Errata

Title & Document Type: **8660A Synthesized Signal Generator Operating and Service Manual**

Manual Part Number: **08660-90080**

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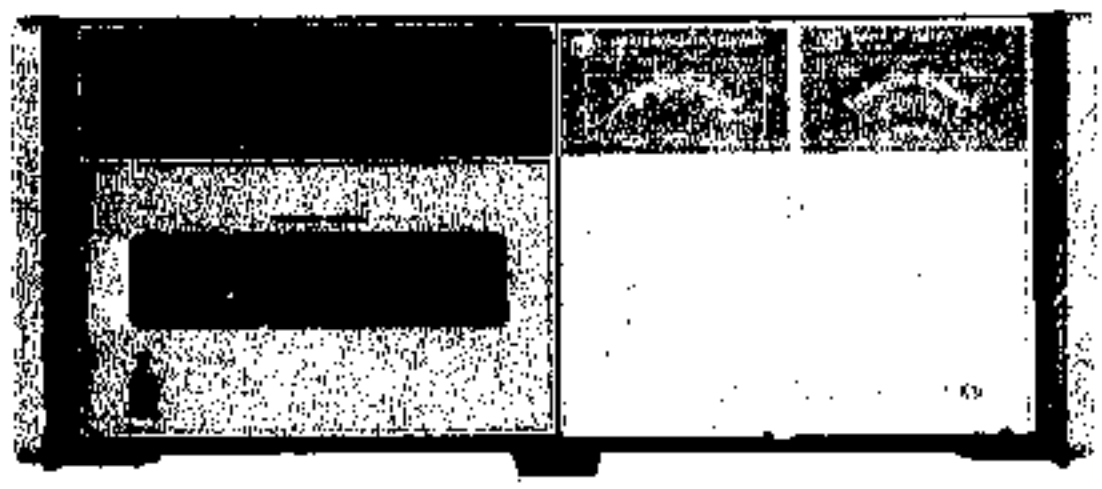
OPERATING AND SERVICE MANUAL

8660A
SYNTHESIZED SIGNAL GENERATOR



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SAFETY CONSIDERATIONS

GENERAL — This is a Safety Class I instrument (provided with terminal for protective earthing).

OPERATION — BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and Safety Precautions are taken (see the following warnings). In addition, note the instrument's external markings which are described under "Safety Symbols."

WARNINGS

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

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminal of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet 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). Grounding one conductor of a two conductor outlet is not sufficient protection.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal is likely to make this instrument dangerous. Intentional interruption is prohibited.

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

Make sure that only fuses with the required rated current and of the specified type (normal blow, time-delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

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.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

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

SAFETY SYMBOLS

Instruction manual symbol: the apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Indicates dangerous voltages.

Earth terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

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 injury or loss of life. 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 equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

OPERATING AND SERVICE MANUAL

8660A
SYNTHESIZED SIGNAL GENERATOR

(includes options 001, 002, 003, 004, 005, and 009)

This manual applies directly to instruments with serial numbers prefixed 1815A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1109A, 1140A, 1141A, 1142A, 1201A, 1219A, 1225A, 1231A, 1239A, 1242A, 1246A, 1317A, 1330A, 1334A, 1343A, 1349A, 1352A, 1404A, 1420A, 1425A, 1445A, 1451A, 1504A, 1508A, 1519A, 1528A, 1539A, 1551A, 1620A, 1629A, 1633A, 1636A, 1638A, 1651A, 1708A, 1714A, 1734A, 1750A, 1812A, and 1814A.

For additional important information about serial numbers, see INSTRUMENT COVERED BY MANUAL in Section 1.

HEWLETT PACKARD

EAST 24001 MISSION AVENUE, TAF C-34, SPOKANE, WASHINGTON, U.S.A., 99220

Manual Part No. 08660-90060

Operating Information Supplement Part No. 08660-90061

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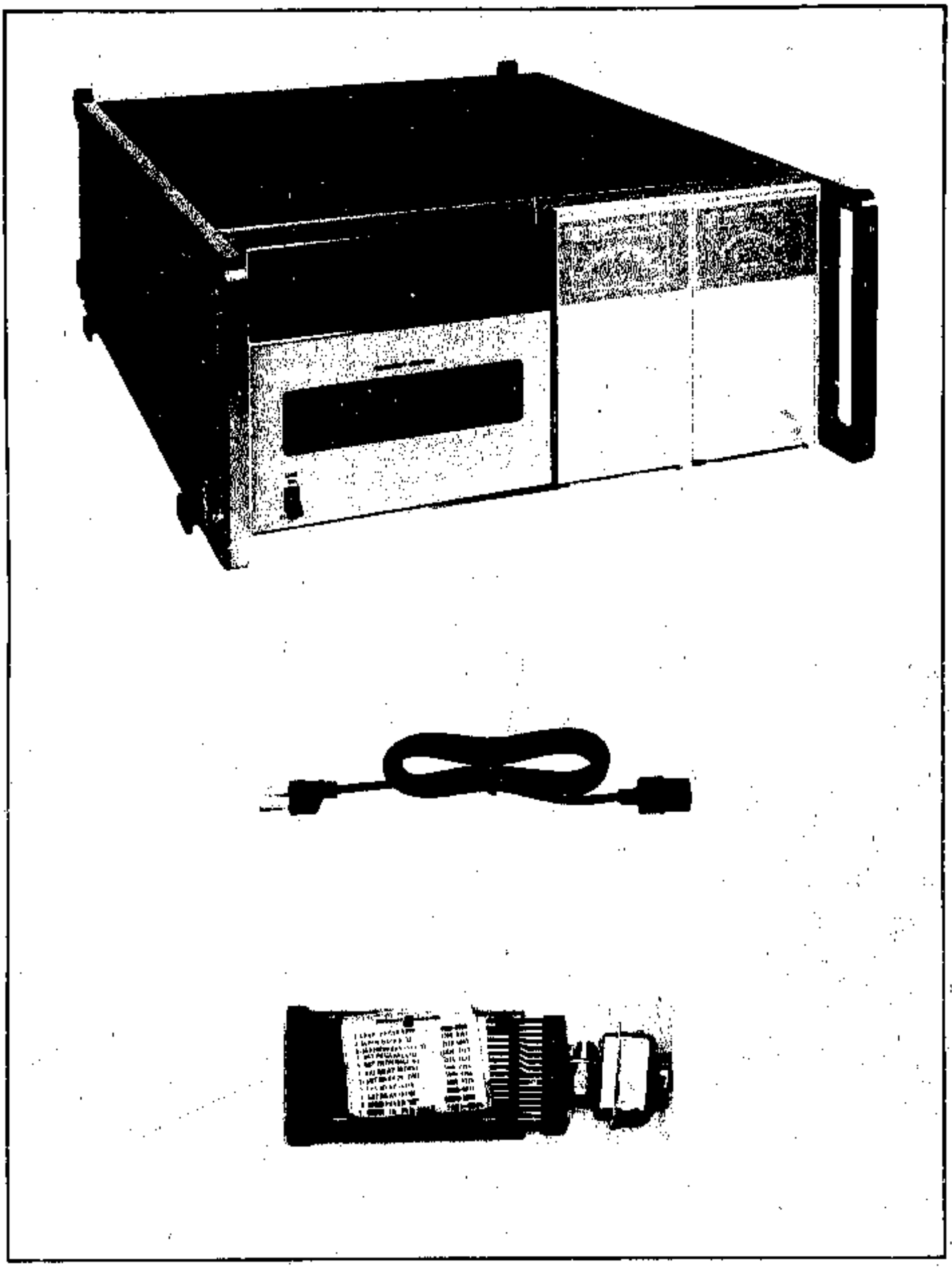


Figure 1-1. Model 8660A Synthesized Signal Generator and Accessories Provided

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains all information required to install, operate, test, adjust and service the Hewlett-Packard Model 8660A Synthesized Signal Generator mainframe. This section covers instrument identification, specifications and other basic information.

1-3. Figure 1-1 shows a front view of the instrument and accessories supplied.

1-4. The various sections of this manual provide information as follows:

a. SECTION I, GENERAL INFORMATION, contains the instrument description and specifications as well as the accessory and recommended test equipment list.

b. SECTION II, INSTALLATION, contains information relative to receiving inspection, preparation for use, mounting, packing, and shipping.

c. SECTION III, OPERATION, contains operating instructions for the instrument.

d. SECTION IV, PERFORMANCE TESTS, contains information required to verify that instrument performance is in accordance with published specifications.

e. SECTION V, ADJUSTMENTS, contains information required to properly adjust and align the instrument after repair.

f. SECTION VI, REPLACEABLE PARTS, contains information required to order all parts and assemblies or effect exchange of assemblies.

g. SECTION VII, MANUAL CHANGES, contains backdating information to make documentation in this manual applicable to all earlier versions of this instrument.

h. SECTION VIII, SERVICE, contains descriptions of the circuits, schematic diagrams, parts location diagrams, and troubleshooting procedures to aid the user in maintaining the instrument.

1-5. Packaged with this instrument is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. This supplement should stay with the instrument for use by the operator. Additional copies of the Operating Information supplement may be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

1-6. On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4 x 6-inch microfilm transparencies of the manual. Each microfiche contains up to 60 photoduplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-7. Instrument specifications are listed in Table 1-1. These specifications are the performance standards, or limits against which the instrument may be tested. Table 1-2 lists supplemental characteristics. Supplemental characteristics are not specifications but are typical characteristics included as additional information for the user.

1-8. INSTRUMENTS COVERED BY MANUAL

1-9. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

1-10. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" that documents the differences.

1-11. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-12. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-13. DESCRIPTION

1-14. The Model 8660A Synthesized Signal Generator is a mainframe unit which requires two plug-in sections to provide a useable RF output. The plug-ins required are an RF Section and a Modulation (or Auxiliary) Section. These plug-in sections are inserted into the front of the Model 8660A; all operating controls are on the front panels.

1-15. All of the signals generated in the Model 8660A are phase locked, directly or indirectly, to a 100 MHz master oscillator in the reference section. The 100 MHz master oscillator is phase locked to an internal 10 MHz temperature controlled oscillator or to an external standard. Provisions are made for the internal reference to be used as a reference signal for other equipment.

1-16. The Model 8660A uses synthesizer techniques to provide digitally controlled precise rf frequencies which are used in RF Section output plug-ins to produce the selected output frequency. The output frequency is exactly that selected, in 1 cycle increments in the standard instruments, or in 100 Hz increments in Option 004 instruments.

1-17. Six phase lock loops, (four in Option 004), all phase locked to the 100 MHz master oscillator, are used to generate the rf signals used in the RF Section plug-ins to produce the final output signal.

1-18. The Model 8660A output frequency may be selected by front panel thumbwheel controls or by a remote programming device.

1-19. Operation of the plug-in sections may also be remotely programmed through the mainframe circuits.

1-20. Descriptions, operating instructions and service information for the various plug-in sections will be provided in separate manuals.

1-21. SPECIFICATIONS

1-22. Specifications for the Model 8660A appear in Table 1-1.

1-23. SUPPLEMENTAL PERFORMANCE CHARACTERISTICS

1-24. Supplemental performance characteristics appear in Table 1-2.

1-25. OPTIONS

1-26. Option 001: Internal reference oscillator with aging rate of less than ± 3 parts in 10^9 /24 hours.

1-27. Option 002: No internal standard reference oscillator.

1-28. Option 003: 50 to 400 Hz ac operation.

1-29. Option 004: 100 Hz resoltuion.

1-30. Option 005: HP-IB Interface.

1-31. Option 009: Light Emitting Diode (LED) display (displays center frequency in BCD format (1 2 4 8) in local or remote operation.

1-32. RF SECTIONS AND FREQUENCY EXTENTION MODULES

1-33. The Model 86600-series RF Section and the 11661-series Frequency Extension Module mix the RF inputs from the mainframe and Modulation Section to produce the system center frequency. Systems with maximum center frequency less than, or equal to, 160 MHz do not use a Frequency Extension Module.

1-34. AUXILIARY SECTION

1-35. The Auxiliary Section plug-in provides a means of applying externally generated amplitude or pulse modulation drive signals to modulate the RF Section's output carrier.

1-36. MODULATION SECTION PLUG-INS

1-37. The Model 86630-series Modulation Section can accept external modulation drive signals or generate internal drive signals to amplitude, fre-

quency, or phase modulate the RF sections output signal.

NOTE

Refer to paragraphs entitled Compatibility in Section I of 86602B and 86603A RF Section manuals; 86632B, 86633B, 86634A, and 86635A Modulation Section manuals.

1-38. HP-IB (OPT 005). HP-IB circuits convert the HP-IB (Hewlett-Packard Interface Bus) data to data, which also can be used to remotely control the Model 8660A Synthesized Signal Generator and its plug-in sections.

1-39. Instruments in the HP-IB system can be talkers, listeners or controllers.

1-40. A talker is an instrument which can send data to another instrument, e.g., a counter which "talks" frequency measurements out to a printer.

1-41. A listener is an instrument which receives data or commands. Model 8660A is a listener.

1-42. A controller is an instrument which controls the operation of other instruments.

1-43. Information (addresses, measurement results, or other data) is transferred on the data lines under control of the three-wire handshake technique. The functional description is contained in the Operation section of this manual.

1-44. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-45. An RF Section and a Modulation or Auxiliary Section must be installed in the Model 8660A mainframe.

1-46. EQUIPMENT AVAILABLE

1-47. A service kit, Hewlett-Packard accessory number 11672A, is recommended for servicing and adjusting the mainframe and the plug-in sections. Contents of the service kit are listed in Table 1-3. Individual items in the kit may be ordered separately, if desired. The 11707A Test Plug-In is also available.

1-48. ACCESSORIES SUPPLIED

1-49. The following accessories are provided with the 8660A:

a. A detachable three-wire power cable. The type of power cord will be determined by the shipment destination.

b. Accessory Kit, Part No. (08660-60070), contains the following:

1	Connector, Type N-to-BNC	1250-0780
1	Extender Board, 20 contact	5060-0256
1	Extender Board, 24 contact	5060-0258
2	Extender Boards, 15 contact	5060-0276
1	Extender Board, 18 contact	5060-0277
1	Connector 36 pin with hood and clamp	1251-0084
1	Extender Board A3 Interface, 18 contact	08660-60348
1	Extender Board A3 Interface, 12 contact	08660-60349
1	Extender Interface Cable	08660-60361

1-50. WARRANTY

1-51. Certification and warranty information for the Model 8660A appears on the inside front cover of this manual.

1-52. TEST EQUIPMENT AND ACCESSORIES

1-53. Table 1-3 lists the test equipment and accessories recommended to test, adjust and service the Model 8660A.

Table 1-1. Specifications

Frequency Selection: Ten digits selected by thumbwheel switches. Least significant digit either 1 Hz (standard) or 100 Hz (Option 004).

Reference Oscillator Internal: 10 MHz quarts oscillator. Aging rate less than ± 3 parts in 10^{-8} per 24 hours after 72 hour warmup. (± 3 parts in 10^{-9} per 24 hours after 30 day warmup, Option 001).

Reference Oscillator External: Rear Panel switch allows operation from any 5 MHz or 10 MHz signal at a level between 0.5 and 2.5 Vrms into 170 ohms. Stability and spectral purity will be partially determined by the characteristics of the external reference oscillator.

Reference Output: Rear panel BNC provides output of reference signal selected (INT or EXT) at the following levels into 170 ohms:

Internal Reference: 0.75 to 1.5 Vrms

External Reference: Nominally equal to external input

Table 1-2. Supplemental Performance Characteristics

Display:

Frequency selection thumbwheels provide mechanical display of frequency. Optional LED display indicates output frequency in 4-bit BCD code in either local or remote operating mode, Option 009.

Remote Programming

Functions:

All front panel frequency, output level, and modulation functions are programmable.

Output Level:

Programmable in 1 dB steps over the output range of the RF Section installed. (For output level accuracy see RF Section Specifications.)

Modulation:

See specifications for Moduation Section and RF Section installed.

Programming Input:

Connector type: 36-pin Cinch Type 57 (mating connector supplied).

Logic: TTL compatible (negative true) "0" logic state corresponds to > 2V. "1" logic corresponds to < 0.8V.

Internal Fan-in from Programming Connector: 10; (required current approximately 15 mA per line in the "1" state).

General:

Operating temperature range: 0° to 55°C.

Leakage: Meets radiated and conducted limits of MIL-I-6181D.

Power: 100, 120, 220, or 240 volts +5%, -10%, 48—66 Hz, 400 VA maximum.

Size: 16-3/4 in. wide x 7 in high x 21-1/2 in. deep behind rack mounting surface.

Weight: Net 48 lb (21,6 kg).

The values in this table are not specifications but are typical performance characteristics included as additional information for the user.

Table 1-3. Test Equipment and Accessories List

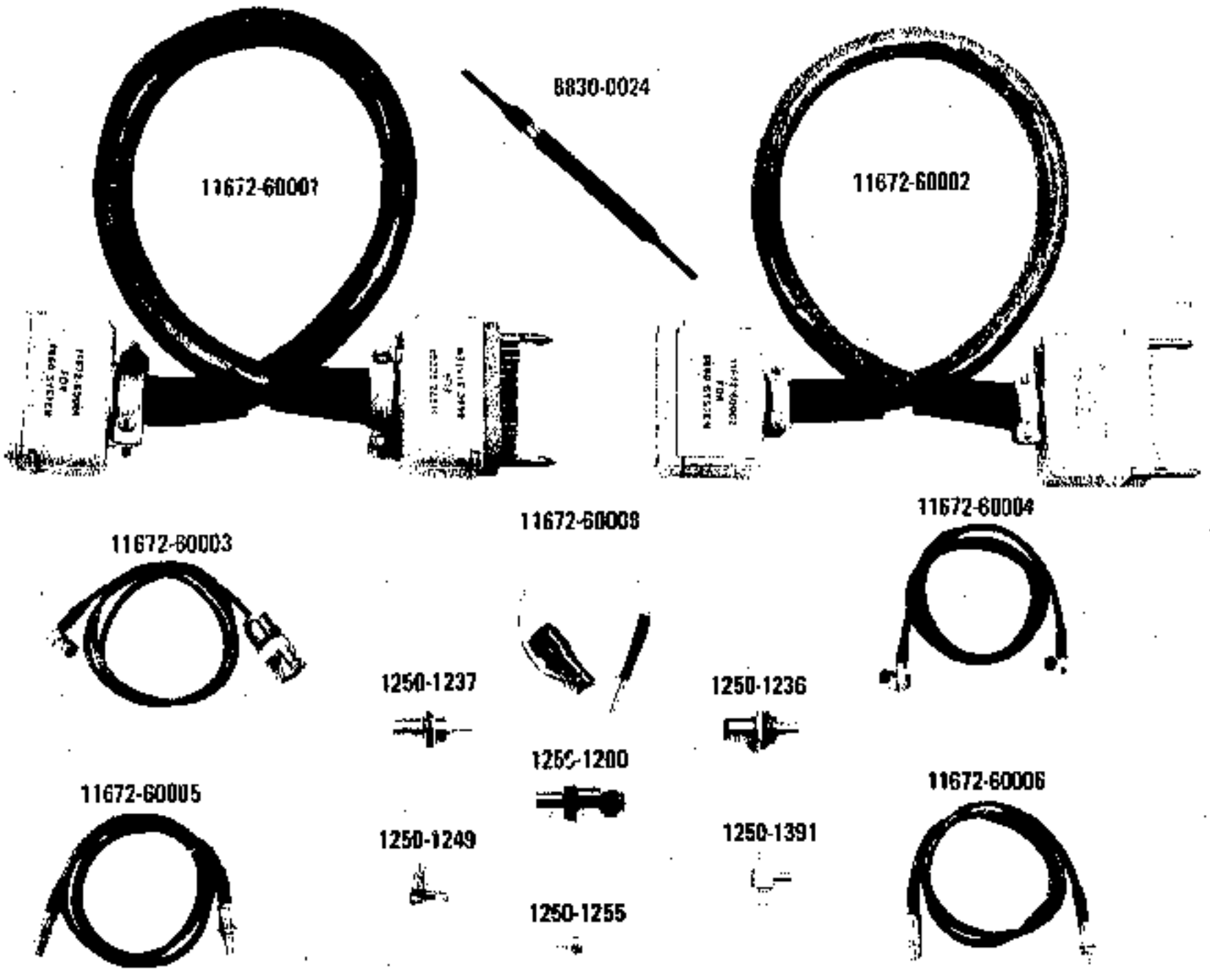
ITEM	MINIMUM SPECIFICATIONS	SUGGESTED MODEL	USE*
Digital Voltmeter	Voltage accuracy ± 0.2% Range: 0 to 60 V	HP 3435A	A, S
AC Voltmeter	3 μV to 3 V Frequency Range 5 Hz to 2 MHz	HP 403B	A, S
Variable Voltage Transformer	Range 103 to 127 Vac Meter Range 103-127 Vac ± 1 V	General Radio W4MT3A	A
Frequency Standard	Frequency 10 MHz Long Term Stability < 1 x 10^{-10} /24 hours	HP 5065A	P
Oscilloscope	Frequency dc to 50 MHz Time base 10 Ns to 1 s Time base accuracy 3%	HP 180 with HP 1801A and HP 1821A plug-ins	P, A, S
10:1 divider probes	10:1 Divider 10 Megohm 10 pF	HP 10004D (2)	P, A, S
Spectrum Analyzer	Frequency Range 10 to 600 MHz, Response ± 1 dB, Measurement accuracy ± 2.0 dB	HP 140/HP 8554B/ HP 8552B	A, S
Electronic Counter	Range 0 - 50 MHz, 0 - 500 MHz with plug-in Accuracy ± 1 count ± time base accuracy. External time base 10 MHz	HP 5328A Option 030	P, A, S
Pulse Generator	Pulse rate 100 kHz Pulse width .035 μs Amplitude .5V Polarity - Selectable	HP 214B	A
Signal Generator/ Sweeper	Frequency -- 1 - 110 MHz Output Range +20 to −20 dBm Output CW or swept	HP 8601A	P, A, S
RF Voltmeter	Range .1 to 2 V Freq. Range 1 to 10 MHz	HP 3406A	P
Test Oscillator	Freq. Range 10 Hz to 1 kHz Output level +10 to −20 dBm	HP 651B	A, S
Frequency Synthesizer	Freq. Accuracy .001% Freq. Stability ± 10 parts in 10^6 per year	HP 3320B	P

*P = Performance Tests A = Adjustments S = Service

Table 1-3. Test Equipment and Accessories List (Cont'd)

ITEM	MINIMUM SPECIFICATIONS	SUGGESTED MODEL	USE*
Service Kit	Consisting of:	HP 11672A	A, S
	Adapter: BNC female to OSM male	1250-1200	
	Adapter: BNC Female, Sealectro female	1250-1236	
	Adapter: BNC female, Sealectro male	1250-1237	
	Adapter: Right angle OSM male/female	1250-1249	
	Sealectro jack (printed circuit mount)	1250-1255	
	Adapter: Sealectro Tee	1250-1391	
	Tool: Adjustment	8830-0024	
	Cable: Extender, 66 pin, gray	11672-60001	
	Cable: Extender, 42 pin, gray	11672-60002	
	Cable Assy: Sealectro male and female, 24 inches long, gray	11672-60005	
	Cable Assy: Sealectro male and female right angle connectors 24" long, red	11672-60004	
	Cable Assy: Sealectro right angle female, BNC male, 24" long, gray	11672-60003	
	Cable Assy: Sealectro male and female, 24" long, gray with blue stripe	11672-60006	
	Cable Assy: BNC female, Winchester male, 12" long, white.	11672-60008	

*P = Performance Tests A = Adjustments S = Service



INSTALLATION

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section explains how to prepare the Model 8660A Synthesized Signal Generator. Also included is information relative to power requirements, environmental requirements, bench operation, rack mounting, etc.

2-3. INITIAL INSPECTION

2-4. 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.

2-5. The contents of the shipment should be as shown in Figure 1-1 of this manual and Figure 1-1 of the manuals for the plug-in sections in use. Procedures for checking electrical performance appear in Section IV of all applicable manuals.

2-6. 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 carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-7. PREPARATION FOR USE

2-8. Power Requirements

2-9. The Model 8660A requires a power source of 100, 120, 220, or 240 volts +5%, −10%, 48—66 Hz. Power consumption is approximately 400 VA maximum.

2-10. 100, 120, 220, or 240 Volt Operation

2-11. To prepare the instrument for operation, install a fuse of the correct rating. Use a 3.0A slo-blo for 100V, 120V operation; a 1.5A slo-blo for 200V, 240V operation.

CAUTION

To prevent damage to the instrument, install the correct fuse for the line voltage available BEFORE connecting the line power.

2-12. Power Cable

2-13. In accordance with international safety standards this instrument is equipped with a three wire power cable. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet. Figure 2-1 shows the types of plugs available on power cables supplied with HP instruments. The numbers under the plug silhouetts are part numbers for complete power cables.

2-14. Mating Connectors

2-15. Internal mating connectors between the 8660A and the plug-in sections are in fixed positions. Refer to Section VIII for connector information.

2-16. Operating Environment

2-17. The Operating environment should be within the following limitations:

a. Temperature: 0°C to +55°C.
b. Humidity: < 85% relative.
c. Altitude: <4600 metres (15 000 feet).

2-18. A forced air cooling system is used to maintain the operating temperature required within the instrument. The air intake and filter are located on the rear panel. When operating the instrument, choose a location that provides at least three inches of clearance at the rear and at least an inch of clearance for each side. The clearances provided by the plastic feet in bench stacking and the filter strip in rack mounting are adequate for the top and bottom cabinet surfaces.

2-19. Bench Operation

2-20. The instrument Cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation. The tilt stands raises the front of the

instrument for easier viewing of the control panel and the plastic feet are shaped to make full width modular instruments self aligning when stacked.

2-21. Rack Mounting (Opt. 908)

2-22. The Rack Mounting Kit (Opt. 908), 08660-60070, can be ordered with, or separately from, the Model 8660A. This kit contains all the necessary hardware and installation instructions for mounting the instrument in a 19-inch spaced rack.

2-23. STORAGE AND SHIPMENT

2-24. Environment

2-25. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

a. Temperature: −40° C to +75° C.
b. Humidity: < 95% relative.
c. Altitude: <7600 metres (25 000 feet).

2-26. Packaging

2-27. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-28. 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, attach a tag indicating the type of service required, return address, and model number, and full serial number.)

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 inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

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

2-29. HEWLETT-PACKARD INTERFACE BUS (HP-IB) SYSTEM (Option 005)

2-30. Cable Adapter (HP Part No. 08660-60187) must be used to connect J3 to the HP-IB bus peripheral equipment (see Figure 2-3).

2-31. HP-IB MODIFICATION INSTALLATION

2-32. To modify a 8660A to accept the HP-IB bus, explicitly follow the instructions contained in the modification kit to install the two circuit boards. Check the jumper positions on the HP-IB output board (HP Part No. 08660-60188). Refer to Figure 2-3.

2-33. Before installing the HP-IB output board, check the address jumpers, and change the address if desired.

NOTE

Each instrument will require a different address, if the parameters will not be the same, when more than one Model 8660A is used in a system. (Refer to the HP-IB Assembly in Section VIII.)

2-34. Install jumper J2 in the 8660A. Jumper J1 is an operator's choice. When jumper J1 is installed, the internally generated BUSY signal is used to delay the RFD response. Without jumper J1, the operator must make allowances in programming for the necessary settling time delays of the 8660A.

