. Connect the oscilloscope to A3A1A1TP1 and observe the display

   The display should be as shown on Service Sheet 1 for A3A1A1TP1.

   If the display is correct, proceed with Step 7.

   If the display is not correct, proceed with Step 6.

6. Connect the oscilloscope probe to U1 pin 7 and verify that the signal is 10 MHz (100 ns period) with a peak-to-peak amplitude of 2.5 volts.

   If the signal is correct, check U2 and associated components.

   If the signal is not correct, check U1 and associated components.

7. Connect the oscilloscope probe to the collector (case) of Q1 and verify that the signal is 10 MHz (100 ns period) with a peak-to-peak amplitude of 2.8 volts.

   If the signal is correct, proceed with Step 9.

   If the signal is not correct, proceed with step 8.

8. Connect the oscilloscope probe to U3 pin 14 and verify that the signal is 10 MHz (100 ns period) with a peak-to-peak amplitude of 1.0 volts.

   If the signal is correct, check Q1 and associated components.

   If the signal is not correct, U3 is defective.

9. Connect the DVM to Q4 pin 3 and verify that the dc voltage is 0 volt.

   If the voltage is correct, check Q4, Q5, Q6, and associated components.

   If the voltage is not correct, check CR3, CR4 and associated components.

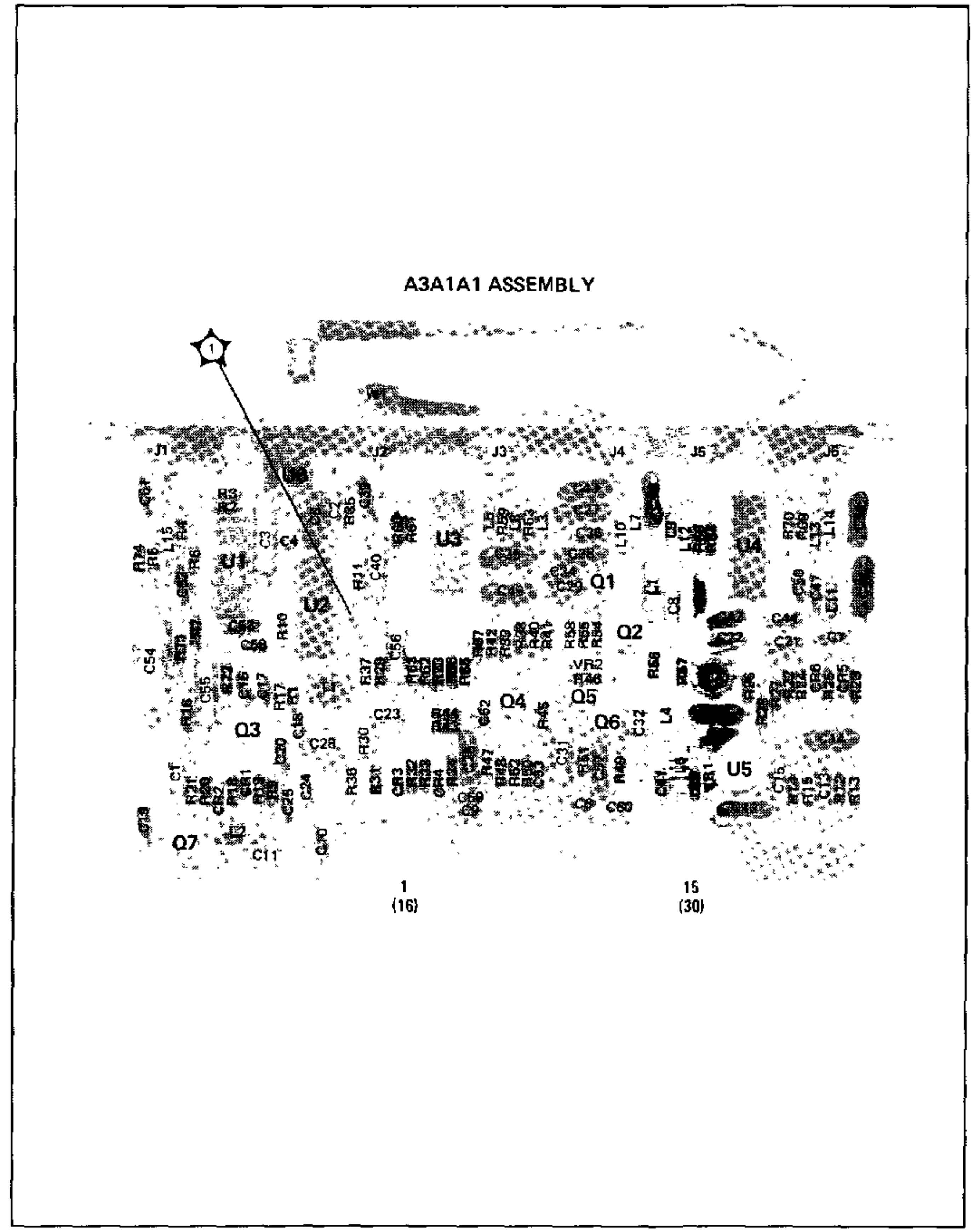
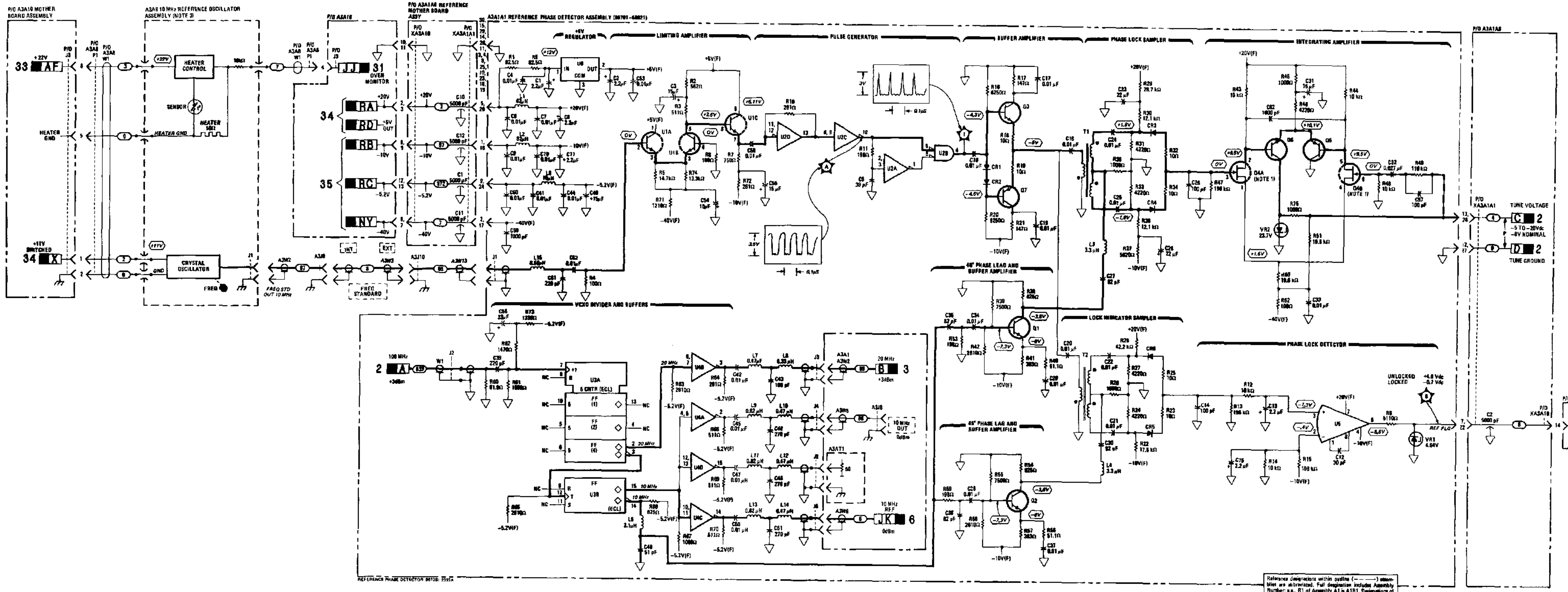
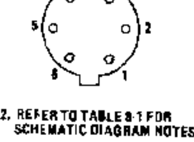


Figure 8-57. A3A1A1 Reference Phase Detector Assembly Component and Test Point Locations



NOTES

1. REFER TO THE FOLLOWING DIAGRAM FOR PIN LOCATIONS



2. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.

3. FIELD REPARABLE COMPONENT. REFER TO OSCILLATOR OPERATING AND SERVICE MANUAL.

REFERENCE DESIGNATIONS

A3	A3A1A3
AT1 J8–10 W2,3,5,6,13	W2
	A3A1A6
A3A1A1	C1,2,10–12 XA3A10 XA3A1A1
C1–62 CR1–6 J1–6 L1–15 Q1–7 R1–75 T1,2 TP1 U1–6 VR1,2 W1	A3A6
	P1 W1
	A3A10
	J3

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH(1)	≥2V	≥–0.9V	≥–0.1V	≈VDD
LOW(0)	≤0.8V	≤–1.5V	≤–0.8V	≤0.1V
≤ = EQUAL TO OR MORE NEGATIVE THAN ≥ = EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH(1)	LOW(0)
OPEN	HIGH(1)	LOW(0)	LOW(0)	X
GROUND ~ 0V; X = UNDEFINED				

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1–3	1854–0019
Q4	1855–0049
Q5,6	1853–0451
Q7	1854–0834
U1	1821–0001
U2	1820–0328
U3	1820–1383
U4	1820–0802
U5	1820–0223
U6	1820–0429

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U2	+5V(F) – 14 ⏚ – 7
U3	–5V(F) – 8 ⏚ – 1,16
U4	–5V(F) – 8 ⏚ – 16

1
A3A1A1,A3A6

Figure 8-58. Reference Phase Detector Assembly Schematic Diagram

SERVICE SHEET 2

100 MHz VCXO ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1	Service Sheet BD1
Time Base Reference Block Diagram	Service Sheet BD2
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The 100 MHz VCXO Assembly, A3A1A2, is part of the Time Base Reference Loop. It generates a 100 MHz signal that is phase locked to the 10 MHz internal (or 5 or 10 MHz external) reference signal by circuitry on Reference Phase Detector Assembly A3A1A1. The stable 100 MHz signal thus produced is multiplied by four and routed to M/N Output Assembly A3A1A5. The 100 MHz signal is also available at rear panel connector A3J7.

Detailed Discussion

100 MHz Oscillator. The heart of the Time Base Reference Loop is the 100 MHz voltage controlled crystal oscillator (VCXO). Crystal Y1, that controls the frequency, and varactor diode CR1, that allows a small deviation, are both found in the VCXO's feedback path. Some degree of manual frequency control is provided by C4. Diodes CR3 and CR4 limit the VCXO's output to ±0.4 volts peak.

The output of the oscillator is buffered by 100 MHz Buffer Q9, Q8 and Q11. One output of the buffer is routed back to the A3A1A1 Assembly where it is sampled by the phase detector circuits. The other output of the buffer is applied to power splitter T1. One output of the splitter is routed through 100 MHz Amplifier Q6 to rear panel output connector A3J7. The other output goes to the Quadrupler.

Quadrupler. The Quadrupler is a Class C push-push amplifier. The output approximates a pulse and is rich in even harmonics. The 400 MHz Amplifier that follows the Quadrupler is tuned to, and therefore amplifies the 400 MHz output of the Quadrupler. The output level to the M/N Loop is critical and is set by selecting the values of R67, R68, and R69.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated

Reference Phase Detector (A3A1A1) SERVICE SHEET 1

SERVICE SHEET 2 (cont'd)

with Service Sheets BD1 and BD2 have been used to isolate a problem to the 100 MHz VCXO Assembly. The following procedures can be used to further isolate the problem to the defective component.

Test Equipment

Frequency Counter	HP 5343A
Variable Power Supply	HP 6200B
Digital Voltmeter	HP 3456A
Oscilloscope	HP 1980B

Troubleshooting Procedures

There are two troubleshooting procedures. The first isolates between the 100 MHz Oscillator and the 100 MHz Buffer. The second isolates between the elements of the Quadrupler.

100 MHz Amplifier. There is only one active component in the 100 MHz Amplifier. Therefore, if the procedures in BD2 indicate a problem with this amplifier, check Q6 and associated components.

100 MHz Oscillator/100 MHz Buffer.

1. If it has not already been done, remove A3A1A1 and set the power supply to 8 volts.

2. Remove A3A1A2 and replace it on a 30-pin extender board, connect the negative lead of the power supply to TP1 TUNE test point and the positive lead to chassis ground.

3. Connect the Oscilloscope to the cathode of CR4. The display should show a 100 ±1 MHz sine wave at a peak-to-peak amplitude of 1.6 volt.

   If the display is as indicated, check Q8, Q9, and associated components.

   If the display is not as indicated, check Q5 and associated components.

Quadrupler.

1. If it has not already been done, repeat steps 1 and 2 above.

2. Connect the oscilloscope to the collector of Q7.

   The display should show a 100 ±1 MHz sine wave at a peak-to-peak amplitude of 2.5 volts.

   If the display is as indicated, proceed with Step 3.

   If the display is not as indicated, check Q7 and associated components.

3. Connect the oscillscope to the collector of Q3.

   The display should show a 100 ±1 MHz signal at a peak-to-peak amplitude of 150 mV.

   If the signal is as indicated, check Q1, Q2, and associated components.

   If the signal is not as indicated, check Q3, Q4, and associated components.

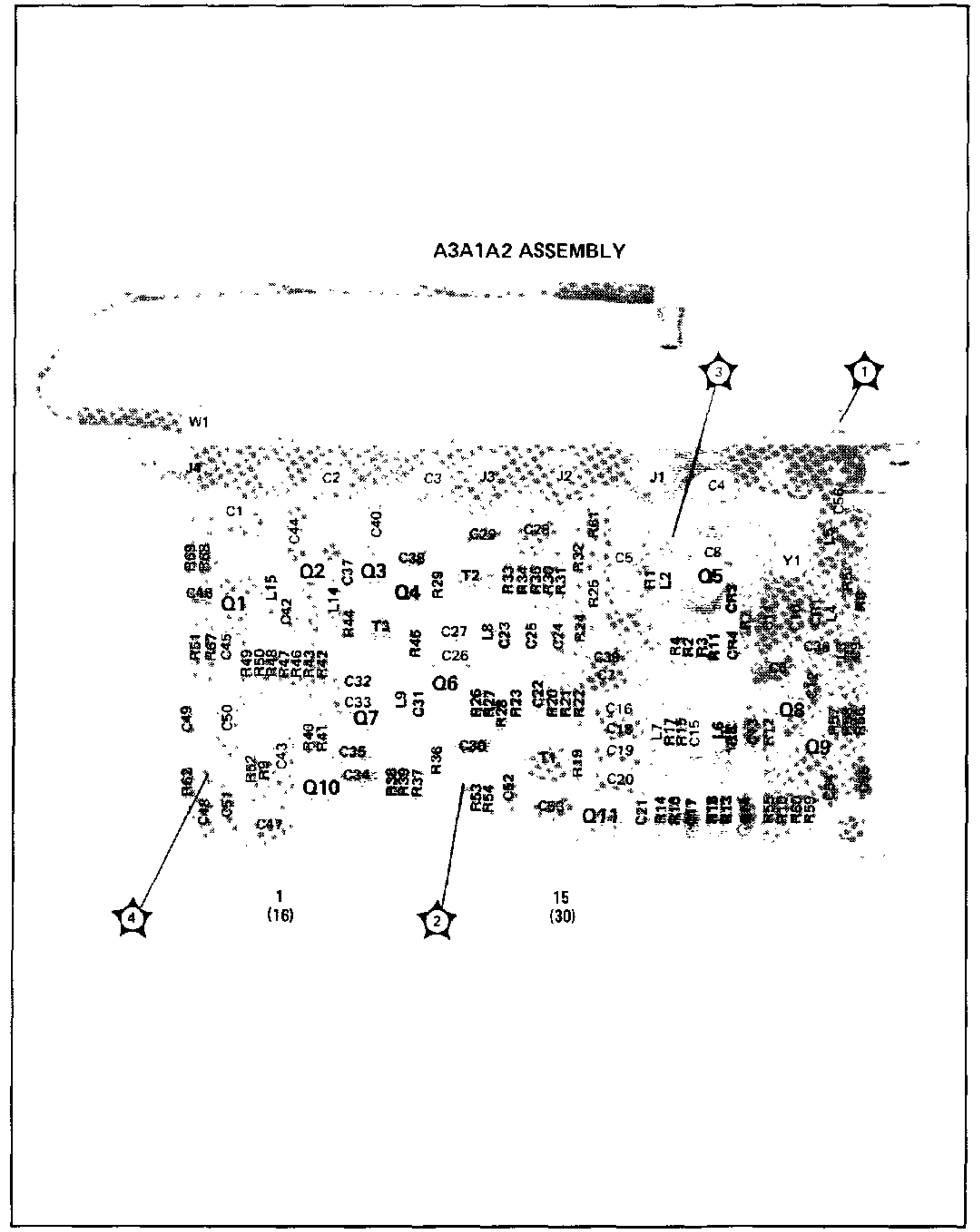


Figure 8-59. A3A1A2 100 MHz VCXO Assembly Component and Test Point Locations

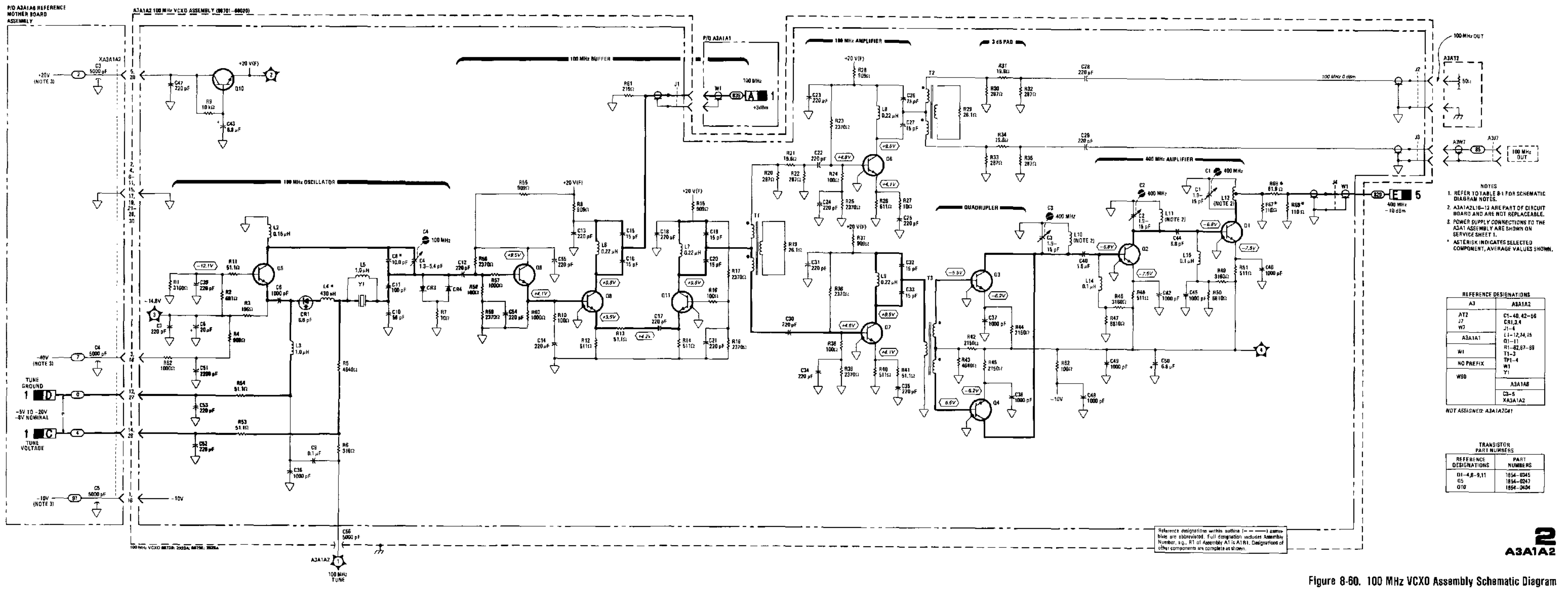


Figure 8-60. 100 MHz VCXO Assembly Schematic Diagram

SERVICE SHEET 3
M/N PHASE DETECTOR ASSEMBLY
REFERENCES

PRINCIPLES OF OPERATION

General

The frequency output of the M/N loop is dependent on the front panel frequency. A digital equivalent of the M/N loop frequency (dependent upon the front panel frequency's most significant digits, 10 MHz to 10 GHz) is input to the M/N loop as M and N numbers. The ratio of the M and N numbers actually determine the M/N OUT frequency. The M/N OUT frequency's Nth harmonic (based on the N number and selected by the YTO pretuning) tunes the YTO frequency in 10 MHz steps. There is a 10 MHz step (or band) for each valid M/NOUT frequency (M/N ratio) and Nth harmonic (N number). This 10 MHz band complements the 20/30 MHz loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N loop, YTO pretuning and 20/30 MHz loop are able to tune the YTO from 2000.000 to 6599.999 MHz in 1 kHz steps. The YTO frequency is the front panel frequency divided by the band number, see Service Sheet BD1 for a list of band numbers and corresponding frequencies.

The M/N loop provides a tunable phase locked reference signal for the YIG Tuned Oscillator (the Synthesizer's microwave signal source). The M/N OUT frequency (177.5 to 197.5 MHz) is obtained by dividing the M/N VCO signal (355—395 MHz) by two. The M/N IF signal (5—45 MHz) is the lower mixing sideband of the VCO signal and the 400 MHz reference. The M/N loop is phase locked by comparing a fraction of 20 MHz (20 MHz divided by the N number) to a fraction of the IF signal (5—45 MHz divided by the M number) in the phase detector. The phase detector generates an error that is integrated and coupled to the VCO as a tuning signal. The M and N numbers are determined by the A2 Controller and vary with the 10 MHz steps of the YTO frequency. The M/N OUT frequency is dependent on the ratio of the M and N numbers as expressed in the following formula:

$$
\begin{aligned}
f_{M/N} &= [200-10(M/N)]\text{MHz} \\
\text{where } f_{M/N} &= \text{M/N OUT frequency} \\
M &= \text{M number} \\
N &= \text{N number}
\end{aligned}
$$

To determine M (M varies from 8 to 27):

If the 100 MHz digit of the YTO Frequency is even then M = 17−10 MHz digit

If the 100 MHz digit is odd then M = 27−10 MHz digit.

To determine N (N varies from 11 to 34):

Divide the left two (most significant) digits of the YTO Frequency by 2.

SERVICE SHEET 3 (cont'd)

Add 1 to the result and round up if necessary to the nearest integer.

For example, if the ratio is 1-to-1 (M=N) then $f_{M/N}$ = 190.000 MHz. If the ratio is 1-to-2 (M=2N) the $f_{M/N}$ = 195.000 MHz. Refer to Table 8-5 in Service Sheet BD3 Principles of Operation for a complete list of M and N Numbers and Resulting Frequencies.

Detailed Discussion

M and N Dividers. The Phase Detector Assembly's M and N Dividers are essentially identical in operation. In each case the input frequency is divided by the divide number (a binary coded number input from the A2 Controller Assembly). The resulting output pulses are frequency and phase compared to produce an error voltage which ultimately tunes the M/N VCO. The following formulas show the frequency relationship of the inputs and outputs of the dividers:

$$
\begin{aligned}
f_N &= (4/N)20\ \text{MHz} \\
f_M &= (4/M)f_{IF} \\
\text{where } f_N &= \text{N Divider Output pulse repetition frequency (PRF) MHz} \\
f_M &= \text{M Divider Output PRF (MHz)} \\
N &= \text{N Divide number} \\
M &= \text{M Divide number} \\
f_{IF} &= \text{M Divider Clock frequency (MHz)} \\
20\ \text{MHz} &= \text{N Divider Clock frequency} \\
f_N &= f_M \text{ when the loop is phase locked therefore} \\
(4/N)20\ \text{MHz} &= (4/M)f_{IF} \\
\text{and } f_{IF} &= [(M/N)20]\ \text{MHz for the phase locked condition.}
\end{aligned}
$$

Because of the similarities of the M and N Dividers, only the N Divider will be described in detail.

The N divider circuit is clocked by a pulse train derived from the input frequency (in this case the 20 MHz reference signal). The divider outputs 4 pulses for each sequence of clock pulses which add up to the N number. In other words, a pulse is output for each N/4 or N/4+1 clock pulses. If dividing the N number by 4 leaves no remainder, the number of clock pulses between output pulses is determined solely by N/4. If there is a remainder the number of clock pulses between outputs is determined by N/4 and N/4+1, where N/4+1 replaces N/4 once for each unit in the remainder. For example, if N=16, then N/4=16/4=4 with a remainder of R=0. An output pulse occurs for each 4 clock pulses. If N=19, then N/4=19/4=4 with R=3. An output pulse occurs once with a spacing of 4 clock pulses and three with a spacing of 5 clock pulses.

a. **Counting Operation and Control.** Refer to the schematic diagram and Figure 8-61, and to Table 8-38, and consider the example N=16. At the beginning of a divide sequence (clock 1) the 4 most significant bits (MSB) of the N number (0100) are loaded into the programmable counter. Clock 2 subtracts 4 (0001) from the previous total leaving (0011), Clock 3 subtracts 4 more and the 0010 output enables the End of Count Decoder. At Clock 4, Count Control U2B

SERVICE SHEET 3 (cont'd)

and Output Flip-Flop U2B are set. The Count Control outputs inhibit the End of Count Decoder, cause the Programmable Counter to enter its load mode, and clocks the Divider Flip-Flops U4A & B. The Output Flip-Flop U2A outputs a high to the Phase/Frequency Detector. Clock 5 resets the flip-flops and loads the counter. This series of events repeats itself 3 more times for the N=16 sequence.

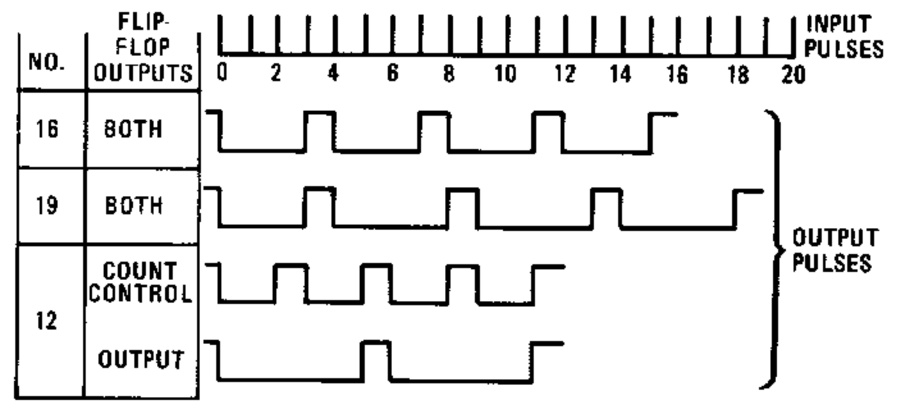
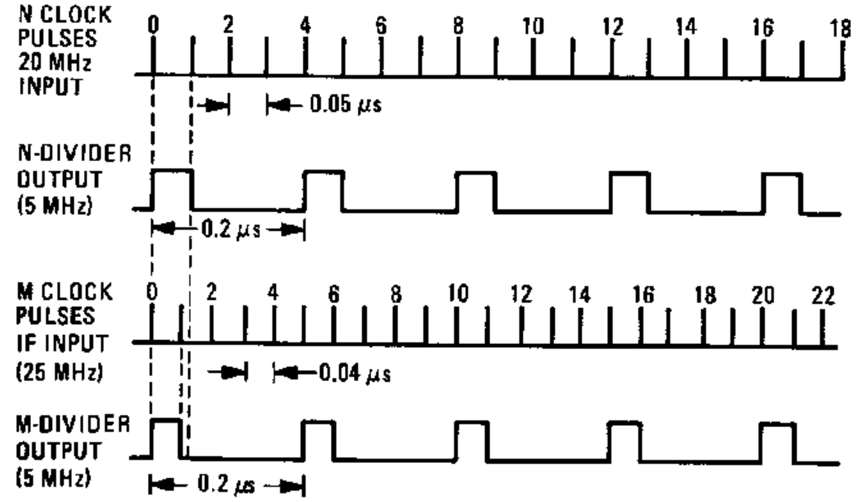


Figure 8-61. Divider Operation Timing Diagram

b. **Increment Decoder Operation.** The Increment Decoder and Divider (divide by four) circuits come into play if the N number cannot be divided by four evenly. The 2 least significant bits (LSB) of the N number (N2 and N1) control the output of the Increment Decoder. The divide-by-four circuit provides a sequence of four sequential states, that are the input to the Increment Decoder. Each state coincides with one of the four count down sequences whose length is characterized by N/4 or N/4+1. Refer to Table 8-39. Note that for the N=16 sequence (N2=N1=0), the Increment Decoder Output Sequence (TP6) never leaves the low state and the count down sequences are N/4. For N=19 (N2=N1=1) the first output is low with the remaining three high. This means that the first pulse occurs after N/4 clock pulses and the other three occur after N/4+1 pulses. During the final count down sequences, the high at the Increment Decoder Output inhibits U11B allowing the counter to count down to 0001 (rather than 0010) before the End of Count Decoder is enabled through U11A. This allows the extra count to occur. The rest of the sequence occurs as described in the previous section. See also Table 8-38 and Figure 8-61.

c. **Divide-by-1 or 2 Operation.** When the N input is equal to or greater than 16, the N5 or N6 inputs are high and the Divide-by-1 or 2 Decoder is enabled. Thus the Output Flip-Flop follows the Count Control Flip-Flop and each End of Count pulse is passed directly to the output. If N<16, then the Divide-by-1 or 2 Decoder is enabled and therefore passes only every other End of Count pulse to set the Output Flip-Flop. (Refer to Table 8-38 and Figure 8-62).

SERVICE SHEET 3 (cont'd)



FREQUENCY AND TIME RELATIONSHIPS FOR N=16 AND M=20

Figure 8-62. Divider Clock Pulses versus Output Pulses Timing Diagram

This circuit reduces the apparent gain of the of the Phase/Frequency detector. This keeps the $\text{Delta}F_{VCO}/\text{Delta}V$ sensitivity of the VCO in a specific portion of its tuning curve thereby keeping the M/N bandwidth constant. Note that the N5 and N6 inputs are also connected to the M Divider in same manner as in the N Divider. Note also that the frequency of the M and N Divider Outputs is halved for N<16.

Phase/Frequency Detector

The output of the M and N dividers are fed to the phase/frequency detector U1. If the output of the N Divider leads the output of the M Divider, a negative going pulse appears at U1-3 and U1-12 will remain at dc level (about −1.7 Vdc). If the output of the M Divider leads the output of the N Divider, then the output of U1-3 will remain at dc level and a positive going pulse will appear at U1-12. The pulse width of the output pulse is a measure of the phase or frequency difference between inputs at U1-6 and U1-9. When the loop is locked, TP2 will be between 20 and 90 mV (nominal 60 mV) more positive than TP1. U7 forms a dual comparator which gives an unlocked indication if TP1 and TP2 are outside the normal range.

Q1, Q2 and Q15 form an integrating differential amplifier whose inputs are the bases of Q1 and Q2. C14 and R25 form the feedback path from the amplifier output at U15-6 to the inverting input at the base of Q1. The output of the amplifier varies from −2 Vdc to −35 Vdc depending on the required VCO frequency and is varied to achieve phase lock as determined by the dc levels from the outputs of U1.

TROUBLESHOOTING

It is assumed that the troubleshooting information associated with Service Sheets BD1 and BD3 was used to isolate a malfunction to the M/N Loop. The following procedures can be used to further isolate a malfunction to the defective component.

SERVICE SHEET 3 (cont'd)

Test Equipment

Frequency Counter .... HP 5343A
Digital Voltmeter .... HP 3456A
Logic Pulser .... HP 546A
Oscilloscope .... HP 1980B

Troubleshooting Procedure

1. Press RCL 0.
2. Observe the M/N loop lock indicator on A2A7. The lamp should be on. If the lamp is not on, continue with this procedure. If the lamp is on, perform the next two steps to confirm correct loop operation.
3. Connect 10 MHz output from the frequency counter to the external reference input on the Signal Generator, then connect the frequency counter input to the M/N output on A3A1A5. The frequency should be 189.375000 MHz.
4. Check the following frequencies (the extremes of the M/N loop).

RF Output Frequency	M/N Loop Output
2100 MHz	177.500000 MHz
6090 MHz	197.419355 MHz

   If the frequencies are correct, the M/N VCO loop has adequate tuning range and is probably operating correctly.

5. Using the oscilloscope, measure the signal at A3A1A3TP1 with the Signal Generator set to 6100 MHz. The signal should be 20 MHz divided by N/4 (N=32 at 6100 MHz) or exactly 2.50 MHz (period = 400 ns) at ECL levels. Refer to schematic notes for a definition of ECL levels
6. Tune the Signal Generator to 2900 MHz. The signal at TP1 should be 5.0 MHz (period = 200 ns) (N=16).
7. Tune the Signal Generator to 2900 MHz. The signal at TP1 should be 2.666666 MHz (2/N x 20 MHz; N=15). If steps 5, 6 and 7 were correct, the N Divider is working properly and N decoder in the controller is operating correctly. If steps 5, 6 and 7 are not correct, proceed to step 11.
8. Connect the IF IN white-red coaxial cable to the 20 MHz reference signal in place of the gray-white coax. This connects a known (20 MHz signal to the M Divider. Tune to 3010 MHz and measure the frequency at TP4. It should be 5.0 MHz. (period = 200 ns).
9. Tune to 2820 MHz (M=15). The frequency at TP4 should be 2.666666 MHz. (period = 375 ns) If steps 8 and 9 are correct the M

100 MHz VCXO Assembly (A3A1A1) SERVICE SHEET 2

SERVICE SHEET 3 (cont'd)

   Divider is working properly and the M Decoder in the Controller is operating properly. If not, proceed to step 11.

10. Reconnect the IF and 20 MHz inputs. Tune to 2800 MHz. Connect the voltmeter to A3A1A5 TUNE test point. The voltage should be about −4 Vdc. Tune to 3010 MHz. The voltage should change to about −26.2 Vdc. If these voltages are correct, the Phase Detector Assembly is operating correctly. If the voltages are not correct, proceed to step 16.
11. Because of the similarities of the N Divider and the M Divider, only the troubleshooting procedure for the N Divider will be described here. To troubleshoot the N Divider perform the following steps.
12. Place the M/N Phase Detector Assembly on an extender board.
13. Disconnect the gray-white coaxial cable from the 20 MHz Reference connect the Logic Pulser in its place.
14. Tune the Signal Generator to 3500 MHz (N=19) if troubleshooting the N Divider or 4980 MHz (M=19) if troubleshooting the M Divider.
15. Use the Logic Pulser to inject one pulse at a time and use the Divider Operation and the Increment Decoder Operation tables to verify the proper signal at succeeding nodes until the faulty part is located.
16. To troubleshoot the Phase/Frequency Detector U1 and the succeeding stages perform the following steps.
17. If both the M Divider and the N Divider are working, place the M/N Phase Detector Assembly on an extender board.
18. Connect the oscilloscope to A3A1A3TP3 and TP2. Press RCL 0. Observe the waveform which should be as shown in Figure 8-63. Repeat this step for A3A1A3TP4. If the waveforms are not as shown, the Phase/Frequency Detector U1 is faulty and should be replaced.
19. If the waveforms of step 18 were correct, disconnect the 20 MHz Reference input. Ground the junction of C14 and C17. Measure the voltages at the collectors of Q1 and Q2. The voltages should be −17.9 volts and −15.9 volts respectively.
20. Replace the 20 MHz Reference coaxial cable and disconnect the IF IN coax. Measure the voltages at the collectors of Q1 and Q2. The voltages should be −15.7 volts and −18 volts respectively. If the voltages in step 19 and 20 are not correct replace the faulty part.

NOTE

After repairing the A3A1A3 Assembly, perform the M/N Loop Adjustments in Section V.

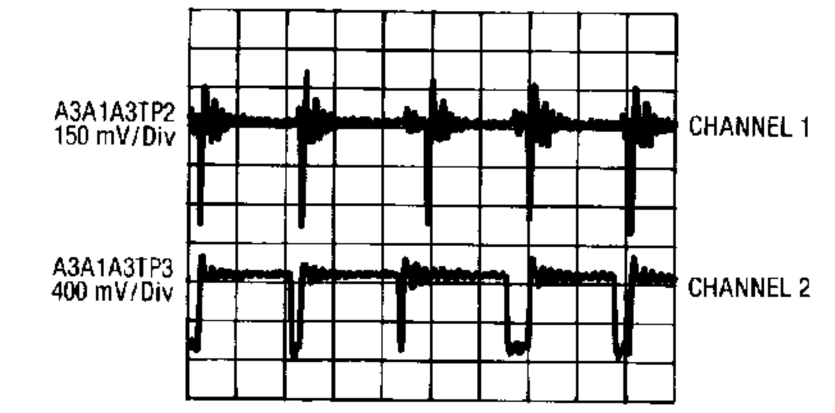


Figure 8-63. A3A1A3TP2 and TP3 Waveforms

SERVICE SHEET 3 (cont'd)

Table 8-38. Divider Operation

N	Input-Clock Pulses	Operation	Counter Output	End of Count Decoder	Flip-Flops	
					Count Control	Output
16	0,4,8,12 1,5,9,13 2,6,10,14 3,7,11,15	Load Counter Minus 4 Minus 4 Minus 4	0100 0011 0010 0001	Inactive Inactive Active Inactive	Reset Reset Reset Set	Reset Reset Reset Set
19	0,4,9,14 1,5,10,15 2,6,11,16 3,7,12,17 8,13,18	Load Counter Minus 4 Minus 4 Minus 4 Minus 4	0100 0011 0010 0001 0000	Inactive Inactive Inactive[1] Active[2] Inactive	Reset Reset Reset Reset[3] Set	Reset Reset Reset Reset[3] Set
12	0,3,6,9 1,4,7,10 2,5,8,11	Load Counter Minus 4 Minus 4	0011 0010 0001	Inactive Active Inactive	Reset Reset Set	Reset Reset Set[4]

[1] Active for step 3 only.
[2] Inactive for step 4 only.
[3] Set for step 4 only.
[4] The Output Flip-Flop is set only every other time the Counter Control Flip-Flop is set for N<16.

Table 8-39. Increment Decoder Operation

Increment Decoder Control Inputs		Increment Decoder Output Sequence*			
N2	N1	1	2	2	4
L(0)	L(0)	L	L	L	L
L(0)	H(1)	L	L	H	L
H(1)	L(0)	L	H	L	H
H(1)	H(1)	L	H	H	H

*The sequence of four states is controlled by a modified ring counter made up of the two flip-flops contained in U4. The count sequence of U4 may be checked by verifying that the active high outputs of the flip-flops follow the sequence LL, HH, LH, and HL (U4A-2 and U4B-15 respectively).

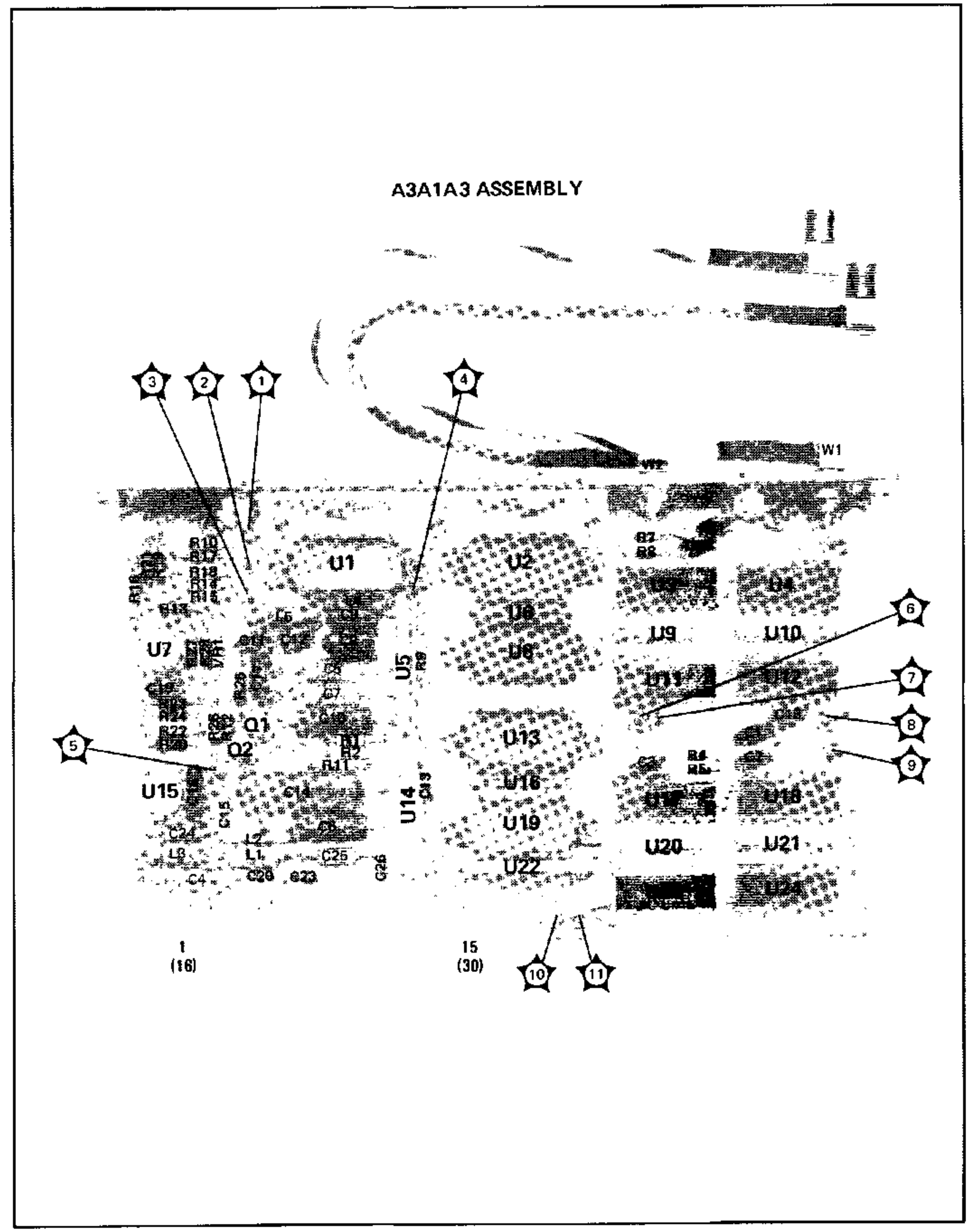


Figure 8-64. A3A1A3 M/N Phase Detector Assembly Component and Test Point Locations

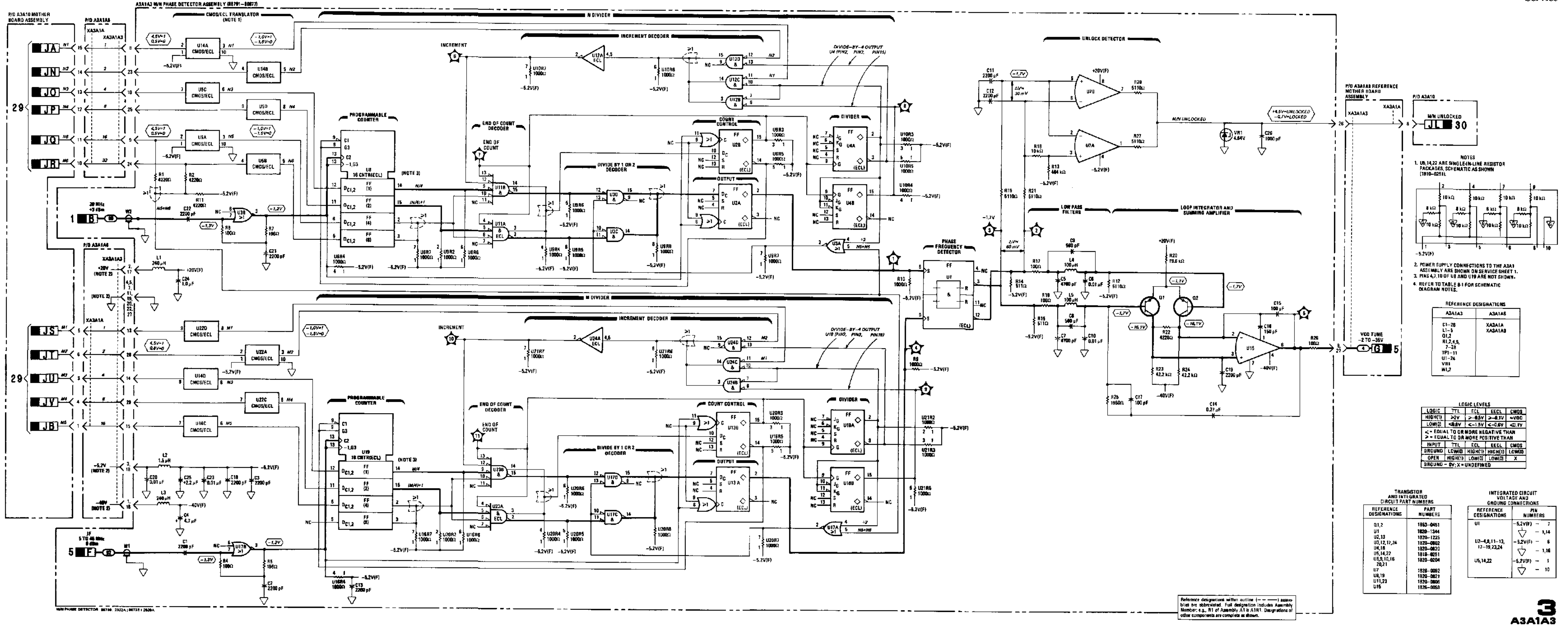


Figure 8-65. M/N Phase Detector Assembly Schematic Diagram

SERVICE SHEET 4

M/N VCO ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1	Service Sheet BD1
RF Phase Locked Loops Block Diagram	Service Sheet BD3
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

The frequency output of the M/N loop is dependent on the front panel frequency. A digital equivalent of the M/N loop frequency (dependent upon the front panel frequency's most significant digits, 10 MHz to 10 GHz) is input to the M/N loop as M and N numbers. The ratio of the M and N numbers actually determine the M/N OUT frequency. The M/N OUT frequency's Nth harmonic (based on the N number and selected by the YTO pretuning) tunes the YTO frequency in 10 MHz steps. There is a 10 MHz step (or band) for each valid M/N OUT frequency (M/N ratio) and Nth harmonic (N number). This 10 MHz band complements the 20/30 MHz loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N loop, YTO pretuning and 20/30 MHz loop are able to tune the YTO from 2000.000 to 6599.999 MHz in 1 kHz steps. The YTO frequency is the front panel frequency divided by the Band Number. See Service Sheet BD1 for a list of band numbers and corresponding frequencies.

The M/N loop provides a tunable phase locked reference signal for the YIG-Tuned Oscillator (the Synthesizer's microwave signal source). The M/N OUT frequency (177.5 to 197.5 MHz) is obtained by dividing the M/N VCO signal (355—395 MHz) by two. The M/N IF signal (5—45 MHz) is the lower mixing sideband of the VCO signal and the 400 MHz reference. The M/N loop is phase locked by comparing a fraction of 20 MHz (20 MHz divided by the N number) to a fraction of the IF signal (5—45 MHz divided by the M number) in the phase detector. The phase detector generates an error voltage that is integrated and coupled to the VCO as a tuning signal. The M and N numbers are determined by the Digital Control Unit (DCU) and vary with the 10 MHz steps of the YTO frequency. The M/N VCO frequency is dependent on the ratio of the M and N numbers as expressed in the following formula:

$$f_{M/N\ VCO} = [400-20(M/N)]\text{MHz}$$

where $f_{M/N\ VCO}$ = M/N VCO frequency
M = M number
N = N number

M/N Phase Detector
A3A1A3
SERVICE SHEET 3

SERVICE SHEET 4 (cont'd)

To determine M (M varies from 8 to 27):

If the 100 MHz digit of the YTO Frequency is even then M=17−10 MHz digit

If the 100 MHz digit is odd then M=27−10 MHz digit.

To determine N (N varies from 11 to 34):

Divide the left two (most significant) digits of the YTO Frequency by 2.

Add 1 to the result and round up if necessary to the nearest integer.

For example, if the ratio is 1-to-1 (M=N) then $f_{M/N\ VCO}$ = 380.000 MHz. If the ratio is 1-to-2 (M=2N) then $f_{M/N\ VCO}$ = 390.000 MHz. Refer to Table 8-5 in Service Sheet BD3, RF Phase-Locked Loops, for a complete list of M and N Numbers and Resulting Frequencies.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD3 was used to isolate a malfunction to the M/N VCO Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information allows further isolation to the defective component.

Test Equipment

Digital Voltmeter (DVM)	HP 3456A or 3455A
Power Supply	HP 6200B
Spectrum Analyzer	HP 8556A/ 8552B/141T
High Impedance Probe	HP 1121A

Troubleshooting Procedures

1. Remove A3A1A3 to open the M/N Loop.
2. Remove A3A1A4 and replace it on an extender board.
3. Connect the positive lead of the power supply to chassis ground and the negative lead to A3A1A4TP1 TUNE test point.

   CAUTION

   Do not apply a positive voltage to A3A1A4TP1. This would forward bias the VCO tuning diodes and could destroy them.

4. Set the power supply to −35 volts and connect the spectrum analyzer, using the high impedance probe, to the emitter of Q2.

   The spectrum analyzer display should show a 395 MHz signal at 0 dBm.

   If the signal is as indicated, proceed with Step 5.

   If the signal is not as indicated, check Q2 and associated components.

5. Connect the high impedance probe to the base of Q1.

   The spectrum analyzer display should show a 395 MHz signal at −34 dBm.

   If the signal is as indicated, check Q1 and associated components.

   If the signal is not as indicated, replace VCO Resonator Assembly A3A1A4A1.

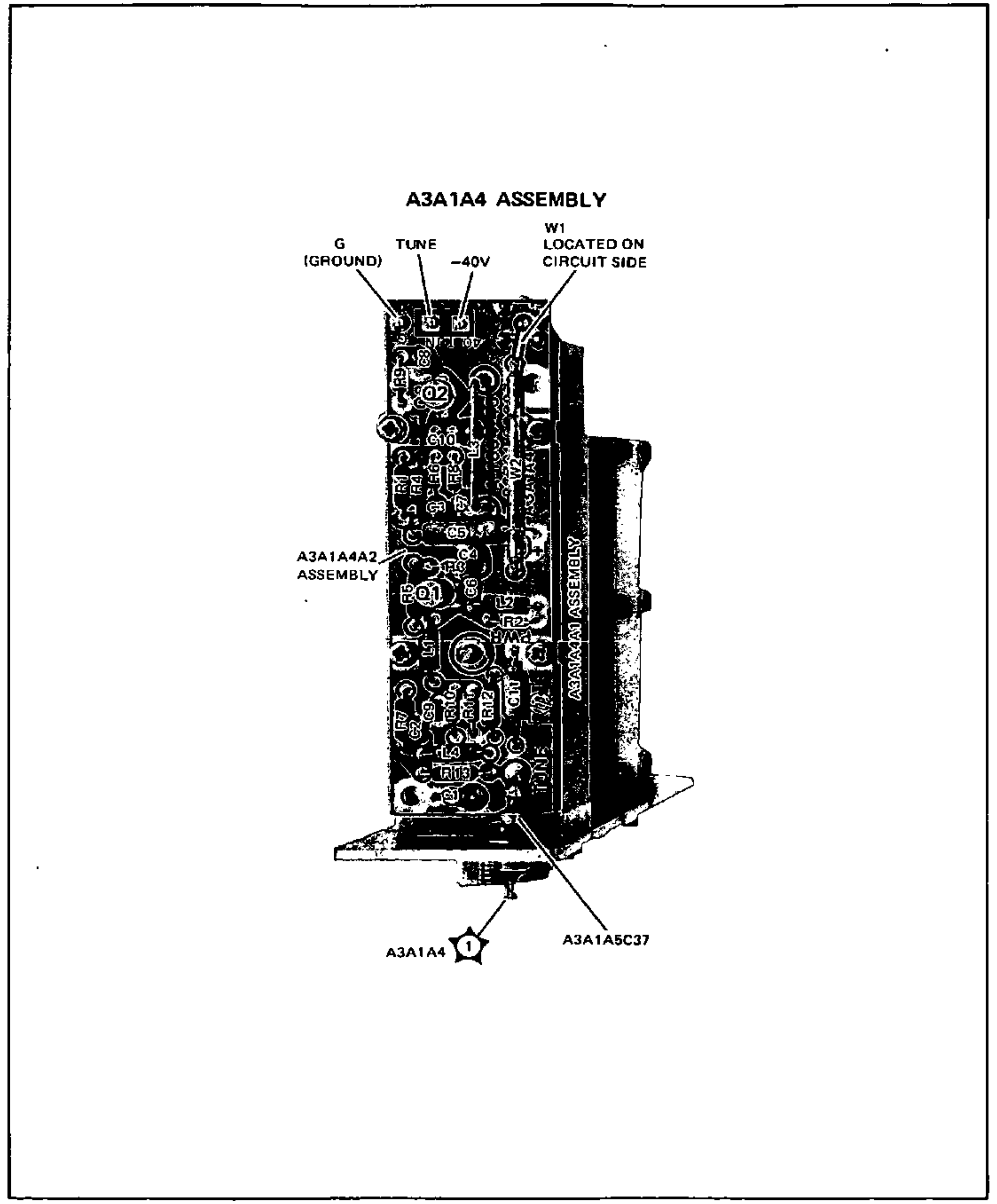
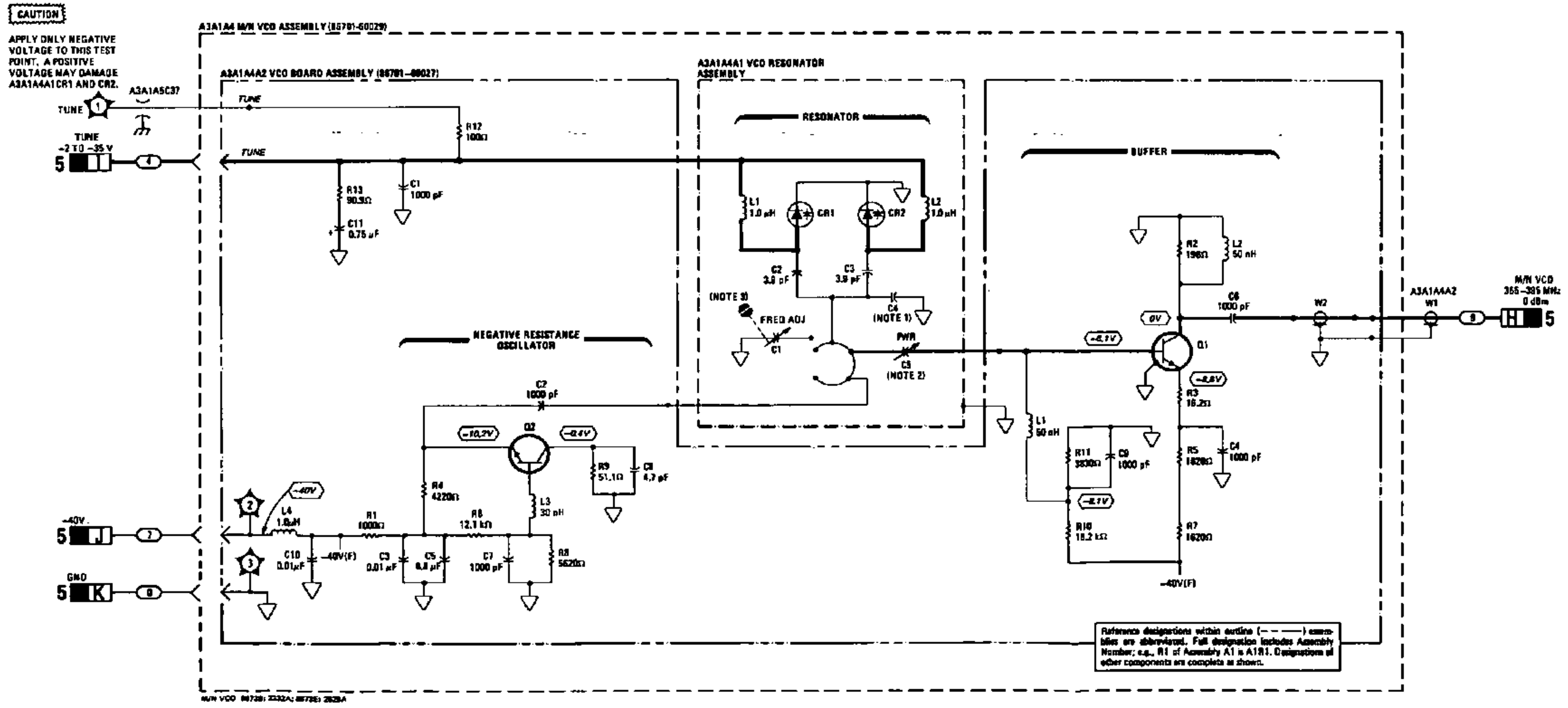


Figure 8-66. A3A1A4A2 M/N VCO Assembly Component and Test Point Locations



NOTES

1. A3A1A4A1C4 IS AN AIR DIELECTRIC CAPACITOR FORMED BY RESONATOR HOUSING AND RESONATOR CENTER CONDUCTOR.
2. PWR ADJUSTMENT IS AN ADJUSTABLE PROBE MOUNTED ON A3A1A4A2 AND EXTENDING INTO THE VCO RESONATOR ASSEMBLY.
3. ADJUSTMENT SCREW LOCATED ON COVER OF M/N OUTPUT ASSEMBLY A3A1A5.
4. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS

A3A1A4A1	A3A1A4A2
C1-5 CR1,2 L1,2	C1-11 L1-4 Q1,2 R1-13 TP1 W1,2
A3A1A5	
C37	

TRANSISTOR PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854-0610
Q2	1854-0686

4
A3A1A4

Figure 8-67. M/N VCO Assembly Schematic Diagram

SERVICE SHEET 5

M/N OUTPUT ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting,
BD1 .... Service Sheet BD1
RF Phase Locked Loops Block Diagram ...... Service Sheet BD3
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

The frequency output of the M/N loop is dependent on the front panel frequency. A digital equivalent of the M/N loop frequency (dependent upon the front panel frequency's most significant digits, 10 MHz to 10 GHz) is input to the M/N loop as M and N numbers. The ratio of the M and N numbers actually determines the M/N OUT frequency The M/N OUT frequency's Nth harmonic (based on the N number and selected by the YTO pretuning) tunes the YTO frequency in 10 MHz steps. There is a 10 MHz step (or band) for each valid M/N OUT frequency (M/N ratio) and Nth harmonic (N number). This 10 MHz band complements the 20/30 MHz loop because its tuning range is 10 MHz and step size is 1 kHz. Together, the M/N loop, YTO pretuning and 20/30 MHz loop are able to tune the YTO from 2000.000 to 6599.999 MHz in 1 kHz steps. The YTO frequency is the front panel frequency divided by the Band Number. See Service Sheet BD1 for a list of band numbers and corresponding frequencies.

The M/N loop provides a tunable phase locked reference signal for the YIG Tuned Oscillator (the Synthesizer's microwave signal source). The M/N OUT frequency (177.5 to 197.5 MHz) is obtained by dividing the M/N VCO signal (355—395 MHz) by two. The M/N IF signal (5—45 MHz) is the lower mixing sideband of the VCO signal and the 400 MHz reference. The M/N loop is phase locked by comparing a fraction of 20 MHz (20 MHz divided by the N number) to a fraction of the IF signal (5—45 MHz divided by the M number) in the phase detector. The phase detector generates an error voltage that is integrated and coupled to the VCO as a tuning signal. The M and N numbers are determined by the Digital Control Unit (DCU) and vary with the 10 MHz steps of the YTO frequency. The M/N Out frequency is dependent on the ratio of the M and N numbers as expressed in the following formula:

$$f_{M/N} = [\,200 - 10(M/N)\,]\ \text{MHz}$$

where $f_{M/N}$ = M/N OUT frequency
M = M number
N = N number

SERVICE SHEET 5 (cont'd)

To determine M (M varies from 8 to 27):

If the 100 MHz digit of the YTO Frequency is even then M=17−10 MHz digit

If the 100 MHz digit is odd then M=27−10 MHz digit.

To determine N (N varies from 11 to 34):

Divide the left two (most significant) digits of the YTO Frequency by 2.

Add 1 to the result and round up if necessary to the nearest integer.

For example, if the ratio is 1-to-1 (M=N) then $f_{M/N}$ = 190.000 MHz. If the ratio is 1-to-2 (M=2N) then $f_{M/N}$ = 195.000 MHz. Refer to Table 8-5 in Service Sheet BD3, RF Phase Locked Loops, for a complete list of M and N Numbers and Resulting Frequencies.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD3 was used to isolate a malfunction to the M/N VCO Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Spectrum Analyzer .... HP 8556A/8552B/141T
High Impedance Probe .... HP 1121A

Troubleshooting Procedures

There are two procedures provided below, one for IF OUT problems and the other for M/N OUT problems.

IF OUT. Use this procedure if the procedures in Service Sheet BD3 indicate a problem with the IF OUT signal.

1. Remove A3A1A5 and replace it on a 30-pin extender board.
2. Connect A3A5TP5 (−5.2 volts) to A3A1A5TP1 TUNE test point. This sets the M/N VCO output at about 365 MHz.
3. Using the high impedance probe, connect the spectrum analyzer to the collector of Q5.

   The spectrum analyzer should show a signal of about 365 MHz at a level of +5 dBm.

   If the signal is as indicated, proceed with Step 4.

   If the signal is not as indicated, check Q9, Q7, Q5 and associated components.
4. Using the high impedance probe, connect the spectrum analyzer to pin 6 of the mixer U1.

   The spectrum analyzer should show a signal of about 35 MHz at a level of −18 dBm.

   If the signal is as indicated, check Q1, Q2 and associated components.

   If the signal is not as indicated, check U1 and associated components.

M/N OUT. Use this procedure if the procedures in Service Sheet BD3 indicate a problem with the M/N OUT signal.

1. Remove A3A1A5 and replace it on a 30-pin extender board.
2. Connect A3A5TP5 (−5.2 volts) to A3A1A5TP1 TUNE test point. This sets the M/N VCO output at about 365 MHz.
3. Using the high impedance probe, connect the spectrum analyzer to U2 pin 13.

   The spectrum analyzer should show a signal of about 365 MHz at a level of −15 dBm.

   If the signal is as indicated, proceed with Step 4.

   If the signal is not as indicated, check Q8, Q6, and associated components.
4. Using the high impedance probe, connect the spectrum analyzer to U2 pin 6.

   The spectrum analyzer should show a signal of about 182 MHz at a level of −6 dBm.

   If the signal is as indicated, check Q4, Q3, and associated components.

   If the signal is not as indicated, check U2 and associated components.

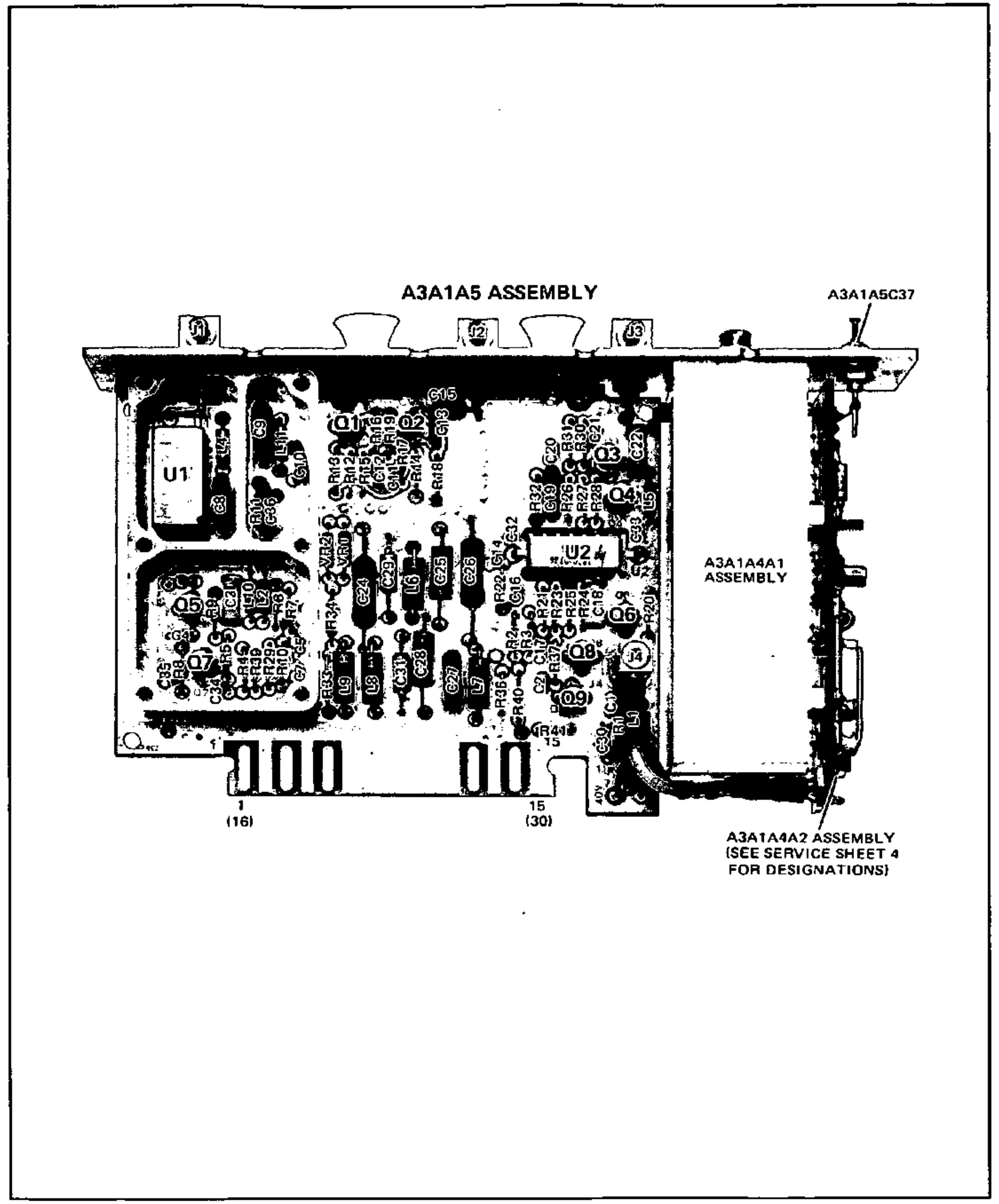
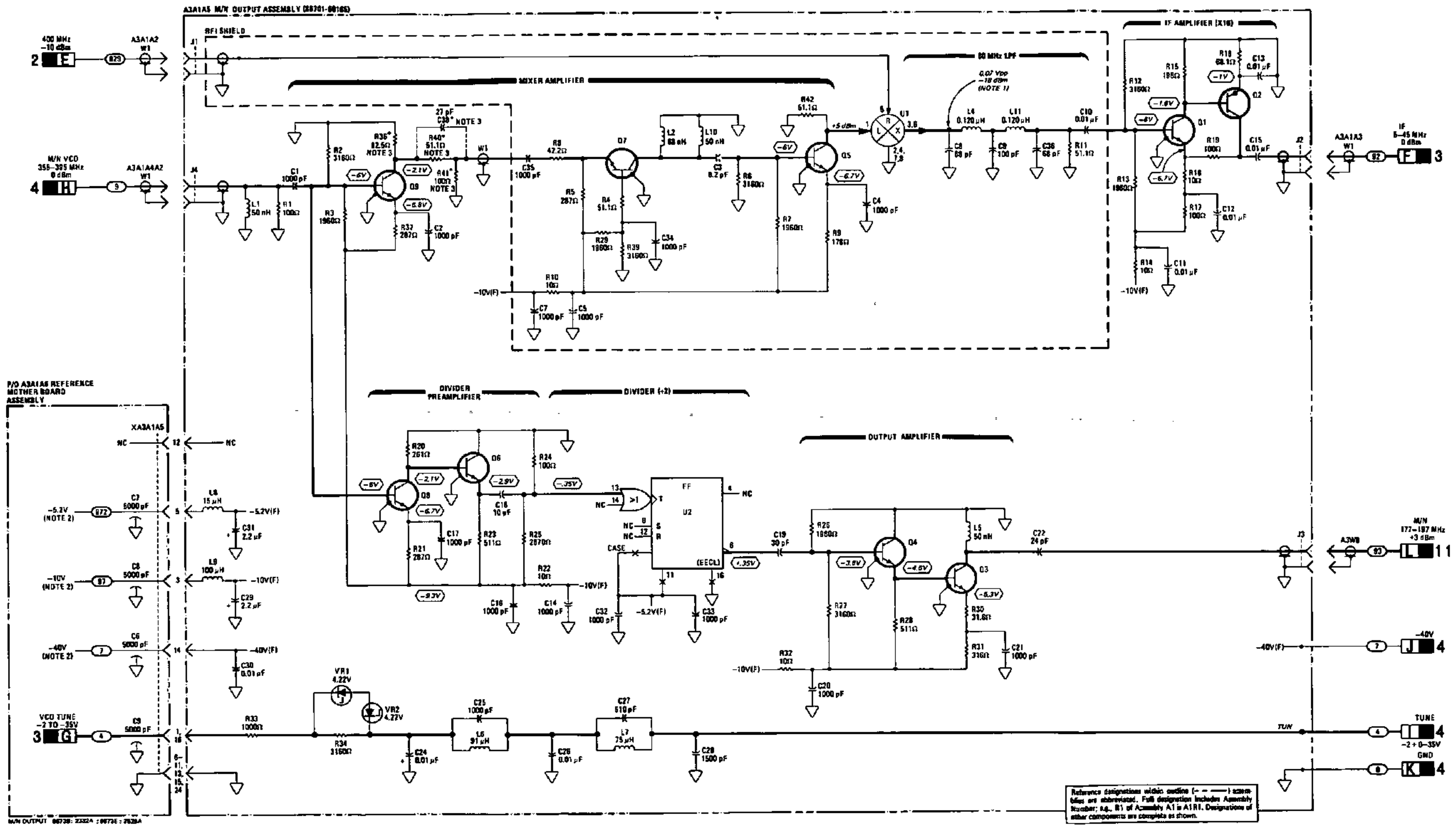


Figure 8-68. A3A1A5 M/N Output Assembly Component and Test Point Locations



NOTES

1. MEASURED WITH SPECTRUM ANALYZER HIGH IMPEDANCE PROBE.
2. POWER SUPPLY CONNECTIONS TO THE A3A1 ASSEMBLY ARE SHOWN ON SERVICE SHEET 1.

* ASTERISK INDICATES SELECTED COMPONENTS. NOMINAL VALUES SHOWN. EITHER R40 OR C38 WILL BE USED IN ANY INSTRUMENT. SELECTION IS COVERED IN SECTION V.

3. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS

A3	A3A1A5
W8	C1–5,7–22, 24–[illegible]
A3A1A2	J1–4
W1	L1,2,4–11
	Q1–8
A3A1A3	R1–34,36, 37,39–42
W1	U1,2
	VR1,2
A3A1A4A2	W1
W1	A3A1A6
	C8–9 XA3A1A5

DELETED: A3A1A5C6,C39,L3,L12, R35,R38

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH(1)	>2V	>–0.5V	>–0.1V	≈VDD
LOW(0)	<0.8V	<–1.5V	<–0.6V	<0.1V
< = EQUAL TO OR MORE NEGATIVE THAN > = EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW(0)	HIGH(1)	HIGH(1)	LOW(0)
OPEN	HIGH(1)	LOW(0)	LOW(0)	X
GROUND – 0V; X = UNDEFINED				

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1,3,4	1854–0345
Q2	1853–0015
Q5-8	1854-0548
U1	0955–0083
U2	1820–2842

5
A3A1A5

Figure 8-69. M/N Output Assembly Schematic Diagram

SERVICE SHEET 6

20/30 DIVIDER ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
RF Phase Locked Loops Block Diagram ...... Service Sheet BD3
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB).................... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The 20/30 MHz Loop (LFS Loop) converts tuning information of the four least significant digits (1 MHz through 1 kHz) of the YTO frequency into a frequency between 20 MHz and 30 MHz. (The YTO frequency is the input frequency divided by the Band Number.) This frequency is obtained by dividing the 160—240 MHz VCO output by 8. The 160—240 MHz is fed back to a programmable divider where it is divided by a number N1, to produce 80 kHz. The 10 MHz reference is divided (by 125) to obtain 80 kHz and the two are compared in the phase detector. Phase difference is converted into a VCO TUNE voltage and applied to the VCO.

Detailed Description

The 20/30 Mhz divider (A2A5 board) consists of a programmable divider and a fixed divider. The programmable divider consists of a divide by 10 or 11 prescaler and a low frequency divider. It divides by N1 which varies between 2000.1 and 3000.0, depending on the four digits of the YTO frequency. The relationship is as follows:

N1 = 8(30 MHz—D4.D3 D2 D1 MHz)/80 kHz

where:

D4 = 1 MHz digit of the YTO Frequency
D3 = 100 kHz digit of the YTO Frequency
D2 = 0 kHz digit of the YTO Frequency
D1 = 1 kHz digit of the YTO frequency

If D1 and D2 are zero, the prescaler divides by 11 for 5 of its output cycles and by 10 for the rest, and the low frequency divider counts the programmed number of prescaler output pulses. When D2 is not zero, unit division takes place. This is done by the prescaler, which divides by 11 one less time for each increment of D2. For example, if D2 is 4, the prescaler will divide by 11 four times less. If D1 is not zero, fractional division is done by changing the unit division number over ten 80 kHz cycles. For example, if N1 is 2100.5, the 20/30 divider will divide by 2100 five times and by 2101 five times. This results in an average N1 of 2100.5 and an average frequency (over ten output cycles) of 80 kHz.

SERVICE SHEET 6 (cont'd)

The prescaler U8 divides the 160—240 MHz VCO output by 10 if pin 2 is high and by 11 if it is low. The resulting pulses are counted by the low frequency divider. The count starts with the numbers preset by the 1 MHz and 100 kHz digits and ends at 299. This results in a pulse at the beginning of each 80 kHz cycle. It stays that way until the first time U15A goes low. This clocks a low through U7B which causes the prescaler to divide by 11. When U14 reaches a count of 9, the J input of U7A goes high and is clocked through U7A by the next low going prescaler output. This causes a high to be clocked through U7B which tells the prescaler to divide by 10 until the end of the 80 kHz cycle.

Fractional division depends on the 1 kHz digit. Rate multiplier U12 outputs a number of negative transitions per ten 80 kHz cycles. This number is the value of the 1 kHz digit. Each of these negative transitions causes the prescaler to divide by 11 one less time than programmed by the D2 information.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD3 was used to isolate a malfunction to the 20/30 Divider Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Frequency Counter	HP 5343A
Oscilloscope	HP 1980B
Pulse Generator	HP 8013B or HP 8031A
Digital Voltmeter (DVM)	HP 3456A or HP 3455A

Troubleshooting procedures

There are two procedures, the first is used for problems with the 80 kHz reference signal and the second for problems with the ÷N1 signal.

80 kHz Reference Prodedure. Use this procedure if the troubleshooting information in Service Sheet BD3 indicates that the 80 kHz reference signal is not correct.

1. Install A2A5 on an extender board.
2. Connect the DVM to U9 pin 2.

The DVM should indicate +5 volts.

If the indication is normal, troubleshoot the ÷125 Counter Q1, U10, U1, and U2.

M/N Output (A3A1A5) SERVICE SHEET 5

SERVICE SHEET 6 (cont'd)

If the indication is not normal, U9 is defective.

÷N1 Procedure. Use this procedure if the troubleshooting information in Service Sheet BD3 indicates that the ÷N1 output is not correct.

1. Remove A2A5 and replace it on a 36-pin extender board.
2. Remove A2A3 and set the test switch to the TEST HIGH FREQ position. Reinstall A2A3. Confirm that the frequency at A2A5J1 is greater than 240 MHz. This signal will be used to test the divider assembly.
3. Set the Signal Generator frequency to 3000.000 MHz. Attach a counter or oscilloscope to A2A5TP5. The frequency should be about 25 MHz at TTL levels. This signal is rich in harmonics (i.e., the sine wave is distorted). If the signal is near 22.7 MHz, the 10/11 prescaler is dividing incorrectly (or its input control at pin 2 is wrong).
4. Ground A2A5TP4 (LSB). The frequency should drop to about 22.7 MHz as the prescaler is switched to divide by 11. If this does not happen, troubleshoot U8 and associated components.
5. Disconnect the ground on TP4 and observe the signal at TP4 on an oscilloscope. Set the frequency to 2999.900 MHz. There should be low true pulses about 0.65 μs wide with a 8 μs spacing, TTL levels.
6. Increase the frequency in 1 kHz steps to 2999.999 MHz. The pulses should become narrower and finally disappear. This pattern is repeated every 100 kHz. The pulse spacing varies with frequency from 12 μs for frequencies ending in 0.000 to 8 μs for frequencies ending 9.9xx. If the pulse does not behave properly, troubleshoot the ÷10/11 Controller, the Unit Divide Controller and the Fractional Divide Control.
7. Connect the oscilloscope or frequency counter to TP3. At 3000.000 MHz the frequency should be about 83.3 kHz (period = 1.2 μs; 250 MHz divided by 3000). Change frequency to 2999.999 MHz and TP3 should go to about 125 kHz (period = 8 μs; 250 MHz divided by 2000.1). If both of these frequencies are correct the A2A5 divider assembly is probably functioning properly. Otherwise, troubleshoot the Low Frequency Divider (U14, U13, U11, U3 and U6).
8. As a final check of the dividers, tune in 1 kHz and 10 kHz steps from 3000.000 MHz to 2009.999 MHz to assure that the divider output frequency increases as the frequency is turned higher. If this happens, the divider is functioning normally. Be sure to reset the TEST switch to the NORMAL position.