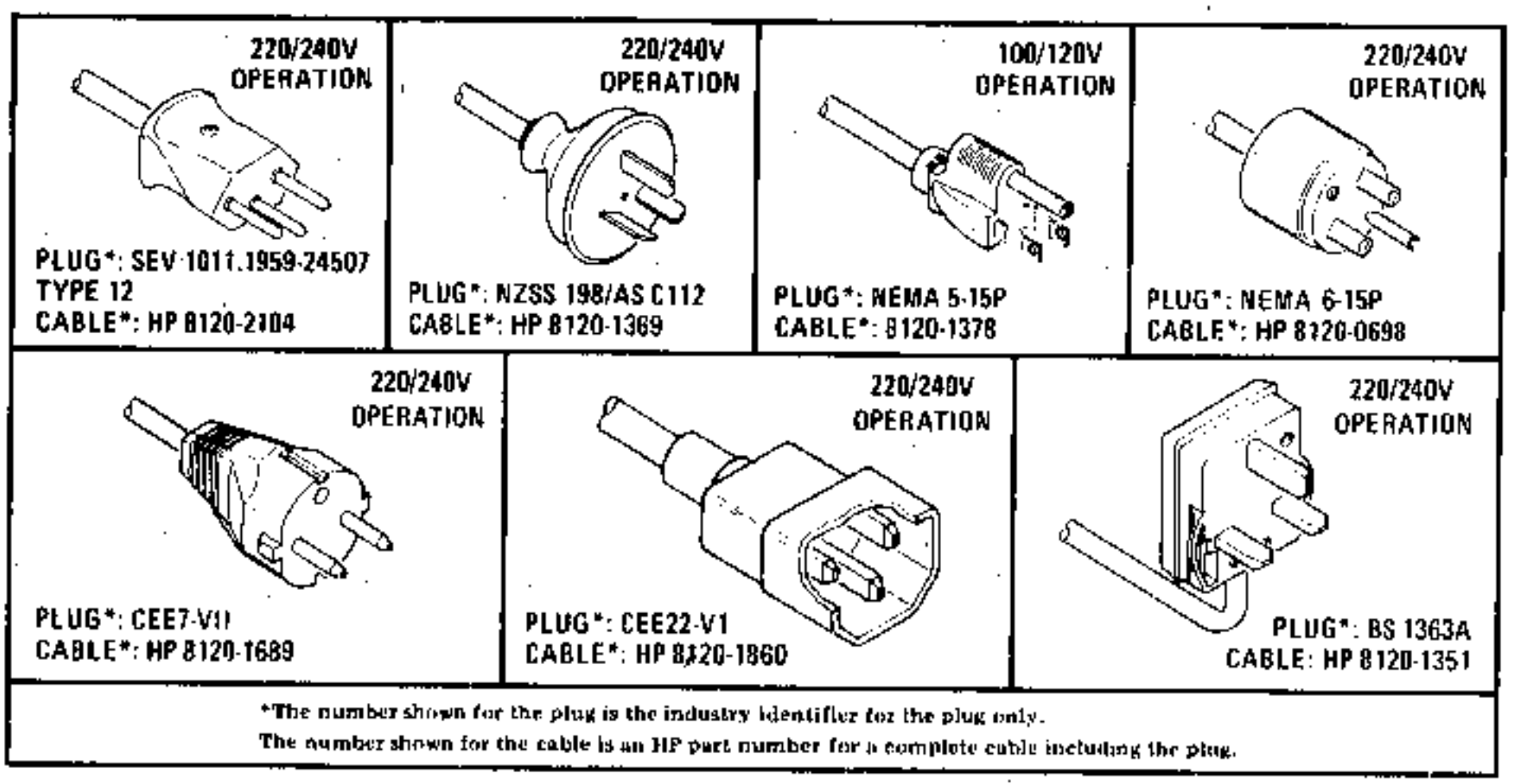


Figure 2-1. Power Cable and Mains Plug Part Numbers

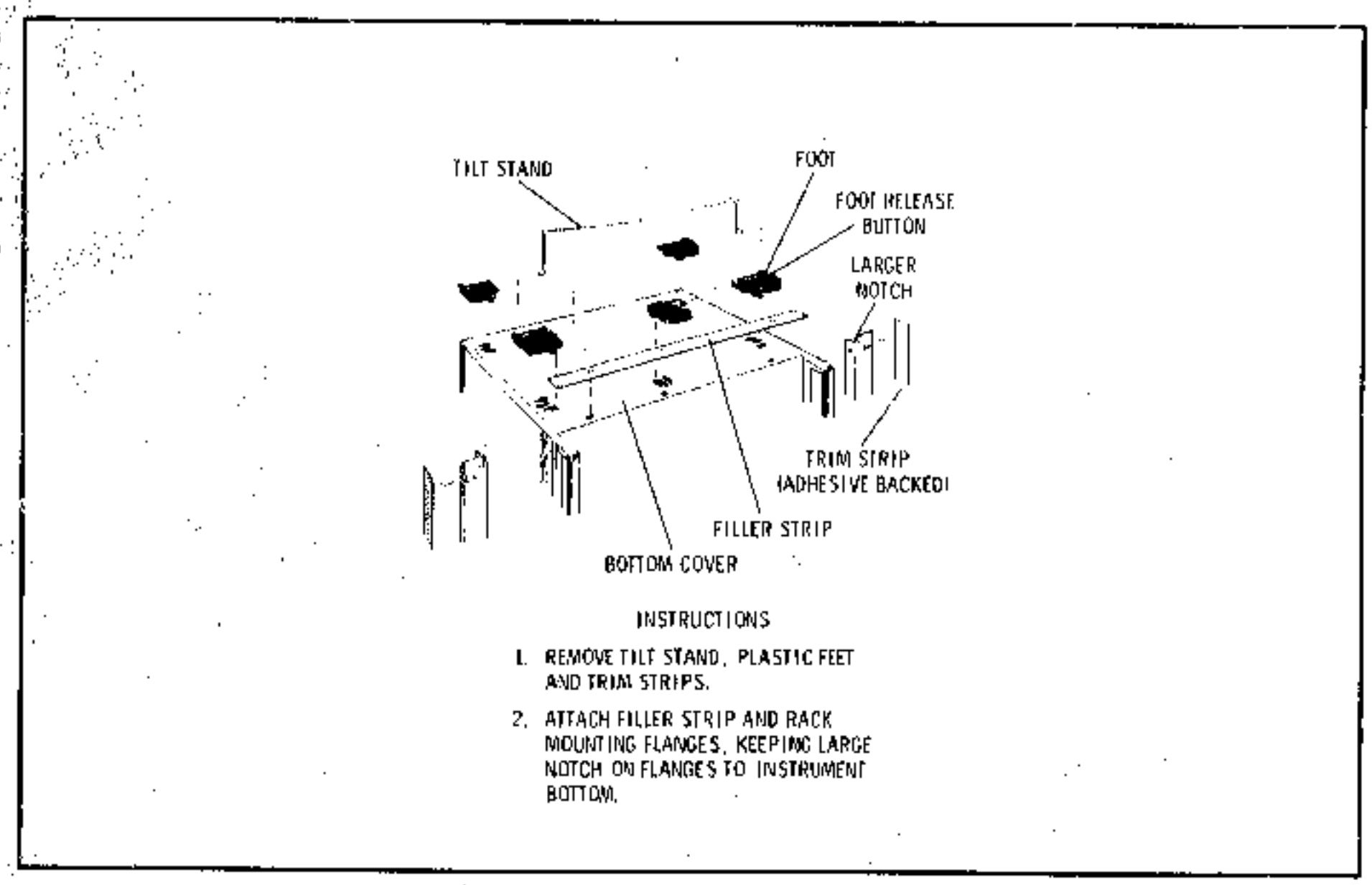
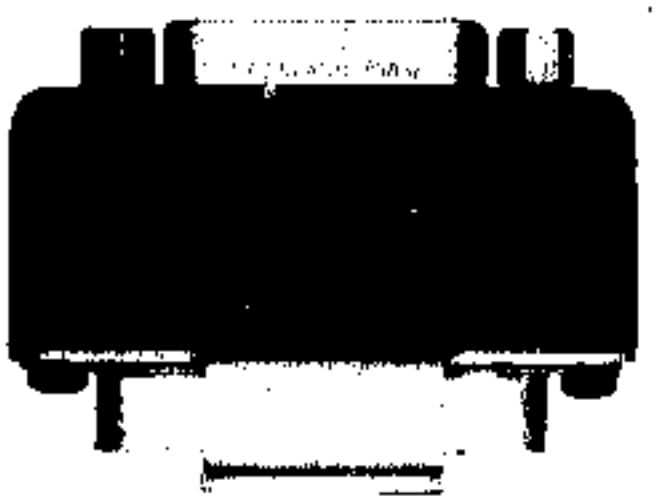
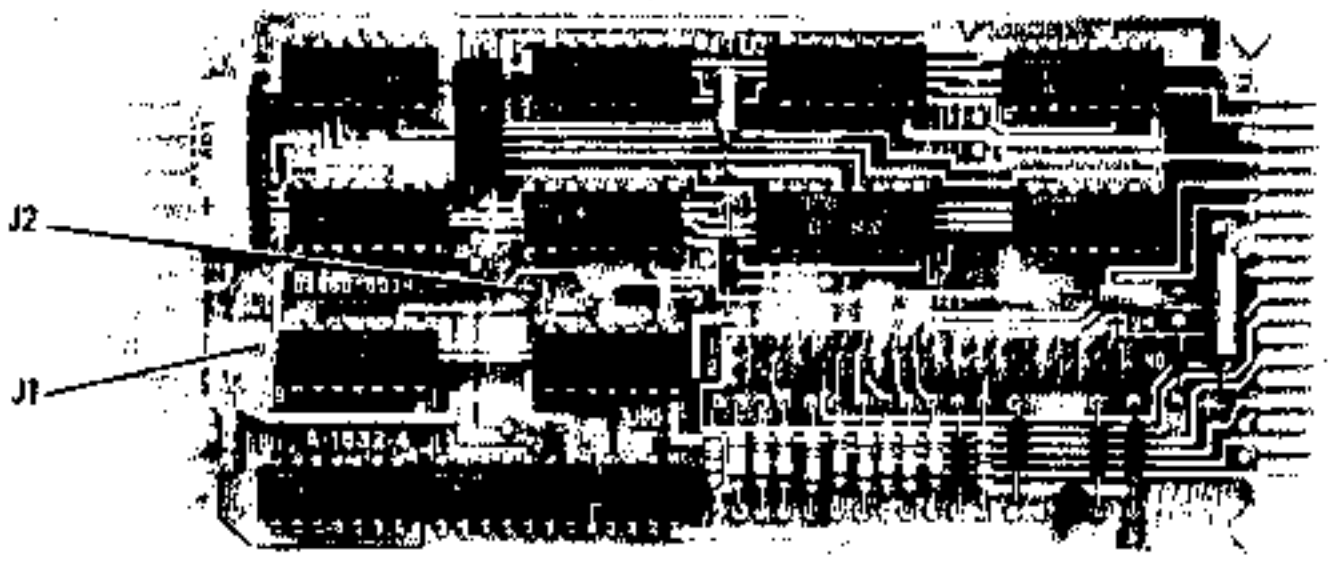


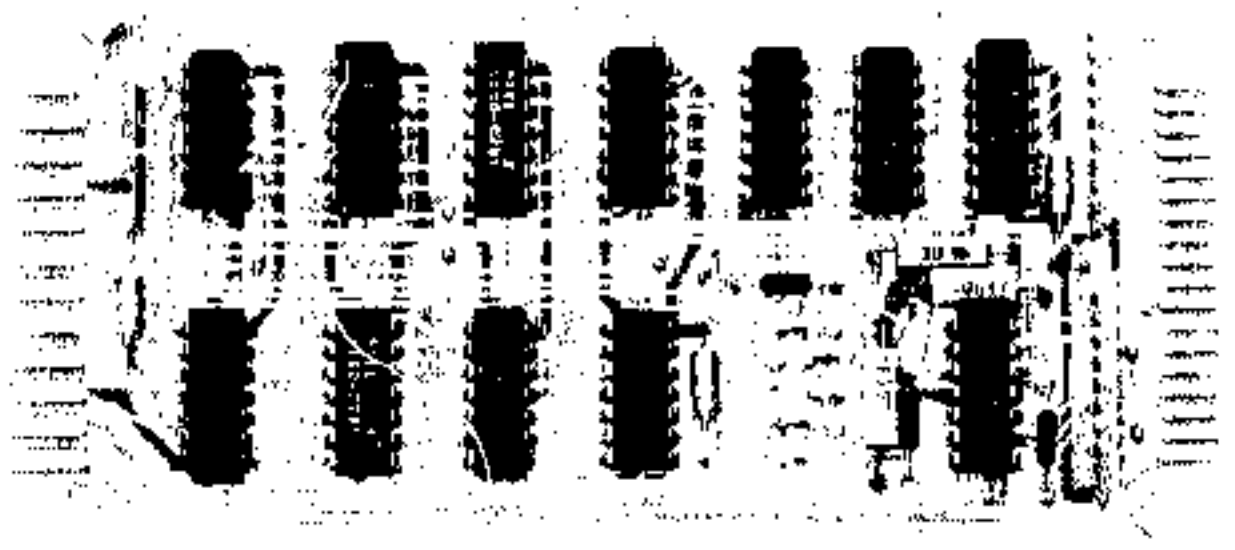
Figure 2-2. Preparation for Rack Mounting



CONNECTOR ADAPTER J3A1 ASSEMBLY



HP-IB A3A1 ASSEMBLY



HP-IB A3A2 ASSEMBLY

Figure 2-3. HP-IB Interface Assemblies

OPERATION

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section provides operating instructions for the Hewlett-Packard Model 8660A Synthesized Signal Generator mainframe.

3-3. The Model 8660A is designed to provide precise digitally controlled signals for use in plug-in sections which provide the selected output frequency. It will be necessary to have the operating manual(s) for the plug-in sections being used in order to efficiently operate the instrument.

NOTE

If a modulation plug-in section is not used it will be necessary to have an Auxiliary Section in place in the modulation plug-in drawer. The Auxiliary Section completes a signal path from the mainframe to the RF Section plug-in and also provides a means of modulating the RF Section from an external source.

3-4. The Model 8660A Synthesized Signal Generator and its associated plug-in sections can be remotely controlled by either the standard supplied BCD programming, or by the Option 005 HP-IB.

3-5. PANEL FEATURES

3-6. Front and rear panel controls, indicators and connectors of the 8660A are shown, and their functions described in Figure 3-1.

3-7. OPERATOR'S MAINTENANCE

3-8. Operator maintenance is limited to replacement of the line fuse and periodic cleaning of the air filter.

3-9. OPERATOR'S CHECKS

3-10. The 8660A is factory calibrated. No adjustment is required when the instrument is received. Refer to Figure 3-2 for timing information and to Table 3-1 for interconnection information.

NOTE

It is not necessary to program functions in a given sequence. However, to minimize the actual time required for entering data, it is suggested to first program frequency, then modulation (if any), and then attenuation.

3-11. When the 8660A is first turned on, the reset will control the DCU circuits in the same manner as the DCU power detect circuit.

NOTE

It is not necessary to program a reset after each entry. The DCU storage register automatically resets after each addressed function.

3-12. Perform the following:

1. Set the rear panel line select switch in the power line module to the same available line power.

2. Connect the power outlet.

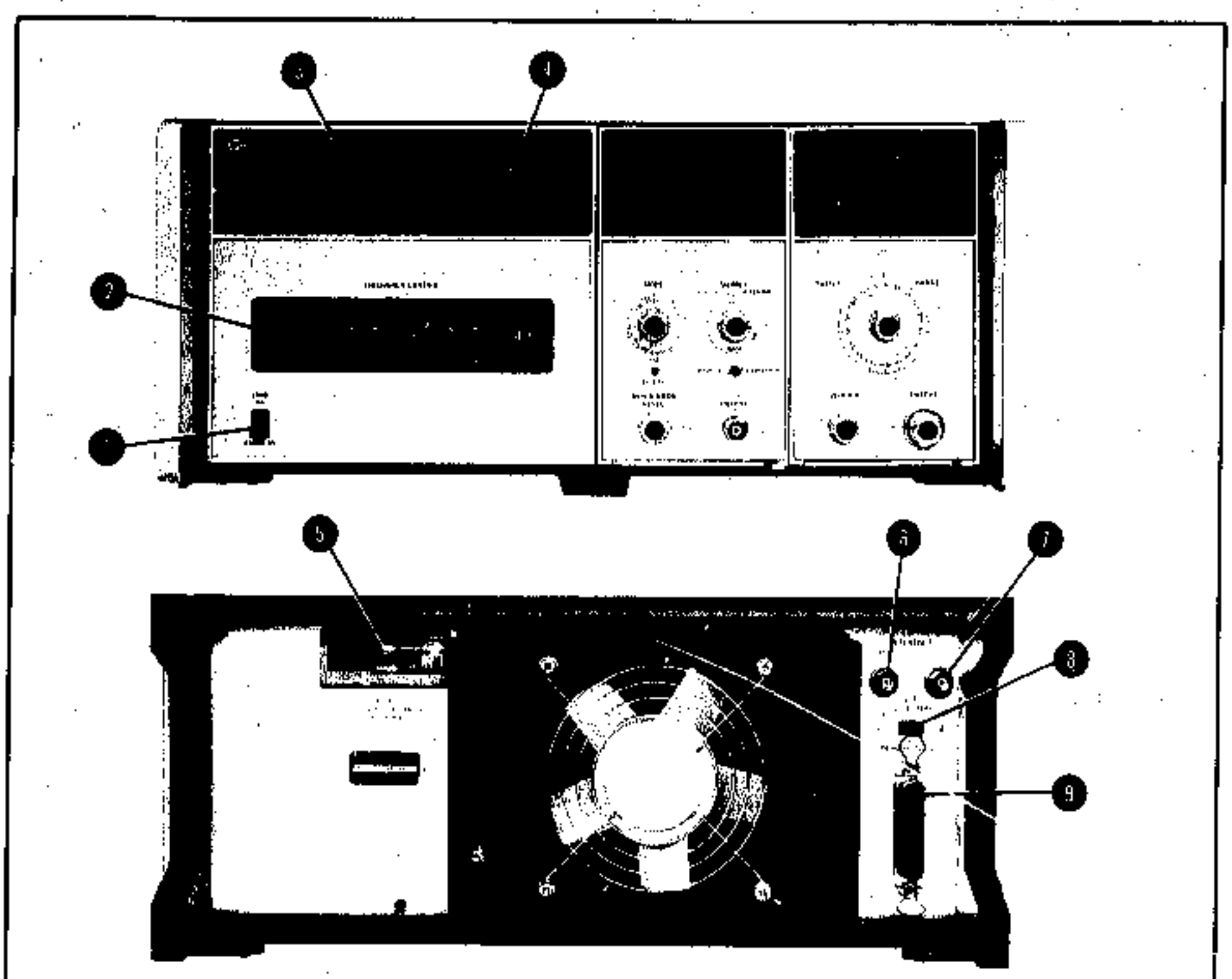
NOTE

When the instrument is connected to the power source, but is not in use, place in the STANDBY mode. Constant temperature in the crystal oscillator will then be maintained.

3. Connect an electronic counter, with the sume reference source as the 8660A, to the RF section plug-in OUTPUT connector.

4. Set the LINE ON/STAND BY switch to the LINE ON position. Allow a minimum of 15 minutes warmup time before operating the instrument.

3-13. Local Mode. Set the thumbwheel switches within the range of the RF section plug-ins being used. When the instrument is equipped with option 009, the LED (light emitting diode) BCD readout should exactly track the frequency set by the thumbwheels. The electronic counter should track



1 LINE switch. In the STAND BY position, with the instrument connected to the line (Mains) power, the reference oscillator oven temperature is maintained at the operating temperature to avoid the necessity of a long warmup period each time the instrument is used. (15 minutes minimum is required.)

2 Frequency select thumbwheel switches. (10) Selects the operating frequency when the instrument is operated in the local mode. Least significant digit (thumbwheel digit 1) is on the right.

3 LED (light emitting diode) readout. OPT 009. Provides a visual BCD readout of the frequency programmed into the thumbwheel control circuit storage registers.

4 Annunciator Block. Provides visual indications for REMOTE (instrument is being programmed from a remote source), OUT OF RANGE (programmed frequency is not within the range of the RF Section plug-in-flashing light), OVEN (indicates oven temperature has not stabilized when lit), FM MODE (when lit indicates that output center frequency is not accurate down to 1 Hz. Occurs when the output frequency is being frequency modulated).

5 Line Module. Contains 100, 120, 220, or 240V switch, fuse, line cable connector and filtering.

6 Reference input. Used when an external standard of 5 or 10 MHz is used.

7 Reference output. Provides the capability of using the internal reference as time base in external equipment.

8 Reference switch. Selects internal or external reference.

9 Remote programming input connector. When the instrument is operated in the remote mode (pin 5 of this connector grounded by the programming device), all functions of the instrument are controlled by the remote device. Front panel controls (except for LINE —STAND BY) have no effect on operation of the instrument.

Figure 3-1. Front and Rear Panel Controls, Indicators and Connectors

the selected frequency ± the counter accuracy. Set the thumbwheel switches to several other frequencies; the BCD readout and the counter display should track the selected frequency.

3-14. Perform the Operator's Checks specified in the manuals for the plug-in sections being used.

3-15. Remote Mode. Refer to paragraphs 3-22 through 3-33. Refer also to Table 3-1 through 3-4 in order to understand the operation of the device to program the 8660A. Table 3-2 illustrates the Remote Programming Timing.

3-16. OPERATING PRINCIPLES

3-17. The Model 8660A may be operated by front panel controls in the local mode or externally programmed in the remote mode.

3-18. Local Operation

3-19. In local operation only the center frequency of the RF Section output plug-in is controlled by the Model 8660A front panel controls. The frequency set on the thumbwheels is automatically clocked into the center frequency storage register every time one or more of the thumbwheels switch positions is changed.

3-20. In local operation of the Model 8660A, the only operator controls are the thumbwheels, the LINE switch and the REFERENCE SELECTOR. Front panel controls are self-explanatory. The REFERENCE SELECTOR switch, located on the rear panel, must be set to INT when an internal standard is used and to EXT when an external standard is used.

NOTE

The Model 8660A Option 002 has no internal standard. An external standard must be used.

3-21. Local control operation of Option 005 instruments is the same as that described for the standard instruments.

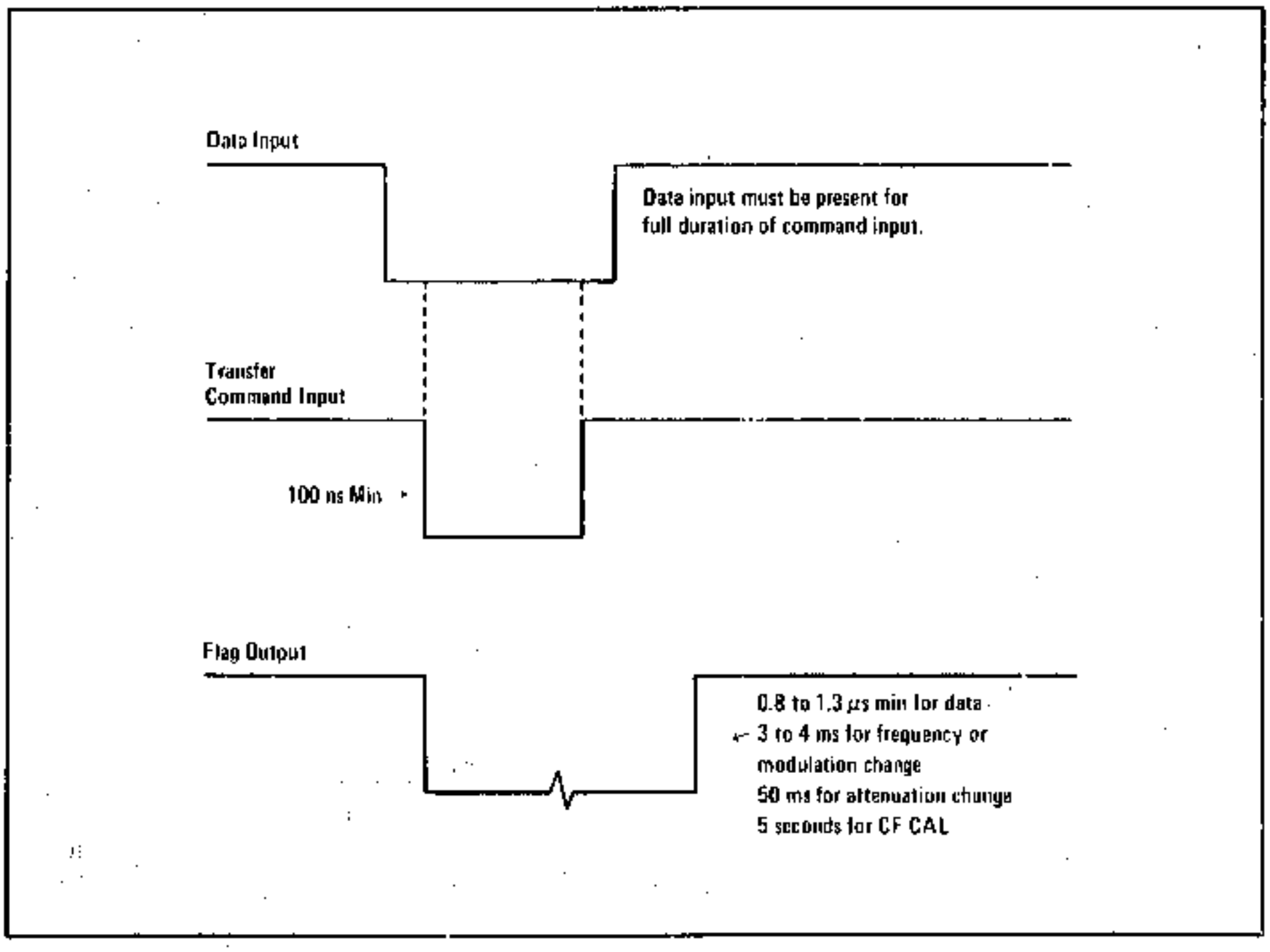


Figure 3-2. Remote Programming Timing

Table 3-1. BCD Programming Connections to J3

J3 Pin No.	To A3XA5 Pin No.	Signal	Other
1			To J3 pin 18
3	2	Error	
5	5	LCL-RMT	
9	11	Command	
13	15	Digit 1 - 8	
14	16	Digit 1 - 4	
15	17	Digit 1 - 2	
16	18	Digit 1 - 1	
17	A	Flag (Busy)	
24	J	Reset	
28	S	Digit 2 - 8	
29	T	Digit 2 - 4	
30	U	Digit 2 - 2	
31	V	Digit 2 - 1	
36			Ground

J3 pins not listed are also wired to A3XA5. See the rear interface board schematic diagram for wiring information.

3-22. Remote BCD Operation

NOTE

The remote mode is selected by the external programming device which places a ground on pin 5 of the blue ribbon connector (J3) on the rear panel of the Model 8660A.

3-23. In remote operation two four-line parallel codes are applied to the instrument circuits through a rear panel connector. These inputs, if numeric data, are converted to 2 BCD digit serial information and clocked into a temporary storage register. If the inputs are address information they are used to direct a clock to strobe the data in the temporary storage register into the desired final storage register.

3-24. The input programming requirements of the 8660A dictate that BCD inputs are as follows: approximately 0 volts (TTL LOW) = 1 and approximately +5 volts (TTL HIGH) = 0 (sometimes referred to as negative true or ground true logic). Another requirement is that the least significant data digit must be entered first, then the next least significant data digit, etc.

3-25. When all of the significant data entries have been stored in the temporary storage registers, input digit 1 is set to binary 15 to indicate that the digit 2 information is the address to which the information stored in the temporary storage register is to be transferred.

Table 3-2. Storage Register Addresses

REGISTER	ADDRESS 0 = High, 1 = Low	MAINFRAME	FUNCTION
Center Frequency	0000 (0)	Mainframe	To set Center Frequency
Attenuator	0011 (3)	RF Section	Controls level of RF Output
Modulation Function	0100 (4)	Modulation Section Plug-In	Selection Modulation Function
Modulation Rate	0101 (5)	Modulation Section Plug-In	Selects AM%, FM Deviation or ØM degrees
FM Calibrate	0110 (6)	Modulation Section Plug-In	Phase locks 20 MHz FM Oscillator to the Reference Loop 20 MHz
Frequency X2	0111 (7)	Mainframe	Doubles Frequency Output
Frequency X1	1001 (9)	Mainframe	Turns off Frequency Doubler

3-26. There are seven final storage registers which may be programmed via the rear panel connector on the 8660A. These storage registers, their addresses, locations and functions are identified in Table 3-3.

3-27. Operation of the storage registers not located in the 8660A mainframe is detailed in the manuals for the plug-in sections in which they are physically located. Table 3-2 provides examples of programming the registers which may be programmed when the 8660A mainframe is used.

3-28. In the remote mode, the temporary storage register is reset to zero each time information is transferred to a final storage register.

3-29. Data inputs (logic 1 = 0V) must be referenced to the transfer command pulse, as illustrated in Figure 3-2. The data inputs may be terminated after the command pulse trailing edge.

3-30. The transfer command pulse will temporarily store the input data in the temporary storage register (thumbwheel control assembly). When the data input is an address, it is stored in one of the seven final storage registers. These pulses are logic 1 (0V) pulses of 100 nanoseconds minimum width, with a maximum 500 kHz frequency. When consistent with the duty cycle, the pulses for low transfer frequencies may be wider. The leading edge must have a fall time of 100 nanoseconds or less. Transfer occurs on the leading edge of the pulse.

NOTE

Data must be held until the command pulse terminates.

3-31. The flag signal is also initiated by the falling (leading edge) of the transfer command pulse. The flag signal is a logic 1 (0V) command which indicates receipt and execution of the transfer command pulse from the remote programming device. Duration of the signal is dependent on the function programmed, and may last from 0.8 μs to 5 seconds. (See Figure 3-2.)

3-32. The error signal indicates frequency out of range or non-stabilized crystal oven temperature. The flag signal stays at a logic 1 (0V) for the duration of the function error.

Table 3-3. Model 8660A BCD Programming Examples

Set 107.654321 MHz Center Frequency (CF)		
INPUT 0 = High 1 = Low	**TEMPORARY REGISTER**	**CF REGISTER**
Data: D_1 0111 (7) D_2 0000 (0)	65 43 21 00 00	Last Input
Transfer Command	07 65 43 21 00	Last Input
Data: D_1 0001 (1) D_2 0000 (0)	07 65 43 21 00	Last Input
Transfer Command	01 07 65 43 21	Last Input
Address: D_1 1111 (15) D_2 0000 (0)	01 07 65 43 21	Last Input
Transfer Command	00 00 00 00 00	01 07 65 43 21
Set 120 dB Attenuation (RF SECTION) Below +13 dBm (1 volt)		
INPUT 0 = High 1 - Low	**TEMPORARY REGISTER**	**ATTEN REGISTER**
Data: D_1 0010 (2) D_2 0001 (1)	00 00 00 00 00	Last Input
Transfer Command	12 00 00 00 00	Last Input
Address: D_1 1111 (15) D_2 0011 (3)	12 00 00 00 00	Last Input
Transfer Command	00 00 00 00 00	120
NOTE The attenuator is a three-digit register; only the three most significant digits are retained.		
Set 7 dB Attenuation (RF SECTION) Below +13 dBm (1 volt)		
INPUT 0 = High 1 = Low	**TEMPORARY REGISTER**	**ATTEN REGISTER**
Data: D_1 0000 (0) D_2 0111 (7)	00 00 00 00 00	Last Input
Transfer Command	70 00 00 00 00	Last Input
Data: D_1 0000 (0) D_2 0000 (0)	70 00 00 00 00	Last Input
Transfer Command	00 70 00 00 00	Last Input
Address: D_1 1111 (15) D_2 0011 (3)	00 70 00 00 00	Last Input
Transfer Command	00 00 00 00 00	007
See note for Example 3		

Table 3-3. Model 8660A BCD Programming Examples (Cont'd)

Shut off Modulation (MODULATION SECTION)		
INPUT 0 = High 1 = Low	**TEMPORARY REGISTER**	**MODULATION FUNCTION REGISTER**
Address: D_1 1111 (15) D_2 0100 (4)	00 00 00 00 00	Last Input
Transfer Command	00 00 00 00 00	00
NOTE All digits are zero - no modulation		
Set 3% AM Modulation, Internal 1 kHz (MODULATION SECTION)		
INPUT 0 = High 1 = Low	**TEMPORARY REGISTER**	**MODULATION RATE REGISTER**
Data: D_1 0011 (3) D_2 0000 (0)	00 00 00 00 00	Last Input
Transfer Command	03 00 00 00 00	Last Input
Address: D_1 1111 (15) D_2 0101 (5)	03 00 00 00 00	Last Input
Transfer Command	00 00 00 00 00	03 into % Storage
Data: D_1 0001 (1) D_2 1000 (8)	00 00 00 00 00	
Transfer Command	81 00 00 00 00	
Address: D_1 1111 (15) D_2 0100 (4)	81 00 00 00 00	
Transfer Command	00 00 00 00 00	81 into Modulation Function Register Set AM and 1 kHz
NOTE See Table 3-4 for Modulation Function Register Codes.		

Table 3-4. Modulation Function Register Coding

DIGIT 2 (D_2)		DIGIT 1 (D_1)	
0 = High	**1 = Low**	**0 = High**	**1 = Low**
AM	1000	EXT. AC	1000
FM x .1	0100	EXT.DC	0100
FM x 1	0010	INT. 400 Hz	0010
FM x 10	0001	INT. 1 kHz	0001
ØM	1100	EXT. AC Unleveled	1001
OFF	0000		

3-33. HP-IB Remote Operation (Option 005)

3-34. This information applies only to Model 8660A Option 005 instruments. Table 3-6 contains the HP-IB codes.

3-35. The Model 8660A Option 005 instruments are the same as that described for Model 8660A instruments with the exception of remote operation utilizing the HP-IB.

3-36. Option 005 allows remote programming, via the HP-IB, of all 8660A front panel controls except LINE POWER. All the front panel controls except LINE and FM CAL (86632B and 86635A) will be locked out when the 8660A is in REMOTE.

3-37. 8660A HP-IB interface will recognize an internally preset "listen" address and accept bit-parallel, word serial HP-IB information. When addressed to listen, the 8660A will shift incoming data into a temporary storage register.

NOTE

This data must first be presented to the interface least significant digit in order to satisfy the internal logic requirements of the 8660A.

3-38. When an internal address character is detected in the input data, the contents of the temporary storage register are shifted into the register selected by the internal address character. The temporary is then cleared to receive more data.

3-39. HP-IB Programming. Application Note 164-2 describes programming with the use of calculators as controllers. Table 3-5 shows the general code allocations.

3-40. Data String. Commands to the 8660A consists of a string of numerical data which is followed by a character from the internal address section of Table 3-6. The character defines the meaning of the data string. The following paragraphs describe how the data strings are formatted for each of the programmable functions: Center Frequency, Output Level, Modulation Mode/Source, Modulation Level, FM Calibrate, and Frequency X1, Frequency X2. The commands for all of these are used in the command for an HP 9830 calculator as defined in Table 3-7.

3-41. Center Frequency. The data string contains 10 digits. Write out the frequency in Hertz, then add leading zeroes to form the 10 digits. Reverse the order of the digits to form the data string. Leading zeroes can be deleted in the reversed data, e.g. 3 MHz would be written as 0 003 000 000. Data string would be 000 000 3000; the command sent to the 8660A would be 3000(.

3-42. Output Level. Three digits form the data string. Programmed output level is the number of dB below +13 dBm. Write out this number, then add leading zeroes to form three digits. Reverse the order of the digits to form the data string. Leading zeroes can be deleted in the reversed data, e.g., an output level of −10 dBm is programmed by writing 023. Data string would be 320. Add the internal address code to give the command 320#.

3-43. Modulation Mode/Source. The data string contains two (2) digits; refer to Table 3-6 to form the data string. The left digit represents the mode and the right digit represents the source, e.g. to program FM X1 mode with internal 1 kHz source, the command is 21$.

3-44. Modulation Level. The data string contains two digits. The programmed modulation mode will determine what it represents. In AM, the data represents the degree of modulation expressed in %. In FM, the data represents the number of increments of 2% of full scale deviation, e.g. to program a 50 kHz FM deviation, first program the FM X1 modulation mode which has a 100 kHz full scale deviation. A 2% increment of full scale is 2 kHz. Therefore, 25 increments are required. Reverse the digits to give 52, then add the internal address code to give the command 52%. In phase modulation, the data represents half the number of degrees of deviation desired. Refer to Table 3-6.

3-45. FM Calibrate. There is no data with this command. Send the character & to initiate the FM calibration cycle.

3-46. Frequency X1, Frequency X2. There is no data with these commands. Send either the I or G character to enter the mode desired.

3-47. Refer to Table 3-7 to observe that the command for an HP 9830 calculator utilizes all of the commands defined in the previous paragraphs.

Table 3-5. HP-IB General Code Allocations

DIO LINES	UNIVERSAL BUS COMMANDS		DEVICE LISTEN ADDRESS		DEVICE TALK ADDRESS	
8 → 7 → 6 → 5 →	x [H H] H	x [H H] L	x [H L] H	x [H L] L	x [L H] H	x [L H] L
	COLUMN →	1	2	3	4	5
4 3 2 1 ↓ ↓ ↓ ↓	ROW ↓ OCTAL DECIMAL BUS COMMAND	OCTAL DECIMAL BUS COMMAND	OCTAL DECIMAL SYMBOLIC ADDRESS	OCTAL DECIMAL SYMBOLIC ADDRESS	OCTAL DECIMAL SYMBOLIC ADDRESS	OCTAL DECIMAL SYMBOLIC ADDRESS
H H H H	0	0 0.	20 16.	40 32. SP	60 48. 0	100 64. @	120 80. P
H H H L	1	1 1.	21 17. *LLO	41 33. !	61 49. 1	101 65. A	121 81. Q
H H L H	2	2 2.	22 18. R*	42 34. "	62 50. 2	102 66. B	122 82. R
H H L L	3	3 3.	23 19. R*	43 35. #	63 51. 3	103 67. C	123 83. S
H L H H	4	4 4.	24 20. DCR	44 36. $	64 52. 4	104 68. D	124 84. T
H L H L	5	5 5.	25 21.	45 37. %	65 53. 5	105 69. E	125 85. U
H L L H	6	6 6.	26 22.	46 38. &	66 54. 6	106 70. F	126 86. V
H L L L	7	7 7.	27 23.	47 39. '	67 55. 7	107 71. G	127 87. W
L H H H	8	10 8.	30 24. SPE	50 40. (	70 56. 8	110 72. H	130 88. X
L H H L	9	11 9.	31 25. SPD	51 41.)	71 57. 9	111 73. I	131 89. Y
L H L H	10	12 10.	32 26.	52 42. *	72 58. :	112 74. J	132 90. Z
L H L L	11	13 11.	33 27.	53 43. +	73 59. ;	113 75. K	133 91. [
L L H H	12	14 12.	34 28. R*	54 44. ,	74 60. <	114 76. L	134 92. \
L L H L	13	15 13.	35 29. R*	55 45. -	75 61. =	115 77. M	135 93.]
L L L H	14	16 14.	36 30.	56 46. .	76 62. >	116 78. N	136 94. ^
L L L L	15	17 15.	37 31.	57 47. /	77 63. ? UNLISTEN COMMAND	117 79. O	137 95. - UNTALK COMMAND

UNASSIGNED

UNASSIGNED

H = High State.
L = Low State.
X = Unused when MRE is low.
LLO = Local Lockout.
DCR = Device Clear.
R* = Reserved for future assignments.
SPE = Status Poll Enable.
SPD = Status Poll Disable.
[ ] = Control Bits.
DIO = Data Input Output Signal Lines, DIO1-8.

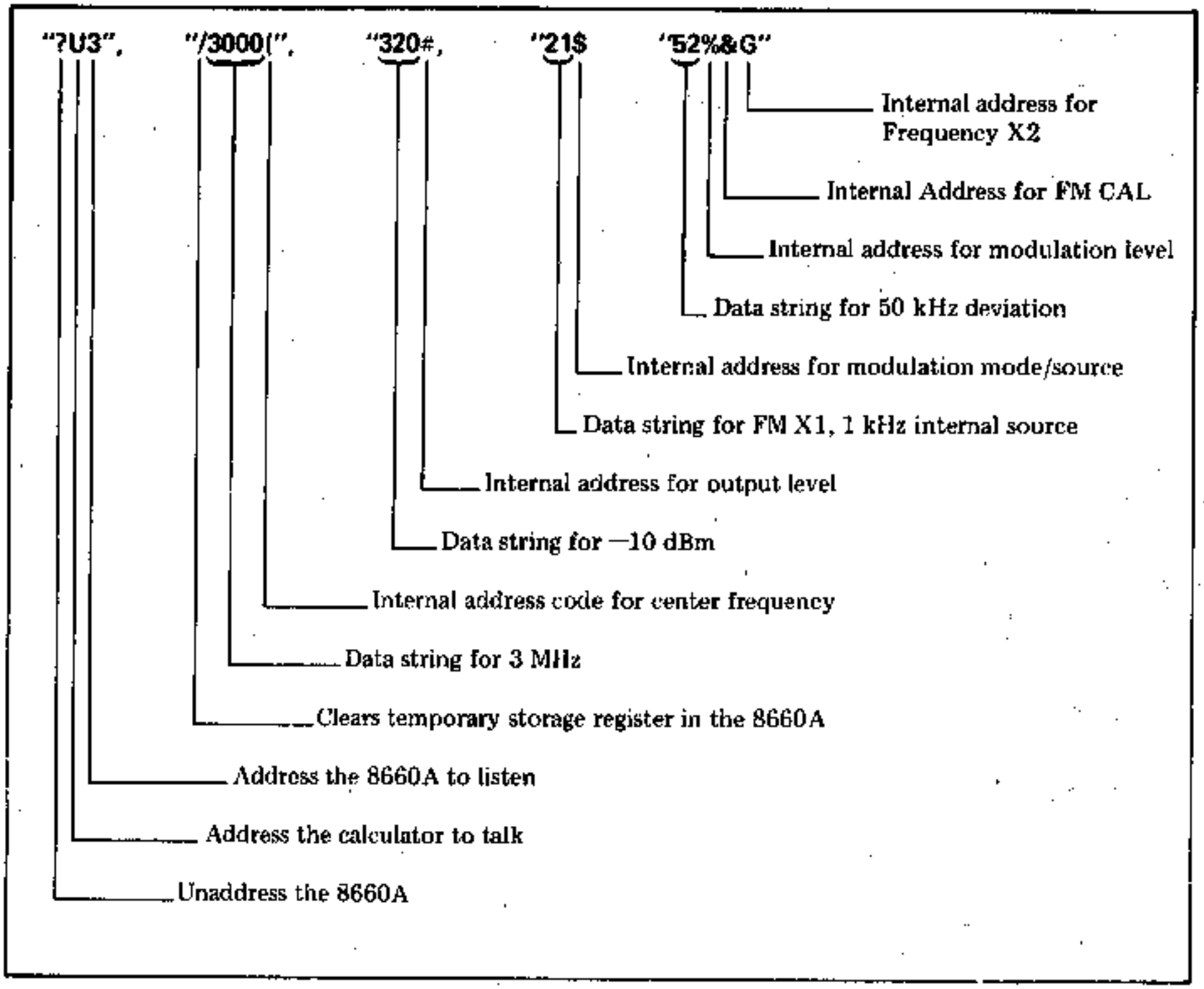
Table 3-6. 8660A HP-IB Interface Coding Table

INTERFACE	FUNCTION		OCTAL CODE	HP-IB CHARACTER
INTERNAL ADDRESSES	OUTPUT LEVEL		043	C
	MODULATION MODE/SOURCE		044	$
	MODULATION LEVEL		045	%
	FM CALIBRATE*		046	&
	CENTER FREQUENCY		050	(
	FREQUENCY X1		111	I
	FREQUENCY X2		107	G
MODULATION MODE SOURCE	OFF	MSD	060	0
	FM X10*	MSD	061	1
	FM X1	MSD	062	2
	FM X.1	MSD	064	4
	AM	MSD	070	8
	ØM	MSD	074	<
	INT 1 KHZ	LSD	061	1
	INT 400 HZ	LSD	062	2
	EXT DC	LSD	064	4
	EXT AC	LSD	070	8
	EXT AC (UNLEVELED)**	LSD	071	9
HP-IB SYSTEM ADDRESSES	8660A LISTEN ADDRESS		063	3
	OTHER ADDRESSES	for multiple units	073	;
	OTHER ADDRESSES	for multiple units	075	=
	OTHER ADDRESSES	for multiple units	076	>
	UNIVERSAL UNLISTEN		077	?
DIGITS	0		060	0
	1		061	1
	2		062	2
	3		063	3
	4		064	4
	5		065	5
	6		066	6
	7		067	7
	8		070	8
	9		071	9

*86632 and 86635 only.

**86633 only.

Table 3-7. HP 9830 Calculator Commands



PERFORMANCE CHECK

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. A simpler operations test is included in Section III under Operator's Checks.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in the Recommended Test Equipment table in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models(s).

4-5. TEST RECORD

4-6. Results of the performance tests may be tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

PERFORMANCE TESTS

4-7. INTERNAL CRYSTAL OSCILLATOR AGING RATE

SPECIFICATION:

Reference Oscillator Internal: 10 MHz quartz oscillator. Aging rate less than ± 3 parts in 10^{-8} per 24 hours after 72 hour warmup. (± 3 parts in 10^{-9} per 24 hours after 30 day warmup, Option 001).

DESCRIPTION:

This test verifies the reference oscillator aging rate after the instrument has been connected to the ac line for 72 hours.

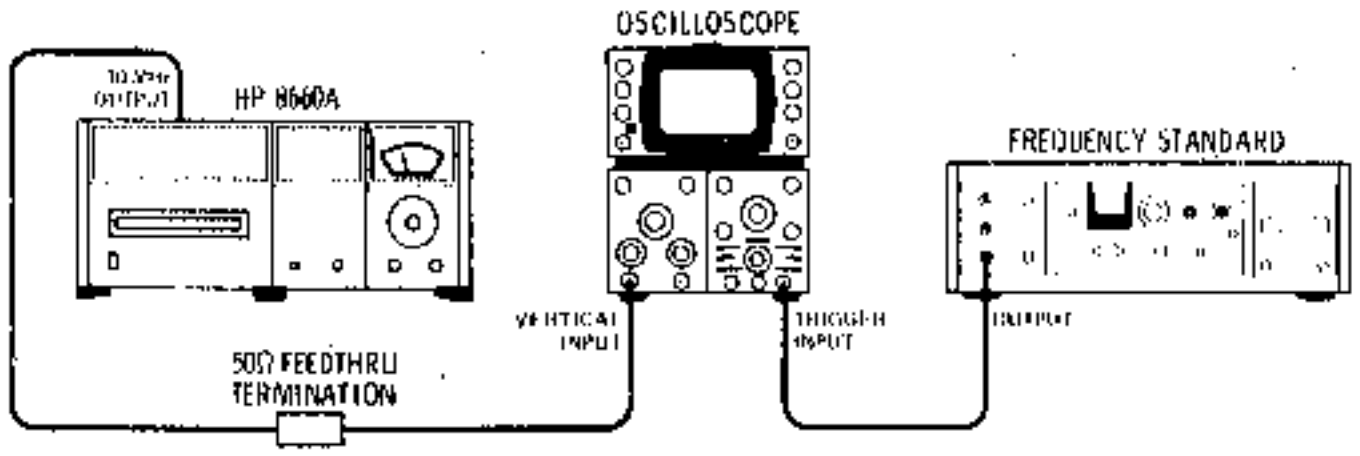


Figure 4-1. Crystal Oscillator Aging Rate Test Setup

EQUIPMENT:

Frequency Standard	HP 5065A
Oscilloscope	HP 180/1801A/1821A
50 Ohm Feedthru Termination	HP 11048C

PERFORMANCE TESTS

4-7. INTERNAL CRYSTAL OSCILLATOR AGING RATE (Cont'd)

PROCEDURE:

1. Set the rear panel REFERENCE switch to INT.
2. Connect the equipment as shown in Figure 4-1.
3. Adjust the oscilloscope controls for a stable display of the 10 MHz output.
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 (T_2). Record the period of time between measurements (T_3) in hours.

T_2 = _____ s
T_3 = _____ h

6. Calculate the aging rate from the following equation:

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

where: 1 cycle = the phase change reference for the time measurement (in this case 360°)

f = Synthesizer'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 = final time measurement(s) for a 360° (1 cycle) change

T_3 = time between measurement (h)

for example:

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

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

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

PERFORMANCE TESTS

4-7. INTERNAL CRYSTAL OSCILLATOR AGING RATE (Cont'd)

7. Record the aging rate. Aging Rate_____3×10^{-8}/day

NOTE

If the absolute frequencies of the frequency standard and the Generator's reference oscillator are extremely close, the measurement time in steps 4 and 5 (T_1 and T_2) can be reduced by measuring the time required for a phase change of something less than 360°. Change 1 cycle in the formula (e.g., 180° = 1/2 cycle, 90° = 1/4 cycle).

4-8. INPUT SENSITIVITY FOR EXTERNAL REFERENCE

SPECIFICATION:

Reference Oscillator External: Rear Panel switch allows operation from 5 MHz, or 10 MHz signal at a level between 0.5 and 2.5 Vrms into 170 ohms. Stability and spectral purity will be partially determined by the characteristics of the external oscillator.

DESCRIPTION:

This test verifies that the Model 8660A will operate with specified reference inputs.

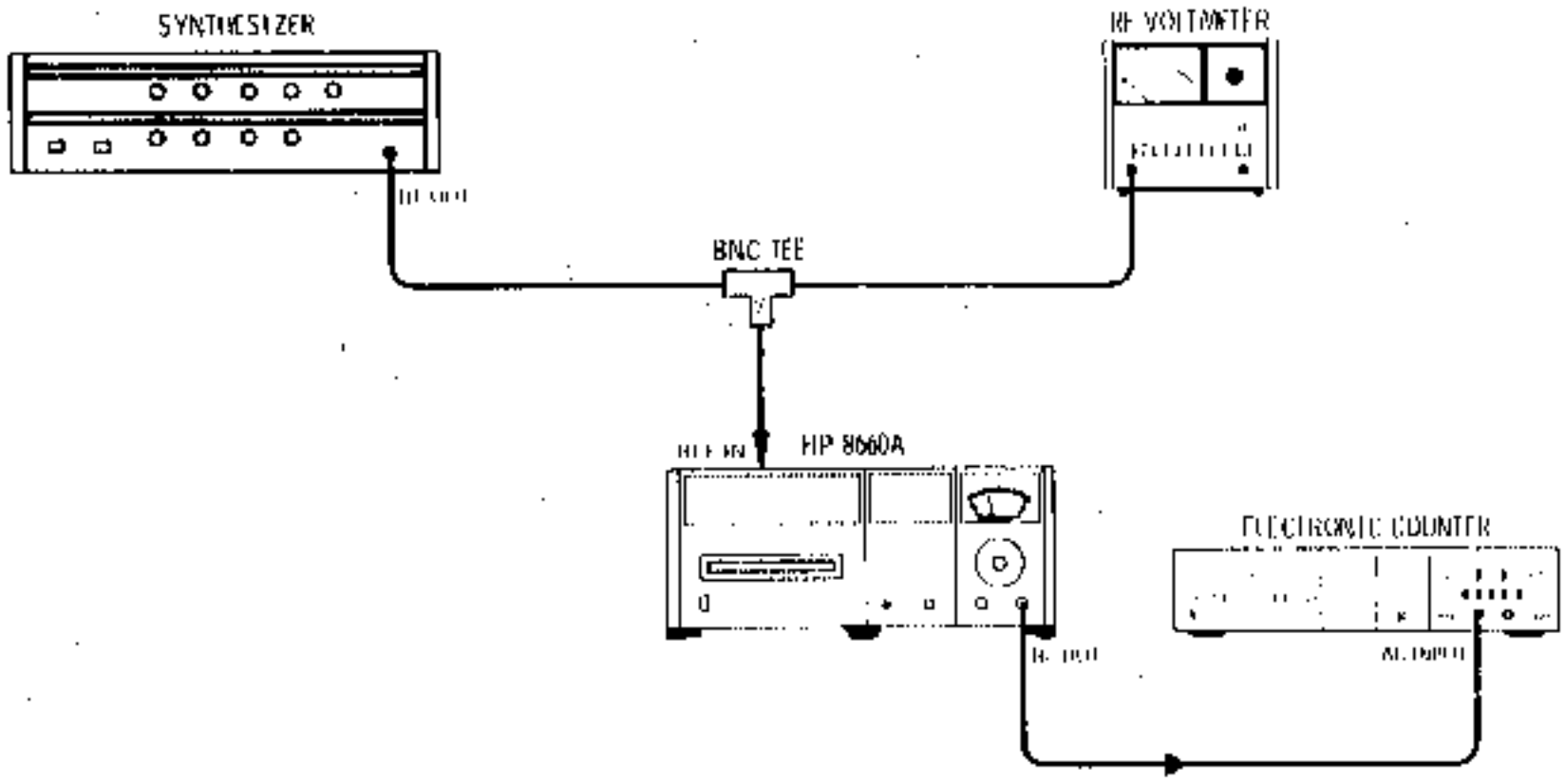


Figure 4-2. Input Reference Sensitivity Test Setup

EQUIPMENT:

Electronic Counter	HP 5328A Option 030
RF Voltmeter	HP 3406A
Synthesizer	HP 3320B

PERFORMANCE TESTS

4-8. INPUT SENSITIVITY FOR EXTERNAL REFERENCE (Cont'd)

PROCEDURE:

1. Connect the Synthesizer to the REFERENCE INPUT (J1) and set the SELECTOR switch S1 to EXT.

2. Set the Synthesizer controls to provide an output of 5 MHz at .5 Vrms as indicated on the RF Voltmeter.

3. Connect the Counter to the output of the RF Section in use and set the thumbwheels for a 5 MHz output frequen ·. The Counter readout should be about 5 MHz. (Actual frequency will be determined by stability and ettability of the Synthesizer used.)

4. Readjust the Synthesizer output to 2.5 Vrms. The counter readout should remain at about 5 MHz.

5. Repeat steps 2 through 4 with the Synthesizer set to 10 MHz.

4-9. REFERENCE OUTPUT CHECKS

SPECIFICATION:

Approximately 0.75 to 1.5 Vrms, 10 MHz into 170 ohms.

DESCRIPTION:

This test verifies proper operation of the reference amplifier and relay switching circuits.

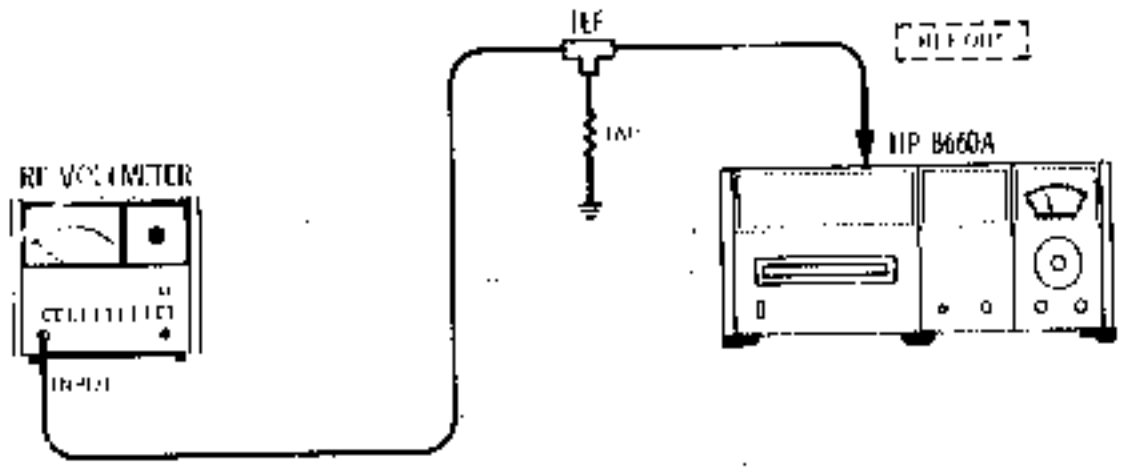


Figure 4-3. Reference Output Test Setup

TEST EQUIPMENT:

RF Voltmeter (with high impedance probe)	HP 3406A

PROCEDURE:

1. Connect the RF Voltmeter to the REFERENCE OUTPUT (rear panel) jack and set the SELECTOR switch (rear panel) to the INT position.