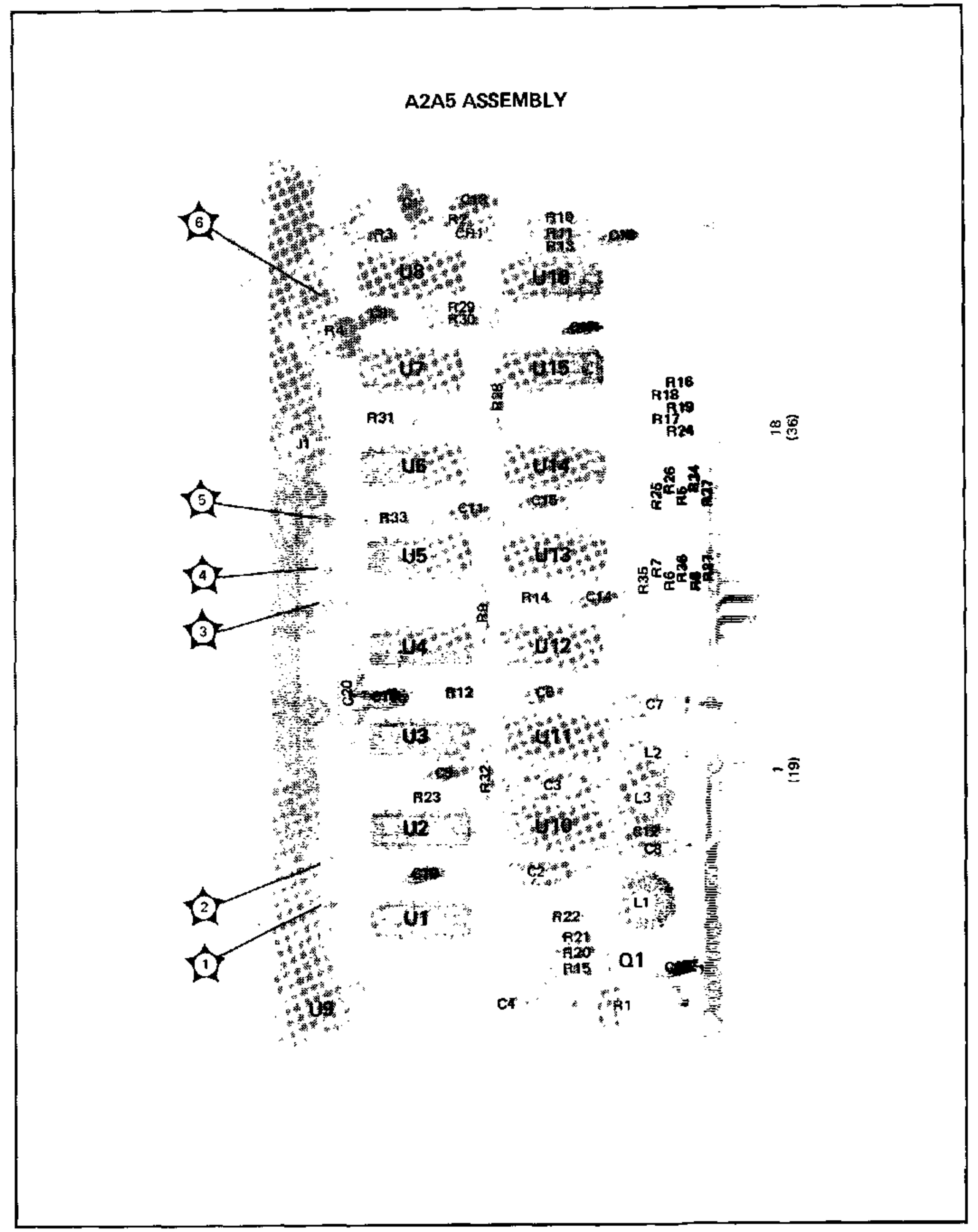
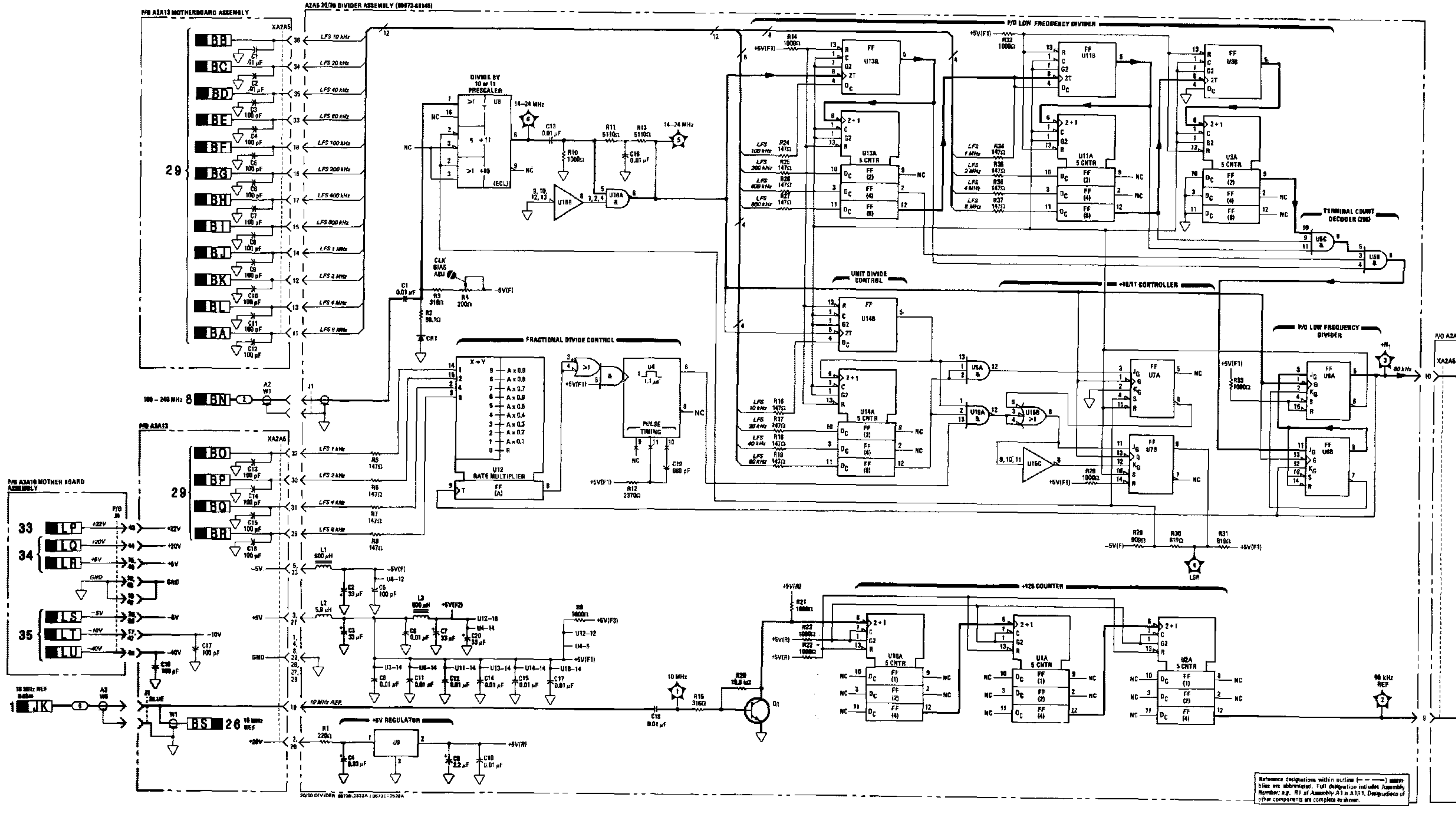


Figure 8-70. A2A5 20/30 Divider Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS

A2	A2A13
W2	C1–18 J2 W1 XA2A5
A2A5	
C1–20 CR1 J1 L1–3 Q1 R1–37 TP1–6 U1–16	A3
	W6
	A3A10
	J4

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH (1)	>2V	>–0.5V	>–0.1V	~VDD
LOW (0)	<0.8V	<–1.5V	<–0.8V	<0.1V
<= EQUAL TO OR MORE NEGATIVE THAN >= EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW (0)	HIGH (1)	HIGH (1)	LOW (0)
OPEN	HIGH (1)	LOW (0)	LOW (0)	X
GROUND – 0V; X = UNDEFINED				

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854-0019
U1–3, 10, 11	1820-1251
U4	1820-0261
U5	1820-0686
U6, 7	1820-0629
U8	1820-1384
U9	1820-0429
U12	1820-0809
U13, 14	1820-0751
U15	1820-0685
U16	1820-0690

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U1, 2, 10	+5V(R) – 14 ▽ – 7
U3, 5, 11, 13–16	+5V(F1) – 14 ▽ – 7
U4	+5V(F2) – 14 ▽ – 7
U6, 7	+5V(F1) – 16 ▽ – 8
U8	–5V(F) – 12 ▽ – 5
U12	+5V(F2) – 16 +5V(F3) – 12 ▽ – 8

6
A2A5

Figure 8-71. 20/30 Divider Assembly Schematic Diagram

SERVICE SHEET 7

20/30 MHz PHASE DETECTOR ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

The 20/30 MHz Loop (LFS Loop) converts tuning information of the four least significant digits (1 MHz through 1 kHz of the YTO frequency) into a frequency between 20 MHz and 30 MHz. The YTO frequency is the input frequency divided by the Band Number. The frequency between 20 and 30 MHz is obtained by dividing the 160—240 MHz VCO output by 8. The 160—240 MHz is fed back to a programmable divider where it is divided by a number N1, to produce 80 kHz. The 10 MHz reference is divided (by 125) to obtain 80 kHz and the two 80 kHz frequencies are compared in the phase detector. Phase difference is converted into a VCO TUNE voltage and applied to the VCO.

Detailed Description

The Digital Phase Detector compares the REF 80 kHz and ÷N1 80 kHz and uses the phase difference to produce a dc voltage, VCO TUNE, which sets the VCO frequency. When the loop is unlocked, the Gain Control Logic and Pulse Width Detector (pulse width varies directly with frequency or phase error) circuitry increases the integrating amplifier's gain (and thus increases bandwidth) during unlocked conditions, speeding up the re-lock process. When the loop is unlocked, the Unlock Detector will pulse the LFS UNLOCKED line high. If the loop remains unlocked, the signal on the LFS UNLOCKED line will be a string of 140 μs pulses.

Flip-flops U3A, B and NAND gate U2C phase compare the two 80 kHz inputs by generating a pulse that represents, by its width, the phase error. Starting in the reset state, the flip-flop's non-inverting output will go high on the trailing edge of the first input pulse. When both U3A and U3B are high, the NAND gate, U2C goes low and resets the flip-flops, restarting the process. If the two 80 kHz inputs are in phase, the pulses at TP1 and TP2 will occur at the same time which, to the integrating amplifier's input, means no change in the VCO TUNE voltage. See Figure 8-72. But if a phase difference exists, one of the flip-flops will output a longer pulse which the Integrating Amplifier will translate to a positive or negative dc voltage. Normally, the 80 kHz REF pulse will begin to rise about 20 ns before the ÷N1 pulse.

SERVICE SHEET 7 (cont'd)

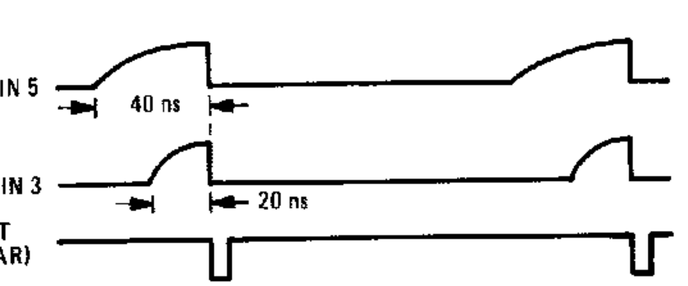


Figure 8-72. Phase Detector Timing

Q1 and U5 form an operational amplifier which amplifies and integrates differences between inputs to produce the VCO TUNE voltage. R8, R12, R16 and C9, R11, R13, R20 and C12 determine the gain and integrating time constant, while CR1 and CR2 speed up the integration during fast input changes. VR1 and the voltage divider R27 and R29 act as a clamp to keep VCO TUNE under 14 volts. A linearizing network, CR3, CR4 and associated resistors, modifies the VCO TUNE voltage so that loop bandwidth will be nearly constant for all frequencies, thus yielding a constant phase noise characteristic.

When the loop is out of lock, switches U4C and U4D close which shunts R8, R12, and R11 with R10 and R14. This increases the Integrating Amplifier's gain allowing the loop to relock faster.

The 8 kHz notch filter removes the 8 kHz and 16 kHz sidebands produced during fractional division. Higher sidebands are attenuated by the low pass filter in the next stage.

One shot U7, flip-flop U8 and NAND gate U2D activate the switches U4C and D, if the phase detector pulse width exceeds 1.5 μs. When the output of U2D goes high, the one shot will trigger, but normally the input will stay high for only about 20 ns so by the time U7-6 goes high the D input to U8 is low and a low is clocked through to the switches. If a phase error exists for more than about 150 μs, U8-12 will still be high when the one shot's output pulse goes positive and a high will be clocked through U8. One shot U16 and NAND Gate U2A signal the front panel indicator and the HP-IB status byte circuitry when the LFS loop is unlocked. During lock periods and brief unlock periods both inputs to U2A are high. When the loop is unlocked for short periods, U2A outputs very short negative pulses which increase to 140 μs for long unlock periods.

Short pulses are attenuated by R21 and C15 but longer ones will trigger U6, the output of which will cause the LFS UNLOCKED line to pulse high. As long as the loop remains unlocked, U6 will be triggered and output a string of 140 μs pulses to the LFS UNLOCKED line via U2A.

20/30 Divider Assembly
A2A5
SERVICE SHEET 6

SERVICE SHEET 7 (cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheets BD1 and BD3 was used to isolate a malfunction to the 20/30 MHz Phase Detector. It is also assumed that an attempt has been made to correct the malfunction using the appropriate adjustment procedue, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Frequency Counter .... HP 5343A
Oscilloscope .... HP 1980B
Digital Voltmeter (DVM) ...... HP 3456A or 3455A

Troubleshooting Procedures

Two procedures are provided, one for problems with the VCO TUNE output and the other for problems with the LFS UNLOCKED output.

VCO TUNE Procedure. Use this procedure if the troubleshooting information on Service Sheet 3 indicates a problem with the VCO TUNE output.

1. Remove A2A4 and replace it on a 36-pin extender board. Be sure all loop cables remain connected.

2. Connect the DVM to U1 pin 2.

   The DVM should read +5.0 volts dc.

   If the reading is as indicated, proceed with Step 3.

   If the reading is not as indicated, check U1, Q2 and associated components.

3. Connect the oscilloscope to test points TP1 and TP2.

   The waveforms should be as shown on the schematic.

   If the waveforms are as indicated, proceed with Step 4.

   If the waveforms are not as indicated, check U3 and associated components.

4. Using the DVM, check the voltage at pins 2 and 3 of U5.

   In both cases the DVM should indicate 12.1 volts dc.

   If the voltages are as indicated, check U5 and associated components.

   If the voltages are not as indicated, check Q1 and asssociated components.

5. The Gain Control Logic speeds up the phase locking process by extending the loop bandwidth. If the loop is not locked, there is no way to check this circuit except to see that U8 pin 9 is high and that the same signal appears at pins 11 and 12 and pins 8 and 9 of U4, that is, that U4C and U4D are turned on.

LFS UNLOCKED Procedure. Use this procedure if the Signal Generator seems to be operating normally, but the LFS LED on A2A7 is off.

1. Connect the DVM to U2 pin 3, then, while observing the DVM display, disconnect the red cable from A2A5J1.

   The DVM should initially indicate less than about 0.5 volt dc, then jump to about 4.5 volts dc when the cable is removed.

   If the DVM indication is normal, the Unlock Detector is functioning normally. Proceed to Service Sheet 30 to further isolate the problem.

   If the DVM indication is not normal, check U2 and U6.

A2A4 ASSEMBLY

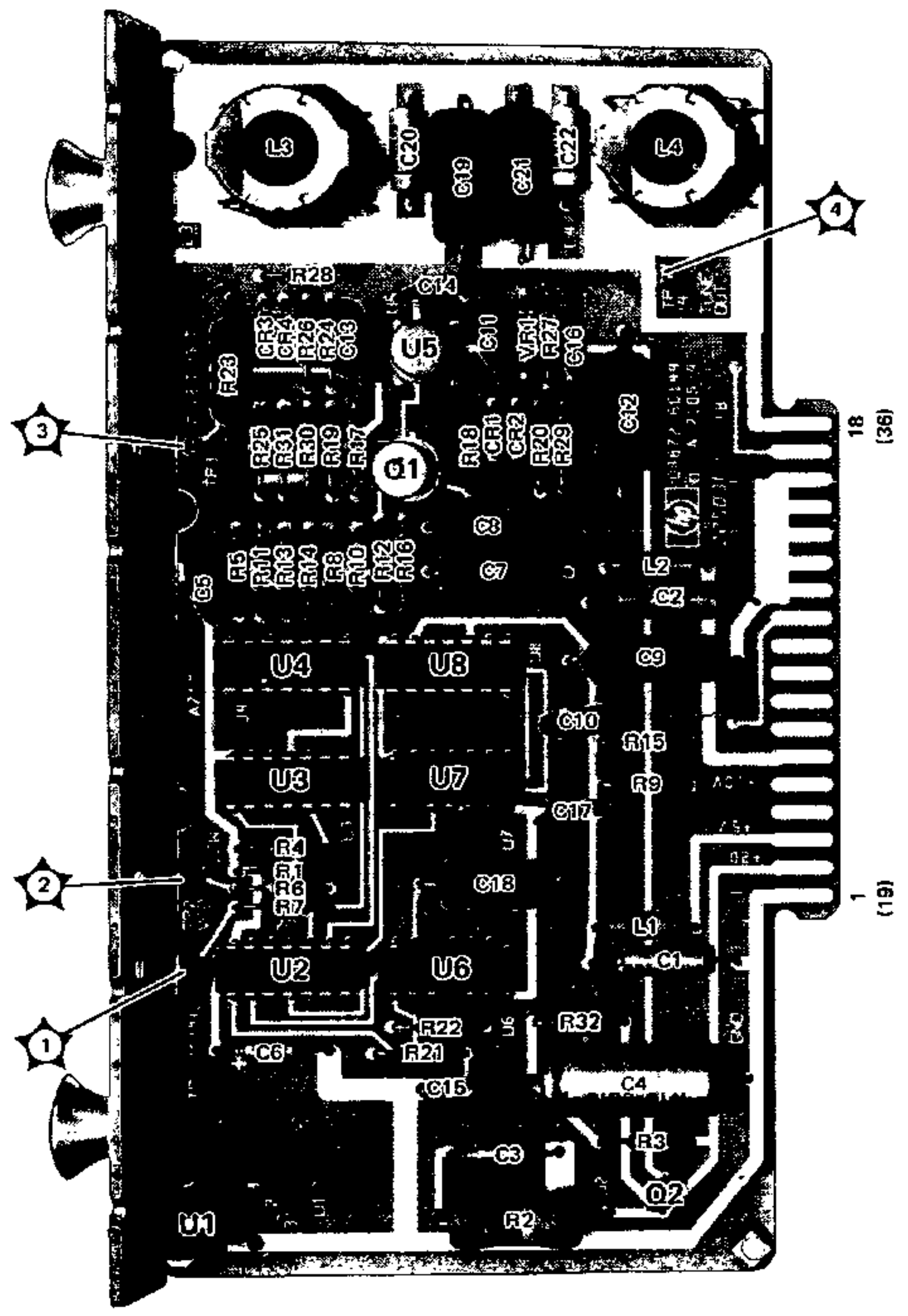
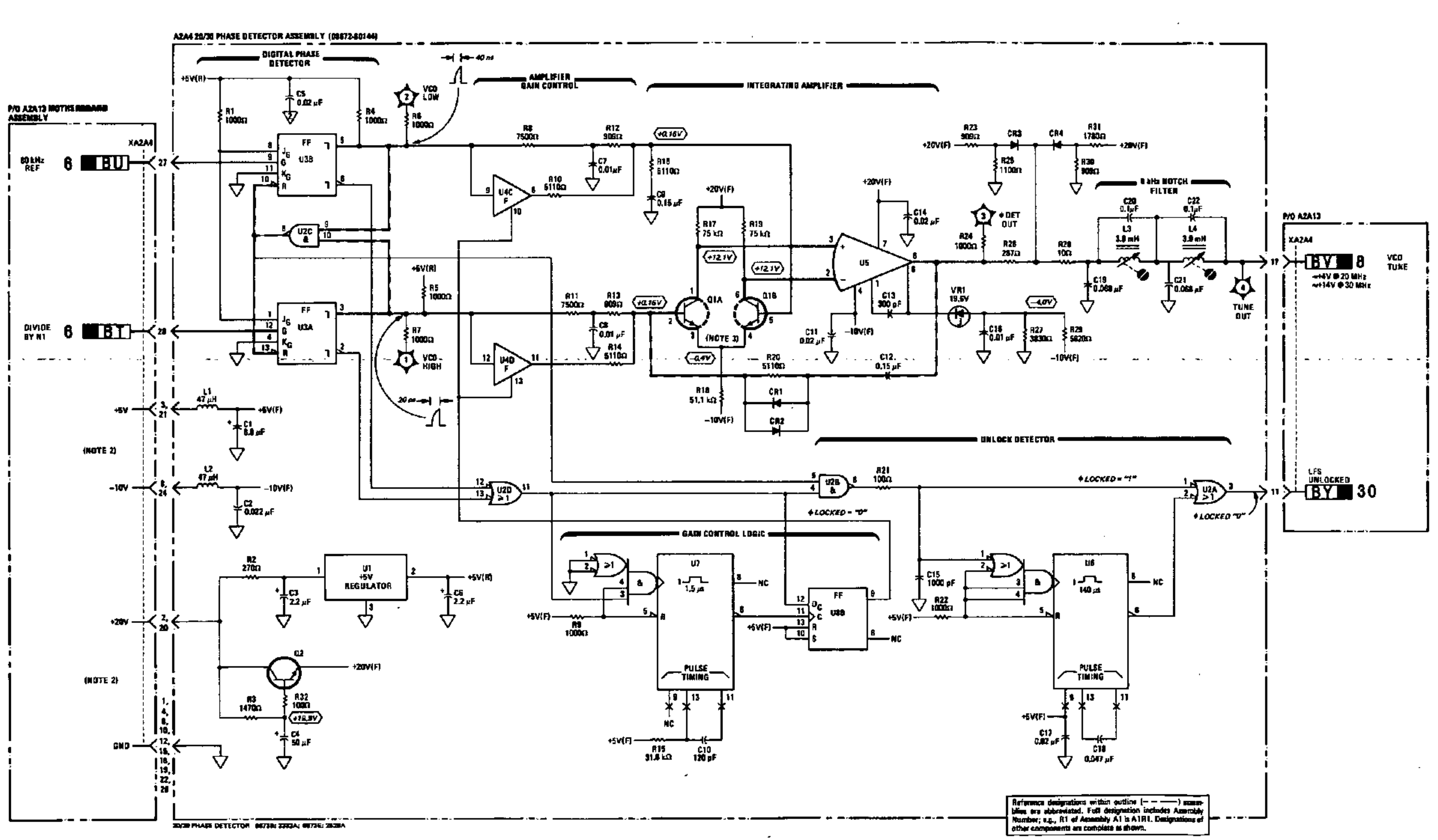
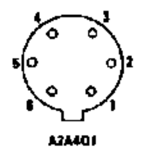


Figure 8-73. A2A4 20/30 Phase Detector Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE A2 ASSEMBLY ARE SHOWN ON SERVICE SHEET 6.
3. REFER TO THE FOLLOWING DIAGRAM FOR PIN LOCATIONS.



A2A4Q1
TOP VIEW

REFERENCE DESIGNATIONS

A2A4	A2A13
C1–22 CR1–4 L1–4 Q1–2 R1–32 TP1–4 U1–8 VR1	XA2A4

LOGIC LEVELS

LOGIC	TTL	ECL	EECL	CMOS
HIGH (1)	≥2V	≥−0.5V	≥−0.1V	≈VDD
LOW (0)	≤0.8V	≤−1.5V	≤−0.8V	≤0.1V
≤ = EQUAL TO OR MORE NEGATIVE THAN ≥ = EQUAL TO OR MORE POSITIVE THAN				
INPUT	TTL	ECL	EECL	CMOS
GROUND	LOW (0)	HIGH (1)	HIGH (1)	LOW (0)
OPEN	HIGH (1)	LOW (0)	LOW (0)	X
GROUND – 0V; X = UNDEFINED				

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854-0712
Q2	1854-0071
U1	1820-0429
U2	1820-1197
U3	1820-0281
U4	1820-0846
U5	1820-0223
U6–7	1820-1422
U8	1820-1112

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATIONS	PIN NUMBERS
U2, 3	+5V(R) – 14 ⏚ – 7
U4, 8	+5V(F) – 14 ⏚ – 7
U6, 7	+5V(F) – 16 ⏚ – 7

7
A2A4

Figure 8-74. 20/30 Phase Detector Assembly Schematic Diagram

SERVICE SHEET 8

VCO 160—240 MHZ ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
RF Phase Locked Loop Block Diagram .... Service Sheet BD3
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The 20/30 MHz Loop (LFS Loop) converts tuning information of the four least significant digits (1 MHz through 1 kHz on the front panel display) into a frequency between 20 and 30 MHz. This frequency is obtained by dividing the 160—240 MHz voltage controlled oscillator (VCO) output by 8. The 160—240 MHz is fed back to a programmable divider where it is divided by a number, N1, to produce 80 kHz. The 10-MHz reference is divided by 125 to obtain 80 kHz and the two are compared in a phase detector. Phase difference is converted into a VCO TUNE voltage and applied to the VCO.

Detailed Description

The VCO 160—240 MHz Assembly uses a varactor tuned oscillator and dividers to produce a 20—30 MHz signal, which is used in the YTO Summing Loop, and a 160—240 MHz signal which is fed back to the N1 divider. The VCO TUNE voltage, after passing through a low-pass filter, tunes the VCO over its 160—240 MHz range. A power splitter and drivers buffer the VCO output and drive a divider for the 20—30 MHz output and a low pass filter for the 160—240 MHz output.

The oscillator consists of Q1 with the primary of T1 and CR1 through CR4 for the tuned circuit. Feedback is provided through C6. The VCO TUNE voltage is applied through the low-pass filter and switch S1. In the NORM position S1 connects the VCO TUNE voltage to the varactor diodes, but in TEST HIGH FREQ and TEST LOW FREQ, a dc voltage is substituted for the VCO Tune signal that sets the VCO frequency to greater than 240 MHz or less than 160 MHz. Transistor Q1 is biased by the −40 volt supply through ripple filter Q6. RF energy is coupled to the Power Splitter by the one-turn secondary of T1.

Amplifier Q4 buffers the VCO from the two common base drivers Q2 and Q3. Transistor Q5 acts as a ripple filter for the Q2, Q3,

20/30 Phase Detector A2A4 SERVICE SHEET 7

SERVICE SHEET 8 (cont'd)

and Q4 bias supply. The output of Q2 is filtered and applied to J2 as the 160—240 MHz OUTPUT. The signal at the collector of Q3 is divided by U2, U1A, and U1B, filtered and applied to J1 as the 20/30 MHz output.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD3 was used to isolate a malfunction to the VCO 160—240 MHz Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM)	HP 3456A or 3455A
Frequency Counter	HP 5343A
Spectrum Analyzer	HP 8556A/8552B/141T
High Impedance Probe	HP 1121A

Troubleshooting Procedures

There are two procedures provided below, one for problems with the 160—240 MHz output and the second for problems with the 20/30 MHz output.

160—240 MHz Output. Use this procedure if the troubleshooting information in Service Sheet BD3 indicates a problem with the 160—240 MHz output.

1. Remove A2A3, set the Test Switch to TEST HIGH FREQ and replace it on 36-pin extender board.
2. Using the DVM, check the voltages at the emitters of Q5 and Q6 against the voltages given on the schematic.

   If either voltage is not as indicated on the schematic, check the affected transistor and associated components.

   If both voltages are as indicated, proceed with Step 3.
3. Using the high impedance probe, connect the spectrum analyzer to the collector of Q4.

   The spectrum analyzer should show a signal greater than 240 MHz, at about −10 dBm.

   If the signal is as indicated, check Q2 and associated components.

   If the signal is not as indicated, check Q4, Q1 and associated components.

20/30 MHz Output. Use this procedure if the troubleshooting information in Service Sheet BD3 has indicated a problem with the 20/30 MHz output.

1. Remove A2A3, set the Test Switch to TEST HIGH FREQ and replace A2A3 on a 36-pin extender board.
2. Using the high impedance probe, connect the spectrum analyzer to U2 pin 7.

   The spectrum analyzer should show a signal greater than 240 MHz at a level of about −10 dBm.

   If the signal is as indicated, check U1 and associated components.

   If the signal is not as indicated, check Q3 and associated components.

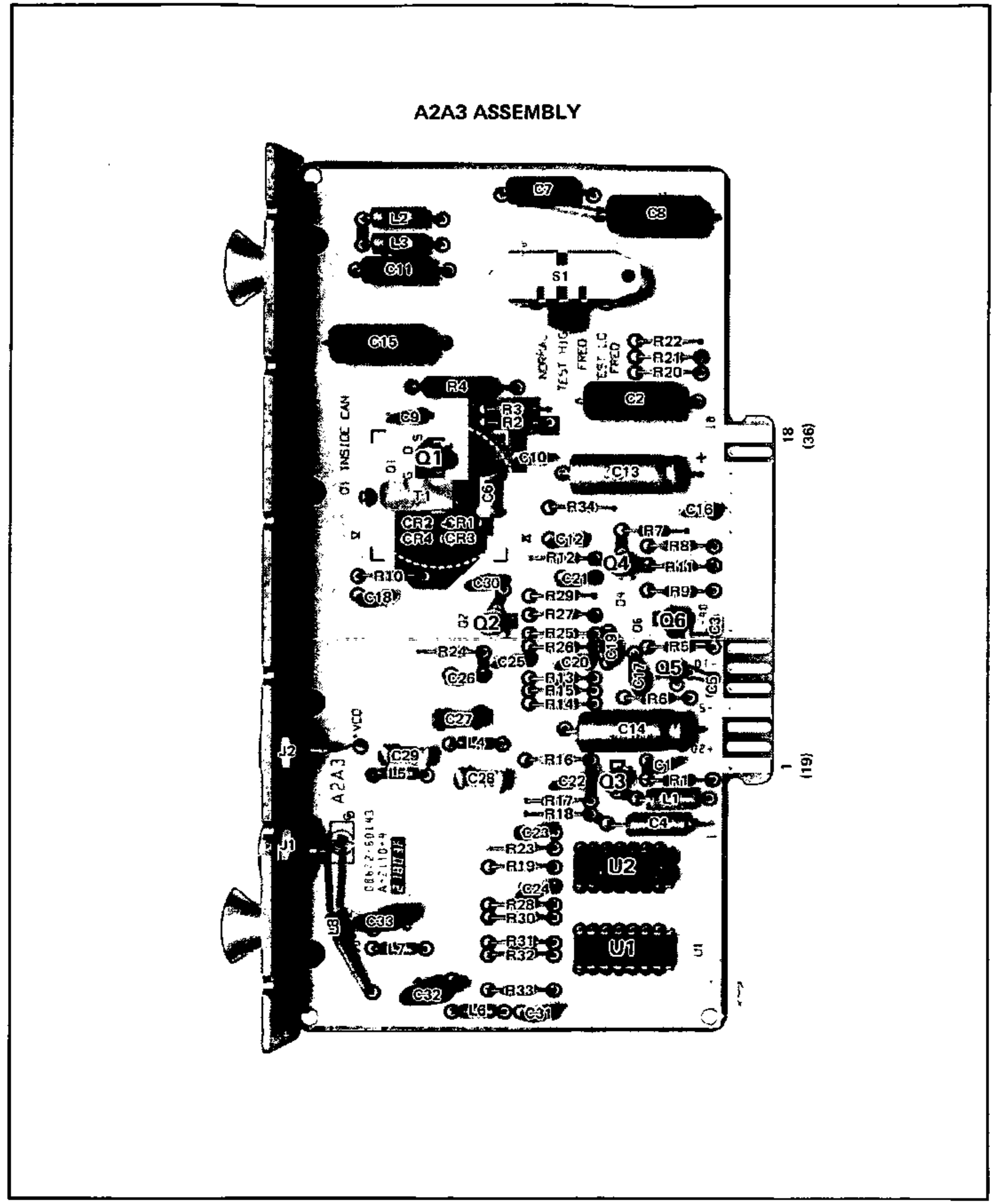


Figure 8-75. A2A3 VCO 160-240 MHz Assembly Component and Test Point Locations

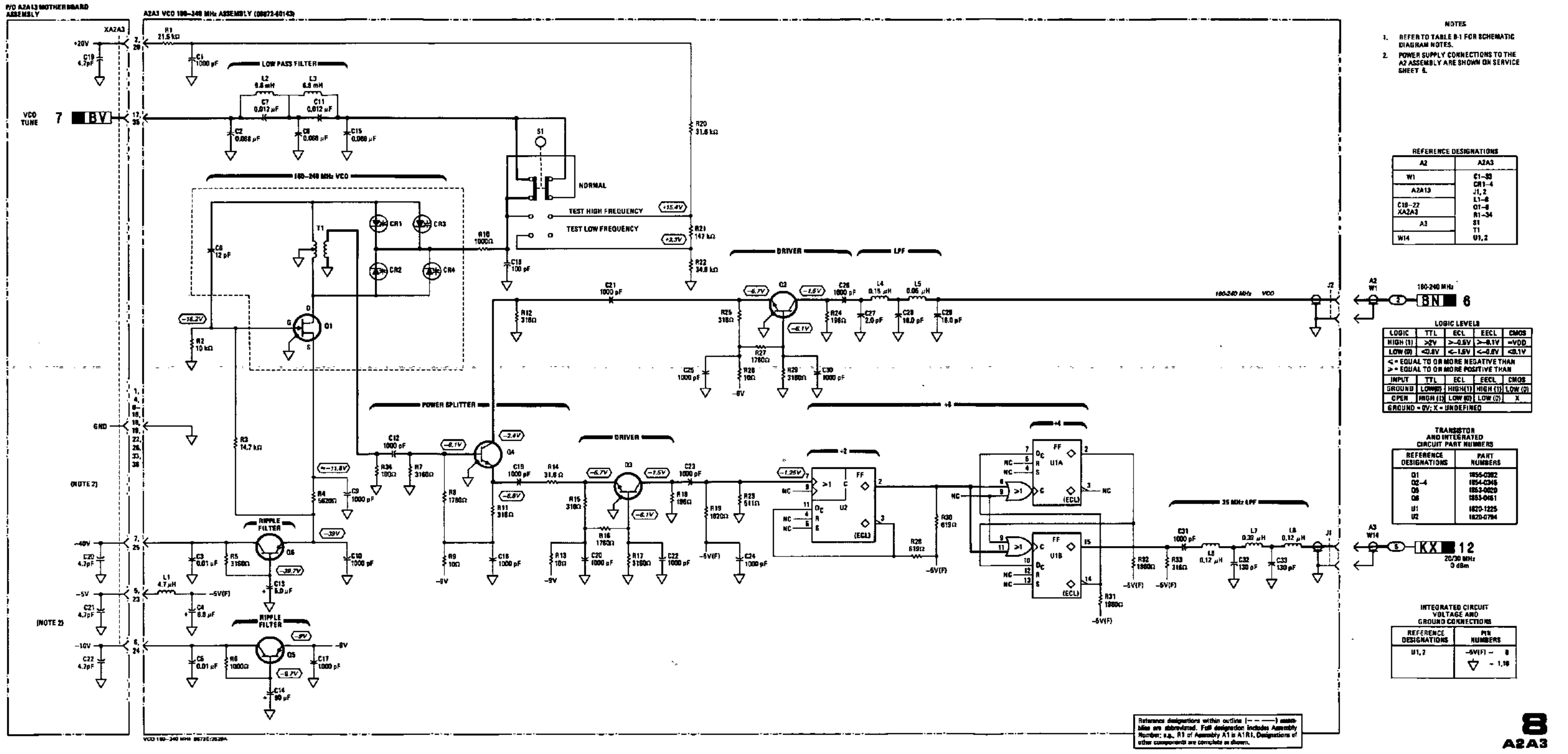


Figure 8-76. VCO 160-240 MHz Assembly Schematic Diagram

SERVICE SHEET 9

DIGITAL TO ANALOG CONVERTER ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
YTO Loop Block Diagram .... Service Sheet BD4
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

YTO Phase Lock Loop. The YIG Tuned Oscillator's frequency output is phase-locked: 1, to the difference of the YTO frequency and a selected harmonic of the M/N loop; and 2, to the LFS loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune ciruits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the LFS Loop signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS Loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned)
$f_{M/N}$ = M/N loop output frequency (MHz), and
f_{LFS} = LFS loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up in Table 8-5; M and N Numbers and Resulting Frequencies in Service Sheet BD3.

Also, f_{LFS} = (30.000 − D4 . D3 D2 D1) MHz

where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit for YTO frequencies less than 6600 MHz.

YTO Loop Pretune. The digital control inputs to the DAC from the Digital Control Unit (DCU) select the pretune frequency. These inputs are first converted from a digital signal to an analog dc voltage (the YTO Pretune signal). This signal is amplified (in the Main Coil Driver) and output as a tuning current to the YTO. Notice that the input tuning resolution to the DAC is 1 MHz. If the YTO frequency is within ±10 MHz of the desired frequency (for frequencies less than 6600 MHz) then the pretune circuits are operating properly. Pretuning, however, does normally bring the YTO frequency to within 1 or 2 MHz of the desired YTO frequency.

Detailed Discussion

The digital inputs to the DAC are in BCD and binary format. These inputs, (operating through the open-collector buffers) switch the diodes on or off. When on, current flows through the resistor, the diode and into the current summing node. The resistor value is selected so the current flow is proportional to the BCD weighting of the control input. The total current flow to the major summing node (at the input to the Summing and Buffer Amplifier) is proportional to the frequency as dictated by the digital inputs (0.5 mA/GHz). The Summing and Output Buffer Amplifier, with a gain of −6.000 V/mA, converts the summed current to a voltage (−3.000 V/GHz). Transistors Q6 and Q7 increase the slew rate of the amplifier by quickly charging or discharging C11 when large changes occur. RC network C12 and R59 provide compensation to prevent high frequency oscillation.

Current Summing. The least significant bits of the DAC inputs are summed in a node with 75 mA/GHz sensitivity. Upon dividing this current by 10, it is summed with the mid-range bits at 7.5 mA/GHz. This current is also divided (by 15) and summed with the most significant bits at 0.5 mA/GHz. Note that a 0.8 mA offset current equivalent to 1.6 GHz and used in adjusting the DAC is also summed at the major summing node.

Reference Amplifiers. The Reference Current Source generates a temperature stabilized constant current for VR1 via R6. Reference Buffer U1B isolates VR1 and provides a stable but adjustable voltage reference for the rest of the circuits. This voltage is further buffered by Reference Buffers U3 and U4.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the Digital-to-Analog Converter Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM) .... HP 3456A or 3455A

Troubleshooting Hints

Before attempting to troubleshoot the DAC Assembly, clean it thoroughly using the procedure outlined in the front of Section VIII, and try it again. Experience has shown this board to be sensitive

to contamination by foreign matter. If the DAC functions normally at some frequencies but not others, the problem is most likely in U5, U6, U7, U8, U9, or U10. Check these by setting the Signal Generator to various frequencies to exercise all inputs and check that the highs are getting through the diodes.

Troubleshooting Procedure

1. Remove A3A5 and replace it on a 36-pin extender board.

2. Check the voltages at TP1 and TP2 against the voltages on the schematic.

   If both voltages are correct, proceed with Step 4.

   If either is incorrect, proceed with Step 3.

3. Check the voltage at TP4 against the voltage on the schematic.

   If the voltage is within the tolerance given, the affected reference buffer, U3 or U4, is defective.

   If the voltage is not within tolerance, check U1 and Q1.

4. Connect the DVM to Q5 pin 6.

   The voltage at this point should be at or near ground.

   If the voltage is as indicated, the Summing and Output Buffer Amplifier is working normally so the problem must be with Current Buffer/Divider. Check U2, Q2, Q3, and associated components.

   If the voltage is not as indicated, the problem is with the Summing and Output Buffer Amplifier (although the Current Buffer/Divider could also be faulty). Because of the feedback around the Summing and Output Buffer Amplifier it is difficult to troubleshoot here. The best thing to do is to check the bias on each transistor and replace any that are faulty.

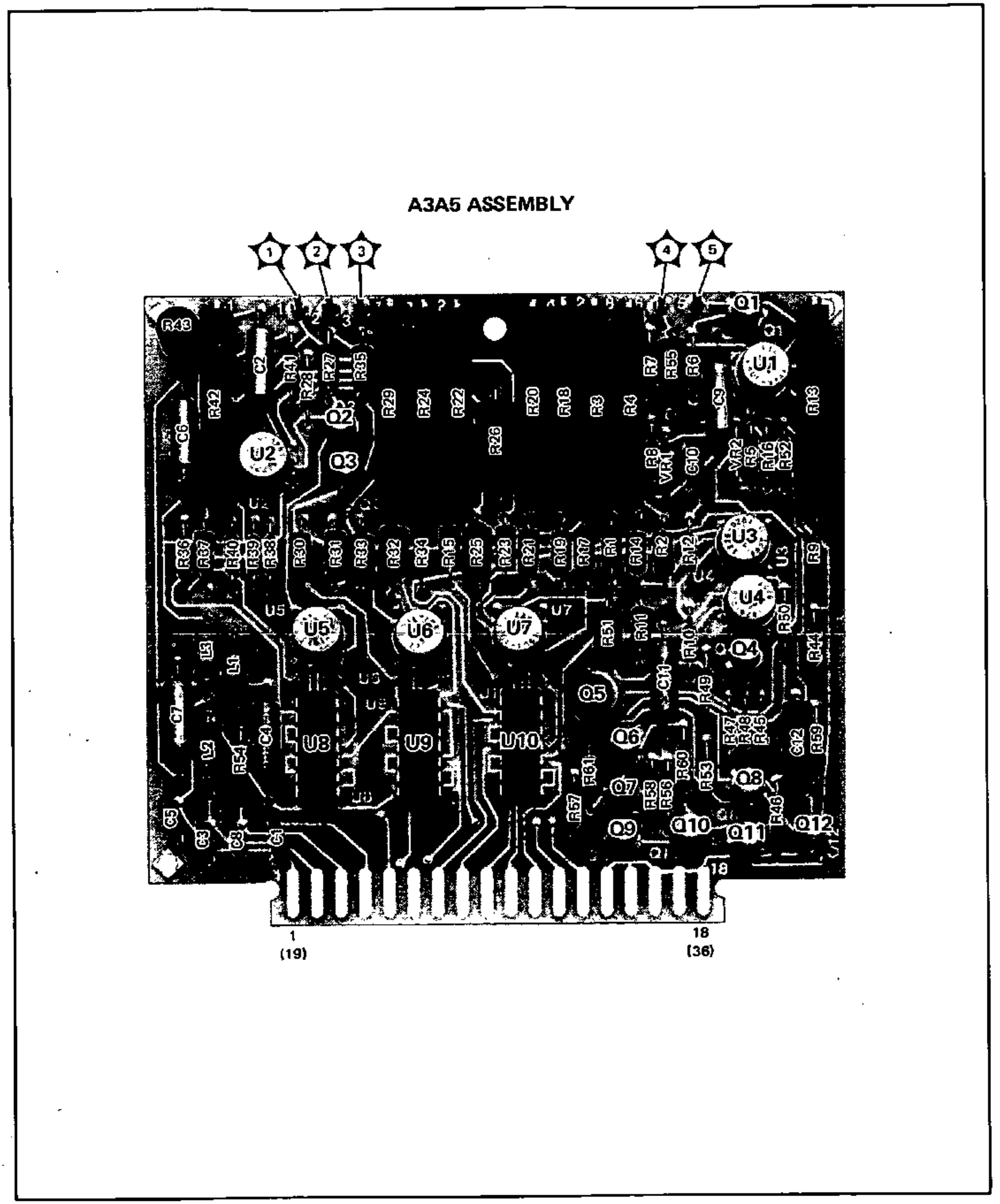


Figure 8-77. A3A5 DAC Assembly Component and Test Point Locations

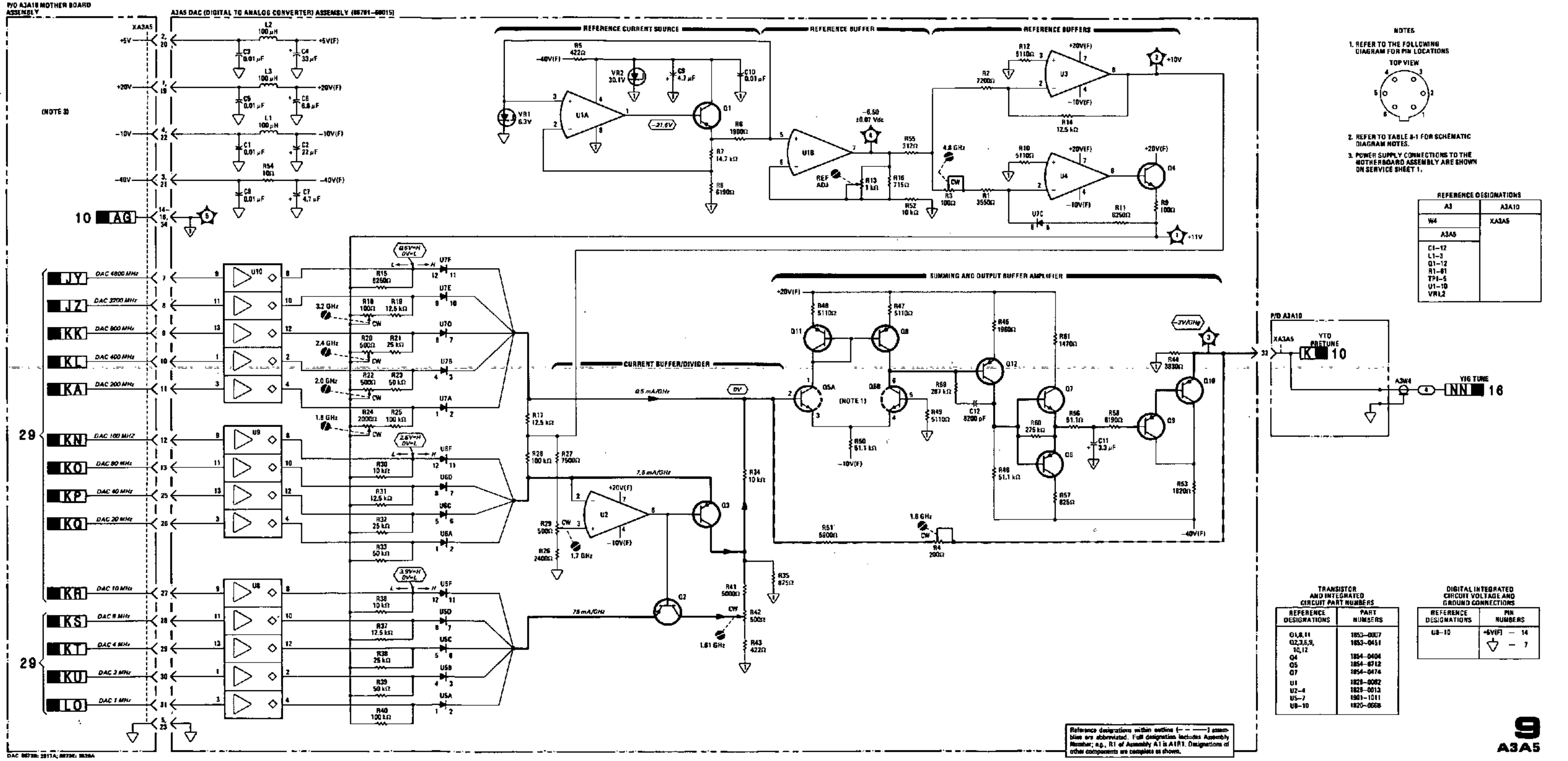


Figure 8-78. Digital-to-Analog Converter Assembly Schematic Diagram

SERVICE SHEET 10

YTO DRIVER ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

YTO Phase Lock Loop. The YIG Tuned Oscillator's frequency output is phase locked: 1, to the difference of the YTO frequency and a selected harmonic of the M/N loop; and 2, to the LFS loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the LFS Loop signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS Loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned)
$f_{M/N}$ = M/N loop output frequency (MHz), and
f_{LFS} = LFS loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up in Table 8-5; M and N Numbers and Resulting Frequencies in Service Sheet BD3.

Also, f_{LFS} = (30.000 − D4 . D3 D2 D1) MHz

where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit for YTO frequencies less than 6600 MHz.

YTO Loop Pretune. The digital control inputs to the DAC from the Digital Control Unit (DCU) select the pretune frequency. These inputs are first converted from a digital signal to an analog dc voltage (the YTO Pretune signal). This signal is amplified (in the Main Coil Driver) and output as a tuning current to the YTO. Notice that the input tuning resolution to the DAC is 1 MHz. If the YTO frequency is within ±10 MHz of the desired frequency (for

SERVICE SHEET 10 (cont'd)

frequencies less than 6600 MHz) then the pretune circuits are operating properly. Pretuning, however, does normally bring the YTO frequency to within 1 or 2 MHz of the desired YTO frequency.

Detailed Discussion

The YTO Driver Assembly produces a current in the YTO main coil that is proportional to the sum of the YTO Pretune (DAC output), the YTO TUNE 2 (the low frequency component of the YTO TUNE 1), and an offset voltage.

Coil Driver. The Coil Driver acts in two primary capacities. It provides a summing point for the input currents and it outputs a current to the YTO main coil. It is important to realize that the Coil Driver current flow is supplied through the Sense Resistor (this current is dependent upon the YTO Pretune voltage input) and from the Phase Lock Amplifier. The currents are summed at the Coil Driver's non-inverting output. The total current flows into the non-inverting input and out the inverting output as the YTO Main Coil Drive.

Input Amplifier. The YTO Pretune Voltage is amplified by the Input Amplifier (a discrete component operational amplifier). The output voltage appears at the Coil Driver's non-inverting output and therefore across the Sense Resistor. A portion of this voltage is returned to the Input Amplifier's inverting input. This return voltage is adjustable to allow for variation in the frequency-to-voltage sensitivity of different Tuned Oscillators. See Figure 8-79. RC network C4 and R10 provide compensation to prevent high frequency oscillation.

The Shaping Network (connected across the Sense Resistor) compensates for the non-linearity of the YTO frequency-to-voltage curve.

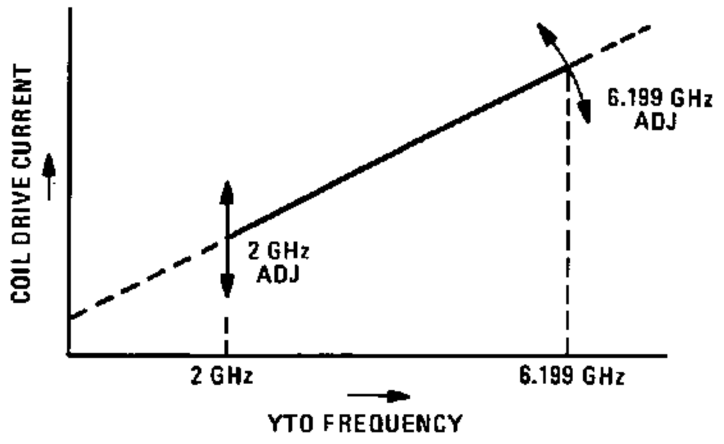


Figure 8-79 YTO Frequency versus Coil Drive Current

DAC Assembly A3A5 SERVICE SHEET 9

SERVICE SHEET 10 (cont'd)

NOTE

The YTO Main Coil Drive current contributed by the Input Amplifier is equal to the YTO Pretune voltage divided by the sum of R16 (125 ohms) and that portion of R24 (15 ohms) that supplies the feedback voltage to the Input Amplifier through R25. The remaining summed current flows through R30.

The dominant pole of this amplifier (at 0.8 Hz) is set by R11 and C7. They also provide noise filtering. Transistors Q8 and Q12 increase the slew rate of the amplifier by quickly charging or discharging C7 when large changes occur. Current limiter Q13 protects its associated components by removing the drive voltage from Q12 if the current is excessive.

Phase Lock Amplifier. The YTO Tune 2 and Offset voltages are summed in the Phase Lock Amplifier. The YTO Tune 2 signal is the low frequency component of the YTO tuning voltage (YTO Tune 1). The 100 Hz low-pass filter removes the high frequency components of the tuning voltage. The offset voltage is adjusted at 2 GHz (2 GHz Adj) so the YTO Frequency extrapolated to 0 GHz is 0 volt.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the YTO Driver Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM) .... HP 3456A or 3455A

Troubleshooting Procedure

1. Remove A3A6 and replace it on a 30-pin extender board.
2. Using the DVM, measure the voltages at TP1 and TP4.

   The voltage at TP4 should be 2.9 + (0.64 x VTP1).

   If the voltage at TP4 is as indicated, proceed with Step 4.

   If the voltage at TP4 is not as indicated, proceed with Step 3.
3. Connect the DVM to U1 pin 1.

   The voltage should be +6.2 Vdc.

   If the voltage is as indicated, check U1B and associated components.

   If the voltage is not as indicated, check U1A and associated components.
4. Because of feedback it is difficult to isolate between the Input Amplifier, the Current Limiter, and the Coil Driver. The best way to proceed is to check the voltages on the transistors against the voltages on the schematic. Be sure to press RCL 0 to set the Signal Generator Frequency to 3 GHz before proceeding.
5. If a slewing detector problem is suspected, proceed as in Step 4 for Q2 and Q3.

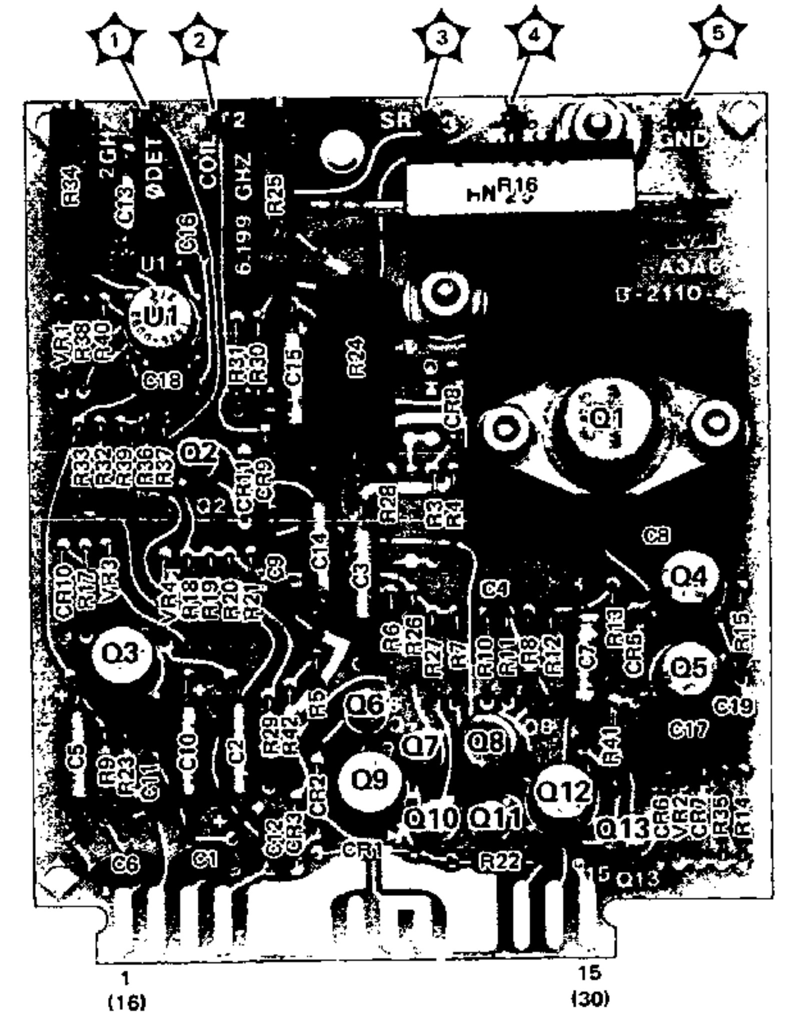
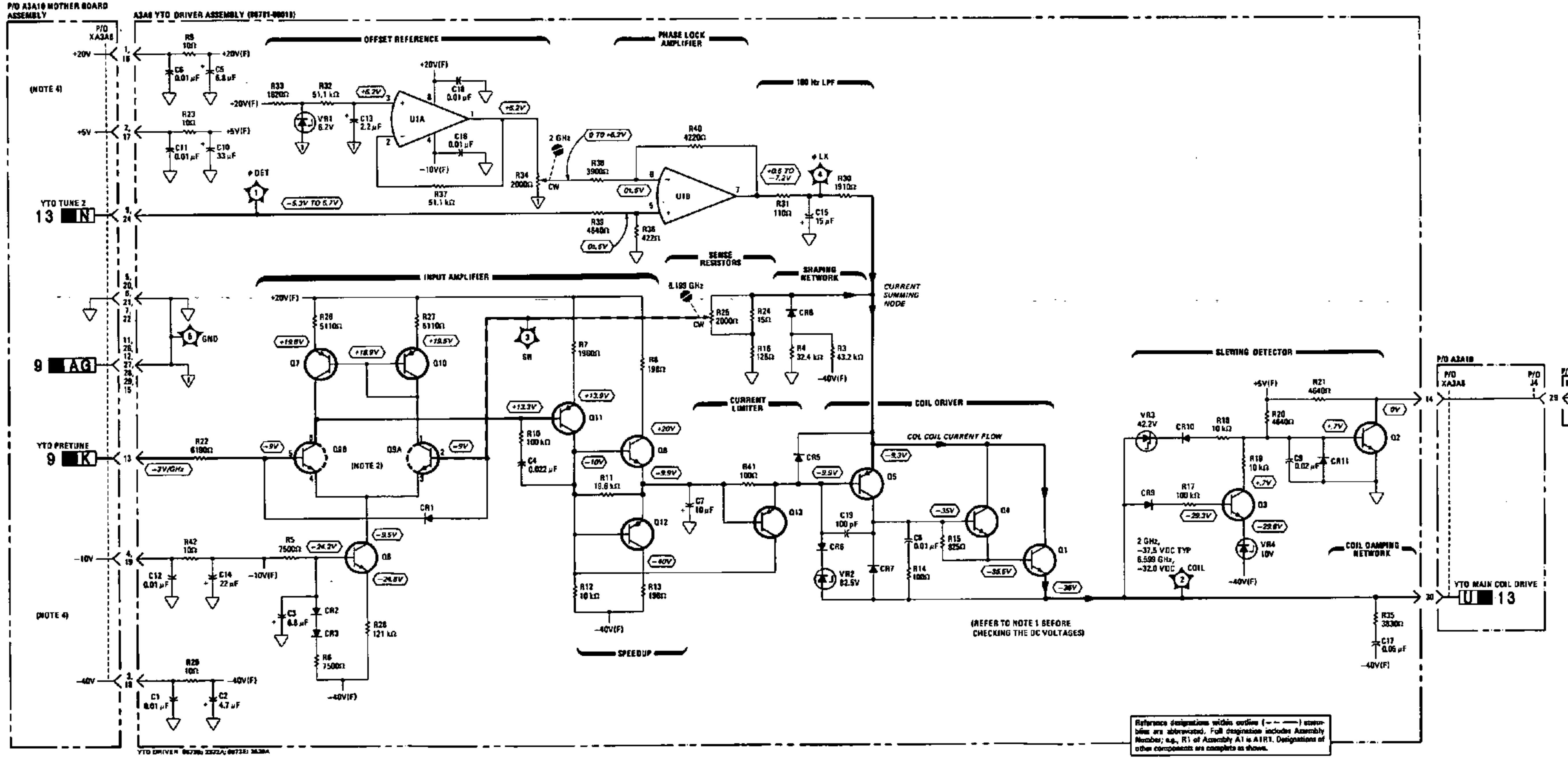


Figure 8-80. A3A6 YTO Driver Assembly Component and Test Point Locations



NOTES

1. THE DC VOLTAGES SHOWN ARE FOR A CARRIER FREQUENCY OF 3 GHz.
2. REFER TO THE FOLLOWING DIAGRAM FOR PIN LOCATIONS.

TOP VIEW

3. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
4. POWER SUPPLY CONNECTIONS TO THE MOTHERBOARD ASSEMBLY ARE SHOWN ON SERVICE SHEET 1.

REFERENCE DESIGNATIONS

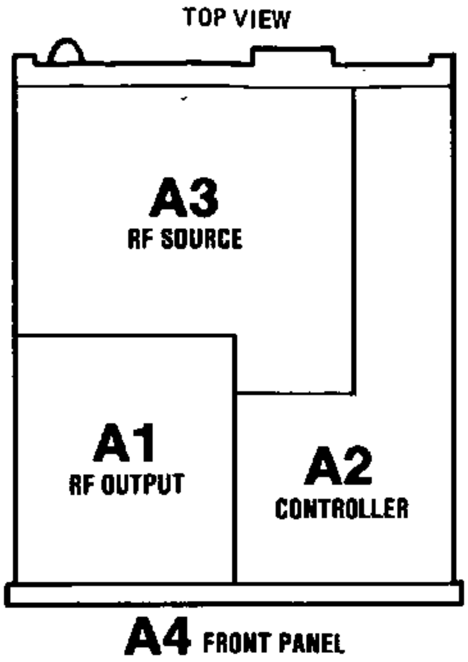
A3A6	A3A10
C1–19 CR1–3,5–11 Q1–13 R3–42 TP1–5 U1 VR1–4	XA3A6

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854-0237
Q2,6	1854-0404
Q3,8	1854-0022
Q4	1854-0237
Q5	1853-0038
Q7,10	1853-0007
Q9	1854-0712
Q11,13	1853-0451
Q12	1853-0012
U1	1826-0092

10
A3A6

Figure 8-81. YTO Driver Assembly Schematic Diagram



MAJOR ASSEMBLIES

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Attenuator Driver Board Assembly	18
A1A2	Detector Module Assembly	14,17
A1A2A1	ALC Board Assembly	14,17
A1A2A2	Detector Board Assembly	17
A1A3	Function Board Assembly	20
A1A4	Pulse Driver Board Assembly	15
A1A5	DAC and Enable Board Assembly	22
A1A6	Meter Board Assembly	21
A1A7	YTM Driver Board Assembly	16
A1A8	SRD Bias Board Assembly	19
A1A9	Preamp Assembly	14,16
A1A10	YTM Assembly	16
A1A10A1	YIG Heater Control Assembly	16
A1A11	Power Amplifier Assembly	16
A1A12	Motherboard Assembly	14-16,18-22, 30,31
A1A13	Terminal Strip	15
A1A14	Amp Bias Board Assembly	17
A2A1	Panel Driver Board Assembly	25
A2A2	Key Code Board Assembly	24
A2A3	VCO Assembly	8
A2A4	Phase Detector Assembly	7
A2A5	Divider Assembly 20/30	6
A2A6	Not Assigned	
A2A7	I/O Board Assembly	30,31
A2A8	Microprocessor Board Assembly	26
A2A9	Frequency/HP-IB Board Assembly	29
A2A10	RAM Board Assembly	28
A2A11	ROM Board Assembly	27
A2A12	Not Assigned	
A2A13	Motherboard Assembly	6-8,10,20-32
A2A14	Rear Interconnect Board Assembly	24,29,31
A2A15	HP-IB Connector Board Assembly	29
A3A1	Rectifier Assembly	33
A3A1A1	Reference Phase Detector Assembly	1,2
A3A1A2	100 MHZ VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator	4
A3A1A4A2	VCO Board Assembly	4
A3A1A5	M/N Output Assembly	5
A3A1A6	M/N Reference Motherboard Assembly	1-3,5
A3A1A7	Reference Housing Assembly	
A3A2	Not Assigned	
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	DAC Assembly	9
A3A6	YTO Driver Assembly	10
A3A7	FM Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Sampler Assembly	11
A3A9A6	Attenuator Assembly	13
A3A9A7	6.2 GHz Low Pass Filter	13
A3A10	Motherboard Assembly	1,3,4,6,10, 12-14,21-23, 26,29-31, 33-35
A4A1	Front Panel Board Assembly	20,22,23,32

SERVICE SHEET 11

P/O YTO LOOP ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
YTO Summing Loop Block Diagram .... Service Sheet BD4
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The YIG-Tuned Oscillator's frequency output is phase-locked: 1, to the difference of the YTO frequency and a selected harmonic of the M/N loop; and 2, to the LFS loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the LFS Loop signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS Loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned)
$f_{M/N}$ = M/N loop output frequency (MHz), and
f_{LFS} = LFS loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up in Table 8-5; M and N Numbers and Resulting Frequencies in Service Sheet BD3.

Also, f_{LFS} = (30.000 − D4 . D3 D2 D1) MHz
where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit
for YTO frequencies less than 6600 MHz.

Detailed Discussion

The YTO Output signal is mixed with the Nth harmonic of the M/N OUT signal. The difference signal (20/30 MHz) is output to the YTO Loop Phase Detector where it is phase compared to the LFS Loop Output.

The M/N Summing Loop Signal is matched to the input of the Sampler Drive Amplifier by R40, L1 and C10. This signal is amplified and matched to the Sampler's Harmonic Generator input. The numerous harmonics are mixed with the RF Input signal in the Sampler's Harmonic Mixer. The outputs are summed and matched to the IF Preamplifier by L10 and R13. The impedance matching throws the IF Amplifier's frequency response off. The de-emphasis network at the output provides compensation that brings the frequency response back to normal. After buffering, the signal passes through a 70-MHz low-pass filter to remove the multitude of unimportant harmonics of the mixing process. The signal is then amplified and output to the YTO Phase Detector. The important signal is the 20 to 30 MHz signal which is to be phase compared with the LFS Loop signal in order to phase lock the YTO Summing Loop.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the YTO Loop Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Spectrum Analyzer .... HP 8566B
High Impedance Probe .... HP 1121A

Troubleshooting Procedure.

1. Install the A3A9 assembly in the service position according to the procedure on Service Sheet A. Remove the cover on the right side of the YTO Loop Assembly to expose the A3A9A5 assembly.

2. Press RCL 0, then, using the high impedance probe, connect the spectrum analyzer to the gate of Q4.

SERVICE SHEET 11 (cont'd)

The spectrum analyzer should show a 30-MHz signal at −30 dBm.

If the signal is as indicated, proceed with Step 4.

If the signal is not as indicated, proceed with Step 3.

3. Using the high impedance probe, connect the spectrum analyzer to the base of Q6.

   The spectrum analyzer should show a 30-MHz signal at −31 dBm.

   If the signal is as indicated, check Q6, Q5, Q1, and associated components.

   If the signal is not as indicated, check Q2, Q4, Q7, and associated components.

4. Using the high impedance probe, connect the spectrum analyzer to the right (non-grounded) side of R9.

   The spectrum analyzer should show a 189-MHz signal at +7 dBm.

   If the signal is as indicated, Sampler U12 is defective.

   If the signal is not as indicated, check Q3, Q8, and associated components.

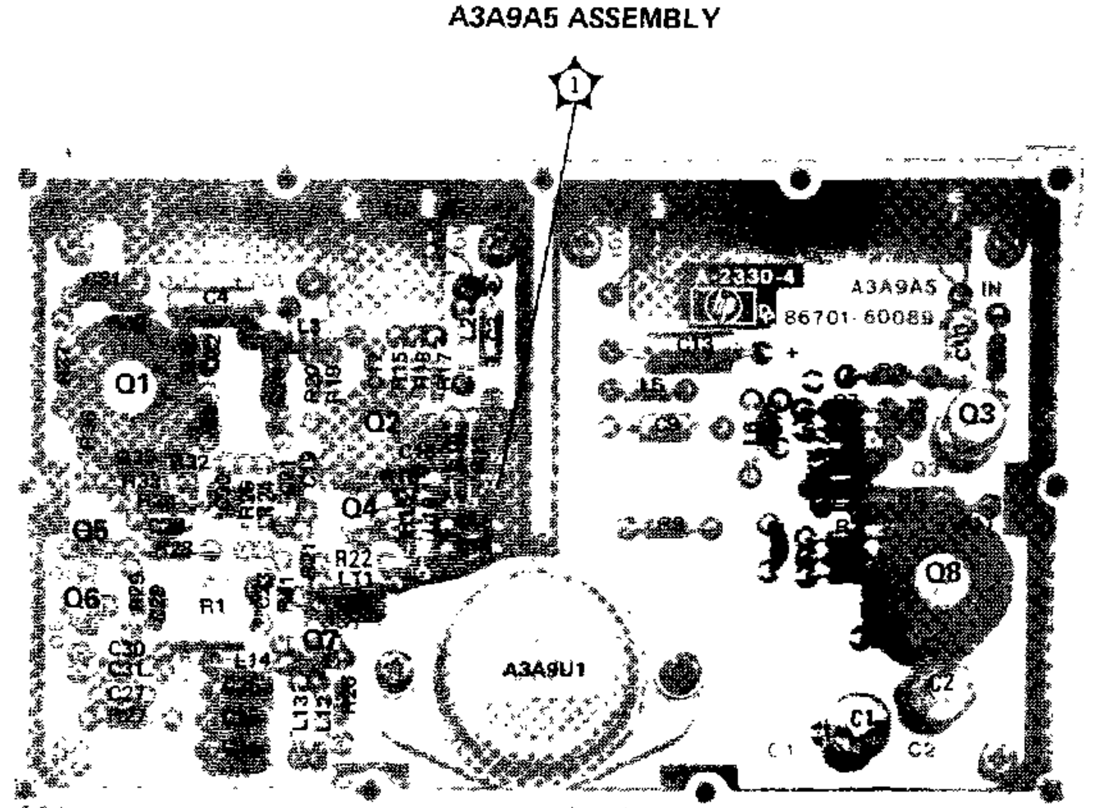


Figure 8-82. A3A9A5 Sampler Assembly Component and Test Point Locations

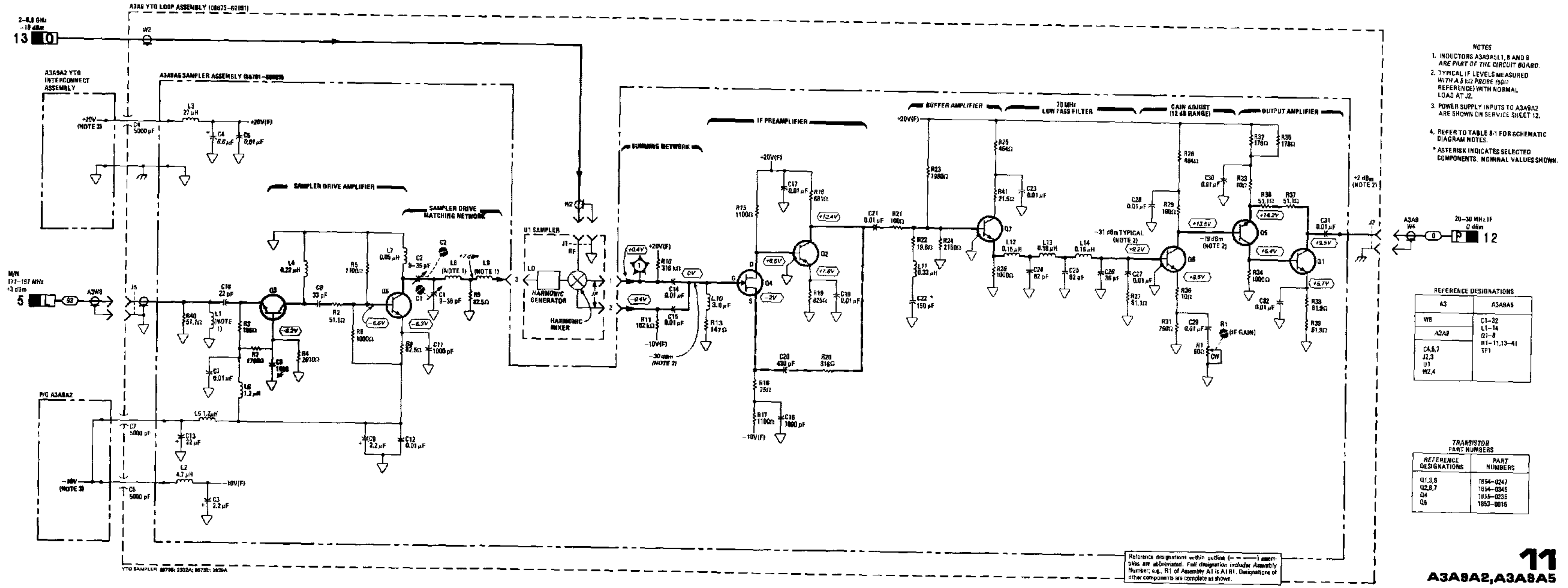


Figure 8-83. P/O YTO Loop Assembly Schematic Diagram

SERVICE SHEET 12

P/O YTO LOOP ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting BD1	Service Sheet BD1
YTO Summing Loop Block Diagram	Service Sheet BD4
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The YIG Tuned Oscillator's frequency output is phase locked 1) to the difference of the YTO frequency and a selected harmonic of the M/N loop and 2) to the LFS loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the LFS Loop signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS Loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned)
$f_{M/N}$ = M/N loop output frequency (MHz), and
f_{LFS} = LFS loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up in Table 8-5 M and N Numbers and Resulting Frequencies (in Service Sheet BD3).

Also, $f_{LFS} = (30.000 - D4\,.\,D3\;D2\;D1)$ MHz

where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit
for YTO frequencies less than 6600 MHz.

Detailed Discussion

YTO Summing Loop FM Circuits. In the Signal Generator's CW mode of operation, the Phase Detector's error voltage is proportional to the integral of the YTO frequency. In the FM mode, the error voltage is due to the sum of the integrals of YTO frequency and the frequency deviation. Since the deviation is directly proportional to the modulation drive voltage, the error voltage may be expressed as follows:

SERVICE SHEET 12 (cont'd)

$$V_e = \int f_o(t)\,dt + \int V_{FM}(t)dt$$

where V_e = phase detector's error voltage
$f_o(t)$ = YTO frequency
$V_{FM}(t)$ = FM drive voltage

The result is a cancellation of modulation for FM rates inside the YTO loop bandwidth (20 kHz). In order to make the YTO loop response to FM essentially flat, a portion of the FM drive signal is integrated and subtracted from the error voltage output by the Phase Detector. This voltage is adjusted to just cancel the error voltage caused by the FM signal. With this correction, the YTO loop effectively passes all specified rates to the YTO with little or no degradation. Note that the FM drive signal is added after the loop Integrator and the integrated FM is subtracted from the error voltage just before the Loop Integrator.

YTO Phase Detector Assembly. The Phase/Frequency detector compares the frequency and phase of the Sampler IF signal to the output of the LFS loop. The resultant error signal is integrated and amplified in the Loop Integrators. The output signal YTO Tune 1 is applied to the YTO coils to achieve phase lock.

During frequency modulation, the integrated FM signal from the A3A7 FM Driver Assembly is subtracted from the phase error signal. The net result is that the loop does not attempt to cancel the modulating signal and the YTO can be modulated at rates within the loop bandwidth.

The IF IN (from the Sampler) and the LFS loop signal are divided by two and routed to the Phase/Frequency Detector. If the phase of the IF signal leads that of the LFS loop signal, a negative going pulse appears at U1 pin 12 (TP3). Pin 3 (TP4) remains at a steady dc level (about −0.6 Vdc). If the LFS loop signal leads, a negative pulse appears at pin 3. In each case the pulse width is proportional to the phase difference between the signals. The outputs are filtered and coupled to the differential amplifier whose output is then applied to the Loop Integrator. The output (YTO Tune 1) tunes the YTO frequency. When FM is applied to the YTO loop, the Phase/frequency detector discriminates the FM signal. The following expression shows the relationship between modulation index (β), frequency deviation (f_{dev}) and rate of modulation (f_{mod}).

$$\beta = f_{dev}/f_{mod}$$

The detector's practical operating range is approximately 0.5 radians ($\beta = 3.0$). Because of the divider circuits which precede the detector, β is effectively doubled to 6.0. Note that the Overmodulation detector is disarmed to allow a higher modulation index in the 10 MHz FM DEVIATION range.

Unlock Detector. The Unlock Detector compares the YTO TUNE 1 signal to a preset reference. If the voltage swing exceeds ±5 Vdc, a YTO unlock signal is generated. RC network C12/R14 prevents transients from causing an unlock signal.

SERVICE SHEET 12 (cont'd)

NOTE

The Overmodulation Detector, Divide Selector, and FM Status Enable circuits are not used in this Generator.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the YTO Summing Loop Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM)	HP 3456A or 3455A
Test Oscillator	HP 3335A

Troubleshooting Procedures

There are two procedures provided, the first is for YTO Loop problems, the other is for FM problems.

YTO Loop Procedure. Use this procedure if the procedures in Service Sheet BD4 indicate a problem with the A3A9A4 portion of the YTO loop.

1. Place A3A9 in the service position using the procedure in Service Sheet A. Remove the cover from A3A9A4.

2. Press RCL 0 and ground A3A6TP1.

3. Connect the oscilloscope to TP2.

   The display should show a signal between 10 and 15 MHz (100 to 66 ns period), and a peak-to-peak amplitude of between 1 and 1.5 volts.

   If the signal is as indicated, proceed with Step 5.

   If the signal is not as indicated, proceed with Step 4.

4. Connect the oscilloscope to U6 pin 14.

   The display should show a 30 MHz (33 ns period) signal at a peak-to-peak amplitude of between 1 and 1.5 volts.

   If the signal is as indicated, U7 is defective.

   If the signal is not as indicated, U6 is defective.

5. Connect the oscilloscope to TP5.

P/O YTO Loop
A3A9A2, A3A9A5
SERVICE SHEET 11

SERVICE SHEET 12 (cont'd)

   The display should show a signal between 10 and 15 MHz (100 to 66 ns period) at a peak-to-peak level of between 1 and 1.5 volts.

   If the display is as indicated, proceed with Step 7.

   If the display is not as indicated, proceed with Step 6.

6. Connect the oscilloscope to U6 pin 2.

   The display should show a signal greater than 30 MHz (less than 33 ns period) at a peak-to-peak level of 1 to 1.5 volts.

   If the signal is as indicated, U9 is defective.

   If the signal is not as indicated, check U6 and asssociated components.

7. Connect the DVM to U4 pin 6 then, while observing the DVM display, disconnect the black IF IN cable from A3A9J1

   The DVM should initially indicate about +10.5 Vdc, dropping to about +9.5 Vdc when the cable is removed.

   If the indication is correct, replace the black cable and proceed with Step 8.

   If the indication is not correct, check U5, Q4, Q5, and associated components.

8. Repeat Step 7 but remove the green LFS cable from A3A9J3.

   The DVM should initially indicate about +10.5 Vdc, rising to about +11.5 Vdc when the cable is removed.

   If the DVM indication is correct, check U3 and associated components.

   If the indication is not correct, check U5, Q4, Q5, and associated components.

FM Procedure. Use this procedure for FM problems.