2. The RF voltmeter should indicate a signal level between .75 to 1.5 Vrms.

Table 4-1. Performance Test Record

Hewlett-Packard Model 8660A
Synthesized Signal Generator

Test performed by _____

Serial No. _____

Date _____

4-7. Reference Oscillator Internal; aging rate

Specified: ± 3 parts in 10^{-9} per day after a 72 hour warmup period. Actual _____

Option 100 Specified: ± 3 parts in 10^{-9} per day after a 30 day warmup period. Actual _____

4-8. Input Sensitivity for External Reference

5 MHz 0.2 Vrms Output _____ MHz 5 MHz 2.0 Vrms Output _____ MHz

10 MHz 0.2 Vrms Output _____ MHz 10 MHz 2.0 Vrms Output _____ MHz

NOTE

Frequency will be determined by the stability and settability of the reference source used.

4-9. Reference Output Levels

	MIN	ACTUAL	MAX
10 MHz	0.75 Vrms	_____	1.5 Vrms

ADJUSTMENTS

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes adjustments and checks required to return the Model 8660A to peak operating capabilities when repairs have been made. Included in this section are test setups and procedures.

5-3. Except for the power supply adjustment procedures, which should be performed before repairs are made to any part of the instrument, the adjustment procedures are arranged in the same sequence as the service sheets to which they refer.

5-4. EQUIPMENT REQUIRED

5-5. Each adjustment procedure in this section contains a list of test equipment and accessories required to perform the procedure. Each test setup identifies test equipment and accessories by call-outs.

5-6. Minimum specifications for test equipment used in the adjustment procedures are detailed in Table 1-3. Because the Model 8660A is an extremely accurate instrument, minimum specifications in Table 1-3 are particularly important in performing these adjustment procedures.

5-7. ADJUSTMENT AIDS

5-8. The HP 11672A Service Kit is an accessory item available from Hewlett-Packard for use in maintaining the Model 8660A Synthesized Signal Generator. Table 1-3 contains a detailed description of the Service Kit. Any item in the kit may be ordered separately.

5-9. FACTORY-SELECTED COMPONENTS

5-10. Factory-selected components are identified on the schematics and parts lists by an asterisk which follows the reference designator. The nominal value of the components are normally shown. The manual change sheets will provide updated information pertaining to the selected components. Table 5-1 lists the reference designator, the criterion used for selecting a particular value, the normal value range, and the service sheet where the component part is shown.

5-11. RELATED ADJUSTMENTS

5-12. Most of the adjustments within any given phase lock loop are interrelated. This is especially true in digital-to-analog converters. Adjustments should be made in the order in which they appear for any given loop.

5-13. Generally, it will not be necessary to adjust any of the phase lock loops except the one in which the component failure occurred. An exception to this will be when adjustment to any phase lock loop has been attempted while the reference section is not functioning correctly.

5-14. ADJUSTMENT LOCATIONS

5-15. Adjustment locations are identified pictorially on Section VIII foldout Service Sheets referred to in the individual procedures.

5-16. CHECKS AND ADJUSTMENTS

5-17. Data taken while following the adjustment procedures should be recorded in spaces provided.

NOTES

a. In the following tests it is assumed that all thumbwheel switches are in the 0 position at the start of the test.

b. An RF Section output plug-in must be in place during the tests.

c. A Modulator Section or an Auxiliary Section must be in place in the modulator drawer.

d. All tests in which a counter is used should be made with the Model 8660A and the counter referenced to the same source.

Table 5-1. Factory Selected Components

Reference Designators	Purpose	Normal Value Range	Service Sheet
A4A2C11	Selected for a reference loop 3 dB bandwidth of 60 to 160 kHz (±30 to ±80 kHz) measured at 100 MHz output. A variable 10 MHz signal (at −45 dBm) is connected in parallel with the 10 MHz reference signal at A4J5. The frequency is varied to show the 3 dB points.	39 to 70 pF	2
A4A4C10	Reference VCO Assembly, to set the reference loop bandwidth and capture range. (Interacts with A4A2C11.)	15 to 56 pF	3
A4A4R29	To compensate for variations in the 100 MHz reference output level. Selected for an output level of +11 to +13 dBm into a 50 ohm load at the output of A4A8.	42.2 to 196 ohms	3
A4A5R37, 39, and 41 (50 ohm pad)	To compensate for variations in the 350/450 MHz output level to the ϕ Detector. Selected for a level of +10 to +12 dBm.	(See below.)*	6
A4A5R38, 40, and 42 (50 ohm pad)	To compensate for variations in the 350/450 MHz output level. Selected for a level of +10 to +13 dBm.	(See below.)**	6
A4A6C6	HF loop, to ensure tuning range is sufficient to trap the 10 MHz signal.	16 to 24 pF	4
A4A6R19	To center the travel of A4A6R20.	287 to 422 ohms	4
A13R60	To compensate for variations in the varactor diode by reducing phase error output of the N2 assembly. Selected for an output of A2TP10 ϕ monitor of 0.000 ±0.350 Vdc.	68 to 120 ohms	10
A19R55	SL1 Oscillator Assembly, to set the SL1 Oscillator output between −3 and −5 dBm.	681 to 1470 ohms	17

*Normal Value Range:

	2 dB	4 dB	6 dB	8 dB
R37	422	215	147	165
R39	12.1	29.7	34.8	51.1
R41	436	221	150	116

**Normal Value Range:

	2 dB	4 dB	6 dB	8 dB
R38	10.0	26.1	34.8	46.4
R40	511	215	147	133
R42	511	215	147	133

ADJUSTMENTS

5-18. POWER SUPPLY

REFERENCE:

Service Sheet 24.

DESCRIPTION:

The power supplies in the Model 8660A provide regulated outputs of +20 volts, +5.25 volts, −10 volts and −40 volts. Unregulated supplies provide +30 volts, +21 volts, +4 volts and −21 volts. These checks verify proper operation of the power supplies.

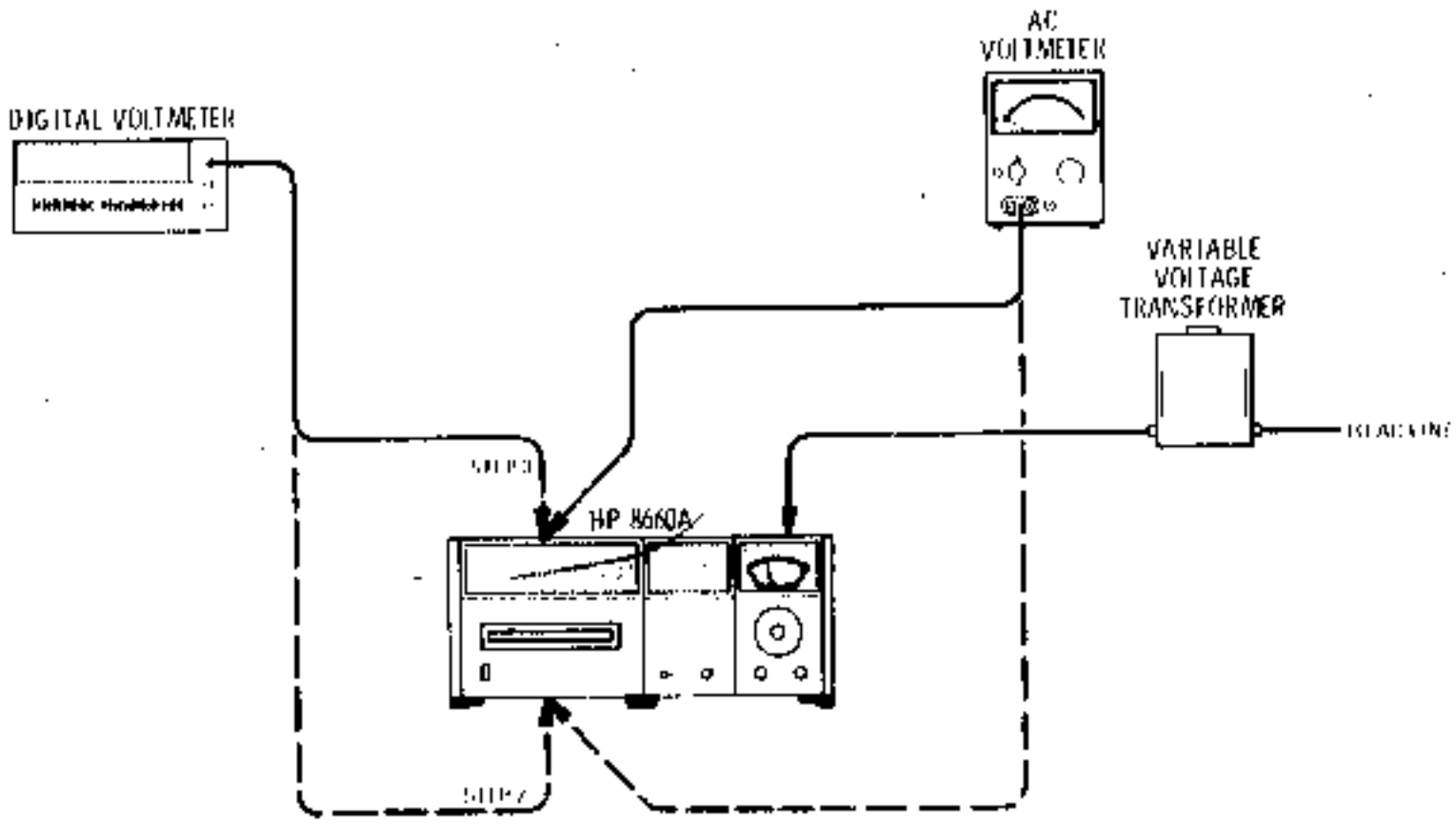


Figure 5-1. Power Supply Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3435A
AC Voltmeter	HP 403B
Variable Voltage Transformer	General Radio W5MT3A

PROCEDURE:

1. Remove the top and bottom covers of the Model 8660A and connect the instrument to the ac line through the variable voltage transformer.

2. Use the digital voltmeter and the ac voltmeter to check voltages, tolerances and ripple at A20 test points specified in Table 5-2. Adjust the variable voltage transformer to check tolerance of the power supplies at ± 10% line voltage variations.

ADJUSTMENTS

5-18. POWER SUPPLY (Cont'd)

Table 5-2. Unregulated Power Supplies

Test Location	Voltage at normal line	Tolerance high to low line (from normal line)	120 Hz Ripple (at normal line)
+ side of A20C7	Typical + 4.4 V	Specified ± 0.6 V	Typical 3 mVrms
	Actual_____	Actual_____	Actual_____
+ side of A20C4	Typical +20.5 V	Specified ± 2.4 V	Typical 300 mVrms
	Actual_____	Actual_____	Actual_____
—side of A20C5	Typical —20.5 V	Specified ± 2.4 V	Typical 300 mVrms
	Actual_____	Actual_____	Actual_____
+ side of A20C1	Typical +33 V	Specified ± 4 V	Typical 600 mVrms
	Actual_____	Actual_____	Actual_____

3. Use the digital voltmeter and the ac voltmeter to check for voltages, tolerances and 120 Hz ripple at A5 test points specified in Table 5-3. Adjust the dc levels shown in Table 5-3 with controls specified in Table 5-3, then adjust the variable voltage transformer to check tolerance of the power supplies at ± 10% of the normal line voltage.

Table 5-3. Regulated Power Supplies

Test Point	Adjust Control	Voltage at Normal Line Specified	Tolerance High to Low Line Specified	rms Ripple 120 Hz (Normal Line)
A5TP4	A5R24	+ 5.25 V	± 20 mV	125 μV
	+5.25 ADJ	Actual_____	Actual_____	Actual_____
A5TP2	A5R26	— 10.0 V	± 5 mV	50 μV
	— 10 ADJ	Actual_____	Actual_____	Actual_____
A5TP3	A5R21	+ 20.0 V	± 10 mV	50 μV
	+20 ADJ	Actual_____	Actual_____	Actual_____
A5TP1	A5R28	— 40.0 V	± 20 mV	50 μV
	— 40 ADJ	Actual_____	Actual_____	Actual_____

ADJUSTMENTS

5-19. REFERENCE SECTION

REFERENCE:

Service Sheets 2 and 3.

DESCRIPTION:

The reference section contains a voltage controlled master oscillator from which all RF signals generated in the Model 8660A main frame are derived. The master oscillator is phase locked to an internal temperature controlled crystal oscillator or to an external standard. The reference section provides outputs of 500 MHz, 100 MHz, 20 MHz, 10 MHz, 2 MHz, 400 kHz and 100 kHz. These checks verify proper operation of the circuits within the reference section.

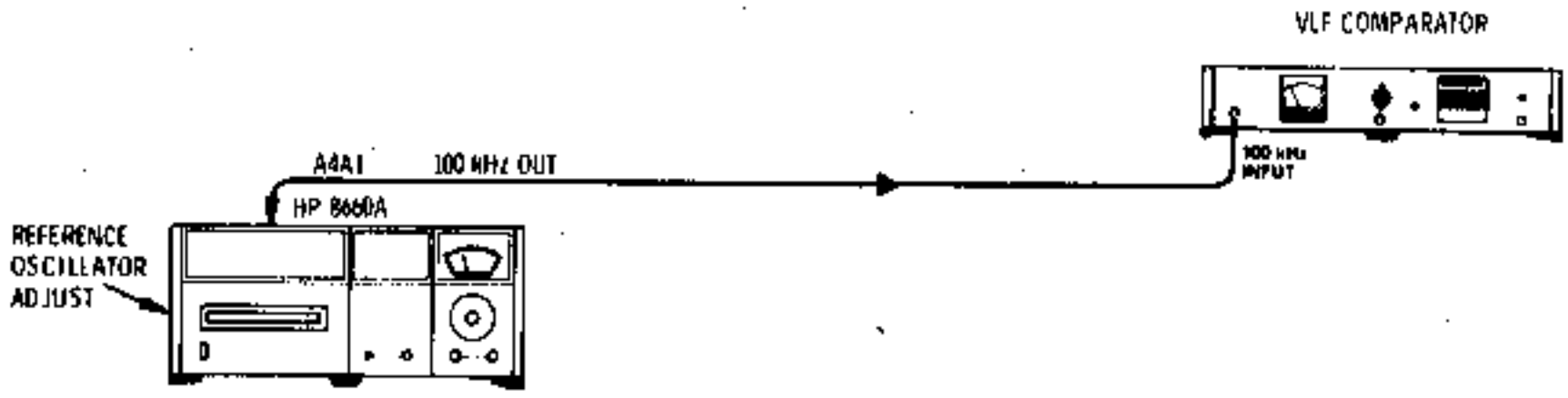


Figure 5-2. Reference Accuracy Adjustment Test Setup

EQUIPMENT:

VLF Comparator	HP 117A
Oscilloscope (with 10:1 divider probes)	HP 180A/1801A/1821A
Spectrum Analyzer	HP 140/8554B/8552
Electronic Counter	HP 5328A Option 030

PROCEDURE:

1. **Internal Reference Accuracy Adjustment (See Figure 5-2) (Allow adequate warm up time).**

a. Remove the Model 8660A top cover and connect the 100 kHz output from the A4A1 assembly to the 100 kHz input of the VLF Comparator.

b. Remove the left side panel from the Model 8660A.

c. Remove the cap screw to provide access to the adjustment point of the A21 Crystal oscillator assembly.

d. Refer to Section III of the VLF Comparator Operating and Service manual for operating instructions and align the Model 8660A A21 assembly.

NOTE

If the VLF Comparator is not available, and an accurate house standard is, the reference oscillator may be adjusted by using an oscilloscope for comparison of the two signals.

ADJUSTMENTS

5-19. REFERENCE SECTION (Cont'd)

2. Alternate Reference Accuracy Adjustment (See Figure 5-3).

a. Use the house standard to trigger the oscilloscope and connect the reference output from the Model 8660A rear panel reference output to the oscilloscope vertical input.

b. Observe the 10 MHz sine wave on the oscilloscope and adjust the A21 oscillator until the oscilloscope display stops drifting.

c. Set the oscilloscope to sweep at 0.1 μs/division and the sweep magnifier to X10. If drift is observed readjust the A21 oscillator.

NOTE

When the oscilloscope display drift is less than 1 division in 10 seconds the Model 8660 reference oscillator is set within 1 part in 10^{-9} of the house standard.

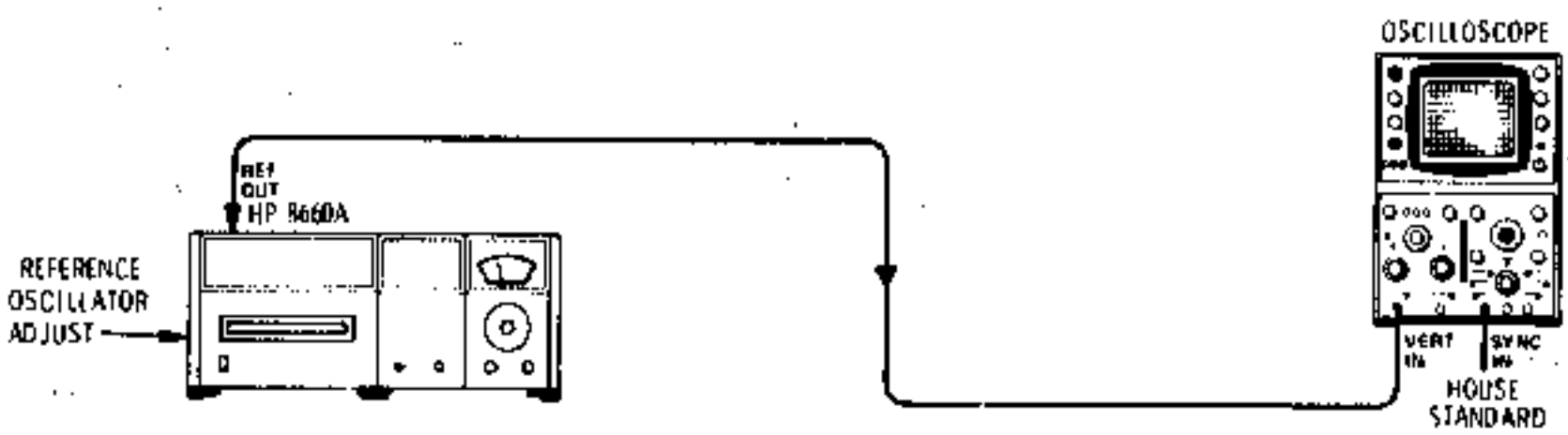


Figure 5-3. Alternate Reference Accuracy Adjustment Test Setup

3. 100 MHz Output Adjustment.

a. Connect the electronic counter to the 100 MHz output on the A4A4 assembly. (See Figure 5-4).

b. If the internal reference is being used, place the rear panel INT/EXT switch in the EXT position to open the 100 MHz phase lock loop. (If an external reference is being used, disconnect the source).

c. Allow 15 minutes warmup time for the oscillator to stabilize and adjust A4A4C2 for a counter readout of 100.000 MHz ± 20 kHz. Disconnect the electronic counter.

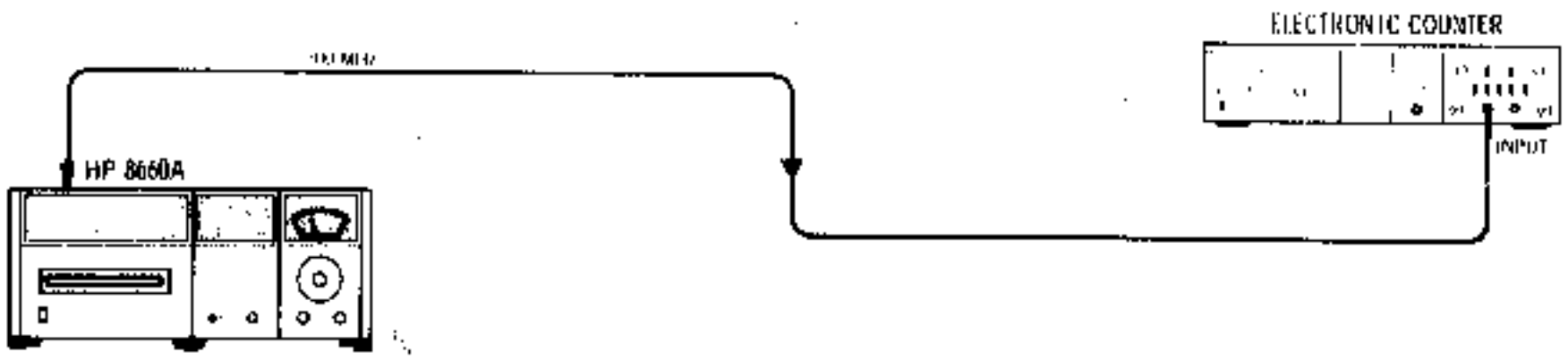


Figure 5-4. 100 MHz Adjustment Test Setup

ADJUSTMENTS

5-19. REFERENCE SECTION (Cont'd)

d. Connect the Spectrum Analyzer RF INPUT to the 100 MHz output of the A4A4 assembly and tune the Spectrum Analyzer CENTER FREQUENCY to 100 MHz. (See Figure 5-5.)

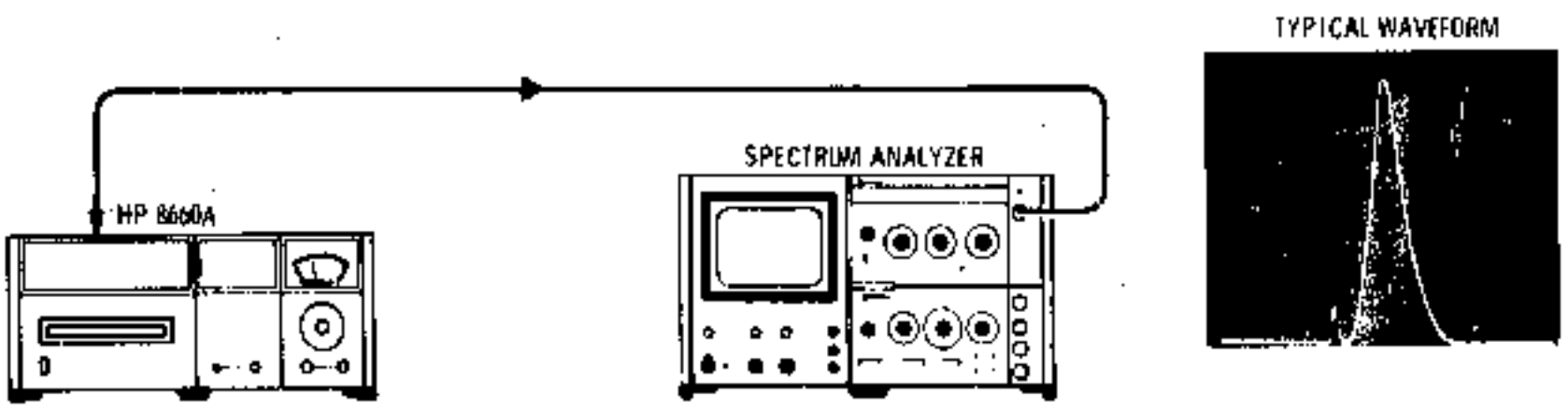


Figure 5-5. RF Level Checks Test Setup

e. Enable the 100 MHz phase lock loop by returning the INT/EXT switch to INT, or by reconnecting the external standard.

NOTE

Steps f through q need to be performed only if the 100 MHz output is low or if the total harmonic distortion in the FM mode is > 1%.

f. Use a standard flatblade screwdriver to loosen the fastener which locks the A4 Assembly in place. Rotate A4 up and to the right until it locks into position.

g. Disconnect W6 and A23W9 from the A4A8 100 MHz Band Pass Filter Assembly. Connect W6 to A23W9.

h. Set the 8660A controls for a center frequency of 100 MHz at +10 dBm.

i. Set the spectrum analyzer controls as follows: center frequency 100 MHz, frequency span per division 5 MHz, resolution bandwidth 100 kHz, input attenuation 20 dB, vertical sensitivity per division 10 dB, reference level +10 dBm, and sweep time per division 2 ms.

j. Connect the euqipment as shown in Figure 5-6. If necessary, readjust the analyzer controls to center the 100 MHz signal on the display.

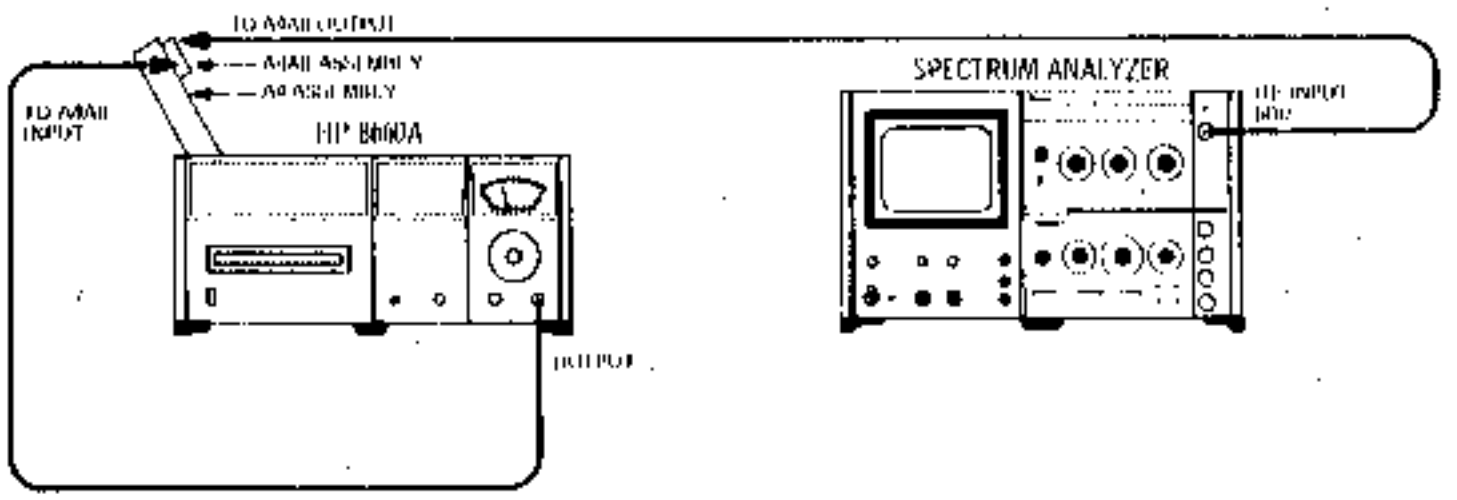


Figure 5-6. 100 MHz Band Pass Filter Adjustment Test Setup

ADJUSTMENTS

5-19. REFERENCE SECTION (Cont'd)

k. With a non-conducting alignment tool, adjust A4A8C1 and C2 for peak output at 100 MHz.

l. Set the spectrum analyzer vertical sensitivity to 2 dB log per division or linear.

m. Step the center frequency from 100 to 110 MHz in 1 MHz steps. If the display is a variable persistence type, set the controls to retain each trace on the display for a few minutes. Otherwise, record the level at each step.

n. Set the center frequency to 90 MHz. Step the frequency to 99 MHz in 1 MHz steps. Record or retain each step.

o. Verify that the flatness is 3 dB for a bandwidth of > 4 MHz.

p. Check that the insertion loss is ≤ 1 dB. Bypass the 100 MHz Band Pass Filter and measure the output directly from the signal source. Compare the direct signal with the signal level through the filter. To achieve the 1 dB maximum insertion loss, flatness may be compromised slightly.

q. Reconnect W6 to the A4A8 Assembly. Monitor the 100 MHz output level of the A4A8 Assembly with the RF Voltmeter (into 50Ω).

r. Adjust A4C41 for the maximum output level. Verify that the level is between +11 and +13 dBm.

s. If the level is incorrect, change A4R29 to a lower value (42.2Ω minimum) and peak the output level. Continue until the output level is 12 ± 1 dBm.

t. Reconnect A23W9 to the output of the A4A8 Assembly. Unlock A4 and return it to the original position. Lock A4 into place.

4. 500 MHz Output Adjustment.

a. Connect the Spectrum Analyzer RF INPUT to the 500 MHz output connector on the A4A4 assembly and tune the analyzer to 500 MHz. Set the analyzer scan width to 50 MHz per division and other analyzer controls for a clear display. (See Figure 5-7).

b. Adjust A4A4C17, A4A4C23 and A4A4C31 for a peak amplitude of the 500 MHz signal. The 500 MHz signal amplitude should be $> +3$ dBm. The 400 MHz signal is typically < -10 dBm. The 600 MHz signal is typically < -20 dBm. Disconnect the analyzer.

500 MHz dBm _____
400 MHz dBm _____
600 MHz dBm _____

5. 20 MHz Output Check.

a. Connect the Spectrum Analyzer RF INPUT to the 20 MHz output on the A4A4 assembly and tune the analyzer to 20 MHz. The 20 MHz signal should be > -6 dBm and < -2 dBm. Disconnect the analyzer.

20 MHz dBm _____

6. Reference Section Outputs Not Previously Checked.

a. Check the outputs listed in Table 5-4 for the levels shown (see Figure 5-8).

ADJUSTMENTS

5-19. REFERENCE SECTION (Cont'd)

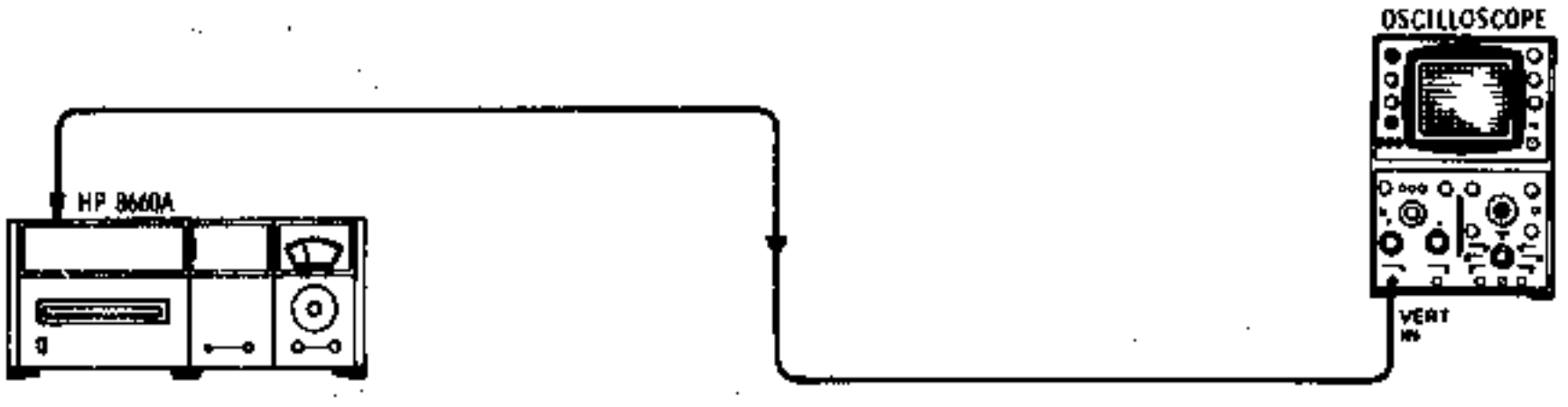


Figure 5-7. Oscilloscope Level Checks Test Setup

Table 5-4. Reference Section Output Levels

Test Point	Frequency	Specified Level	Actual Level
A4J6	10 MHz	> 1 Vp-p	_____
A4J1	2 MHz	> 2.2 Vp-p	_____
A4J3	400 kHz	> 2.2 Vp-p < 5.0 V	_____
A4J2	100 kHz	> 2.2 Vp-p < 5.0 V	_____
A4J4	100 kHz	> 2.2 Vp-p < 5.0 V	_____

5-20. 10 MHz BANDPASS FILTER ADJUSTMENT (AFTER REPAIR)

NOTE

Perform this adjustment ONLY when the Reference Assembly has been repaired, because this assembly must be removed from the mainframe in order to perform the adjustments.

DESCRIPTION:

The 700 Hz sidebands are set at least 20 dB down from the 10 MHz reference oscillator signal.

ADJUSTMENTS

5-20. 10 MHz BANDPASS FILTER ADJUSTMENT (AFTER REPAIR) (Cont'd)

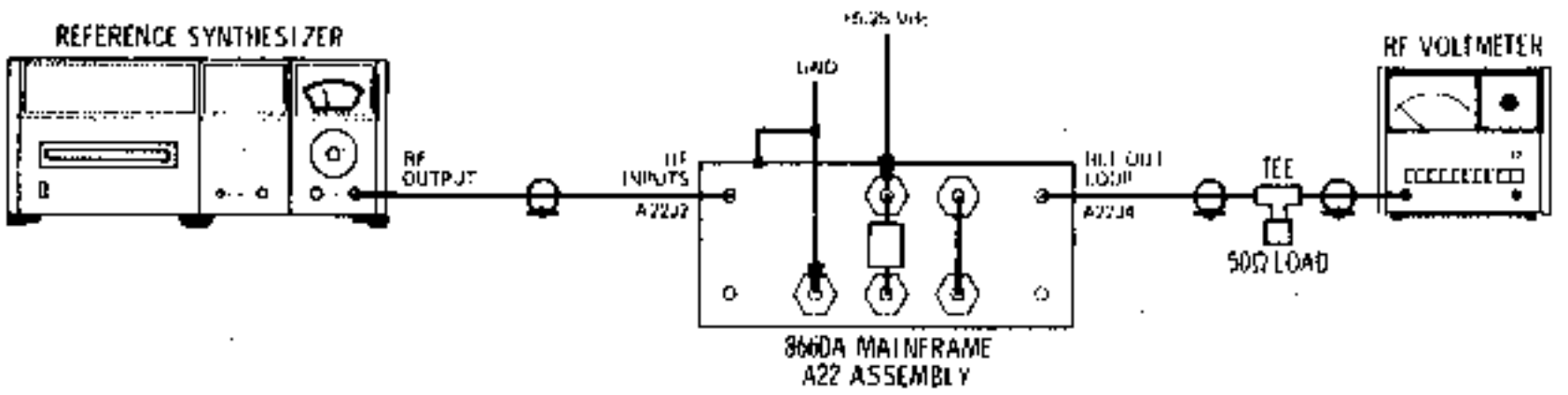


Figure 5-8. A22A1 Adjustment Test Setup (After Repair)

TEST EQUIPMENT:

Synthesizer	HP 8660 or HP 3320B
RF Voltmeter	HP 3406A
BNC Tee	UG 274B/U
50-Ohm Termination	HP 11593A

PROCEDURE

1. Connect equipment as shown in Figure 5-8. +5.25 Vdc must be connected to the junction of the inductor and feedthrough capacitor. The ground return must be connected to the chassis and feedthrough capacitor.

2. Release and rotate the A4 assembly up and out of the chassis. Locate A21 output cable J1 (white) and disconnect from reference oscillator A21. Connect external synthesizer to cable. Set Reference Synthesizer to 10.000000 MHz, +13 dBm.

3. Set the unit under test reference switch to INTERNAL.

4. Adjust A22A1C3 for maximum RF Voltmeter reading (use a non-metallic adjustment tool).

5. Adjust A22A1R2 for an RF Voltmeter reading of 270 mVrms.

6. Set the Reference Synthesizer to 10.000700 MHz, record RF Voltmeter reading in dBm.

7. Set the Reference Synthesizer to 0.999300 MHz, record RF Voltmeter reading in dBm.

8. Establish the higher of the power levels in steps 6 and 7 as a reference. Reset the Reference Synthesizer to 10.000000 MHz. Adjust A22A1R6 for a voltmeter reading 20 dB above the reference.

Example:	Reference level	−18 dBm
		+20 dBm
	Step 8 level	+ 2 dBm

9. Reinstall the complete A22 Assembly.

10. Perform the adjustments found in paragraph 5-21.

ADJUSTMENTS

5-21. 10 MHz BANDPASS FILTER ADJUSTMENT

NOTE

It is recommended that this procedure, along with the Reference Section procedure, be performed at least every six months.

DESCRIPTION:

The A22A1 sub-assembly is adjusted to the internal 10 MHz reference frequency. The assembly level is adjusted for 270 mV into 50 ohms.

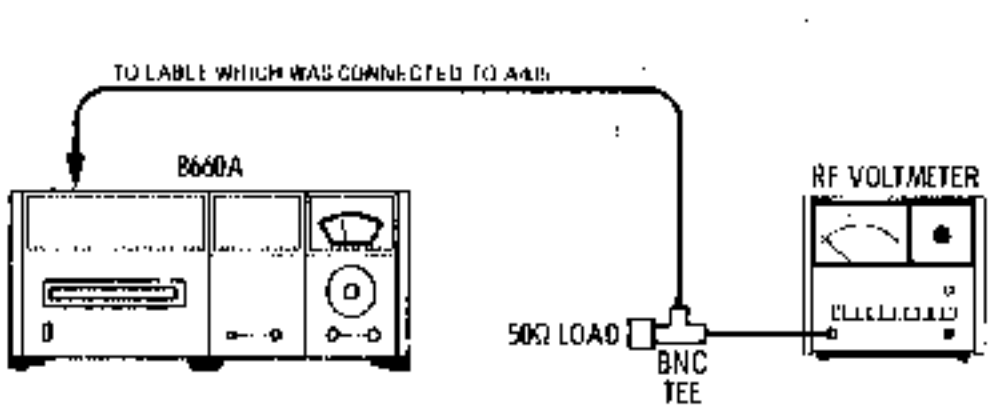


Figure 5-9. A22A1 Adjustment Test Setup

EQUIPMENT:

RF Voltmeter	HP 3406A
BNC Tee	UG 274B/U
50 Ohm Termination	HP 11593A

PROCEDURE:

1. Perform Test Procedure 5-19.
2. Remove 8660A left side and top covers. Turn power ON and allow 8660A to operate for 2 hours to ensure reference stability. Set INT/EXT Reference switch to INT.
3. Remove 5/10 MHz Reference input cable from A4J5. Connect the cable to the RF Voltmeter as shown in Figure 5-9.
4. Adjust A22A1C3 (using a non-metallic tool) accessible through hole in A22 assembly for maximum reading on the RF Voltmeter.
5. Adjust A22A1R2 (accessible through a hole in the A22 assembly) for an RF Voltmeter reading of 270 mVrms.
6. Reconnect the Reference Input cable to A4J5.

5-22. HIGH FREQUENCY SECTION *Instruments with serial prefix 1231A and above only*

NOTE

For instruments with serial prefix 1219A and below refer to adjustment procedure in paragraph 7-9.

REFERENCE:

Service Sheets 4, 5 and 6.

ADJUSTMENTS

5-22. HIGH FREQUENCY SECTION *Instruments with serial prefix 1231A and above only (Cont'd)*

DESCRIPTION:

The High Frequency Section contains a voltage controlled oscillator which provides eleven discrete output frequencies from 350 to 450 MHz in 10 MHz steps. The output of the voltage controlled oscillator is phase locked to a 10 MHz reference derived from the master oscillator in the reference section. The output from the HF section is used in the RF Section plug-in or in the internal frequency extension plug-in module. These checks verify proper operation of the High Frequency Section circuits.

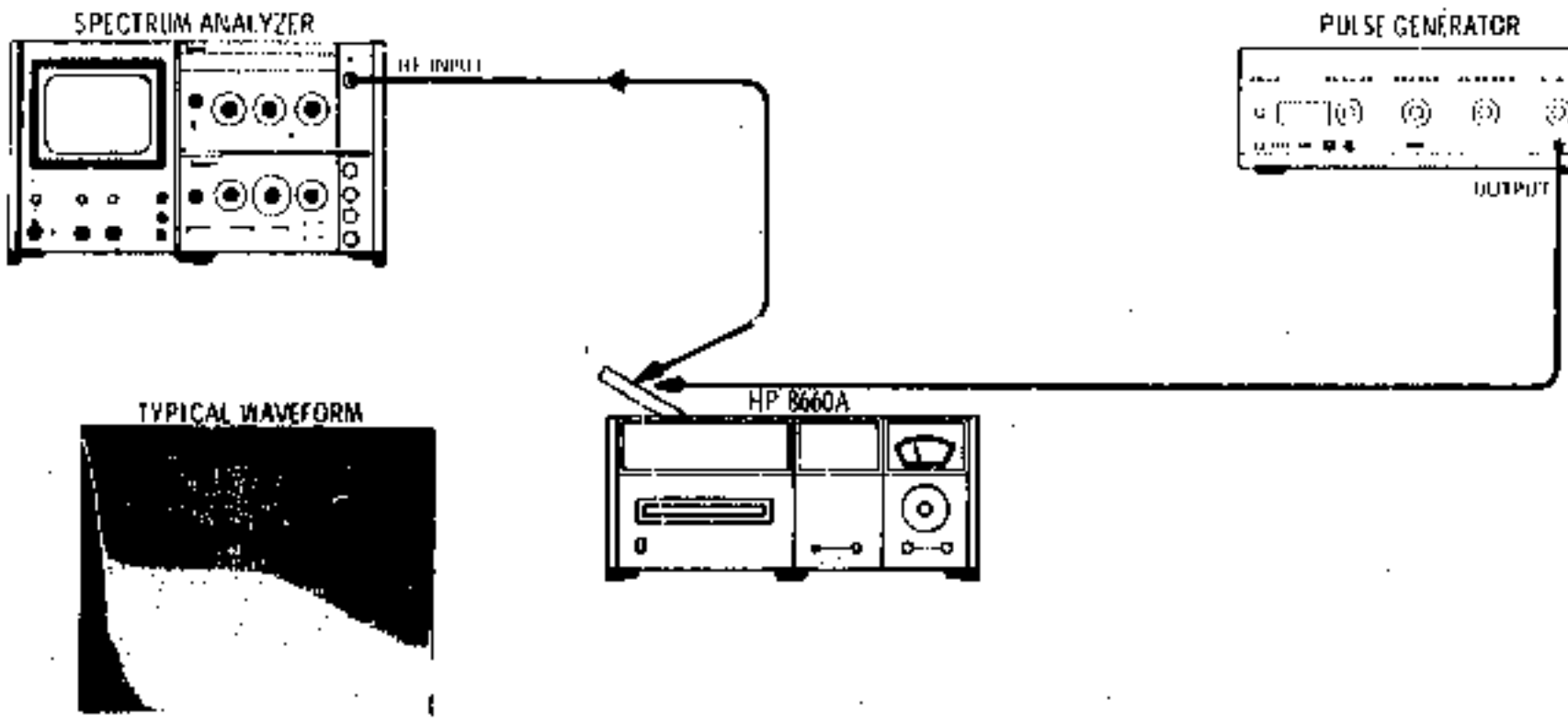


Figure 5-10. Phase Detector Response Adjustment Test Setup

EQUIPMENT:

Electronic Counter	HP 5328A Option 030
Digital Voltmeter	HP 3435A
Pulse Generator	HP 214B
Spectrum Analyzer	HP 140/8554B/8552B/8553
Oscilloscope (with 10:1 divider probes)	HP 180A/1801A/1821A
Signal Generator/Sweeper	HP 8601A

NOTE

When the Model 86602A is installed in the mainframe, the 350 MHz output of the High Frequency section is not used. This invalidates the adjustment procedure for A4A6R15 "10". When this situation exists, perform the following:

1. Ground the collector of A4A6Q1.

2. Adjust A4A6R15 "10" for 350.000000 MHz.

3. Remove the ground from the collector of A4A6Q1.

ADJUSTMENTS

5-22. HIGH FREQUENCY SECTION *Instruments with serial prefix 1231A and above only (Cont'd)*

PROCEDURE:

Preliminary:

Remove the cover from the A4A7 phase detector assembly. Tighten the screws holding the A4A5 voltage controlled oscillator assembly cover.

1. Phase Detector Response Adjustments. (See Figure 5-10.)

a. Disconnect the coaxial cable from VCO INPUT A4J11. Connect the PULSE OUTPUT of the Pulse Generator to A4J11. Set the Pulse Generator for 100 kHz pulse rate, .035 μSec pulse width, .5 volt amplitude and + polarity.

b. Connect the Spectrum Analyzer RF INPUT to the phase error signal at the white wire. Set the analyzer controls as follows:

CENTER FREQUENCY	5 MHz
SCAN WIDTH PER DIVISION	1 MHz
SCAN TIME PER DIVISION	1 ms
Gain and Attenuation	as required

c. Adjust EFFiciency control A4A7R18 for a flat response to approximately 5 MHz with very slight peaking (1 dB ± 1 dB). See the waveform in Figure 5-10 for typical response.

d. Disconnect the Pulse Generator and the Spectrum Analyzer.

2. Balance Adjustment.

a. Connect the digital voltmeter to A4TP1.

b. Adjust the BALance control (A4A7R22) for a reading of 0 volts ± .05 volt. Disconnect the digital voltmeter.

3. Voltage Controlled Oscillator Adjustment. (See Figure 5-11.)

a. Remove the A4A6 cover. With the output cable of the A4A5 assembly disconnected from the VCO OUTPUT (A4J10), connect the Digital Voltmeter to the A4A6 FREQuency control output (white lead).

b. Adjust the A4A6 "0" control (A4A6R13) for a Digital Voltmeter reading of −34 volts (voltage should be adjustable from about −33 to −35 volts).

c. Connect the Electronic Counter to the A4A5 voltage controlled oscillator output, A4J12. Replace the A4A6 assembly cover.

ADJUSTMENTS

5-22. HIGH FREQUENCY SECTION *Instruments with serial prefix 1231A and above only (Cont'd)*

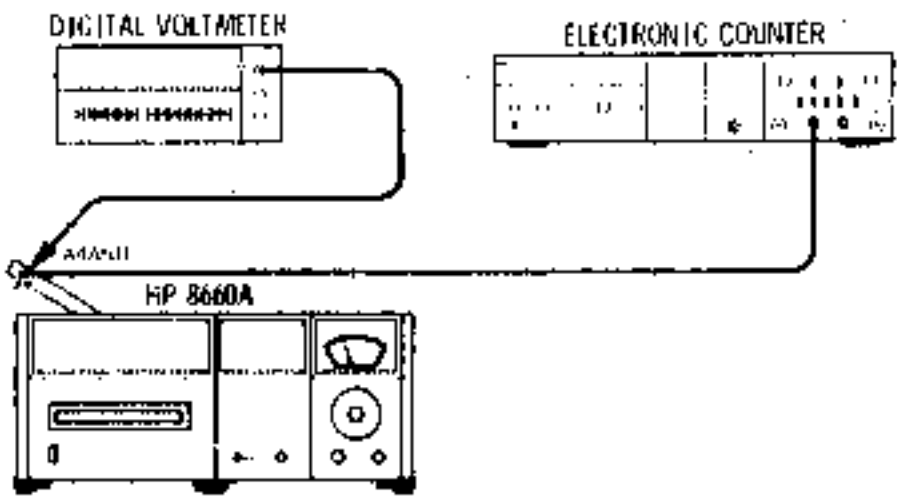


Figure 5-11. Voltage Controlled Oscillator Adjustments Test Setup

d. The Counter should display 450 MHz ± 1 MHz. If the correct reading is obtained proceed to step f. If the frequency reading is not correct, proceed to step e.

e. Remove the A4A5 cover and adjust A4A5C3 for a 450 MHz ± 1 MHz reading. Replace the A4A5 cover and hold it firmly in place to verify that the frequency remains as specified. If the frequency is not correct with the cover held in place, repeat the step until the frequency is as specified. Fasten the A4A5 cover in place.

f. Disconnect the electronic counter and reconnect the voltage controlled oscillator output to the phase detector.

g. Connect the Digital Voltmeter to the phase error test point A4TP1. Connect the Electronic Counter to A4J12 (350-450 MHz OUTPUT).

h. Set the thumbwheels as shown in Table 5-5 and set the digital to analog controls on the A4A6 assembly for 0 ± 0.1 volt for each frequency listed. Note that the counter displays the output frequency listed for each thumbwheel setting.

i. If any of the controls listed in Table 5-5 cannot be adjusted to 0 volts, adjust A4A6R20 'profile' to obtain additional range. Repeat all pretune adjustments until satisfactory results are obtained. Disconnect the Digital Voltmeter and the Electronic Counter.

ADJUSTMENTS

5-22. HIGH FREQUENCY SECTION (Cont'd)

Table 5-5. Pretune Adjustments

Thumbwheel Settings	Adjust Control	Counter Readout
0000000000	A4A6R13 "0"	450.000000 MHz
0010000000	A4A6R60 "1"	440.000000 MHz
0020000000	A4A6R56 "2"	430.000000 MHz
0030000000	A4A6R52 "3"	420.000000 MHz
0040000000	A4A6R48 "4"	410.000000 MHz
0050000000	A4A6R44 "5"	400.000000 MHz
0060000000	A4A6R40 "6"	390.000000 MHz
0070000000	A4A6R35 "7"	380.000000 MHz
0080000000	A4A6R28 "8"	370.000000 MHz
0090000000	A4A6R22 "9"	360.000000 MHz
0100000000	A4A6R15 "10"	350.000000 MHz

4. Loop Gain Adjustment. (See Figure 5-12.)

a. With all thumbwheel digits set to 0 connect the Spectrum Analyzer RF INPUT to A4J12 (350-450 MHz OUTPUT) and set the analyzer controls as follows:

CENTER FREQUENCY . . . . . 450 MHz
BANDWIDTH . . . . . 30 kHz
SCAN WIDTH PER DIVISION . . . . . 5 MHz
SCAN TIME PER DIVISION . . . . . 5 ms

b. Disconnect the reference input to A4J13 and reconnect it together with the RF output of the Signal Generator/Sweeper.

c. Set the Signal Generator/Sweeper to 11.5 MHz CW at −35 dBm and symmetrical sweep width to 3 MHz. The analyzer display should be approximately as shown in the typical waveform shown in Figure 5-12. Adjust the A4A6R2 (GAIN) control for the response shown.

d. Disconnect the analyzer and the Generator/Sweeper. Reconnect the reference signal to A4J13.

ADJUSTMENTS

5-22. HIGH FREQUENCY SECTION (Cont'd)

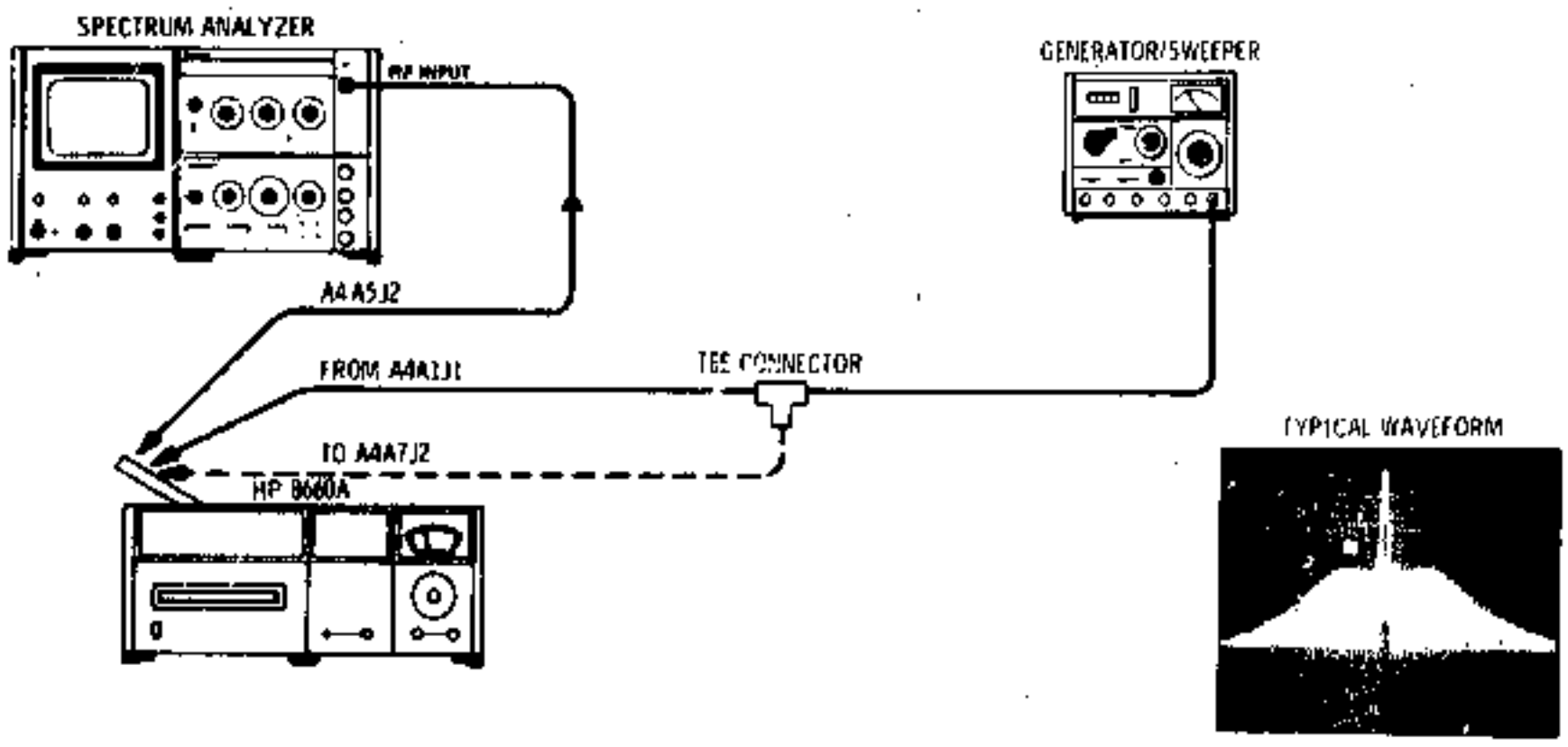


Figure 5-12. Loop Gain Adjustment Test Setup

5. 10 MHz Trap Adjustment (See Figure 5-13.)

NOTE

This adjustment is necessary only if the A4A6 10 MHz trap has been repaired.

a. Disconnect the coaxial cable from A4J10 (350/450 MHz to ϕ detector).

b. Disconnect the 10 MHz reference signal from A4J13 and reconnect it using a TEE connector. Connect the 10 MHz reference signal from the other TEE port to the ϕ input of the A4A6 assembly (white wire from the A4A7 assembly).

c. Connect the Spectrum Analyzer RF INPUT to the A4A6 FREQuency control output (white-black-violet wire). Set the analyzer controls as follows:

CENTER FREQUENCY	10 MHz
BANDWIDTH	30 kHz
SCAN WIDTH PER DIVISION	200 kHz
VIDEO FILTER	OFF
INPUT ATTENUATION	0 dB
SCAN TIME PER DIVISION	1 ms
REF LEVEL	−30 dBm

d. Adjust A4A6C5 for minimum 10 MHz amplitude.

e. Remove the input to the ϕ input from A4A6 and the TEE connector. Reconnect the reference signal to A4J13 and disconnect the Spectrum analyzer.

f. Replace all High Frequency Section Covers.