1. Press FM DEVIATION MHz OFF, and MTR FM.

2. Tune the test oscillator to 2 MHz and connect its 50-ohm output to the Signal Genertor's FM IN connector.

3. Set the DVM to measure resistance and connect it to the drain of Q3. While observing the DVM display, press the following FM DEVIATION MHz keys: .03, .1, .3, 1, 3, 10.

   The DVM should initially indicate a few ohms (impedance of conducting FET). Then it should rise to a very high impedance, or open, when the first key is pressed, and remain that way as each of the other keys are pressed.

   If the DVM indication is correct, proceed with Step 5.

   If the indication is not correct for any key, proceed with Step 4.

4. Set the DVM to measure dc voltage and connect it to the base of Q2, then repeat Step 3.

   The DVM should initially indicate +0.1 Vdc. Then it should rise to +4.4 Vdc when the first key is pressed and remain at that voltage as the remaining keys are pressed.

   If the indication is correct, check Q2 and Q3.

   If the indication is not correct, go to Service Sheet 21.

NOTE

The Overmodulation Detector, Divide Selector, and FM Status Enable circuits are disabled in this application, therefore no troubleshooting procedure is provided for them.

5. For Unlock Detector problems check U1.

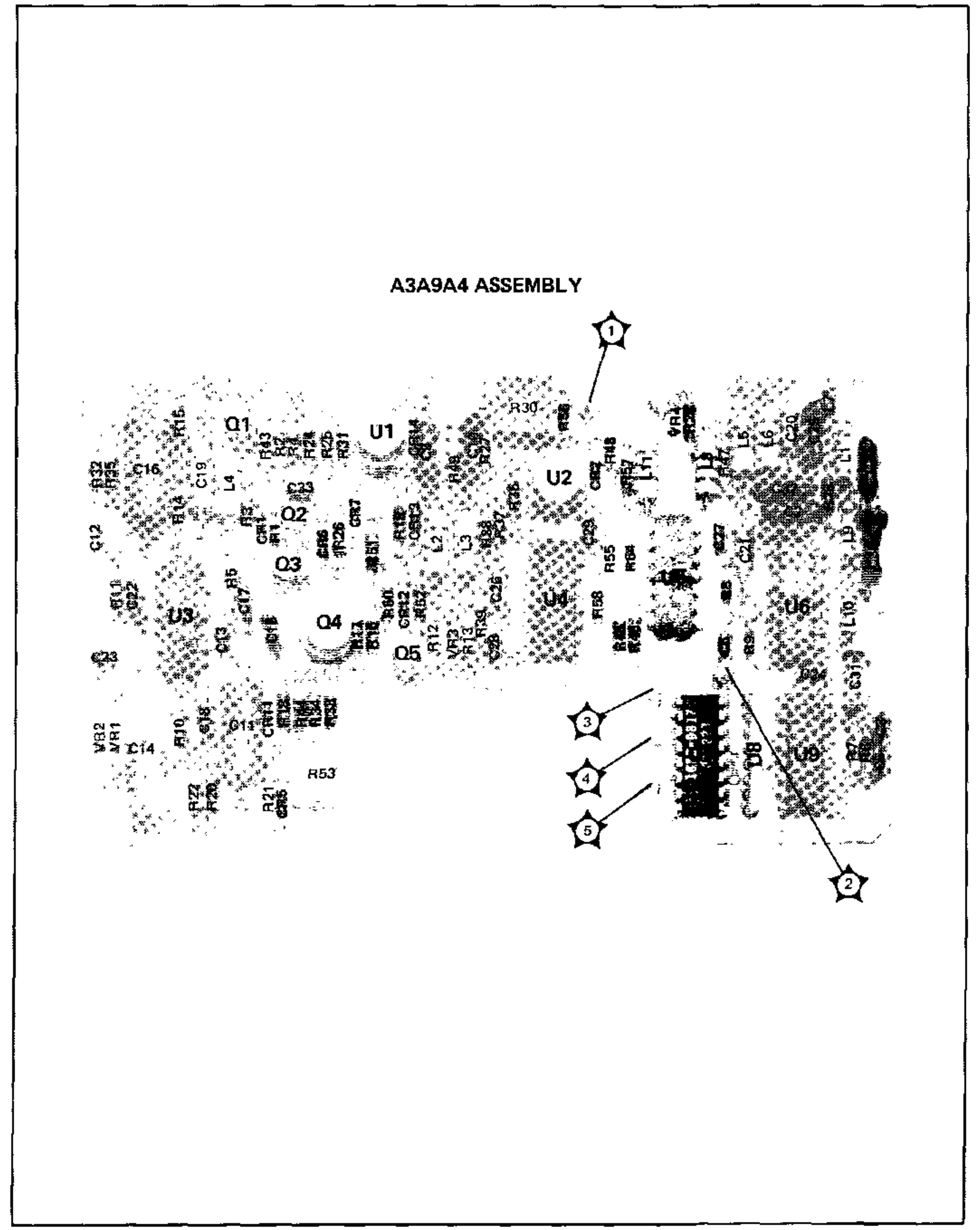
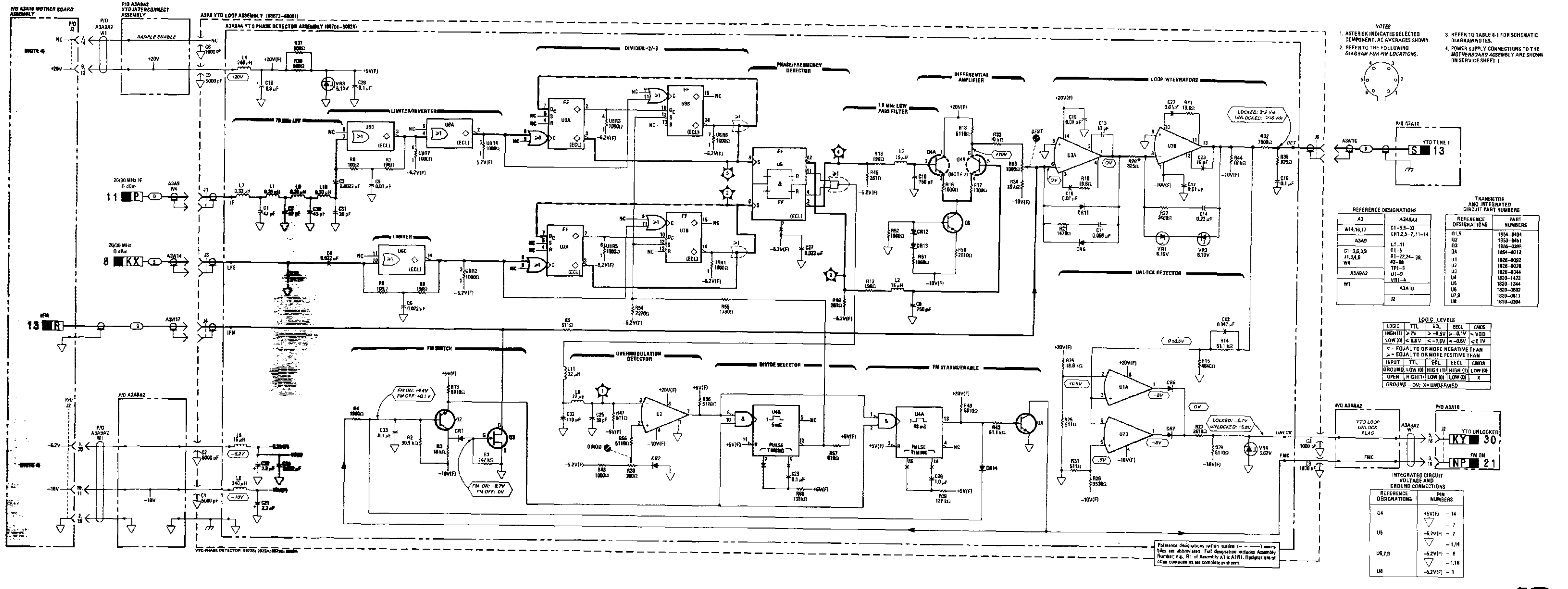


Figure 8-84. A3A9A4 YTO Phase Detector Assembly Component and Test Point Locations



12
A3A9A2,A3A9A4

Figure 8-85. P/O YTO Loop Assembly Schematic Diagram

SERVICE SHEET 13

YTO/FM COIL DRIVER ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

The YIG Tuned Oscillator's frequency output is phase locked: 1), to the difference of the YTO frequency and a selected harmonic of the M/N loop; and 2), to the LFS loop. The YTO is tuned near the correct harmonic of the M/N Output frequency by the YTO pretune circuits which consist of the Digital-to-Analog Converter (DAC) and the Main Coil Driver. Once the pretuning is completed, the IF signal (20/30 MHz) from the YTO Loop Sampler is phase compared to the LFS Loop signal, and the resulting error signal tunes the YTO to achieve phase lock. The YTO Frequency is related to the M/N Out frequency and the LFS Loop frequency in the following manner:

$$f_o = (N)(f_{M/N} - f_{LFS})$$

where f_o = YTO output frequency (MHz)
N = N number input to M/N loop (also the M/N loop harmonic near to which the YTO loop is pretuned)
$f_{M/N}$ = M/N loop output frequency (MHz), and
f_{LFS} = LFS loop output frequency (MHz)

f_{YTO}, N, and $f_{M/N}$ may be looked up in Table 8-5; M and N Numbers and Resulting Frequencies on Service Sheet BD3.

Also, $f_{LFS} = (30.000 - D4\,.\,D3\,D2\,D1)$ MHz

where D4 = Front panel 1 MHz digit
D3 = Front panel 100 kHz digit
D2 = Front panel 10 kHz digit, and
D1 = Front panel 1 kHz digit
for YTO frequencies less than 6600 MHz.

In the Signal Generator's CW mode of operation, the Phase Detector's error voltage is proportional to the integral of the YTO frequency. In the FM mode, the error voltage is due to the sum of the integrals of YTO frequency and the frequency deviation. Since the deviation is directly proportional to the modulation drive voltage, the error voltage may be expressed as follows:

SERVICE SHEET 13 (cont'd)

$$V_e = \int f_o(t)\,dt + \int V_{FM}(t)dt$$

where V_e = phase detector's error voltage
$f_o(t)$ = YTO frequency
$V_{FM}(t)$ = FM drive voltage

The result is a cancellation of modulation for FM rates inside the YTO loop bandwidth (20 kHz). In order to make the YTO loop response to FM essentially flat, a portion of the FM drive signal is integrated and subtracted from the error voltage output by the Phase Detector. This voltage is adjusted to just cancel the error voltage caused by the FM signal. With correction, the YTO Loop effectivly passes all specified rates to the YTO with little or no degradation. Note that the FM drive signal is added after the Loop Integrator and the integrated FM is subtracted from the error voltage just before the Loop Integrator.

Detailed Description

The FM Driver Assembly performs three major functions. First, it combines and sums the FM drive signal with the high frequency component of the YTO Tune 1 signal. Then this combined signal is amplified, compensated (for frequency response) and converted to an FM coil drive current. The FM drive signal is integrated and coupled to the YTO Phase Detector Assembly, where it is summed with the Phase Detector's error voltage output.

Two minor but extremely important functions are 1) shifting the YTO frequency to ensure it will pass through the loop capture range and achieve phase lock in the event the loop has become unlocked and 2) dividing the YTO tuning voltage (YTO Tune 1) into its high and low frequency components.

Phase Lock and FM Drive Signals. The YTO TUNE 1 signal's high frequency component and the FM drive signal are summed at the input to the FM Coil Driver. The combined signal is amplified and the drive current is applied to the FM coil through an impedance matching network. The Frequency Shaping Network, located in the coil driver's feedback loop and the main FM signal path, compensates for the gradual loss in sensitivity of the FM coil at higher frequencies. The 40 dB attenuator in the FM signal path allows switching between the most sensitive and least sensitive FM ranges.

Integrated FM Signal. The FM input signal is integrated by FM Integrator U3A and associated components. The integrator is followed by the FM Integrator Amplifiers, U3B and U2A. The gain of U3B is switched between 0 dB and 20 dB by the FM 40 dB signal. The gain of U2A can be adjusted by R40. This allows for adjustment of the IFM Signal gain to exactly balance the FM signal discriminated by the YTO Phase Detector.

In the most sensitive FM ranges (1, 3, and 10 MHz/V), the gain of U3B is 20 dB and the attenuation at the output of U2A is 0 dB. In the least sensitive ranges (0.03, 0.1, and 0.3 MHz/V), the gain of

SERVICE SHEET 13 (cont'd)

U3B is reduced to unity (0dB) and the output of U2A is attenuated by 20 dB. This 40 dB change in level, in effect, keeps the gain consistent with the FM drive signal applied to the YTO's FM coil.

YTO Loop Reset. The YTO Loop reset ensures that the YTO Loop acquires phase lock after a frequency transition. When a frequency change occurs in less than 15 ms, the YTO achieves lock and the YTO NRST signal does not affect the YTO TUNE 1 input. If the loop does not achieve lock in less than 15 ms, the YTO UNLOCK signal causes YTO NRST to momentarily go low. The YTO TUNE 1 signal is pulsed to 0V. The result is that the YTO frequency is shifted to another frequency and then tries to return to the pre-pulse frequency. During this transition, the YTO 20/30 MHz IF signal passes through the capture range of the loop phase detector and the loop is locked. If a large frequency change occurs (on the order of 100 MHz), YTO SLEW causes the YTO NRST signal to immediately go low. The YTO output is effectively frequency modulated and the IF signal passes through the loop capture range.

Phase Lock Amplifiers. The YTO TUNE 1 signal is amplified by Q10. The YTO TUNE 2 signal is connected to the A3A6 Main Coil Driver Assembly where all frequencies above 100 Hz are filtered out. The high pass filter (C12, R7, and R53) passes only those components of the signal greater than 100 Hz to the Coil Driver.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD4 was used to isolate a malfunction to the YTO/FM Coil Driver Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM) .... HP 3456A or 3455A
Test Oscillator .... HP 3335A
Oscilloscope .... HP 1980B

Troubleshooting Procedures

1. Connect the DVM to A3A6TP1 and disconnect the green cable from LFS connector A3A9J3.

   The DVM should indicate about +6.5 Vdc.

   If the indication is correct, replace the green cable and proceed with Step 2.

   If the indication is not correct, check Q10, Q7, Q8, Q3, Q1, Q2, and associated components.

YTO Phase Detector
A3A9A2, A3A9A4
SERVICE SHEET 12

SERVICE SHEET 13 (cont'd)

2. With the DVM still connected to A3A6TP1, disconnect the black cable from IF connector A3A9J1.

   The DVM should indicate about −5 Vdc.

   If the indication is correct, replace black cable and proceed with Step 3.

   If the indication is not correct, check Q10, Q7, Q8, Q3, Q1, Q2, and associated components.

3. Set the test oscillator for 5 MHz at minimum output level. Connect the test oscillator's 50-ohm output to the Signal Generator's FM IN input.

4. On the Signal Generator, press MTR FM and FM DEVIATION MHz 3. Adjust the test oscillator's output level for a full scale reading on the Signal Generator's OUTPUT LEVEL meter.

5. Connect the oscilloscope to TP1.

   The oscilloscope display should show a 5 MHz signal at a peak-to-peak level of 4.8 Volts.

   If the signal is as indicated, proceed with Step 6.

   If the signal is not as indicated, check Q4, Q6, Q5, U1, and associated components.

6. With the equipment still set up as in Steps 3, and 4, and the oscilloscope still connected to TP1, press the FM DEVIATION .1 key.

   The signal should drop to 48 mV peak-to-peak.

   If the signal changes as indicated, proceed with Step 7.

   If the signal does not change as indicated, check Q13, relay K2 and associated components.

7. Adjust the test oscillator to a frequency of 10 kHz and on the Signal Generator, press the FM DEVIATION MHz 3 key.

8. Connect the oscilloscope to TP4.

   The oscilloscope display should show a 10 kHz signal at a peak-to-peak level of 3 volts.

   If the signal is as indicated, proceed with Step 10.

   If the signal is not as indicated, proceed with Step 9.

9. Connect the oscilloscope to TP3.

   The oscilloscope display should show a 5 MHz signal at a peak-to-peak level of 600 mV.

   If the display is as indicated, check U3B, U2, and associated components.

   If the display is not as indicated, check U3A, Q11 and associated components.

10. Connect the oscilloscope to TP4, and press the FM DEVIATION MHz .1 key.

    The signal should drop to a peak-to-peak level of 300 mV.

    If the signal changes as indicated, Q14, and Q15 are functioning normally.

    If the signal does not change as indicated, check Q14, Q15, and associated components.

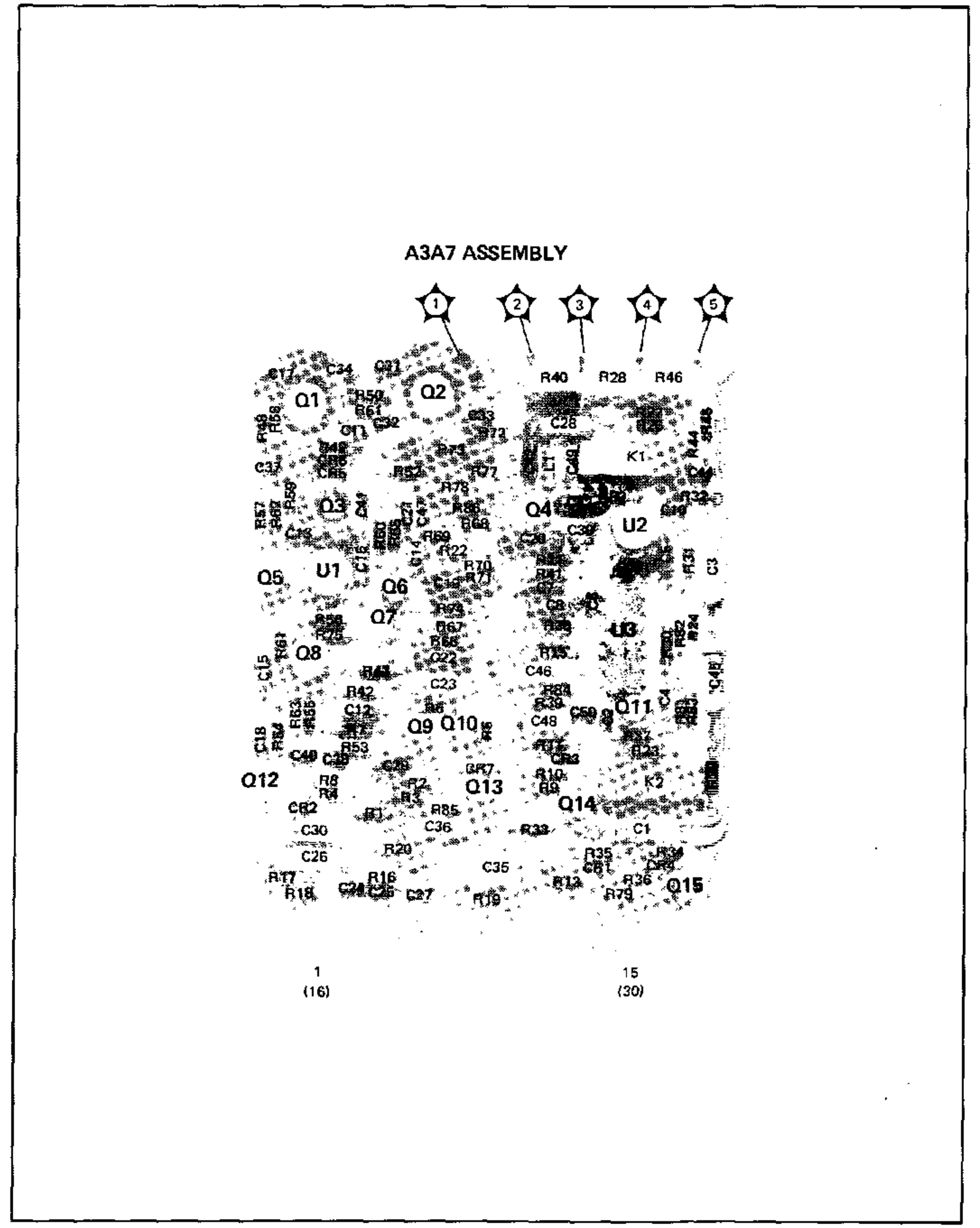
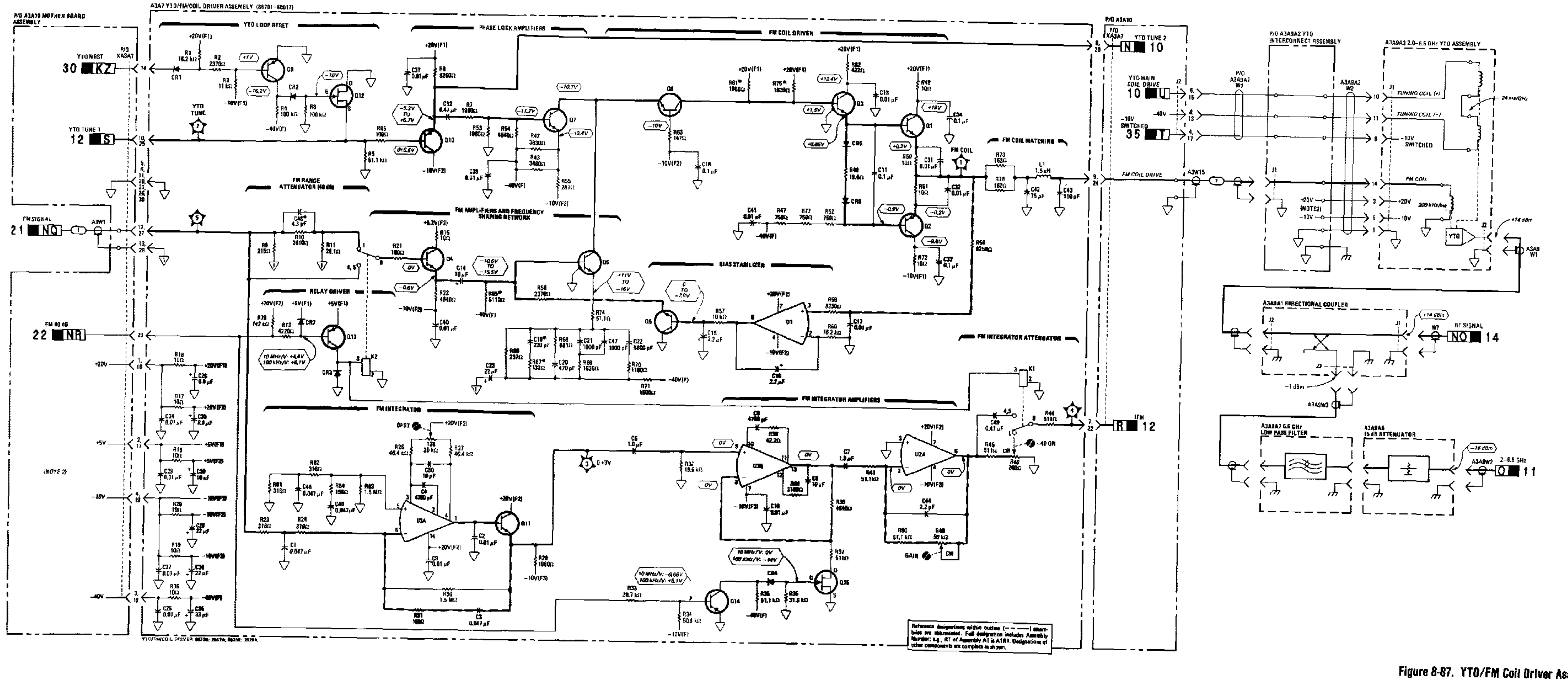


Figure 8-86. A3A7 YTO/FM Coil Driver Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY INPUTS TO A3A9A2 ARE SHOWN ON SERVICE SHEET 11.

* ASTERISK INDICATES SELECTED COMPONENT. AVERAGE VALUES SHOWN.

WARNING

A VOLTAGE DIFFERENTIAL OF 60 Vdc MAY BE FOUND ON THE VTO AND INTERFACE BOARD. THIS VOLTAGE COULD CAUSE PERSONAL INJURY IF CONTACTED. BE CAREFUL WHILE WORKING ON THE VTO WITH POWER SUPPLIED TO THE INSTRUMENT.

REFERENCE DESIGNATIONS

A1	A3A9
W1	W1–3, A6, A7
A3	A3A9A1
W1,16	J1,2,3
A3A7	A3A9A2
C1–60 CR1–7 K1,2 L1 Q1–15 R1–11,13,15–24, 26–63, 65–76, 77–86 TP1–5 U1–3	J1 W1,2 A3A9A3 J1,2 A3A10 J2 XA3A7
NO PREFIX	
W7	

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1	1854-0013
Q2	1853-0012
Q3	1854-0401
Q4,5,11	1854-0404
Q6	1854-0345
Q7	1854-0023
Q8	1854-0247
Q9,10,14	1853-0461
Q12	1855-0020
Q13	1853-0281
Q15	1855-0417
U1	1826-0013†
U2	1828-0081
U3	1826-0044

13
A3A7, A3A9A3

Figure 8-87. YTO/FM Coil Driver Assembly Schematic Diagram

SERVICE SHEET 14

DETECTOR/ALC ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

Service Sheet 14 depicts ALC Board Assembly A1A2A1 and Preamp Assembly A1A9. ALC Board Assembly A1A2A1 is part of the Automatic Level Control (ALC) system of the Signal Generator. It contains the Reference Amplifier, the Integrator, and the Exponentiator used to drive the ALC Modulator. It also includes a sample and hold circuit used for ALC operation during pulse modulation. Preamp Assembly A1A9 includes the ALC/AM modulator and its associated preamplifier and amplifier.

Detailed Description

ALC Board Assembly A1A2A1 contains the following circuits:

- Reference Amplifier
- Error Amp
- Summing Junction
- Integrator
- Exponentiator

Each is discussed separately below.

Reference Amplifier. The Reference Amplifier consists of op amp U3, transistor Q14, and associated FET switches. The op amp is configured as an inverting amplifier with its main feedback path through A1A2A2R28 and A1A2A1R20. A1A2A2R28 is placed next to a thermistor used to temperature stabilize the gain of the Detector Amplifier. This ensures that the gain of the two amplifiers will track over the operating temperature range. A1A2A1Q14 provides the current gain required to drive the Integrator.

When in internal ALC mode, the inputs to the Reference Amplifier are the ALC REF signal from the ALC Reference Amplifier on DAC and Enable Board A1A5 (see Service sheet 22), and the F CORRECT signal from the Coupler Correct Circuit on SRD Bias Board A1A8 (see Service Sheet 19). Switch U5B blocks the F CORRECT signal when operating in the external ALC mode. The remaining switches are used when operating in the power overrange, that is, the +10 dBm range. Switch U5C parallels R18 with

SERVICE SHEET 14 (cont'd)

R19 to reduce the F CORRECT input by 10 dB. Switch U5D turns on switch Q13 to bypass R20 and reduce the gain of U3 by 10 dB. Switch U5A switches in an overrange adjustment circuit so that the front panel meter can be adjusted for a true reading.

Error Amp. The Error Amp consists of op amp U4 configured as a non-inverting amplifier. A small offset provided by R50 and R44 sets the output to about 190 mV. The Error Amp monitors the voltage at the Summing Junction which is normally around zero. If the power drops too low for the ALC modulator to level the signal, this voltage will go negative and the Error Amp output will also go negative. While in pulse mode, if the input pulse is too narrow the output of the Error Amp goes positive. The unleveled Detector on the A1A3 Function Board detects either condition and sends a low LEV signal to the Digital Control Unit to indicate that the Signal Generator is unleveled.

Summing Junction. This is a point in the circuit where various input are summed before being applied to the Integrator. These signals are: BUF, the output of the buffer amplifier on A1A2A2; the AM input signal; the ALC REF signal from the Reference Amplifier; and, the external ALC signal, EXT BUF ALC.

Integrator. The Integrator consists of op amp U1, transistors Q1, Q4, and Q5, and associated components. The integrator amplifies the level at the summing junction and routes it to the exponentiator. While operating in the pulse mode, switch Q3 is turned off between pulses, removing the input to the Integrator. During this time, integrating capacitor C12 holds the Integrator output at the level it had prior to the turning off of Q3. In this way, the ALC circuit does not try to respond to the loss of RF during pulse operation.

During AM or sweep operation, switches Q1, Q9 and Q12 are turned off. This switches in R29, R52, and R76, all of which have the effect of increasing the bandwidth of the integrator and the exponentiator.

Exponentiator. The Exponentiator consists of multiplexer U2, transistors Q8 and Q10 and associated components. Transistor Q7 is part of the power clamp circuit and is discussed below. The multiplexer is controlled by signals HN1 and HN2 from the DCU via the Function Board. These two signals are a two bit digital code representing the band that has been selected (see Service Sheet 20, Principles of Operation). The top section of the multiplexer, input pins 1,2,4, and 5, provide for adjustment of the signal to the exponentiator. The bottom half of the multiplexer provides fixed adjustment of the output of the exponentiator.

Transistor Q8 is a voltage to current converter that is required because the exponentiator is a current driven device. Transistor Q10 is the actual exponentiator. This dual transistor is configured as a current mirror. Because the bases of the two halves of the transistor are connected, the base-emitter current of the two

SERVICE SHEET 14 (cont'd)

must be the same. Therefore, the collector-emitter current of Q10B will mirror changes in the base drive of Q10A. Exponentiation results from the exponential relationship between base-emitter voltage and base-emitter current.

Transistor Q7, also configured as a current mirror, is part of the clamp circuit. When Q7 is activated by the CLAMP input, it overrides Q10 and holds the drive to the ALC modulator at a level determined by the adjustment of the clamp circuit on the Function Board.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with BD1 and BD6 has been used to isolate a malfunction to ALC Board Assembly A1A2A1. It is also assumed that an attempt has been made to correct the malfunction using the appropriate adjustment procedures, if any, in Section V. The following procedures allow for isolating a malfunction to a defective component on ALC Board Assembly A1A2A1.

Test Equipment

Oscilloscope .... HP 1980B
Digital Voltmeter (DVM) .... HP 3456A or 3455A
Power Supply .... HP 6200B

Troubleshooting Hint

If the ALC problem occurs in only certain bands but not in all bands, the problem is most likely multiplexer U2.

Reference Amplifier Troubleshooting

1. Place the A1A2 assembly on an extender board. Use the cable in the HP 11726A service kit to connect Detector A1CR1 to the A1A2A2 assembly.

2. Connect the Digital Voltmeter (DVM) to TP4, and press RCL 0.

3. Turn the VERNIER control fully counterclockwise then fully clockwise and record the DVM reading at each extreme.

   The DVM indication should be as shown below:

CCW	+1.0 V
CW	−0.75V

   If the indication is correct, proceed with Step 5.

   If the indication is not correct, proceed with Step 4.

4. Set the Signal Generator LEVEL dBm setting to +10 dBm and repeat Step 3.

SERVICE SHEET 14 (cont'd)

   The DVM indication should be as shown below:

CCW	−0.133V
CW	−0.19V

   If the indication is correct, proceed with Integrator Troubleshooting.

   If the indication is not correct, proceed with Step 5.

5. Connect the DVM to U3-6 and repeat Step 3.

   The DVM indication should be as shown below:

CCW	+1.7V
CW	−0.133V

   If the indication is correct, Q14 is at fault.

   If the indication is not correct, proceed with Step 6.

6. Connect the DVM to XA2-9 and repeat Step 3.

   The DVM indication should be as shown in the table below:

CCW	−7.5V
CW	0.0V

   If the indication is correct, there is a problem with either U5 or U3. Because of the feedback around U3 it is very difficult to isolate between the two. Therefore first replace U5 as being the most likely to fail. If this does not correct the problem, replace U3.

   If the indication is not correct, proceed to Service Sheet 22 to check the ALC Reference circuit on the DAC and Enable Board.

7. Set the DVM for the 1 kOhm resistance range and connect it across R20. Then, while observing the DVM indication, increase the LEVEL dBm setting to +10 dBm and set the VERNIER to 0 dBm.

   The initial DVM indication should be 227Ω then drop to about 100Ω when the LEVEL dBm setting is set to +10 dBm.

   If the indication is correct, U5 is at fault.

   If the indication is not correct, proceed to Step 8.

8. Set LEVEL to 0.0 dBm and connect the DVM to the collector of Q16. Then, while observing the DVM display, increase LEVEL dBm to +10 dBm.

SERVICE SHEET 14 (cont'd)

   The DVM indication should initially be about −10 volts, then drop to about zero when the range is set to +10 dBm.

   If the indication is correct, Q13 is defective.

   If the indication is not correct, proceed with Step 9.

9. Set LEVEL dBm setting to 0.0 dBm and connect the DVM to U5-14. Then, while observing the DVM display, increase LEVEL setting to +10 dBm.

   The initial DVM indication should be about +4.8 volts, then drop to about −0.7 volts when LEVEL setting is increased to +10 dBm.

   If the indication is correct, Q16 is defective.

   If the indication is not correct, U5 is defective.

Error Amplifier Troubleshooting

Problems with the Error Amp can be caused by the Error Amp itself or by switch Q6. Because of feedback around U4 it is difficult to isolate between them. Therefore, for Error Amp problems, first replace Q6. If the problem persists, replace U4.

Integrator Troubleshooting

AM Problems. If the detected output of the Signal Generator is seriously distorted or attenuated when the Signal Generator is being amplitude modulated, and the AM circuits seem to be working properly, check Q11, Q1, Q9, and Q12.

Excessive Integrator Output. The integrator output is clamped to a maximum of about ±3 volts by Q4 and Q5. Therefore, if the integrator output is much higher than this, suspect Q4, and Q5.

Pulse Modulation Problems. If the Signal Generator will not properly level during pulse modulation, but is normal otherwise, and no problem is found on the pulse board, check Q3 and Q6.

1. Connect the test equipment as shown in Figure 8-88.

CAUTION

Do not exceed 1V with the power supply or damage will result to the input circuitry.

2. Connect the DVM to A1A2C6 and adjust the power supply for a DVM indication of 0.1 volt.

3. Press RCL 0 on the Signal Generator and set VERNIER fully CCW.

YTO/FM Coil Assembly
A3A7, A3A9A3
SERVICE SHEET 13

SERVICE SHEET 14 (cont'd)

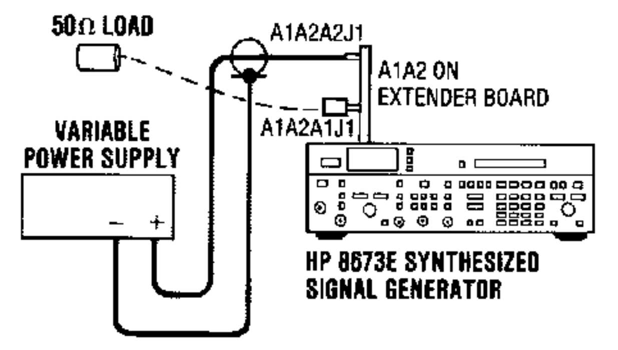


Figure 8-88. Integrator Troubleshooting Test Setup

4. Connect the DVM to TP3.

5. The DVM should read −2.5 volts. Set the VERNIER fully CW and verify that the DVM reads about +2.5 volts.

   If the DVM indication is correct, the Integrator is operating normally. Proceed with Exponentiator Troubleshooting.

   If the DVM indication is not correct, proceed with Step 6.

6. Connect the DVM to the drain of Q2.

   The DVM indication should be +0.1 volt.

   If the DVM indication is correct, the problem is either Q3 or U1. Because of the feedback around U1 it is difficult to isolate between the two. Therefore, first replace Q3. If the problem persists, replace U1.

   If the indication is not correct, replace Q2.

Exponentiator Troubleshooting

1. If it has not already been done, connect the test equipment as shown in Figure 8-88.

2. Connect the DVM to A1A2C6 and adjust the power supply for a DVM reading of +0.1 volt.

3. Connect the DVM to U2-3. Then set the Signal Generator to each of the frequencies listed below and check for the corresponding DVM indication for each.

Frequency	DVM Indication
3.0 GHz	+0.99V
9.0 GHz	+0.84V
15.0 GHz	+0.78V

   If the DVM indication is correct for all frequencies, proceed with Step 4.

   If the DVM indication is not correct for any of the frequencies, U2 is defective.

4. Set the frequency to 3.0 GHz and connect the DVM to the collector of Q8.

   The DVM should read +4.8 volts.

   If the DVM indication is correct replace Q10.

   If the DVM indication is not correct, replace Q8.

5. Reconnect A1CR1 between A1DC1 and A1A2A2J1. Remove the 50 Ohm load from A1A2A1J1; reconnect A1W13 (green cable) to A1A2A1J1.

6. Press RCL 0, connect the DVM to the collector of Q7B. Then, while observing the DVM display, press ALC DIODE.

   The DVM should initially indicate +0.9 volt, then drop to +0.8 volts when ALC DIODE is pressed.

   If the DVM responds as indicated, the clamp circuit is functioning normally.

   If the DVM does not respond as indicated, replace Q7.

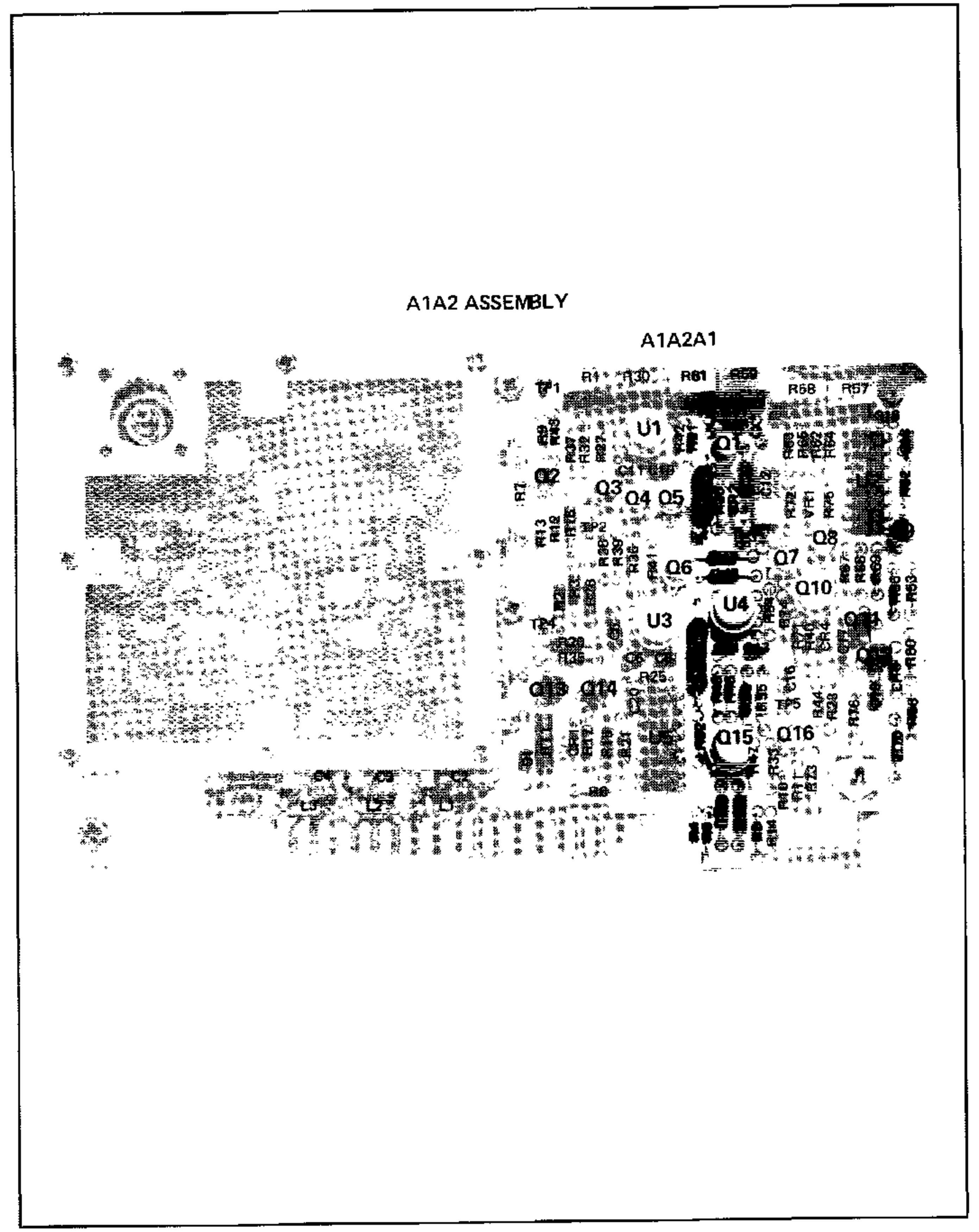
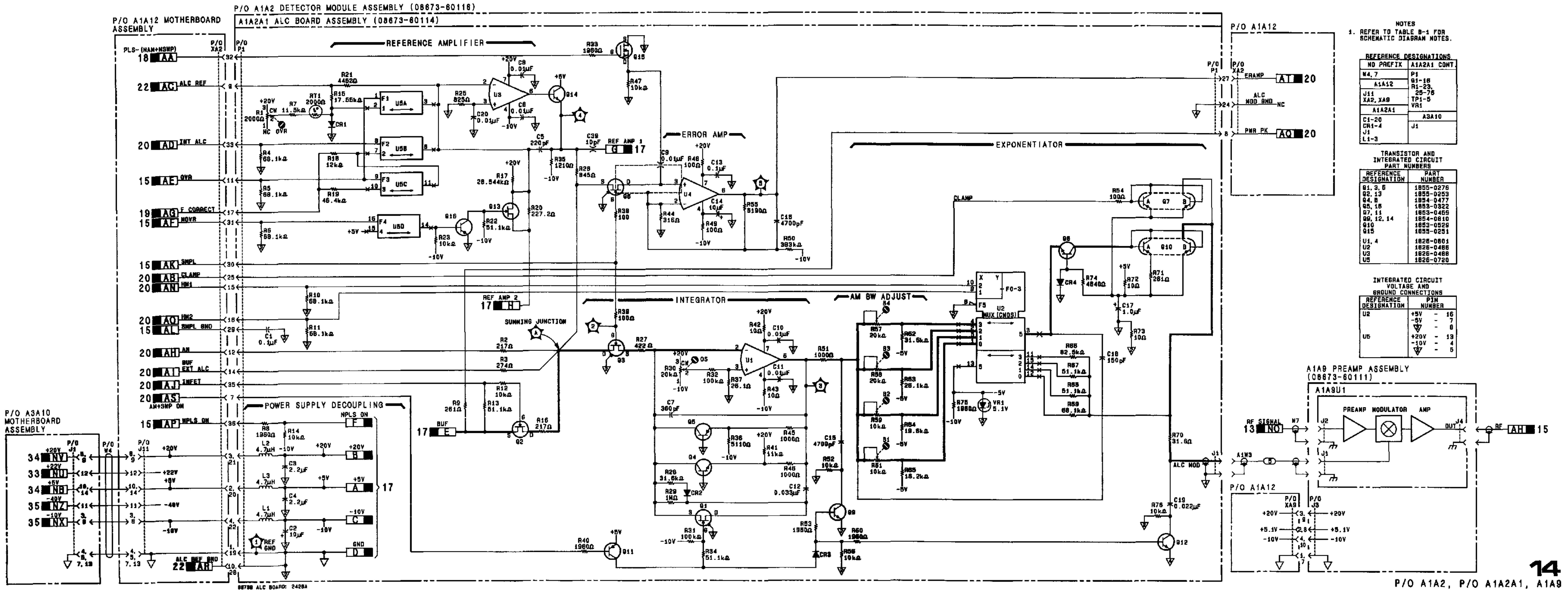


Figure 8-89. A1A2A1 Detector/ALC Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS

NO PREFIX	A1A2A1 CONT.
W4, 7	P1
A1A12	Q1-16
J11 XA2, XA9	R1-23, 25-76 TP1-5 VR1
A1A2A1	**A3A10**
C1-20 CR1-4 J1 L1-3	J1

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
Q1, 3, 6	1855-0276
Q2, 13	1855-0253
Q4, 8	1854-0477
Q5, 16	1853-0322
Q7, 11	1853-0459
Q9, 12, 14	1854-0810
Q10	1853-0529
Q15	1855-0251
U1, 4	1826-0601
U2	1826-0466
U3	1826-0468
U5	1826-0720

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U2	+5V - 16 -5V - 7 - 8
U5	+20V - 13 -10V - 4 - 5

Figure 8-90. Detector/ALC Assembly Schematic Diagram

SERVICE SHEET 15

PULSE DRIVER PROCESSING ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1	Service Sheet BD1
Pulse Modulation Block Diagram	Service Sheet BD7
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

Pulse Driver Processing Board Assembly A1A4 is part of the RF Output Assembly. It receives the input pulse signal and generates signals to drive the pulse modulator. Other signals generated are used for automatic level control and SRD bias while in the pulse mode. The width of the input pulse is monitored and a signal is sent to the Digital Control Unit (DCU) if the pulse is too narrow to be properly leveled.

Input Control Circuits

The input control circuits include: data latch input protection, norm/complement switching, pulse mode enable, pulse shutdown, and delay switching. The data latch consists of addressable latch U9. It latches control signals from the DCU. These signals are discussed with the circuits they control.

Input protection consists of diodes CR1, CR2, and VR1 that limit the input pulse level to between +5 and −0.5 volts. Norm/complement switching consists of exclusive OR gate U1C. When U1-9 is low, the pulse is not inverted, when U1-9 is high the pulse is inverted. Pulse mode enable consists of NAND gate U6A. When U6-2 is high, pulse mode is enabled. When U6-2 is low, pulse mode is disabled. The pulse shutdown circuit, consisting of AND gates U3A, B, and C, is controlled by the NSHDN signal received from the Digital to Analog Converter (DAC) and Enable assembly A1A5 (service sheet 22). This signal is generated by the DCU to switch the unit to CW mode when a frequency or amplitude change makes it necessary to adjust the YIG Tuned Multiplier (YTM) injected pulse.

Sample Pulse Circuits

These circuits generate the sample pulse that is routed to the Automatic Level Control (ALC) board to control ALC operation while operating in the pulse mode. The circuits are adjusted so that the sample pulse starts after the output pulse has stabilized and turns off when the output pulse turns off. The sample pulse turns on a sample-and-hold circuit on the ALC board to establish an ALC reference. Then, the pulsed RF is turned on and holds the ALC reference while the RF is pulsed off. This keeps the ALC circuitry from responding to the extreme output level changes while the RF is being pulse modulated.

The individual circuits used to generate the sample pulse are:

SERVICE SHEET 15 (cont'd)

- Enable Delay
- Trailing Edge (T.E.) One-Shot
- Leading Edge (L.E.) One-Shot
- Sample Gate
- Sample Gate Driver

The input pulse from the delay switching circuit is routed through fixed delays to the L.E. One-Shot, the Sample Gate, and the T.E. One-Shot. Note that the path to the T.E. One-Shot also includes an inverter so that the one-shot is triggered by the trailing edge of the pulse. The two one-shots generate pulses with adjustable width. The Sample Gate receives the delayed input pulse plus the outputs of the T.E. and L.E. one-shots. When all of these signals are high, the output of the Sample Gate to the Sample Gate Driver, is low.

The Sample Gate Driver receives the output of the Sample Gate and drives the sample and hold circuit on the ALC board. When pulse modulation has not been selected, this output is high to allow normal ALC operation. During pulse modulation, this output is pulsed high during the last half of the output pulse.

Series Pulse Circuits

The Series Pulse circuits consist of the Series Pulse Delay and the Series Pulse One-Shot. The delay is needed so that the YTM pulse generated by the YTM Pulse One-Shot can reach the YTM before the pulsed RF reaches it. *A similar delay in the shunt pulse circuit* sets the timing between the series and shunt pulses, see Figure 8-91.

The Series Pulse One-Shot is designed to drive the series diode in the Pulse Modulator A1AT3 in such a way as to minimize the turn-on time of the diode. The limiting factor in the diode turn-on time is the capacitance of the diode. To ensure minimum turn-on time, the pulse must first rise to a relatively high positive level to quickly charge the diode capacitance, and then drop to its steady state level. Note that though the steady state level of the series pulse is negative, the corresponding steady state value of the shunt pulse is more negative so that the series diode is biased on. The overshoot at the end of the series pulse speeds the turn-off time of the series diode.

Shunt Pulse Circuits

The Shunt Pulse Circuits consist of the Shunt Pulse Delay and the Shunt Pulse Driver. The delay was discussed under Series Pulse Circuits above. The pulse requirements for the shunt pulse are similar to that of the Series, but because more diodes are being driven, greater current drive is required. For this reason TTL/Modulator Drive U7 is used to generate the pulse shown in the bottom of Figure 8-91. Again notice the overshoot at the beginning and end of the pulse used to speed up the turn-on and turn-off times of the shunt diodes.

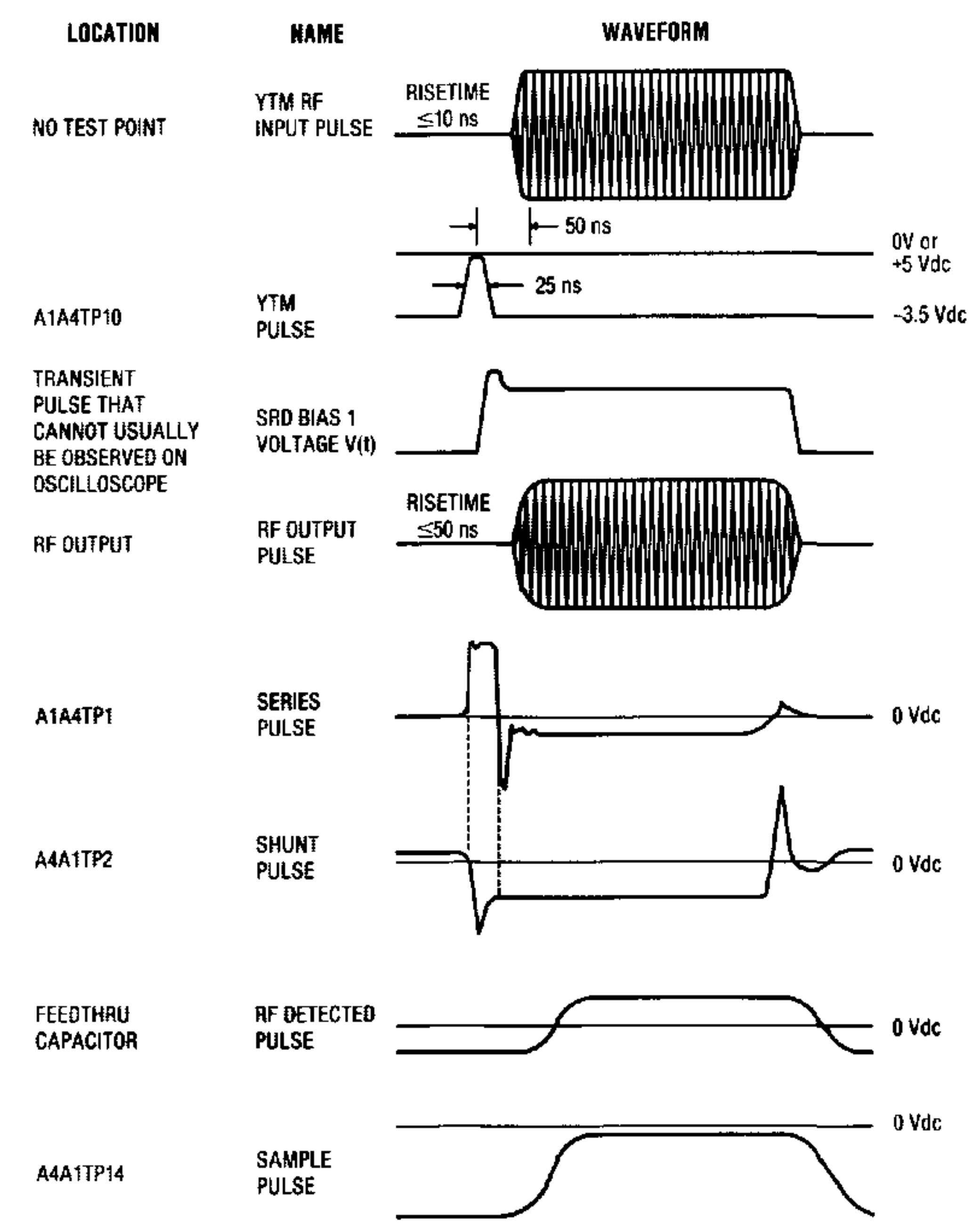


Figure 8-91. Pulse Modulation Waveforms

SERVICE SHEET 15 (cont'd)

YTM Pulse One-Shot

The YTM Pulse One-Shot consists of inverter U8A, transistors Q6, Q7, Q8, Q9, and associated components. A NOR gate, U5B, receives the NPLS signal from the Data Latch and the BND 1 signal from the SRD Control Board. These signals disable the YTM Pulse One Shot when the Signal Generator is operating in band 1 (no YTM pulse is required in this band) and when pulse modulation has not been selected.

The PAC signal from the SRD control board is set by the DCU at a level equal to the SRD bias in CW mode. This signal is the supply voltage for the YTM Pulse One-Shot. Thus, when Q6 is briefly turned on by the one-shot action, the YTM Pulse One-Shot output is a pulse whose amplitude is the same as the CW bias level of the SRD. Because of the delays in the Series and Shunt pulse one-shots, the YTM pulse reaches the YTM before the RF is pulsed on and sets the SRD bias to the proper level.

Minimum Pulse Width Detector

The Minimum Pulse Width Detector consists of AND gate U3D, one-shots U10A and U10B, NOR gate U5A, transistor Q14 and associated components. The Schmitt-trigger input of U10A receives the input pulse from U3C via a delay circuit consisting of R9, R10, and C22. This delay circuit is set by R9 such that the positive-going input pulse must be about 90 ns long before the voltage at U10-2 is sufficiently high to trigger U10A. When U10A is triggered, it triggers U10B. This places a high at U5-3.

During normal operation, U10A is retriggered with each new input pulse. Since the U10A output pulse is only 90 ns long, U10B is retriggered with each new input pulse, and, since its output pulse is very long, U5A is always high. Because of the time constant of R31 and C24, U5-2 is always high while the Signal Generator is in the pulse mode. Therefore, when in pulse mode, with the positive-going portion of the input pulse train at least 90 ns long, U5-1 is low. This keeps transistor Q14 off, placing a high impedance at XA4-25. XA4-25, in turn, is pulled to +5 volts by the pull-up resistor shown on Service Sheet 30.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with Service Sheets BD1 and BD7 have been used to isolate a malfunction to Pulse Driver Processing Assembly A1A4. It is also assumed that an attempt has been made to correct the malfunction using the appropriate adjustment procedures in Section V. The following procedures allow for isolating a malfunction to a defective component on Pulse Driver Processing Board Assembly A1A4.

Detector/ALC Assembly
P/O A1A2, P/O A1A2A1, A1A9
SERVICE SHEET 14

SERVICE SHEET 15 (cont'd)

Test Equipment

Signature Analyzer	HP 5005A/B or HP 5006A
Oscilloscope	HP 1980B
Digital Voltmeter (DVM)	HP 3456A or HP 3455A
Variable Power Supply	HP 6200B
Pulse Generator	HP 8013B

Troubleshooting Procedures

The following troubleshooting information is divided into the following procedures:

- Initial Setup and Check
- Input Circuits Troubleshooting
- Shunt Pulse Circuit Troubleshooting
- Series Pulse Circuit Troubleshooting
- Sample Gate Circuit Troubleshooting
- Minimum Pulse Width Detector Troubleshooting
- YTM Pulse One-Shot Troubleshooting
- Data Latch Troubleshooting

Initial Setup and Check. The following two steps should be performed prior to using any of the troubleshooting procedures that follow. These two steps give the test setup used for most of the other procedures and provide a check of the PLS signal at A1A4TP3 which is used in the other circuits on the board.

1. Connect the test equipment as shown in Figure 8-92. Set the pulse generator as follows:

   Pulse Period to 1 μs
   Pulse Width to 200 ns
   Pulse Amplitude to +3 volts

   On the Signal Generator press RCL 0 and PULSE NORM.

2. Connect channel 1 of the oscilloscope to TP3 and observe the display.

   The display should be as shown in Figure 8-93.

   If the display is as indicated, the input circuits are working normally, proceed to desired troubleshooting procedure.

   If the display is not as indicated, proceed with Input Circuits Troubleshooting.

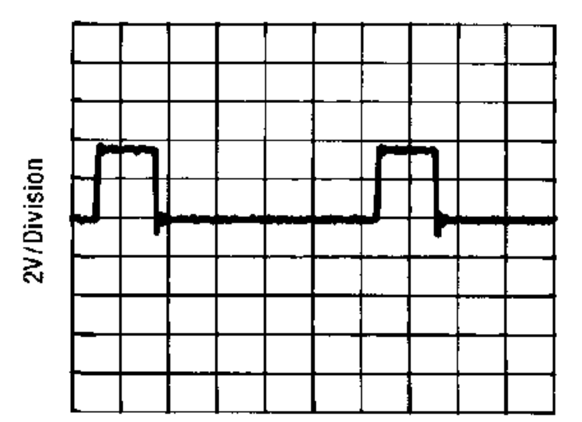


Figure 8-93. TP3 Waveform

Input Circuits Troubleshooting:

1. On the Signal Generator press RCL 0. Then connect channel 2 of the oscilloscope to U1-10.

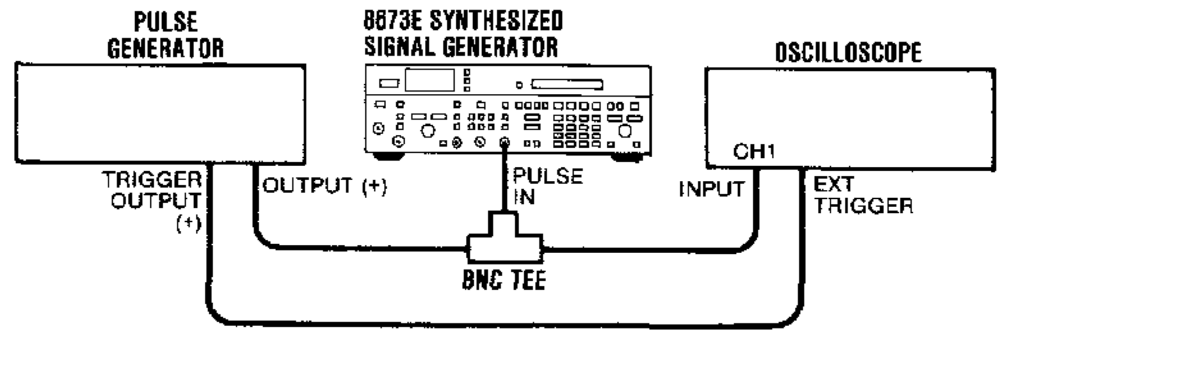


Figure 8-92. Pulse Modulation Test Setup

SERVICE SHEET 15 (cont'd)

2. Disconnect the pulse generator from the pulse input connector on the Signal Generator. Connect the power supply in place of the pulse generator.

3. Slowly increase the dc level on the power supply and observe the oscilloscope display. The level as seen on the oscilloscope should stop increasing at about +5 volts.

   If the display is as indicated, proceed with Step 4.

   If the display is not as indicated, check CR1, CR2, and VR1.

4. Setup the power supply to provide a negative voltage. Slowly increase the dc level on the power supply and observe the oscilloscope display. The display should stop increasing at about −1 volt.

   If the display is as indicated, proceed to Step 5.

   If the display is not as indicated, check CR1.

5. Disconnect the power supply from the Signal Generator. Replace the power supply with the pulse generator.

6. Readjust the pulse generator for a peak level of +3 volts and connect channel 2 of the oscilloscope to U6-3. While observing the oscilloscope display, press PULSE COMPL.

   The channel 2 display should look like the channel 1 display until PULSE COMPL is pressed. It will then invert to a negative-going pulse.

   If the display is as indicated, U3 is defective.

   If the display is as initially indicated but does not invert when PULSE COMPL is pressed, proceed with Step 9.

   If the display is not as indicated for either condition, preceed with Step 7.

7. Connect channel 2 of the oscilloscope to U1-8 and press PULSE NORM.

   The display should be as shown in Figure 8-94.

   If the display is as indicated, proceed with Step 8.

   If the display is not as indicated, U1 is defective.

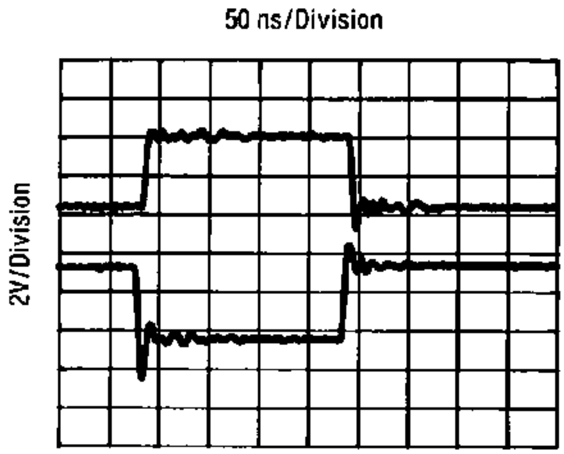


Figure 8-94. Norm/Complement Input Waveform

8. While observing the oscilloscope display, press PULSE COMPL.

   The channel 2 display should invert 180 degrees when PULSE COMPL is pressed.

   If the display changes as indicated, U6 is defective.

   If the display does not change as indicated, proceed with Step 9.

9. Connect the DVM to U9-5. While observing the DVM, press PULSE NORM, then press PULSE COMPL.

   The DVM should read about +4 volts after PULSE NORM is pressed, then drop to about +0.5 volt when PULSE COMPL is pressed.

   If the DVM reading is as indicated, U1 is defective.

   If the DVM reading is not as indicated, proceed to Data Latch Troubleshooting to isolate the problem with the Data Latch.

Shunt Pulse Circuit Troubleshooting. This procedure should be used if the Shunt Pulse Check procedure in the troubleshooting information asso-

SERVICE SHEET 15 (cont'd)

ciated with BD7 indicates a malfunction in the Shunt Pulse Circuit of A1A4, or if for any other reason it is known that such a malfunction exists. With the test equipment connected as indicated in Initial Setup, proceed as follows:

1. Connect channel 2 of the oscilloscope to U2-6 and observe the display.

   The display should be as shown in Figure 8-95.

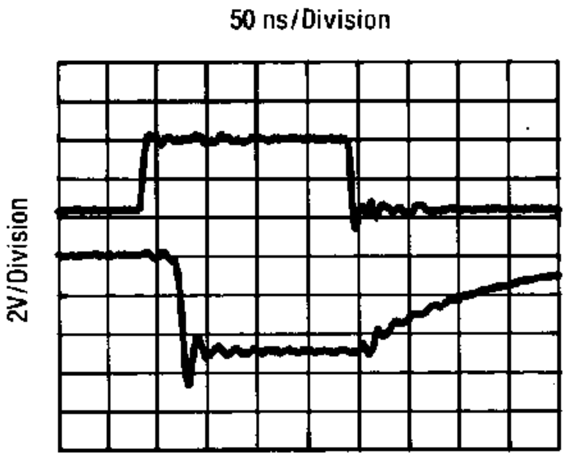


Figure 8-95. TP3 and U2-6 Waveforms

   If the display is as indicated, proceed with Step 3, otherwise proceed with Step 2.

2. Connect channel 2 of the oscilloscope to U8-4 and observe the display.

   Channel 2 of the oscilloscope display should be as shown in Figure 8-96.

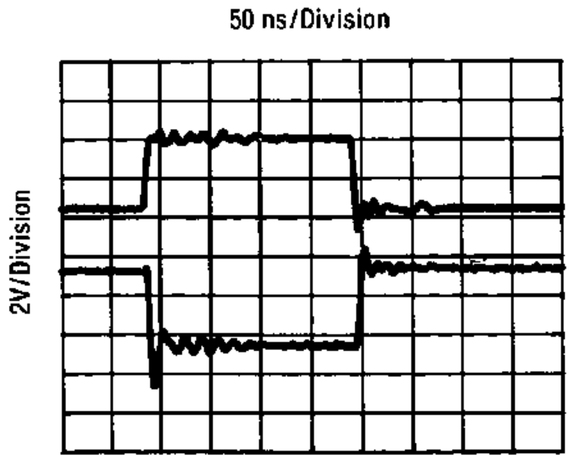


Figure 8-96. TP3 and U8-4 Waveforms

   If the display is as indicated, U2 is defective.

   If the display is not as indicated, U8 is defective.

3. Connect channel 1 of the oscilloscope to U1-3 and channel 2 of the oscilloscope to U1-6.

   The display should be as shown in Figure 8-97.

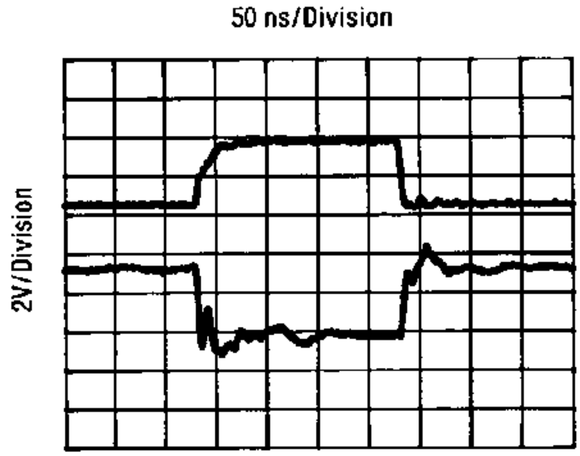


Figure 8-97. U1-3 and U1-6 Waveforms

If the display is as indicated, U1 is defective.

If the display is not as indicated, check U7 and associated components.

Series Pulse Circuit Troubleshooting

1. Connect the oscilloscope to U1-11.

   The display should be as shown in Figure 8-98.

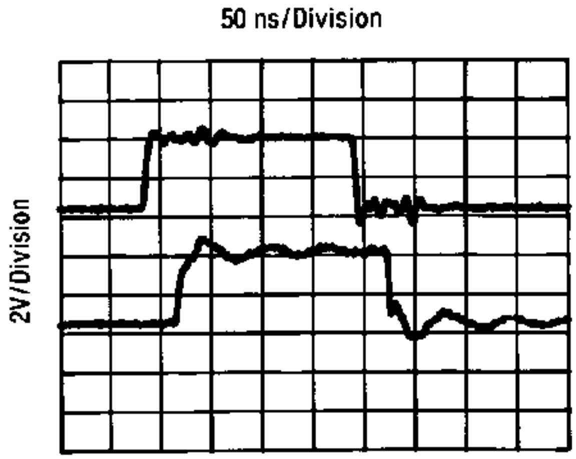


Figure 8-98. U1-11 Waveform

If the display is as shown, check Q1, A2, and associated components.

SERVICE SHEET 15 (cont'd)

If the display is not as indicated, proceed with Step 2.

2. Connect the oscilloscope to U2-4.

   The display should be as shown in Figure 8-99.

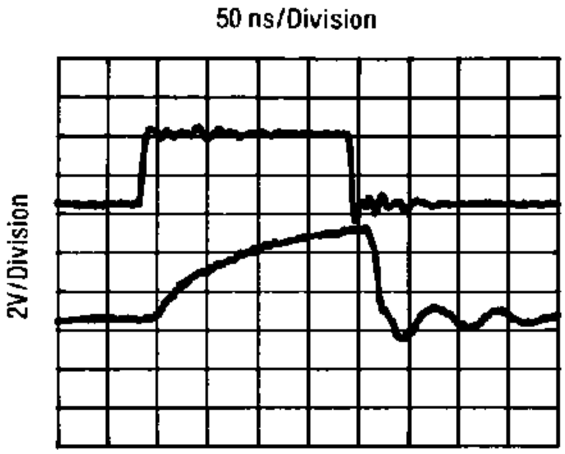


Figure 8-99. U2-4 Waveform

If the display is as shown, U1 is defective.

If the display is not as shown, U2 is defective.

Sample Gate Circuit Troubleshooting.

1. Connect the oscilloscope to TP13.

   The display should be as shown in Figure 8-100.

   If the display is as indicated, proceed with Step 4, otherwise proceed with Step 2.

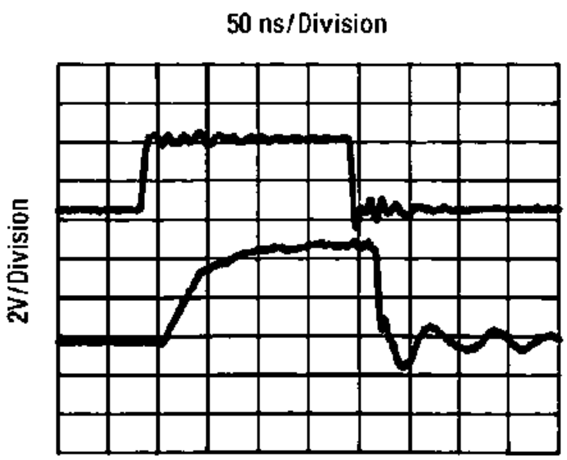


Figure 8-100. TP13 Waveform

2. Connect the oscilloscope to TP12.

   The display should be as shown in Figure 8-101.

   If the display is as indicated, proceed with Step 3.

   If the display is not as indicated, U4 is defective.

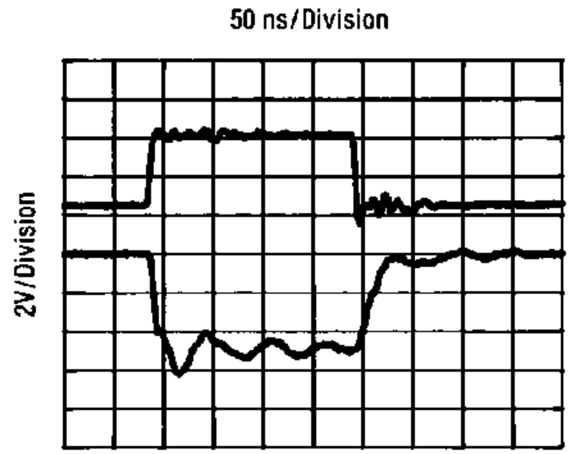


Figure 8-101. TP12 Waveform

3. Connect the oscilloscope to U2-12.

   The display should be as shown in Figure 8-102.

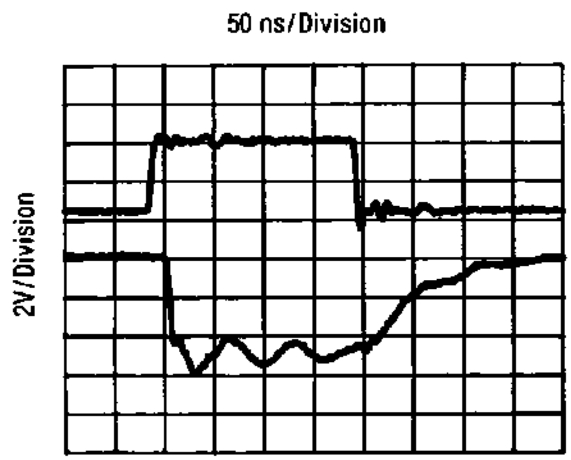


Figure 8-102. U12-2 Waveform

If the display is as shown, U4 is defective.

If the display is not as shown, U2 is defective.

4. Connect the oscilloscope to TP8.

SERVICE SHEET 15 (cont'd)

The display should be as shown in Figure 8-103.

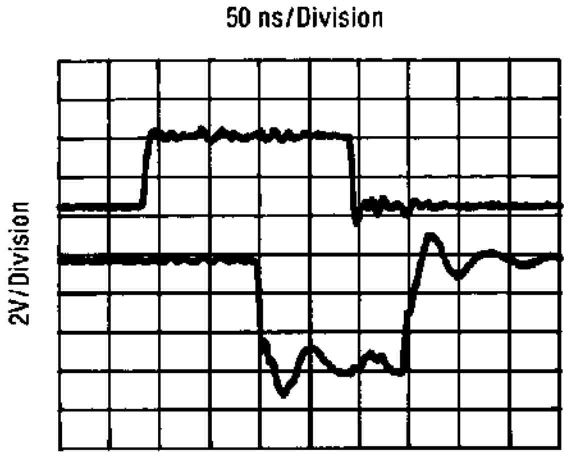


Figure 8-103. TP8 Waveform

If the display is as indicated, check Q13, Q15 and associated components.

If the display is not as indicated, proceed with Step 5.

5. Connect the oscilloscope to TP4.

   The display should be as shown in Figure 8-104.

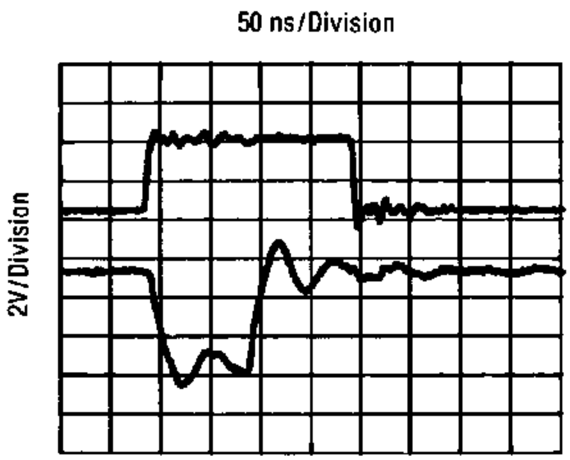


Figure 8-104. TP4 Waveform

If the display is as indicated, proceed with Step 6.

If the display is not as indicated, check Q3, Q4, Q5, and associated components.

If the display is not as indicated, check Q10, Q11, Q12, and associated components.

6. Connect the oscilloscope to TP11.

   The display should be as shown in Figure 8-105.

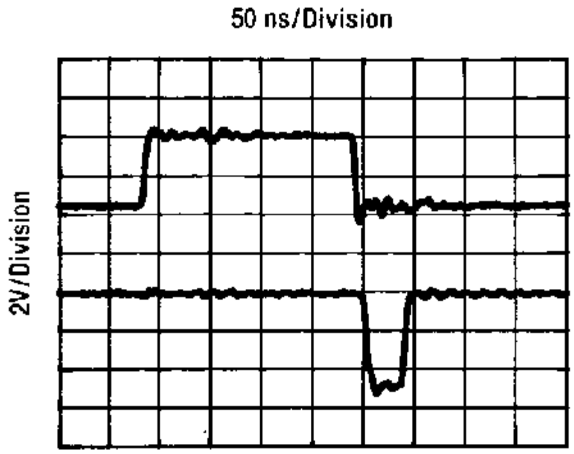


Figure 8-105. TP11 Waveform

If the display is as indicated, U6 is defective.

If the display is not as indicated, check Q10, Q11, Q12, and associated components.

Minimum Pulse Width Detector Troubleshooting. This procedure should be used if the Level Check procedure associated with BD7 troubleshooting indicates a problem with the minimum pulse width detector.

1. Connect the DVM to U10-5 and, while watching the DVM display, gradually reduce the pulse width from the pulse generator to 50 ns.

   If the pulse width is reduced to between 100 ns and 50 ns, the DVM should change from an inital indication of about +4.5 volts to about +0.5 volt.

   If the DVM reading is as indicated above, proceed with Step 2, otherwise proceed with Step 4.

2. Connect the oscilloscope to U5-2 and set the pulse generator for a 1 kHz square wave.

   The oscilloscope display should show a square wave at 1 kHz.

   If the oscilloscope display is as indicated, proceed with Step 3.

   If the oscilloscope display is not as indicated, check CR3 and associated components.

SERVICE SHEET 15 (cont'd)

3. Connect the DVM to TP5 and repeat step 1.

   If the pulse is reduced to between 100 ns and 50 ns, the DVM should change from an initial indication of about 0.5 volt to about 4.5 volts.

   If the DVM reading is as indicated, Q14 is defective.

   If the DVM reading is not as indicated, U5 is defective.

4. Connect the oscilloscope to U10-2.

   The display should be as shown in Figure 8-106.

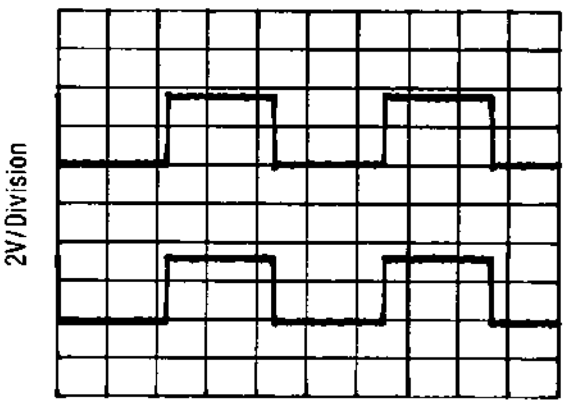


Figure 8-106. U10-2 Waveform

   If the display is as shown in the figure, U10 is defective.

   If the display is not as shown in the figure, proceed with Step 5.

5. Connect the oscilloscope to U3-11.

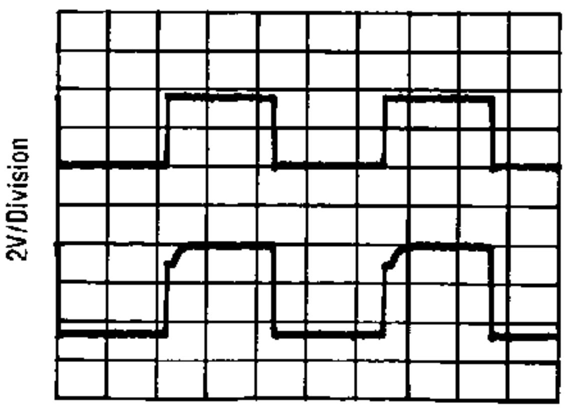


Figure 8-107. U3-11 Waveform

   The display should be as shown in Figure 8-107.

   If the display is as shown, check CR4, CR6, and associated components.

   If the display is not as shown, U3 is defective.

YTM Pulse One-Shot Troubleshooting.

1. On the Signal Generator set the frequency to 10 GHz, press PULSE NORM, then connect the DVM to the emitter of Q9.

   The DVM indication should be −3.4 volts. If the DVM reading is as indicated proceed with Step 2.

   If the DVM reading is not as indicated, check Q9 and associated components.

2. Connect the oscilloscope to the base of Q8.

   The display should be as shown in Figure 8-108.

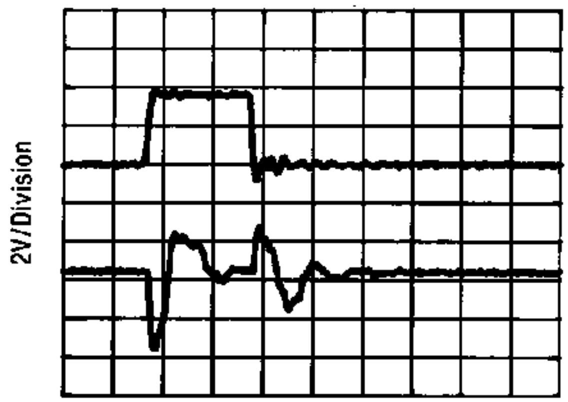


Figure 8-108. Q8 Base Waveform

   If the display is as shown in the figure, check U6, U7, U8, and associated components.