ADJUSTMENTS

5-22. HIGH FREQUENCY SECTION (Cont'd)

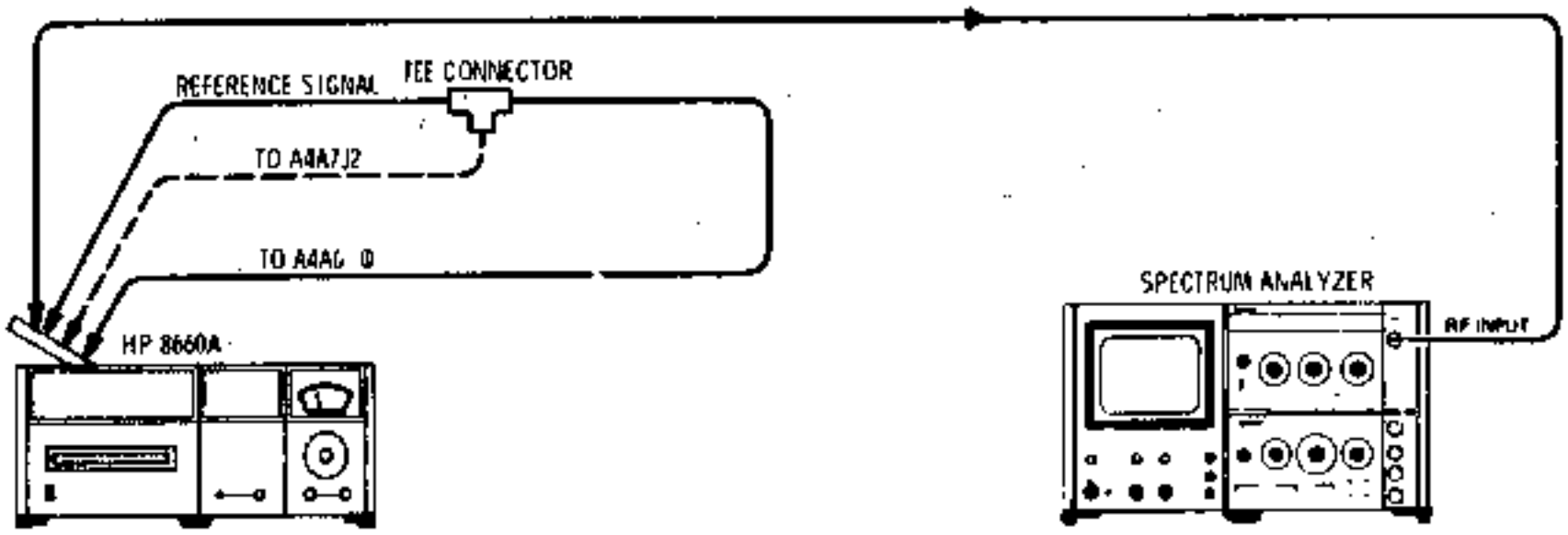


Figure 5-13. 10 MHz Trap Adjustment Test Setup

6. Output Frequency and Amplitude Check. (See Figure 5-13.)

a. Connect the Spectrum Analyzer RF INPUT to A4A5J2. Set the analyzer controls as required to view the 450 MHz signal. (All thumbwheels are set to 0). The output should be +13 dBm to +15 dBm.

_____ dBm

b. Switch thumbwheel digits 9 and 8 from 00 through 10. The frequency should decrease in 10 MHz steps (amplitude remains at +13 dBm minimum).

440 MHz _____ dBm	430 MHz _____ dBm	420 MHz _____ dBm
410 MHz _____ dBm	400 MHz _____ dBm	390 MHz _____ dBm
380 MHz _____ dBm	370 MHz _____ dBm	360 MHz _____ dBm
350 MHz _____ dBm		

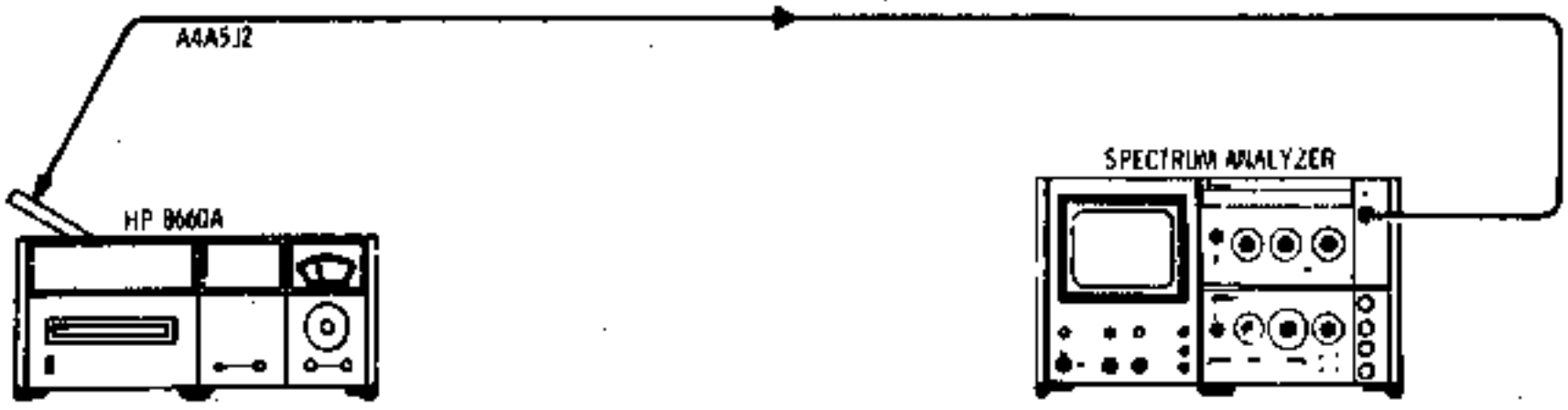


Figure 5-14. Output Amplitude Check Test Setup

ADJUSTMENTS

5-23. N1 PHASE LOCK LOOP

REFERENCE:

Service Sheets 7 and 8.

DESCRIPTION:

The N1 phase lock loop produces digitally controlled RF signals from 19.8 to 29.7 MHz in 100 kHz steps. The output frequency is selected by thumbwheel digits 6 and 7. These checks verify proper operation of the loop circuits.

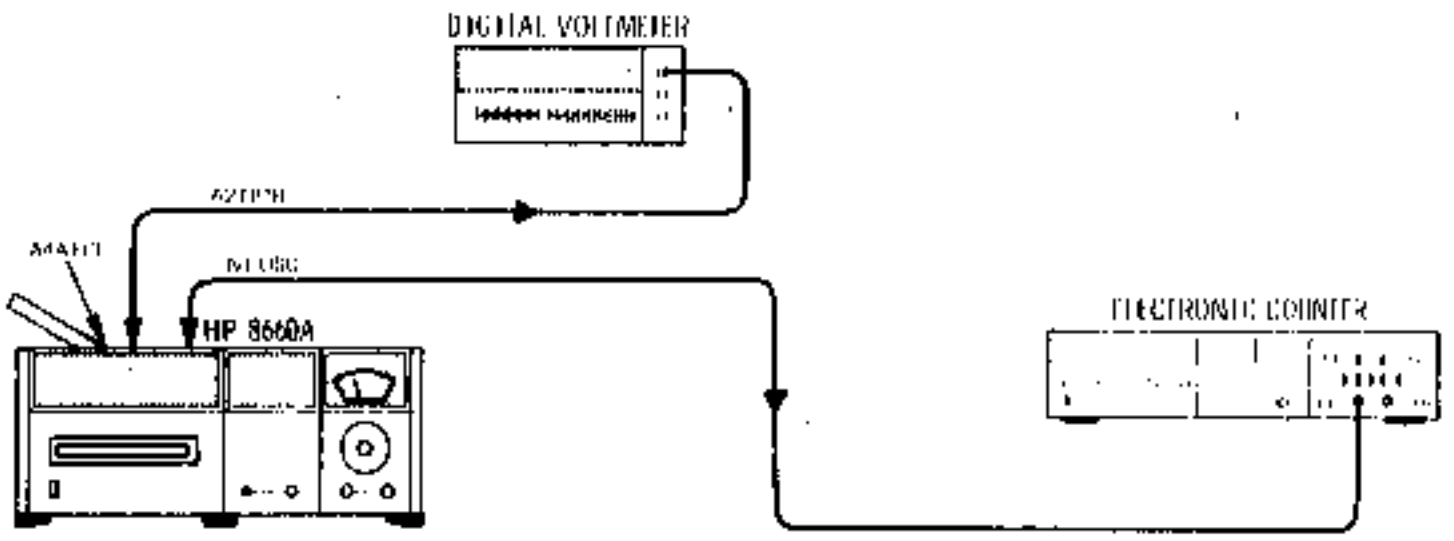


Figure 5-15. N1 Loop Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3435A
Electronic Counter	HP 5328A Option 030

PROCEDURE: (See Figure 5-15).

1. Set all thumbwheel digits to 0 and ground motherboard test point A2TP16 with one of the jumper plugs provided. Connect the digital voltmeter to A2TP18.

2. Adjust A17R31 or A17R29 for a voltmeter reading of −30 volts and disconnect the digital voltmeter.

3. Connect the electronic counter to the N1 oscillator output on the A2 mother board and adjust A17C17, for a counter reading as close as possible to 29.7 MHz (must be within ± 200 kHz).

4. Set thumbwheel digit 6 to a 5 and adjust A17R28 or A17R31 for a counter reading of 29.2 MHz.

5. Set thumbwheel digit 7 to 9 and record the counter readout. _____ MHz

6. Determine the frequency difference between the readout for step 5 and 20.2 MHz and record:

_____ MHz

ADJUSTMENTS

5-23. N1 PHASE LOCK LOOP (Cont'd)

7. Reset thumbwheel digit 7 to a 0.

   a. When the reading in step 5 is higher than 20.2 MHz, adjust A17R28 for a counter readout of 29.2 MHz plus the difference frequency recorded in step 6.

   b. When the reading in step 5 is lower than 20.2 MHz, adjust A17R28 for a counter readout of 29.2 MHz minus the difference frequency recorded in step 6.

   c. Adjust A17R31 for an output frequency readout of 29.2 MHz.

8. Repeat steps 5 through 7 until the counter readout is 29.2 MHz ± 20 kHz for a thumbwheel digits 7 and 6 setting of 05 and 20.2 MHz ± 20 kHz for a thumbwheel digits 7 and 6 setting of 95.

9. Remove the ground jumper from A2TP16.

10. Disconnect the 400 kHz reference signal by disconnecting the cable from A4A1J3 and connect the digital voltmeter to A2TP17. Adjust A16R38 for a digital voltmeter readout of 0V ± 10 mV. Reconnect the 400 kHz reference signal.

11. Set front panel thumbwheels as shown in Table 5-6. The counter readings should be as shown in the table.

Table 5-6. N1 Loop Output Frequency Checks

Thumbwheel Settings	Counter Readout	Thumbwheel Settings	Counter Readout
0000000000	29.700000 MHz	0005500000	24.200000 MHz
0001100000	28.600000 MHz	0006600000	23.100000 MHz
0002200000	27.500000 MHz	0007700000	22.000000 MHz
0003300000	26.400000 MHz	0008800000	20.900000 MHz
0004400000	25.300000 MHz	0009900000	19.800000 MHz

5-24. N2 PHASE LOCK LOOP

NOTE

Option 004 instruments use a different N2 programmable divider designated as N2a. In the following procedure the frequencies shown in parenthesis apply to N2a.

REFERENCE:

Service Sheets 9 and 10.

DESCRIPTION:

The N2 phase lock loop produces digitally controlled RF signals from 19.80 to 29.79 MHz in 10 kHz increments. The output frequency is selected by thumbwheel digits 3, 4 and 5. These checks verify proper operation of the loop circuits.

ADJUSTMENTS

5-24. N2 PHASE LOCK LOOP (Cont'd)

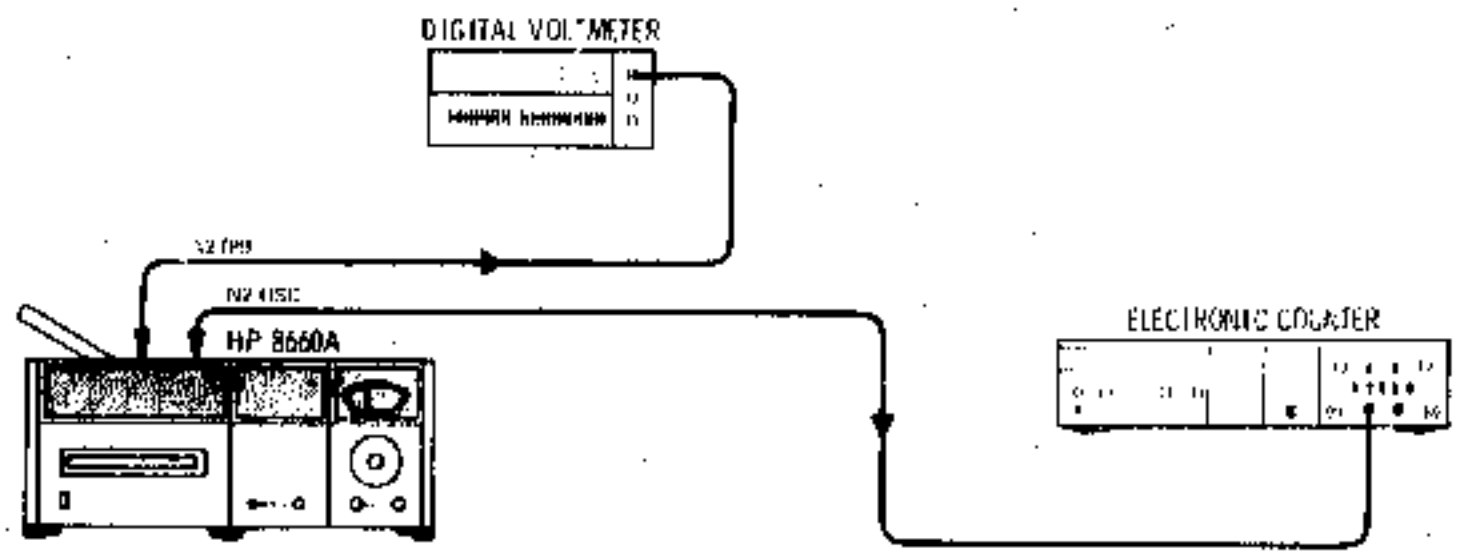


Figure 5-16. N2 Loop Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3435A
Electronic Counter	HP 5328A Option 030

PROCEDURE: (See Figure 5-16).

1. Set all thumbwheel digits to 0 and ground A2TP12 on the mother board with one of the jumper plugs provided.

2. Connect the digital voltmeter to A2TP9 and adjust A13R37 or A13R39 to −30 volts. Disconnect the digital voltmeter.

3. Connect the electronic counter to the N2 oscillator output at XA13-14. Adjust A13C19 for a counter reading as close as possible to 29.79 MHz (N2a 30.00 MHz) (must be within ± 230 kHz).

4. Set thumbwheel digits 3 and 4 to a 5 (thumbwheels read 0000005500). Adjust A13R37 or A13R39 for an output frequency reading of 29.240 MHz. (N2a 29.450 MHz).

5. Set thumbwheel digit 5 to a 9 (thumbwheels read 0000095500) and record the counter readout.

_____ MHz

6. Determine the frequency difference between step 5 and 20.24 MHz (N2a 20.450 MHz) and record:

_____ MHz

7. Reset thumbwheel digit 5 to a 0 (thumbwheels read 0000005500).

   a. If the reading in step 5 was more than 20.24 MHz (N2a 20.45 MHz) adjust A13R39 to 29.25 MHz (N2a 29.45 MHz) plus the difference frequency recorded in step 6.

   b. If the reading in step 5 was less than 20.24 MHz (N2a 20.45 MHz) adjust A13R39 to 29.25 MHz (N2a 20.45 MHz) minus the difference frequency recorded in step 6.

   c. Adjust A13R37 for an output frequency of 29.24 MHz (N2a 29.45 MHz).

ADJUSTMENTS

5-24. N2 PHASE LOCK LOOP (Cont'd)

8. Repeat steps 4 through 7 until the counter readout is 29.24 MHz (N2a 29.45 MHz) ± 20 kHz for a thumbwheel setting of 0000005500 and 20.24 MHz (N2a 20.45 MHz) ± 20 kHz for a thumbwheel setting of 0000095500.

9. Remove the ground from A2TP12.

10. Set front panel thumbwheels as shown in Table 5-7. The counter readings should be as shown in the table.

Table 5-7. N2 Oscillator Output Frequency Checks

Thumbwheel Settings	Counter Readout N2	Counter Readout N2a
0000000000	29.790000 MHz	30.000000 MHz
0000011100	28.680000 MHz	28.890000 MHz
0000022200	27.570000 MHz	27.780000 MHz
0000033300	26.460000 MHz	26.670000 MHz
0000044400	25.350000 MHz	25.560000 MHz
0000055500	24.240000 MHz	24.450000 MHz
0000066600	23.130000 MHz	23.340000 MHz
0000077700	22.020000 MHz	22.230000 MHz
0000088800	20.910000 MHz	21.120000 MHz
0000099900	19.800000 MHz	20.010000 MHz

5-25. N3 PHASE LOCK LOOP

NOTE

Option 004 instruments do not include the N3 loop.

REFERENCE:

Service Sheets 11 and 12.

DESCRIPTION:

The N3 phase lock loop produces digitally controlled RF signals from 2.001 to 2.100 MHz in 1 kHz increments. The output frequency is selected by thumbwheel digits 1 and 2. These checks verify proper operation of the loop circuits.

ADJUSTMENTS

5-25. N3 PHASE LOCK LOOP (Cont'd)

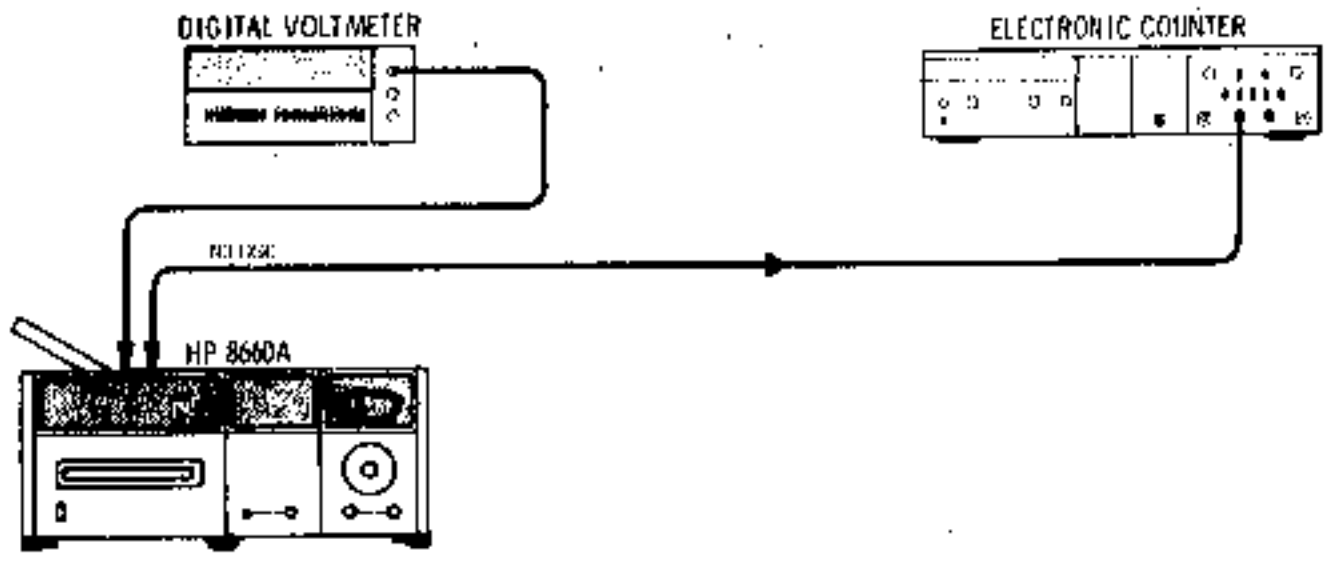


Figure 5-17. N3 Loop Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3435A
Electronic Counter	HP 5328A Option 030

PROCEDURE: (See Figure 5-17).

1. Set all thumbwheel digits to 0 and ground A2TP4 on the mother board with one of the jumper plugs provided.

2. Connect the counter to the N3 oscillator output at XA8-1-4 on the mother board. Adjust A8R26 or A8R24 for a counter readout of 2.100 MHz.

3. Set thumbwheel digit 1 to a 5 (thumbwheels read 0000000005). Adjust A8R24 for a counter reading of 2.095 MHz. (Must be within ± 20 kHz.

4. Set thumbwheel digit 2 to a 9 (thumbwheels read 0000000095), and record the frequency displayed on the counter.

   _____ MHz

5. Determine the frequency difference between that recorded in step 4 and 2.005 MHz and record.

   _____ MHz

6. Reset thumbwheel digit 2 to a 0 (thumbwheels read 0000000005).

   a. If the reading in step 4 was less than 2.005 MHz adjust A8R24 to 2.095 MHz minus the frequency difference recorded in step 5.

   b. If the reading in step 4 was less than 2.005 MHz adjust A8R24 to 2.095 MHz plus the frequency difference recorded in step 5.

   c. Adjust A8R26 for an output frequency of 2.095 MHz.

ADJUSTMENTS

5-25. N3 PHASE LOCK LOOP (Cont'd)

7. Repeat steps 3 through 6 until the counter readout is 2.095 MHz ± 20 kHz for a thumbwheel setting of 0000000005, and 2.005 MHz ± 20 kHz for a thumbwheel setting of 0000000095.

8. Remove the ground from A2TP4.

9. Set front panel thumbwheels as shown in Table 5-8. The counter readings should be as shown in the table.

Table 5-8. N3 Oscillator Output Frequency Checks

Thumbwheel Settings	Counter Readout
0000000000	2.1000000 MHz
0000000011	2.0890000 MHz
0000000022	2.0780000 MHz
0000000033	2.0670000 MHz
0000000044	2.0560000 MHz
0000000055	2.0450000 MHz
0000000066	2.0340000 MHz
0000000077	2.0230000 MHz
0000000088	2.0120000 MHz
0000000099	2.0010000 MHz

5-26. SUMMING LOOP 2 (OMIT FOR OPT 004 INSTRUMENTS)

REFERENCE:

Service Sheets 13 and 14.

DESCRIPTION:

SL2 is a phase lock loop that provides a digitally controlled RF output to Summing Loop 1. This output, which is from 20.0001 to 30.000 MHz in 100 Hz steps, is preset by thumbwheel digits 3, 4 and 5; it is also indirectly controlled by thumbwheel digits 1 and 2. These checks verify proper operation of the loop circuits.

ADJUSTMENTS

5-26. SUMMING LOOP 2 (OMIT FOR OPT 004 INSTRUMENTS) (Cont'd)

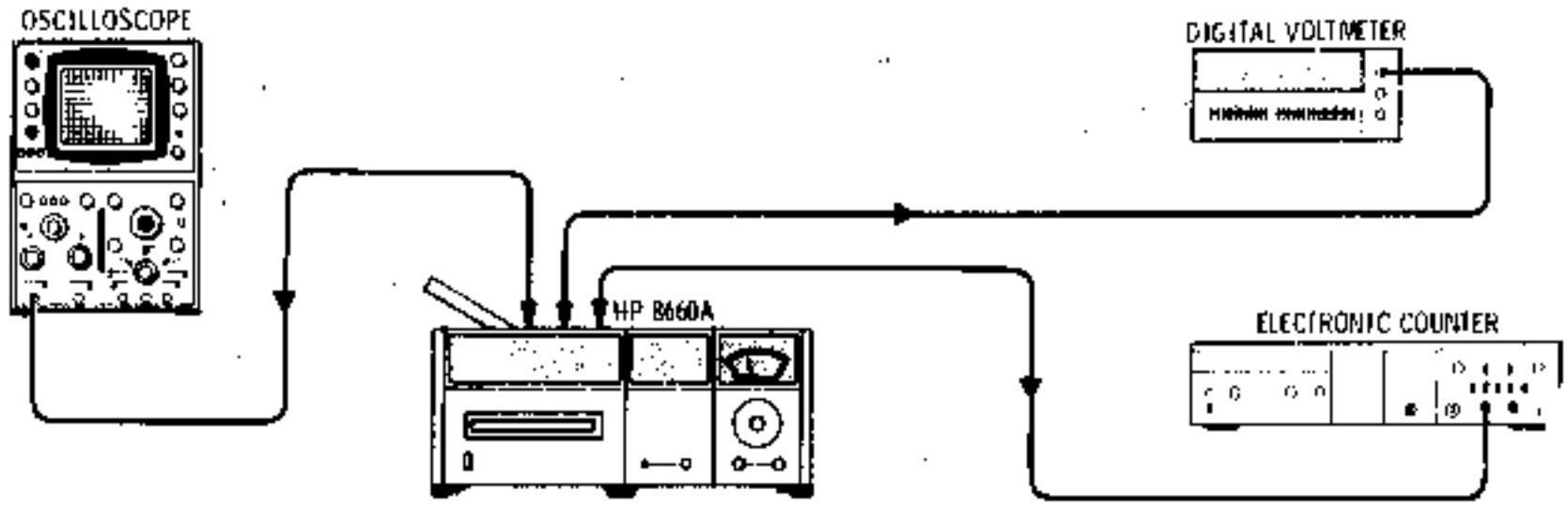


Figure 5-18. SL2 Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3435A
Electronic Counter	HP 5328A Option 030
Oscilloscope (with 10:1 divider probes)	HP 180A/1801A/1821A

PROCEDURE: (See Figure 5-18).

1. Set thumbwheel digits 3, 4 and 5 to a 5 (thumbwheels read 0000055500).

   a. With the digital voltmeter connected to A2TP8, adjust A11R15 or A11R19 to 0.000 ± 10 millivolts.

   b. With the oscilloscope connected to A2TP7 adjust A12R37 for 50/50 symmetry.

   c. Disconnect the digital voltmeter and the oscilloscope.

2. Connect the digital voltmeter to varactor test point A2TP5, ground mother board test point A2TP6 with a clip lead and reset all thumbwheel digits to 0.

   a. Adjust A11R15 or A11R19 to read −30 volts on the digital voltmeter and then disconnect the digital voltmeter.

   b. Connect the counter to test point A2TP6 and adjust A11C17 for a counter readout as close to 30 MHz as possible (must be within ± 300 kHz).

3. Set thumbwheel digits 4 to a 4 and 3 to a 5 (thumbwheels read 0000004500). Adjust A11R15 or A11R19 for a counter reading of 29.550 MHz.

4. Set thumbwheel digit 5 to a 9 (thumbwheels read 0000094500). Record the output at A2TP6 as read on the counter.

   _____ MHz

ADJUSTMENTS

5-26. SUMMING LOOP 2 (OMIT FOR OPT 004 INSTRUMENTS) (Cont'd)

5. Determine the difference frequency between that recorded in step 4 and 20.5500 MHz and record:

_____ MHz

a. Set thumbwheel digit 5 to a 0 (thumbwheels read 000004500).

b. When the frequency readout in step 4 is higher than 20.5500 MHz, adjust A11R15 to 29.550 MHz plus the difference frequency determined in step 5.

c. When the frequency readout in step 4 is lower than 20.5500 MHz, adjust A11R15 to 29.550 MHz minus the difference frequency determined in step 5.

d. Reset the frequency to 29.5500 with A11R19.

e. Repeat steps 3, 4 and 5 until the counter indicates 20.550 MHz ± 20 kHz for a thumbwheel setting of 0000094500 and 29.5500 MHz ± 20 kHz for a thumbwheel setting of 0000004500.

6. Set front panel thumbwheels as shown in Table 5-9. Adjust the controls listed for counter readouts shown.

Table 5-9. SL2 Oscillator Output Frequency Adjustments

Thumbwheel settings	Adjust	Counter Readout
0000084500	A11R39 "8"	21.55 MHz ± 20 kHz
0000074500	A11R54 "7"	22.55 MHz ± 20 kHz
0000064500	A11R60 "6"	23.55 MHz ± 20 kHz
0000054500	A11R67 "5"	24.55 MHz ± 20 kHz
0000044500	A11R73 "4"	25.55 MHz ± 20 kHz
0000034500	A11R77 "3"	26.55 MHz ± 20 kHz
0000024500	A11R83 "2"	27.55 MHz ± 20 kHz
0000014500	A11R90 "1"	28.55 MHz ± 20 kHz

7. Disconnect the counter, remove the ground from A2TP8 and connect the oscilloscope to A2TP7.

8. Set thumbwheels as shown in Table 5-9 and adjust the associated potentiometers for 50/50 symmetry as seen on the oscilloscope (all must be within 40/60).