   If the display is not as indicated, proceed with Step 3.

3. Connect the DVM to U5-4.

   The DVM should indicate about +4.5 volts.

   If the indication is correct, U8 is defective.

   If the indication is not correct, proceed with Step 4.

SERVICE SHEET 15 (cont'd)

4. Connect the DVM to XA4-14.

   The DVM should indicate about +0.3 volts.

   If the indication is correct, proceed with Step 5.

   If the indication is not correct, go to Service Sheet 19 to troubleshoot the Band Logic Latch.

5. Connect the DVM to U5-6.

   The DVM should indicated about +0.3 volts.

   If the indication is correct, U5 is defective.

   If the indication is not correct, proceed with Step 6.

6. Connect the DVM to U8-11.

   The DVM should indicate about +4.5 volts.

   If the indication is correct, U8 is defective.

   If the indication is not correct, there is a problem with the Data Latch, proceed with Data Latch troubleshooting to isolate the problem.

Data Latches. This procedure should be used if it is suspected that one of the control signals latched into U9 is malfunctioning. The problem could be in U9, the signal EN8 from the DAC and Enable Board, or a broken trace on the mother board. Signature analysis is used to isolate the problem as quickly as possible. Proceed as follows:

1. Set the LINE switch to STBY.
2. On Microprocessor Assembly A2A8, set Diagnostic Switch A2A8S1 to position 5.
3. Connect the MPU Test Board from the 11726A Service Kit to the test connectors at the top of the Microprocessor Assembly A2A8.
4. Install a shorting clip between A2A8TP5 and the adjacent GND.
5. Connect the signature analyzer as follows:

Signature Analyzer Timing Pod	A2A8 Microprocessor Test Point
START	TP4
STOP	TP4
CLOCK	TP3
GND	TP GND

6. Set the signature analyzer pushbuttons as follows:

   START — leading edge
   STOP — trailing edge
   CLOCK — trailing edge

7. Remove A1A4 and replace it on a 36-pin extender card.
8. Set LINE switch to ON.

CAUTION

Do not leave the Signal Generator in this mode any longer than necessary. To do so would cause excessive wear on several relays that are heavily exercised in this mode.

9. Verify the FREQUENCY MHz display indicates 05-1.
10. Touch the signature analyzer probe to +5V and verify the signature is C37F.
11. Check the signatures shown in Table 8-40.

    If all of the signatures are correct the Latches are working normally, any problems with control signals are probably a result of broken traces.

    If any of the signatures are incorrect, proceed with Step 12.

Table 8-40. U9 Output Signatures

PIN NO.	SIGNATURE	SIGNAL
U9-4	0258	PLS ON
U9-5	4843	N/A
U9-6	C961	ALC LOOP HOL
U9-7	8075	OVR
U9-9	680H	D0
U9-10	4089	D5
U9-11	6FFU	D10

SERVICE SHEET 15 (cont'd)

12. Check the signatures shown in Table 8-41.

    If all the signatures are as shown, then U9 is faulty.

    If the enable line (EN8) signature is incorrect, proceed to Service Sheet 22 to troubleshoot the Enable Decoder circuit.

    If any of the data input lines (DATA 0—3) signatures are incorrect, proceed to Service Sheet 30 to isolate the problem.

Table 8-41. U9 Input Signatures

PIN	SIGNATURE	SIGNAL
XA4-31	8958	DATA 0
XA4-32	U194	DATA 1
XA4-33	9F1C	DATA 2
XA4-34	39P1	DATA 3
XA4-35	3352	EN8

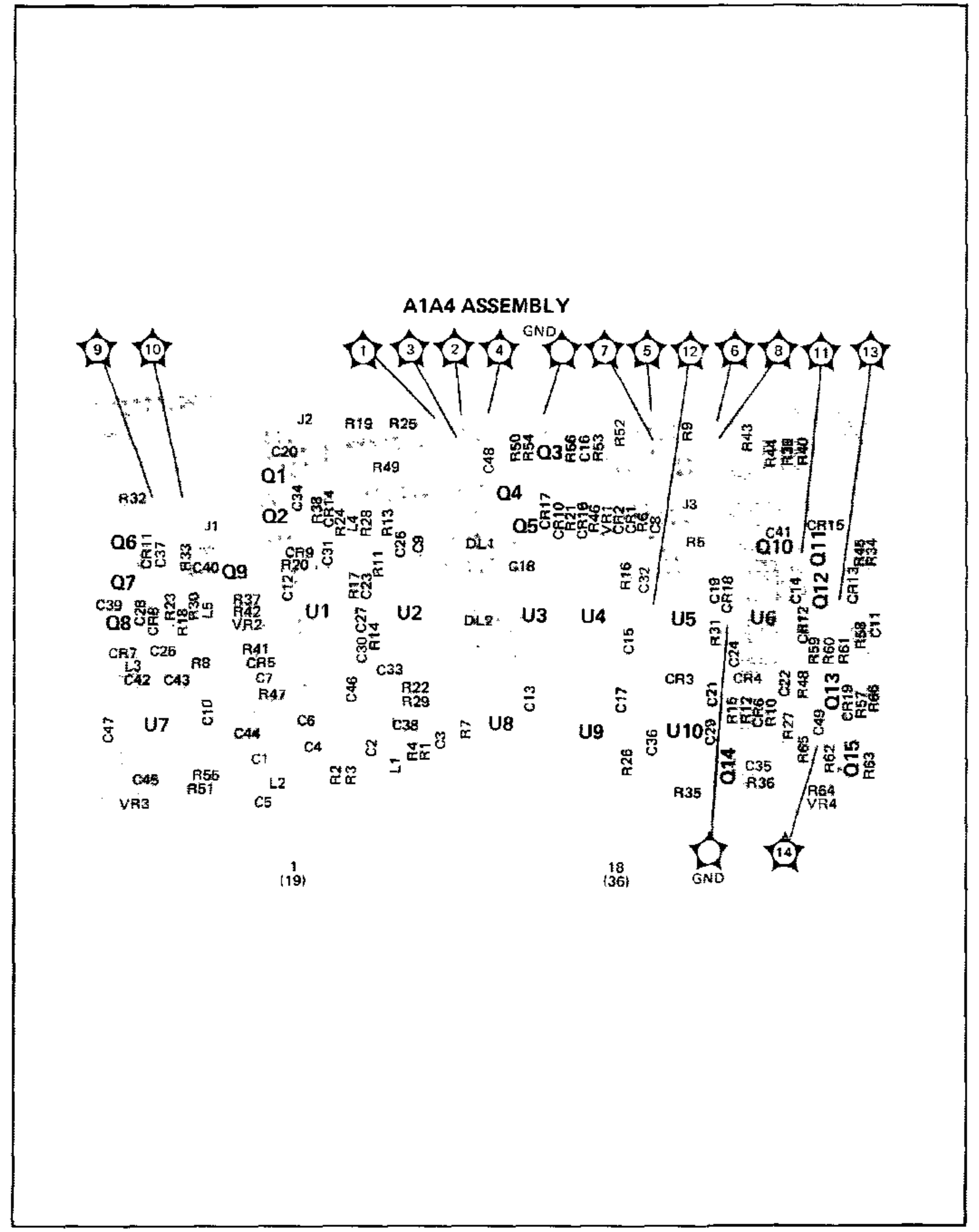
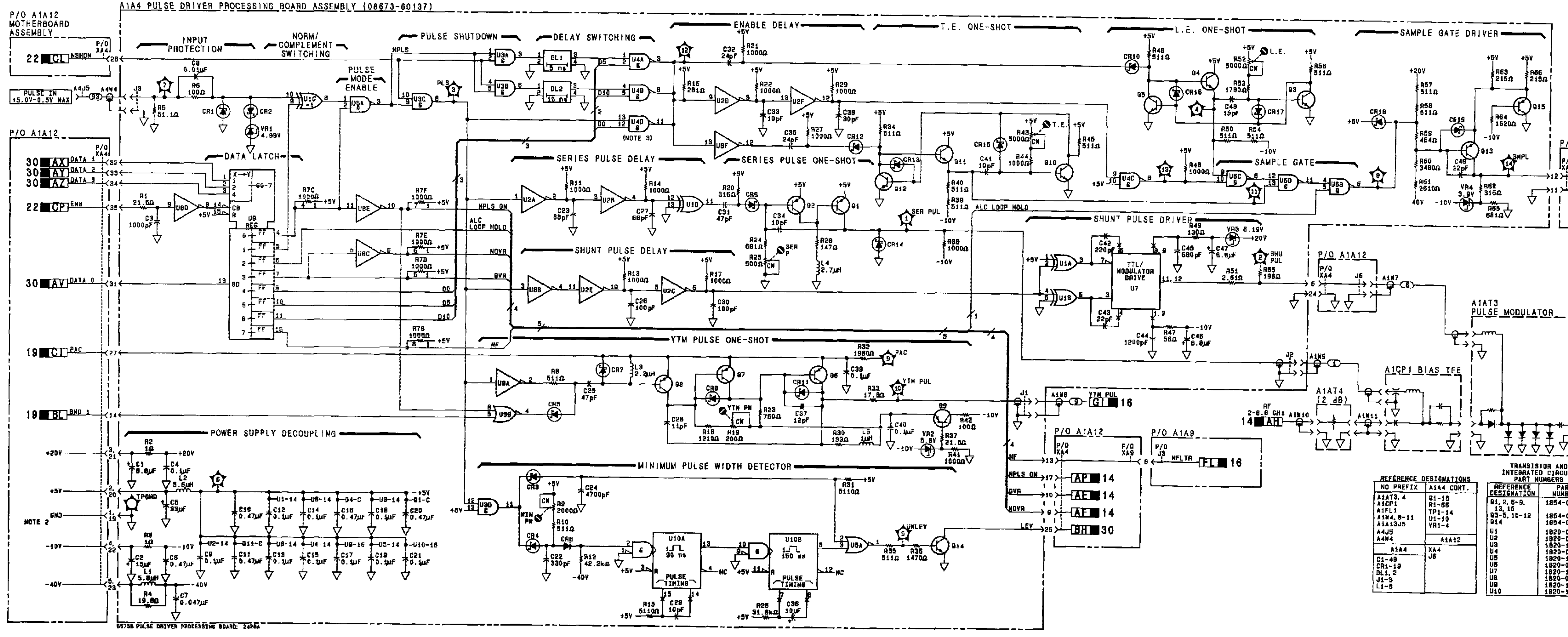


Figure 8-109. A1A4 Pulse Driver Processing Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE MOTHERBOARD ASSEMBLY ARE SHOWN ON SERVICE SHEET 1-A1.
3. ZERO DELAY ALWAYS ACTIVE IN HP 8673B/E/M.

REFERENCE DESIGNATIONS

NO PREFIX	A1A4 CONT.
A1AT3, 4 A1CP1 A1FL1 A1W4, 8-11 A1A13J5 A4J5 A4W4	Q1-15 R1-66 TP1-14 U1-10 VR1-4
A1A4	**A1A12**
C1-49 CR1-19 DL1, 2 J1-3 L1-5	XA4 J6

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
Q1, 2, 6-9, 13, 15	1854-0405
Q3-5, 10-12	1854-0809
Q14	1854-0810
U1	1820-0694
U2	1820-0694
U3	1820-1367
U4	1820-0682
U5	1820-1144
U6	1820-0681
U7	1820-1797
U8	1820-0683
U9	1820-1729
U10	1820-1429

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U1-6, 8	+5V - 14 ▽ - 7
U7	+5V - 10 ▽ - 5
U9, 10	+5V - 16 ▽ - 8

15
A1A4

Figure 8-110. Pulse Driver Processirng Assembly Schematic Diagram

SERVICE SHEET 16

YIG DRIVER ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

Service Sheet 16 depicts YIG Driver Assembly A1A7, YTM Assembly A1A10, Power Amplifier Assembly A1A11, Isolator A1AT2, and part of Pre-Amp A1A9. The Pre-Amplifiers and Power Amplifier boost the baseband signal power to drive the YTM Assembly. The Isolator provides isolation between the Power Amplifier and the YTM Assembly. The YTM (YIG-Tuned Multiplier) Assembly contains an SRD (step recovery diode) harmonic generator and a YIG tuned filter. It multiplies the baseband signal. and is driven by the YIG Driver Assembly and SRD Bias Board Assembly.

The YIG Driver Assembly shapes the YIG TUNE signal from the A3A5 DAC Assembly and drives the YIG-Tuned Multiplier (YTM). Adjustments are made to the slope and offset of the drive signal for each band so that the YIG-tuned filter will linearly track the RF signal.

Power Amplifier Assembly A1A11

This assembly receives the baseband signal from the pulse modulator and amplifies it to the level necessary to drive the YTM. It is biased by part of the Pre-Amp Bias Assembly. Isolator A1AT2 prevents reflections from the YTM being fed back to the power amplifier.

YIG Assembly A1A10

The YIG Assembly contains a Step Recovery Diode (SRD) Harmonic Generator, a YIG-Tuned Filter, and YIG Heater Control Assembly A1A10A1. The SRD Harmonic Generator is biased by the SOURCE and GATE signals from the SRD Bias Board. It receives the baseband signal from the Isolator and produces a comb spectrum with harmonics to more than 30 GHz. The YIG Tuned Filter is tuned by the YIG Driver Board to select the desired harmonic. The YTM output goes to the directional coupler. output attenuator, and detector. The YTM PUL signal from the Pulse Processor Board is active only during pulse modulation. It compensates for SRD bias lost between pulses.

The YIG Heater Control Assembly drives a heater to keep the YTM at a constant temperature. Amplifier U1 receives an input from the sensor and controls Q1 to maintain the proper current flow into the heater. Voltage follower U2 monitors the bias voltage on the SRD and buffers it for developing the PAC (Peak Amplitude Control) voltage on the DAC and Enable board. The PAC voltage controls the level of the YTM pulse, YTM PUL.

YIG Driver Board Assembly A1A7. The main drive for the YTM comes from the YIG TUNE signal through amplifier U3, and darlington pair Q1 and A1Q1. U3 is a non-inverting amplifier, with feedback from A1Q1, modified by a current source and current sink. Since different drive levels are required for each band, the YTM TUNE signal is first applied to a voltage divider consisting of resistors R35, R36, R37, and R38. The appropriate input for U3 is selected by Four Band Switch U4, driven by the signals NBND1—NBND3 (band 4 is not used).

Since the response of the YTM is not perfectly linear, corrections to the YTM drive are needed. These are provided by the Voltage Follower and 3 Band Switch; by the Band Offset Switch and Positive Current Source; and by the Band 3 and 4 Break Points and Negative Current Sink. Band 4 Breakpoint is also not used.

The effect of this circuit is to provide adjustable slopes in bands 2 and 3, as shown in Figure 8-111.

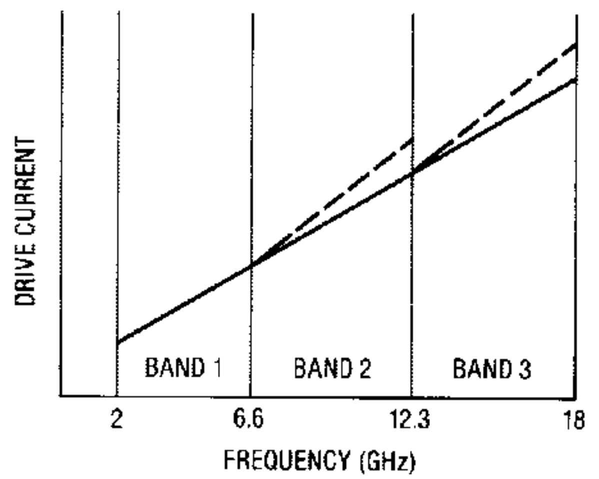


Figure 8-111. Drive Current Variation with 3 Band Switch Slope Control

The Band Offset Switch and Positive Current Source provides an adjustable offset for each of the three bands. Amplifier U7 is a voltage follower driving Q3 which acts as a current source for the coils in the YIG-Tuned Filter. The higher the setting of the active Band Offset Switch potentiometer, the more drive to Q3 and thus the more current driven into the YTF coils. Note that the offset provided by this circuit is only in the positive direction. See Figure 8-112.

The Band 3 Break Point and Negative Current Sink provide additional slope control at higher frequencies where more correction is required. Additionally, the Negative Current Sink is driven directly by the PK DAC signal to sweep the frequency during auto-peaking. The band 3 breakpoint at 18 GHz is controlled by differential amplifier Q10 and diode CR4. The anode of CR4 is at ground potential because of the virtual ground at pin 2 of U1. The values of R25 and R31 have been selected so that the voltage at their junction becomes negative enough to turn on CR4 when the frequency is at 18 GHz. When CR4 turns on, the voltage at U6-2,

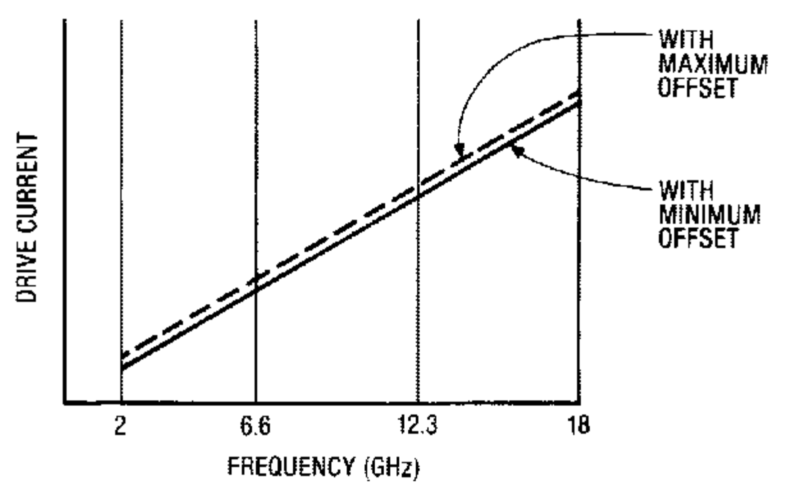


Figure 8-112. Drive Current Variation with Band Offset Switch and Positive Current Source Control

minus the voltage drop across CR4, is routed to the inverting inputs of U1 and U2 through a variable voltage divider formed by potentiometer R51. Op Amps U1 and U2 are configured as inverting amplifiers. Amplifier U1 drives the non-inverting input of U9 and U2 drives the inverting input of U9. In this way Q2 can be driven to either increase or decrease the current through the YTM coil, depending on the setting of R51. This is illustrated in Figure 8-113.

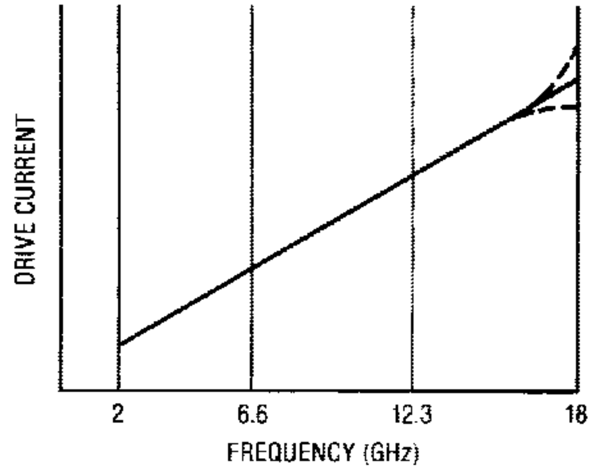


Figure 8-113. Drive Current Variation with Band 3 and 4 Break Points and Negative Current Sink Control

A stable 12.4 Volt reference is provided by the +12.4 Voltage Reference circuit consisting of U10, Q4, and associated components. Amplifier U10 has feedback for both its inverting and non-inverting inputs. Thus, the output of U10 at pin 11 will assume whatever voltage is necessary to balance its two inputs. Potentiometer R8 provides an adjustment. Diode CR1 provides the voltage to initiate the circuit action described above. It is quickly reverse biased and takes no more part in the circuit.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information associated with BD1 and BD5 has been used to isolate a malfunction to YIG Driver Board Assembly A1A7 or YIG Assembly A1A10. It is also assumed that an attempt has been made to correct the problem using the applicable adjustment procedures in Section V. The following procedures may be used to further isolate the problem to a defective component on the affected assembly.

Test Equipment

Digital Voltmeter .... HP 3456A or HP 3455A
Power Meter .... HP 436A
Power Sensor .... HP 8481A
Variable Power Supply .... HP 6200B

Troubleshooting Hints

The results of the adjustment procedures performed in Section V can give you an idea of where the problem is. For instance, if none of the adjustments work, the problem could be the power amplifier, the isolator, the YTM or the main drive components (U3, Q1, and A1Q1) of the YIG Driver Board. In this case start with the Power Amplifier/Isolator Check. This is true also if there is a catastrophic YTM output failure. If there is only a minor degradation of the YTM output, the problem would probably be in the positive current source or negative current sink circuits.

Troubleshooting Procedures

Troubleshooting for Service Sheet 16 is divided into procedures as follows:

A1A11 Power Amplifier/A1AT2 Isolator Check

A1A10 YIG Assembly

- Main Amplifier/Heater Driver
- Bias Buffer

A1A7 YIG Driver Board Assembly

- +12.4 Voltage Reference
- Main Coil Shaping
- Voltage Follower/3 Band Switch
- Band Offset Switch/Positive Current Source
- Band 3 and 4 Break Points/Negative Current Sink

A1A11 Power Amplifier/A1AT2 Isolator Check. In order to properly test the Power Amplifier it should be provided with an input of close to +10 dBm. In order to do this, proceed as follows:

1. Press RCL 0 and ALC DIODE, then set the variable power supply for zero and attach it to the EXT ALC IN port. Polarity is not important because of the absolute value amplifier in the external ALC input circuit.

2. Remove cable A1W4 from the output of High Pass Filter AlFL1. and connect the power meter in its place.

3. Adjust the variable power supply for a reading of +10 dBm on the power meter. Do not change the frequency setting of the Signal Generator after setting this power level.

CAUTION

Do not exceed an output level of ±1 volt from the power supply. To do so could damage the external ALC input circuits.

4. Remove the power meter, then disconnect cable A1W5 from the output of Isolator A1AT2, and connect the power meter in its place.

NOTE

Temporarily removing the high pass filter will facilitate access to the isolator.

5. The power meter should read +23 dBm.

   If the power is as indicated, the power amplifier and isolator are functioning normally, proceed with YIG Assembly Troubleshooting.

   If the power is not as indicated, proceed with Step 6 to isolate between the power amplifier and isolator.

6. Disconnect cable A1W10 from the output of the power amplifier and connect the power meter in its place.

   The power should be +23 dBm.

   If the power is as indicated, the isolator is defective.

   If the power is not as indicated, the power amplifier is defective.

YIG Assembly Troubleshooting

Main Amplifier/Heater Driver Troubleshooting.

1. Connect the DVM to A1A10A1TP2. The voltage should be 14.9 volts.

   If the voltage is as indicated, the YTM heating system is working normally. Proceed with Bias Buffer Check.

   If the voltage is not as indicated, proceed with Step 2.

2. Connect the DVM to A1A10A1TP1.

Pulse Driver A1A4 SERVICE SHEET 15

The voltage should be −4.9 volts.

   If the voltage is as indicated, U1 or Q1 are defective, proceed with Step 3.

   If the voltage is not as indicated, the YTM heating system is defective.

3. Check the biasing on Q1 using the DVM.

   If the biasing is normal (Vbe=0.7V) then U1 is defective.

   If the biasing is not normal, either U1 or Q1 could be defective.

Bias Buffer Check.

1. Press RCL 0 and connect the DVM to A1A10A1TP8.

   The voltage should be −0.8 volt.

   If the voltage is correct, the YTM is properly biased. Proceed with YIG Driver Board Troubleshooting.

   If the voltage is not correct, proceed with Step 2.

2. Connect the DVM to A1A10A1E3.

   The voltage should be −0.8 volt.

   If the voltage is as indicated, U2 is defective.

   If the voltage is not as indicated, recheck the SRD bias voltages per Check (√2▲) of Service Sheet BD5. If the voltages are not correct, remove cable A1W6 from A1A10A1 and check the SRD bias voltages again. If they are still incorrect, go to Service Sheet 19 to troubleshoot the SRD bias circuit. If the voltages are correct with cable A1W6 removed, the YTM is defective.

YIG Driver Board Troubleshooting

Main Coil Shaping Troubleshooting.

1. Set the LINE switch to STBY, then remove cable A1W6 from J2 on the YIG assembly.

2. Connect one lead of the Digital Voltmeter to A1A10A1TP7 (−40V) and the other lead to A1A10A1J2 pin 7 (YIG Tune).

3. Verify that the resistance is about 45Ω. If the resistance measures open or shorted, troubleshoot the A1A10A1 board assembly for open or shorted traces. Otherwise, replace the cable and continue.

4. Set the Signal Generator to the frequencies shown in the table below, and check for the corresponding voltages at A1A7TP3.

Frequency	Voltage at TP3
2.0 GHz	−0.75
8.0 GHz	−2.97
15.0 GHz	−5.6

   If all the voltages are correct, replace the YTM.

   If all the voltages are not correct, the problem is most likely with U3, Q1, or A1Q1. Check the voltages on these components to see which is at fault.

   If some of the voltages are correct, but others are not, the problem is most likely with switch U4, or the inputs to U4. Proceed with Step 5 to check the NBND1—NBND4 and G2—G3 inputs.

5. Refer to Table 8-42. Set the Signal Generator to each of the frequencies shown and check for the corresponding logic level at the input pins indicated.

Table 8-42. YIG Driver Band Control Inputs

XA7-	3.0 GHz	8.0 GHz	15.0 GHz
30	0	1	1
31	1	0	1
32	1	1	0
33	1	1	1
35	0*	1*	0*
36	0*	0*	1*
17	0*	0*	0*
* 0 = −29 volts 1 = −1.5			

SERVICE SHEET 16 (cont'd)

If any of the above readings are incorrect, there is a problem on the SRD Bias Board, Service Sheet 19.

Voltage Follower and 3 Band Switch Troubleshooting.

1. Check the voltage at U11 pins 6 and 3.

   The two voltages should be the same.

   If the two voltages are the same, U11 is functioning normally. Proceed with Step 2.

   If the two voltages are not the same, U11 is defective.

2. Press RCL 0, then connect the DVM to TP2.

3. While observing the DVM, change the setting of R17.

   The voltage at TP2 should not change when R17 is adjusted.

   If the voltage does not change, proceed with Step 4.

   If the voltage does change, Q5 is shorted and should be replaced.

4. Set the Signal Generator frequency to 8 GHz and repeat Step 3.

   If the voltage changes when R17 is adjusted, Q5 is functioning normally.

   If the voltage does not change, Q5 is open and should be replaced.

5. Without changing the Signal Generator Frequency, adjust R18.

   The voltage should not change.

   If the voltage does change, Q6 is shorted.

   If the voltage does not change, proceed with Step 6.

6. Set the Signal Generator Frequency to 15.0 GHz and again adjust R18.

   The voltage at TP2 should change as R18 is adjusted.

   If the voltage changes, proceed with Step 7.

   If the voltage does not change, Q6 is open.

7. Without changing the Signal Generator Frequency, adjust R19.

   The voltage at TP2 should not change.

   If the voltage changes, Q7 is shorted.

   If the voltage does not change, Q7 is functioning normally.

Band Offset Switch/Positive Current Source Troubleshooting

1. Press RCL 0, then connect the DVM to TP5.

2. While observing the DVM, adjust R69.

   The voltage should change as R69 is adjusted.

   If the voltage changes proceed with Step 4.

   If the voltage does not change, proceed with Step 3.

3. Connect the DVM to U7-3 and repeat Step 2.

   The voltage at U7-3 should change when R69 is adjusted. If the voltage does not change, switch U5 is defective.

   If the voltage does change, U7 or Q3 is defective.

4. Repeat Steps 2 and 3 for frequencies of 8.0 and 15.0 GHz while adusting R68 and R67 respectively. In each case, make sure that the switch is checked twice, once when it should be turned on and again when it should be turned off.

Band 3 and 4 Break Points/Negative Current Sink Troubleshooting.

1. Connect the DVM to TP4, and set the Signal Generator Frequency to 18 GHz.

2. While observing the DVM display, adjust R51, R54, and R55.

   The DVM indication should change when R51 is adjusted, but should not change when R54, and R55 are adjusted.

SERVICE SHEET 16 (cont'd)

If the indication is as indicated, proceed with Step 4.

If the DVM indication does not change when R51 is adjusted, proceed with Step 3.

If the indication changes when R54, or R55 are adjusted, U6 is defective.

3. Connect the DVM to the anode of CR4.

   The voltage should be −0.002.

   If the voltage is as indicated, the problem is with U1, U2, U9 or Q2. Check the output voltage of U1 and U2 per the schematic to further isolate the problem.

   If the voltage is not as indicated, proceed with Step 4.

4. Connect the DVM to pin 3 of U6.

   The voltage should be −0.47.

   If the volage is correct, proceed with Step 6.

   If the voltage is not correct, proceed with Step 5.

5. Connect the DVM to the emitter of Q8.

   The voltage should be −10.65.

   If the voltage is correct, check Q10, Q11, and Q12 and associated components.

   If the voltage is not correct, check Q8 and associated components.

6. Connect the DVM to pin 2 of U6.

   The voltage should be −0.47.

   If the voltage is correct, check CR4.

   If the voltage is not correct, U6 is defective.

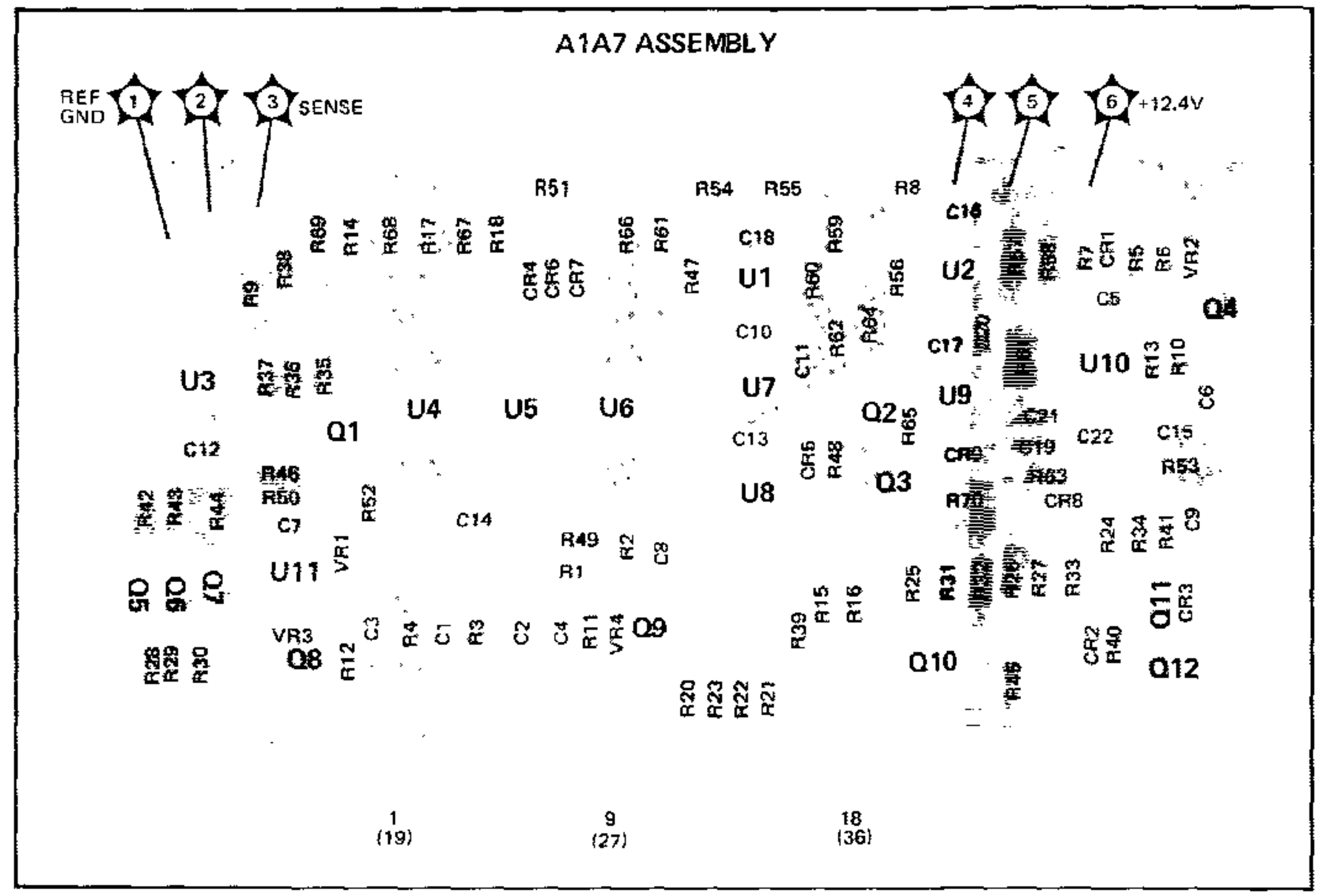


Figure 8-114. A1A7 YIG Driver Assembly Component and Test Point Locations

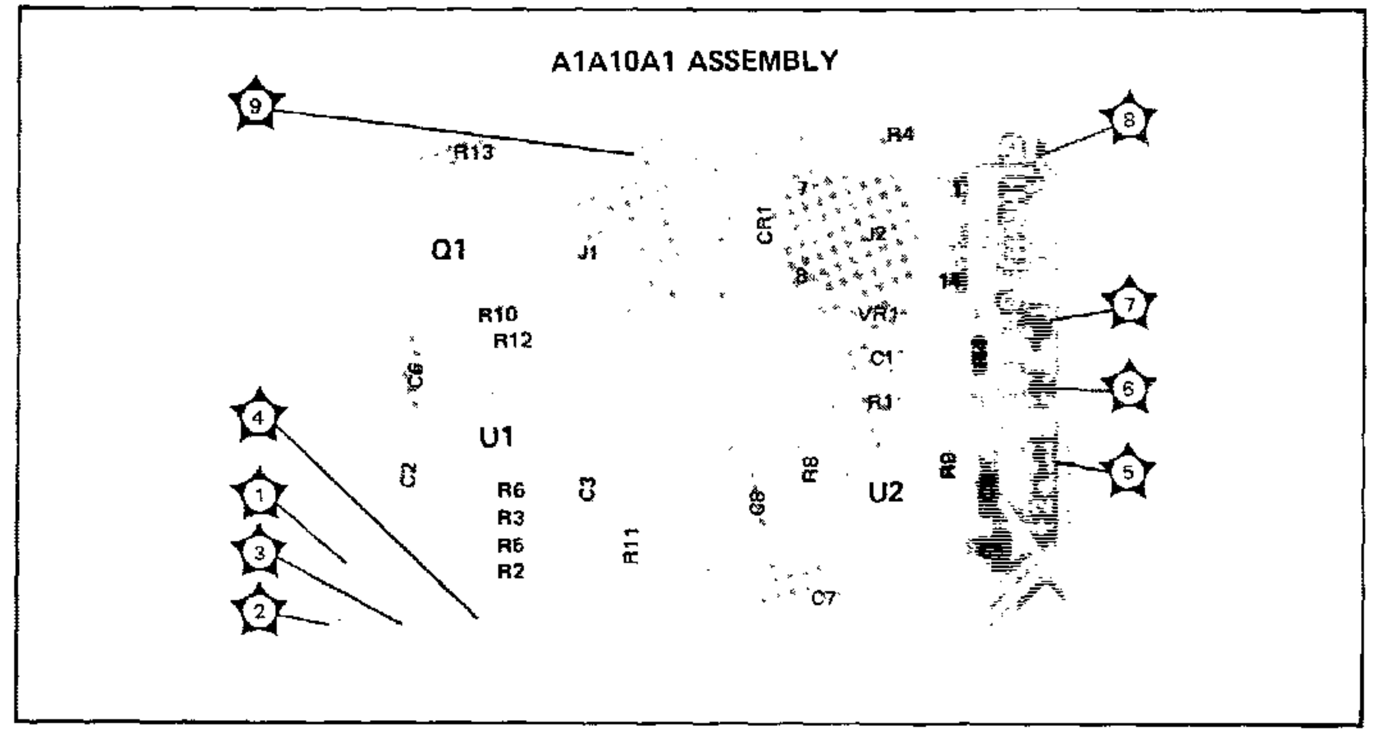
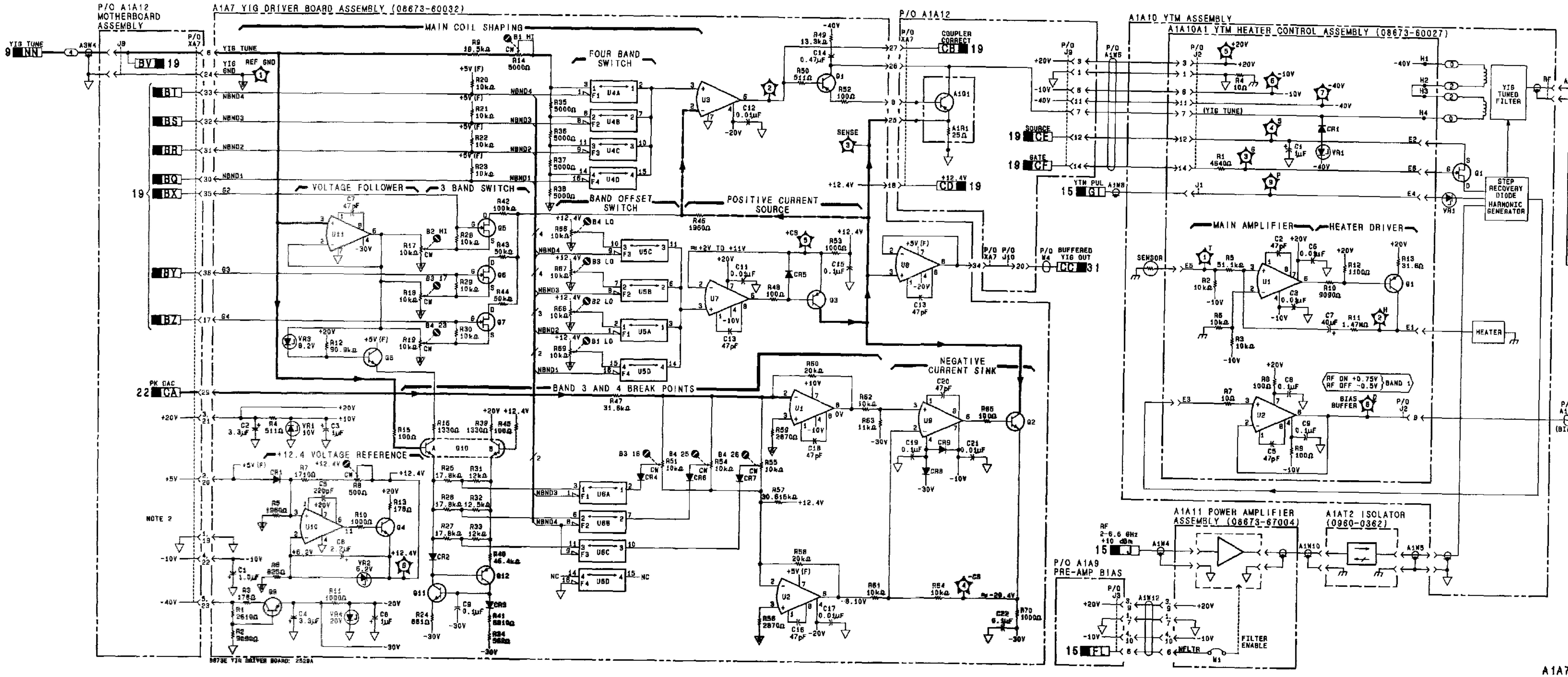


Figure 8-115. A1A10A1 YIG Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE MOTHERBOARD ASSEMBLY ARE SHOWN ON SERVICE SHEET 14.

REFERENCE DESIGNATIONS

A1	A1A10
AT2, Q1, R1, W3, 4-6, 8, 10, 12	Q1, VR1
A1A7	**A1A10A1**
C1-22, CR1-9, Q1-12, R1-70, TP1-6, U1-11, VR1-4	C1-9, CR1, J1, 2, Q1, R1-13, TP1-9, U1, 2, VR1
A1A9	**A1A11**
J3	W1
	A1A12
	J8-10, XA7

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
A1	
Q1	1853-0344
A1A7	
Q1	1853-0462
Q2	1854-0637
Q3, 12	1853-0459
Q4, 8, 11	1854-0810
Q5-7	1855-0020
Q9	1853-0314
Q10	1854-0712
U1, 2, 7-11	1820-0223
U3	1826-0229
U4-6	1826-0582
A1A10A1	
Q1	1853-0314
U1	1826-0059
U2	1826-0025

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U4	+10V - 13
	⏚ - 5
	-20V - 4
U5, 6	+20V - 13
	⏚ - 5
	-10V - 4

16

A1A7, A1A10, A1A10A1, A1A11, A1AT2

Figure 8-116. YIG Driver Assembly Schematic Diagram

SERVICE SHEET 17

DETECTOR ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

Service Sheet 17 depicts the following assemblies:

- Directional Coupler A1DC1
- Detector A1CR1
- Detector Board Assembly A1A2A2

The directional coupler receives the RF signal from the YTM, and sends it to the Attenuator. It also sends a −16 dB signal to the detector. The detector converts the signal to a DC voltage proportional to the power of the RF signal power, and routes it to the Detector Board Assembly.

On the Detector Board Assembly the DC signal is routed through a log amp that converts it to a level proportional to the power of the RF signal in dB. The DC signal is then buffered and routed to the ALC board. A power clamp is provided to speed the amplifier response during pulse operation.

Detector Board Assembly

The Detector Board Assembly consists of the log amp, the power clamp, and the buffer amp. Each is discussed separately below.

Log Amplifier. The log amplifier actually consists of two amplifiers: a DC low frequency amplifier to amplify the leveling signal, and an AC amplifier to amplify the AM and pulse modulation components of the signal. The DC amplifier consists of amplifier U1 and Q12 configured as a non-inverting amplifier. The AC amplifier consists of transistors Q3, Q4, Q5, and Q6 configured as a differential amplifier.

The separate outputs of the two amplifiers are combined in transistor Q7 and routed to the common feedback element consisting of transistor Q8A. The feedback voltage is developed across the parallel combination of R24 and RT1 and routed to the gate of Q4 and the inverting input or U1. Thermistor RT1 provides temperature stabilization for the circuit. Feedback through grounded base transistor Q8A provides the logarithmic response of the amplifier. The second half of Q8 is configured as a simple diode and provides temperature stabilization of the output.

Power Clamp. The power clamp circuit consists of transistors Q1, and Q13A and associated resistors. The clamp sets the minimum voltage level to which the output of the log amp can drop. The voltage at the emitter of Q13A is one diode drop below the voltage at its base (when Q13A is turned on) and also one diode drop below the output of the log amp. Therefore, when the log amp output is at the same level as that set by R21, Q13A starts to conduct. This injects a small negative voltage into the feedback path of the log amp an prevents any further drop in the log amp output.

Transistor Q1 is a switch that is turned off during normal (non pulse) operation, and on during pulse operation. When off, the voltage at the base of Q13A is determined by a voltage divider consisting of R22, R21, and R20. When Q1 is on R20 is shorted by Q1 and the voltage at the base of Q13 increases by about 600 mV dc. In practice, R21 is set for a voltage of −0.56 volt at TP1 in pulse mode. This translates to about −0.11 volt at A1A2A2TP2. This speeds the response of the amplifier by keeping it out of the high gain, narrow bandwidth, slow response operating region.

Buffer Amplifier. The Buffer Amplifier provides amplification and isolation of the Log Amplifier output. It consists of transistors Q9, Q10, Q11, Q2 and associated components. Dual transistor Q9 is a differential amplifier whose output is further amplified by Q10. The output of Q10 goes to emitter follower Q2. The output of Q2 is the BUF output. Part of the output is fed back to Q9 through divider R43/R41 and −10 level adjust network R39 and R40.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1, BD5, and BD6 was used to isolate a malfunction to the A1A2A2 Detector Board Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Pulse Generator	HP 8013B
Oscilloscope	HP 1980B
Digital Voltmeter (DVM)	HP 3456A or 3455A
Power Supply	HP 6200B

Troubleshooting Procedures

1. Remove power from the instrument.
2. Remove the crystal detector from A1A2A2J1 and install the Detector Board on an extender card. Connect the power supply to A1A2A2J1 with the positive lead connected to the center pin of J1, and the negative lead to the outer conductor.
3. Set the output of the power supply tc mVdc. Apply power to the instrument and press RCL 0.
4. Connect the DVM to A1A2A2TP1. The DVM should read 890 mV dc.

   If the voltage is as indicated, the DC section of the Log Amplifier and the Buffer Amplifier are functioning normally, proceed with Step 6 to check the AC portion of the Log Amplifier.

   If the voltage is not as indicated, proceed with Step 5.
5. Connect the DVM to TP2.

   The voltage should be 40 mVdc.

   If the voltage is as indicated, the Buffer Amplifier is defective. Check Q10, Q11, Q2 and Q9.

   If the voltage is not as indicated, check Q12, Q7, and Q8.

   If these transistors check out, the problem is U1.
6. Connect the equipment as shown in Figure 8-117. Set the oscilloscope input to 50Ω.
7. Set the pulse generator as indicated below using the displayed pulse.

Frequency	1 kHz
Amplitude	200 mVdc
Offset	Off
Function	Square Wave

8. Set the oscilloscope controls as indicated in Figure 8-118 and connect the oscilloscope to TP2.

   The waveform should be as shown in Figure 8-118. The low part of the waveform may be unstable, and can be ignored.

   If the waveform is as indicated, the AC portion of the Log Amplifier is functioning normally. Proceed with Step 9 to check the clamp circuit.

   If the waveform is not as indicated in the figure, check Q3, Q4, Q5, and Q6.

YIG Driver and YTM A1A7, A1A10 SERVICE SHEET 16

SERVICE SHEET 17 (cont'd)

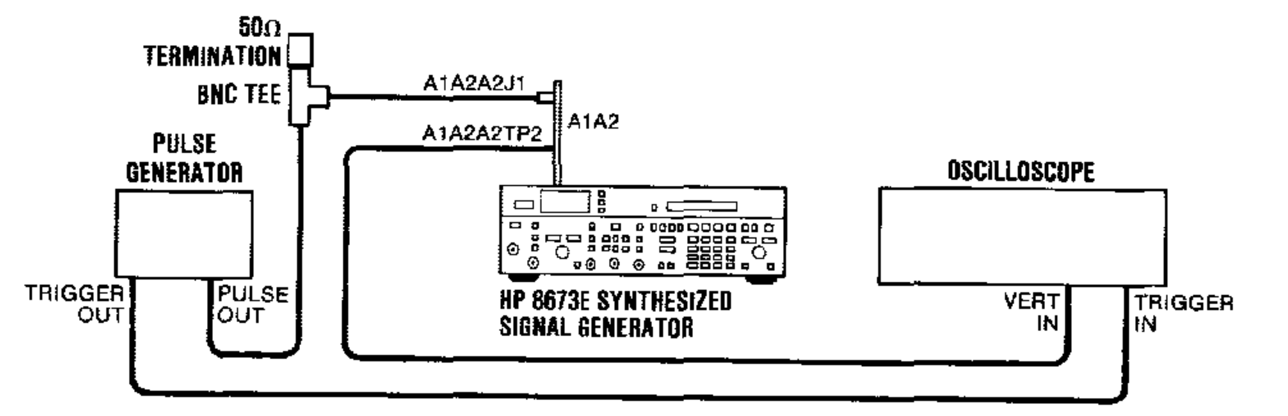


Figure 8-117. Detector Board Assembly Troubleshooting Test Setup

9. While observing the oscilloscope display, press PULSE NORM.

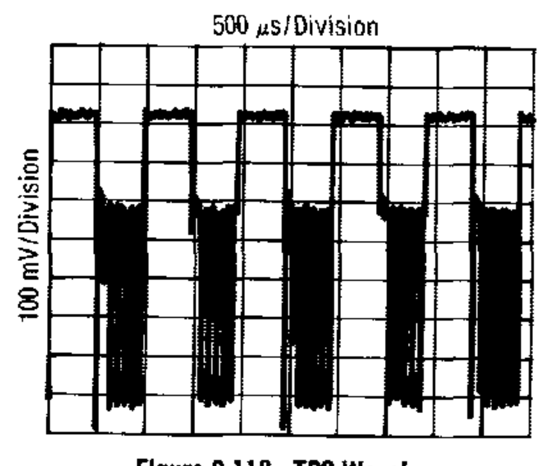


Figure 8-118. TP2 Waveform

The waveform should initially be as shown in Figure 8-118, then change to the waveform shown in Figure 8-119. The low part of the waveform should now be stable.

If the waveform changes as indicated, the clamp is functioning normally.

If the waveform does not change as indicated, proceed with Step 10.

10. Press PULSE OFF and connect the DVM to feedthrough capacitor A1A2C7.

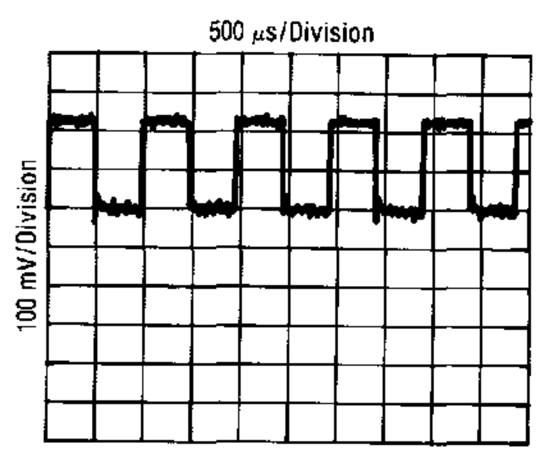


Figure 8-119. TP2 Waveform, Pulse Mode

11. While observing the DVM, press PULSE NORM. The DVM should initially indicate +1.6 volts, then drop to −0.7 volts when PULSE NORM is pressed.

    If the DVM responds as indicated, the clamp circuit is defective, check Q1 and Q13.

    If the DVM does not respond as indicated, proceed to Service Sheet 14 to check the NPLS ON signal.

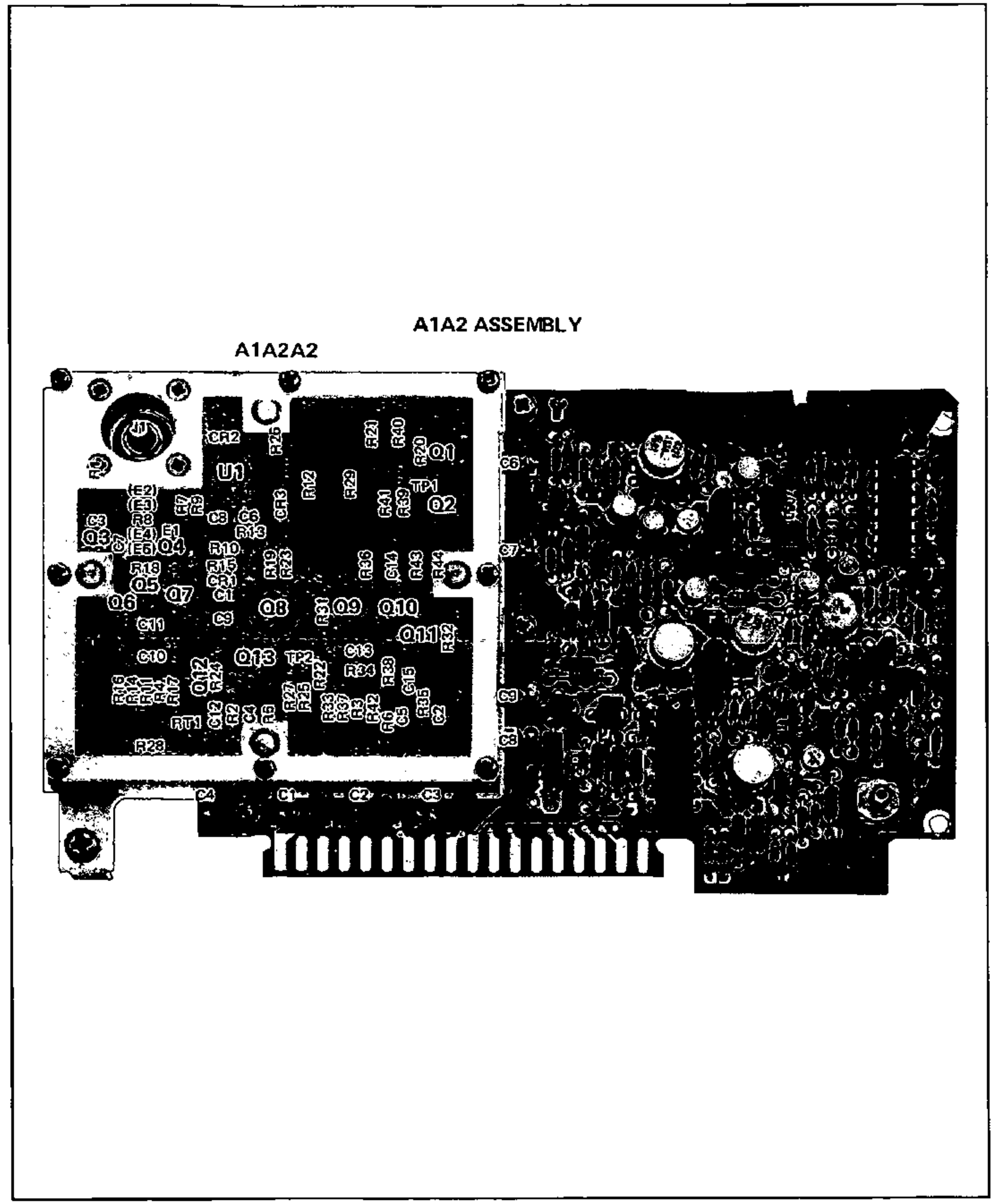
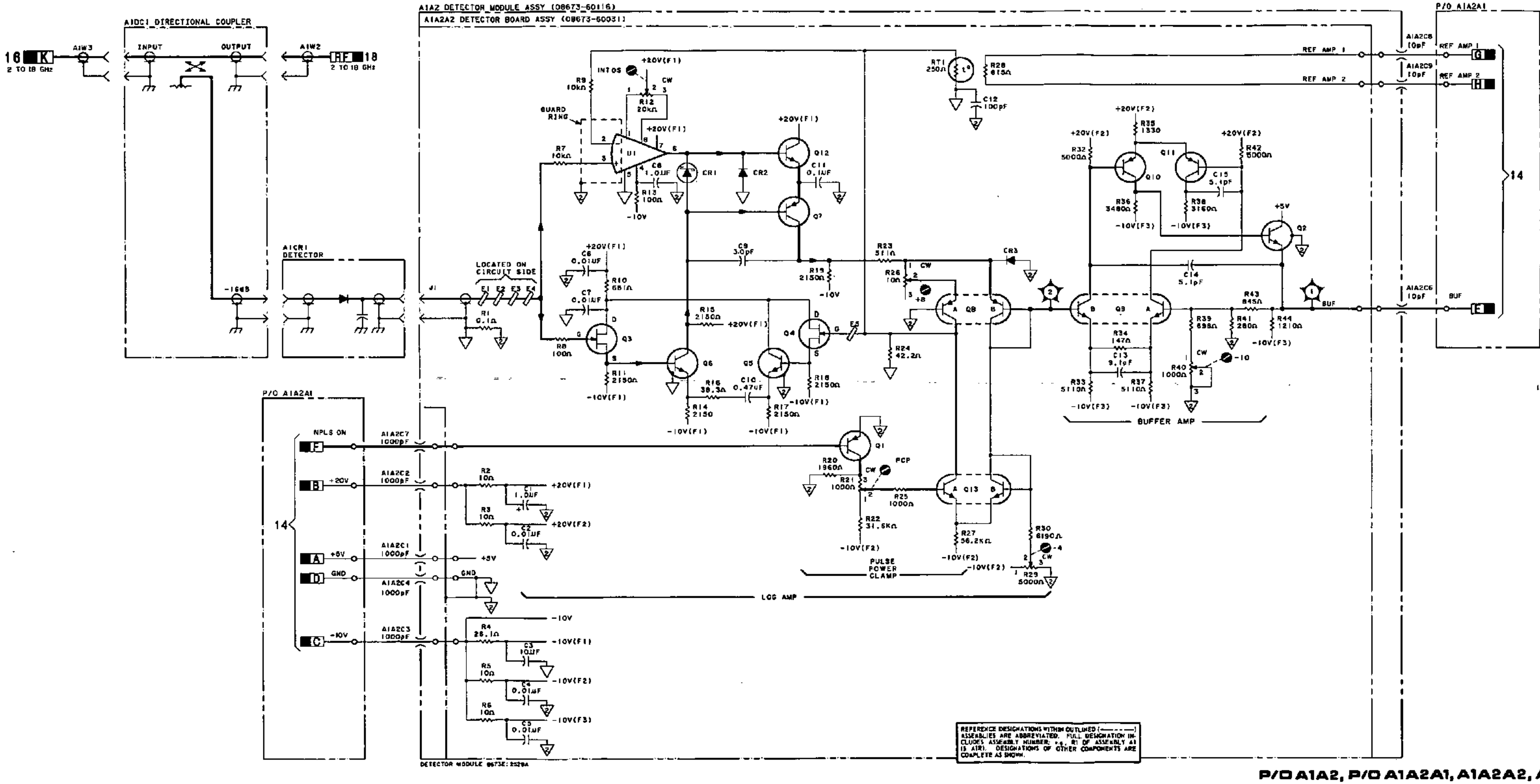


Figure 8-120. A1A2A2 Detector Assembly Component and Test Point Location



NOTES
1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS

A1	A1A2A2 CONT
CR1 DC1 W2,3,15,16,17	TP1,2 U1
A1A2	
C1-4,6-9	
A1A2A2	
C1-15 CR1-3 E1-5 Q1-13 R1-30,31-44 RT1	

A1A2C5 NOT ASSIGNED
A1A2A2,R31 NOT ASSIGNED

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
A1A2A2	
Q1	1853-0459
Q2, 5, 6	1854-0345
Q3, 4	1855-0268
Q7	1853-0405
Q8	1853-0075
Q9	1854-0475
Q10, 11	1853-0451
Q12	1854-0810
Q13	1854-0295
U1	1826-0471

17

P/O A1A2, P/O A1A2A1, A1A2A2, A1CR1, A1DC1

Figure 8-121. P/O Detector Module Assembly Schematic Diagram

SERVICE SHEET 18
ATTENUATOR DRIVER ASSEMBLY
REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
Microwave Signal Path Block Diagram ...... Service Sheet BD5
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION
General

Service Sheet 18 depicts Attenuator Driver Board Asembly A1A1 and Programmable Attenuator A1AT1. The Attenuator Driver Assembly receives data from the Digital Control Unit (DCU) to set the Programmable Attenuator to the selected attenuation level. Data is also received from the DCU to generate control signals for other circuits in the Signal Generator. The Programmable Attenuator is controlled by the DCU to provide 0 to 110 dB of attenuation in 10 dB steps. The attenuator sections that are switched into and out of the signal path for each RANGE are described in the following table.

NOTE

The +10 and 0 dBm ranges are not affected by the Programmable Attenuator. These ranges are controlled exclusively by the Automatic Level Control (ALC) circuit. In these two ranges, all attenuator sections are out of the signal path.

	Attenuator Sections			
RANGE	10 dB	20 dB	40 dB (First)	40 dB (Second)
+10 dBm	Out	Out	Out	Out
0 dBm	Out	Out	Out	Out
−10 dBm	In	Out	Out	Out
−20 dBm	Out	In	Out	Out
−30 dBm	In	In	Out	Out
−40 dBm	Out	Out	In	Out
−50 dBm	In	Out	In	Out
−60 dBm	Out	In	In	Out
−70 dBm	In	In	In	Out
−80 dBm	Out	Out	In	In
−90 dBm	In	Out	In	In
−100 dBm	Out	In	In	In
−110 dBm	In	In	In	In

SERVICE SHEET 18 (cont'd)

Detailed Description

The Attenuator Driver Assembly contains two quad D-type latches, U3 and U6, that receive data from the DCU and latch it under control of enable signals EN1 and EN2 from DAC and Enable Board A1A5. The outputs from Latch U3 are used to drive the Programmable Attenuator.

The outputs from Latch U6 are used to generate various control signals used elsewhere in the Signal Generator. The NORMAL/BYPASS and AMP IN/AMP OUT signals are not used in this Signal Generator. The PLS.(NAM+NSWP) signal is used on the Detector/ALC Board to control certain parameters in the ALC Error Amp circuit while in the pulse mode. The METER HOLD signal is used on the Function Board to stabilize the front panel meter while in the sweep mode.

TROUBLESHOOTING
General

It is assumed that the troubleshooting information on Service Sheets BD1 or BD5 was used to isolate a malfunction to the Attenuator Driver Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Oscilloscope .... HP 1980B
Spectrum Analyzer .... HP 8566B

Attenuator and Drive Troubleshooting

NOTE

These steps check that the attenuator is being driven correctly and that it is switching. Attenuator accuracy is checked in the Output Level Accuracy tests in Section IV, Performance Tests.

1. Remove A1A1 and replace it on a 24-pin extender card.
2. Connect the spectrum analyzer to the RF OUTPUT connector. Press RCL 0. Set output level first to −5 dBm. Then, with the VERNIER only, set output level to 0 dBm as read on the spectrum analyzer. (This ensures that all attenuator sections are out of the signal path at the start of the test.)
3. Using the RANGE down-arrow key, change the output level to the values shown below. The spectrum analyzer indication should decrease 10 dB for each keystroke.

   If there is a failure, troubleshoot the indicated signal paths. The signals are TTL active-high. Therefore, when the LEVEL dBm display indicates −10 dBm, for example, U3-3 and U1-3 should both be high.

Detector Assembly P/O A1A2, P/O A1A2A1, A1CR1, A1DC1 SERVICE SHEET 17

SERVICE SHEET 18 (cont'd)

LEVEL	LATCH OUTPUTS	DRIVER OUTPUTS
−10 dBm	U3-3,2	U1-3,5
−20 dBm	U3-11,10	U4-3,5
−40 dBm	U3-13,14	U5-3,5
−80 dBm	U3-5,6	U2-3,5

Meter Hold Signal

The Meter Hold signal can be verified as follows:

1. Connect the oscilloscope probe to the A1A3 Function Board edge connector at XA3-18 with 3V/division, 1.0 ms/division settings.
2. Press RCL 0 and AUTO SWEEP.
3. A series of pulses between zero and three volts should be seen on the oscilloscope display.
4. If a failure is observed, troubleshoot the signal path on the Attenuator Driver Board.

PLS·(NAM+NSWP) Signal

To verify this signal, connect the oscilloscope probe to A1A1U6-6 with 3V/division, 1.0 ms/division. The signal should be high when RCL 0 is depressed. The signal should go low when PULSE NORM is selected. The signal should pulse high and low when AUTO SWEEP and PULSE NORM are selected.

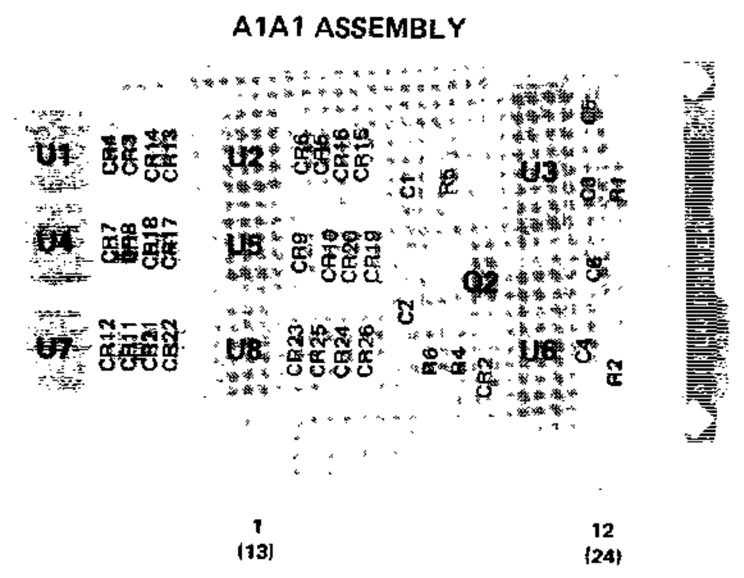
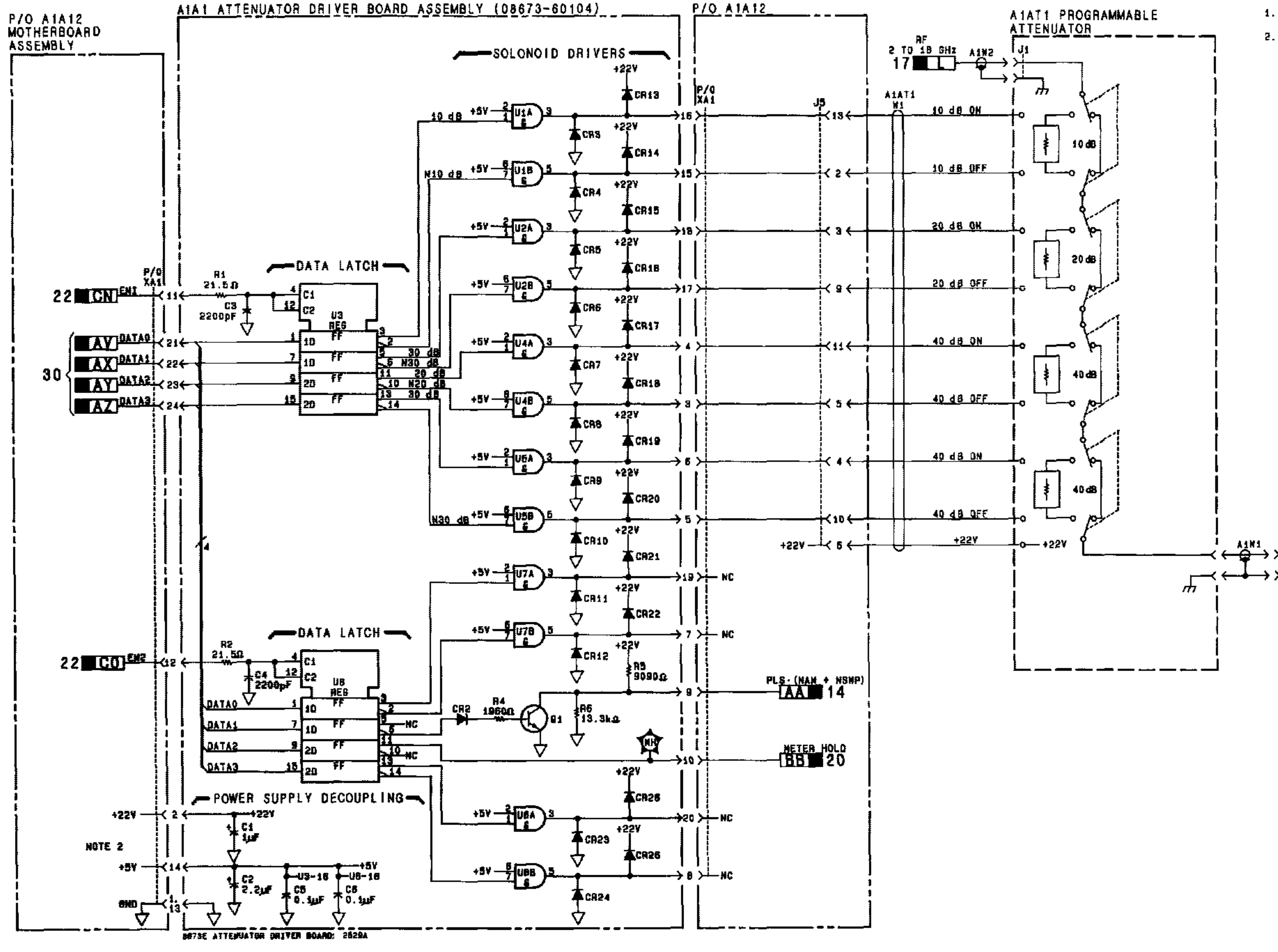


Figure 8-122. A1A1 Attenuator Driver Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE MOTHERBOARD ASSEMBLY ARE SHOWN ON SERVICE SHEET 14.

REFERENCE DESIGNATIONS

A1	A1A12
AT1, AT1W2, W1, 2	J5, XA1
A1A1	A1AT1
C1-6, CR2-16, Q1, R1, 2, 4, 6, TPMH, U1-8	J1, W1
	A4
	J1

A1A1CR1 NOT ASSIGNED

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
Q1	1854-0810
U1, 2, 4, 5, 7, 8	1820-0535
U3, 6	1820-1445

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U1, 2, 4, 5, 7, 8	+5V - 8; ▽ - 4
U3, 6	+5V - 16; ▽ - 8

Figure 8-123. Attenuator Driver Assembly Schematic Diagram

SERVICE SHEET 19

SRD BIAS BOARD ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

The Step Recovery Diode (SRD) Bias Board Assembly performs the following functions:

a. Produces the F Correct signal to the Detector/Automatic Level Control (ALC) Assembly A1A2A1 (Service Sheet 14).

b. Produces the Pulse Amplitude Control (PAC) signal to the Pulse Driver Board A1A4 (Service Sheet 15).

c. Modifies the YIG Tune signals to generate the Source and Gate signals to the YIG Driver Assembly A1A7 (Service Sheet 16).

d. In response to DATA0−3 signals from the Microprocessor, generates band selection control signals BND1−4 and NBND1−4.

NOTE

BND4 and NBND4 lines exist in the Signal Generator but are unused.

e. In response to DATA0−3 signals from the Microprocessor, generates band switch signals G1−3 to the YIG Driver Assembly A1A7 (Service Sheet 16).

F Correct (Flatness Correction) Signal

The F Correct signal is used to improve the output flatness of the Signal Generator by compensating for flatness excursions caused by components such as cables, the crystal detector, the directional coupler and the attenuator. By adjusting the F Correct circuit properly, the output flatness can be improved.

The input to the F Correct circuit, the Coupler Correct signal, comes from the Digital to Analog Converter Assembly A3A5, (Service Sheet 9) via the YIG Driver Assembly A3A6 (Service Sheet 10). The potentiometers associated with the F Correct circuit are adjusted to yield maximum flatness using the procedures described in Section V.

PAC (Pulse Amplitude Control)

The PAC signal is used to generate the YTM Pulse on the Pulse Driver Board A1A4

SERVICE SHEET 19 (cont'd)

(Service Sheet 15) during pulse modulation. The input Bias 2 signal is the output of the PAC DAC on the Digital to Analog Converter (DAC) and Enable Board A1A5 (Service Sheet 22). The PAC circuitry is used to adjust the slope and offset of the signal for Bands 2 and 3 only, since the YIG Tuned Multiplier (YTM) injected pulse is not used in Band 1.

Gate Signal

The Gate circuit drives the gate of the FET in the YIG Assembly A1A10 (Service Sheet 16). The FET is used to bias the Step Recovery Diode (SRD), located on A1A10, for proper YTM performance. The input to the Gate Supply circuit is the buffered YIG Tuned Oscillator (YTO) Tune voltage from the DAC Board A3A5 (Service Sheet 9). The Gate circuitry adjusts the YTO Tune signal for offset and gain slope.

Source Signal

The Source circuitry establishes a bias for the SRD FET for each one of the three frequency bands. The bias is constant within each band. Each frequency band has a separate voltage adjustment that allows the source voltage to be set to its optimum setting. Between the Gate voltage and the Source voltage the SRD FET is biased for optimum performance in each frequency band.

Band Selection

The Band Logic latch U5 latches Data 0−3 signals from the data bus and generates BND1−4 and NBND1−4 signals for distribution to the Pulse Driver, YIG Driver and Metering Control Assemblies.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1, BD5, BD6, or BD7 was used to isolate a malfunction to the SRD Control Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM) .... HP 3456A or 3455A
Signature Analyzer .... HP 5005A/B or 5006A

Band Logic Latch

The Band Logic Latch is checked with a signature analyzer.

1. Set the LINE switch to STBY and disconnect the power cord.
2. Set the diagnostic switch A2A8S1 to position 5.
3. Connect the MPU Test Board (from the HP 11726A Service Kit) to the top of A2A8.

SERVICE SHEET 19 (cont'd)

4. Place the SRD Bias Board on an extender and install it in the instrument.
5. Install a shorting clip between A2A8TP5 and the adjacent TP GND.
6. Connect the signature analyzer as follows:

Signature Analyzer Timing Pod	A2A8 Microprocessor Test Point
START	TP4
STOP	TP4
CLOCK	TP3
GND	TP GND

7. Set the signature analyzer pushbuttons as follows:

   START — OUT (positive edge)
   STOP — IN (negative edge)
   CLOCK — IN (negative edge)
   HOLD — OUT (not activated)
   SELF-TEST — OUT (not activated)

8. Install the Generator's power cord and set the LINE switch to ON.

CAUTION

Do not leave the Signal Generator in this mode any longer than necessary. To do so would cause excessive wear on several relays that are heavily exercised in this mode.

9. Verify the FREQUENCY MHz display indicates 05-1.
10. Touch the signature analyzer to +5V and verify the signature is C37F.
11. Verify the signatures in Table 8-43. If there are any incorrect input signatures, troubleshoot the I/O Assembly shown on Service Sheet 30 and its related interconnections.

    If there are any incorrect output signatures, troubleshoot the associated circuitry of the SRD Bias Board.

Logic Level Converter

1. Place the SRD Bias Board on an extender and install it in the instrument.
2. Using a Digital Voltmeter, measure the logic levels at the pins indicated in Table 8-44.
3. If any abnormalities are noted, troubleshoot the associated circuitry.

SERVICE SHEET 19 (cont'd)

Table 8-43. Band Logic Latch Signatures

PIN NO.	SIGNATURE	MNEMONIC
U5 - 1	8958	DATA0
2	UHPP	NBND1
3	4P92	BND1
4	8319	EN 3
5	2PF9	BND3
6	9HC5	NBND3
7	9F1C	DATA2
8	0000	GND
9	39P1	DATA3
10	A0H6	NBND4
11	13AA	BND4
12	8319	EN 3
13	4AC9	BND2
14	U9F5	NBND2
15	U194	DATA1
16	C37F	+5V

Table 8-44. Logic Level Converter Voltages

SIGNAL	XA8 PIN NO.	BAND			
		1	2	3	4
NBND2*	27	H	L	H	H
NBND3*	28	H	H	L	H
NBND4*	29	H	H	H	L
G2**	17	L	H	L	L
G3**	18	L	L	H	L
G4**	35	L	L	L	H

* TTL Levels: $H \geq +2V$, $L \leq +0.8V$ ** ECL Levels: $H \approx -1V$, $L \approx -29V$

FET Gate and FET Source Supplies

Troubleshooting of the Source and Gate signals are very similar. To troubleshoot these signals, proceed as follows:

1. Refer to the SRD BIAS label on the bulkhead of the A2 section, a typical example of which is shown in Figure 8-124.
2. Set the Generator to 6.7 GHz (low end of Band 2). With the DVM, measure the voltages at TP1 (SOURCE) and TP2 (GATE). The voltages should be as shown on the label plus or minus 0.001 Vdc.
3. Set the Generator to 12.29999 GHz (high end of Band 2). Repeat Step 2.

SERVICE SHEET 19 (cont'd)

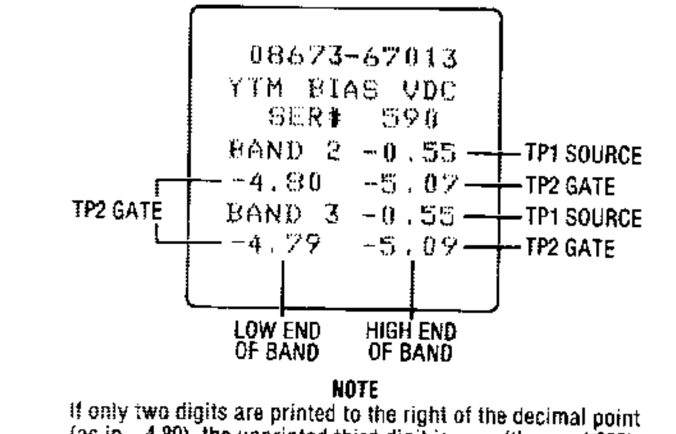


Figure 8-124. YTM Bias Label

NOTE

On the label, if only two digits are printed to the right of the decimal point (such as the −4.80 Vdc in the figure), the unprinted third digit is zero (thus, −4.800 Vdc).

4. Set the Generator to 12.31 GHz (low end of Band 3). Repeat step 2.
5. Set the Generator to 18.6 GHz (high end of Band 3). Repeat step 2.

Source Supply Problems. If the steps above indicate there is a problem with the Source signal, perform the following steps.

6. If there is a fault in only one band, troubleshoot the appropriate band switch.
7. If there is a fault in all bands perform the following steps in the order given:

   a. Check the voltage at U3-14, which should be approximately +12.4V. If not, troubleshoot U3D.

   b. Check the voltage at A1A8TP1 and vary the potentiometer B2 or B3 (appropriate to the operating band) to verify that the voltage at U3-7 varies with the setting of the potentiometer. If no variation is seen, troubleshoot U3 and Q5.

Gate Supply Problems. If the steps above indicate there is a problem with the Gate signal, perform the following steps.

8. If there is a fault in one band only, troubleshoot the associated band switch.

SERVICE SHEET 19 (cont'd)

9. If there is a problem in both bands, check the following in the order given:

   a. Check the voltage at U3-14 which should be approximately +12.4V. If not, troubleshoot U3D.

   b. Compare the input YIG TUNE voltage at XA1A8-10 with the voltage at A1A8TP4. These voltages should be approximately equal. If not, troubleshoot U9 and Q11.

   c. Check the voltage at U3-8. It should be approximately equal to the YIG TUNE signal at XA1A8-10 plus 10.13V. If not, troubleshoot U3C.

   d. Compare the voltage at U2-14 and that at U3-3 in Band 2 or 3. They should be approximately equal. If not, troubleshoot U3A and Q6.

PAC Troubleshooting

If the PAC signal is defective in only one band, troubleshoot the associated band switch. If the PAC signal is defective in all bands perform the following steps:

1. Compare the voltages at XA8-30 and U7-1. The voltage at U7-1 should be approximately two times that at XA8-30. If not, troubleshoot U7 and associated circuitry.
2. Check the voltage at U7-7 and verify that it varies as the slope adjust potentiometer B2 or B3 is varied. If the voltage does not vary, troubleshoot U7B and associated circuitry. If the voltage does vary, troubleshoot Q7 and associated circuitry.