5-27. SUMMING LOOP 1

REFERENCE:

Service Sheets 15, 16 and 17.

ADJUSTMENTS

5-27. SUMMING LOOP 1 (Cont'd)

DESCRIPTION:

SL1 is a phase lock loop that provides a digitally controlled RF output to the RF Section plug-in. This output, which is from 20.000001 to 30.000000 MHz in 1 Hz steps is pretuned by thumbwheel digits 5, 6 and 7 and is also indirectly controlled by thumbwheel digits 1 through 4. These checks verify proper operation of the loop circuits.

NOTE

In Option 004 instruments, the SL1 output is 100 Hz steps.

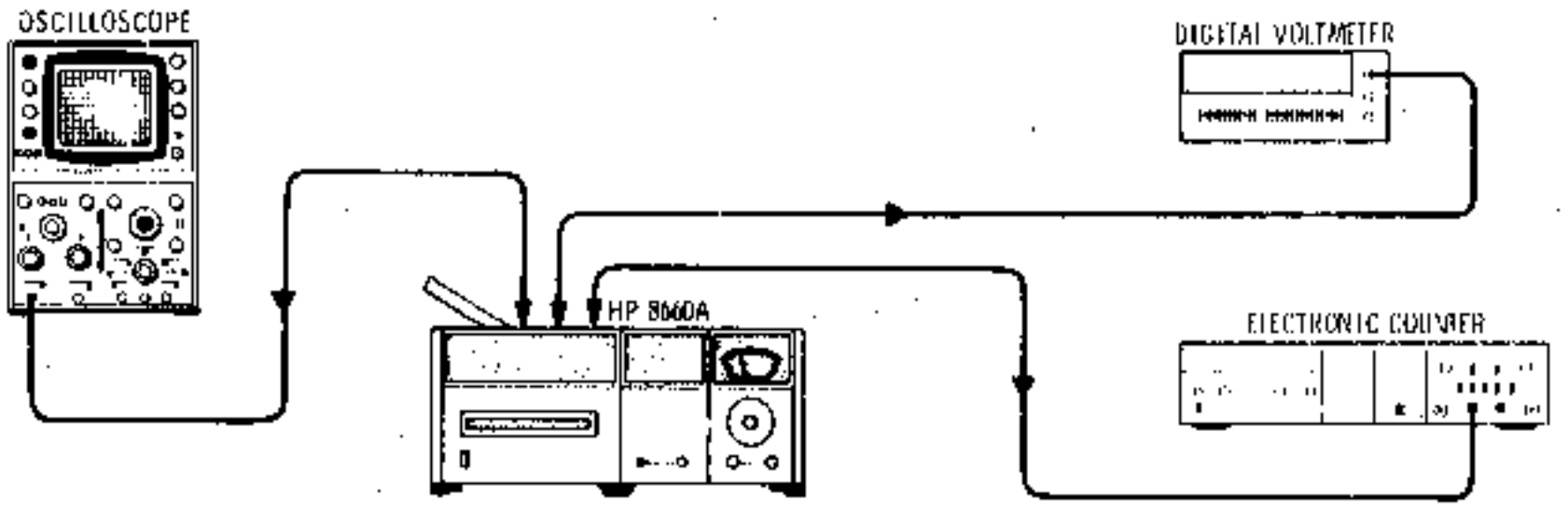


Figure 5-19. SL1 Test Setup

EQUIPMENT:

Digital Voltmeter	HP 3435A
Electronic Counter	HP 5328A Option 030
Oscilloscope (with 10:1 divider probes)	HP 180A/1801A/1821A

PROCEDURE: (See Figure 5-19).

1. Set thumbwheel digits 5, 6 and 7 to a 5 (thumbwheels read 0005550000).

   a. With the digital voltmeter connected to A2TP14, adjust A19R3 or A19R9 to 0.00 volt ± 10 millivolts.

   b. With the oscilloscope connected to A2TP13, adjust A15R14 for 50/50 symmetry.

   c. Disconnect the digital voltmeter and the oscilloscope.

2. Connect the digital voltmeter to varactor test point A2TP21, ground mother board test point A2TP14 with the jumper provided, and reset all thumbwheel digits to 0.

   a. Adjust A19R3 or A19R9 to −30 volts and disconnect the digital voltmeter.

   b. Connect the counter to SL1 OSC at XA19-1-2 and adjust A19C18 for a counter readout as close as possible to 30 MHz (must be within ± 300 kHz).

ADJUSTMENTS

5-27. SUMMING LOOP 1 (Cont'd)

3. Set thumbwheel digits as follows; digit 6 to a 4 and digit 5 to a 5 (thumbwheels read 0000450000). Adjust A19R3 or A19R9 for a counter reading of 29.550 MHz.

4. Set thumbwheel digit 7 to a 9 (thumbwheels read 0009450000). Record frequency of output at SL1 OSC at XA19-1-2.

_____ MHz

5. Determine the difference frequency between that recorded in step 4 and 20.550 MHz and record:

_____ MHz

a. Set thumbwheel digit 7 to a 0 (thumbwheels read 0000450000).

b. When the frequency readout in step 4 is higher than 20.550 MHz, adjust A19R3 to 29.550 plus the difference frequency recorded in step 5.

c. When the frequency readout in step 4 is lower than 20.550 MHz, adjust A19R3 to 2955 MHz minus the difference recorded in step 5.

d. Reset the frequency to 29.550 MHz with A19R9.

e. Repeat steps 3 through 5 until the counter indicates 20.550 MHz ± 20 kHz for a thumbwheel setting of 0009450000 and 29.550 MHz ± 20 kHz for a thumbwheel setting of 0000450000.

6. Set front panel thumbwheels as shown in Table 5-10. Adjust controls listed for counter readouts shown.

7. Disconnect the counter, remove the ground from A2TP14 and connect the oscilloscope to A2TP13.

8. Set the thumbwheels as shown in Table 5-10 and adjust the controls listed for 50/50 symmetry as seen on the oscilloscope. Disconnect the oscilloscope. (All settings must be within 40/60 symmetry.)

Table 5-10. SL1 Oscillator Output Frequency Adjustments

Thumbwheel Settings	Adjust	Counter Readout
0008450000	A18R35 "8"	21.550 MHz ± 20 kHz
0007450000	A18R40 "7"	22.550 MHz ± 20 kHz
0006450000	A18R44 "6"	23.550 MHz ± 20 kHz
0005450000	A18R51 "5"	24.550 MHz ± 20 kHz
0004450000	A18R55 "4"	25.550 MHz ± 20 kHz
0003450000	A18R62 "3"	26.550 MHz ± 20 kHz
0002450000	A18R67 "2"	27.550 MHz ± 20 kHz
0001450000	A18R74 "1"	28.550 MHz ± 20 kHz

PARTS LIST

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information relative to ordering replacement parts and assemblies.

6-3. Table 6-1 contains the cabinet parts list.

6-4. Table 6-2 provides an index of reference designations and abbreviations used in the preparation of Hewlett-Packard manuals.

6-5. Table 6-3 is the table of replaceable parts and is arranged as follows:

a. Electrical assemblies and their component parts in alpha-numerical order by reference designation.

b. Chassis parts in alpha-numerical order by reference designation.

c. Miscellaneous parts.

6-6. The information given for each part contains the following:

a. The reference designator.

b. The Hewlett-Packard part number.

c. Part Number check digit (CD).

d. Total quantity (TQ) in the instrument. Total quantity for each part is given only once, at the first appearance of the part number.

e. Description of the part.

f. Manufacturer of the part, in a five-digit code.

g. The manufacturer's number for the part.

6-7. Table 6-4 contains the names and addresses that correspond to the manufacturers code number.

6-8. ORDERING INFORMATION

6-9. To order a part listed in the replaceable parts table, indicate the Hewlett-Packard part number, 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.

6-10. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

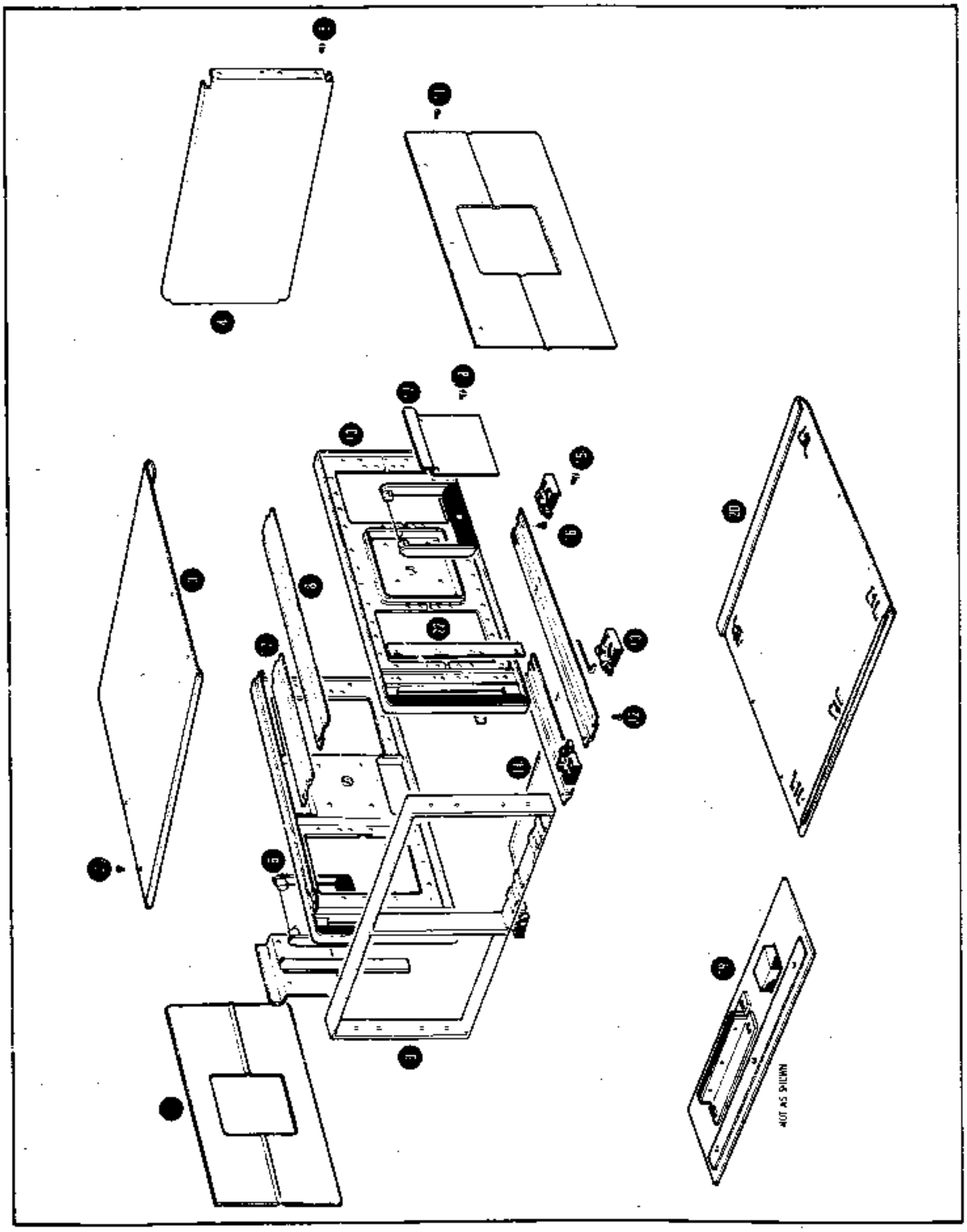


Figure 6-1. Cabinet Parts

Table 6-1. Cabinet Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08660-00024	2	Cover:Side	28480	08660-00024
2	2360-0198	8	Screw:Flat HD Pozi Dr 6-32 x 0.438" LG	00000	OBD
3	08660-60026	1	Cover:Top	28480	08660-00026
4	08660-00001	1	Panel:Rear	28480	08660-00001
5	2510-0099	4	Screw:SST Pan HD Pozi Dr 8-32 x 0.250"	00000	OBD
6	5060-0222	2	Handle Assy:5H Side	28480	5060-0222
7	08660-20057	2	Guide:Mod. Plug-in	28480	08660-20057
8	08660-20058	2	Guide:RF Plug-in	28480	08660-20058
9	08660-20061	1	Frame:Front	28480	08660-20061
10	08660-20076	2	Frame:Side	28480	08660-20076
11	2360-0190	12	Screw: Flat HD Pozi Dr 6-32 x .188 LG	00000	OBD
12	2200-0164	8	Screw: Flat HD Pozi Dr 4-40 x 3/16	00000	OBD
13	5060-0767	5	Foot Assy: FM	28480	5060-0767
14	1490-0030	1	Stand: Tilt	28480	1490-0030
15	2510-0050	8	Screw: Flat HD Pozi Dr 8-32 x 0.500" LG	00000	OBD
16	2360-0111	8	Screw: SST Pan HD Pozi Dr 8-32 x 0.188"	00000	OBD
17	5060-8735	2	Retainer Handle Assy: Olive Gray (STD)	28480	5060-8735
18	2510-0101	4	Screw: Pan HD Pozi Dr 8-32 x 0.312" LG	00000	OBD
19	08660-60070	1	Kit: Rack Mount	28480	08660-60070
20	08660-00025	1	Cover: Bottom	28480	08660-00025
21	08660-20172	2	Foot: Extruded, rear	28480	08660-20172
22	5000-0052	2	Plate: Fluted Aluminum	28480	5000-0052

NOTE: Reference Designator Number 21, not shown, may be ordered separately or as part of Field Update Kit 08660-60273 for 50–60 Hz fan or part of Field Update Kit 08660-60274 for 50–400 Hz fan.

Table 6-2. Reference Designators and Abbreviations used in Parts List

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
B	= motor	FL	= Filter	Q	= transistor		
BT	= battery	J	= jack	R	= resistor	VR	= voltage regulator
C	= capacitor	K	= relay	RT	= thermistor	W	= cable
CP	= coupler	L	= inductor	S	= switch	X	= socket
CR	= diode	LS	= loud speaker	T	= transformer	Y	= crystal
DL	= delay line	M	= meter	TB	= terminal board	Z	= tuned cavity, network
DS	= device signaling (lamp)	MK	= microphone	TP	= test point		
E	= misc electronic part	MP	= mechanical part	U	= integrated circuit		

ABBREVIATIONS

A	= amperes	h	= henries	N/O	= normally open	RMO	= rack mount only
AFC	= automatic frequency control	HDW	= hardware	NOM	= nominal	RMS	= root-mean square
		HEX	= hexagonal	NPO	= negative positive zero (zero temperature coefficient)	RWV	= reverse working voltage
AMPL	= amplifier	HG	= mercury			S-B	= slow-blow
		HR	= hour(s)			SCR	= screw
BFO	= beat frequency oscillator	Hz	= Hertz			SE	= selenium
BE CU	= beryllium copper	IF	= intermediate freq	NPN	= negative-positive-negative	SECT	= section(s)
BH	= blader head	IMPG	= impregnated			SEMICON	= semiconductor
BP	= bandpass	INCD	= incandescent	NRFR	= not recommended for field replacement	SI	= silicon
BRS	= brass	INCL	= includo(s)			SIL	= silver
BWO	= backward wave oscillator	INS	= insulation(ed)	NSR	= not separately replaceable	SL	= slide
		INT	= internal			SPG	= spring
						SPL	= special
CCW	= counterclockwise	K	= kilo = 1000	OBD	= order by description	SST	= Stainless steel
CER	= ceramic					SR	= split ring
CMO	= cabinet mount only			OH	= oval head	STL	= steel
COEF	= coefficient	LH	= left hand	OX	= oxide		
COM	= common	LIN	= linear taper				
COMP	= composition	LK WASH	= lock washer	P	= peak	TA	= tantalum
COMPL	= complete	LOG	= logarithmic taper	PC	= printed circuit	TD	= time delay
CONN	= connector	LPF	= low pass filter	PF	= picofarads = 10^{-12} farads	TGL	= toggle
CP	= cadmium plate					THD	= thread
CRT	= cathode-ray tube	M	= milli = 10^{-3}	PH BRZ	= phosphor bronze	TI	= titanium
CW	= clockwise	MEG	= meg = 10^{6}	PHL	= Phillips	TOL	= tolerance
		MET FLM	= metal film	PIV	= peak inverse voltage	TRIM	= trimmer
DEPC	= deposited carbon	MET OX	= metallic oxide			TWT	= traveling wave tube
DR	= drive	MFR	= manufacturer	PNP	= positive-negative-positive		
		MHz	= mega Hertz				
ELECT	= electrolytic	MINAT	= miniature	P/O	= part of	μ	= micro = 10^{-6}
ENCAP	= encapsulated	MOM	= momentary	POLY	= polystrene		
EXT	= external	MOS	= metalized substrate	PORC	= porcelain	VAR	= variable
				POS	= position(s)	VDCW	= dc working volts
F	= farads	MTG	= mounting	POT	= potentiometer		
FH	= flat head	MY	= "mylar"	PP	= peak-to-peak		
FIL H	= Fillister head			PT	= point	W/	= with
FXD	= fixed			PWV	= peak working voltage	W	= watts
		N	= nano (10^{-9})			WIV	= working inverse voltage
G	= giga (10^{9})	N/C	= normally closed	RECT	= rectifier		
GE	= germanium	NE	= neon	RF	= radio frequency	WW	= wirewound
GL	= glass	NI PL	= nickel plate	RH	= round head or right hand	W/O	= without
GRD	= ground(ed)						

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08660-60041	9	1	DIGITAL CONTROL ASSEMBLY	28480	08660-60041
A1S1	08660-00024	8	1	SWITCH-TGL BASIC DPDT 3A 125VAC SLDR-LUG	28480	08660-00024
	7120-1254	1	1	NAMEPLATE .312-IN-WD .50-IN-LG AL	28480	7120-1254
	08660-00011	6	1	SUPPORT, DIGITAL, TOP	28480	08660-00011
	08660-00012	9	1	SUPPORT, DIGITAL, BOTTOM	28480	08660-00012
	08660-00023	7	1	PANEL, FRONT	28480	08660-00023
	08660-00039	5	1	INSULATOR	28480	08660-00039
	08660-00040	8	1	SHIELD, RF	28480	08660-00040
	08660-20060	4	1	PANEL, SUB, FRONT	28480	08660-20060
	08660-20073	6	1	MASK, FRONT WINDOW (OPTION 009)	28480	08660-20073
	08660-20077	1	1	FERRULE	28480	08660-20077
	08660-20078	4	1	HOLDER, BULB	28480	08660-20078
	08660-20080	8	1	WINDOW	28480	08660-20080
	08660-40004	6	1	BLOCK, ANNUNCIATOR	28480	08660-40004
	08660-20075	1	1	MASK, FRONT WINDOW (OPTION 008)	28480	08660-20075
	08660-20081	9	1	MASK FRONT WINDOW (OPTION 009)	28480	08660-20081
A1A1†	08660-60035	7	1	MOTHER BOARD ASSEMBLY, DIGITAL CONTROL	28480	08660-60035
A1A1C1	0180-0197	8	24	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A1J1	1250-1255	1	4	CONNECTOR-RF BNC M PC 50-OHM	28480	1250-1255
	0360-1514	7	2	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1A1XA5	1251-2026	8	9	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A1XA6	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A1XA7	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A1XA8	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1A1XA9	1251-2035	9	25	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A1A1XA9	1251-2361	4		CONTACT-CONN MALE DPSLDR	28480	1251-2361
A1A1XA10	1251-2361	4		CONTACT-CONN MALE DPSLDR	28480	1251-2361
A1A2	08660-60036	8	1	BOARD ASSEMBLY, ANNUNCIATOR BLOCK	28480	08660-60036
A1A2DS1	2140-0356	9	4	LAMP-INCAND 7683 5VDC 60MA T-1-BULB	71744	CM7-7683
A1A2DS2	2140-0356	9		LAMP-INCAND 7683 5VDC 60MA T-1-BULB	71744	CM7-7683
A1A2DS3	2140-0356	9		LAMP-INCAND 7683 5VDC 60MA T-1-BULB	71744	CM7-7683
A1A2DS4	2140-0356	9		LAMP-INCAND 7683 5VDC 60MA T-1-BULB	71744	CM7-7683
A1A2DS5	2140-0427	5	1	LAMP-INCAND 5VDC 60MA T-1-BULB	28480	2140-0427
A1A2XA1	1251-2823	3	1	CONN-STRIP,7 POS,.X MALE CONT	28480	1251-2823
A1A3	08660-60034	6	1	BOARD ASSEMBLY, L.E.D.	28480	08660-60034
A1A3C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A3C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A3C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A3DS1	1990-0325	2	31	LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS2	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS3	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS4	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS5	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS6	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS7	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS8	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS9	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS10	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS11	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS12	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS13	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS14	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS15	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS16	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS17	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS18	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS19	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS20	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS21	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS22	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS23	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS24	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403
A1A3DS25	1990-0325	2		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4403

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A30826	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30827	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30828	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30829	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30830	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30831	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30832	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30833	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30834	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30835	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30836	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A30837	1990-0325	2		LED-VISIBLE LUM-INTNS 80UCD IF=50MA-MAX	28480	5082-4403
A1A3R1	0698-3442	9	37	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R2	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R3	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R4	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R5	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R6	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R7	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R8	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R9	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R10	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R11	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R12	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R13	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R14	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R15	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R16	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R17	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R18	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R19	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R20	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R21	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R22	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R23	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R24	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R25	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R26	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R27	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R28	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R29	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R30	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R31	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R32	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R33	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R34	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R35	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R36	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3R37	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1A3U1	1820-0174	0	5	IC INV TTL HEX	01295	SN7404N
A1A3U2	1820-0548	4	12	IC REGTR TTL 8BIT 10-BIT	18324	MB202N
A1A3U3	1820-0548	4		IC REGTR TTL 8BIT 10-BIT	18324	MB202N
A1A3U4	1820-0548	4		IC REGTR TTL 8BIT 10-BIT	18324	MB202N
A1A3U5	1820-0548	4		IC REGTR TTL 8BIT 10-BIT	18324	MB202N
A1A3XA1	1251-1631	9	1	CONNECTOR-PC EDGE 10-CONT/ROW 1-ROW	28480	1251-1631
A1A9	3100-3004	7	1	SWITCH, THUMBWHEEL 10 MODULES + SPACER M (FOR STANDARD INSTRUMENT)	28480	3100-3004
A1A9	3100-3026	3	1	SWITCH, THUMBWHEEL (FOR OPTION 004 ONLY)	28480	3100-3026
A1A9	08660-60032	4	1	BOARD ASSEMBLY, THUMBWHEEL	28480	08660-60032
A1A9C1	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A9C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A9C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A9C4	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A9C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A9C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A9DS1	2140-0627	5		LAMP-INCAND 5VDC 60MA T-1-BULB	28480	2140-0627
A1A9DS2	2140-0627	5		LAMP-INCAND 5VDC 60MA T-1-BULB	28480	2140-0627
A1A9Q1	1854-0071	7	12	TRANSISTOR-NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A9Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A9Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A9Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071

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
A1A5R1	0757-0416	7	11	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A5R2	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A5R3	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A5R4	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A5R5	0757-0280	5	7	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A1A5R6	1810-0020	8	9	NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0020
A1A5R7	1810-0020	8		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0020
A1A5R8	1810-0020	8		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0020
A1A5R9	1810-0020	8		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0020
A1A5R10	1810-0020	8		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0020
A1A5R11	1810-0020	8		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0020
A1A5U1	1820-0054	5	9	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A5U2	1420-0511	0	1	IC-DIGITAL SN74LS00N TTL QUAD 2-AND	01295	SN74LS00N
A1A5U3	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A5U4	1820-0055	6	1	IC CNTR TTL DECO SYNCHRO POS-EDGE-TRIG	01295	SN74160N
A1A5U5	1820-0622	3	4	IC MUXR/DATA-SEL TTL 4-TO-1-LINE 4-INP	01295	SN74153AN
A1A5U6	1820-0622	3		IC MUXR/DATA-SEL TTL 4-TO-1-LINE 4-INP	01295	SN74153AN
A1A5U7	1820-0622	3		IC MUXR/DATA-SEL TTL 4-TO-1-LINE 4-INP	01295	SN74153AN
A1A5U8	1820-0622	3		IC MUXR/DATA-SEL TTL 4-TO-1-LINE 4-INP	01295	SN74153AN
A1A5U9	1820-0328	4	4	IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A1A5U10	1820-0077	2	4	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A1A5U11	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A1A5U12	1820-0511	0		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A1A5U13	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A5XA1	1251-1941	6	10	CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A5XA2	1251-1941	6		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A5XA3	1251-1941	6		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A5XA8	1251-1941	6		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A5XA9	1251-1941	6		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A5XA6	1251-1941	6		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A5XA7	1251-1941	6		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A5XA8	1251-1941	6		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A5XA9	1251-1941	6		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A5XA10	1251-1941	6		CONNECTOR-PC EDGE 6-CONT/ROW 1-ROW	28480	1251-1941
A1A6†	08660-60352	1	1	BOARD ASSEMBLY: CONTROL	28480	08660-60352
A1A6C1†				DELETED		
A1A6C2	0180-0375	2	2	CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
A1A6C3	0160-0945	2	1	CAPACITOR-FXD 910PF +-5% 100VDC MICA	28480	0160-0945
A1A6C4	0160-2204	0	3	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A1A6C5	0160-2209	5	1	CAPACITOR-FXD 360PF +-5% 300VDC MICA	28480	0160-2209
A1A6C6	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A1A6C7	0160-3456	6	24	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A1A6C8	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A1A6C9	0180-2206	4	1	CAPACITOR-FXD 6.8UF+-10% 6VDC TA	56289	150D685X9006B2
A1A6C10	0180-1743	2	1	CAPACITOR-FXD .1UF+-10% 35VDC TA	56289	150D104X9035A2
A1A6C11	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C12	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C13	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C14	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C15	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6CR1	1901-0040	1	4	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6Q1	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A6Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A6Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A6R1†	0757-0401	0	2	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-TO-101-F
A1A6R2	0757-0438	3	4	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A1A6R3	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A1A6R4	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-TO-101-F
A1A6R5	0757-0280	5		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A1A6R6	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A6R7	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A6R8	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A6R9	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A6R10	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A6R11	0757-0442	9	7	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A1A6R12	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A1A6R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A1A6R14	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A1A6R15	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A1A6R16	0698-3446	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-TO-383R-F
A1A6R17	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1471-F
A1A6R18	0757-0280	5		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A1A6R19	0757-0280	5		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C O	Qty	Description	Mfr Code	Mfr Part Number
A1A6U1	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A1A6U2	1820-0072	7	4	IC GATE TTL AND-OR-INV DUAL 2-INP	01295	SN7454N
A1A6U3	1820-0508	4		IC RGTR TTL DFF 10-BIT	18324	N8202N
A1A6U4	1820-0508	8		IC RGTR TTL DFF 10-BIT	18324	N8202N
A1A6U5	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U6	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U7	1820-0262	1	1	IC GATE TTL ENCL-OR QUAD 2-INP	01295	SN74664N
A1A6U8	1820-0072	7		IC GATE TTL AND-OR-INV DUAL 2-INP	01295	SN7454N
A1A6U9	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A1A6U10	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A1A6U11	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A1A6U12	1820-0174	0		IC INV TTL HEX	01295	SN7404N
A1A6U13	1820-0508	4		IC RGTR TTL DFF 10-BIT	18324	N8202N
A1A6U14	1820-0508	8		IC RGTR TTL DFF 10-BIT	18324	N8202N
A1A6U15	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U16	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A1A6U17	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U18	1820-0174	0		IC INV TTL HEX	01295	SN7404N
A1A6U19	1820-0492	5	1	IC CNTR TTL BIN ASYNCHRO NEG-EDGE-TRIG	18324	N82S16
A1A6U20	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A1A7				NOT ASSIGNED		
A1A8†	08660-60098	2	1	BOARD ASSEMBLY, CENTER FREQUENCY	28480	08660-60098
A1A8C1	0160-0107	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A8C2	0160-0107	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A8C3	0160-0107	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A8C4	0160-0107	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A8C5	0160-0107	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A8C6	0160-0107	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A8C7	0160-3533	0	1	CAPACITOR-FXD 470PF +-5% 300VDC MICA	28480	0160-3533
A1A8C8	0180-1714	7	1	CAPACITOR-FXD 330UF+-10% 6VDC TA	56289	150D337X0006B2
A1A8C9	0180-2207	9	1	CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010R2
A1A8CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A8Q1	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A8Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A8Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A8R1	0757-0279	0	3	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1A8R2	0757-0280	1		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A8R3	0757-0280	1		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A8R4	0757-0340	5	10	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A1A8R5	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1A8R6	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1A8R7	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A8R8	0757-0420	3	1	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1A8R9	0757-0280	1		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A8U1	1820-0508	4		IC RGTR TTL DFF 10-BIT	18324	N8202N
A1A8U2	1820-0508	4		IC RGTR TTL DFF 10-BIT	18324	N8202N
A1A8U3	1820-0508	4		IC RGTR TTL DFF 10-BIT	18324	N8202N
A1A8U4	1820-0508	8		IC RGTR TTL DFF 10-BIT	18324	N8202N
A1A8U5	1820-0610	5	1	IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	07263	9322PC
A1A8U6	1820-0049	7	2	IC GATE TTL NAND DUAL 4-INP	01295	SN7420N
A1A8U7	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A1A8U8	1820-0041	0	2	IC GATE TTL OR QUAD 2-INP	01295	SN7432N
A1A8U9	1820-0068	1	1	IC GATE TTL NAND TPL 3-INP	01295	SN7410N
A1A8U10	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A1A8U11	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A1A8U12	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A8U13	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A1A8U14	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A1A8U15	1820-0041	0		IC GATE TTL OR QUAD 2-INP	01295	SN7432N
A1A8U16	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A1A8U17	1820-0174	0		IC INV TTL HEX	01295	SN7404N
A2	08660-60020	0	1	BOARD ASSY, INTERCONNECTION	28480	08660-60020
A2C1	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C2	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C3	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C4	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C5	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C6	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C7	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C8	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C9	0160-2055	8	16	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C10	0160-2055	8		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C13	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C14	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C15	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C16	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C17	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C18	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C19	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C20	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C25	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C26	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C27	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C29	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C31	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C32	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C33	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C34	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C35	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C36	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C37	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C38	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C39	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C40	0160-3454	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3454
A2C41	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C42	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C43	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C44	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2J1	1250-1295	1		CONNECTOR-RF BNC M PC 50-OHM	28480	1250-1295
A2J2	1250-1295	1		CONNECTOR-RF BNC M PC 50-OHM	28480	1250-1295
A2J3	1250-1295	1		CONNECTOR-RF BNC M PC 50-OHM	28480	1250-1295
A2J4	1250-1295	1		CONNECTOR-RF BNC M PC 50-OHM	28480	1250-1295
A2N2	08660-60080	2	1	CABLE ASSY, GRAY	28480	08660-60080
A2XA8-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA8-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA9-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA10-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA10-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA11-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA11-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA12-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA12-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA13-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA13-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA14-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA14-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA15-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA15-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA16-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA16-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA17-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA17-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA18-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA18-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA19-1	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A2XA19-2	1251-2035	4		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035