F Correct

If the F Correct signal is defective in only one band, troubleshoot U8A and U8B and associated circuitry. If the F Correct signal is defective in several bands, set the output frequency to those values shown in Table 8-45 and observe the signal at XA8-15 while the indicated potentiometer is varied. If a variation of the signal is not seen, troubleshoot the circuitry indicated.

Table 8-45. F Correct Fault Location

Frequency (GHz)	Potentiometer	Circuitry
3	R55 "2"	Q3
16	R82 "14"	Q4
18.6	R67 "18"	Q2,U1B

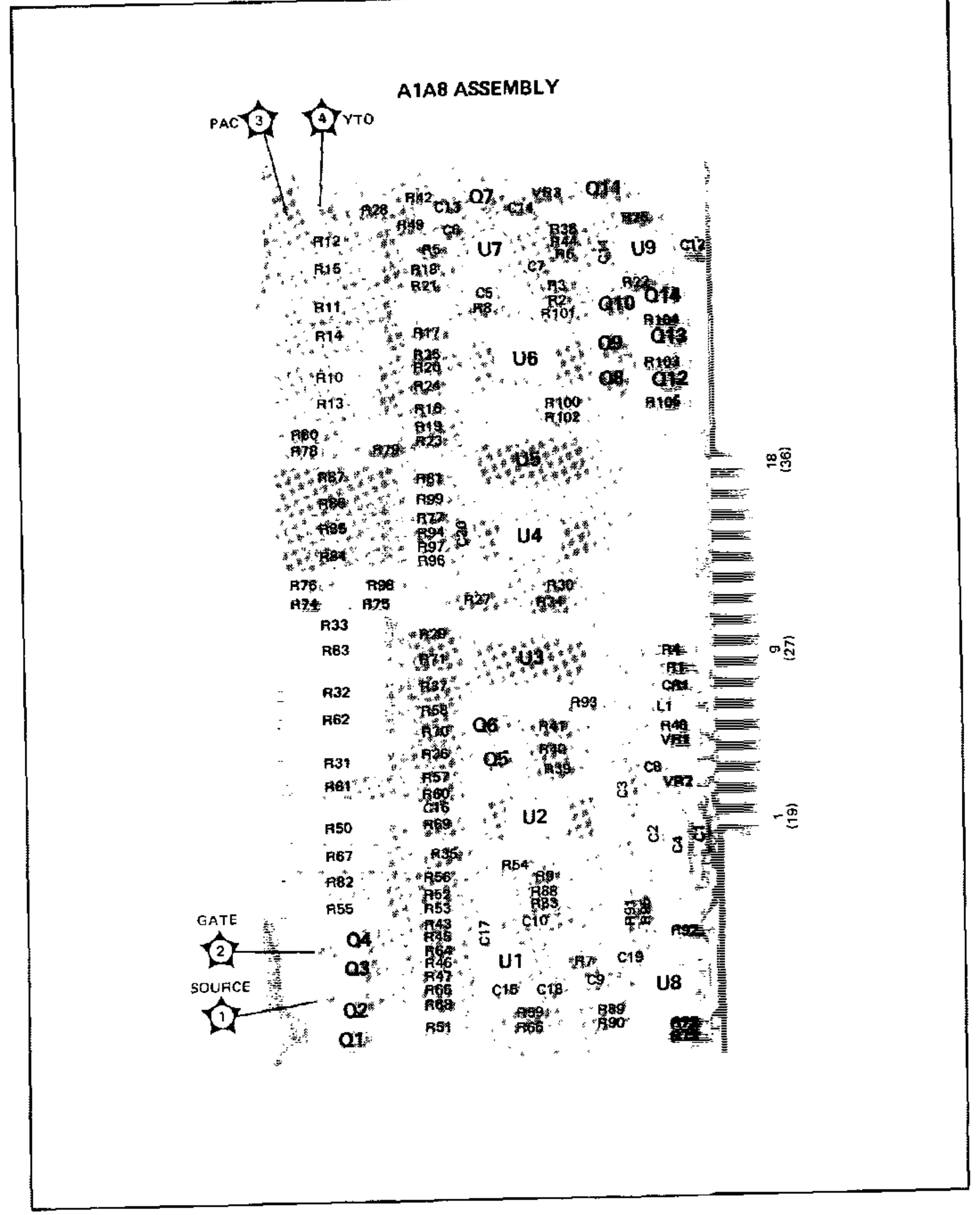


Figure 8-125. A1A8 Bias Assembly Component and Test Point Locations

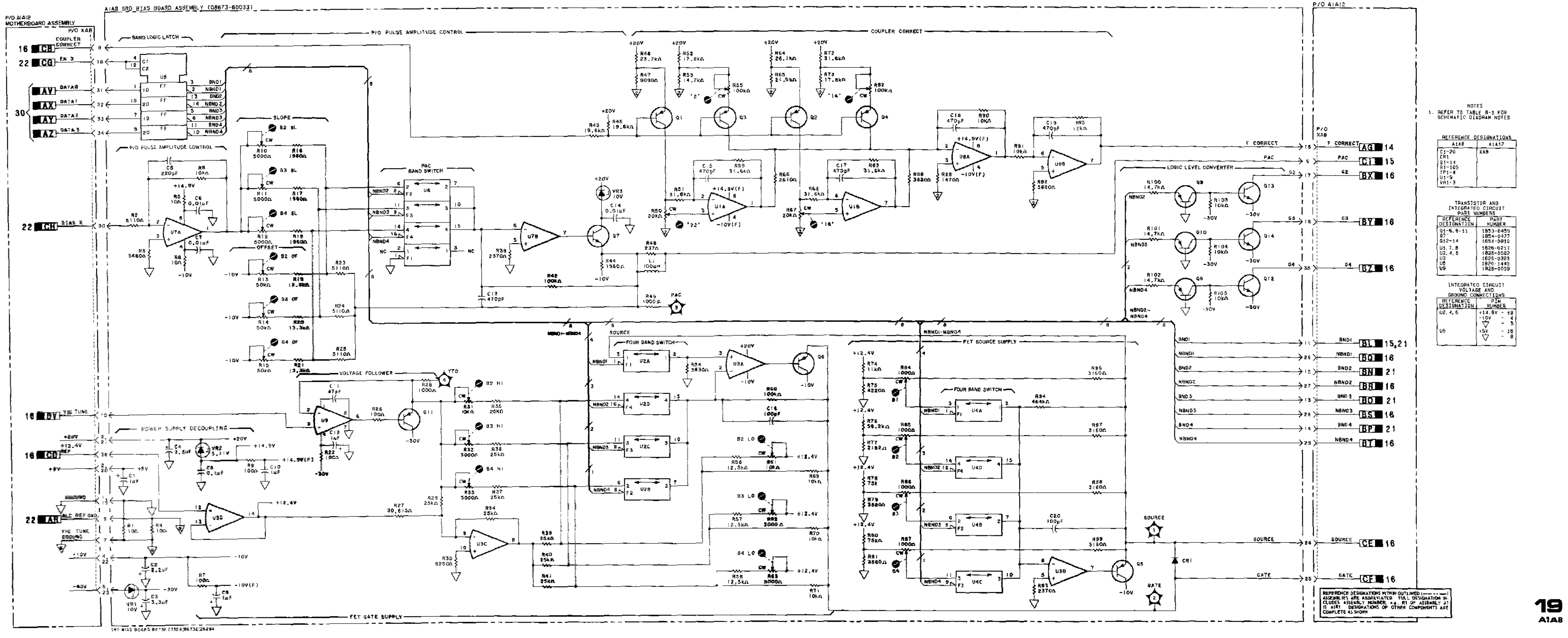


Figure 8-126. SRD Control Assembly Schematic Diagram

SERVICE SHEET 20
FUNCTION BOARD ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

The Function Board Assembly contains circuits to perform seven independent functions, as described below.

- Latches — Used to latch control signals from the Digital Control Unit (DCU) for use on this Service Sheet and on Service Sheet 14.
- Unleveled Detector — Monitors the ERAMP signal from the ALC Board Assembly, Service Sheet 14, to detect Automatic Level Control (ALC) unleveled condition. Sends LEV signal to the DCU.
- Meter Level — Drives the front panel meter when in LVL mode, based on ALC REF input from the front panel VERNIER control. Has provision for holding meter steady during sweep.
- External ALC — Amplifies and conditions the external ALC input and routes it to the ALC Board Assembly, Service Sheet 14.
- AM — Amplifies and conditions the AM input signal and routes it to the ALC Board Assembly, Service Sheet 14.
- Power Clamp — Used to clamp band 1 signal during external ALC operation to prevent over-driving of the YIG Tuned Multiplier (YTM).
- Peaker — Hardware used by the DCU for the Auto Peaking function.

Latches

These consist of quad D-type latches U10 and U11. The enable signals EN5 and EN4 from the DAC (Digital to Analog Convertor) and Enable Assembly, Service Sheet 22, latch the four data bits, Data 0—4 into U10 and U11 respectively. Individual control signals are discussed in connection with the circuits they control.

SERVICE SHEET 20 (cont'd)

Unleveled Detector

The Unleveled Detector consists of dual comparator U7 configured as a window detector. Anytime the ERAMP signal is between 0 and 320 mV, U7 output is low and Q14 is off, making LEV high. If the ERAMP signal should fall below zero volts (ALC unleveled) or rise above 320 mV (modulating pulses too narrow) U7 output goes high and turns Q14 on. This drives LEV low which signals the DCU that an unleveled condition exists. Back-to-back zener diodes, VR4 and VR5, limit input to U7 to aproximately ± 4 volts to prevent damage to U7.

Meter Level

The Meter Level circuit consists of operational amplifier (op amp) U3 configured as a voltage follower with Q9 providing the necessary current drive for the meter. Three inputs are summed into U3 through FET switch Q2, ALC REF, ERAMP, and +20V. During normal operation, with the ALC loop leveled, the ALC REF input is a dc voltage between 0 and −7 volts depending upon the setting of the front panel VERNIER control, the ERAMP signal is approximately +160 mV, and FET switch Q2 is on. The +20 volts offsets the negative ALC REF input to a positive level. Thus, during normal operation, the meter is controlled by the front panel VERNIER control.

If the ALC loop is unleveled, the ERAMP voltage goes negative when the front panel VERNIER control is turned clockwise. This negative-going ERAMP voltage exactly conteracts the positive-going ALC REF voltage. Thus, the meter does not move.

The METER HOLD signal is used only during sweep to keep the meter from moving erratically. The signal goes high each time the output frequency is stepped. This turns Q2 off to stop input to U3. Capacitor C34, at the input to U3, retains the input level when Q2 is off.

External ALC

The External ALC circuit amplifies the external ALC input and conditions it so that it is proportional to the output power in dB. It consists of an input amplifier, an absolute value amplifier, a log amplifier, two buffer amplifiers, and five FET switches.

Input amplifier U14 is a non-inverting amplifier whose gain is controlled by the front panel CAL potentiometer. This allows the user to calibrate the front panel LEVEL meter to read true output power. The absolute value amplifier consists of op amp U15 and diodes CR2 and CR3. The output of this amplifier is negative whether the input is positive or negative. This is necessary because the Log Amplifier operates on negative inputs only.

The Log Amplifier consists of op amp U13 and dual transistor Q13. Op amp U13 is configured as an inverting amplifier with one half of Q13, in its feedback path. The exponential relationship between the

SERVICE SHEET 20 (cont'd)

voltage at the emitter of Q13A and the emitter-collector current of Q13A causes the output at the emitter of Q13A to be logarithmic with respect to the input to U13. The second half of Q13 is connected as a diode (base and collector joined) and provides temperature stabilization for the log amp. Diode CR8 limits the output to about −1.2 volts to protect U12. Schottky diode CR5 provides feedback to U13 when Q13A is turned off because the output is below about 0.6 volts.

Amplifier U12 boosts the INT ALC signal to the proper level for summing the signal with the AC coupled PWR PEAK IN signal. This signal is the same as the BUF OUT signal from the buffer amplifier in the Detector assembly. By AC coupling this signal into the EXT ALC signal, the loop is stabilized and the loop response is speeded up.

FET switches, Q10, Q15, and two switches in U8, are used to switch between internal and external ALC. The remaining switch is controlled by the signal XTAL to switch the two 2.2 μF capacitors into the PWR PEAK IN line when a power meter is being used for the external reference. This speeds up the loop response even more to compensate for the slow response of power meters.

AM

The AM circuit consists of a 30 to 100% Range Change circuit, a log amplifier, switches, and a driver amplifier. These circuits are used to adjust the level and change other characteristics of the AM signal prior to summing it into the ALC loop.

The 30 to 100% Change circuit consists of transistor switches Q11 and Q12 controlled by the AM 30% signal through switch U4B. When the AM 30% signal is high, Q12 is turned on and the AM IN signal is attenuated by R25 and R26.

The log amplifier consists of op amp U6 and dual transistor Q5. Its operation is identical to that of the log amp in the external ALC circuit described above. It is used to make the AM signal compatible with the other signals (BUF OUT and BUF EXTERNAL ALC) that are summed into the ALC loop.

Switch U4A routes the output of the log amplifier to the driver amplifier when the active high AM ON signal is active. When the AM ON signal is inactive, the input to the driver amplifier is grounded.

The driver amplifier provides the power necessary to drive the ALC modulator. It consists of dual transistor Q3, op amp U5 and transistor Q4. The differential amplifier formed by Q3 provides about 20 dB of gain at the input to U5. This has the effect of increasing the loop bandwidth of U5 so that AM rates up to 200 kHz can be used. Transistor Q4 provides the amplification needed to drive the ALC loop summing junction.

SERVICE SHEET 20 (cont'd)

Power Clamp

The Power Clamp is used to reduce the power of the signal from the YIG Tuned Oscillator (YTO) in band 1 (2—6.6 GHz) while in external ALC. This is done to prevent squegging of the YIG Tuned Multiplier (YTM) in band 1 caused by too much power being applied to the YTM. The signal INT ALC turns the Power Clamp off when the unit is operating in internal ALC. The two signals HN1 and HN2 form a digital signal that specifies what band the unit is operating in, as follows:

Band	HN1	HN2
1	0	0
2	1	0
3	0	1

Peaker

The Peaker circuit is used by the DCU to perform the peaking algorithms. It consists of quad op amp U2 FET switch Q8, and associated components.

The PEAK PWR IN signal, which is a dc level corresponding to the Signal Generator's output power in dB, is buffered by U2A and applied to comparator U2D and switch Q8. The SAMPLE POWER signal from the Latch, is used by the DCU to turn on switch Q8. This charges capacitor C32 to the same dc level as the PEAK PWR IN signal and serves as a reference to the second input of comparator U2D through U2C. Resistors R86 and R87 apply an offset voltage equivalent to a 3 dB change to comparator U2D when the PEAK PWR signal is active. With the 3 dB offset applied, the output of U2D is low if the level at U2D-12 (the buffered PEAK PWR IN signal) is 3 dB or more below the reference set on C32, and high otherwise.

In operation, the DCU turns Q8 on long enough to charge C32. It then activates the 3 dB offset and, using the Peaker DAC on the DAC and Enable Board, tunes the YTM frequency up and down until the two 3 dB down points have been located. The peak is then halfway between the two. The use of this algorithm assumes that the YTM is close to its peak when the algorithm begins. If the algorithm fails, the DCU removes the 3 dB offset and uses a coarse tuning algorithm to get the YTM close to its peak, and tries again. If it still fails, the DCU issues the Auto Peak failure message, Error Message 90.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1 and BD6 was used to isolate a malfunction to the Function Board Assembly. It is also assumed that an attempt has been

SERVICE SHEET 20 (cont'd)

has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter (DVM) .... HP 3456A or 3455A
Oscilloscope .... HP 1980B
Power Supply .... HP 6200B
Signature Analyzer .... HP 5005A/B or 5006A
Test Oscillator .... HP 3335A

Latches

This procedure should be used if it is suspected that one of the control signals latched into U10 or U11 is malfunctioning. The problem could be in U10 or U11, the signals EN4 or EN5 from the DAC and Enable Board, or a broken trace on the mother board. Signature analysis is used to isolate the problem as quickly as possible. Proceed as follows:

1. Set the LINE switch to STBY.
2. On Microprocessor Assembly A2A8, set Diagnostic Switch A2A8S1 Kit to the top of the Microprocessor Assembly A2A8.
3. Connect the MPU Test Board from the HP 11726A Service Kit to the top of the Microprocessor Assembly A2A8.
4. Install a shorting clip between A2A8TP5 and the adjacent GND.
5. Connect the signature analyzer as follows:

Signature Analyzer Timing Pod	A2A8 Microprocessor Test Point
START	TP4
STOP	TP4
CLOCK	TP3
GND	TP GND

6. Set the signature analyzer pushbuttons as follows:
   START—leading edge
   STOP—trailing edge
   CLOCK—trailing edge
7. Remove A1A3 and replace it on a 44-pin extender card.
8. Set LINE switch to ON.

SRD Bias Assembly A1A8 SERVICE SHEET 19

SERVICE SHEET 20 (cont'd)

CAUTION

Do not leave the Signal Generator in this mode any longer than necessary. To do so would cause excessive wear on several relays that are heavily exercised in this mode

9. Verify the FREQUENCY MHz display indicates 05-1.
10. Touch the signature analyzer probe to +5V and verify the signature is C37F.
11. Check the signatures shown in Table 8-46.

    If all of the signatures are correct the Latches are working normally, and any problems with control signals are probably a result of broken traces.

    If any of the signatures are incorrect, proceed with Step 13.

Table 8-46. U10, U11 Output Signatures

Pin	Signature	Signal
U10-5	4258	PEAK PAR
U10-3	H101	AM 30%
U10-13	8PCA	AM SWP ON
U10-11	H0HA	SAMPLE POWER
U11-5	F16P	INT ALC
U11-6	7212	EXT ALC
U11-3	C3C6	PWR MTR
U11-13	AF90	HN1
U11-11	3H32	HN2

12. Check the signatures shown in Table 8-47.

    If all the signatures are as shown, U10 or U11 is faulty, depending on which had incorrect signatures in Step 12.
    If one or both of the enable lines (EN4 and EN5) signatures are incorrect, proceed to Service Sheet 22 to troubleshoot the Enable Decoder circuit.

    If any of the data input lines (DATA 0—3) signatures was incorrect, proceed to Service Sheet 30 to isolate the problem.

Table 8-47. U10, U11 Input Signatures

Pin	Signature	Signal
U10-4,12	09C6	EN5
U11-4,12	4C1C	EN4
U10-7	8958	DATA 0
U10-1	U194	DATA 1
U10-15	9F1C	DATA 2
U10-9	39P1	DATA 3

Unleveled Detector

This procedure should be used if the ALC UNLEVELED annunciator does not come on when it should, that is, external ALC selected with no external ALC input, or a 50 ns or narrower pulse applied in pulse mode. It is assumed that the incandescent bulb has been checked.

13. Connect the test equipment as shown in Figure 8-127.
14. Remove A1A2 and set it aside temporarily.

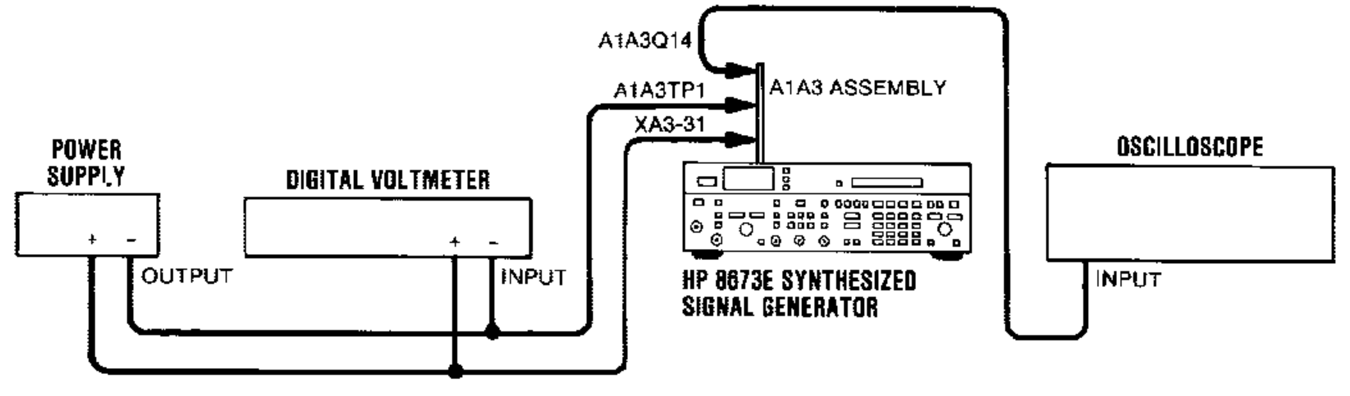


Figure 8-127. Unleveled Detector Test Setup

SERVICE SHEET 20 (cont'd)

15. Remove A1A3 and replace it on a 44-pin extender card.

16. Set the power supply for zero volts as read on the DVM. Then connect the positive lead to XA3-31 and the negative lead to A1A3TP1.

17. Connect the oscilloscope to the collector of Q14.

18. Set the power supply output voltage for 200 mV as read on the DVM.

19. While observing the oscilloscope display, slowly decrease the power supply output voltage, using the fine adjustment, if available.

    The oscilloscope display should show a TTL high (>+3 volts) when the power supply is at 200 mV, and drop to zero when the DVM reading is 10 mV or less.

    If the oscilloscope display is as indicated, the Unleveled Detector is working normally and the fault is in the DCU. Proceed to Service Sheet 25 to begin isolating the fault.

    If the oscilloscope display is not as indicated, proceed with Step 20.

20. Leave the power supply connected as in Step 16, move the oscilloscope to U7-9, and reduce the power supply voltage to zero as read on the DVM.

21. While observing the oscilloscope display, slowly increase the power supply voltage, using the fine adjustment if available.

    The oscilloscope display should be at zero when the power supply is at 10 mV. It should then rise to about +4 volts when the DVM reading is 320 mV ±10%.

    If the display is as indicated, Q14 is defective and should be replaced.

    If the indication is not as indicated, U7 is defective. Before replacing U7 check VR4 and VR5 per Step 23. If one or both are bad, they could be the reason U7 is bad.

22. Move the oscilloscope to U7-9 and reduce the power supply output to zero as read on the DVM.

23. While observing the oscilloscope display, slowly increase the power supply voltage, using the fine adjustment, if available.

    The oscilloscope display should be at +4V when the power supply is at zero and drop to 0 volts when the DVM reading is 10 mV or more.

    If the display is as indicated, Q14 is defective and should be replaced.

    If the display is not as indicated, U7 is defective. Before replacing U7 check VR4 and VR5 per Step 12. If either is defective, it could be the reason U7 is bad.

24. If not already connected, connect the positive lead from the power supply to XA3-31 and the negative lead to A3A1TP1. Set the power supply to zero as read on the DVM, and connect the oscilloscope to U7-3.

25. While observing the oscilloscope display, gradually increase the power supply output voltage.

    The oscilloscope display should increase as the power supply voltage is increased until it reaches about 4.6 volts, at which point the oscilloscope display will stop increasing.

    If the display does not rise above about 0.7 volts, VR4 is shorted and should be replaced before replacing U7.

    If the display does not rise above about 3.6 volts, VR5 is shorted and should be replaced before replacing U7.

    If the display continued to rise above 4.6 volts, either VR4 or VR5, or both, are open. Replace both before replacing U7.

    If the indication is normal, both VR4 and VR5 are operating normally and U7 may be replaced.

Meter Level

This procedure can be used for meter problems in the level mode, that is, MTR LVL key pressed. There are two failure modes: the meter does not respond to the VERNIER control, and the meter responds normally to the VERNIER control but is not steady during sweep.

SERVICE SHEET 20 (cont'd)

Meter Not Steady During Sweep.

26. Remove A1A3 and replace it on a 44-pin extender card.

27. Connect the oscilloscope to XA3-18, press RCL 0, press SWEEP MODE SINGLE twice, and observe the oscilloscope display.

    If the display is as indicated, check Q6, Q7, and associated components.

    If the display is not as indicated, proceed to Service Sheet 18 to troubleshoot Data Latch U6.

Meter Does Not Respond to VERNIER Control.

28. Remove A1A3 and replace it on a 44-pin extender card.

29. Press MTR AM. This isolates the meter circuit on Service Sheet 40 from the Meter Level circuit.

30. Connect the DVM to the collector of Q9 and observe the DVM display while turning the VERNIER control from full CCW to full CW.

    The DVM indication should vary as shown below:

CCW	+8.8V
CW	+1.7V

    If the DVM indication is as indicated, the Meter Level circuit is working normally and the problem is with the meter circuit. Proceed to Service Sheet 21 to isolate the problem.

    If the DVM indication varies, but the range is not as indicated above, either the Meter Level circuit needs adjustment, or the meter level bias circuit on Service Sheet 21 is defective. First proceed to Section V to adjust MET CAL. If it cannot be adjusted, proceed to Service Sheet 21 and check VR3 and associated components.

    If the DVM indication does not vary, proceed with Step 31.

31. Connect the DVM to U3-3 and observe the DVM display while turning the VERNIER control from full CCW to full CW.

    The DVM indication should vary as indicated below:

CCW	−0.049V
CW	+1.7V

    If the DVM indication is as indicated, check U3, Q9 and associated components.

    If the DVM indication is not as indicated, check Q2.

External ALC

This procedure should be used if the Signal Generator operates normally in the Internal ALC mode, but will not level in External ALC mode.

32. Connect the variable power supply for floating outputs. Using the DVM, set the voltage to 500 mV, and connect the output to the EXTERNAL ALC connector (positive lead to the center conductor).

33. With an adjustment tool turn the front panel CAL potentiometer fully clockwise.

34. Connect the DVM to U12-3.

    The voltage should be −0.1V.

    If the voltage is as indicated, proceed with Step 35.

    If the voltage is not as indicated, proceed with Step 36.

35. Reverse the power supply connections to the Signal Generator so that the negative lead is connected to the center conductor of the EXTERNAL ALC IN connector and recheck the voltage at U12-3.

    The voltage should be the same as measured in Step 34.

    If the voltage is as indicated, Input Amp, the Absolute Value Amp and the Log Amp are working normally, proceed with Step 38.

    If the voltage is not as indicated, the Absolute Value Amp is defective, check U15 and associated components.

36. Connect the DVM to the junction of R29 and CR3 and observe the DVM indication.

SERVICE SHEET 20 (cont'd)

The DVM indication should be −0.33V.

If the DVM indication is as indicated, the Log Amp is defective. Check U13, Q13 and associated components.

If the DVM indication is not as indicated, proceed with Step 37.

37. Connect the DVM to A1A3TP5 and observe the DVM indication.

    The DVM indication should be −0.66V.

    If the DVM indication is as indicated, the Absolute Value Amp is defective. Check U15 and associated components.

    If the DVM indication is not as indicated, the Input Amp is defective. Check U14 and associated components.

38. Connect the DVM to A1A3TP2 and observe the DVM reading.

    The DVM reading should be 0 volts.

    If the DVM reading is as indicated, proceed with Step 39.

    If the DVM reading is not as indicated, proceed with Step 41.

39. Connect the DVM to U8-2 and, while observing the DVM, press ALC INTERNAL and then ALC DIODE.

    The DVM should read −13 volts after ALC INTERNAL is pressed and rise to about zero volts when ALC DIODE is pressed.

    If the reading is as indicated, Q10 is defective.

    If the reading is not as indicated, proceed with Step 40.

40. Connect the DVM to U8-1 and, while observing the DVM, press ALC INTERNAL and then ALC DIODE.

    The DVM should read zero volts after ALC INTERNAL is pressed and rise to about +4 volts when ALC DIODE is pressed.

    If the DVM indication is normal, switch U8 is defective.

    If the DVM indication is not normal, proceed to Step 1 to check the input Latches.

41. Connect the DVM to U12-6 and observe the DVM. The DVM should read −0.01V.

    If the reading is as indicated, check U9 and associated components.

    If the reading is not as indicated, check U12 and associated components.

AM

This procedure should be used if the Signal Generator works normally, but will not amplitude-modulate properly. Before performing this procedure, the AM adjustment procedures in Section V should be performed to make sure that the problem is not an adjustment problem.

42. Construct a calibration adapter as shown in Figure 8-128, and connect it with the test oscillator and oscilloscope as shown in Figure 8-129.

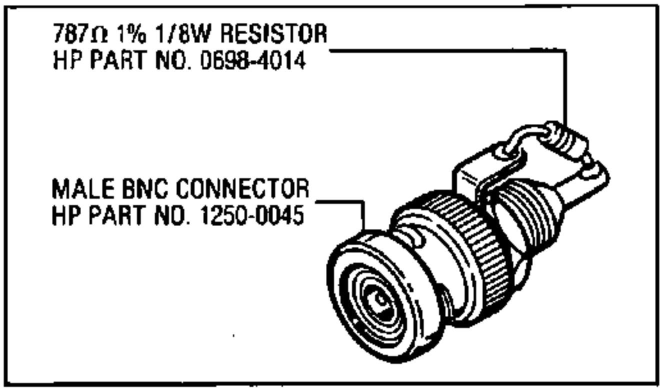


Figure 8-128. AM Calibration Adapter

43. Set the test oscillator for 10 kHz, 600 ohm output, and adjust the output level for a 1V peak signal as read on the oscilloscope.

NOTE

If the test oscillator being used does not have a 600 ohm output use the highest unbalanced output impedance available (under 600 ohms) and adjust as indicated. The only requirement is that the test oscillator be capable of producing a signal of at least 1 V peak into 787 ohms.

44. Disconnect the Tee and calibration adapter and connect the test oscillator directly to the AM IN connector of the Signal Generator.

SERVICE SHEET 20 (cont'd)

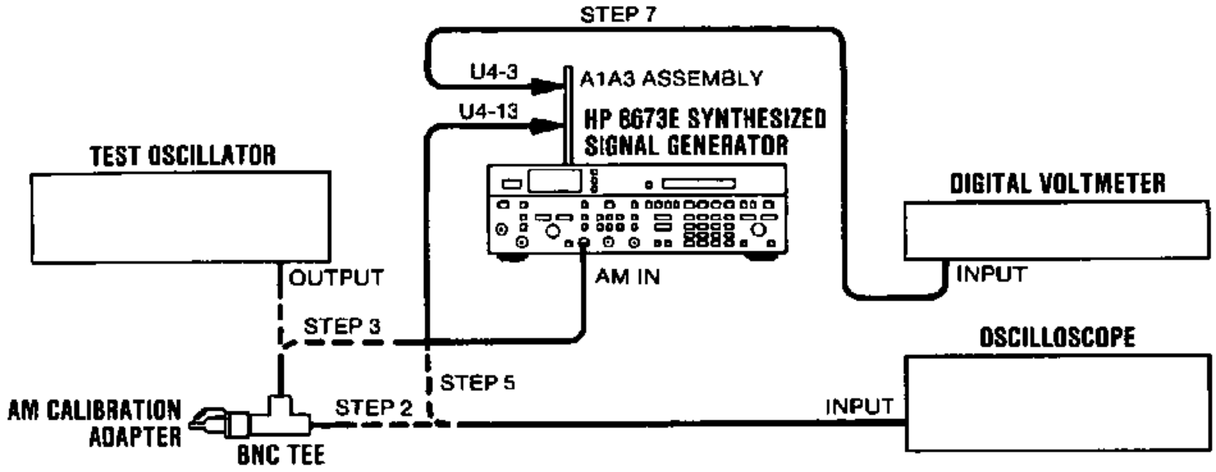


Figure 8-129. AM Test Setup

45. Remove A1A3 and replace it on a 44-pin extender card. Then set A1A3R43 (AM BAL) fully clockwise.

46. Press RCL 0 and AM 30%. Connect the oscilloscope to U4-13.

    The oscilloscope display should be as shown in Figure 8-130.

    If the oscilloscope display is as indicated, proceed with Step 50.

    If the oscilloscope display is not as indicated, proceed with Step 47.

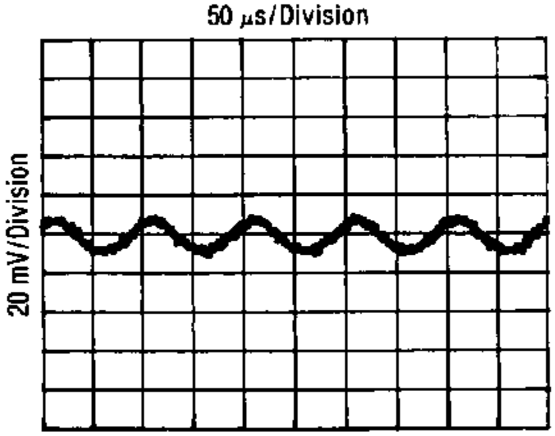


Figure 8-130. Log Amp Output Waveform, 30% AM

47. Connect the oscilloscope to the right side of A1A3R28 as viewed in Figure 8-135.

    The oscilloscope display should be as shown in Figure 8-131.

    If the display is as indicated, the problem is with U6, Q5, or associated components.

    If the display is not as indicated the problem is either Q11, switch U4, or input latch U10. Proceed with Step 48.

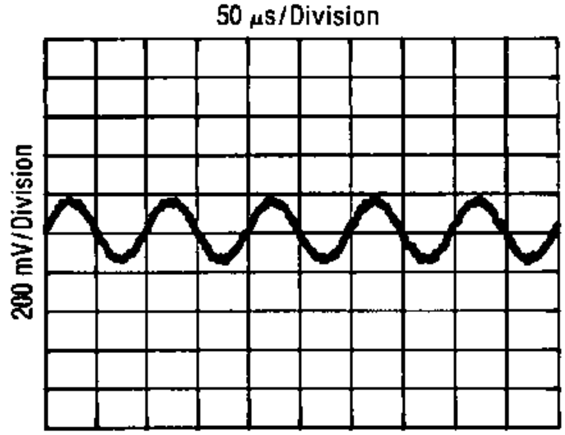


Figure 8-131. Log Amp Input Waveform, 30% AM

48. Select AM 100% and connect the DVM to U4-3. While observing the DVM, press AM 30%. The DVM should indicate about −4 volts and then change to +1 volt when AM 30% is pressed.

    If the indication is correct, Q11 is at fault and should be replaced.

    If the indication is not correct, proceed with Step 51.

49. Connect the oscilloscope to U4-13 and press the AM 100% key.

    The oscilloscope display should be as shown in Figure 8-132.

SERVICE SHEET 20 (cont'd)

If the display is as indicated, the 30 to 100% RANGE CHANGE CKT and the LOG AMP are working normally, proceed with Step 52.

If the display is not as indicated, proceed with Step 50.

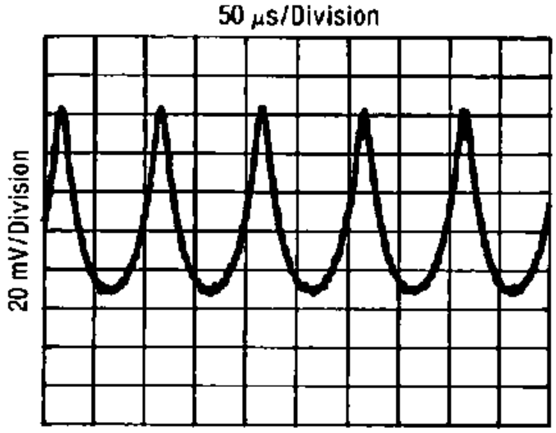


Figure 8-132. Log Amp Output Waveform, 100% AM

50. Connect the DVM to U4-5. Then, while observing the DVM display, press AM 100%, then AM 30%.

    The DVM should should indicate about +1 volt after AM 100% is pressed and change to about −4 volts when AM 30% is pressed.

    If the indication is correct, Q12 is defective.

    If the indication is not correct, proceed with Step 51.

51. Connect the DVM to U4-9. Then press AM 100% followed by AM 30%.

    The DVM indication should be zero when AM 100% is pressed and about +4 volts when AM 30% is pressed.

    If the indication is correct, switch U4 is faulty and should be replaced.

    If the indication is not correct, proceed with Step 1 to check the input latches.

52. Connect the oscilloscope to U4-14 and verify that the Signal Generator is still set for AM 100%.

    The oscillocope display should be as shown in Figure 8-133.

    If the display is as indicated, proceed with Step 54.

    If the display is not as indicated, proceed with Step 53.

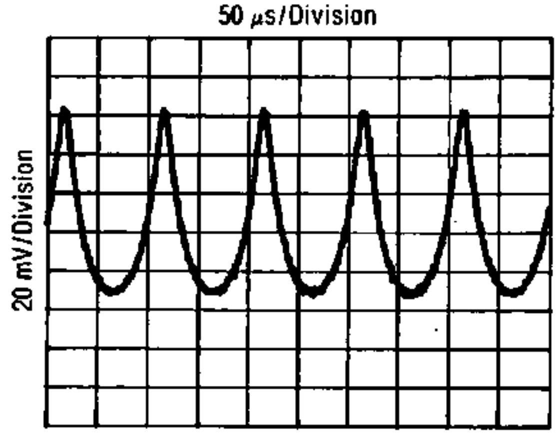


Figure 8-133. AM Switch Output Waveform

53. Connect the DVM to U4-11, press AM OFF, and then AM 100%.

    When AM OFF is pressed, the DVM should indicate zero and change to about +4 volts when AM 30% is pressed.

    If the DVM indication is correct, switch U4 is defective.

    If the DVM indication is not correct, go to Service Sheet 21 and check MODULATION MODE SELECTION Latch U6.

54. Connect the oscilloscope to the bottom of R64 as viewed in Figure 8-135.

    The oscilloscope display should be as shown in Figure 8-134.

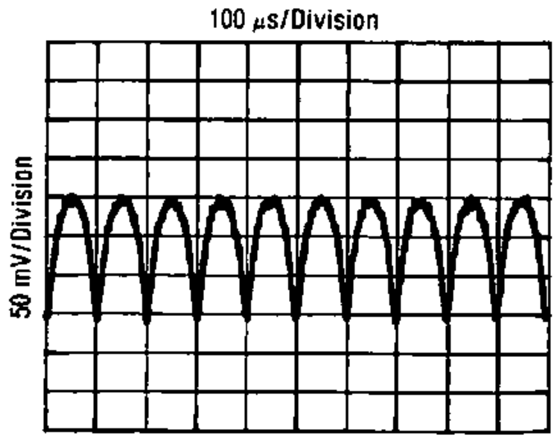


Figure 8-134. AM Driver Amp Waveform

SERVICE SHEET 20 (cont'd)

If the display is as indicated, the problem is with Q3B, U5, or Q4. Since these components are in a closed loop it is difficult to isolate between them. The best that can be done is to check the biasing on Q3B and Q4. If the biasing is correct, replace U5.

If the display is not as shown, replace Q8.

Power Clamp

This procedure should be run if a power plot, such as those run in the procedures associated with Service Sheet BD5, indicates that the power clamp is malfunctioning, or if for any other reason it is suspected that the power clamp is defective.

55. Connect the DVM to U1-2 and press RCL 0.

    The DVM should indicate about 0 volts.

    If the DVM indication is correct, proceed with Step 56.

    If the DVM indication is not correct, proceed with Step 58.

56. With the DVM still connected to U1-2, set the Signal Generator frequency to 8 GHz and press ALC DIODE.

    The DVM should indicate about 0 volts.

    If the DVM indication is correct, proceed with Step 57.

    If the DVM indication is not correct, replace CR9 and proceed with Step 59.

57. With the DVM still connected to U1-2, and the ALC DIODE indicator on, set the Signal Generator frequency to 15 GHZ. The DVM should indicate about 0 volts.

    If the DVM indication is correct, proceed with Step 58.

    If the DVM indication is not correct, replace CR10 and proceed with Step 59.

58. Connect the DVM to the cathode of CR11 and press ALC DIODE. While observing the DVM, press ALC INTERNAL.

    The DVM should indicate +2.9V while ALC DIODE is active and then change to about +3 volts when ALC INTERNAL is pressed.

    If the DVM indication is correct, Q1 is defective.

    If the DVM indication is not correct, CR11 is defective.

59. Connect the DVM to U4-2. Then press RCL 0 and ALC INTERNAL.

    The DVM should indicate about +5.4 volts.

    If the DVM indication is correct, proceed with Step 60.

    If the DVM indication is greater than +5.4 volts, check VR6 and VR7.

    If the indication is +4.7 volts, check VR6.

    If the indication is otherwise incorrrect, proceed with Step 61.

60. Connect the DVM to U4-15.

    The DVM should indicate +5.4 volts.

    If the DVM indication is incorrect, replace U4.

61. Without changing the front panel settings, connect the DVM to U1-3.

    The DVM should indicate +0.47V.

    If the DVM indication is correct, U1 is defective. If the DVM indication is not correct, check CR12 and associated components.

Peaker

This procedure should be used if a peaker malfunction has been isolated to the Peaker circuit on Service Sheet 20. It is assumed that an attempt has been made to correct the malfunction by adjusting the Peaker DAC on the DAC and Enable Assembly A1A5, Service Sheet 22.

62. Place A1A3 on a 44-pin extender board.

63. Discharge C32 by momentarily connecting a jumper lead across it.

64. Press RCL 0. Then set the frequency increment to 50 MHz.

65. Connect the DVM to U2-10 and, while observing the DVM display, press FREQUENCY INCREMENT (up arrow).

SERVICE SHEET 20 (cont'd)

The DVM should initially indicate about zero. Then it should rise to some positive voltage when the FREQUENCY INCREMENT (up arrow) is pressed.

If the DVM indication is correct, proceed with Step 67.

If the DVM indication is not correct, proceed with Step 66.

66. Connect the oscilloscope to U2-7, and while observing the display, press FREQUENCY INCREMENT (up arrow).

The oscilloscope display should initially be at about −9 volts, then briefly rise to about +19 volts, and finally drop back to −9 volts.

NOTE

The intensity of the oscilloscope display may need to be adjusted to observe the +19V signal. Holding down the FREQUENCY INCREMENT key (Up-Arrow) will cause the +19V signal to repeat.

If the oscilloscope display is as indicated, check CR13, Q8, and associated components.

If the oscillscope display is not as indicated, U2 is defective.

67. Connect the oscilloscope to U10-5. While observing the oscilloscope display, press and hold the FREQUENCY INCREMENT key (up-arrow).

The oscilloscope should show brief positive-going pulses when the FREQUENCY INCREMENT (up arrow) key is pressed. If the pulses cannot easily be seen, verify activity at U10-5 by observing that the oscilloscope is triggering and the display jitters.

If the display is as indicated, and the indication in Step 65 was correct, U2 is defective.

If the display is not as indicated, proceed to Step 1 to check input Latch U10.

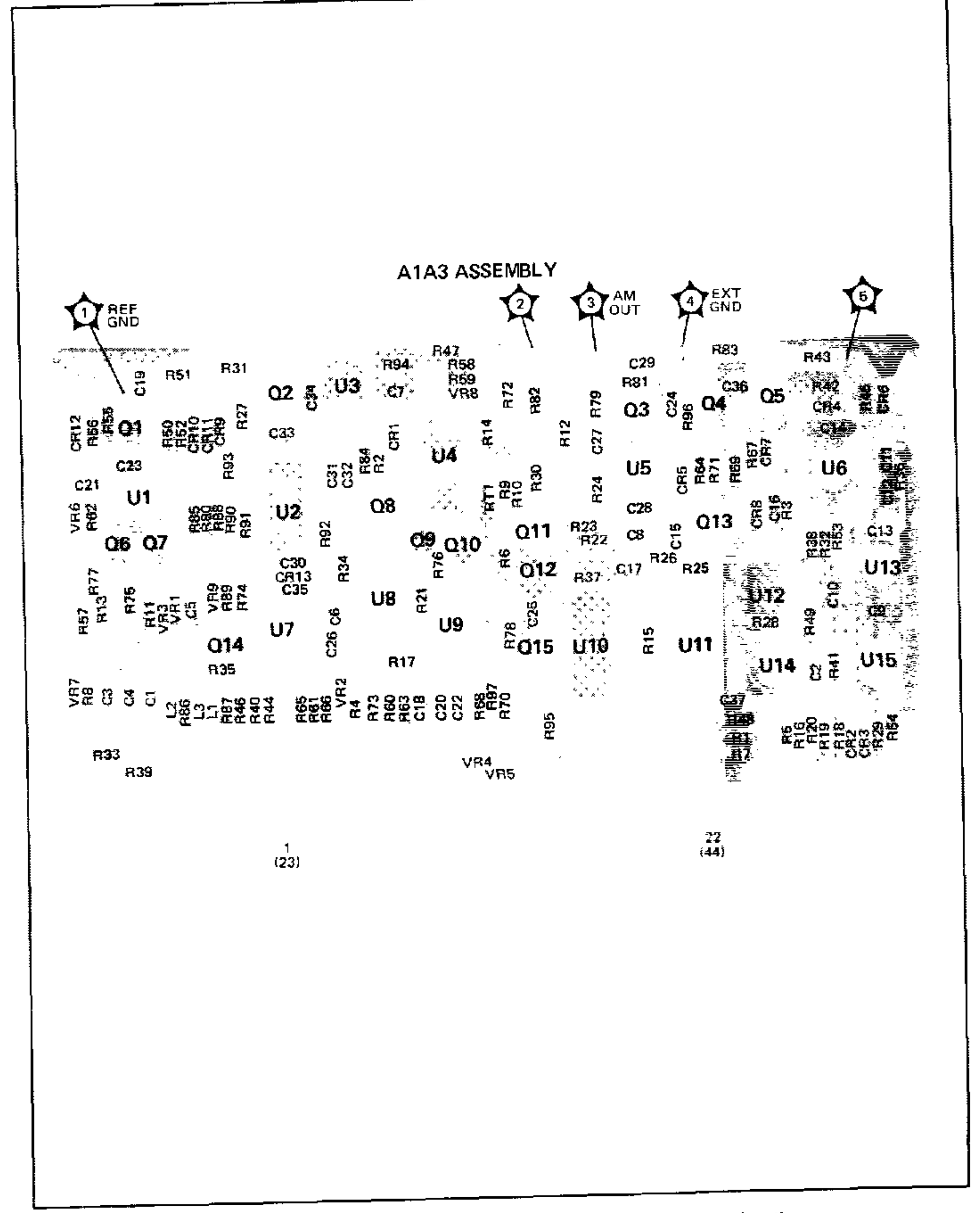
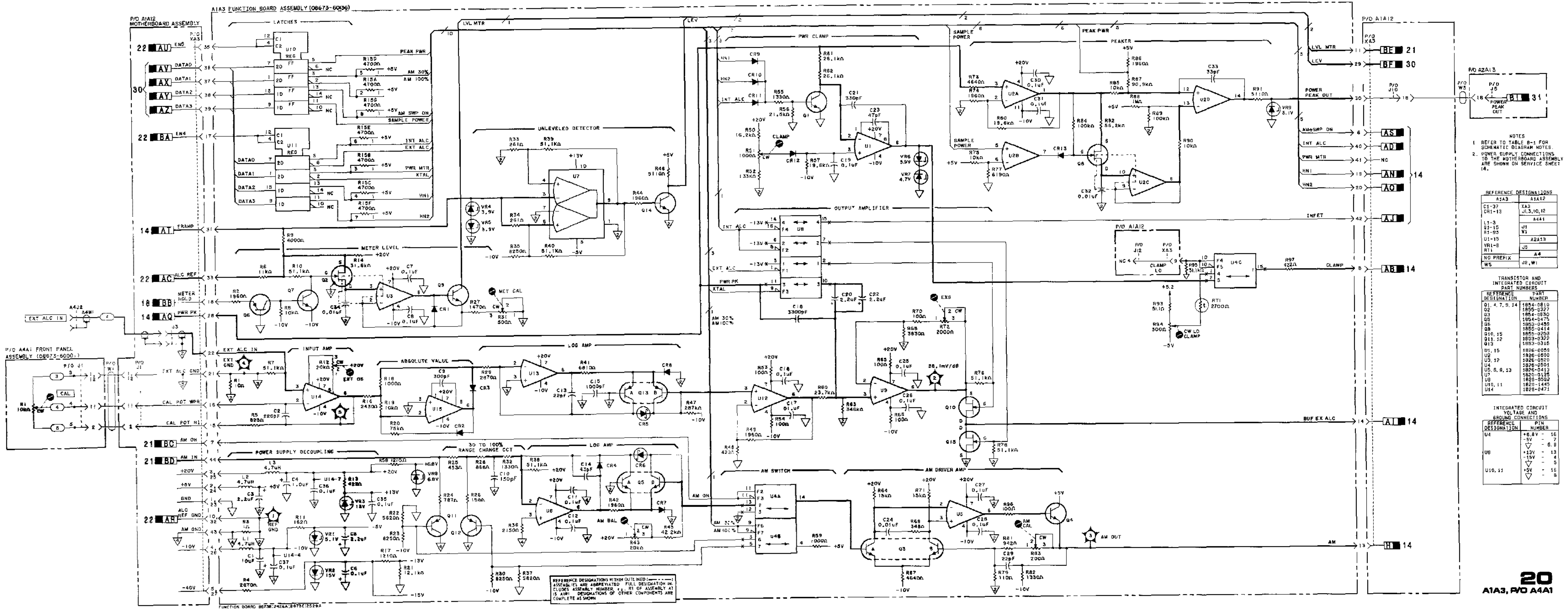


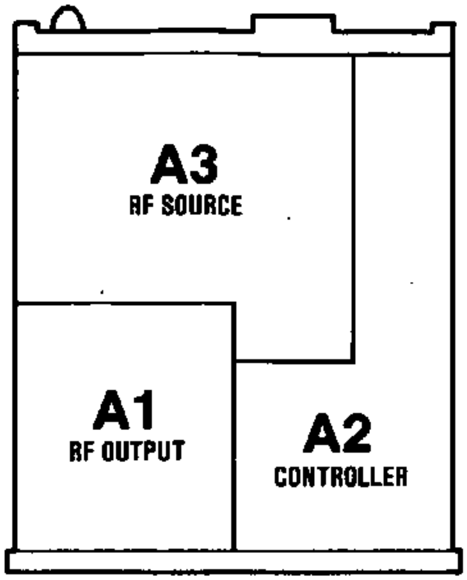
Figure 8-135. A1A3 Function Assembly and Component and Test Point Locations



20
A1A3, P/O A4A1

Figure 8-136. Function Assembly Schematic Diagram

TOP VIEW



A4 FRONT PANEL

MAJOR ASSEMBLIES

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Attenuator Driver Board Assembly	18
A1A2	Detector Module Assembly	14,17
A1A2A1	ALC Board Assembly	14,17
A1A2A2	Detector Board Assembly	17
A1A3	Function Board Assembly	20
A1A4	Pulse Driver Board Assembly	15
A1A5	DAC and Enable Board Assembly	22
A1A6	Meter Board Assembly	21
A1A7	YTM Driver Board Assembly	16
A1A8	SRD Bias Board Assembly	19
A1A9	Preamp Assembly	14,16
A1A10	YTM Assembly	16
A1A10A1	YIG Heater Control Assembly	16
A1A11	Power Amplifier Assembly	16
A1A12	Motherboard Assembly	14-16,18-22, 30,31
A1A13	Terminal Strip	15
A1A14	Amp Bias Board Assembly	17
A2A1	Panel Driver Board Assembly	25
A2A2	Key Code Board Assembly	24
A2A3	VCO Assembly	8
A2A4	Phase Detector Assembly	7
A2A5	Divider Assembly 20/30	6
A2A6	Not Assigned	
A2A7	I/O Board Assembly	30,31
A2A8	Microprocessor Board Assembly	26
A2A9	Frequency/HP-IB Board Assembly	29
A2A10	RAM Board Assembly	28
A2A11	ROM Board Assembly	27
A2A12	Not Assigned	
A2A13	Motherboard Assembly	6-8,10,20-32
A2A14	Rear Interconnect Board Assembly	24,29,31
A2A15	HP-IB Connector Board Assembly	29
A3A1	Rectifier Assembly	33
A3A1A1	Reference Phase Detector Assembly	1,2
A3A1A2	100 MHZ VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator	4
A3A1A4A2	VCO Board Assembly	4
A3A1A5	M/N Output Assembly	5
A3A1A6	M/N Reference Motherboard Assembly	1-3,5
A3A1A7	Reference Housing Assembly	
A3A2	Not Assigned	
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	DAC Assembly	9
A3A6	YTO Driver Assembly	10
A3A7	FM Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Sampler Assembly	11
A3A9A6	Attenuator Assembly	13
A3A9A7	6.2 GHz Low Pass Filter	13
A3A10	Motherboard Assembly	1,3,4,6,10, 12-14,21-23, 26,29-31, 33-35
A4A1	Front Panel Board Assembly	20,22,23,32

SERVICE SHEET 21
METERING CONTROL ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

The Metering Control Assembly performs the following functions:

a. Generates AM ON signal to the Function Board A2A7 (Service Sheet 20) in response to DATA0—3 from the I/O Assembly A2A7 (Service Sheet 20).

b. Varies the FM signal level according to the band of the Synthesizer output frequency so that the FM deviation will not be affected by the frequency multiplication in the YIG Tuned Multiplier (YTM).

c. Sets the proper FM signal level for the selected deviation range.

d. Provides the front panel meter with a current proportional to the modulating AM or FM signal amplitude.

e. Generates the FM Overmodulation status signal to the microporcessor.

FM Signal Path

The FM signal produces a peak deviation proportional to the peak input signal amplitude. The input signal from the front panel is first applied to the FM Band Select circuit. FM Band Select changes the attenuation of the input signals according to the frequency band of the output signal. This is necessary because the YTM multiplies the FM deviation of the carrier as well as the carrier frequency. For example, if the YTO (YIG Tuned Oscillator) frequency is at 4 GHz with 1 MHz deviation and the output frequency selected is in Band 2, then the output frequency would be 8 GHz with 2 MHz of deviation if the band attenuator were not used. The band attenuator attenuates the modulating signal by factors of 1, 1/2 or 1/3 to maintain constant deviation regardless of the output frequency selected. The three BND1—3 signals control the selection of the attenuation.

The output of FM Band Select is applied to the FM Amplifier. This amplifier acts as a buffer between FM Band Select and the Range Attenuators and provides a means of setting the gain to calibrate the FM deviation. The Range Attenuators vary the FM signal amplitude to correspond to the selected FM Range.

The emitter follower following the Range Attenuator acts as a buffer and provides the drive to the input of the FM Driver.

Meter Drivers

The FM Meter Driver is a peak detector that converts the FM signal voltage at its input into a direct current at its output. This current drives the front panel meter to indicate peak FM deviation. The peak detector also provides a dc voltage proportional to peak signal amplitude as an input to the overmodulation detector.

The AM Meter Driver is a peak detector that converts the AM signal voltage at its input to a dc current at its output. The AM Meter scale is calibrated in rms volts. This assumes a sinusoidal input waveform.

FM Overmodulation Detector

The overmodulation detector senses excessive deviation and is located on the Metering Control Assembly. The input to the Overmodulation Detector from the FM Meter Driver Q10 is a dc voltage proportional to FM input signal and hence, proportional to deviation. When the level of this signal exceeds that level established by R54, an overmodulation condition is indicated.

TROUBLESHOOTING

General

It is assumed that the troubleshooting information on Service Sheets BD1, BD4, and BD6 was

SERVICE SHEET 21 (cont'd)

used to isolate a malfunction to the A1A6 Metering Control Assembly. It is also assumed that an attempt has been made to correct the malfunction by using the appropriate adjustment procedure, if any, in Section V. The following information will aid in isolating the defective component.

Digital Voltmeter
(DVM) .... HP 3456A or 3455A
Oscilloscope .... HP 1980B
Test Oscillator .... HP 3335A
Signature Analyzer .... HP 5005A/B or 5006A

Digital Circuitry Troubleshooting with a Signature Analyzer

The digital portions of the Meter Board Assembly may be checked by either of two methods. The first method uses signature analysis and the second uses a DVM. To troubleshoot the Meter Board using signature analysis proceed as follows:

1. Set the LINE switch to STBY.
2. Place the Metering Board Assembly on an extender board.
3. Connect the MPU connector to the top of A2A8. Install a shorting clip between A2A8TP5 and the adjacent TP GND.
4. Connect the signature analyzer as follows:

SIGNATURE ANALYZER TIMING POD	MICROPROCESSOR ASSEMBLY TEST POINTS
START	A2A8TP4
STOP	A2A8TP4
CLOCK	2A8TP3
GND	A2A8TP GND

5. Set the signature analyzer as follows:

   START-(leading edge)
   STOP- (trailing edge)
   CLOCK-(trailing edge)

6. Set the Diagnostic Switch, A2A8S1, to position 5.
7. Use the signatures of Table 8-48 to verify the inputs to the Meter Board Assembly.
8. Use the signatures of Table 8-49 to verify the digital portions of the Meter Board Assembly for fault location.

Table 8-48. Meter Board Input Signatures

PIN NO.	SIGNATURE	MNEMONIC
11	4P92	BND1
12	4AC9	BND2
13	2PF9	BND3
14	13AA	BND4
16	3818	EN6
17	16F3	EN7
31	8958	DATA0
32	U194	DATA1
33	9F1C	DATA2
34	39P1	DATA3

Table 8-49. Meter Board Diagnostic Signatures

PIN NO.	SIGNATURE	MNEMONIC
U2-6	57UP	FM
U3-3	636F	R0
4	FFFC	R10
5	58AF	R20
6	40P7	R30
U4-1	47A9	M4
8	9CHP	M1
9	U4H5	M2
16	1361	M3
U5-1	U194	DATA1
3	FFFC	R10
4	38188	EN6
5	636F	R0
7	8958	DATA0
9	39P1	DATA3
11	40P7	R30
12	3818	EN6
13	58AF	R20
15	9F1C	DATA2
U6-1	U194	DATA1
2	5038	NAM
3	P344	AM ON
4	16F3	EN7
5	57UP	FM
6	P482	NFM
7	8958	DATA0
9	39P1	DATA3
10	U4H5	M2
11	47A9	M4
13	28A2	
14	9CHP	M1
15	9F1C	DATA2
U7-3	8C1P	BND4
4	1PA8	BND2
5	5H05	BND3
6	F7AC	BND1

SERVICE SHEET 21 (cont'd)

Digital Circuitry Troubleshooting with a DVM

To troubleshoot the digital circuitry perform the following steps:

1. Connect the equipment as shown in Figure 8-137. Set the test oscillator to 100 kHz and adjust the amplitude for a voltmeter reading of 0.707 Vrms.

2. Key in RCL0 on the Signal Generator front panel. Press 6, then press the Service Switch on the A2A2 Key Code Board Assembly.

3. Connect the oscilloscope to the base of Q3.

4. Using the DVM, verify the logic levels in Table 8-50 for the Deviation Ranges shown. Observe signal levels at the base of Q3 decrease as the deviation decreases.

Table 8-50. Signal Levels vs Deviation Range

Mnemonic	Deviation Range	U3-3	U3-4	U3-5	U3-6
R0	10 MHz	H	L	L	L
R10	3 MHz	L	H	L	L
R20	1 MHz	L	L	H	L
R30	.3 MHz	L	L	L	H

5. If the signal levels displayed on the oscilloscope in step 4 do not decrease at each step, troubleshoot U5 and the input lines EN6 and DATA0—3.

6. Connect the oscilloscope to the base of Q16. Press RCL1 and select .3 MHz FM DEVIATION. Verify that the signal voltage decreases at each step as RCL2 and .3 MHz FM DEVIATION, and finally RCL3 and .3 MHz FM DEVIATION are depressed. If the voltage does not decrease at each step, Troubleshoot U7 and the input lines BND1—3.

7. Using the DVM, verify the outputs of U6 using the following table. If the appropriate signal is not observed, troubleshoot the input lines EN7 and DATA0—3.

Pin	Signal	State
5	FM	High when any FM range is selected
3	AM ON	High when either AM range is selected
14	M1	Low when LEVEL is selected
10	M2	Low when FM is selected
13	M3	Low when AM is selected
11	M4	Low except when FM is selected

FM Circuitry Troubleshooting

The FM portion of the Metering Control Assembly consists of the FM Metering Circuit, the FM Overmod Detector, and the FM Amplifier Circuitry. If none of these circuits is working properly, troubleshoot the input circuitry consisting of CR1, CR3, R8, C4 and C6. If the FM meter and FM Overmod Detector circuits are not working properly, troubleshoot the FM Metering circuitry first. If AM Metering and FM Metering are not working properly, troubleshoot U4 and Q20 first. If only one of the circuits is not working properly, proceed to the troubleshooting procedure for that circuit.

FM Signal Troubleshooting. If the FM signal (XA6-9) is faulty in only one frequency deviation range, troubleshoot the associated output of the FM Deviation Range Latch U5, and the FM Range Selector U3. If the FM signal is faulty in all ranges, proceed as follows:

1. Connect the equipment as shown in Figure 8-138. Set the test oscillator to 100 kHz and 0.707 Volts amplitude as read on the Digital Voltmeter.

2. Key in RCL0 on the Signal Generator front panel. Press 6, then press the Service Switch on the A2A2 Key Code Board Assembly.

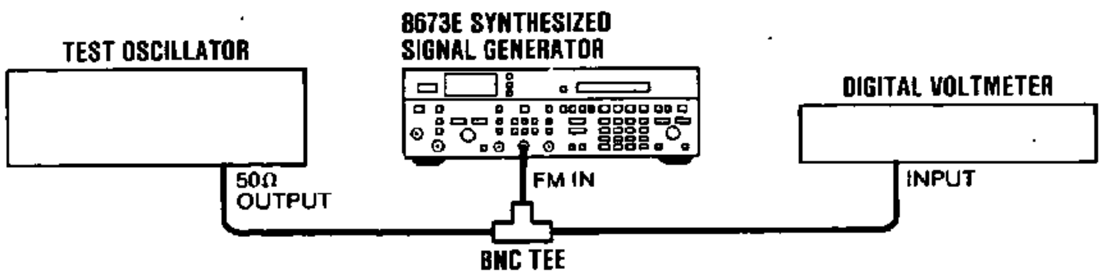


Figure 8-137. Digital Troubleshooting Test Setup

SERVICE SHEET 21 (cont'd)

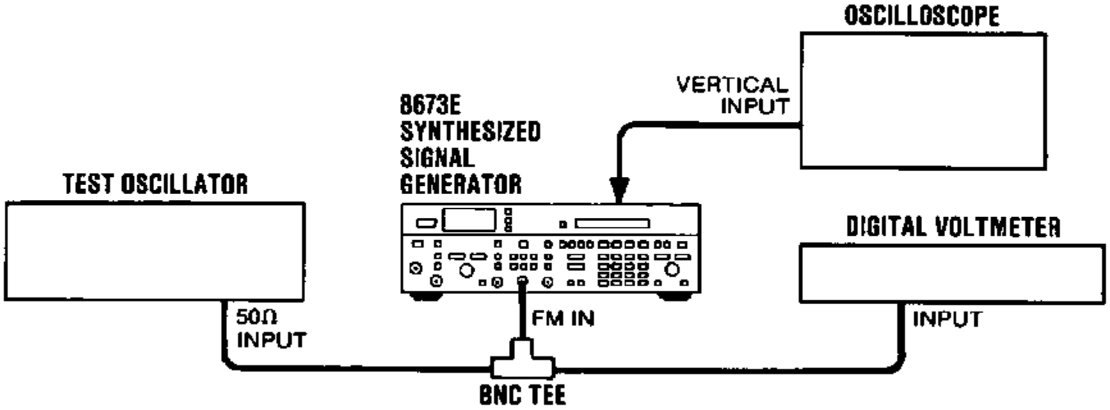


Figure 8-138. FM Signal Troubleshooting Test Setup

3. Connect the oscilloscope to the base of Q16. Press RCL1 and select .3 MHz FM DEVIATION. Verify that the signal voltage decreases at each step as RCL2 and .3 MHz FM DEVIATION, and finally RCL3 and .3 MHz FM DEVIATION are depressed. If the voltage does not decrease at each step, troubleshoot U7, Q13, Q15, Q16 and associated circuits.

4. If the signal level varies in step 3, connect the oscilloscope to the base of Q3 and depress the FM DEVIATION 10 MHz, 3 MHz, 1 MHz and .3MHz keys, observing that the signal level decreases with each step. If the signal level does not change, troubleshoot Deviation Range Attenuation Switch U3. If the signal level does decrease, troubleshoot Q3, Q4 and associated circuitry.

FM Metering Circuit. To troubleshoot the FM Metering Circuits, proceed as follows:

1. Select .3 MHz FM DEVIATION. Verify that NFM at the base of Q2 is a TTL Low. If it is not, troubleshoot Modulation Mode Latch U6 and input lines EN7 and DATA0—3.

2. Connect the equipment as shown in Figure 8-137. Set the test oscillator's output to 0.707 Vrms at 100 KHz.

3. Connect the oscilloscope to the base of Q10 and verify that the level varies as the amplitude of the test oscillator output is varied. If it changes, troubleshoot Q10. If it does not change, place the oscilloscope probe at the base of Q9 and verify that the negative going pulse width varies as the output of the test oscillator is varied. If it changes, troubleshoot U1B. If it does not vary, troubleshoot Q9 and associated circuitry.

FM Overmod Detector. To troubleshoot the FM Overmod Detector, proceed as follows:

1. Select .3 MHz FM DEVIATION.

2. Verify that FM at U2-6 is TTL High and NFM at the base of Q2 is TTL Low. If not, troubleshoot U6 and input lines EN7 and DATA0—3.

3. Connect the equipment as shown in Figure 8-138. Set the test oscillator to 100 kHz with an amplitude of 0.707 Vrms.

4. Increase the amplitude of the test oscillator signal and observe that the FM O.M. signal at XA1A6-30 goes to a TTL High. If not, connect the oscilloscope lead to A1A6TP2 and observe that the dc level increases and decreases as the test oscillator output is varied. If it does not, troubleshoot the FM Metering as described above. If it does vary, troubleshoot U2 and Q6.

AM Metering Circuitry. To troubleshoot the AM Metering Circuitry, proceed as follows:

1. Press RCL0 and select AM 30%. Verify that NFM at the base of Q2 is a TTL High. If it is not, troubleshoot U6 and input lines EN7 and DATA0—3.

2. Connect the equipment as shown in Figure 8-139. Set the test oscillator's output to 0.5303 Vrms at 1 kHz.

3. Connect the oscilloscope lead to the base of Q7 and observe that the negative going pulse width varies as the amplitude of the test oscillator signal is varied. If it does not, troubleshoot Q1, U1A and associated circuitry. If it does, troubleshoot Q7, Q8 and associated circuitry.

SERVICE SHEET 21 (cont'd)

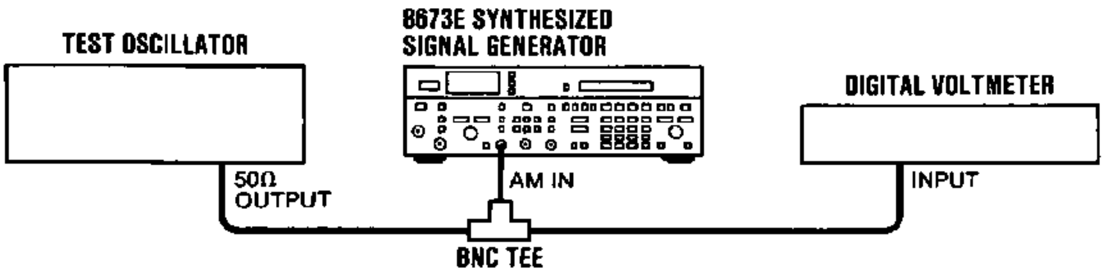


Figure 8-139. AM Metering Circuitry Troubleshooting Test Setup

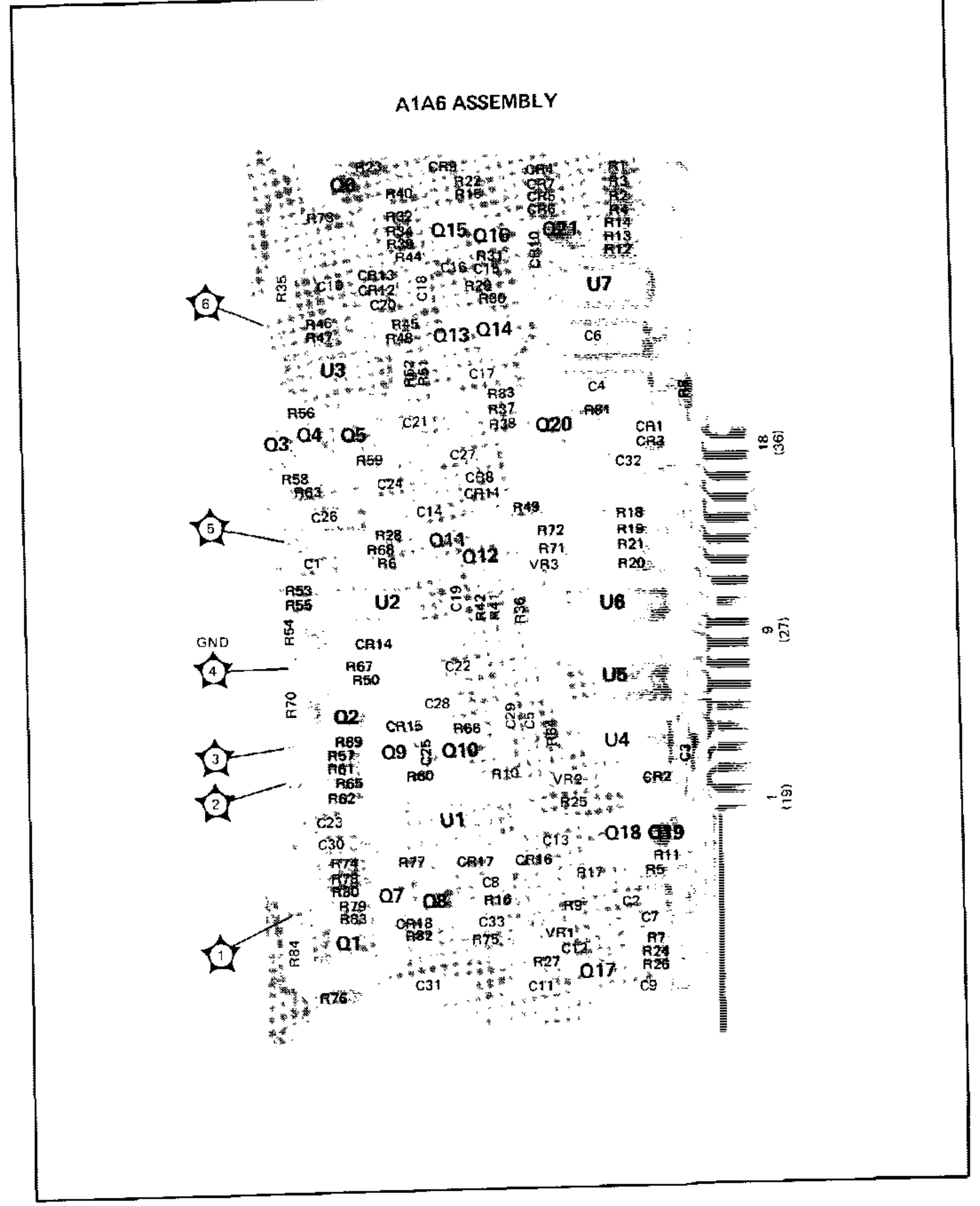
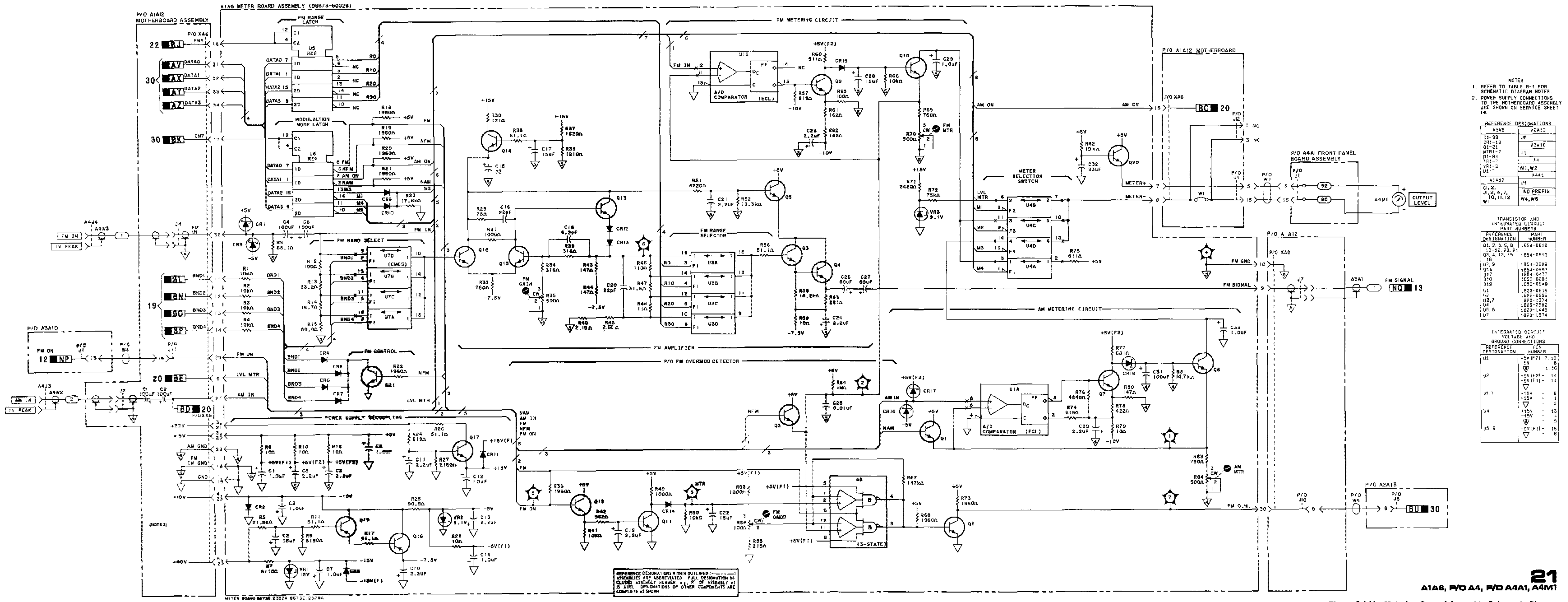


Figure 8-140. A1A6 Meter Assembly Component and Test Point Locations



21
A1A6, P/O A4, P/O A4A1, A4M1

Figure 8-141. Metering Control Assembly Schematic Diagram

SERVICE SHEET 22

DAC AND ENABLE ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
Digital Control Unit (DCU) Block Diagram .... Service Sheet BD8
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The DAC and Enable Assembly A1A5 contains three digital-to-analog converters for the generation of the following signals:

1. ALC REF - Automatic Level Control Reference
2. BIAS 2
3. PK DAC - Peaker DAC

In addition, the DAC and Enable Assembly generates two signals VUP and VDN which are sent to the Microprocessor Board via the I/O Board. These signals also generate an interrupt to the Microprocessor via the I/O Board. Address bus signals are decoded by the Enable Decoder to generate enable signals for use on the following assemblies:

1. Pulse Driver Processing Board
2. Attenuator Driver Board
3. SRD Control Assembly
4. Function Board Assembly
5. Local/Remote Switch, Peaker DAC and Bias 2 DAC (Pulse Amplitude Control DAC) on the DAC and Enable Board itself.

Automatic Level Control

Automatic Level Control can be exerted from the front panel by the VERNIER or by remote control via the HP-IB bus. In the remote mode of control, digital data from the I/O Assembly is received via the data bus and converted by DAC U4 into an analog signal which is amplified and output as the ALC REF signal. Data Bus signal DATA0, when enabled by NRN11 (which is generated by the Address Bus Decoder U8), controls the Local/Remote switches Q9 and Q8. A1A5R9 is the adjust for the level of the ALC REF output in the Local mode.

TROUBLESHOOTING

Component-level troubleshooting procedures for the DAC and Enable Assembly are contained in Service Sheet BD8.

Metering Control Assembly A1A6, P/O A4, P/O A4A1, A4M1 SERVICE SHEET 21

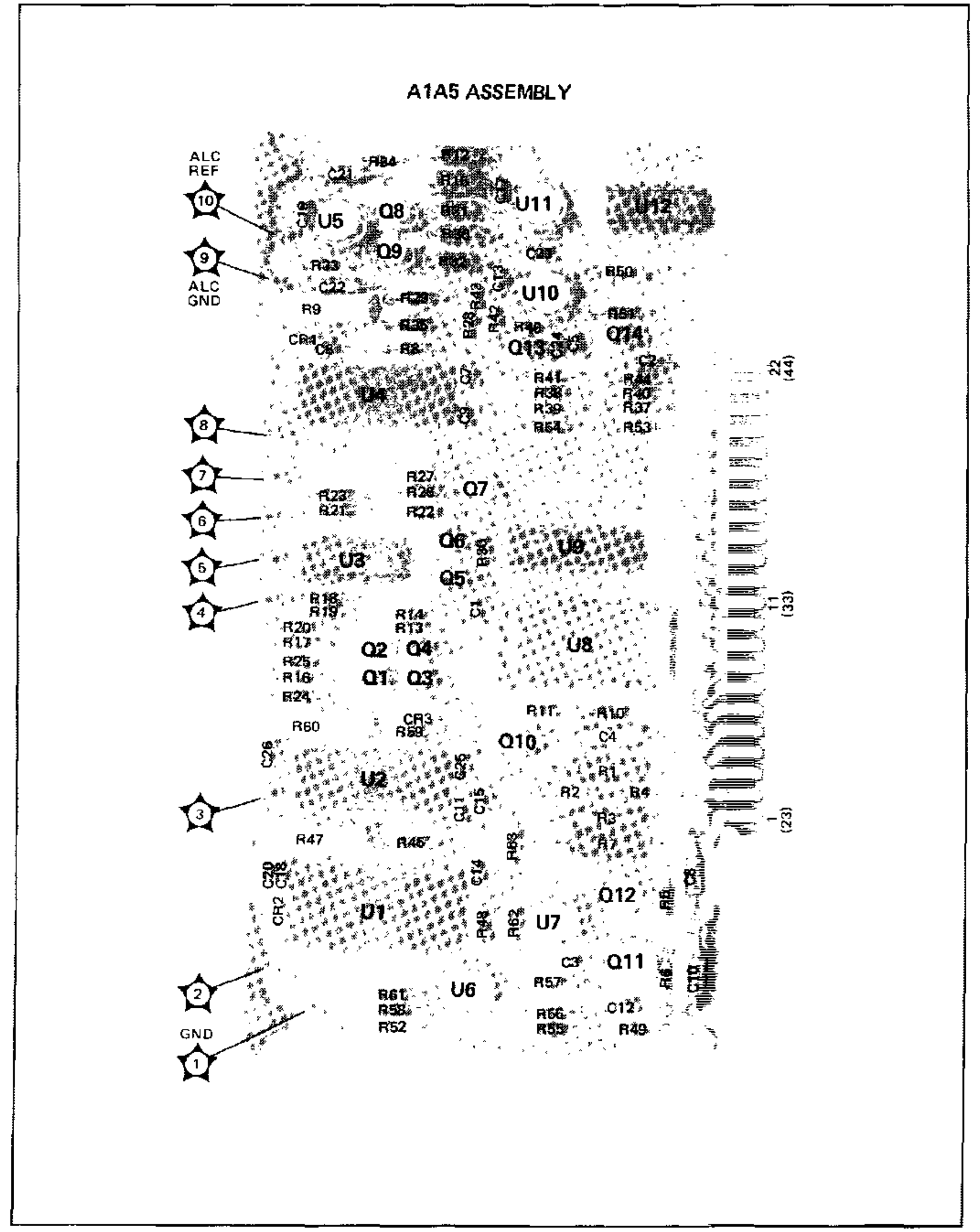
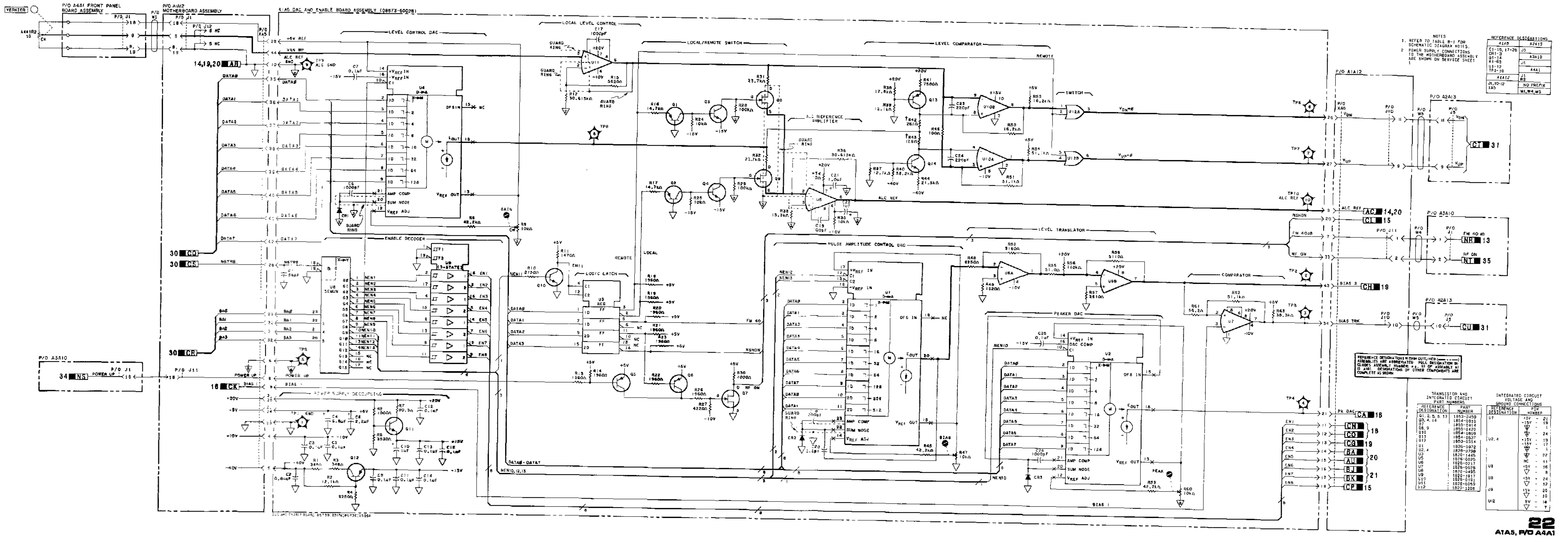


Figure 8-142. A1A5 DAC and Enable Assembly Component and Test Point Locations



22
A1A5, P/O A4A1

Figure 8-143. DAC and Enable Assembly Schematic Diagram

SERVICE SHEET 23

FRONT PANEL KEYBOARD

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
Digital Control Unit (DCU) Block Diagram .... Service Sheet BD8
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

TROUBLESHOOTING

Component-level troubleshooting procedures for the Front Panel Keyboard are contained in Service Sheet BD8.

DAC and Enable Assembly
A1A5, P/O A4A1
SERVICE SHEET 22

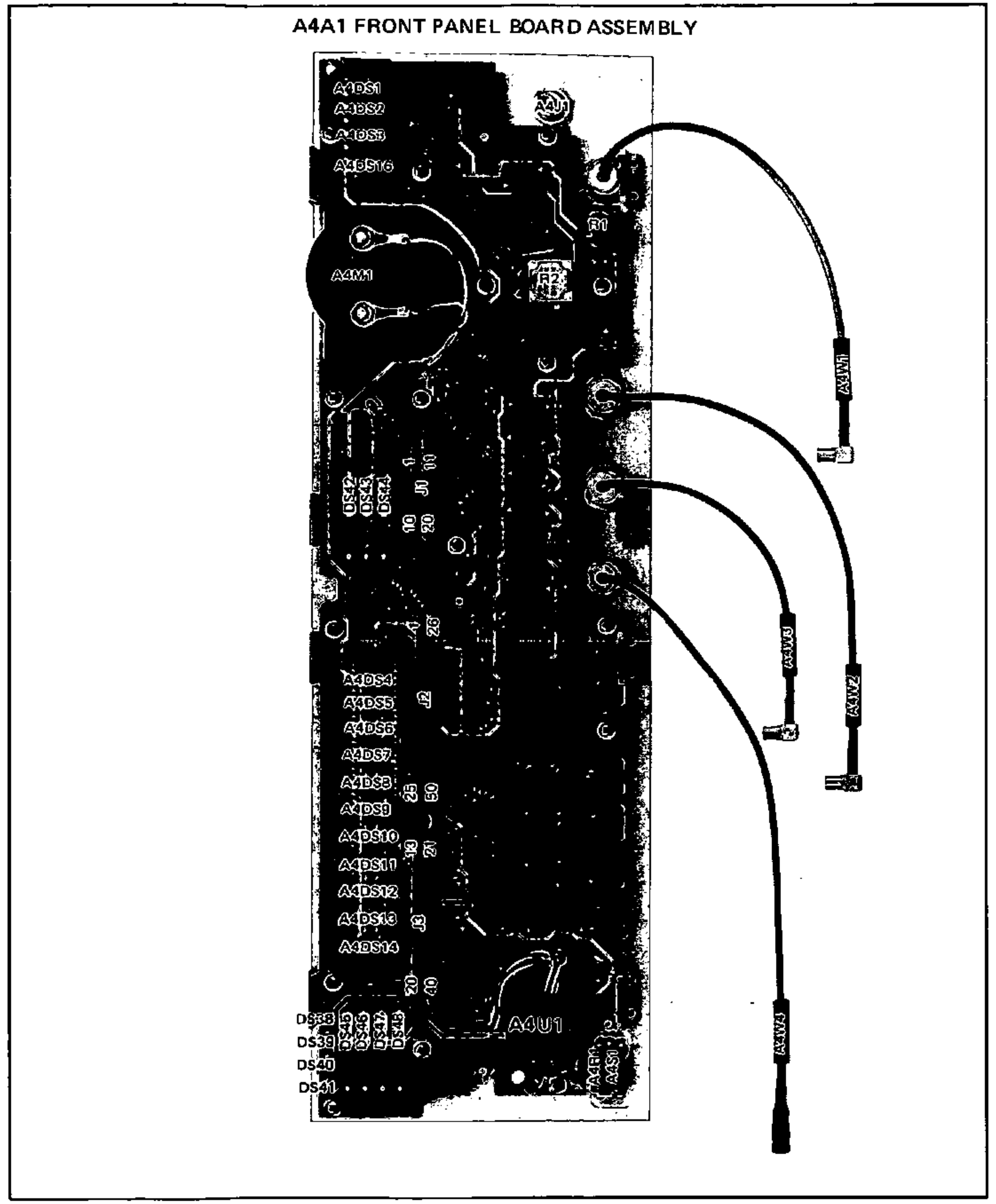


Figure 8-144. P/O A4A1 Front Panel Assembly Component and Test Point Locations

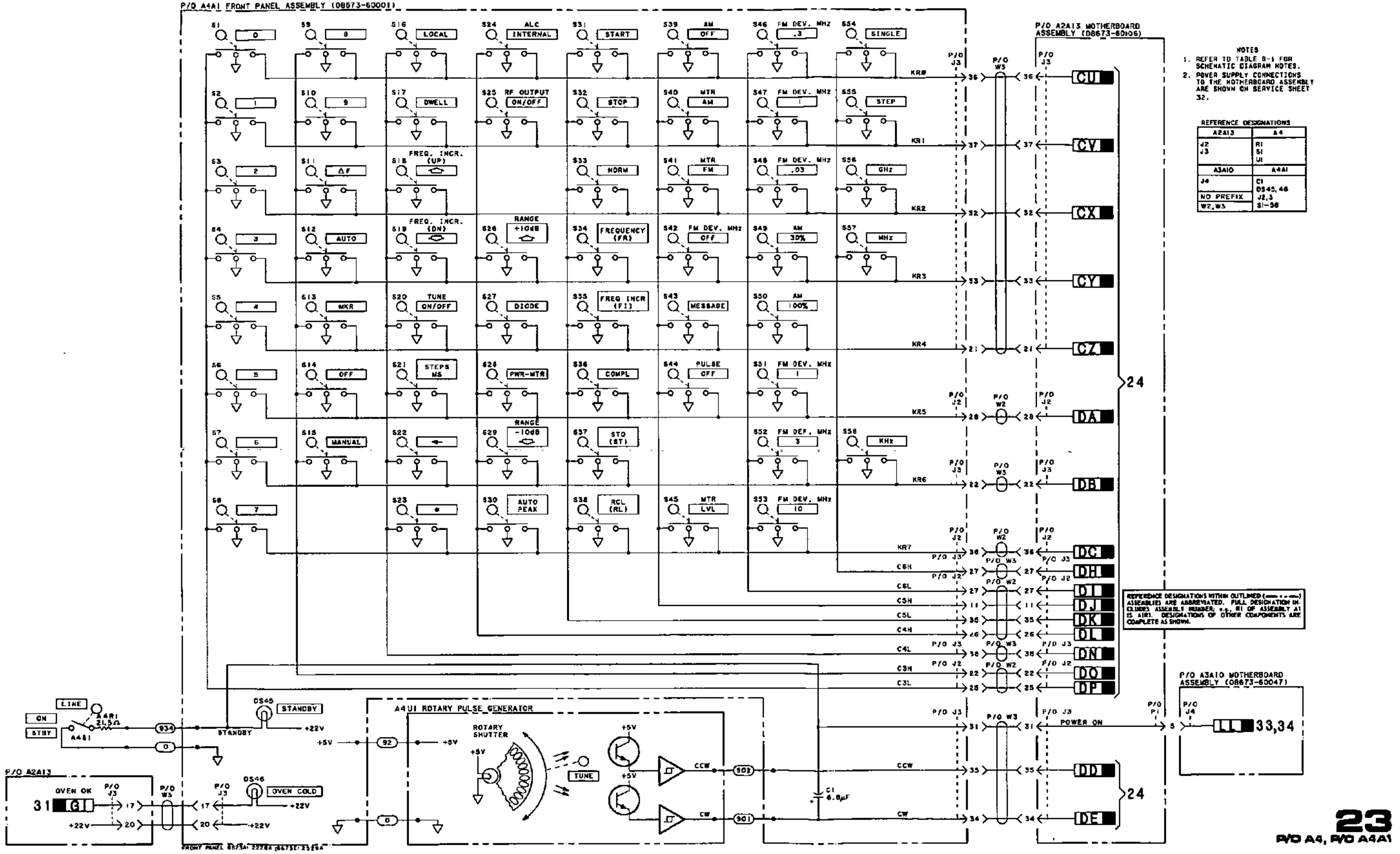


Figure 8-145. A4 Front Panel Keyboard Schematic Diagram

SERVICE SHEET 24

KEYCODE ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

The main function of the Keycode Assembly is to monitor the front panel push button switches. When a switch is pressed, an interrupt is generated in the digital control unit (DCU) by the low signal on KDN-L and the keycode circuitry generates a code corresponding to the particular switch selected on output lines K0—K6. When this code has been read by the DCU, the keycode circuitry is reset with a pulse from the DCU on KACK-L. As a convenience in troubleshooting, the encoded keycode lines are monitored and displayed by the Keyboard Status indicators on the top edge of the Keycode Assembly.

Switch Encoding

The "row" lines, KR0—KR7, from the front panel switch matrix are connected to the Row Encoder, U13. When one of the eight inputs to U13 is low, the output of the Row Encoder will be a 3-bit code corresponding to the input that is low. U13 pin 14 goes low to indicate that a row input is active (low) and the three row output lines are used to drive the K0—K2 lines of the Keycode Assembly.

The Row Encoder is a priority encoder which means that if more than one Row Encoder input is active (low) at the same time, the input with the lowest corresponding output code will be encoded. The KR0 input has the highest priority in the row encoder.

One of the Row Encoder output signals, U13 pin 14, enables the Column Encoder, U12, which is used to encode the eight key column lines, C3L—C6L and C3H—C6H. The output of the Column Encoder is used to complete the remaining code lines, K3—K6. The Column Encoder is also a priority encoder with C3H having the highest priority.

The Service Switch is connected as an additional switch and is encoded like the other front panel switches. The diodes, CR1 and CR2, allow the service switch to activate a row and column line simultaneously so a valid code is generated by the row and column encoders.

Switch Debouncing

An active input to the Row Encoder will cause U13 pin 14 to go low which will enable the Column Encoder via U1C. Once the Column Encoder is

Front Panel Keyboard
P/O A4, P/O A4A1
SERVICE SHEET 23

SERVICE SHEET 24 (cont'd)

enabled, any active Column Encoder input will cause U12 pin 14 to go low and will force U8C pin 8 high which in turn will start the timing cycle of the re-triggerable one-shot, U2.

The re-triggerable one-shot is used to introduce a delay to the encoding process. This delay eliminates problems with switch bounce. Once the one-shot timing cycle is complete, U2 pin 6 will return to a high state and cause U9A to be clocked to a high state. As long as U12 pin 13 is low, U1D pin 11 will remain high and the one-shot will remain disabled.

The release of the selected key is also debounced in a similar manner. When the Column Encoder is disabled or the active inputs are removed, U1D pin 11 changes to a low state and which again triggers the one-shot. The end of the timing cycle sets U9A pin 6 to a low state which inhibits further triggering of the one-shot.

The KDN-L signal is generated after the key release and can only be reset by a low pulse on the KACK-L line from the DCU. This handshaking ensures that the DCU receives only one interrupt per key selection and that the DCU has read the data before the circuitry is reset.

Rotary Pulse Generator (RPG) Encoding

RPG operation is disabled when RPG NENA is in a high state by holding the RPG LATCH, U7A, in a reset state. A front panel key closure will also disable the RPG by holding the RPG LATCH in a reset state until the key is released.

The output of the RPG LATCH is used to gate the RPG signals through U8A and U8B. When the RPG LATCH is set, the signals present at U8A pin 3 and U8B pin 6 will be the complements of CCW and CW respectively. When the RPG LATCH is disabled, the output of the two gates will be kept high no matter what state CW and CCW are in.

The two outputs of the RPG (CW and CCW) indicate the direction of rotation. Clockwise rotation of the RPG holds CW high longer than CCW. A counter-clockwise rotation holds CCW high longer. Both signals will be high for the first part of each sequence.

When both CW and CCW are high during an RPG sequence, U10B pin 6 will change to a low state in preparation for clocking the RPG LATCH. If the latch is not disabled (not held in the reset state), the latch will be set when one RPG output goes low and the two gates, U8A and U8B, will be enabled. The complements of CW and CCW will be passed to the external input encoder and to U11A whenever the two gates are enabled.

U11A will go to the high state any time one of its inputs goes low. This will set the EXTERNAL INPUT FLIP-FLOP, U9B which sets the KEY DOWN FLIP-FLOP and clocks the encoded outputs of the EXTERNAL INPUT ENCODER into the EXTERNAL INPUT LATCH, U6. The EXTERNAL INPUT ENCODER will be driven by NCW or NCCW (whichever is still in the high state). A code will be presented on lines K0—K2. The code will be 000 for counterclockwise rotation and 001 for clockwise rotation.

External Inputs

The remaining function of the Keycode board is to decode the six Auxiliary inputs from the rear panel. If any of the inputs to the EXTERNAL INPUT ENCODER, U14, is active (low), the same sequence of events will occur as when the RPG is turned, except that different codes will be formed.

If jumper W2 is removed and W1 is installed, the external inputs will go through the same debouncing process as the column and row inputs. The RPG encoding will also go through a debounce process with W1 installed.

TROUBLESHOOTING

Component-level troubleshooting procedures for the Keycode Assembly are contained in Service Sheet BD8.

A2A2 ASSEMBLY

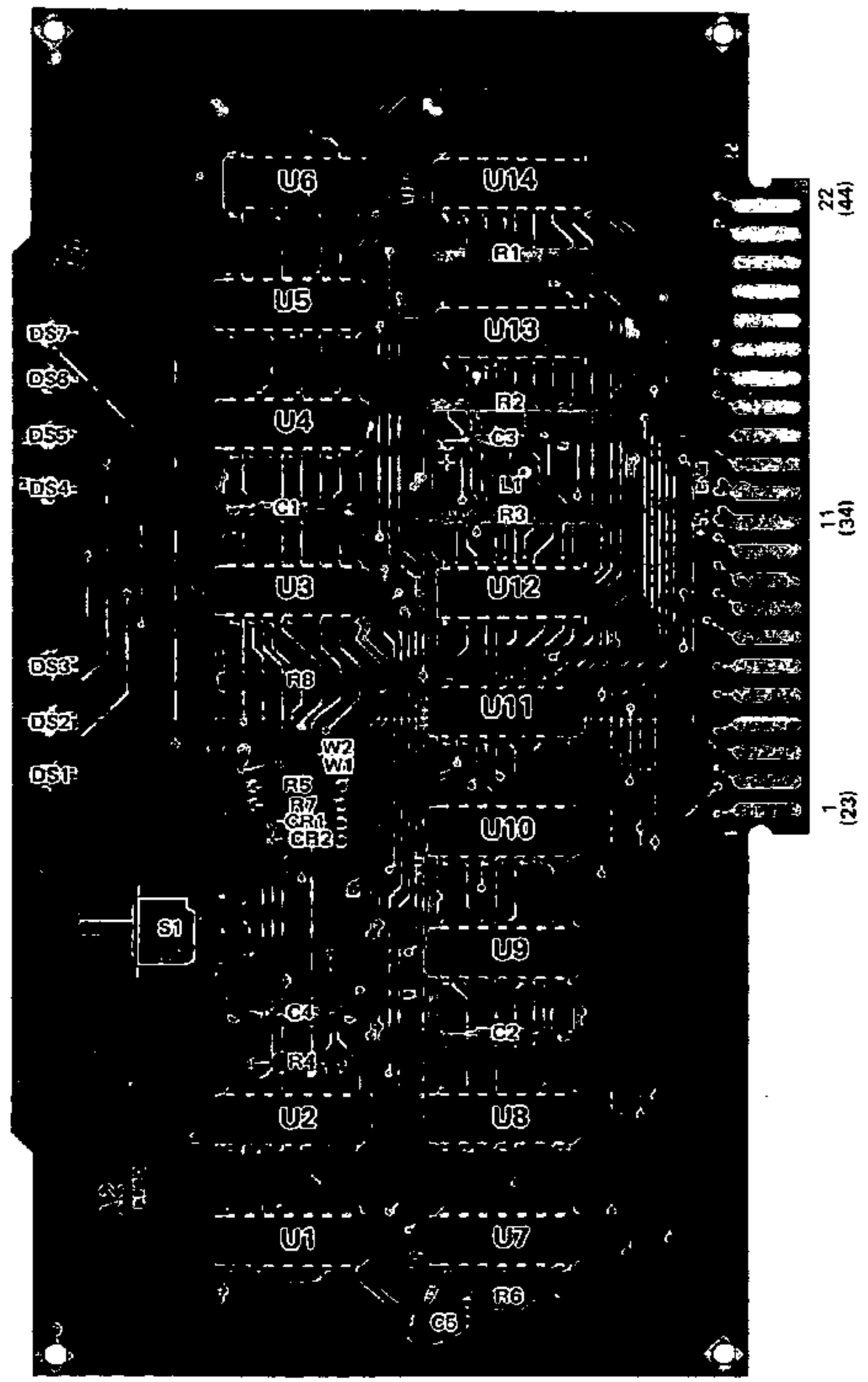
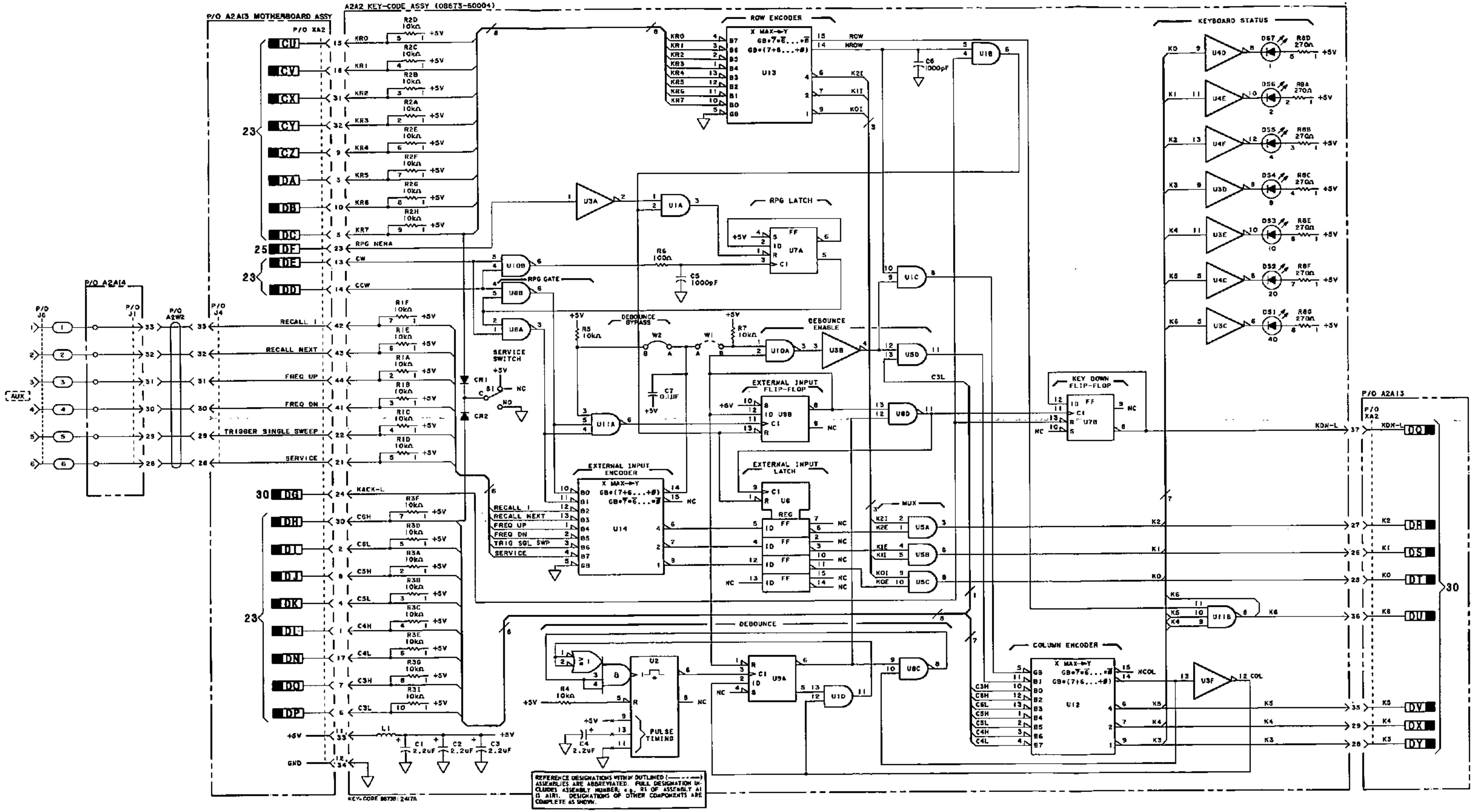


Figure 8-146. A2A2 Key Code Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE MOTHERBOARD ASSEMBLY ARE SHOWN ON SERVICE SHEET 6.

REFERENCE DESIGNATIONS

A2	A2A2
W2	C1-7 CR1, 2 DS1-7 L1 R1-8 S1 U1-14 W1, 2
A2A13	
J4 XA2	
A2A14	
J1, 6	

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
U1, 5	1820-1201
U2	1820-1422
U3, 4	1820-1199
U6	1820-1195
U7, 9	1820-1112
U8, 10	1820-1197
U11	1820-1202
U12, 13, 14	1820-1051

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U1-5, 7-11	+5V - 14 ⏚ - 7
U6, 12-14	+5V - 16 ⏚ - 8

24
A2A2, P/O A2A14

Figure 8-147. Key Code Assembly Schematic Diagram

SERVICE SHEET 25

PANEL DRIVER ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
Digital Control Unit (DCU) Block Diagram .... Service Sheet BD8
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

The Panel Driver Assembly contains latches used to control the front panel indicators. Data Bus signals FD0—FD7 are latched into one of seven latches, U5—U11. These latches are controlled by decoded address signals from address decoders U14 and U15, and the enable signal PRW. The address decoders are enabled by DLE and NUME, respectively, and PRW. U1 and U2 form the blink circuit for the AUTO indicator. When U4 pin 1 is low, the MESSAGE indicator will blink on and off.

TROUBLESHOOTING

Component-level troubleshooting procedures for the Keycode Assembly are contained in Service Sheet BD8.

Keycode Assembly A2A2, P/O A2A14 SERVICE SHEET 24

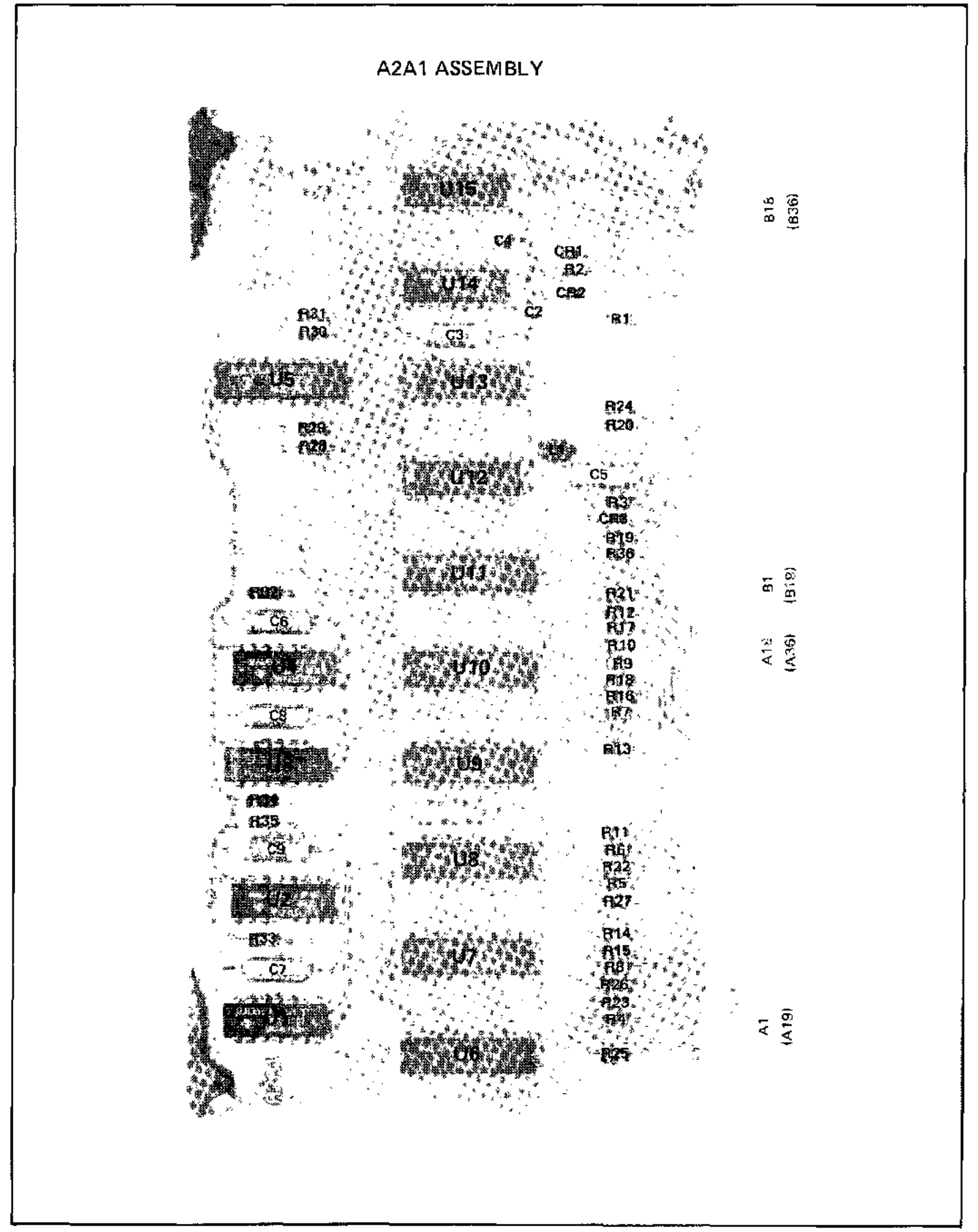


Figure 8-148. A2A1 Panel Driver Assembly Component Locations

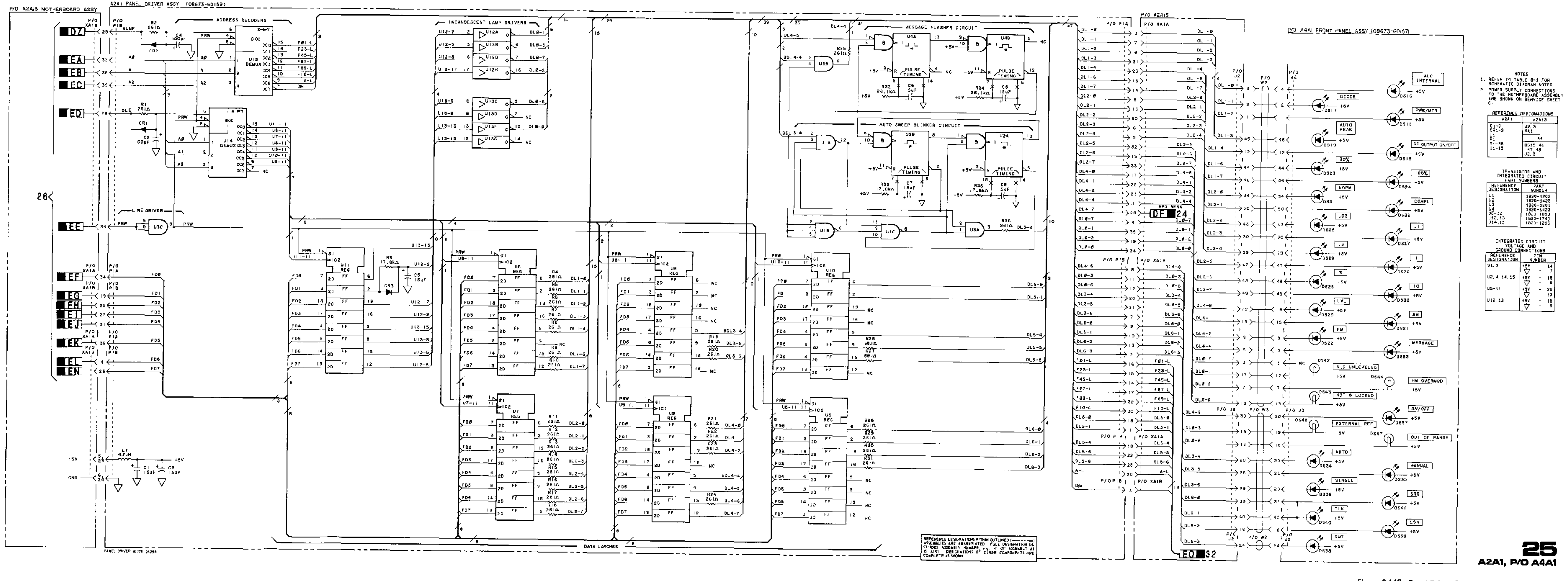


Figure 8-149. Panel Driver Assembly Schematic Diagram

SERVICE SHEET 26

MICROPROCESSOR ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

The Microprocessor Assembly forms the kernel of the Digital Control Unit (DCU). The Microprocessor Assembly contains a Microprocessor and circuits for timing, interrupt encoding, address bus decoding and data bus buffering.

The Microprocessor, U6, is the Motorola 6808. It has six internal registers, a sixteen line address bus, an eight line bi-directional data bus, and various clock and control lines. The Microprocessor begins executing firmware commands by setting the Enable (E) output low. Then, it sets the address bus to the address of the next instruction, sets the Read/Write high (for read), and sets the Valid Memory Address, VMA, high. This in turn causes address decoders on the ROM Board to select a particular byte from Read Only Memory (ROM). Next, the Microprocessor sets Enable high, and the ROM responds by putting the addressed byte on the data bus. At the end of the Enable, the Microprocessor latches the contents of the data bus into an internal instruction register. The Microprocessor internally decodes the data into one of seventy-two possible instructions. Many of the instructions will require one or two additional bytes of data to complete the instruction. In this case, the above cycle will be repeated once or twice until the complete instruction has been read.

The instructions can be grouped into four categories. The simplest are those that cause the Microprocessor to modify contents of an internal register. These instructions require one or more clock cycles to execute. During these cycles VMA is set low, so that devices external to the Microprocessor cannot change state. The next group of instructions cause the Microprocessor to read a byte of data from some input device. Since the Microprocessor treats all input-output operations as memory-mapped, the sequence of events is the same whether the Microprocessor is reading from the ROM, the RAM (Random-Access or Read-Write Memory), the PIA, or HP-IB.

The third group of instructions cause the Microprocessor to write the contents of an internal register to some address, such as RAM, HP-IB or the front panel. The write cycle is similar to a read cycle

SERVICE SHEET 26 (cont'd)

except that during a write cycle, the Microprocessor sets Read/Write (R/W) low instead of high. Then, after Enable is high, the Microprocessor drives the data bus with appropriate data. Finally, at the end of the Enable, the external device is clocked to latch the data.

The fourth, and last, group of instructions are Read-Modify-Write instructions. An example of this type of instruction is one that increments a byte in RAM. The Microprocessor must first read the existing byte from RAM. Next the Microprocessor internally adds one to that value and stores the new value in the same location in RAM.

Clock Conditioning Circuits

The clock that drives the Microprocessor begins with a 10 MHz input from the 10 MHz Reference Oscillator A3A8. The input signal is converted to TTL levels by Q2. Two NAND gates act as a multivibrator. Normally, the oscillation will be injection-locked by the output of Q2. If, for some reason, the 10 MHz input is missing, the multivibrator will free run at 8 to 9 MHz. Without this feature, a failure in the reference section of the instrument would prevent the entire DCU from operating. As it is, a failure of the 10 MHz input will simply cause the DCU to run a little slower than usual. The 10 MHz from the multivibrator is divided by 2 in U10. The resulting 5 MHz is used as a clock input to the Microprocessor. The Microprocessor, in turn, divides this input by 4 to achieve the basic clock frequency of 1.25 MHz. The 1.25 MHz is output by the Microprocessor as the Enable signal.

During a Write cycle, the Microprocessor does not place data on the data bus until after the Enable is high. It then removes the data after the low-going edge of the Enable. There are numerous latches in the DCU that are simple TTL flip-flops with only one clock input. The input must be a combination of various address lines, VMA, Read/Write, as well as Enable. Since the Enable signal undergoes several gate delays before it can reach a given flip-flop clock input, the data may change before it is clocked in.

To overcome this problem, a special clock, PHE-H is generated. On the Microprocessor read cycles, it is essentially the same as the Enable except for a negligible delay. On a write cycle, U1 counts the 5 MHz input to the Microprocessor, and causes the high to low transition on PHE-H to occur before the end of the Enable signal.

Several other lines are used as clocks for different circuits. The Enable from the Microprocessor is sent directly to the HP-IB circuitry. E-PIA, which is used to clock the Peripheral Interface Adapter (PIA), is turned off when the DCU is idle as are all of the clock lines except for Enable.

Timing

Time delays for sweep, etc., are generated by the Programmable Timing Module U8, which is a Motorola MC6840. Internally, U8

Panel Driver Assembly
A2A1, P/O A4A1
SERVICE SHEET 25

SERVICE SHEET 26 (cont'd)

contains several registers and three independent timers. By means of appropriate software, the Microprocessor can enable one or more of the three timers to measure a desired time delay. The timers count down from the 1.25 MHz Enable. When one or more of the timers have timed out, there is an Interrupt Request output. By reading the timer status register, the Microprocessor can tell which timer has timed out, and then branch to routines to compute the next sweep frequency, switch the attenuator, or whatever else is required.

Interrupt Encoding

The DCU is basically interrupt driven. When there is nothing to do, the Microprocessor waits for an Interrupt Request. Interrupts can come from the Vernier Tracking Circuit (VTI-L), the timer, the PIA, HP-IB, and the power supply. An interrupt will cause the Microprocessor to perform some routine and then go back to idle.

To speed up and simplify the programming required to determine which of the six possible interrupts caused the Interrupt Request, there is an Interrupt Priority Encoder U24. When one or more of the interrupts to U24 go low U24-14 will go low and send IRQ-L to the Microprocessor. The Microprocessor then responds by reading the encoded outputs of U24 on the data bus. The Microprocessor now has a numerical code corresponding to the highest priority interrupt that is low at that time.

The highest possible priority interrupt is from the power supply. If there is a power supply problem, the Microprocessor will be prevented from doing anything else.

The other priorities, in order, are HP-IB (IRQIB-L), followed by keyboard inputs (IRQA-L), the timer, the malfunction circuit (IRQB-L), and lastly the vernier tracking circuit (VTI-L). Because of the priority encoder, a rapid series of events on HP-IB, for example, makes the Generator a little slow in keeping up with lower priority interrupts. However, as long as a low priority interrupt condition exists, the Microprocessor will eventually process it.

Turn-on and Reset

The purpose of the Power-On Logic circuit is to ensure an orderly sequence of events during turn-on and turn-off. The inputs are the Power Up signal from the +5 volt regulator in the power supply section, and the +5 volt supply itself. The outputs are RES-L and PWR ON.

For a normal turn-on, the +5 volt supply will slowly come up to the proper regulated voltage. Once the operating voltage is reached, the Power Up line will go high. The Power Up signal goes through U18, which causes a time delay of 50 ms. The output of U18 is combined with its input to generate a reset signal that stays low for at least 50 ms after the +5 volts is on. This signal is used to reset the Microprocessor, the timer, the PIA, and HP-IB. Then, the Microprocessor begins to execute firmware instructions which initialize the rest of the DCU.

The output of U19 pin 3 does two other things. It switches on Q1 which connects the +5 volt supply to the battery protected supply for the RAM. It also sets Pwr On to low so that the Microprocessor can write data into the RAM. Without this write protection, the Microprocessor could change data in RAM during power-up or power-down sequences.

Address Bus Decoding

The 16 address lines from the Microprocessor allow it to address 65,536 locations in memory for reading or writing data. The entire 16 line address bus goes to the RAM and ROM boards, A2A10 and A2A11 which decode the addresses necessary for RAM and ROM functions. Other address decoding is done on the Microprocessor Assembly and the assembly being addressed (such as, Frequency Output-HP-IB A2A9, I/O Board A2A7, etc.). This is done to minimize the number of decoding circuits and address lines.

TROUBLESHOOTING

Component-level troubleshooting procedures for the Microprocessor Assembly are contained in Service Sheet BD8.

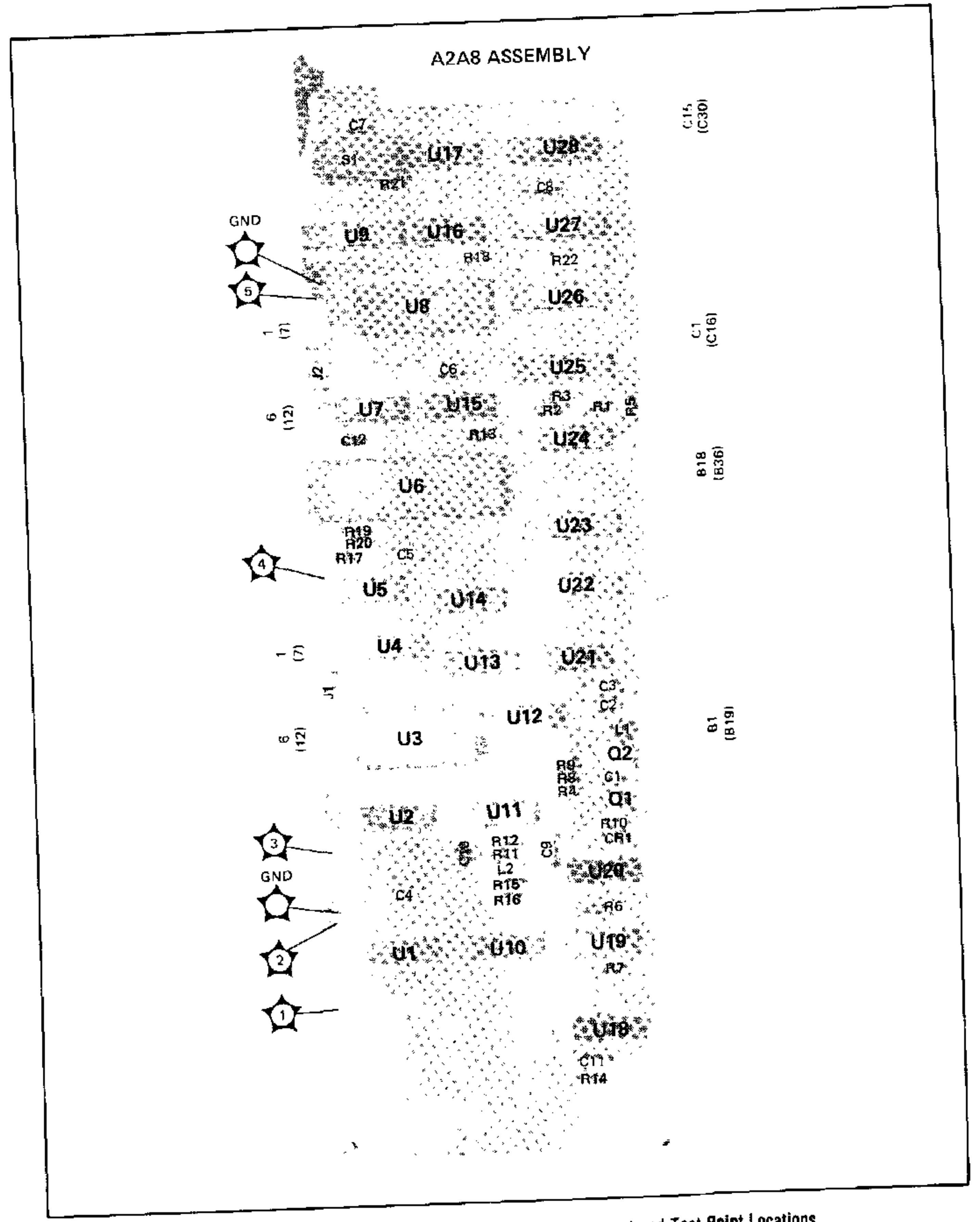


Figure 8-150. A2A8 Microprocessor Assembly Component and Test Point Locations

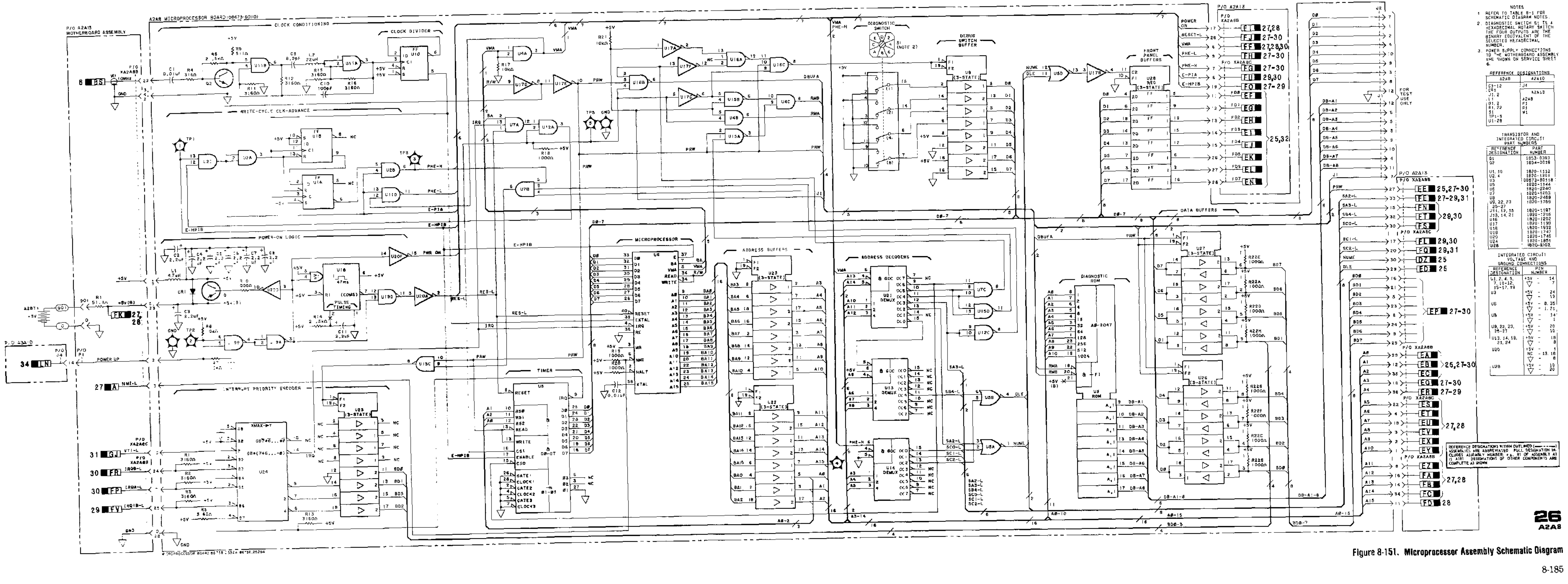


Figure 8-151. Microprocessor Assembly Schematic Diagram

SERVICE SHEET 27

ROM ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

The function of the ROM Assembly is to store firmware instructions for the Microprocessor. U5, U6, and U7 are the ROM's. Each ROM is capable of storing 8192 bytes (eight bits each). U8 is an address decoder which decodes the address bus signals and the VMA signal from the Microprocessor Assembly. It generates enable signals for the ROM and data bus buffers.

TROUBLESHOOTING

Component-level troubleshooting procedures for the ROM Assembly are contained in Service Sheet BD8.

Microprocessor Assembly
A2A8
SERVICE SHEET 26

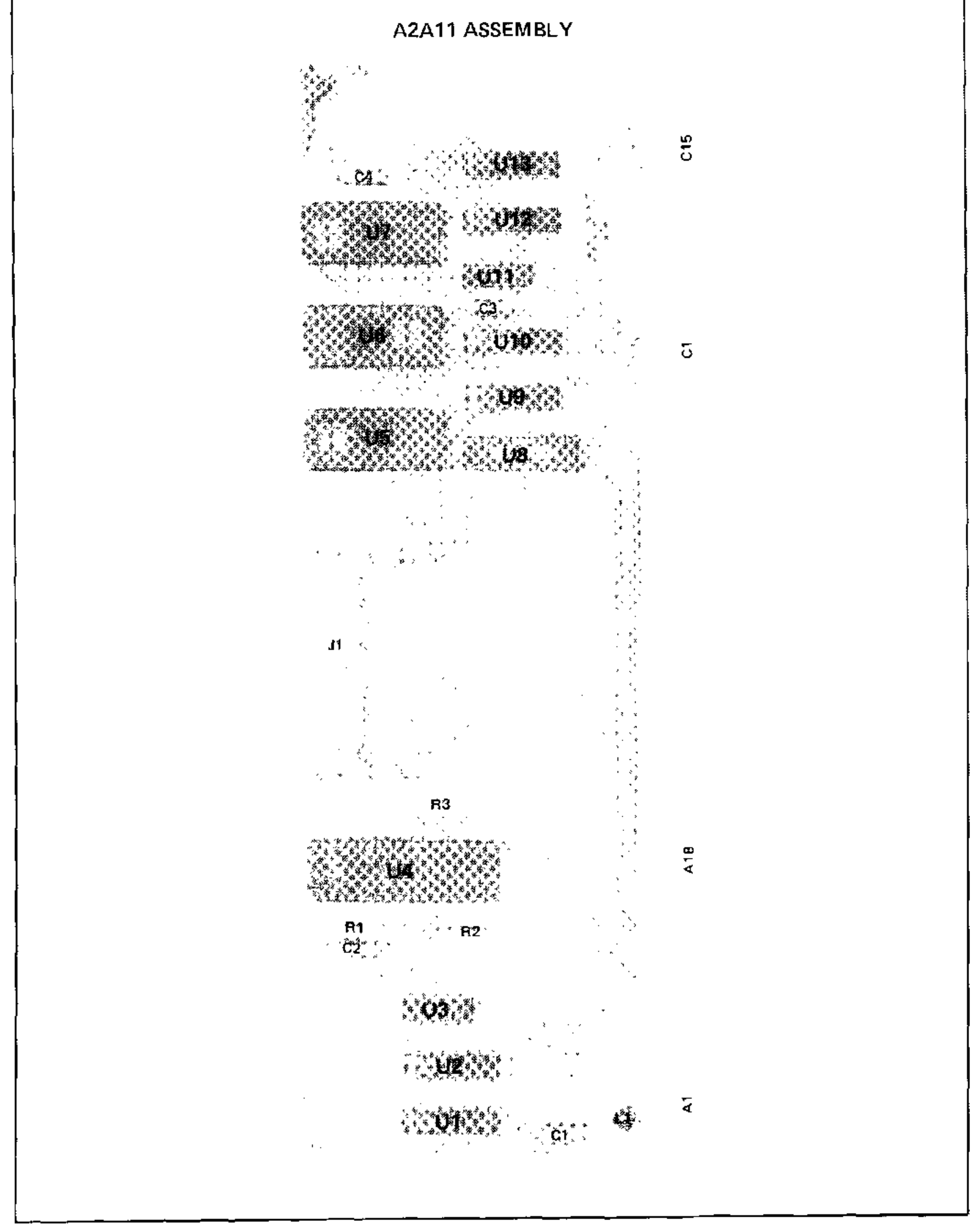
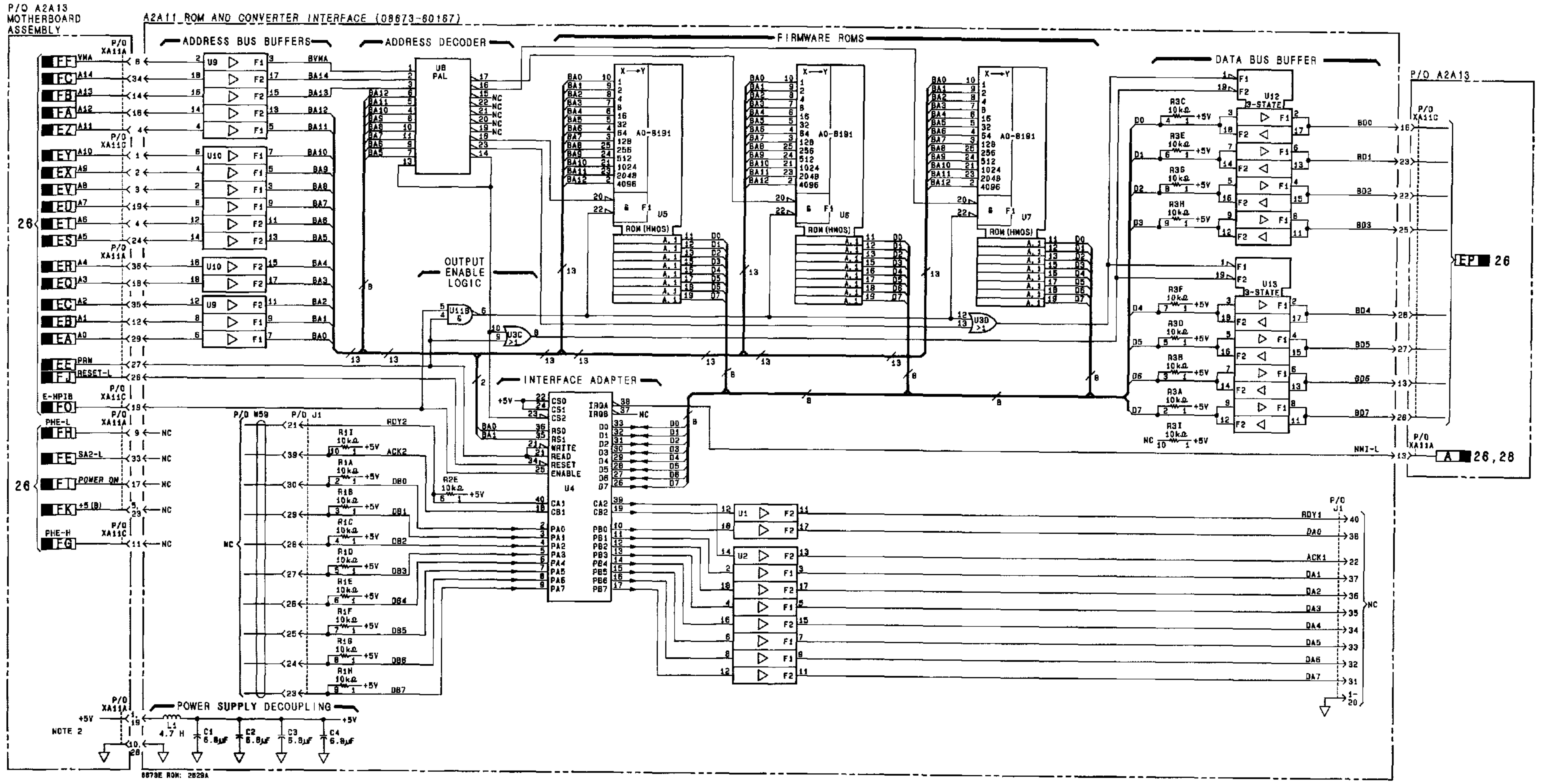


Figure 8-152. A2A11 ROM Assembly Component Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE MOTHERBOARD ASSEMBLY ARE SHOWN ON SERVICE SHEET 6.

REFERENCE DESIGNATIONS

A2A11	A2A13
C1-4	XA11A, C
J1 L1	NO PREFIX
R1-3 U1-13	W59

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
U1, 2, 9, 10, 12, 13	1820-1759
U3	1820-1208
U4	1820-2081
U5	08673-80051
U6	08673-80052
U7	08673-80053
U8	08673-80014
U11	1820-1197

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U1, 2, 9, 10,	+5V - 20 GND -1, 10, 19
U3, 11	+5V - 14 GND - 7
U4	+5V - 20 GND - 1
U5-7	+5V - 1, 27 28 GND - 14
U8	+5V - 24 GND - 12
U12, 13	+5V - 20 GND - 10

27
A2A11

Figure 8-153. ROM Assembly Schematic Diagram

SERVICE SHEET 28

RAM ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
Digital Control Unit (DCU) Block Diagram .... Service Sheet BD8
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The RAM Assembly consists of the RAM (Random Access Memory or Read/Write memory), the associated Read/Write logic circuitry, and the divide-by-three circuitry. The RAM Assembly has two basic functions:

a. To provide temporary storage of data such as frequency values, front panel settings and program addresses when a subroutine is being executed.

b. To divide the selected output frequency value by three to determine the Band 3 YTO frequency value.

Divide-by-Three Circuit

The Signal Generator multiplies the YTO frequency by 1, 2 or 3 to generate the final output frequency. However, the DCU receives the output frequency value directly from the keyboard and must generate the YTO frequency value by dividing it. Division-by-two is simple and fast but division-by-three requires special circuitry to achieve adequate speed. (See Figure 8-154 for a block diagram of the divide-by-three circuitry. Division-by-two is accomplished by firmware within the Microprocessor Assembly.) A general-purpose division algorithm in the microprocessor would take about 20 ms for division-by-three; the circuitry here accomplishes the division in about 200 μs using a look-up table.

The Microprocessor Assembly starts the division cycle by clearing the Input Latch. The most significant digit of the output frequency is retrieved from RAM, passed through the Bi-Directional Data Buffer, and stored in the Input Latch. The Input Latch drives the Look-Up Table (a ROM — Random Access Memory). The Look-Up Table produces the divide-by-three quotient and a remainder. This quotient plus remainder passes through the Data Buffer back to the Microprocessor Assembly. The process repeats for the next significant digit, and so on until the the complete output frequency value has been processed. In each of these subsequent steps, the remainder from the previous step is stored in the Output Latch along with the new data.

TROUBLESHOOTING

Component-level troubleshooting procedures for the RAM Assembly are contained in Service Sheet BD8.

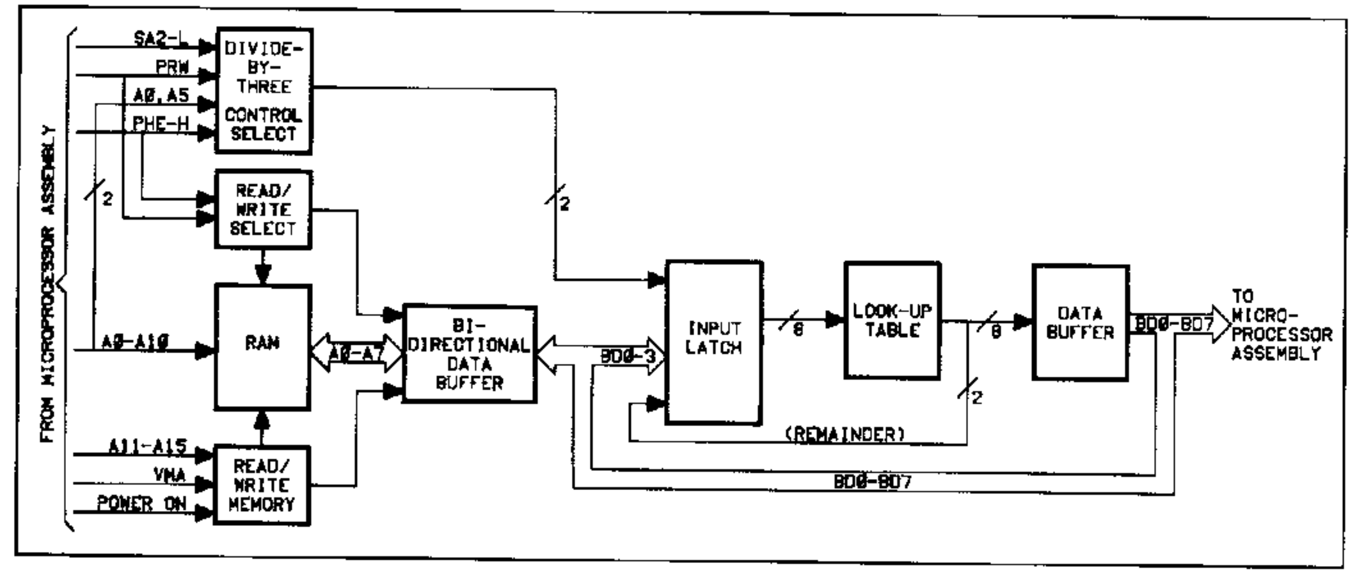


Figure 8-154. Divide-by-Three Functional Block Diagram

ROM and Converter Interface Assembly A2A11 SERVICE SHEET 27

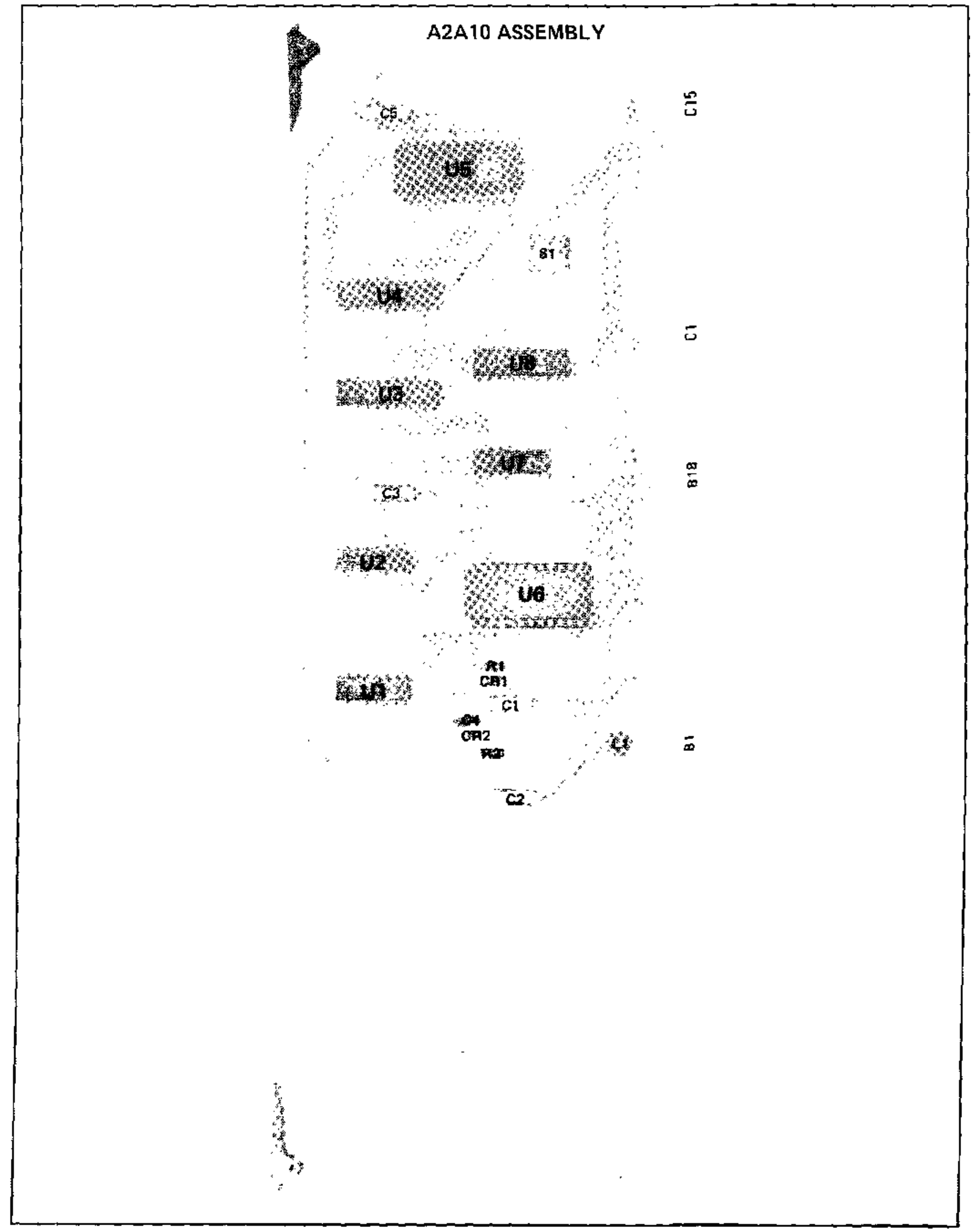
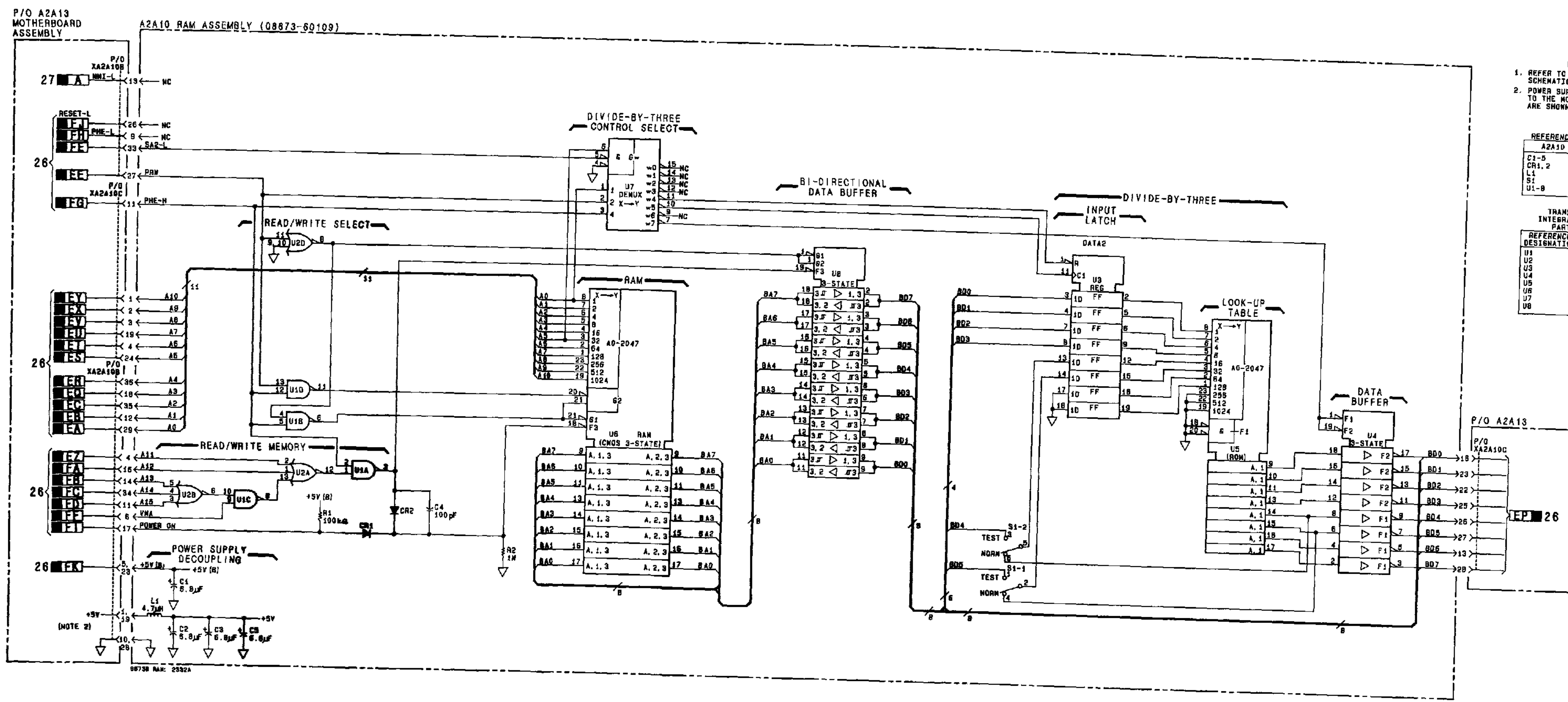


Figure 8-155. A2A10 RAM Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE MOTHERBOARD ASSEMBLY ARE SHOWN ON SERVICE SHEET 6.

REFERENCE DESIGNATIONS

A2A10	A2A13
C1-5 CR1, 2 L1 S1 U1-8	XA2A10B, C

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
U1	1820-1197
U2	1820-1206
U3	08673-80001
U4	1820-1759
U5	1818-0498
U6	1818-1768
U7	1820-1216
U8	1820-2075

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U1, 2	+5V - 14 ▽ - 7
U3, 4, 8	+5V - 20 ▽ - 10
U5	+5V -21, 24 ▽ - 12
U6	+5V - 24 ▽ - 12
U7	+5V - 16 ▽ - 8

28
A2A10

Figure 8-156. RAM Assembly Schematic Diagram

SERVICE SHEET 29

FREQUENCY OUTPUT — HP-IB ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

The Frequency Output - HP-IB Assembly has two groups of circuitry. First is the circuitry that converts Digital Control Unit (DCU) data into frequency data for the phase lock loops. Second is the circuitry that interfaces the Signal Generator to the Hewlett-Packard Interface Bus (HP-IB).

Frequency Data Circuitry

The frequency of the YTO (YIG Tuned Oscillator) calculated by the DCU is presented as a Binary-Coded-Decimal (BCD) signal to the Frequency Output - HP-IB Assembly. The four least significant digits are stored in U17 and U18 and the three most significant digits are stored in U15 and U16. The M/N and DAC decoders then calculate the M and N numbers in BCD, the DAC frequencies in BCD, and the 1 kHz to 800 kHz frequencies for the 20/30 Divider (Service Sheet 6).

The relationships between the output frequency and the various loop frequencies are shown below:

$$f_{YTO} = \frac{f_{OUT}}{B}$$

where the f_{OUT} is the output frequency and B is the band number as shown below.

Output Frequency Band (MHz)	Band Number (B)
2000 to 6599.999	1
6600 to 1299.999	2
12300 to 18599.999	3

f_{LFS} = (30-x.xxxx) MHz, where x.xxxx are the 1 MHz and lower digits of the YTO frequency

$$f_{M/N} = \left[200 - \left(\frac{10M}{N}\right)\right] \text{MHz}$$

To determine M (M varies from 8 to 27):

If the 100 MHz digit of the YTO frequency is even:

M = 17−10 MHz digit

If the 100 MHz digit is odd:

M = 27−10 MHz digit

To determine N (N varies from 11 to 34) Divide the two most significant digits of the YTO frequency by two.

Add 1 to the result and round up to the nearest integer.

To check any calculations:

$$f_{OUT} = B(200N - 10M - f_{LFS})$$

HP-IB Circuitry

The heart of the HP-IB circuitry is U10, an Intel 8291A. U10 contains most of the logic to interface the Signal Generator to the bus. Internally, U10 has eight registers that the DCU can read and eight registers to which the DCU can write. U11 and U22 buffer inputs and outputs to the interface bus while U19 and U20 buffer inputs and outputs to the data bus. U21 allows the DCU to read the address switch setting when so programmed. The firmware decides whether the DCU should write the switch setting or a front panel address entry to U10. U10 can then perform all necessary address decoding internally without assistance from the DCU. Normally, the address will be set either at power up, or when the LOCAL button is pressed. The remaining circuits provide the necessary connection between the address bus and PRW from the DCU, and the read, write and enables for U10, 19, and 20. When there is an HP-IB address status change, or data is to be transferred to or from HP-IB, U10 generates a low on pin 11 that in turn interrupts the Microprocessor.

TROUBLESHOOTING

Component-level troubleshooting procedures for the Frequency Output - HP-IB Assembly are contained in Service Sheet BD8.

RAM Assembly A2A10 SERVICE SHEET 28

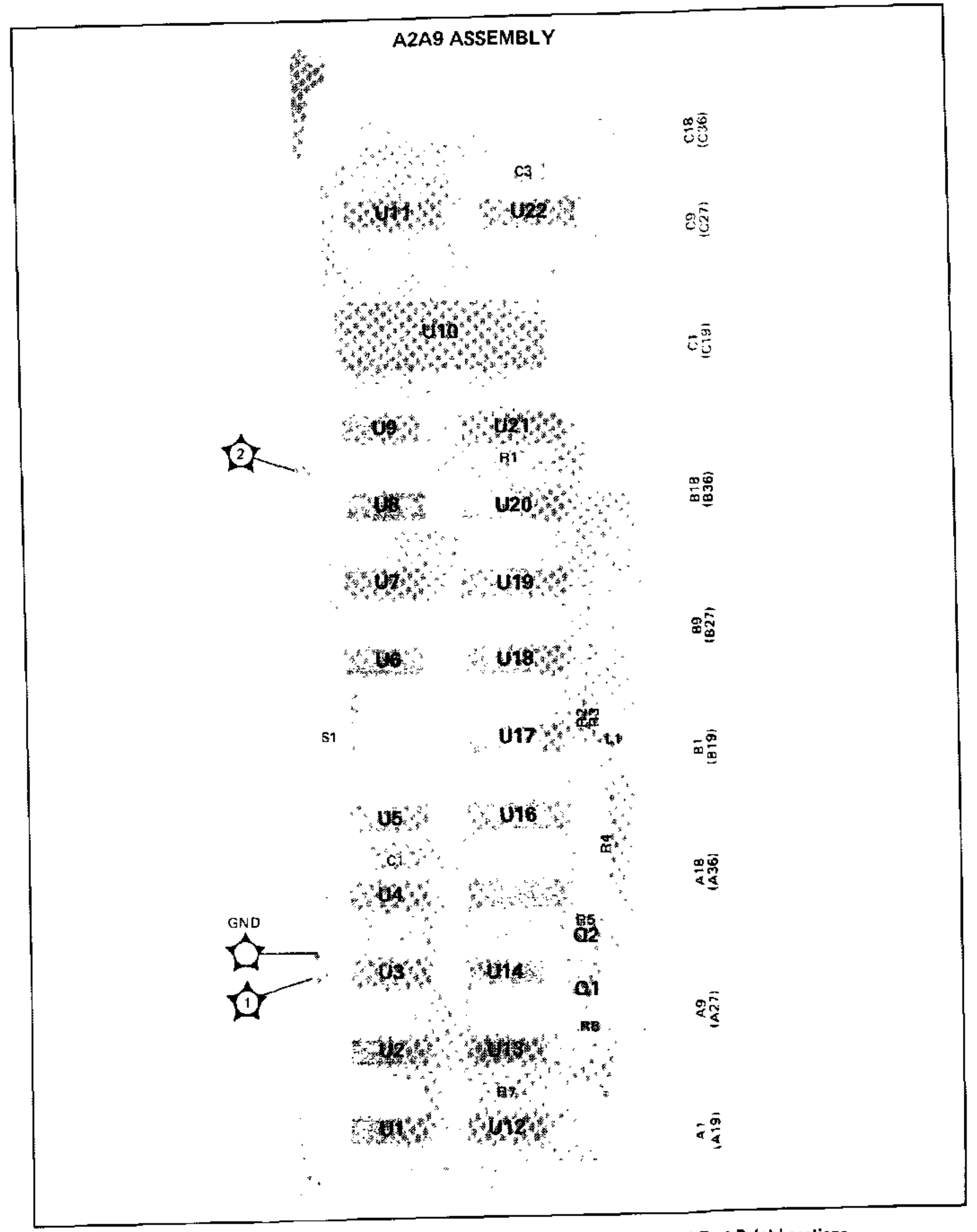
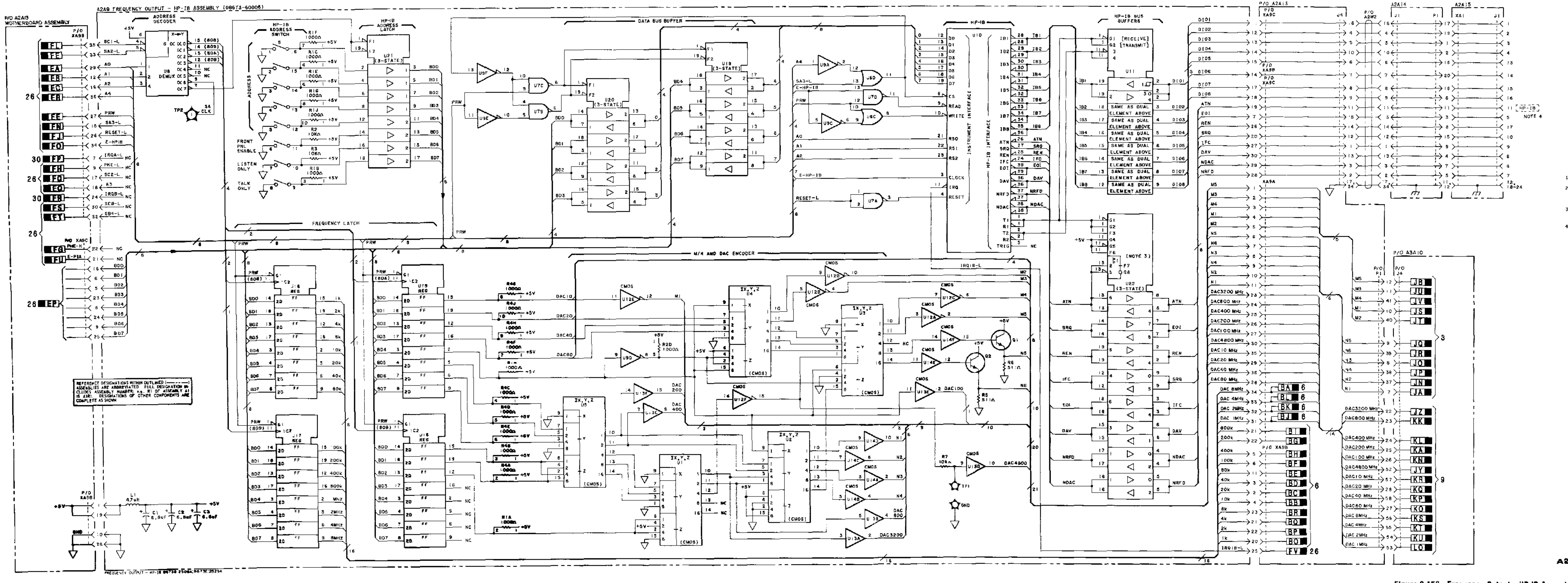


Figure 8-157. A2A9 Frequency Output—HP-IB Assembly Component and Test Point Locations



NOTES

1. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.
2. POWER SUPPLY CONNECTIONS TO THE MOTHERBOARD ASSEMBLY ARE FOUND ON SERVICE SHEET 6.
3. THIS NOTATION INDICATES IF F7 IS ACTIVE, THEN G8 IS INACTIVE, AND VICE VERSA.
4. WHEN USING 10833A/B/C/D CABLES, HP-IB ADAPTER W8 (5060-9462) IS REQUIRED.

REFERENCE DESIGNATIONS

A2A9	A2A13
C1-3 L1 Q1, 2 R1-7 S1 TP1 U1-22	J4 XA9A-C
	A2A14
	J1 P1
A2A10	**A2A15**
J4	J1 XA1

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
U1-5	1820-1955
U6	1820-1208
U7	1820-1197
U8	1820-1216
U9	1820-1199
U10	1820-2549
U11	1820-3431
U12	1820-1746
U13, 14	1820-1976
U15-18	1820-1858
U19-21	1820-1759
U22	1820-3513

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U1-5	+5V - 8 ▽ - 16
U6, 7, 9	+5V - 14 ▽ - 7
U8	+5V - 16 ▽ - 8
U10	+5V - 40 ▽ - 20
U11, 15-18, 19-21	+5V - 20 ▽ - 10
U12	+5V - 1 ▽ - 8 NC -13, 16
U13, 14	+5V - 1 ▽ - 8
U22	+5V -11, 20 ▽ - 10

29
A2A9, A2A14, A2A15

Figure 8-158. Frequency Output—HP-IB Assembly Schematic Diagram

SERVICE SHEET 30
I/O ASSEMBLY, PART 1
REFERENCES

Overall Block Diagram and Troubleshooting, BD1	Service Sheet BD1
Digital Control Unit (DCU) Block Diagram	Service Sheet BD8
Electrostatic Discharge (ESD) Precautions	Section VIII (Front)
Disassembly Procedures	Service Sheet A
Interior Views	Service Sheet B
Replaceable Parts List	Section VI
Illustrated Parts Breakdown (IPB)	Section VI
Post Repair Adjustments	Section V
After Service Safety Checks	Section VIII (Front)

PRINCIPLES OF OPERATION

General

The I/O Assembly interfaces the Microprocessor Assembly to peripheral circuits in the Signal Generator. Interface control is effected through U11, Peripheral Interface Adapter (PIA), the MC68A21. The I/O Assembly contains a variety of circuits whose only common feature is that they are inputs to or outputs from the Digital Control Unit (DCU).

Peripheral Interface Adapter -Key Code Interface

The "A" side of the PIA is used to interface the Key Code Assembly (Service Sheet 24) with the Microprocessor Assembly (Service Sheet 26). The eight lines from the Key Code Assembly are the keyboard data lines. When NKDN goes low, the PIA responds by setting NIRQA low. This is an interrupt request to the DCU. The DCU responds by reading the Key Code input from the data bus. The PIA then sets NKACK low for 1 microsecond.

Phase Lock Indicators and Logic

When one of the normally-low phase lock signals goes high, it turns off the Phase Lock Indicator associated with that signal. For each of the signal lines there is an associated diode, capacitor, resistor and indicator. Only when the phase locked loop remains locked for a period of time can the resistor discharge the capacitor and turn on the indicator. A loop that is not phase locked or is being frequency-switched will not have its indicator turned on. When the YTO Unlocked signal goes high a negative pulse is generated as YTO NRST. Similarly, a positive input pulse at YTO SLEW also causes a negative pulse to be generated at YTO NRST.

The four phase lock signals are combined by a NOR gate, U1, so that when any one of the phase lock signals goes low, an unlock signal is sent to the Status Latch U10.

Status Latch, Malfunction Comparator, and Increment Gate

The I/O Assembly monitors the status of the External/Internal

SERVICE SHEET 30 (cont'd)

Switch, FM Overmodulation, Output Leveling and Not Phase Locked. These signals are stored in the Status Latch U10. The output of the Status Latch is input to the PIA at PB0—3 and the Malfunction Comparator U19. The other PIA "B" lines are used as outputs to the Malfunction Comparator. In normal operation, the following sequence occurs:

1. The DCU reads the status from the PIA.

2. The DCU writes to the PIA to cause the four outputs PB4—7 to be the same as the four inputs PB0—3.

The Malfunction Comparator output will be high. If one of the status signals changes, the comparator output will go low. After a delay, the Malfunction Increment Circuit will enable the Increment Gate. If the Status Latch output and PB4–7 are still different, the PIA's CB2 line will be driven low. The PIA will then set the NIRQB line low, generating an interrupt to the DCU. The DCU repeats the sequence of reading and writing to the PIA. This procedure is used when the DCU updates the front panel annunciators and the HP-IB status. The purpose of the Malfunction Comparator and Malfunction Increment Circuit is to relieve the DCU of having to check the status repeatedly when no change is occurring.

It is possible that the status conditions could change during the brief interval between when the PIA is read and the bit pattern is written back to the PIA. If this occurs, the Malfunction Comparator does not have equal inputs, and another interrupt cannot be generated. For this reason, the Status Latch is included in the circuit to hold the inputs to the PIA until the DCU has actually set the PIA output the same as the output of the Status Latch.

For a brief time following a frequency change, unlocked and unleveled conditions are expected. During this time, the interrupt capability of the PIA is temporarily disabled while the DCU repeatedly checks for phase lock to be re-acquired. This condition will not last more than about 10 milliseconds.

RF Output Module Control

Control of the RF Output Section is effected by the DCU through the I/O Assembly. Four address lines and eight data lines from the DCU are latched on the I/O Assembly board. Five control lines from the DCU are used to control latching of the data on the I/O Assembly board and to generate a strobe signal. Outputs, BA0—BA3, from the Output Module Control address bus latch, U16, are sent to the DAC and Enable Board (Service Sheet 22) where they are decoded by a demultiplexer when strobed by the NSTRB signal. The demultiplexer generates eight enable signals used to latch the data lines from the I/O Assembly into latches on assemblies in the RF Output Section.

TROUBLESHOOTING

Component-level troubleshooting procedures for the I/O Assembly are contained in Service Sheet BD8.

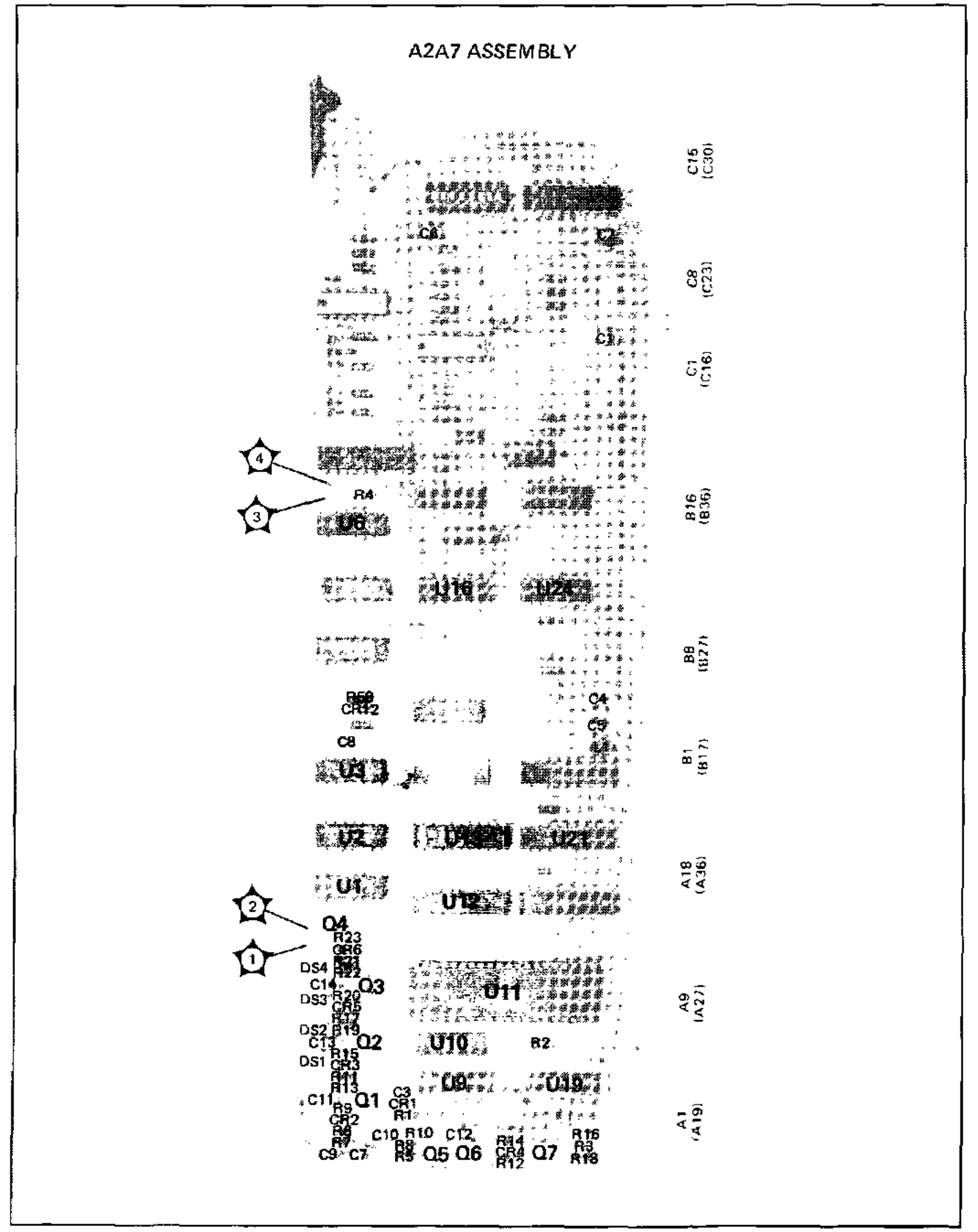


Figure 8-159. A2A7 I/O Assembly Component and Test Point Locations, Part 1

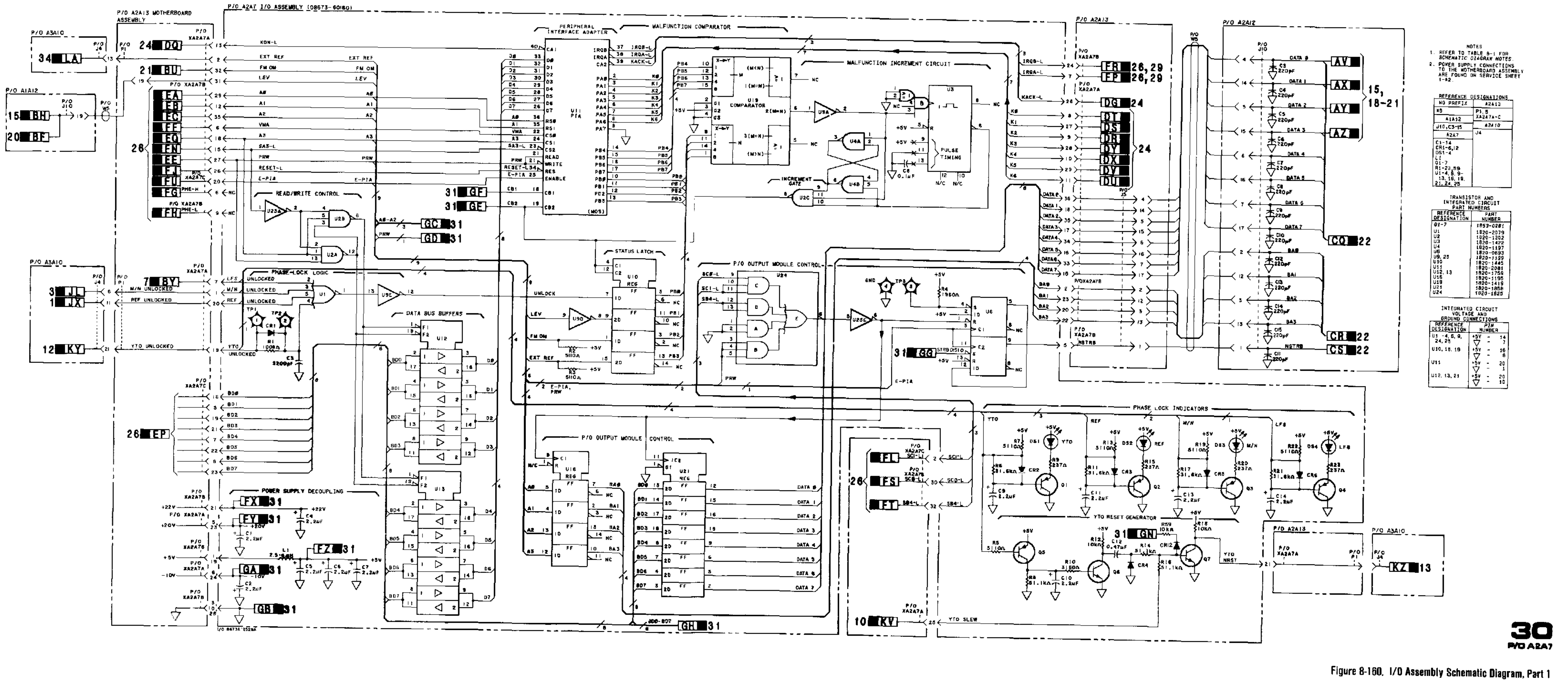
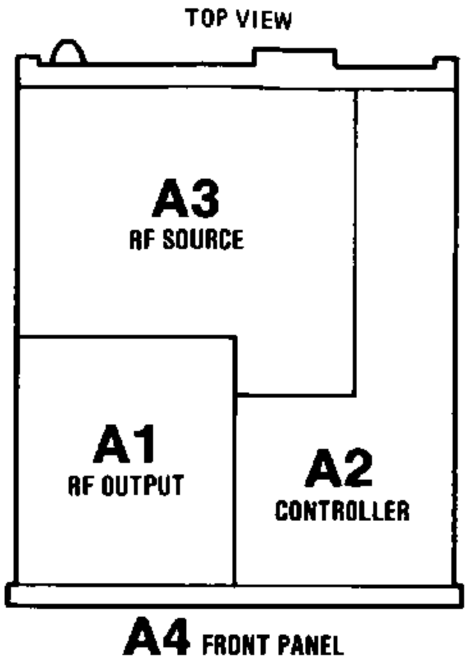


Figure 8-160. I/O Assembly Schematic Diagram, Part 1



MAJOR ASSEMBLIES

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Attenuator Driver Board Assembly	18
A1A2	Detector Module Assembly	14,17
A1A2A1	ALC Board Assembly	14,17
A1A2A2	Detector Board Assembly	17
A1A3	Function Board Assembly	20
A1A4	Pulse Driver Board Assembly	15
A1A5	DAC and Enable Board Assembly	22
A1A6	Meter Board Assembly	21
A1A7	YTM Driver Board Assembly	16
A1A8	SRD Bias Board Assembly	19
A1A9	Preamp Assembly	14,16
A1A10	YTM Assembly	16
A1A10A1	YIG Heater Control Assembly	16
A1A11	Power Amplifier Assembly	16
A1A12	Motherboard Assembly	14-16,18-22, 30,31
A1A13	Terminal Strip	15
A1A14	Amp Bias Board Assembly	17
A2A1	Panel Driver Board Assembly	25
A2A2	Key Code Board Assembly	24
A2A3	VCO Assembly	8
A2A4	Phase Detector Assembly	7
A2A5	Divider Assembly 20/30	6
A2A6	Not Assigned	
A2A7	I/O Board Assembly	30,31
A2A8	Microprocessor Board Assembly	26
A2A9	Frequency/HP-IB Board Assembly	29
A2A10	RAM Board Assembly	28
A2A11	ROM Board Assembly	27
A2A12	Not Assigned	
A2A13	Motherboard Assembly	6-8,10,20-32
A2A14	Rear Interconnect Board Assembly	24,29,31
A2A15	HP-IB Connector Board Assembly	29
A3A1	Rectifier Assembly	33
A3A1A1	Reference Phase Detector Assembly	1,2
A3A1A2	100 MHZ VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator	4
A3A1A4A2	VCO Board Assembly	4
A3A1A5	M/N Output Assembly	5
A3A1A6	M/N Reference Motherboard Assembly	1-3,5
A3A1A7	Reference Housing Assembly	
A3A2	Not Assigned	
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	DAC Assembly	9
A3A6	YTO Driver Assembly	10
A3A7	FM Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Sampler Assembly	11
A3A9A6	Attenuator Assembly	13
A3A9A7	6.2 GHz Low Pass Filter	13
A3A10	Motherboard Assembly	1,3,4,6,10, 12-14,21-23, 26,29-31, 33-35
A4A1	Front Panel Board Assembly	20,22,23,32

SERVICE SHEET 31

I/O ASSEMBLY, PART 2

REFERENCES

Overall Block Diagram and
Troubleshooting, BD1 .... Service Sheet BD1
Digital Control Unit (DCU) Block
Diagram .... Service Sheet BD8
Electrostatic Discharge (ESD)
Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety
Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

The I/O Assembly interfaces the Microprocessor Assembly to peripheral circuits in the Signal Generator. Interface control is effected through the Peripheral Interface Adapter (PIA) shown on Service Sheet 30. The I/O Assembly contains a variety of circuits whose only common feature is that they are inputs to or outputs from the Digital Control Unit (DCU).

Oven Monitor

An analog voltage from the Reference Oscillator heater circuit (Service Sheet 1) is monitored by the Oven Monitor circuit. When the heater is cold, the OVEN OK line is low. This drives the OVEN light on the front panel directly (Service Sheet 23). Therefore, the OVEN COLD light will function even in Standby power mode. A signal is also available to the DCU via the Auxiliary Status Buffer, U20, and to the PIA to generate an interrupt. The PIA is configured to generate the interrupt on the low-to-high transition when the heater is warming up, or on the high-to-low transition if a warm heater should malfunction.

TROUBLESHOOTING

Component-level troubleshooting procedures for the I/O Assembly are contained in Service Sheet BD8.

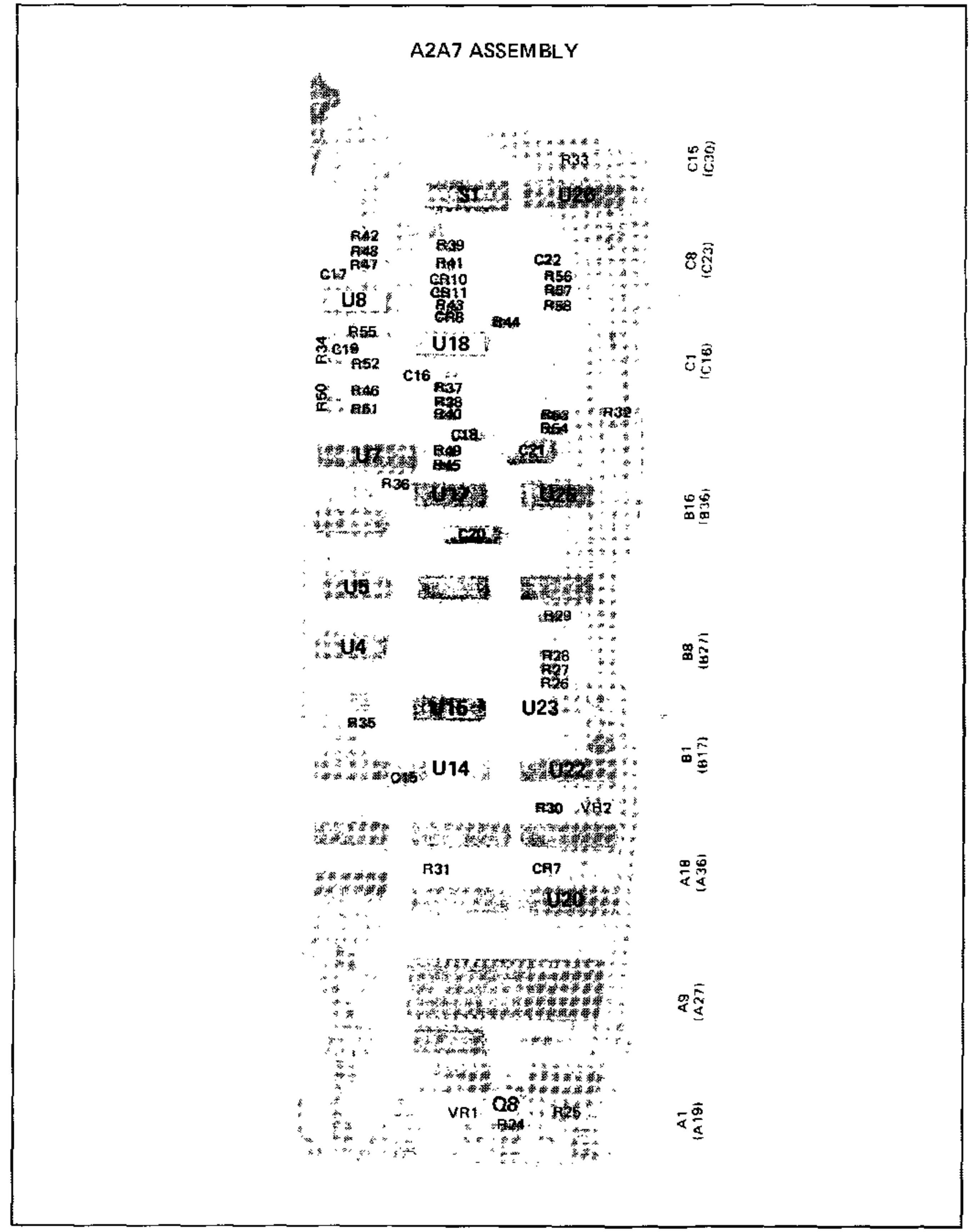
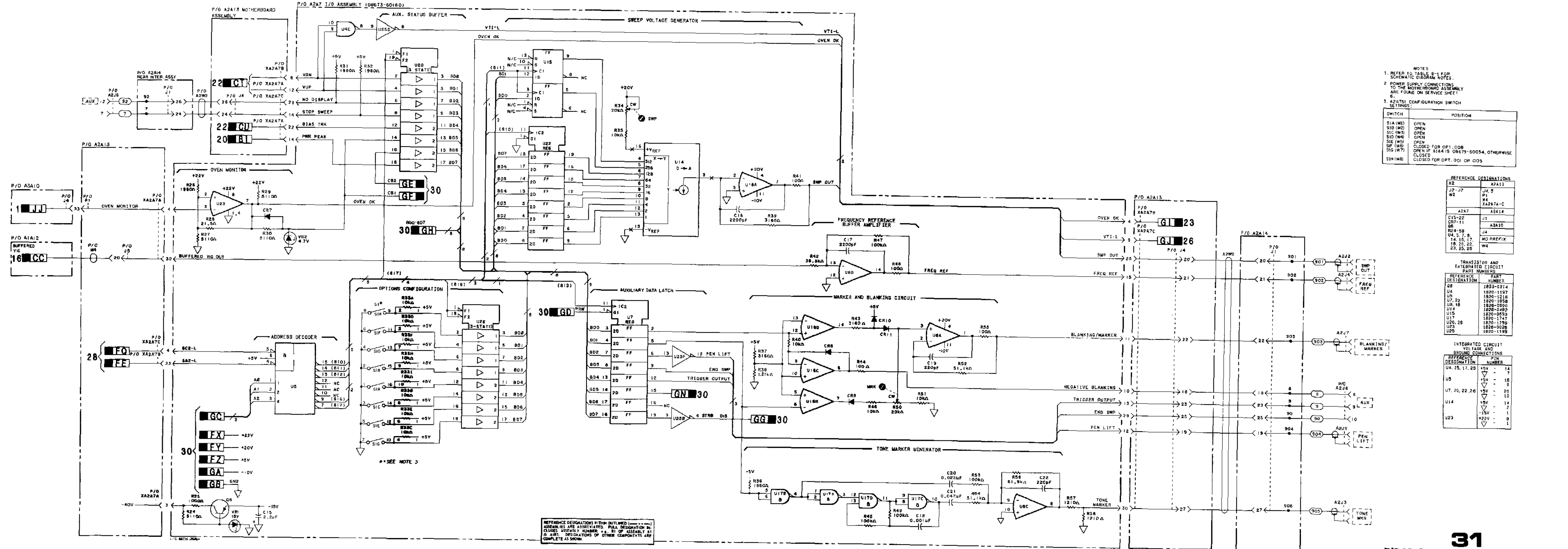


Figure 8-161. A2A7 I/O Assembly Component and Test Point Locations, Part 2



31

P/O A2A7, A2A13, A2A14

Figure 8-162. I/O Assembly Schematic Diagram, Part 2

SERVICE SHEET 32

FRONT PANEL DISPLAY

REFERENCES

Overall Block Diagram and Troubleshooting, BD1 .... Service Sheet BD1
Digital Control Unit (DCU) Block Diagram .... Service Sheet BD8
Electrostatic Discharge (ESD) Precautions .... Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) ... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

TROUBLESHOOTING

Component-level troubleshooting procedures for the Front Panel Display are contained in Service Sheet BD8.

I/O Assembly, Part 2
P/O A2A7, A2A13, A2A14
SERVICE SHEET 31

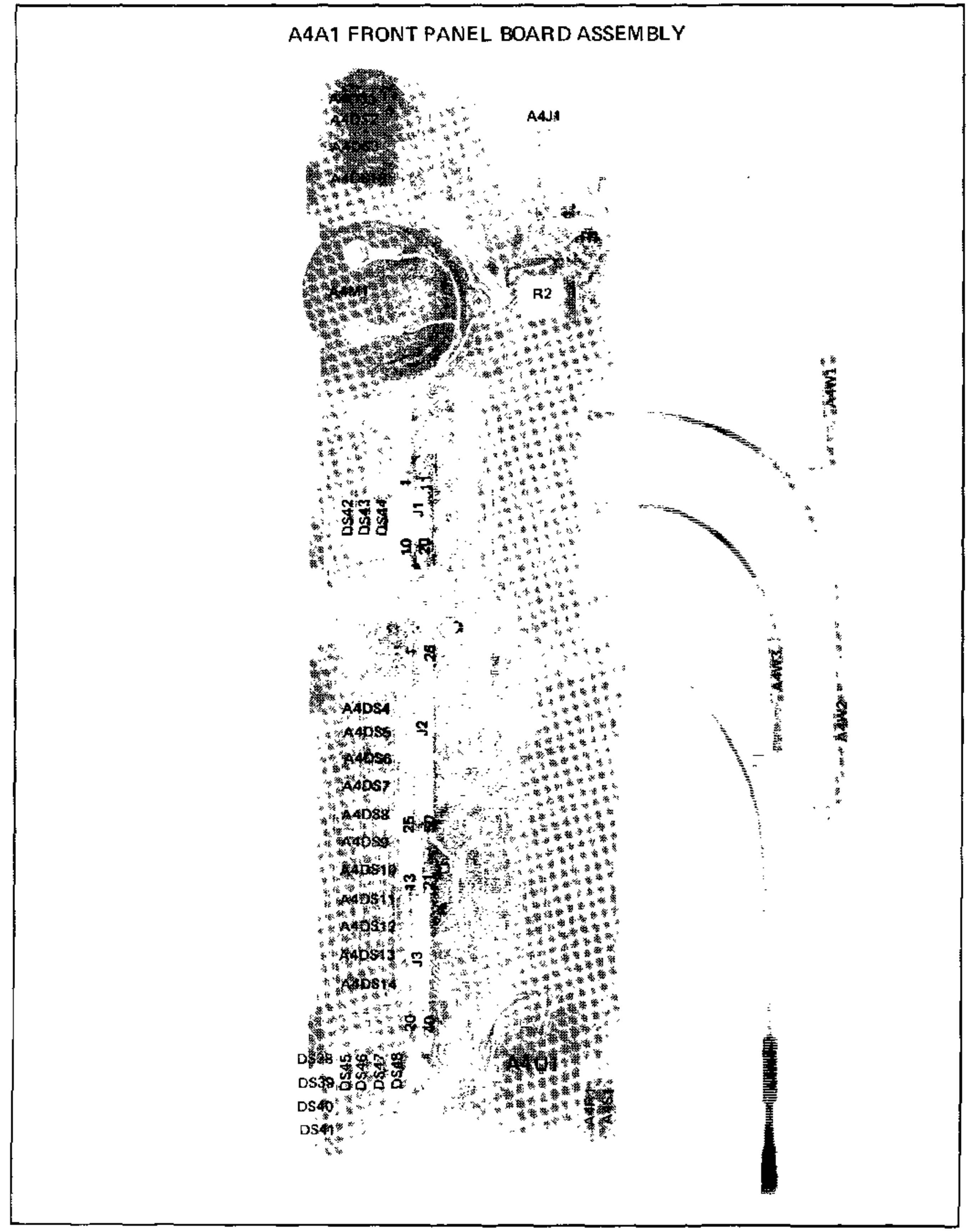


Figure 8-163. P/O A4A1 Front Panel Assembly Component Locations

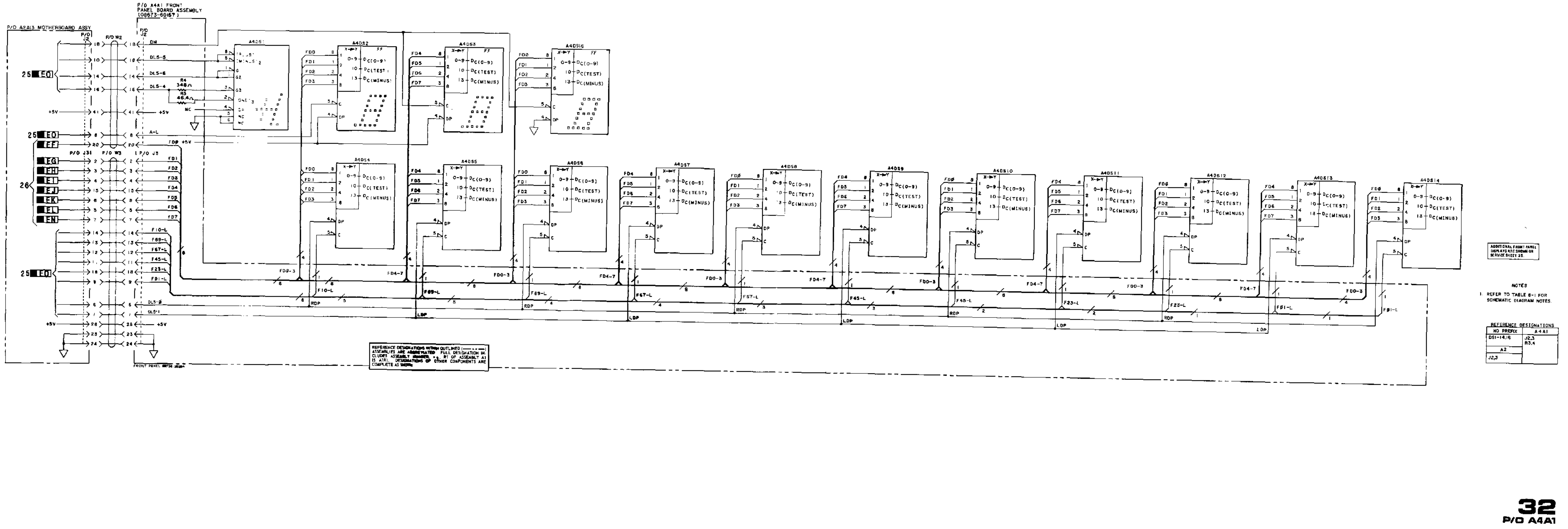


Figure 8-164. A4A1 Front Panel Display Schematic Diagram

SERVICE SHEET 33

RECTIFIER ASSEMBLY

REFERENCES

Overall Block Diagram and Troubleshooting,
BD1 .... Service Sheet BD1
Power Supplies Block Diagram .... Service Sheet BD9
Electrostatic Discharge (ESD) Precautions .. Section VIII (Front)
Disassembly Procedures .... Service Sheet A
Interior Views .... Service Sheet B
Replaceable Parts List .... Section VI
Illustrated Parts Breakdown (IPB) .... Section VI
Post Repair Adjustments .... Section V
After Service Safety Checks .... Section VIII (Front)

PRINCIPLES OF OPERATION

General

If the power cable W6 is connected between the line (mains) power outlet and the A3A11 Line Module, primary ac power is connected to transformer A3T1 and fan relay A3A10K1. A line voltage selector matches the line voltage to the transformer primary. When the front panel LINE switch is set to ON, 120 Vac is connected to the cooling fan A3B1.

The secondary ac voltages from the transformer are always present on the rectifier circuit board if the line voltage is connected to the Signal Generator. The four inputs are rectified and filtered before being output to the regulator circuits.

+22 Volt Regulator

The +22V Regulator supplies power to the Reference Oscillator's heater circuit any time the instrument is connected to the line voltage, to maintain operating temperature. This keeps the instrument ready to operate immediately after the LINE switch is set to ON.

The unregulated +20V is also used to supply power to the +22V Regulator. A3A1U1 is a monolithic 18 volt regulator that has the common terminal raised +4 Vdc above ground. If the regulated output exceeds +25 Vdc, the overvoltage protection circuit shorts the output to ground which causes the regulator to limit its output current. This action efectively turns the Signal Generator off. If the primary power fuse A3F1 does not burn out, the instrument must be disconnected from the line voltage to reset the overvoltage protection circuit.

Input Overvoltage Protection

If the input voltage on the unregulated −40V line exceeds 82.5 Vdc (measured from −40V Unreg to −40V Return), the overvoltage protection circuit will short circuit the −40V input causing primary power fuse A3F1 to burn out. The intent of this circuit is to protect the instrument if 220 or 240 Vac is input with the Line Voltage

Front Panel
A4A1
SERVICE SHEET 32

SERVICE SHEET 33 (cont'd)

Selector set for 100 or 120 Vac. If this occurs, change the fuse to correct value and orient the Line Voltage Selector so the line voltage is correctly matched to the transformer.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet BD1 and BD9 was used to isolate a malfunction to the A3A1 Rectifier Assembly. It is also assumed that an attempt was made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter ...... HP 3456A or 3455A

To troubleshoot the Rectifier Assembly proceed as follows:

1. Connect the instrument to the line (Mains) power.
2. LED A3A1DS1 should be on.
3. Verify that the voltage at A3A1TP1 is +22.0±0.1 Vdc.
4. Disconnect the power cable from the line power.
5. Install the assembly on an extender board and reconnect the instrument to the line power.

CAUTION

To prevent damage to the power supplies, measure the following voltages with a voltmeter that has a floating common terminal.

6. Measure voltages between edge connector pins as shown below:

Negative Pin	Positive Pin	Voltage Range
5	6	27-35 Vdc
15	17	15-21 Vdc
1	3	48-60 Vdc
7	10	10-14 Vdc

7. If any of the voltages are incorrect, check the ac input voltages from the power transformer. The voltages should be as shown on the schematic.
8. The transformer output may be checked with no load by removing the A3A1 assembly.

NOTE

With A3A1 removed the fan will run continuously in both STBY and ON. After repairing the A3A1 assembly, perform the Power Supply Adjustments in Section V. Also, perform the performance tests (if any) that led to the power supply repair.

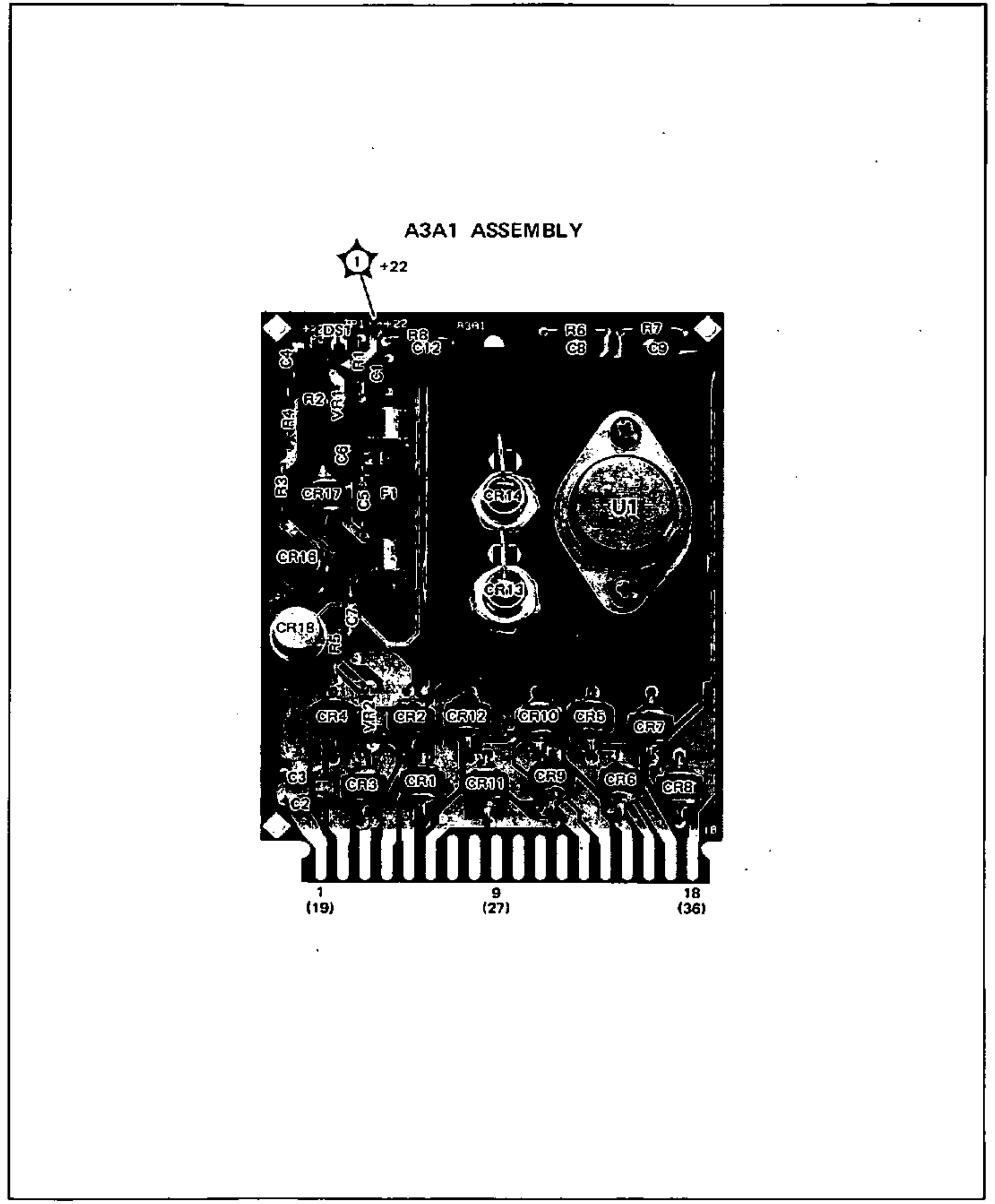


Figure 8-165. A3A1 Rectifier Assembly Component and Test Point Locations

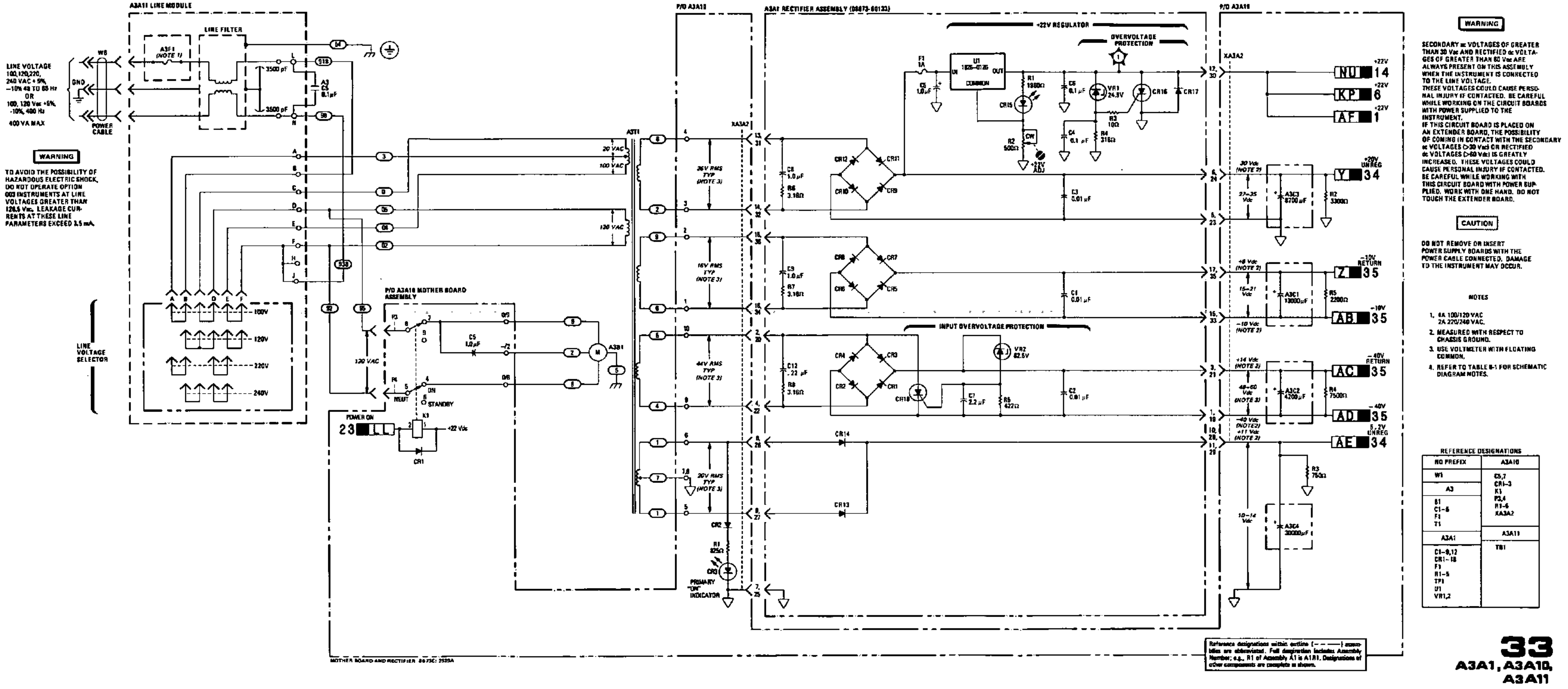


Figure 8-166. Rectifier Assembly Schematic Diagram

SERVICE SHEET 34

POSITIVE REGULATOR ASSEMBLY

REFERENCES

PRINCIPLES OF OPERATION

General

The +20V Regulator provides a reference voltage for all regulated supplies other than the +22V supply. If, for any reason, the +20V supply is turned off, all the power supplies on the A3A3 and A3A4 Assemblies will also be off. This effectively turns off the instrument. Under normal circumstances the +20V Regulator is turned on or off with the front panel LINE switch.

+20V Regulator

A3A3Q2 and Q3 form a current source to bias A3Q3. The output voltage is divided by A3A3R9, R50 and R10 and coupled to the inverting input of A3A3U3. The other input to A3A3U3 is the reference voltage from A3A3VR2. The divided voltage is adjustable and sets the output voltage level.

When current flow through the +20V Regulator gets too high the voltage drop across A3A3R3 will equal that across A3A3R4, and A3A3Q4 will begin to conduct. The output of A3A3U3 will go more positive, which will turn A3A3Q4 on harder. This will shunt the bias current source away from A3A3Q3 and reduce the current drive of A3A3Q3, and limit the current available from the supply.

If the output voltage of the +20V Regulator reaches +23 Vdc, the overvoltage protection circuit shorts the output to ground. This causes the current limiter to turn the regulator off.

Front Panel Shutdown

The front panel LINE switch in the STBY position causes the Power On input to A3A3U1A to be 0V. This turns on A3A3Q3, which turns the +20V Regulator off. In the LINE switch ON position, the input voltage is approximately +22 Vdc which turns A3A3Q8 off.

Thermal Shutdown

This circuit operates much like the Front Panel Shutdown. At normal operating temperatures (less than 55°C) the value of thermistor A3A3RT1 is much greater than the 107 ohms of A3A3R53. Therefore, the voltage at the inverting input of A3A3U1B is more positive than the non-inverting input. This

SERVICE SHEET 34 (cont'd)

causes A3A3Q1 to be turned off. At temperatures exceeding 85°C, the resistance of RT1 drops below 107 ohms which causes A3A3Q1 to turn on. Even though the instrument is effectively turned off, the fan will continue to run to cool the instrument. The instrument will not return to normal operation until the internal temperature drops to +55°C or less.

+5.2V Regulator

The operation of this circuit is much like that of the +20V Regulator. The reference voltage is provided by the +20V supply and a separate fuse is provided for further protection.

Power Up/Down Detector

This circuit outputs a Power Up/Down voltage (+5V or 0V) when the instrument is turned on or off. This lets the last frequency displayed before turn-off to be restored at turn-on.

Reference Oscillator Power Supply

A rear panel switch controls power supplied to the A3A8 Reference Oscillator Assembly. When the FREQUENCY STANDARD INT/EXT switch is set to EXT, the Reference A3A3Q9 is turned on, which turns off A3A3Q10, shutting down the +11V supply. When the switch is set to INT, A3A3Q9 is turned off, and A3A3Q10 is turned on, so that +11V is turned on.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet BD1 and BD9 was used to isolate a malfunction to the A3A3 Positive Regulator Assembly. It is also assumed that an attempt was made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter .... HP 3456A or 3455A

To troubleshoot the Positive Regulator Assembly proceed as follows:

1. Connect the line (Mains) power to the instrument and set the LINE switch to ON. Set rear panel FREQUENCY STANDARD INT/EXT switch to INT.
2. Observe the LED on the A3A3 Assembly. The two red LEDs (+20V and +5.2V indicators) should be on and the yellow LED (Thermal Shutdown indicator) should be off.
3. Set the LINE switch to STBY. The +20V and +5.2V indicators should turn off.
4. Set the LINE switch to ON and measure the following regulator output voltages.

SERVICE SHEET 34 (cont'd)

Regulator	Test Point	Line Switch Position	
		ON	STANDBY
+20V*	A3A3TP5	+20.000±0.001 Vdc	0V
+11V	A3A3TP6	+11±1.1 Vdc	0V
+5.2V	A3A3TP2	+5.2±0.1 Vdc	0V

*The +20V supply is the reference for all other except the +22V supply. If the +20V supply is incorrect, all other supplies except the +22V supply will probably be incorrect.

5. While measuring the +11V supply, switch the FREQUENCY STANDARD INT/EXT switch to EXT. The supply should go to 0V. Set the FREQUENCY STANDARD INT/EXT switch to INT.
6. If the output voltages are incorrect, measure the following input voltages.

Input Voltage	Test Point	Line Switch Position	
		ON	STANDBY
+20VUNREG	A3A3TP4	≈32 Vdc	≈35 Vdc
+5.2 UNREG	A3A3TP1	≈12 Vdc	≈14 Vdc

Connect voltmeter common lead to chassis ground for these measurements.

CAUTION

DO NOT remove or install power supply boards with the power cable connected. Instrument damage may occur.

7. If the output voltages are incorrect and input voltages are correct, check the fuses before continuing. Use the voltages noted on the schematic to continue troubleshooting.
8. To test the Thermal Shutdown circuit, ground A3A3U1B-13. The yellow LED (Thermal Shutdown Indicator) should light and the 5 red LEDs on A3A3 and A3A4 assemblies should turn off. The front panel should turn off and the fan should continue to run. When the ground is removed the instrument should return to normal operation.
9. If the power supply problem is associated with the negative regulator circuits, refer to Service Sheet 35.

Rectifier Board
A3A1, A3A11
SERVICE SHEET 33

SERVICE SHEET 34 (cont'd)

Troubleshooting Line Related Spurious Signals

NOTE

This procedure is not part of the normal troubleshooting information. This procedure normally follows failure of the Power Line Related Spurious Performance Test.

High line related spurious signals can be caused by many different things; some ingenuity may be required to isolate the more subtle causes such as ground loops and externally inducted vibrations. The following procedure suggests items to check when trying to isolate a line spurious problem.

1. With a sensitive oscilloscope, observe the power supply ripple on each of the positive and negative supplies. The +20V, +11V, −10V, and −40V supplies should have ripple less than 300 μV while the +22V, 5.2V, and −5.2V should have ripple less than 1 mV. Power supply induced ripple will generally be twice the line frequency plus harmonics (e.g., 120, 240, 360 Hz, etc., for a 60 Hz line). If one or more supplies has excessive ripple, check the filter capacitors.
2. If any of the circuit boards were removed and reinstalled, line related spurious can increase if the board position in the socket was changed or if ground contact resistance increased. Remove the board, clean the edge connector contact and reinsert the board. When reinserting the board, push it as far as possible toward one end of the edge connector socket and thoroughly tighten any screws holding the board in place.
3. Fan induced spurious will generally be 3 to 5 Hz below line frequency. A loose circuit board (covers not properly tightened) can vibrate more than normal and may increase fan related spurious. The 100 MHz reference oscillator is also sensitive to vibration. Check the reference to make sure the rubber shock mounts are in good condition and the reference oscillator is properly mounted in them. An out of balance fan or one with defective bearings can generate much vibration. To isolate the origin, turn off the instrument and insert an insulated tool to prevent the fan from turning. Then turn on the instrument and see if the spurious signals have decreased. Do not operate the instrument longer than a few minutes with the fan disabled.
4. Apparent line related spurious can be caused by external instruments connected to the FM input when the FM deviation range is set to 10 MHz. A high level hum signal can cause significant FM sidebands even though the FM input is high pass filtered on the wide deviation ranges.
5. Bad ground connections and ground loops can occasionally cause spurious problems. Make sure the A1 and A2 assemblies are fully seated on their connectors and that all coax cables and circuit boards are properly seated in their connectors.

NOTE

After repairing the A3A3 assembly, perform the Power Supply Adjustments in Section V. Also, perform the performance tests (if any) that led to the power supply repair.

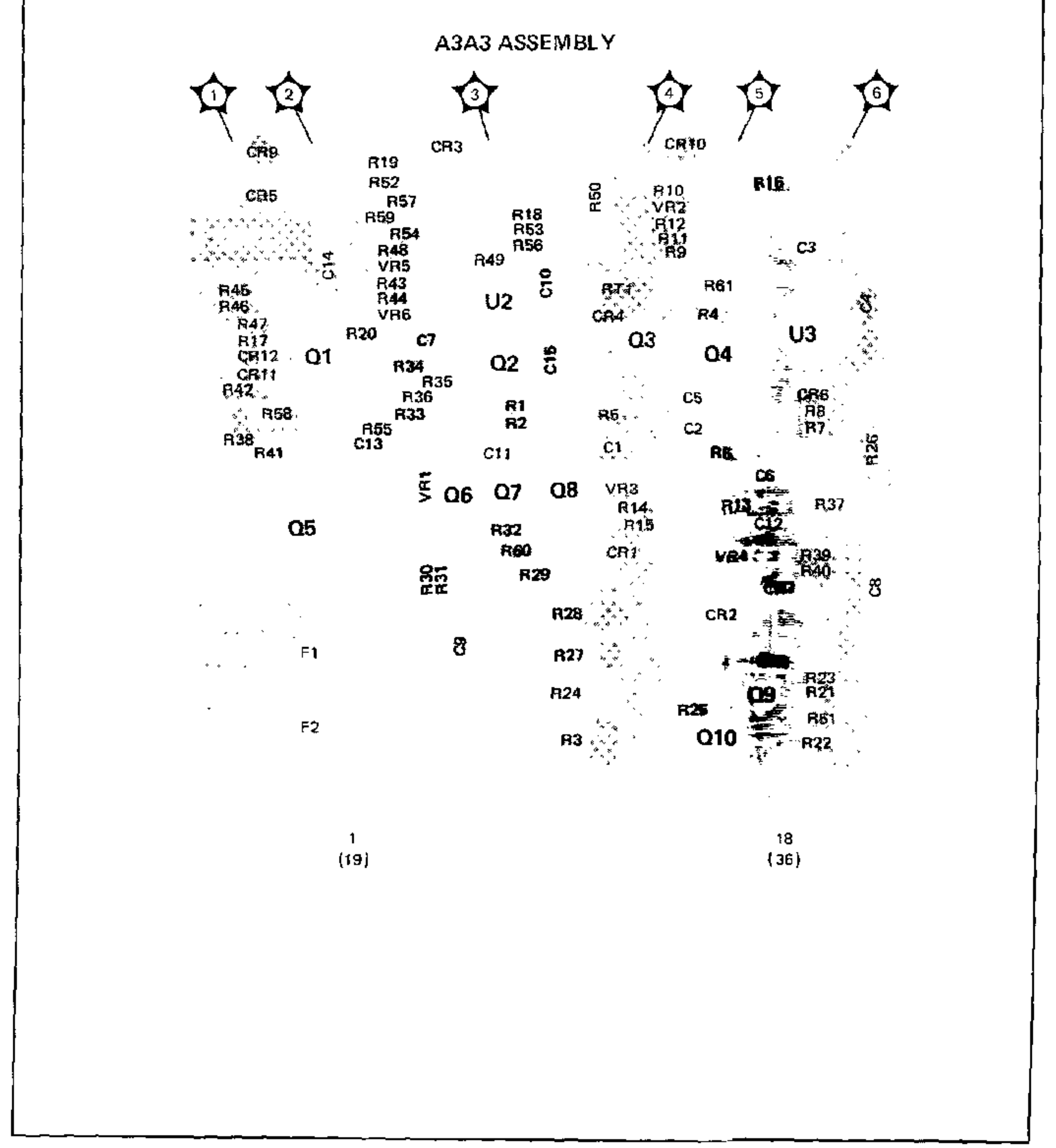
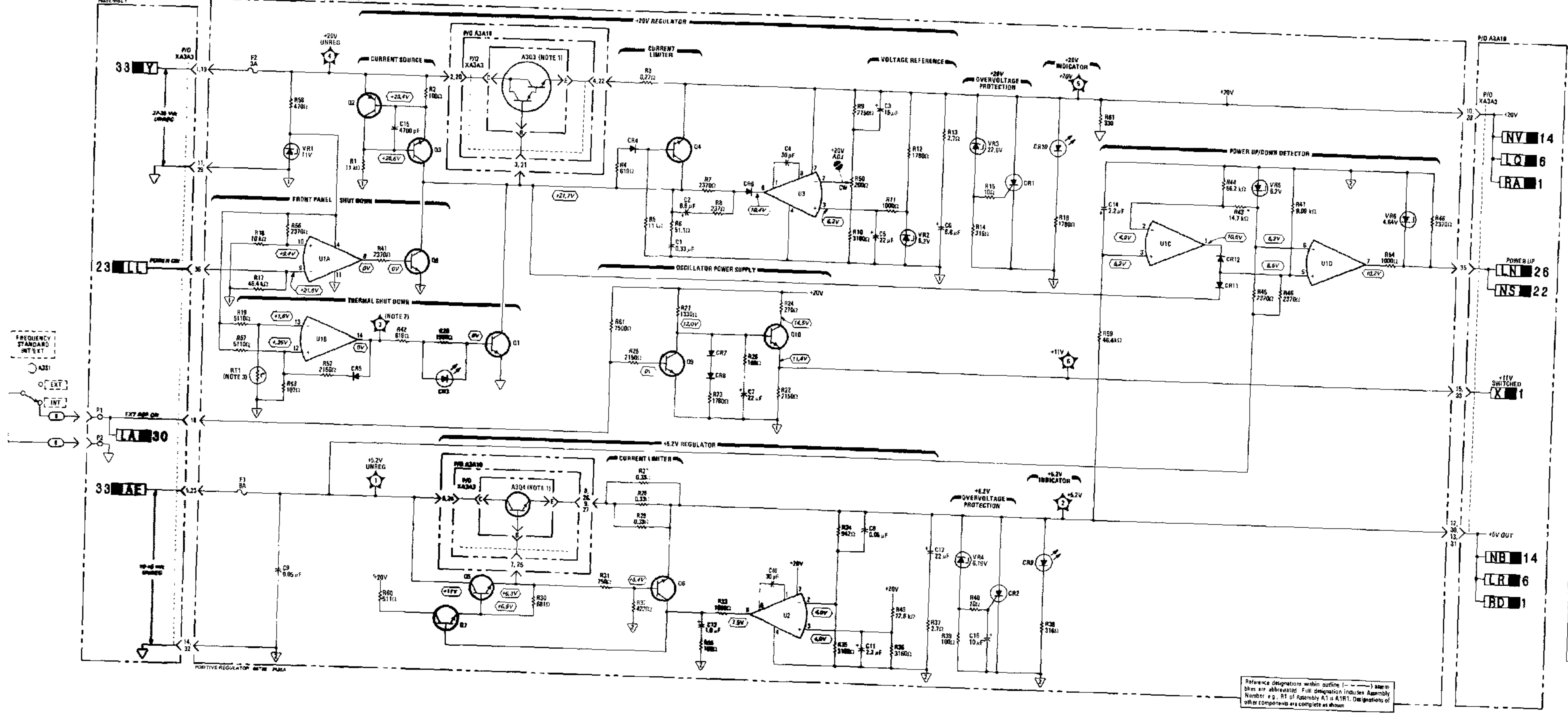


Figure 8-167. A3A3 Positive Regulator Assembly Component and Test Point Locations



WARNING

VOLTAGES OF GREATER THAN 60 Vdc DIFFERENTIAL ARE ALWAYS PRESENT ON THIS BOARD ASSEMBLY WHENEVER THE INSTRUMENT IS CONNECTED TO THE LINE VOLTAGE. THIS VOLTAGE COULD CAUSE PERSONAL INJURY IF CONTACTED. BE CAREFUL WHILE WORKING ON THIS BOARD WITH POWER SUPPLIED TO THE INSTRUMENT.

CAUTION

DO NOT REMOVE OR INSERT POWER SUPPLY BOARDS WITH THE POWER CABLE CONNECTED. DAMAGE TO THE INSTRUMENT MAY OCCUR.

NOTES

1. A3Q3 AND A3Q4 ARE SEPARATE ASSEMBLIES MOUNTED ON THE REAR PANEL HEAT SINK AND A3A10 MOTHER BOARD ASSEMBLY.
2. DURING NORMAL OPERATION THE VOLTAGE AT TP3 IS < 0 Vdc (CR3 IS OFF). IN THE THERMAL SHUT DOWN MODE THE VOLTAGE AT TP3 IS < 10 Vdc (CR3 IS ON).
3. RT1 RESISTANCE IS ABOUT 1000Ω AT 25° C; 107Ω AT 85° C.
4. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.

* ASTERISK INDICATES SELECTED COMPONENTS. AVERAGE VALUE SHOWN.

REFERENCE DESIGNATIONS

A3	A3A3
Q3,4 S1	C1–16 CR1–12 F1,2 Q1–10 R1–61 RT1 TP1–6 U1–3 VR1–6
A3A10	
XA3A3	

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATIONS	PART NUMBERS
Q1,4,6–8	1854-0404
Q2	1853-0451
Q3	1853-0012
Q5	1854-0441
Q9	1854-0005
Q10	1854-0039
U1	1826-0161
U2,3	1820-0221

34
A3A3

Figure 8-168. Positive Regulator Assembly Schematic Diagram

SERVICE SHEET 35
NEGATIVE REGULATOR ASSEMBLY
REFERENCES

PRINCIPLES OF OPERATION

General

The negative regulators are all controlled by the +20V Regulator output. The −10V Regulator and the −40V Regulator operate like the positive regulators. The only difference in the −5.2V Regulator is that the regulation occurs in the negative leg of the supply. Each supply has current limiting and overvoltage protection, and each is fused. The fuse in the −10V Unreg line, A3A4F3, is for the −10V and −5.2V Regulators. Note that there is a separate fuse for the −5.2V Regulator.

−10V Regulator

When the Signal Generator is turned on, +20V is applied to A3A4U2. The −10V output goes more negative until the voltage at the non-inverting input of A3A4U2 is 0 Vdc. When current flow through A3Q1 exceeds normal operation, the voltage drop across A3A4R1 and A3A4R23 will equal that across A3A4R2 and A3A4CR1. Then A3A4Q1 will begin conducting. The output of A3A4U2 will go more positive. This turns A3A4Q1 on harder and reduces the bias on A3Q1 which limits the current available from the −10V supply.

+5.2V Regulator

The operation of this circuit is much like that of the −10V Regulator. The main difference is that the regulation is in the negative leg of the supply. Because it takes a feedback voltage of the opposite sense to control regulation, the +20V to −5.2V voltage divider is applied to the inverting input of U1.

+40V Regulator

The regulating action of this circuit is like that of the −10V Regulator. The differences in component values are due to the difference in voltage and current requirements.

−10V Switch

The RF OUTPUT switch (on the front panel of the Signal Generator) controls the −10V SWITCH. This voltage is the supply voltage for the A3A9A3 YIG Tuned Oscillator Assembly.

Positive Regulator Board
A3A3
SERVICE SHEET 34

SERVICE SHEET 35 (cont'd)

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet BD1 and BD9 was used to isolate a malfunction to the A3A4 Negative Regulator Assembly. It is also assumed that an attempt was made to correct the malfunction by using the appropriate adjustment procedure in Section V. The following information will aid in isolating the defective component.

Test Equipment

Digital Voltmeter ...... HP 3456A or 3455A

CAUTION

DO NOT remove or install power supply boards with the power cable connected. Damage to the instrument's internal circuitry may occur.

To troubleshoot the Negative Regulator Assembly, proceed as follows:

1. Connect the line (Mains) power to the Signal Generator and set the LINE switch to ON.
2. Observe the three red indicators on the A3A4 Assembly. All should be on unless the instrument is in thermal shutdown.

CAUTION

To avoid damage to the power supply circuits, disconnect the power cable from the line voltage before removing or replacing any power supply circuit board.

3. Measure the following regulator output voltages. If any of the voltages are incorrect, go to step 4. If all the voltages are incorrect, place the A3A4 assembly on on extender board and measure the +20V input at pin 9 of the edge connector.

Regulator	Test Point	Output Voltage
−40V	A3A4TP1	−39.0 to −40.6 Vdc
−10V	A3A4TP4	−10.0±0.2Vdc
−5.2V	A3A4TP5	−5.2±0.1Vdc

CAUTION

To avoid damage to the power supply circuits, measure the voltages of step 4 with a voltmeter that has a floating common.

4. Check the fuses for the two supplies shown and measure the input voltages to the regulators. They should be as indicated in the table below.
5. Measure the output voltage at edge connector pin 14. With the front panel RF switch ON, the voltage should measure about −10 Vdc; with the front panel RF switch OFF, the voltage should be approximately +0.5 Vdc.
6. If the input voltages are correct but the output voltages are incorrect, use the voltages on the schematic to isolate the bad component.

NOTE

After the A3A4 assembly is repaired, perform the Power Supply Adjustments in Section V. Also, perform the performance tests (if any) that led to the power supply repair.

Input Voltage	Test Point (Positive)	Test Point (Negative)	Line Switch Position	
			ON	OFF
−10V UNREG	A3A4TP3	A3A4TP4	≈19 Vdc	≈22 Vdc
−40V UNREG	A3A4TP2	A3A4TP1	≈57 Vdc	≈63 Vdc

A3A4 ASSEMBLY

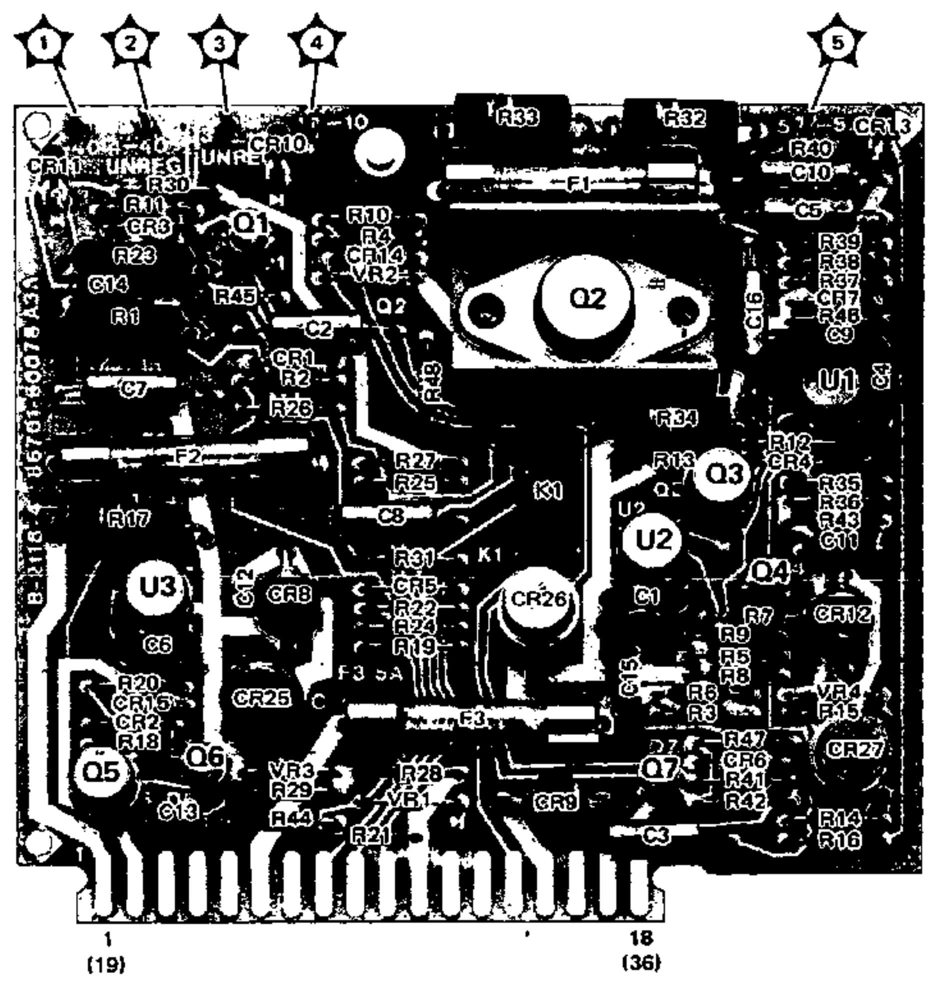
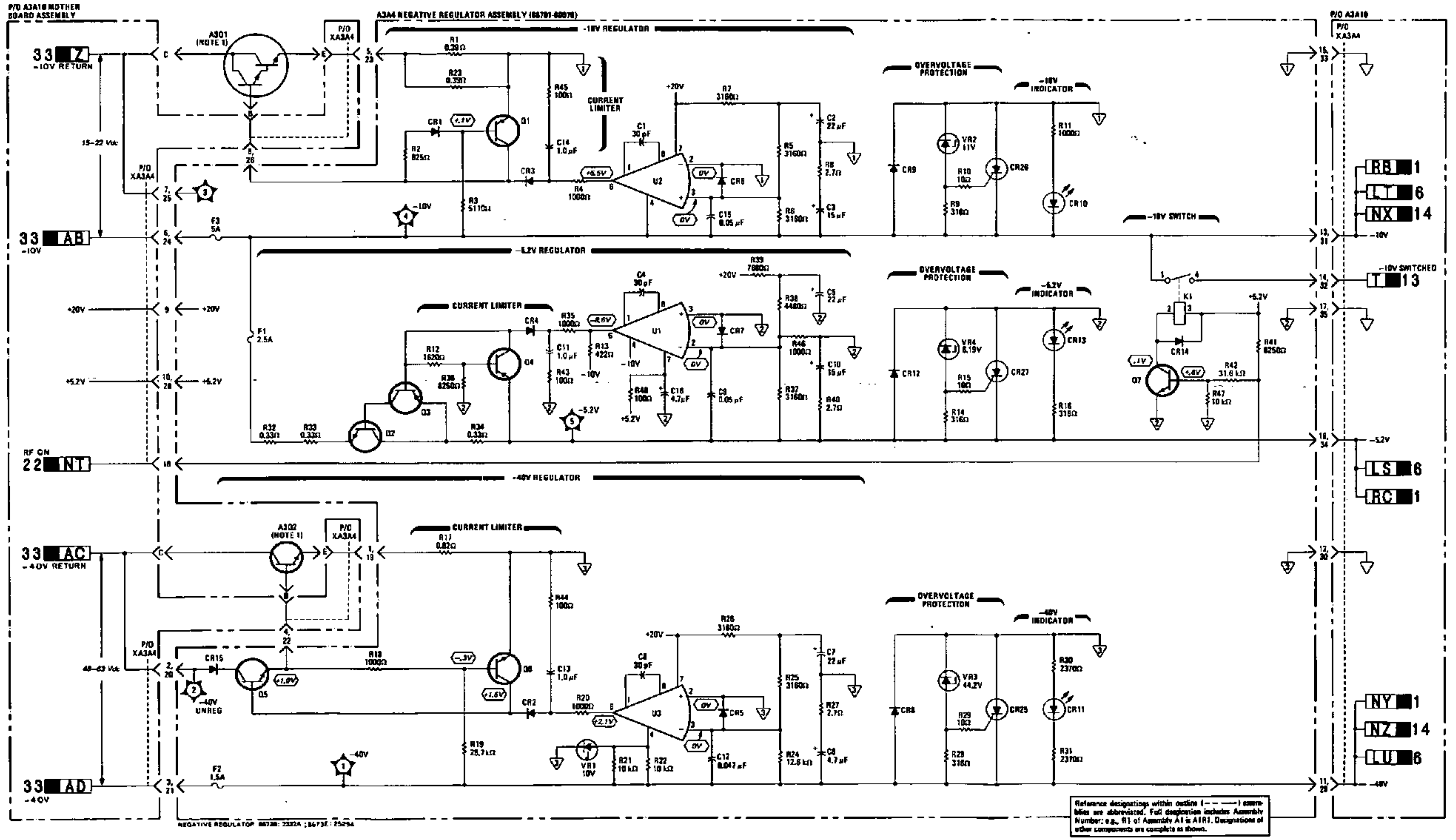


Figure 8-169. A3A4 Negative Regulator Assembly Component and Test Point Locations



WARNING

DC VOLTAGES OF >60 Vdc DIFFERENTIAL ALWAYS PRESENT ON THIS BOARD ASSEMBLY WHENEVER THE INSTRUMENT IS CONNECTED TO THE LINE VOLTAGE. THIS VOLTAGE COULD CAUSE PERSONAL INJURY IF CONTACTED. BE CAREFUL WHILE WORKING ON THIS CIRCUIT WITH THE LINE VOLTAGE CONNECTED. IF THIS CIRCUIT BOARD IS PLACED ON AN EXTENDER BOARD, THE POSSIBILITY OF COMING IN CONTACT WITH THE 60 Vdc DIFFERENTIAL IS GREATLY INCREASED. THIS COULD CAUSE PERSONAL INJURY IF CONTACTED. BE CAREFUL WHILE WORKING WITH THIS CIRCUIT BOARD WITH POWER SUPPLIED. WORK WITH ONE HAND. DO NOT TOUCH THE EXTENDER BOARD.

CAUTION

DO NOT REMOVE OR INSERT POWER SUPPLY BOARDS WITH THE POWER CABLE CONNECTED. DAMAGE TO THE INSTRUMENT MAY OCCUR.

NOTES

1. A3Q1 AND A3Q2 ARE MOUNTED ON THE REAR PANEL HEAT SINK AND A3A10 MOTHER BOARD ASSEMBLY.
2. REFER TO TABLE 8-1 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS

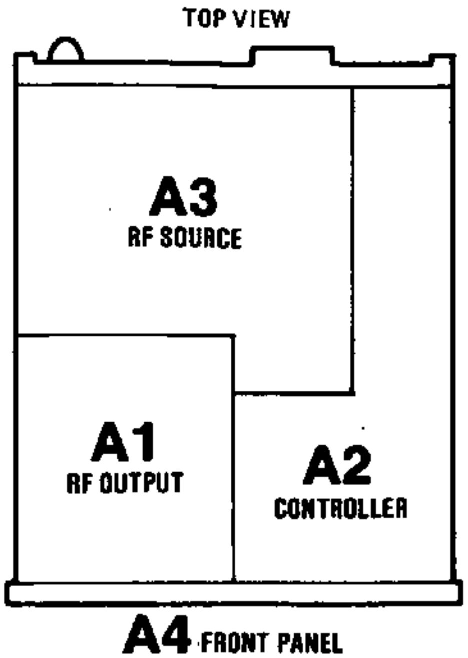
A3	A3A4
Q1, 2	C1-16 CR1-15, 25-27 F1-3 K1 Q1-7 R1-48 TP1-5 U1-3 VR1-4
A3A10	
XA3A4	

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBER

REFERENCE DESIGNATIONS	PART NUMBERS
A3	
Q1	1854-0618
Q2	1854-0294
A3A4	
Q1,6,7	1854-0404
Q2	1854-0441
Q3	1853-0001
Q4	1853-0007
Q5	1854-0271
U1-3	1820-0723

35
A3A4

Figure 8-170. Negative Regulator Assembly Schematic Diagram



MAJOR ASSEMBLIES

Assemblies vs. Service Sheet List

Assembly	Description	Ser. Sheets
A1A1	Attenuator Driver Board Assembly	18
A1A2	Detector Module Assembly	14,17
A1A2A1	ALC Board Assembly	14,17
A1A2A2	Detector Board Assembly	17
A1A3	Function Board Assembly	20
A1A4	Pulse Driver Board Assembly	15
A1A5	DAC and Enable Board Assembly	22
A1A6	Meter Board Assembly	21
A1A7	YTM Driver Board Assembly	16
A1A8	SRD Bias Board Assembly	19
A1A9	Preamp Assembly	14,16
A1A10	YTM Assembly	16
A1A10A1	YIG Heater Control Assembly	16
A1A11	Power Amplifier Assembly	16
A1A12	Motherboard Assembly	14-16,18-22, 30,31
A1A13	Terminal Strip	15
A1A14	Amp Bias Board Assembly	17
A2A1	Panel Driver Board Assembly	25
A2A2	Key Code Board Assembly	24
A2A3	VCO Assembly	8
A2A4	Phase Detector Assembly	7
A2A5	Divider Assembly 20/30	6
A2A6	Not Assigned	
A2A7	I/O Board Assembly	30,31
A2A8	Microprocessor Board Assembly	26
A2A9	Frequency/HP-IB Board Assembly	29
A2A10	RAM Board Assembly	28
A2A11	ROM Board Assembly	27
A2A12	Not Assigned	
A2A13	Motherboard Assembly	6-8,10,20-32
A2A14	Rear Interconnect Board Assembly	24,29,31
A2A15	HP-IB Connector Board Assembly	29
A3A1	Rectifier Assembly	33
A3A1A1	Reference Phase Detector Assembly	1,2
A3A1A2	100 MHZ VCXO Assembly	2
A3A1A3	M/N Phase Detector Assembly	3
A3A1A4	M/N VCO Assembly	4
A3A1A4A1	VCO Resonator	4
A3A1A4A2	VCO Board Assembly	4
A3A1A5	M/N Output Assembly	5
A3A1A6	M/N Reference Motherboard Assembly	1-3,5
A3A1A7	Reference Housing Assembly	
A3A2	Not Assigned	
A3A3	Positive Regulator Assembly	34
A3A4	Negative Regulator Assembly	35
A3A5	DAC Assembly	9
A3A6	YTO Driver Assembly	10
A3A7	FM Driver Assembly	13
A3A8	10 MHZ Reference Oscillator	1
A3A9	YTO Loop Assembly	11,12
A3A9A1	Directional Coupler Assembly	13
A3A9A2	YTO Interconnect Assembly	11-13
A3A9A3	2.0 - 6.6 GHZ YTO Assembly	13
A3A9A4	YTO Phase Detector Assembly	12
A3A9A5	Sampler Assembly	11
A3A9A6	Attenuator Assembly	13
A3A9A7	6.2 GHz Low Pass Filter	13
A3A10	Motherboard Assembly	1,3,4,6,10, 12-14,21-23, 26,29-31, 33-35
A4A1	Front Panel Board Assembly	20,22,23,32

SERVICE SHEET A

DISASSEMBLY AND REASSEMBLY PROCEDURES

Top and Bottom Cover Removal and Replacement. To remove the covers proceed as follows:

1. Place the instrument with the appropriate cover up.
2. Remove the appropriate rear panel standoffs MP33.
3. Loosen the captive screw securing the cover to the frame.
4. Slide the cover to the rear and remove.
5. For replacement, follow the above steps in inverse order.

Transformer A3T1. To remove A3T1, proceed as follows:

1. Place the unit on its right side and remove its bottom cover MP47.
2. Remove the motherboard insulator by removing the five plastic screws.
3. Free the Line Module A3A11 from the rear of the unit. Slide the Line Module out of the chassis sufficiently far to expose the solder terminals.
4. Unsolder the leads from the transformer to the Line Module.
5. Unsolder the transformer leads from the A3 motherboard terminals
6. Refer to Figure 8-171 for the following steps.
7. Remove the two screws securing A3T1 to the A3 motherboard.
8. Remove the screw securing the transformer to the chassis divider A3MP46.
9. Remove the eight screws securing A3T1 to the side rails A3MP44 and A3MP66.
10. Remove the transformer A3T1.
11. For replacement, follow the above steps in inverse order.

Capacitors A3C1-4. To remove a capacitor, proceed as follows:

1. Remove the bottom cover MP47.
2. Refer to Figure 8-171 for the following steps.
3. For removal of A3C1 only, remove the five plastic screws securing the motherboard insulator to the A3 motherboard.
4. Remove the two screws securing the capacitor to the A3 motherboard, remove the capacitor support A3MP56 (for A3C1-3 only) and remove the capacitor.
5. If A3C4 is to be removed, loosen the clamp A3MP15 and remove the capacitor.
6. For replacement, follow the above steps in inverse order.

Front Panel Board Assembly A4A1. To remove A4A1, proceed as follows:

1. Remove the top trim from the frame.
2. Remove screws securing the front panel to the mainframe. (There are five screws on the top and on the bottom. The center screw is not to be removed for this procedure.)
3. Disconnect the RF Coaxial Cable A1W1 from Attenuator A1AT1.
4. Remove cables W1, W2 and W3 from A4A1J1, J2, and J3.
5. Remove the following cables from connectors indicated.

CABLE	CONNECTOR
A4W1	A1A13J2
A4W2	A1A13J4
A4W3	A1A12J4
A4W4	A1A13J6

6. Unsolder the leads from the Line Switch A4S1.
7. Unsolder the leads from the Rotary Pulse Generator A4U1
8. Disconnect the leads from the meter A4M1.

SERVICE SHEET A (cont'd)

9. Remove the knobs from the Vernier A4A1R2 and Rotary Pulse Generator A4U1.
10. Remove the screws securing A4A1 to A4.
11. Remove the nut securing the Rotary Pulse Generator A4U1 to A4A1.
12. Remove A4A1 from A4.
13. For replacement, follow the above steps in inverse order.

Attenuator A1AT1. To remove A1AT1, proceed as follows:

1. Remove the screws securing RF Cover and remove cover.
2. Refer to Figure 8-178 for the following steps.
3. Remove cable A1W17 from A1DC1.
4. Remove cable A1W2 from A1DC1.
5. Remove Crystal Detector A1CR1 from A1DC1.
6. Remove the two screws which secure the Coupler Support A1MP37 to RF Gusset (Left) A1MP30 and remove the support and A1DC1.
7. Remove cable A1W2 from A1AT1.
8. Remove A1W1 from A1AT1 and from A4J1.
9. Remove Circuit Card Assembly A1A2.
10. Remove cable A1AT1W1 from A1J5.
11. Remove two screws securing A1AT1 to RF Gusset (Left) A1MP30.
12. Remove A1AT1, A1MP43 and A1MP44.
13. For replacement, follow the above steps in inverse order.

YTM Assembly A1A10. To remove the YTM, proceed as follows:

1. Remove top and bottom covers.
2. Remove the RF Cover MP49.
3. Refer to Figure 8-172 for the following steps.
4. Disconnect cable A1W2 from Directional Coupler A1DC1.

SERVICE SHEET A (cont'd)

5. Remove Crystal Detector A1CR1 from A1DC1 and Circuit Card Assembly A1A2.
6. Remove cable A1W3 from YTM Assembly A1A10 and Directional Coupler A1DC1.
7. Remove cable A1W5 from YTM Assembly A1A10.
8. Remove cable A1W6 from Circuit Card Assembly A1A10A1J2.
9. Remove cable A1W3 from A1DC1 and A1A10.
10. Remove cable A1W8 from A1A10A1J1.
11. Remove the two screws securing Directional Coupler bracket A1MP37 to RF Gusset (Left) A1MP30 and remove the bracket and coupler.
12. Remove two screws which secure the YTM A1A10 to the A1 motherboard and remove 1A1A10.
13. Remove MP64 from A1A10.
14. For replacement, follow the above steps in inverse order.

(continued)

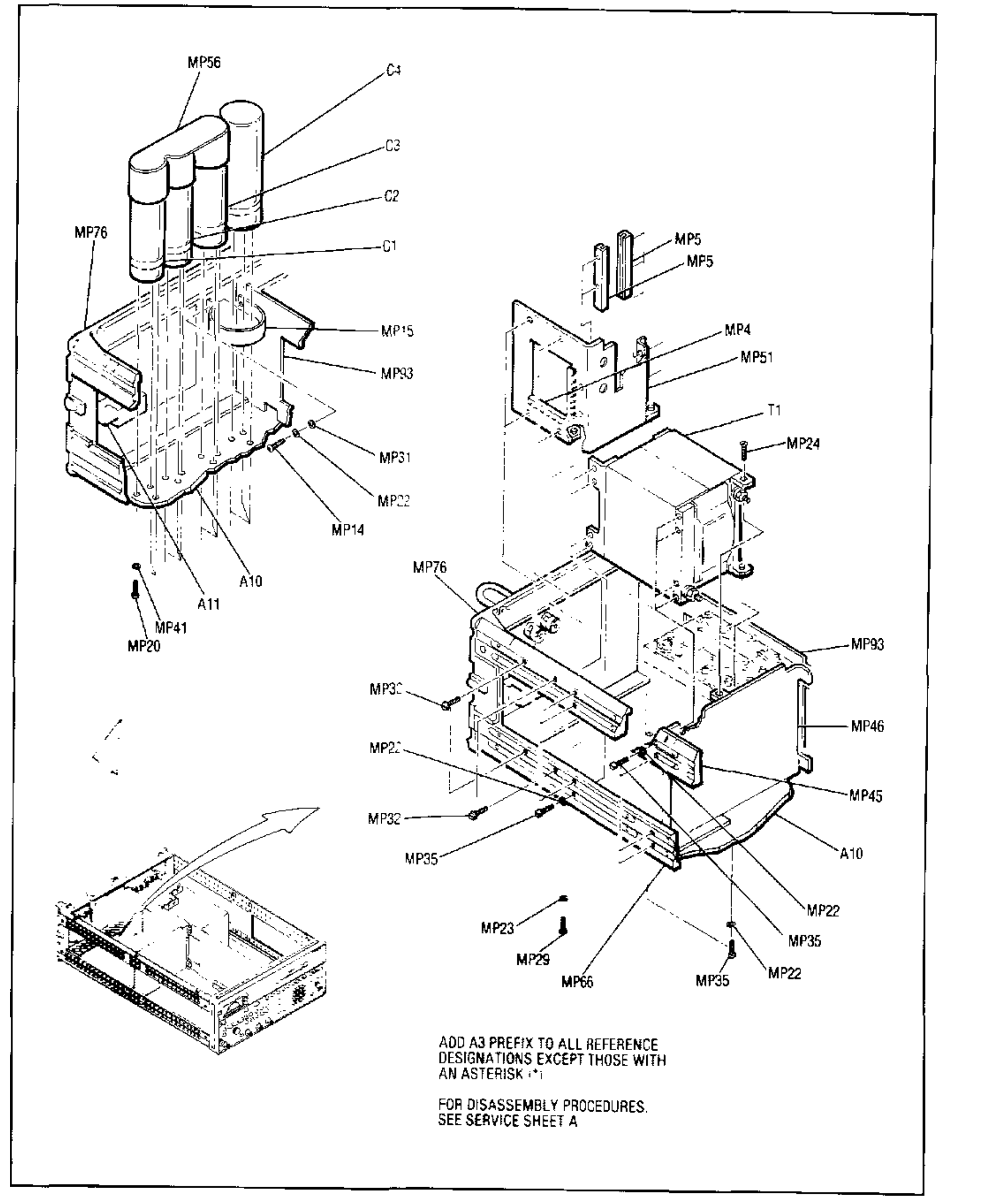


Figure 8-171. Transformer and Filter Capacitor Removal

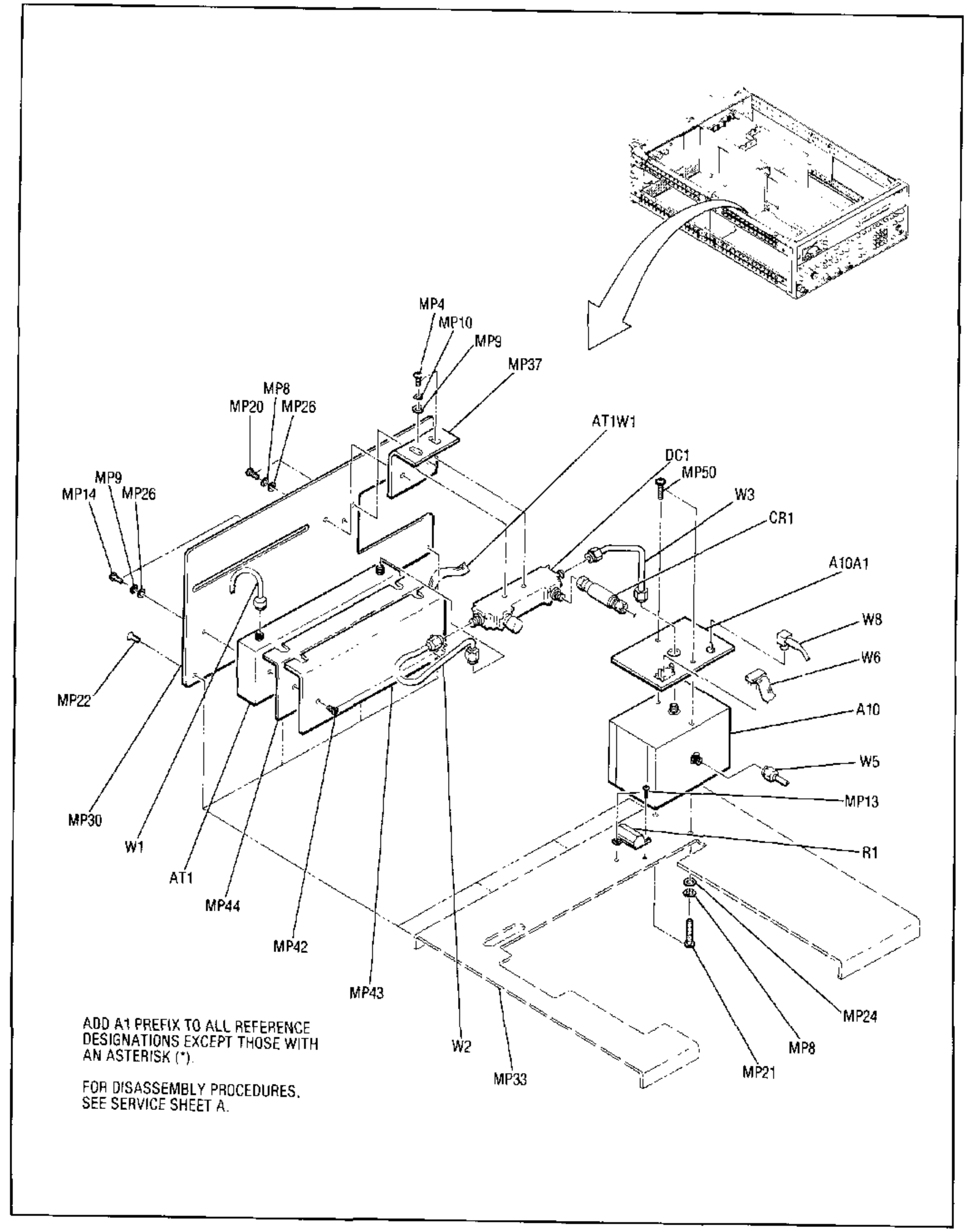


Figure 8-172. A1 RF Output Assembly, Attenuator and YTM

SERVICE SHEET A (cont'd)

Amplifiers A1A9 and A1A11. To remove either amplifier, proceed as follows:

1. Remove the top cover.
2. Remove the RF Cover.
3. Refer to Figure 8-173 for the following steps.
4. Remove cable A1W4 from Filter A1FL1 and Amplifier A1A11J1.
5. Remove cable W7 from Preamplifier A1A9J2 and Directional Coupler A3A9A1J1.
6. Remove Attenuator Cable A1AT4 and A1W11 from Preamplifier A1A9J4 and Bias Tee Assembly A1CP1.
7. Remove Cable A1W13 from Preamplifier A1A9J1.
8. Remove two screws A3MP32 which secure A1MP28 to chassis divide A3MP46.
9. Remove two screws A1MP18 which secure A1MP28 to chassis A1MP33.
10. Remove A1MP28 from the unit.
11. To remove either amplifier, remove the eight screws around each amplifier, the screw A1MP15 with its flat washer, lock-washer and nut and screw A1MP13. Retain insulator A1MP1.
12. Remove the appropriate amplifier.
13. For replacement, follow the above steps in inverse order.

Placement of the YTO Loop in the Service Position. To place the YTO Loop in the service position, proceed as follows:

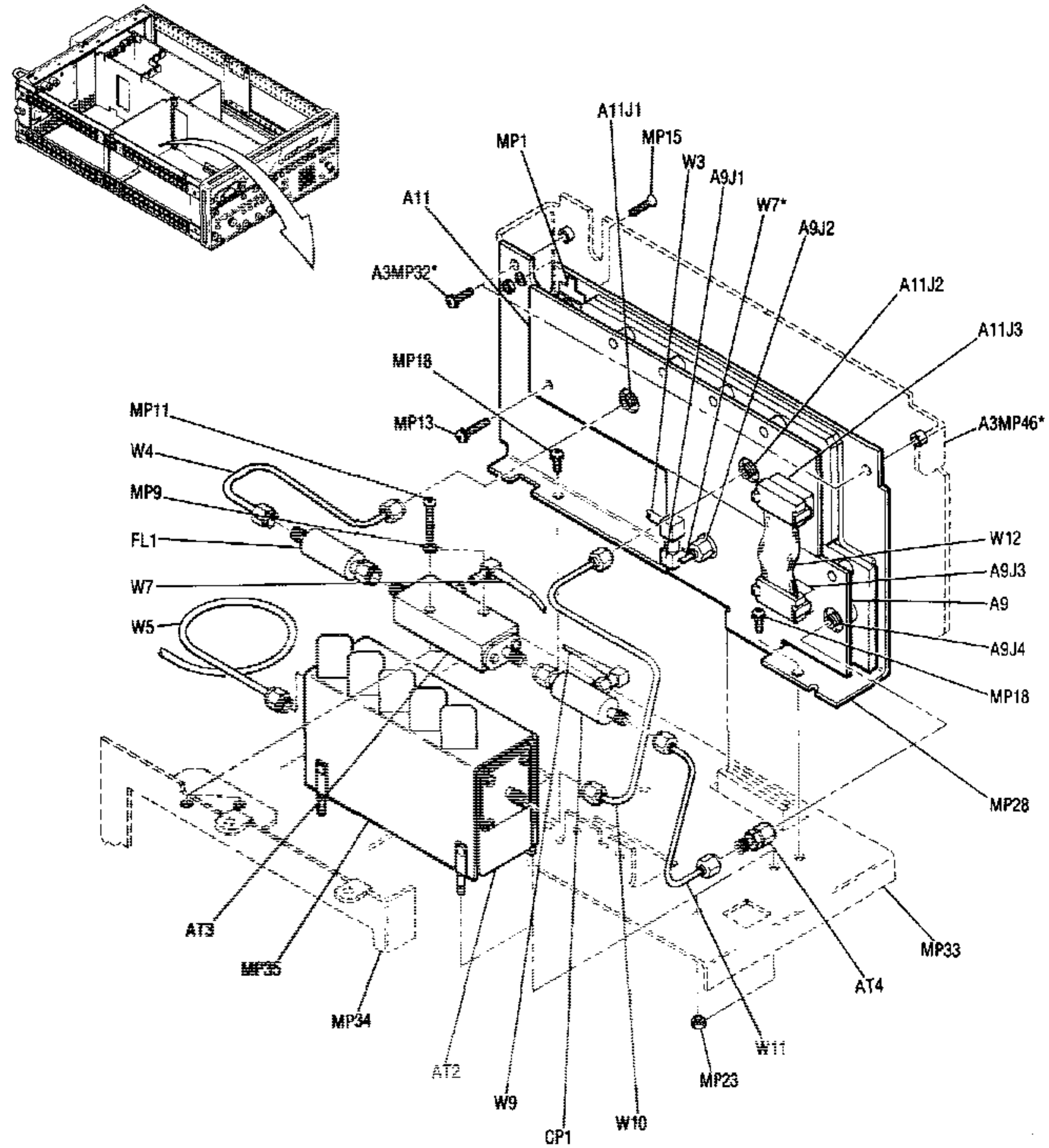
1. Remove the top and bottom covers.
2. Place the instrument on its right side.
3. Remove the two screws securing the YTO Phase Detector. The screws are accessible through the holes marked A in the A3 Motherboard.
4. Refer to Figure 8-174 for the following steps.
5. Remove the screw located at the side of the YTO Phase Lock Deck A3MP102, which secures A3MP102 to the center divider A3MP18.
6. Loosen end of Coaxial Cable W7 on A1A9J2 and remove W7 from A3A9A1J1.

SERVICE SHEET A (cont'd)

7. Move W7 out of the way and lift the YTO Phase Lock Deck to an upright position.
8. Secure the YTO Phase Lock Deck in the service position using the Servicing Support Screw.
9. For replacement, follow the above steps in inverse order.

Removal and Replacement of 10 MHz Reference Oscillator A3A8. To remove the 10 MHz Reference Oscillator, proceed as follows:

1. Remove the top and bottom covers.
2. Place the YTO Loop in the service position.
3. Refer to Figure 8-174 for the following steps.
4. Remove the two screws which secure the Support-Mount A3MP69 to the center divider A3MP18.
5. Remove flexible cable A3W2 from the Reference Oscillator.
6. Remove cable A3A8W1 from A3A10J3.
7. Remove the Reference Oscillator.
8. For replacement, follow the above steps in inverse order.



ADD A1 PREFIX TO ALL REFERENCE DESIGNATIONS EXCEPT THOSE WITH AN ASTERISK (*).

FOR DISASSEMBLY PROCEDURES, SEE SERVICE SHEET A.

Figure 8-173. A1 RF Output Assembly, Preamp and Power Amp

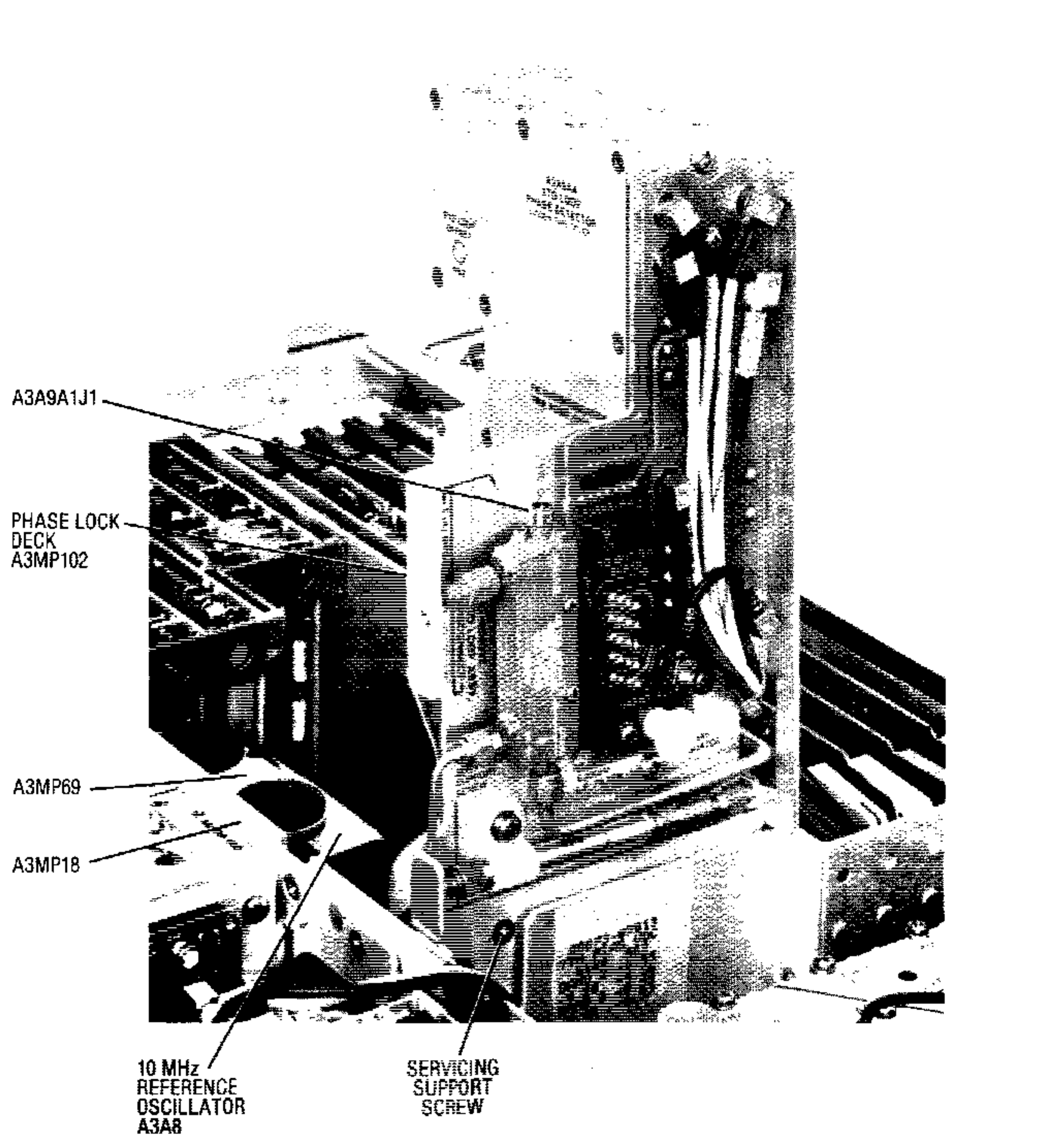


Figure 8-174. YTO Loop in Service Position

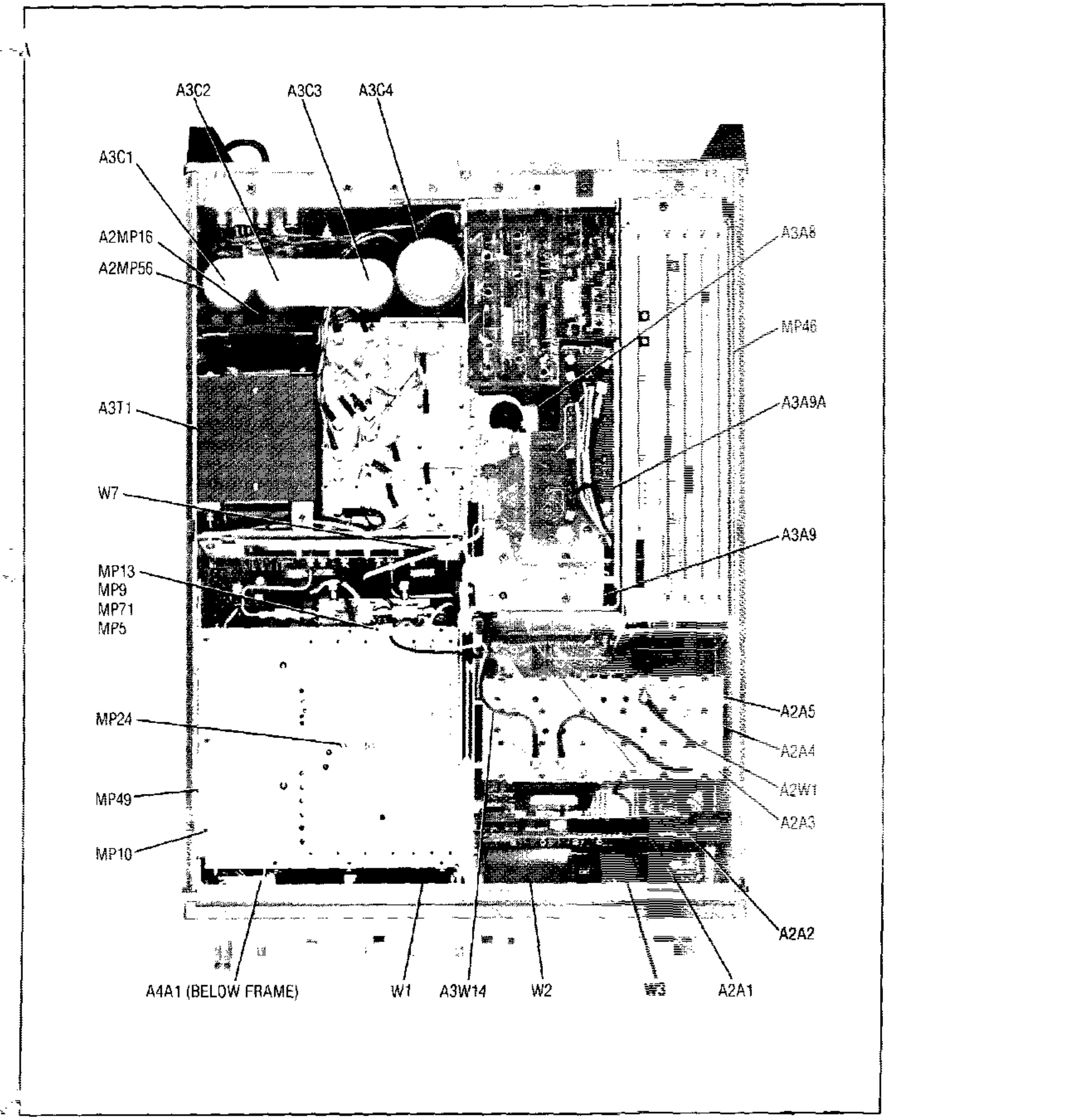


Figure 8-175. Top View, Component Location

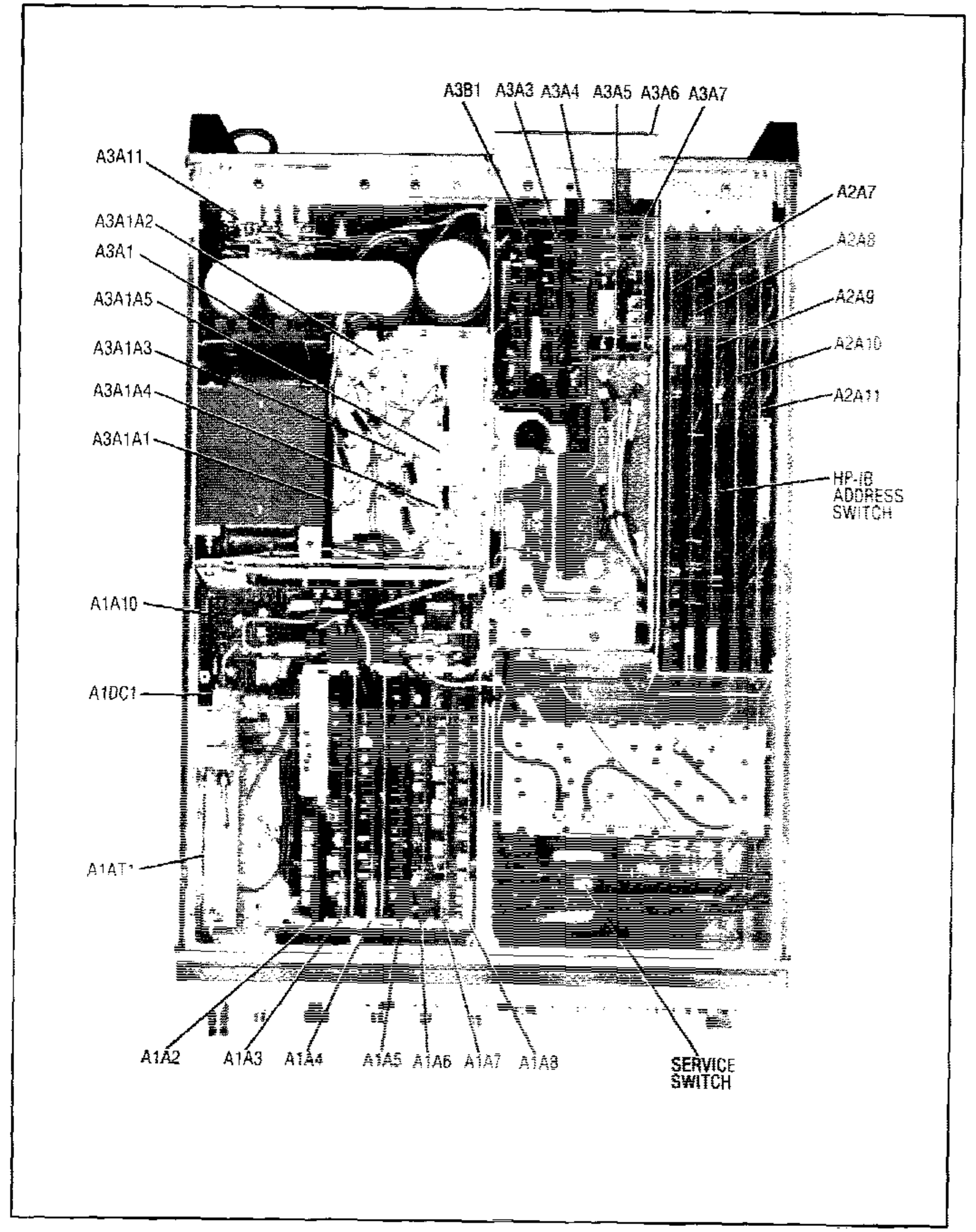


Figure 8-176. Top View, Assembly Location, Covers Removed

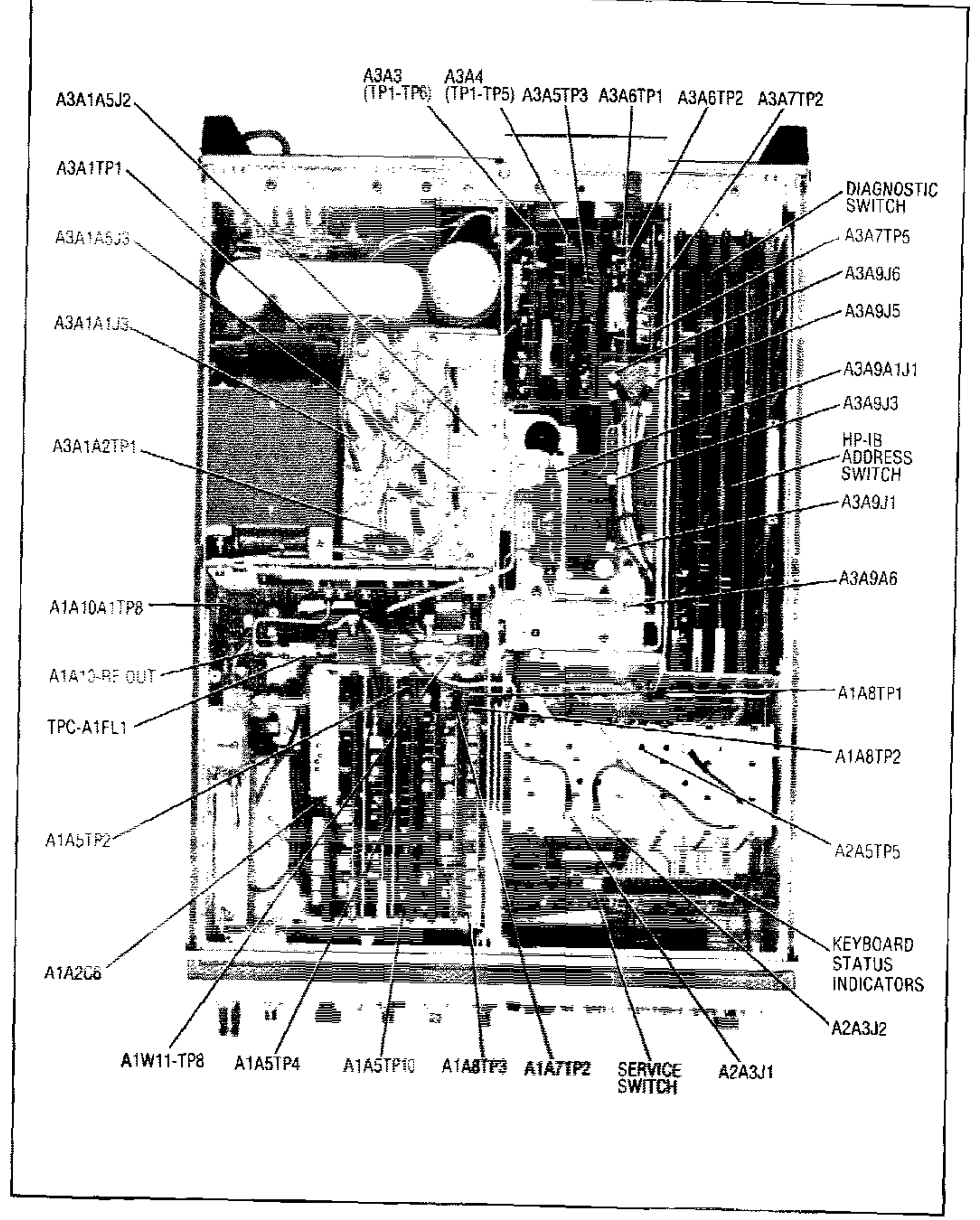


Figure 8-177. Top View, Test Point Location

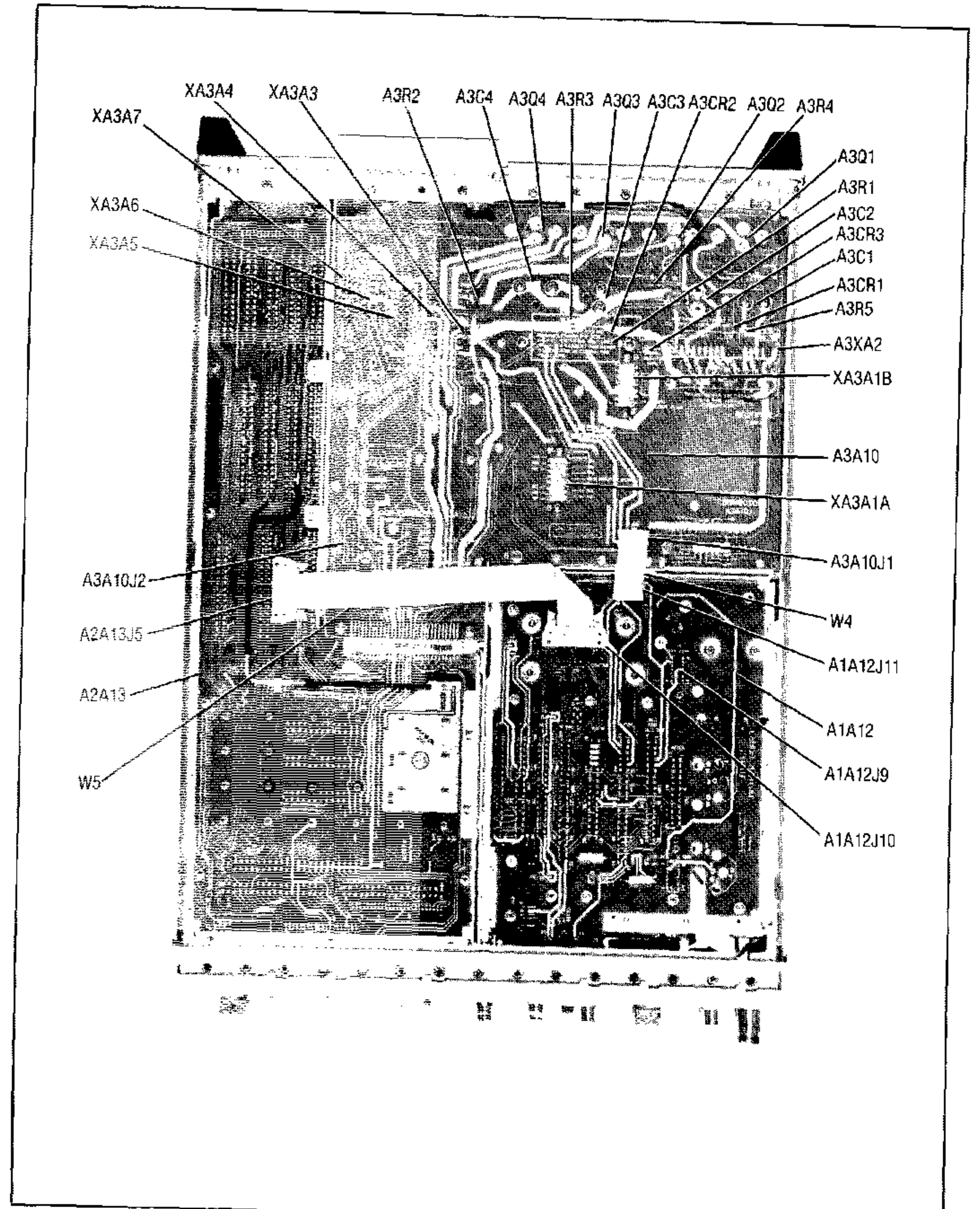


Figure 8-178. Bottom View, Component Location

Interior Views
SERVICE SHEET B

REGIONAL SALES AND SERVICE OFFICES

NORTH/CENTRAL AFRICA
Hewlett-Packard S.A.
7, Rue du Bois-du-Lan
CH-1217 **MEYRIN** 2, Switzerland
Tel: (022) 83 12 12
Telex: 27835 hpse
Cable: HEWPACKSA Geneve

ASIA
Hewlett-Packard Asia Ltd.
6th Floor, Sun Hung Kai Centre
30 Harbour Rd.
G.P.O. Box 795
HONG KONG
Tel: 5-832 3211
After Jan. 1, 1984
47th Floor, China Resources Bldg.
26 Harbour Rd., Wanchai
HONG KONG
Telex: 66678 HEWPA HX
Cable: HEWPACK HONG KONG

CANADA
Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
Telex: 610-492-4246

MEDITERRANEAN AND MIDDLE EAST
Hewlett-Packard S.A.
Mediterranean and Middle East Operations
Atrina Centre
32 Kifissias Ave.
Paradissos-Amarousion, **ATHENS**
Greece
Tel: 682 88 11
Telex: 21-6588 HPAT GR
Cable: HEWPACKSA Athens

EASTERN EUROPE
Hewlett-Packard Ges.m.b.h.
Lieblgasse 1
P.O. Box 72
A-1222 **VIENNA**, Austria
Tel: (222) 2365110
Telex: 1 3 4425 HEPA A

NORTHERN EUROPE
Hewlett-Packard S.A.
Uilenstede 475
P.O. Box 999
NL-1180 AZ **AMSTELVEEN**
The Netherlands
Tel: 20 437771

SOUTH EAST EUROPE
Hewlett-Packard S.A.
7, Rue du Bois-du-Lan
CH-1217 **MEYRIN** 2, Switzerland
Tel: (022) 83 12 12
Telex: 27835 hpse
Cable HEWPACKSA Geneve

OTHER EUROPE
Hewlett-Packard S.A.
P.O. Box
150, Rte du Nant-D'Avril
CH-1217 **MEYRIN** 2, Switzerland
Tel: (022) 83 8111
Telex: 22486 hpsa
Cable: HEWPACKSA Geneve

EASTERN USA
Hewlett-Packard Co.
4 Choke Cherry Road
ROCKVILLE, MD 20850
Tel: (301) 258-2000

MIDWESTERN USA
Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800

SOUTHERN USA
Hewlett-Packard Co.
2000 South Park Place
P.O. Box 105005
ATLANTA, GA 30348
Tel: (404) 955-1500

WESTERN USA
Hewlett-Packard Co.
3939 Lankershim Blvd.
P.O. Box 3919
LOS ANGELES, CA 91604
Tel: (213) 506-3700

OTHER INTERNATIONAL AREAS
Hewlett-Packard Co.
Intercontinental Headquarters
3495 Deer Creek Road
PALO ALTO, CA 94304
Tel: (415) 857-1501
Telex: 034-8300
Cable: HEWPACK

SERVICE NOTE

SUPERSEDES:
None

HP MODEL 8673E SYNTHESIZED SIGNAL GENERATOR

2704A and Below

PREFERRED REPLACEMENT FOR A2A10 and A2A11 ASSEMBLIES

The A2A10 Memory Board Assembly (08673-60155) and EPROM (08673-80082) are the preferred replacement for the A2A11 ROM and A2A10 RAM assemblies, (08673-60109 and 08673-60167). The new Memory board combines the functions of two boards into one assembly and the EPROM has a larger memory capacity.

The RAM and ROM assemblies should be replaced by the Memory Board only when one of the assemblies has failed. To replace the RAM and ROM assemblies, use the following procedure.

The following parts will need to be ordered to complete the conversion.

A2A10 Memory board	08673-60155
A2A10U7 EPROM	08673-80082
MP46 Cover, DCU	08673-00073

REPLACEMENT PROCEDURE:

1. Remove the mains source from instrument.

   NOTE: Use proper ESD precautions when removing and handling static sensitive devices or assemblies.

2. Remove top cover and the internal cover from the A2 DCU assembly.

3. Remove and discard the RAM A2A10 (08673-60109) and ROM A2A11 (08673-60167) assemblies.

4. Install the new EPROM onto the Memory board. Insert the Memory board into the A2A10 board slot.

   NOTE: take care not to bend any of the pins on the EPROM.

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4/87-04/DS

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5. Reapply mains power by reconnecting the line cord.

6. Turn on the Signal Generator and enter RCL 0, to preset the instrument.

7. Verify that the Signal Generator presets correctly. Refer to the operating manual or the information pul-lout card for proper preset conditions.

8. Set the Signal Generator to 10 GHz. Press the LVL key near the meter and the FM 3 MHz deviation key simultaneously to initialize the internal memory. The Signal Generator will preset to 3 GHz when the initialization takes places.

9. Enter "RCL ".", verify that the firmware date code for the instrument is "2624".

S E R V I C E N O T E

SUPERSEDES 8673E-01

HP 8673E Synthesized Signal Generator

Serial Numbers: 0000A00000/2704A99999

Duplicate Service Notes:

8673B-06B
8673C-06B
8673D-06A

New Memory Board and an EPROM are preferred replacements

To Be Performed By: Customer

Parts Required:

HP P/N	Description
08673-60155	A2A10 Memory Board
08673-80106	A2A10U7 EPROM
08673-00073	MP46 Cover, DCU

Continued

DATE 26 JULY 1990

ADMINISTRATIVE INFORMATION

SERVICE NOTE CLASSIFICATION:

INFORMATION ONLY

AUTHOR:	ENTITY:	ADDITIONAL INFORMATION:
DH	0400	

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Situation:

The A2A10 Memory Board Assembly (08673-60155) and EPROM (08673-80106) are the preferred replacement for the A2A11 ROM and A2A10 RAM assemblies (08673-60109 and 08673-60167). The new memory board combines the functions of two boards into one assembly. The EPROM has a larger memory capacity which makes firmware fixes possible.

You should replace the old ROM and RAM assemblies with the new Memory Board Assembly only if one of the old assemblies has failed.

EPROM 08673-80106 replaces 08673-80091 and 08673-80082 in earlier A2A10 Memory Board Assemblies. This also corrects an intermittent failure of Master/Slave operation between two 8673 signal generators. This failure, however, is rarely seen.

Replacement Procedure:

CAUTION:

Use proper ESD precautions when removing and handling pc boards and integrated circuits. ESD (Electrostatic Discharge) can damage these sensitive components if they are not properly protected.

1. Remove the mains source from the signal generator.
2. Remove the signal generator's top cover. Remove and discard the internal cover for the A2 DCU Assembly.
3. Remove and discard the old A2A10 RAM and A2A11 assemblies.

CAUTION:

In the next step, take care not to bend any of the pins on the EPROM. They break easily.

4. Install the EPROM onto the new A2A10 Memory Board Assembly. Insert the A2A10 Memory Board Assembly into the old A2A10 RAM Assembly slot.
5. Install the new internal cover for the A2 DCU Assembly. Replace the signal generator's top cover.
6. Apply mains power by reconnecting the line cord.
7. Turn on the signal generator. The signal generator normally tries to turn on to the settings that existed in RAM memory prior to power shutdown. Since a new memory board has been installed, the RAM memory will be blank. When the signal generator finds this blank memory, it turns to ROM register 0 to recover data for the turn-on preset conditions. The preset conditions are described in the signal generator's operating manual on page 3-2. (These preset conditions are the same ones that occur with keystrokes RCL and 0.)

Check that the signal generator turned on to the conditions described in the manual.

8. Press RCL, then press and hold the decimal point key (.). The four digits on the left side of the FREQUENCY display are the firmware date code for the EPROM you installed in step 4. Datecode for the new EPROM should be 3011.

SERVICE NOTE

SUPERSEDES 8673E-02

HP 8673E Synthesized Signal Generator

Serial Numbers: 0000A00000/9999A99999

Firmware History

Situation:

This service note documents the various versions of firmware for the HP 8673E. With each new release of the firmware, changes will be incorporated into this service note.

Checking the Firmware Version Date Code

To find out what the present version of firmware is, press "RCL" and then hold the "." key (decimal point). The four digits appearing in the FREQUENCY MHz display are the date code for the installed firmware.

Three-ROM and One-ROM Configurations

Instruments with serial number prefixes 2704A and below were built with a RAM board and a ROM board. Firmware resides on three ROMs on the ROM board.

Instruments with serial number prefixes 2708A and above are built with a single Memory board that includes both RAM and ROM. Firmware resides on a single ROM.

Continued

DATE: 01 October 1990

ADMINISTRATIVE INFORMATION

SERVICE NOTE CLASSIFICATION:		
INFORMATION ONLY		
AUTHOR:	ENTITY:	ADDITIONAL INFORMATION:
DH	0400	

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If either of the old boards (RAM or ROM) needs replacing, the recommended replacement is the newer Memory board and the single ROM. This change is described in the latest issue of service note 8673E-01. It is on this newer Memory board alone that future firmware updates will be made.

Firmware History

8451 Date Code (Three-ROM Configuration): Original Firmware. Had problem with the Special Wideband FM Mode. When a front panel setting of FM Off was stored in an internal register and then 10 MHz/volt wideband FM (Unlocked) setting was selected, a recall of the stored setting did not clear the unlocked FM. The YTO lock could only be restored by presetting the instrument or by selection of another FM range. FM Off did not fix the problem. Additionally, the 10 MHz/volt button did not light to indicate wideband FM, even though a truncated frequency display and the "Not Phase Locked" annunciator were present. If your instrument exhibits these problems, replace controller ROMs with retrofit kit, 08673-60226. Date code will become 2716.

2624 Date Code (Three-ROM Configuration): Fixes problem with wide band FM (date code 8451). ROMs are no longer available for replacement. Instead order retrofit kit, 08673-60226. Date code will become 2716.

2624 Date Code (One-ROM Configuration): Converted firmware to One-ROM configuration which provided greater amount of memory to accommodate future fixes. Some functions were mistakenly programmed into the ROM which the instrument itself could not act upon. These functions were removed in later versions of firmware. If you find it necessary to replace the controller ROM, order 08673-80106 (firmware date code 3011).

2716 Date Code (One-ROM and Three-ROM Configurations): Eliminated non-functioning programs from the 2624 version of firmware. An intermittent problem with master/slave operation was observed in some instruments. 2716 is the last version of firmware in the three-ROM configuration. If you need this firmware to be updated, you will have to convert to one-ROM configuration - see the latest issue of Service Note 8673E-01. If you need to update the one-ROM version of firmware, order 08673-80106 (firmware date code 3011).

3011 Date Code (One-ROM Configuration): Fixes intermittent bug in master/slave mode. No change is required for this firmware.

SERVICE NOTE

SUPERSEDES:
None

HP MODEL 8673E SYNTHESIZED SIGNAL GENERATOR

Serial Prefixes 2708A and Below

INSULATORS FOR A3Q1 THROUGH A3Q4

If during normal troubleshooting of the power supply, it is found that the power supply pass transistor (A3Q1 through A3Q4) collectors is shorted to ground, visually inspect the anodized heat sink (A3MP54) for damage. If scratches or cracks are found on the heat sink, an insulator HP part number 1200-0043, should be added between the case of the pass transistor and the heat sink. The anodized heat sink once scratched or damaged will no longer provide a non-conductive barrier between the case of the pass transistor and ground.

Procedure

1. Remove the mains power source from the instrument. Remove the top and bottom covers. Refer to Section VIII of the Operating and Service Manual for procedures.

2. To remove the defective pass transistor, A3Q1 or A3Q2, remove (2) 4-40 machine screws, A3MP107 and heat sink A3MP53. To remove A3Q3 or A3Q4, remove 2 screws A3MP107 and heat sink A3MP52 (refer to Section VI of the Operating and Service Manual).

3. Use a soldering iron and desoldering tool to desolder the defective pass transistor from the motherboard assembly A3A10.

NOTE

Use proper ESD precautions when removing or handling static sensitive devices or assemblies.

4. Remove the defective pass transistor and replace it with an new part (refer to Section VI of the Operating and Service Manual for correct HP part number). Add thermal compound to the insulator (HP part number 1200-0043) and then place the insulator between the case of the pass transistor and the heat sink (A3MP54).

5. After replacing the pass transistor, perform the adjustments specified in Section V of the Operating and Service Manual.

E/PM/WA

11/87-04/DS

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S E R V I C E N O T E

SUPERSEDES:
8673E-4

HP MODEL 8673E SYNTHESIZED SIGNAL GENERATOR

All Serials

ELIMINATING POWER-UP DELAY

If during normal turn-on of the instrument it is found that there is a 4 second or greater time delay during power-up, it is recommended that the resistor R4 be changed from a value of 619 ohms to 750 ohms (part number 0757-0420). Changing the value of R4 on the 86701-60096 Positive Regulator will eliminate the power-up delay associated with the current limit circuitry on the +20V regulator.

The delayed power-up is usually caused by the series pass transistor (A3Q3) on the +20V regulator. A higher than normal base to emitter voltage causes the current limit circuit to clamp the regulated +20V momentarily low when the instrument is cold.

Changing the value of R4 from 619 ohms to 750 ohms increases the the turn-on threshold of the current limit circuit from 3A to 4A, which is still well below the maximum current rating of the pass transistor A3Q3.

E/OF/WN

12/87-04/DS

Printed In USA

HEWLETT PACKARD

S E R V I C E   N O T E

SUPERSEDES:
None

HP MODEL 8673E SYNTHESIZED SIGNAL GENERATOR

Serial Prefix 2704A and below

INSULATORS FOR A3A12CR13 AND A3A12CR14

If during normal trouble shooting of the Rectifier Assembly A3A12 (08673-60133) it is found that regulator U1 is defective, the most probable cause of the defect is that the anode of CR13 or CR14 has shorted through the anodized surface of the heat sink MP9 (HP part number 86701-00018) to the case of regulator U1. This may be verified by using a digital multimeter to measure the resistance between the case of U1 and the Anodes of CR13 and CR14. If the measured resistance is less than 1 K Ohms, then the anodized surface of the heat sink (MP9) may have been damaged. If the anodized surface has been damaged, it is recommended that a mica insulator (HP part number 3050-0876) be added between the heat sink (MP9) and each of the rectifiers, CR13 and CR14.

Procedure

1. Remove the mains source from the instrument. For procedure to remove the Top cover. Refer to Section VIII of the Operating and Service Manual.

2. Remove the Rectifier Assembly A3A12 (08673-60133) from the unit, refer to Section VIII of the Operating and Service Manual.

NOTE

Use proper ESD precautions when removing and handling static sensitive devices or assemblies. Ensure that all work is done at an ESD certified work station.

3. Using a 3/8 inch open-end wrench remove the two 10-32 nuts securing CR13 and CR14 to the assembly. Carefully remove CR13 and CR14 from the rectifier assembly. It may be necessary to desolder the wires from the cathodes of the diodes to facilitate the removal of CR13 and CR14.

4. Place the two mica insulators (HP part number 3050-0876) between the heat sink (MP9) and anodes of CR13 and CR14.

E/PM/WA

12/87-04/DS

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5. Reinstall CR13 and CR14 using the two 10-32 nuts removed in step 3.

6. Using a digital multimeter, measure the resistance between the anodes of CR13 and CR14 and the case of U1. The resistance measured should be greater than 10 Megohms.

7. Reinstall the rectifier assembly A3A12 into the unit.

8. Reapply the mains power source to the instrument.

9. Turn on the instrument and enter RCL "0", to preset the instrument.

10. Verify that the Signal Generator presets correctly. Refer to the Operating and Service Manual Section III or the information pullout card for proper preset conditions.

Adjustment

Refer to Section V of the Operating and Service Manual for Post-Repair Adjustments of the Power Supplies.

S E R V I C E   N O T E

SUPERSEDES:
None

HP MODEL 8673E SYNTHESIZED SIGNAL GENERATOR

All Serials

MICROWAVE SIGNAL PATH TROUBLESHOOTING

The following information will assist in troubleshooting the microwave signal path within the HP 8673E Synthesized Signal Generator. Refer to the Microwave Signal Path Block Diagram Service Sheet BD5.

NOTE

To determine whether the fault is in the ALC circuitry or in the Microwave Signal Path, set the frequency to 8 GHz and remove the green cable (A1W13) from A1A9J1 on the Preamp/Modulator assembly A1A9. With the Output Level set to + 10 dBm, the Output Level should be greater than the maximum specified power level. If the output level is correct, the fault is in the ALC and the ALC troubleshooting procedure should be used to isolate the fault. If the output power level is not correct, then continue to troubleshoot the Microwave Signal Path.

The levels listed below are for the various test points on BD5 of Section VIII, HP 8673E Operating and Service Manual.

TP-A: 2 to 6.6 GHz, +10 dBm minimum. Typically +11 dBm at 2 GHz to +17 dBm at 6.599 GHz.

TP-B: 2 to 6.6 GHz, +11 dBm. Typically +22 dBm at 2 GHz and +12 dBm at 6.599 GHz.

TP-C: 2.0 to 6.6 GHz, +9 dBm minimum to drive the Power Amplifier A1A11.

The output drive from the Power Amplifier A1A11 to the YTM A1A10 is shown below. The levels indicated are minimum requirements by frequency range to compensate for the conversion efficiency of the YTM and losses related to cables and the isolator A1AT2.

2 to 3 GHz	+20.0 dBm	4 to 5 GHz	+24.5 dBm
3 to 4 GHz	+23.5 dBm	5 to 6.17 GHz	+26.5 dBm

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1/88-04/DS

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YTM A1A10 input levels by frequency range are:

2 to 5 GHz +19 dBm
5.5 to 6.6 GHz +25.5 dBm

With the typical input being from +22 to +27 dBm.

TP-D: YTM A1A10 output levels are shown below. The minimum requirements by frequency range being:

2 to 18 GHz +11.7 dBm

A1DC1: Output levels from the Directional Coupler (A1DC1) should be:

2 to 18 GHz 10.7 dBm

Output: Front Panel Output levels should be as specified in Table 1-1, Specifications for the HP 8673E Synthesized Signal Generator.

Listed below are typical insertion losses for various microwave components within the microwave signal path, the insertion losses will vary with frequency.

A1CP1 (Bias Tee) 0.2 to 0.8 dB.

A1AT3 (Pulse Modulator) 1 to 1.9 dB.

A1FL1 (High Pass Filter) 0.2 to 0.8 dB.

A1AT2 (Isolator) 0.3 to 0.8 dB.

A1A10 (YTM Conversion Efficiency/losses) by frequency band:

2 to 18 GHz 13.8 dB

A1DC1 (directional coupler) through path insertion losses are 0.5 dB to 1.0 dB. The Coupled port is -16 dB +/-1 dB below the input level.

Typical insertion losses for cable assemblies are:

2 to 12 GHz 0.5 dB 12 to 18 GHz 0.75 dB

S E R V I C E N O T E

SUPERSEDES: 8673E-07

HP 8673E Synthesized Signal Generator

Duplicate Service Notes: 8673B-13B
8673G-04
8673H-05

Serial Numbers: 0000A00000 / 3034A99999

Modification to improve power supply reliability

To Be Performed By: HP-qualified personnel

Situation:

It has been determined that connectors (HP part number 1251-2313) may not have been installed correctly during the fabrication process of the Synthesized Signal Generator. This results in intermittent opens between the connectors and transistor leads which then results in blown fuses.

The connectors have been eliminated on newer instruments and the transistor leads are being soldered directly to the mother boards.

Continued

DATE: 15 September 1991

ADMINISTRATIVE INFORMATION

SERVICE NOTE CLASSIFICATION: **MODIFICATION RECOMMENDED**					
ACTION CATEGORY:	☐ IMMEDIATELY ■ ON SPECIFIED FAILURE ☐ AGREEABLE TIME	STANDARDS:	LABOR 0.5 Hours		
LOCATION CATEGORY:	☐ CUSTOMER INSTALLABLE ☐ ON-SITE ■ HP LOCATION	SERVICE INVENTORY:	☐ RETURN ☐ SCRAP ■ SEE TEXT	USED PARTS:	☐ RETURN ☐ SCRAP ■ SEE TEXT
AVAILABILITY:	PRODUCT'S SUPPORT LIFE	RESPONSIBLE ENTITY: 0400		UNTIL: September 1993	
AUTHOR: D.H.	ENTITY: 0400	ADDITIONAL INFORMATION:			

HEWLETT PACKARD

Solution

A fix for intermittent fuse blowing has been made available. Check the Single Contact connectors (HP part number 1251-2313) for proper mechanical fit. The emitter and base leads of the power supply pass transistors (A3Q1 through A3Q4) may make intermittent contact with the surface of the connectors, causing current surges, which open up the power supply fuses.

If it is determined that the connectors are at fault, the pass transistor leads should be soldered directly to the board assembly. Because one faulty connector probably means that all of the connectors were installed wrong, we recommend that the leads of all four transistors be soldered.

There are no parts needed and no inventory involved with this modification.

S E R V I C E   N O T E

SUPERSEDES:
None

HP MODEL 8673E SYNTHESIZED SIGNAL GENERATOR

All Serials

PREFERRED REPLACEMENT FOR PRECISION RESISTORS

The precision resistors listed in this change are the preferred replacement. This change is being made to improve the reliability of circuits using precision resistors. The preferred replacement precision resistors are thin film and much more reliable.

The precision resistors should only be replaced with the new type only if the resistor has failed. It is not the intent of this change to remove all resistors, but only the ones that have failed.

Readjustment of the circuits involved in this change may be necessary. Be sure to update the parts list in the operating and service manual with the new part numbers.

Prelerred replacement by assembly

The following tables list the preferred replacement parts by assembly within the HP 8673B Synthesized Signal Generator.

Table 1. A1A5 DAC and Enable Assembly (08673-60028)

CIRCUIT SYMBOL	OLD	NEW	DESCRIPTION
R15	0811-3377	0698-5355	RF-5.62K 1.0%
R31	0811-3374	0699-0722	RF-23.7K 0.1%
R32	0811-3374	0699-0722	RF-23.7K 0.1%

E/OF/WO

03/88-04/DS

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Table 2. A1A7 YTM Driver Assembly (08673-60032)

CIRCUIT SYMBOL	OLD	NEW	DESCRIPTION
R5	0811-2870	0757-0293	RF-1.96K 1.0%
R7	0811-3372	0699-0237	RF-1.7K 0.1%
R9	0811-3598	0699-2375	RF-18.5 1.0%
R25	0811-3373	0699-1832	RF-17.9K 0.1%
R26	0811-3373	0699-1832	RF-17.9K 0.1%
R27	0811-3373	0699-1832	RF-17.9K 0.1%
R31	0811-3369	0699-0096	RF-12K 0.1%
R32	0811-3359	0699-2373	RF-12.5K 0.1%
R33	0811-3369	699-0096	RF-12K 0.1%
R35	0811-3366	0699-0059	RF-5K 0.1%
R36	0811-3366	0699-0059	RF-5K 0.1%
R37	0811-3366	0699-0059	RF-5K 0.1%
R38	0811-3366	0699-0059	RF-5K 0.1%
R42	0811-3368	0699-0790	RF-100K 0.1%
R43	0811-0648	0699-0473	RF-50K 0.1%
R44	0811-0648	0699-0473	RF-50K 0.1%
R46	0811-2870	0757-0293	RF-1.96K 1.0%
R53	0811-2675	0699-2377	RF-1.0K 0.05%
R57	0811-3202	0699-2376	RF-30.615K 0.1%

Table 5. A3A5 Digital to Analog Converter Assembly (86701-60015)

CIRCUIT SYMBOL	OLD	NEW	DESCRIPTION
R1	0811-3404	0698-8478	RF-3.5K 0.1%
R2	0811-3358	0699-2379	RF-7.2K 0.1%
R11	0811-3357	0699-2378	RF-6.25K 0.1%
R14	0811-3359	0699-2373	RF-12.5K 0.1%
R15	0811-3357	0699-2378	RF-6.25K 0.1%
R17	0811-3359	0699-2373	RF-12.5K 0.1%
R19	0811-3359	0699-2373	RF-12.5K 0.1%
R21	0811-3360	0699-0104	RF-25K 0.1%
R23	0811-3361	0699-0473	RF-50K 0.1%
R25	0811-2919	0699-0790	RF-100K 0.1%
R26	0811-2037	0698-3762	RF-2.4K 0.5%
R27	0811-3235	0699-2447	RF-7.5K 1.0%
R30	0811-1185	0699-0144	RF-10K 0.01%
R31	0811-3359	0698-2373	RF-12.5K 0.1%
R32	0811-3138	0699-0104	RF-25K 1.0%
R33	0811-0647	0699-0473	RF-50K 0.1%
R35	0811-3362	0699-0143	RF-825 0.1%
R37	0811-3359	0699-2373	RF-12.5K 0.1%
R51	0811-3356	0699-0305	RF-5.9K 0.1%
R55	0811-3325	0699-2374	RF-312 1.0%

SERVICE NOTE

SUPERSEDES:
None

HP MODEL 8673E SYNTHESIZED SIGNAL GENERATOR

Serial numbers 2747A00360 to 2747A00392

MODIFICATION FOR IMPROVED RELIABILITY OF THE + 5V SUPPLY

During a recent change to the A3A10 Mother Board Assembly, the unregulated + 5V line was moved. As a result of that move, part of the trace was placed beneath the rectifier board support (A3MP51) which is connected to the chassis. The trace on the A3A10 mother board is insulated, but there is a possibility of the trace shorting to ground.

Adding an insulator (HP part number 0340-0564) between the rectifier board support (A3MP51) and the mother board (A3A10, HP part number 08673-60195) will improve the reliability of the regulated +5 Volt power supply.

Procedure

1. Use Figure 1 for location of parts identified during the following steps.

2. Remove the mains source from the unit.

3. Remove the top and bottom covers from the HP 8673E.

Note

Use proper ESD precautions when removing and handling static sensitive devices or assemblies.

4. Remove the Mother Board Insulator (MP50) by removing the 5 plastic screws (MP2).

5. Refer to Figure 2 for the following steps.

6. Remove the Rectifier Assembly (A3A12) and set aside.

7. Remove 6 screws (MP32 (4 each) and MP29 (2 each)) that secure the rectifier support bracket (MP51) to the side struts (MP45 and MP66) and the mother board assembly (A3A10).

W/PM,OF/WA

05/88-04/DS

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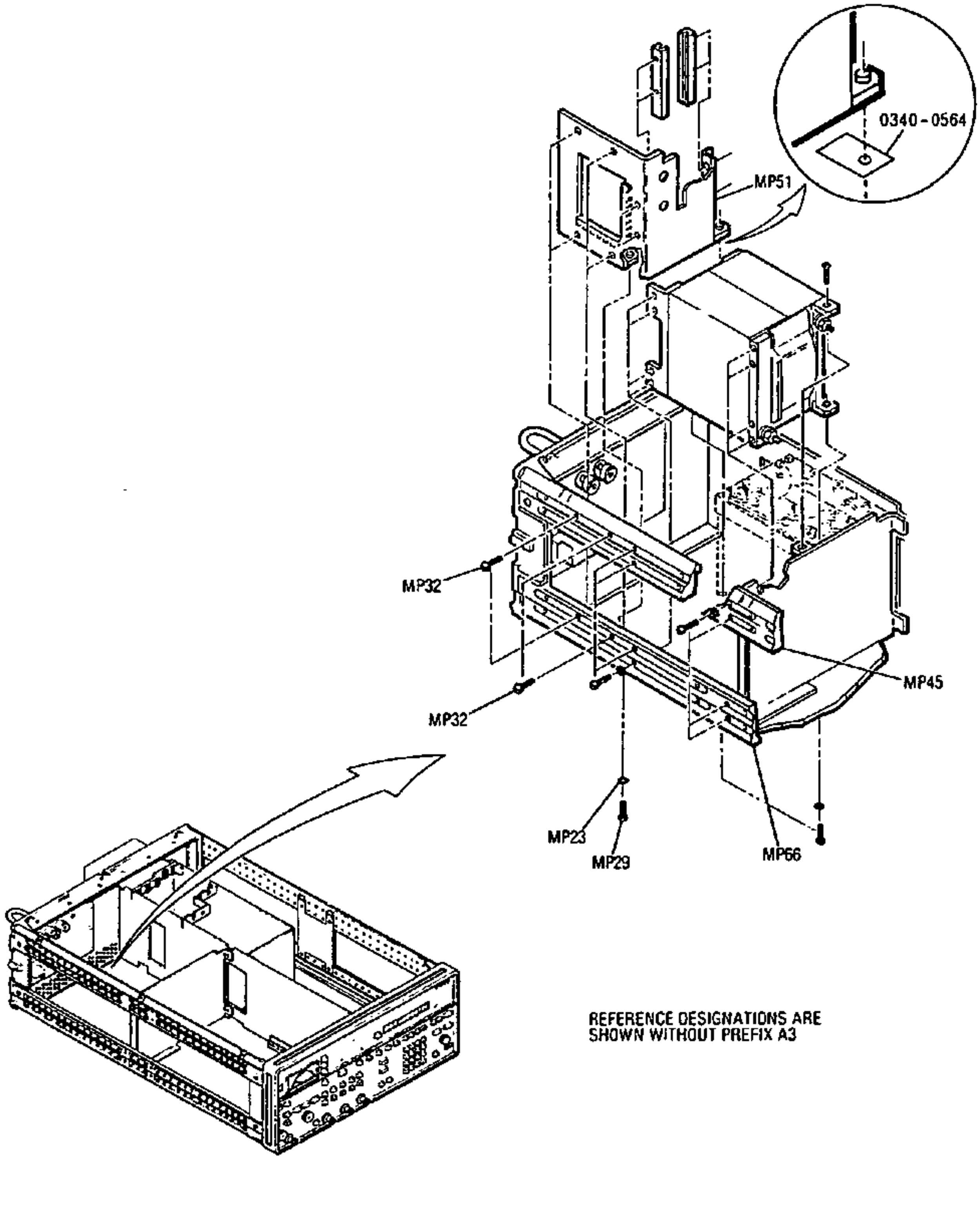

Figure 2. A3 Power Supply Parts Identification

SERVICE NOTE

SUPERSEDES:
None

HP MODEL 8673E SYNTHESIZED SIGNAL GENERATOR

Serial Prefixes 2747A and below

PREFERRED REPLACEMENT FOR THE A3A5 DAC ASSEMBLY

A new DAC Board Assembly (HP part number 08673-60229) is the preferred replacement for A3A5 DAC Assembly (HP part number 86701-60015). The new DAC Board Assembly uses a Monolithic DAC to replace 21 precision resistors and reduce the adjustments from 9 interactive adjustments to 2 non-interactive adjustments.

The DAC Board Assembly (A3A5) should only be replaced by the new part number when the assembly has failed.

The following part will need to be ordered to complete the conversion.

A3A5 YTO DAC Board Assembly 08673-60229

Adjustment of the new YTO DAC assembly will be necessary. Be sure to update the parts list in the operating and service manual with the new part number.

Adjustment Procedure

1. Key in RCL 0 on the Signal Generator and set the frequency to 6598.00 MHz.

2. Connect the DVM ground lead to the reference ground, A3A6TP5. (The ground lead remains connected here for the rest of the procedure).

3. Check the voltage of the Reference Voltage Buffer at A3A5TP4. Verify that the voltage is -6.300 +/-0.063 Vdc. Make repairs if necessary.

4. Connect the DVM to the YTO Pretune Output, A3A5TP5.

5. Connect test points A3A5TP1 and A3A5TP2 together with an alligator clip.

6. Adjust A3A5R15 (OFFSET) to obtain a DVM reading +6.00 mV +/-0.02 mVdc.

I/OF/WO 05/88-04/DS

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7. Remove the alligator clip from testpoints A3A5TP1 and A3A5TP2.

8. Adjust A3A5R8 (GAIN) to obtain a voltage of -19.794 +/-0.001 Vdc.

9. Tune the Signal Generator to 3066.000 MHz. Verify that the voltage at A3A5TP5 is -9.198 +/-0.03 Vdc.

10. Tune the Signal Generator to 4049.000 MHz. Verify that the voltage at A3A5TP5 is -12.147 +/-0.03 Vdc.

SERVICE NOTE

SUPERSEDES:
None

HP MODEL 8673E SYNTHESIZED SIGNAL GENERATOR

Serial Prefixes 2708A through 2821A

IMPROVED RELIABILITY OF THE 20-30 MHz PHASE DETECTOR

On some units it has been determined that under certain conditions the notch filter on the A2A4 Phase Detector (HP part number 08672-60211) may break into oscillations causing the 20 - 30 MHz reference loop to go unlocked. Changing the value of C21 from 47 pF to 10 pF on the A2A4 Assembly will prevent undesired oscillations.

The following part will be needed to complete the change.

10 pF capacitor HP part number 0160-5901

Procedure

1. Remove the mains power from the instrument by unplugging the power cable.
2. Remove the top cover of the instrument.
3. Remove the A2A4 Phase Detector Assembly from the A2 Controller by removing 12 screws.
4. Replace C21 with HP part number 0160-5901 (10 pF +/-0.5 pF).
5. Reinstall A2A4 Phase Detector Assembly and instrument top cover.

Adjustments

There are no adjustment for this assembly.

D/PM,OF/WA

05/88-04/DS

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S E R V I C E   N O T E

SUPERSEDES None

HP 8673E Synthesized Signal Generator

Serial Numbers: 2852A00514/2938A00586

HP 10811-60116 Quartz Oscillator Faulty Thermal Fuse Causes Early Failures

Duplicate Service Notes:

8673B-19A
8673C-22
8673H-01
8673D-23
8672A-24
8671B-07
8673G-01

Improved Reliability

To Be Performed By: Customer or HP-Qualified Personnel

This note provides ordering information for replacing faulty fuse with Fuse Upgrade Kit, HP 10811-67001 or 08673-60262.

Parts Required:

HP P/N	Description	Qty
10811-67001	Fuse Upgrade Kit	1
OR		
08673-60262	Fuse Upgrade Kit	1

(Which includes 10811-67001 and an instrument-specific installation note)

DATE 01 August 1990

Continued

ADMINISTRATIVE INFORMATION

SERVICE NOTE CLASSIFICATION:

MODIFICATION RECOMMENDED

ACTION CATEGORY:	☐ IMMEDIATELY ■ ON SPECIFIED FAILURE ■ AGREEABLE TIME	STANDARDS: LABOR: 1.5 Hours			
LOCATION CATEGORY:	■ CUSTOMER INSTALLABLE ☐ ON-SITE ■ HP LOCATION	SERVICE INVENTORY:	☐ RETURN ☐ SCRAP ■ SEE TEXT	USED PARTS:	☐ RETURN ■ SCRAP ■ SEE TEXT
AVAILABILITY:	PRODUCT'S SUPPORT LIFE	RESPONSIBLE ENTITY: 0400		UNTIL: 01 August 1992	
AUTHOR: DH	ENTITY: 0400	ADDITIONAL INFORMATION:			

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Situation:

The HP 8673E has 10811-60116 as its 10 MHz reference oscillator. A thermal fuse in this oscillator is failing prematurely and causing the oscillator's oven circuitry to lose power. These fuses have been observed to fail as early as three months after delivery of the signal generator.

When the fuse fails, the oven cools down and the oscillator drifts off frequency. Indications of this are as follows:

- The OVEN COLD annunciator will come on and remain on. Normally the OVEN COLD annunciator will turn off within 15 minutes of a cold start.
- The signal generator's output frequency will drift in an unstable manner with changes to its internal temperature.
- The nominal frequency of the reference oscillator will drift out of range of FREQUENCY ADJUST.

Solution/Action:

Order kit 10811-67001 if you already have the installation note 08673-90136 which comes in kit 08673-60262. This installation note contains the following instrument-specific instructions:

- How to determine if a faulty fuse exists
- How to disassemble the instrument
- How to replace the fuse
- How to place new labels identifying the upgrade (Instructions in kit 10811-67001 are incorrect for this signal generator. They cause a label to be placed where it cannot be seen.)
- How to test the instrument after the repair (This involves checking that the OVEN COLD annunciator goes out and performing the the output level and flatness tests found in chapter 4 of the instrument's manual.)

If you don't already have a copy of installation note 08673-90136, order kit 08673-60262 or request a copy directly from the factory customer support engineer. Thereafter, save the installation note for future repairs.

Time required to complete the repair/upgrade and testing is about 1.5 hours.

S E R V I C E N O T E

SUPERSEDES None

HP 8673B/C/D/E/G/H Synthesized Signal & CW Generators

Serial Numbers: 2708A00000 / 2940A99999

Duplicate Service Notes:

8673B-20
8673C-20
8673D-21
8673G-03
8673H-04

Firmware Upgrade

To Be Performed By: Customer or HP Bench Service

Parts Required:

For 8673B/C/D/G........... 08673-80102

For 8673E....................... 08673-80106

For 8673H Option 212... 08673-80104

For 8673H Option 618... 08673-80105

Situation:

The firmware upgrade (a new ROM) corrects a problem in master/slave operation in instruments with serial number prefixes between 2708A and 2940A.

Continued

DATE: 25 October 1990

ADMINISTRATIVE INFORMATION

SERVICE NOTE CLASSIFICATION:

MODIFICATION RECOMMENDED

ACTION CATEGORY:	☐ IMMEDIATELY ☐ ON SPECIFIED FAILURE ■ AGREEABLE TIME	STANDARDS: LABOR: 0.75 Hours			
LOCATION CATEGORY:	■ CUSTOMER INSTALLABLE ☐ ON-SITE ☐ HP LOCATION	SERVICE INVENTORY:	☐ RETURN ■ SCRAP ☐ SEE TEXT	USED PARTS:	☐ RETURN ■ SCRAP ☐ SEE TEXT
AVAILABILITY:	PRODUCT'S SUPPORT LIFE	RESPONSIBLE ENTITY: 0400		UNTIL: November 1991	
AUTHOR: DH	ENTITY: 0400	ADDITIONAL INFORMATION:			

HEWLETT PACKARD

The firmware upgrade is available at no cost to customers whose synthesizers have one of the prefixes mentioned above. Warranty or Extended Warranty will cover the cost of parts (and labor if the customer requests that HP perform the service).

Firmware upgrades are not recommended to customers whose synthesizers have prefixes outside the range mentioned above.

For instruments with prefixes below 2708A, the upgrade is not compatible. For instruments with prefixes above 2940A, the upgrade already exists.

Some incorrect part numbers were published in Instrument News. If your customer requests one of these incorrect part numbers, you should order the number indicated below.

Incorrect Number	Order This Instead	For These Instruments
08673-60263	08673-80102	8673B/C/D/G
08673-60264	08673-80106	8673E
08673-60266	08673-80104	8673H Option 212
08673-60267	08673-80105	8673H Option 618

Solution or Action:

For a customer to receive the no-cost firmware upgrade, his instrument must be in the eligible serial number prefix range. If it is, you can charge the part and any labor to warranty or extended warranty as appropriate. (If the customer is simply ordering the part, intending to to do the labor himself, you can order the part against a materials-only customer service order.)

The ROM with the new firmware is U7 on the instrument's A2A10 Memory/Interface Assembly. The ROM is mounted in a socket and is easily replaceable. The ROM and other instrument circuitry can be damaged by ESD (electrostatic discharge). Follow normal ESD precautions to protect all circuitry.

Only an operational check is required after replacing the ROM. Use the operator's checks found in chapter 3 of the instrument's operating manual.

Table 1-1. Specifications (1 of 2)

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—18.0 GHz	
Display Resolution	3 kHz	2.0 to 18.0 GHz
Display Accuracy	±500 kHz	
Accuracy and Stability	Same as reference oscillator	
Reference Oscillator:		
Frequency	10 MHz	
Aging Rate	<1.5 x 10^{-9}/day	After a 10 day warmup (typically 24 hours in a normal operating environment)
SPECTRAL PURITY		
Single-sideband Phase Noise	−60 dBc	2.0—18.0 GHz 1 kHz offset from carrier
Harmonics	<−40 dBc	Output ≤+3 dBm
Subharmonics	<−35 dBc	Output ≤+3 dBm
Spurious Signals		CW and AM modes
Nonharmonically Related	−50 dBc	2.0 to 18.0 GHz
Power related and fan rotation related within 5 Hz below line frequencies and multiples thereof 2.0—18.0 GHz	−40 dBc	
RF OUTPUT (CW Mode)		2.0 to 18.0 GHz
Output Level	+8 dBm to −120 dBm +3 dBm to −120 dBm	+15 to +35°C 0 to +50°C
Absolute Level Accuracy		
2.0—12.0 GHz	±2.0 dB ±3.5 dB	+8 to −60 dBm output level −61 to −120 dBm output level
>12.0—18.0 GHz	±3.0 dB ±4.5 dB	+8 to −60 dBm output level −61 to −120 dBm output level
Level Resolution	0.1 dB	
Flatness	±4 dB	0 dBm range; +15 to +35°C 2.0—18.0 GHz (minimum to maximum variation in power level across specified frequency limits is less than 2 times flatness spec.)
Residual FM	<10 kHz peak	30 Hz to 15 kHz post detection bandwidth
Residual AM	−50 dBc	50 kHz bandwidth
PULSE MODULATION		
ON/OFF Ratio	>70 dB	
Minimum leveled RF Pulse Width	<80 ns	
Pulse Repetition Frequency	10 Hz to 1 MHz	
Maximum Peak Power	+3 dBm	Leveled pulse
Overshoot	<20% of carrier level	
Undershoot	<20% of carrier level	

Table 1-1. Specifications (2 of 2)

Electrical Characteristics	Performance Limits	Conditions
AMPLITUDE MODULATION		+15 to +35°C 2.0—18.0 GHz; 0 dBm maximum carrier level
Depth	0 to 75%	
Rates	10 Hz to 50 kHz	3 dB bandwidth, 30% depth
Distortion	<8%	50% modulation depth with 1 kHz rate at 0 dBm
Incidental FM	<10 kHz peak to peak	30% modulation depth
FREQUENCY MODULATION		
Frequency Response Relative to a 100 kHz Rate	±3 dB, 50 Hz to 2 MHz	
Maximum Peak Deviation	10 MHz	50 Hz to 1 MHz modulation rate, 10 MHz/volt deviation range
Distortion	<10%	100 kHz rate at 1 MHz peak deviation
Incidental AM	<5%	Rates <100 kHz; peak deviations ≤1 MHz
REMOTE PROGRAMMING	All functions programmable except LINE switch	
GENERAL		
Operating Temperature Range	0 to +55°C	
Power Requirements		
Line Voltage	115 Vac, +5, −10%	50, 60, 400 Hz
Power Dissipation	400 VA maximum	
Conducted and Radiated Electromagnetic Interference	MIL-STD-461A—1968	Conducted and radiated interference is within the requirements of Method CE02.
Net Weight	29 kg (64 lb)	
Dimensions: Height	146 mm (5.7 in)	For ordering cabinet accessories module sizes are 5¼H, 1MW, 23D
Width	425 mm (16.8 in)	
Depth	620 mm (24.4 in)	

Table 1-2. Supplemental Characteristics

Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters. They apply to the 8673E in "Normal" mode, CW operation, and with AUTO PEAK on, except where noted.

FREQUENCY

Internal Reference: The internal reference oscillator accuracy is a function of time base calibration ± aging rate, ± temperature effects, and ± line voltage effects. Typical temperature and line voltage effects are $<1 \times 10^{-7}/°C$ and $<5 \times 10^{-10}$/+5% to −10% line voltage change. Reference oscillator is kept at operating temperature in STANDBY mode with the instrument connected to mains power. The aging rate is $<1.5 \times 10^{-9}$/day after a 24 hour warmup.

External Reference Input: 5 or 10 MHz at a level of 0.1 to 1 Vrms into 50Ω. Stability and spectral purity of the microwave output will be partially determined by characteristics of the external reference frequency.

Reference Outputs: 10 MHz at a level of 0.2 Vrms into 50 ohms. 100 MHz at a level of 0.2 Vrms into 50 ohms.

SPECTRAL PURITY

Residual FM: 250 Hz in a 50 Hz—15 kHz Post-detection bandwidth.

Spurious Signals: Power line and fan rotational related, are located at <−40 dBc.

RF OUTPUT

For power settings >0 dBm, changes in frequency of several GHz in one step may require additional AUTO PEAK enabling to stabilize power at the desired level. Spurious output oscillations may occur for settings above +8 dBm.

External leveling device characteristics will determine output flatness, absolute level accuracy, and switching time in external leveling modes.

Maximum Reverse Power: 1W RF input; 1 MHz—20 GHz, 0 Vdc.

Impedance: 50 ohms.

Source SWR: ≤2.5:1.

PULSE MODULATION

Pulse Input:

Impedance: 50 ohms nominal.

Pulse Repetition Frequency: 50 Hz to 1 MHz.

Minimum Duty Cycle: <0.001 for internally levelled performance, no restriction when unlevelled.

Pulse Width: ≥80 ns.

Levels and Triggering: Rising or falling edge triggered; >3V on, <0.5V off, Normal Mode; <0.05V on, >3V off, Pulse Complement Mode.

Waveform: any.

Level Accuracy: (relative to CW, 15°C to 35°C) ±2 dB, pulse width >100 ns.

Rise/Fall Time: <50 ns.

Video Feedthrough: <−50 dBc.

AMPLITUDE MODULATION

Incidental FM: is the Incidental Phase Modulation times the Modulation Frequency, where Incidental Phase Modulation (at 30% depth) is <1.2 radians, from 2.0 to 18 GHz.

AM Impedance: 600 ohms.

FREQUENCY MODULATION

FM Distortion: ≤5% at >20 kHz rate.

Input Impedance: 50 ohms.

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To Brad Stouten	From Dan Endries
Co. HP	Co. HP
Dept. Service	Phone # 577-2797
Fax # 649-5328	Fax #