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
				OPTION 005 ONLY		
A3A1	08660-60341	5	1	HP-IB OUTPUT ASSEMBLY	28480	08660-60341
A3A1C1	0180-0197	8	2	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C3	0160-0301	4	1	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A3A1C4	0180-0375	2	1	CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
A3A1C5	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1C6	0180-2208	4	1	CAPACITOR-FXD 220UF+-10% 10VDC TA	56289	150D227X9010R2
A3A1CR1	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A1CR2	1901-0539	1	1	DIODE-FW BRDG 600V 1A	28480	1901-0539
A3A1Q1	1854-0071	7	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3A1Q2	1853-0020	4	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A3A1R1	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A3A1R2	0757-0442	9	5	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R7	0757-0278	9	2	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3A1R8	0757-0278	9		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3A1R9	0757-0399	5	9	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R10	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R11	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R12	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R13	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R14	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R15	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R16	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R17	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1U1	1820-0511	9	1	IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A3A1U2	1820-0328	6	1	IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A3A1U3	1820-0054	5	2	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A3A1U4	1820-0218	9	1	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN7442AN
A3A1U5	1820-0150	2	1	IC SHF-RGTR TTL D-TYPE PRL-IN PRL-OUT	07263	9300PC
A3A1U6	1820-0579	9	1	IC MV TTL MONOSTBL RETRIG DUAL	01295	SN74123N
A3A1U7	1820-0076	1	1	IC FF TTL J-K PULSE PRESET/CLEAR DUAL	01295	SN7476N
A3A1U8	1820-0372	0	1	IC GATE TTL H AND TPL 3-INP	01295	SN74H11N
A3A1U9	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A3A1U10	1820-0174	0	1	IC INV TTL HEX	01295	SN7404N
A3A1U11	1820-0065	8	1	IC FF TTL J-K POS-EDGE-TRIG CLEAR	01295	SN7470N
A3A1U12	1820-0935	7	1	IC DRVR TTL AND DUAL 2-INP	01295	SN75451BP
A3A1U13	1820-1056	9	1	IC SCHMITT-TRIG TTL NAND QUAD 2-INP	01295	SN74132N
A3A1VR1	1902-3059	0	1	DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=-.051%	28480	1902-3059
				A3A1 MISCELLANEOUS		
	1251-2194	1	1	CONNECTOR-SGL CONT SKT .021-IN-BSC-SZ	28480	1251-2194
	1251-2361	8	8	CONTACT-CONN MALE DPSLDR	28480	1251-2361

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†	08660-60351	0	1	FRONT INTERFACE ASSEMBLY, BCD (EXCEPT OPTION 005)	28480	08660-60351
A3A1C1	0160-0154	5	1	CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A3A1C2	0180-2208	4	1	CAPACITOR-FXD 220UF+-10% 10VDC TA	56289	150D227X9010B2
A3A1C3	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1C4	0180-0373	2		CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
A3A1C5	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C6	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C7	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1CR1†	1901-0518	3	1	DIODE-SCHOTTKY	28480	1901-0518
A3A1CR2†	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A1Q1	1853-0020	4	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A3A1Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3A1Q3				NOT ASSIGNED		
A3A1Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3A1R1	0698-3151	3	2	RESISTOR 14.0K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1402-F
A3A1R2	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3A1R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R8	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R9	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R10	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R11	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R12	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R13	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R14	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R15	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R16	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1U1	1820-0174	0		IC INV TTL HEX	01295	SN7404N
A3A1U2	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A3A1U3	1820-0069	2		IC GATE TTL NAND DUAL 4-INP	01295	SN7420N
A3A1U4	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A3A1U5†	1820-0328	4		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A3A1U6†	1820-0045	8	1	IC FF TTL J-K POS-EDGE-TRIG CLEAR	01295	SN7470N
A3A1U7†	1820-0207	0	1	IC MV TTL MONOSTBL RET=ED/RESET	0NT13	MC8601P
A3A1U8†	1820-0072	>		IC GATE TTL AND-OR-INV DUAL 2-INP	01295	SN7450N
A3A1U9†	1820-0072	2		IC GATE TTL AND-OR-INV DUAL 2-INP	01295	SN7450N
A3A1U10†	1820-0214	9	1	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN7442AN
A3A1U11†	1820-0328	4		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A3A1U12	1820-1054	4	1	IC SCHMITT-TRIG TTL NAND QUAD 2-INP	01295	SN74132N
A3A1U13	1820-0328	4		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
				A3A1 MISCELLANEOUS		
	1251-2361	4	3	CONTACT-CONN MALE OPBLOR	28480	1251-2361

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3A2	08660-60192	7	1	BOARD ASSY,HP-IB INPUT(OPTION 089 ONLY)	28480	08660-60192
A3A2C1	0180-0197	8	3	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A2C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A2C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A2C4	0160-0157	8	3	CAPACITOR-FXD 6800PF +-10% 200VDC POLYE	28480	0160-0157
A3A2C5	0160-0157	8		CAPACITOR-FXD 6800PF +-10% 200VDC POLYE	28480	0160-0157
A3A2C6	0160-0157	6		CAPACITOR-FXD 6800PF +-10% 200VDC POLYE	28480	0160-0157
A3A2R1	0757-0403	2	3	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-TO-1210-F
A3A2R2	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-TO-1210-F
A3A2R3	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-TO-1210-F
A3A2U1	1820-0054	5	1	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A3A2U2	1820-0021	2	1	IC GATE TTL NAND QUAD 2-INP	01295	SN7438N
A3A2U3	1820-0511	9	2	IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A3A2U4	1820-0070	5	3	IC GATE TTL NAND 8-INP	01295	SN7430N
A3A2U5	1820-0070	5		IC GATE TTL NAND 8-INP	01295	SN7430N
A3A2U6	1820-0174	0	2	IC INV TTL HEX	01295	SN7404N
A3A2U7	1820-1053	6	2	IC SCHMITT-TRIG TTL INV HEX	01295	SN7414N
A3A2U8	1810-0136	3	2	NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
A3A2U9	1820-0077	2	1	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A3A2U10	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A3A2U11	1820-0174	0		IC INV TTL HEX	01295	SN7404N
A3A2U12	1820-0070	5		IC GATE TTL NAND 8-INP	01295	SN7430N
A3A2U13	1820-1053	6		IC SCHMITT-TRIG TTL INV HEX	01295	SN7414N
A3A2U14	1810-0136	3		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	28480	1810-0136
J3A1	08460-60107	0	1	CABLE, ADAPTER, HP-IB(INCL, MKR + HP83)	28480	08460-60107
J3A1MP1	0380-1036	0	2	STANDOFF-HEX .255-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
J3A1MP2	1251-0463	7	2	CONNECTOR 36-PIN M MICRO RIBBON	28480	1251-0463
J3A1MP3	1251-3283	1	2	CONNECTOR 24-PIN F MICRORIBBON	28480	1251-3283
J3A1MP4	08460-60060	2	2	MOUNT, HPIB CONNECTOR	28480	08460-60060
J3A1MP5	08460-20165	0	2	COVER, HP-IB ADAPTER	28480	08460-20165
J3A1MP6	08460-20144	1	2	SPACER, CONNECTOR	28480	08460-20144

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
A3A2	08660-60029	9	1	BOARD ASSY, DIGITAL INTERFACE(REAR) (EXCEPT OPTION 005)	28480	08660-60029
A3A2C1	0180-0197	8	7	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A2C2	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A2C3	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A2C4	0160-2219	7	1	CAPACITOR-FXD 1100PF +-5% 300VDC MICA	28480	0160-2219
A3A2Q1	1854-0071	7	9	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3A2Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3A2R1	0757-0821	4	26	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R2	0698-3445	2	24	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R3	0757-0279	6	30	RESISTOR 3.16M 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A2R4	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R5	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R6	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R7	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R8	0757-0279	6		RESISTOR 3.16M 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A2R9	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R10	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R11	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R12	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R13	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R14	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R15	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R16	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R17	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R18	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R19	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R20	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R21	0757-0916	7	25	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3A2R22	0757-0279	6		RESISTOR 3.16M 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A2R23	0757-0279	6		RESISTOR 3.16M 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A2R24	0757-0279	6		RESISTOR 3.16M 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A2R25	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R26	0757-0821	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A3A2R27	0757-0279	6		RESISTOR 3.16M 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A2R28	0757-0279	6		RESISTOR 3.16M 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A2R29	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2R30	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3A2U1	1820-0058	5	27	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A3A2U2	1820-0301	5	2	IC LCH TTL D-TYPE 4-BIT	01295	SN7475N
A3A2U3	1820-0254	8	1	IC BFR DTL NAND QUAD 2-INP	01295	SN15450N
A3A2U4	1820-0301	5		IC LCH TTL D-TYPE 4-BIT	01295	SN7475N
A3A3	08660-60025	5	1	BOARD ASSY, DIGITAL INTERCONNECT	28480	08660-60025
A3A3J1	1250-1255	1	2	CONNECTOR-RF BNC M PC 50-OHM	28480	1250-1255
A3A3J2	1250-1255	1		CONNECTOR-RF BNC M PC 50-OHM	28480	1250-1255
A4	08660-60042	9	1	LOOP ASSY, M.F.	28480	08660-60042
A4C1	0160-2437	1	23	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C2	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C3	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C4	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C5	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C6	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C7	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C8	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C9	0160-3744	5	4	CAPACITOR-FDTHRU 1000PF +80 -20% 200V	28480	0160-3744
A4C10	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C11	0160-3744	5		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	28480	0160-3744
A4C12	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C13	0160-3744	5		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	28480	0160-3744
A4C14	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C15	0160-3744	5		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	28480	0160-3744
A4C16	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C17	0160-3744	5		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	28480	0160-3744
A4C18	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C19	0160-3744	5		CAPACITOR-FDTHRU 1000PF +80 -20% 200V	28480	0160-3744
A4C20	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C21	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C22	0160-2437	1		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A4C23	0160-2437	1		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
A4J1	1250-0781	2	17	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J2	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J3	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J4	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J5	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J6	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J7	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J8	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J9	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J10	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J11†	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J12	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4J13	1250-0781	2		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	28480	1250-0781
A4L1	9140-0144	6	6	COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A4N1	08660-60050	2		CABLE ASSY, GRAY	28480	08660-60050
A4N2	08660-60050	0	1	CABLE ASSY, GRAY	28480	08660-60050
A4N3	08660-60003	1	1	CABLE ASSY, GRAY	28480	08660-60003
A4N4	08660-60055	1	1	CABLE ASSY, GRAY	28480	08660-60055
				MISCELLANEOUS		
	08660-00014	6	1	COVER, REF, OSC,	28480	08660-00014
	08660-00015	7	1	COVER, REF, DIVIDER	28480	08660-00015
	08660-00016	8	1	COVER, REF, PHASE DETECTOR	28480	08660-00016
	08660-00017	9	1	COVER, DIVIDE BY TWO,	28480	08660-00017
	08660-00018	0	1	COVER, PRETUNE	28480	08660-00018
	08660-00019	1	1	COVER, VCO	28480	08660-00019
	08660-00020	4	1	COVER, PHASE DETECTOR	28480	08660-00020
	08660-20063	7	1	HOUSING, M,F, LP	28480	08660-20063
4A1	08660-60001	9	1	BOARD ASSY, REF, DIVIDER	28480	08660-60001
A4A1C1	0160-2201	7	1	CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0160-2201
A4A1C2	0180-0116	1	7	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4A1C3	0180-0229	7	11	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A4A1C4	0160-2199	2	1	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0160-2199
A4A1C5	0160-0154	5	2	CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A4A1C6	0160-0154	5		CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A4A1C7	0160-0247	7	2	CAPACITOR-FXD 1200PF +-10% 200VDC POLYE	28480	0160-0247
A4A1CR1	1902-0048	3	1	DIODE-ZNR 6.81V 5% DO-7 PD=.4W TC=+.043%	28480	1902-0048
A4A1L1	9100-1642	1	2	COIL-MLD 270UH 5% Q=45 .395DX.445LG-NOM	28480	9100-1642
A4A1L2	9100-1642	1		COIL-MLD 270UH 5% Q=45 .395DX.445LG-NOM	28480	9100-1642
A4A1L3†	9140-0144	6		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A4A1Q1	1854-0019	3	17	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A1Q2	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A1Q3	1854-0045	5	4	TRANSISTOR NPN SI TO-18 PD=500MW	28480	1854-0045
A4A1R1	0757-0464	1	13	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	CW-1/8-TO-1212-F
A4A1R2	0698-3622	7	1	RESISTOR 120 5% 2W MO TC=0+-200	28480	0698-3622
A4A1R3	0698-0083	6	40	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CW-1/8-TO-1961-F
A4A1R4	0757-0280	3	42	RESISTOR 1K 1% .125W F TC=0+-100	24546	CW-1/8-TO-1001-F
A4A1R5	0757-0394	0	24	RESISTOR 51.1 1% .125W F TC=0+-100	24546	CW-1/8-TO-51R1-F
A4A1R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CW-1/8-TO-1001-F
A4A1R7	0698-0083	6		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	CW-1/8-TO-1961-F
A4A1R8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CW-1/8-TO-1001-F
A4A1R9	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	CW-1/8-TO-51R1-F
A4A1R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CW-1/8-TO-1001-F
A4A1R11	0698-3441	5		RESISTOR 215 1% .125W F TC=0+-100	24546	CW-1/8-TO-215R-F
A4A1R12	0698-3441	5		RESISTOR 215 1% .125W F TC=0+-100	24546	CW-1/8-TO-215R-F
A4A1R13	0698-3441	5		RESISTOR 215 1% .125W F TC=0+-100	24546	CW-1/8-TO-215R-F
A4A1R14†	0757-0401	0	30	RESISTOR 100 1% .125W F TC=0+-100	24546	CW-1/8-TO-101-F
A4A1U1	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A4A1U2	1820-0055	4	2	IC CNTR TTL DECD SYNCHRO POS-EDGE-TRIG	01295	SN7490AN
A4A1U3	1820-0055	4		IC CNTR TTL DECD SYNCHRO POS-EDGE-TRIG	01295	SN7490AN
A4A2	08660-60002	8	1	BOARD ASSY,REF, PHASE DETECTOR	28480	08660-60002
A4A2C1	0180-0100	3	1	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A4A2C2	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4A2C3	0180-0228	6	19	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A4A2C4	0160-2055	9	130	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C5	0180-1746	9	2	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A4A2C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C9	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A4A2C10	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
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A2C51†	0140-0191	8	1	CAPACITOR-FXD 56PF +-5% 300VDC MICA * FACTORY SELECTED PART	72136	DM15E560J0300HV1CR
A4A2C52	0160-2308	5	1	CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2308
A4A2C53	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C54	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C55	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C56	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C57	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C58	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C59	0160-2204	0	12	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A4A2C60	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2C61†	0160-1743	2	1	CAPACITOR-FXD .1UF+-10% 35VDC TA	56289	150D104X9035A2
A4A2C62	0160-3537	4	2	CAPACITOR-FXD 680PF +-5% 100VDC MICA	28480	0160-3537
A4A2C63	0160-2205	L	3	CAPACITOR-FXD 120PF +-5% 300VDC MICA	28480	0160-2205
A4A2C64	0160-2218	6	2	CAPACITOR-FXD 1800PF +-5% 300VDC MICA	28480	0160-2218
A4A2C65†	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	150D334X9035A2
A4A2C66	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A2CR1†	1902-0041	A	7	DIODE-ZNR 5.11V 5% DO-7 PC=.4W TC=+.04%	28480	1902-0041
A4A2CR2	1901-0040	1	47	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4A2CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4A2CR4	1901-0179	7	6	DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A4A2CR5	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A4A2L1	9100-1629	4	29	COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A4A2L2	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A4A2L3	9100-2200	1	2	COIL-MLD 1.8UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2200
A4A2L4	9140-0129	3	2	COIL-MLD 220UH 5% Q=65 .155DX.375LG-NOM	28480	9140-0129
A4A2L5	9140-0237	2	2	COIL-MLD 300UH 5% Q=65 .155DX.375LG-NOM	28480	9140-0237
A4A2Q1	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A2Q2	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A2Q3	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A2Q4	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A2Q5	1853-0015	7	6	TRANSISTOR PNP SI PD=200MW FT=60MHZ	28480	1853-0015
A4A2Q6	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A2Q7	1853-0020	4	2	TRANSISTOR PNP SI PD=360MW FT=150MHZ	28480	1853-0020
A4A2Q8	1854-0071	7		TRANSISTOR NPN SI PD=360MW FT=200MHZ	28480	1854-0071
A4A2Q9	1854-0071	7		TRANSISTOR NPN SI PD=360MW FT=200MHZ	28480	1854-0071
A4A2Q10	1854-0071	7		TRANSISTOR NPN SI PD=360MW FT=200MHZ	28480	1854-0071
A4A2Q11	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A2R1	0698-3440	7	25	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4A2R2†	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A4A2R3	0757-0442	9	100	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4A2R4	0757-0441	8	11	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4A2R5	0757-0414	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A4A2R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A2R7	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A2R8	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A4A2R9	0757-0438	3	5	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A4A2R10	0698-3156	2	8	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A4A2R11†	0757-1090	5	1	RESISTOR 3k1 1% .5W F TC=0+-100	28480	0757-1090
A4A2R12	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A2R13	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A4A2R14	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A2R15	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A2R16	0698-0082	7	31	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A4A2R17	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-2150-F
A4A2R18	0698-0054	9	12	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4A2R19	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A2R20	0698-3132	4	13	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A4A2R21	0757-0441	A		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4A2R22	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4A2R23	0698-3438	3	10	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4A2R24	0757-0346	2	12	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A2R25	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A2R26	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4A2R27	0757-0418	9	6	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A4A2R28	0698-3156	8	3	RESISTOR 25.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2572-F
A4A2R29	0698-3154	D	15	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A4A2R30	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A4A2R31	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4A2R32	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A2R33	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A2R34	0698-3453	2	1	RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A4A2R35	0698-3260	9	1	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A2R36	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	28480	C4-1/8-T0-5111-F
A4A2R37†	0757-0296	5	6	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A4A2R38	0698-3448	1	20	RESISTOR 316 1% .125W F TC=0+-100	28480	C4-1/8-T0-316R-F
A4A2R39†	0757-0436	3		RESISTOR 5.11K 1% .125W F TC=0+-100	28480	C4-1/8-T0-5111-F
A4A2R40	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	28480	C4-1/8-T0-316R-F
A4A2R41	0757-0288	1	6	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A4A2R42	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	28480	C4-1/8-T0-101-F
A4A2R43†	0757-0420	5	7	RESISTOR 750 1% .125W F TC=0+-100	28480	C4-1/8-T0-751-F
A4A2R44	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	28480	C4-1/8-T0-101-F
A4A2R45	0757-0419	0	1	RESISTOR 681 1% .125W F TC=0+-100	28480	C4-1/8-T0-681R-F
A4A2R46	0757-0280	5		RESISTOR 1K 1% .125W F TC=0+-100	28480	C4-1/8-T0-1001-F
A4A2R47	0698-3446	3	6	RESISTOR 365 1% .125W F TC=0+-100	28480	C4-1/8-T0-365R-F
A4A2R48	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	28480	C4-1/8-T0-1001-F
A4A2U1	1820-0170	8	1	IC GATE TTL H NAND QUAD 2-INP	01295	SN74H00N
				MISCELLANEOUS A4A2.		
	9170-0029	5	3	CORE-SHIELDING BEAD	28480	9170-0029
A4A3	08660-60084	0	1	BOARD ASSY, REF, DIVIDE BY TWO.	28480	08660-60084
A4A3C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C2	0160-2204	0		CAPACITOR-FXD 180PF +-5% 300VDC MICA	28480	0160-2204
A4A3C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C4	0160-2204	0		CAPACITOR-FXD 180PF +-5% 300VDC MICA	28480	0160-2204
A4A3C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C11	0160-0978	1	1	CAPACITOR-FXD 1980PF +-1% 500VDC MICA	28480	0160-0978
A4A3C12	0160-2534	9	1	CAPACITOR-FXD 300PF +-1% 300VDC MICA	28480	0160-2534
A4A3C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C15	0160-2204	0		CAPACITOR-FXD 180PF +-5% 300VDC MICA	28480	0160-2204
A4A3C16	0180-0197	4	1	CAPACITOR-FXD 680PF +-5% 300VDC MICA	72136	DM15F681J0300WVICR
A4A3C17	0160-2204	0		CAPACITOR-FXD 180PF +-5% 300VDC MICA	28480	0160-2204
A4A3C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A3C19	0180-0194	1	1	CAPACITOR-FXD 470PF +-5% 300VDC MICA	72136	DM15F471J0300WVICR
A4A3CR1	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.005%	28480	1902-0041
A4A3L1	9100-0348	2	2	COIL-MLD 1UH 1% Q=50 .1550X.375LG-NOM	28480	9100-0348
A4A3L2	9100-0348	2		COIL-MLD 1UH 1% Q=50 .1550X.375LG-NOM	28480	9100-0348
A4A3Q1	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A3Q2	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A3Q3	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A3Q4	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A3Q5	1854-0345	8	8	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A4A3R1	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A3R2	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A4A3R3	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4A3R4	0757-0814	9	1	RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A4A3R5	0757-0438	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A4A3R6	0757-0420	5		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A4A3R7	0757-0280	5		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A3R8	0698-3684	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4A3R9	0757-0438	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A4A3R10	0698-3453	9	2	RESISTOR 34.8 1% .125W F TC=0+-100	24546	C4-1/8-T0-34R8-F
A4A3R11	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A3R12	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A4A3R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4A3R14	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A4A3R15	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A4A3R16	0698-3429	2	1	RESISTOR 19.6 1% .125W F TC=0+-100	03888	RN55D-1/8-T0-19R6-F
A4A3R17	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A3R18	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A4A3R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4A3R20	0698-3448	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4A3R21	0757-0418	9		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A4A3R22	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A3R23	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A4A3R24	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4A3R25	0757-0197	2	5	RESISTOR 66.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-66R1-F
A4A3R26	0757-0418	9		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A5U1†	1820-0449	6	3	IC FF TTL M J-K NEG-EDGE-TRIG	01295	SN74H102N
A4A4	08660-60081	7	1	BOARD ASSY,REF, VCO	28480	08660-60001
A4A4C1	0160-3456	6	2	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A4A4C2	0121-0451	3	1	CAPACITOR-V TRMR-ATR 1.7-11PF 250V	74970	187-0106-003
A4A4C3	0180-0110	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4A4C4	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A4A4C5	0160-0214	8	1	CAPACITOR-FXD 10PF +-5% 500VDC CER	28480	0160-0214
A4A4C6	0160-2206	4	10	CAPACITOR-FXD 2PF +-5% 500VDC CER 0+-30	28480	0160-2206
A4A4C7	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4A4C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C10†	0160-2306	3	1	CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0160-2306
A4A4C11	0140-0190	7	4	CAPACITOR-FXD 30PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A4A4C12	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A4A4C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C17	0121-0044	2	2	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	30E322 9/35PF N450
A4A4C18	0160-3870	7	3	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3870
A4A4C19	0160-2327	8	4	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-2327
A4A4C20	0140-0190	7		CAPACITOR-FXD 30PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A4A4C21	0140-0190	7		CAPACITOR-FXD 30PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A4A4C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C23	0121-0451	5		CAPACITOR-V TRMR-ATR 1.7-11PF 250V	74970	187-0106-003
A4A4C24	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-2327
A4A4C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C26	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C29	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C31	0121-0451	5		CAPACITOR-V TRMR-ATR 1.7-11PF 250V	74970	187-0106-003
A4A4C32	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-2327
A4A4C33	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C34	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C35	0140-0190	7		CAPACITOR-FXD 30PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A4A4C36	0150-0207	4	1	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0150-0207
A4A4C37	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C38	0160-2205	1		CAPACITOR-FXD 120PF +-5% 300VDC MICA	28480	0160-2205
A4A4C39	0160-2205	1		CAPACITOR-FXD 120PF +-5% 300VDC MICA	28480	0160-2205
A4A4C40	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4A4C41†	0121-0448	9	1	CAPACITOR-V TRMR-CER 2.5-5PF 63V PC-MTG	28480	0121-0448
A4A4CR1	0122-0287	5	1	DIODE-VVC 10PF 5% C2/C20-MIN=2 BVR=20V	28480	0122-0287
A4A4CR2	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=+.05%	28480	1902-0041
A4A4L1	9100-1633	6	1	COIL-MLD 27UH 5% Q=50 .155DX.375LG-NOM	28480	9100-1633
A4A4L2	9100-1629	4		COIL-MLD 4.7UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A4A4L3	9100-1629	4		COIL-MLD 4.7UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A4A4L4	08660-60002	0	1	INDUCTOR	28480	08660-60002
A4A4L5	08660-60009	7	1	INDUCTOR	28480	08660-60009
A4A4L6	9100-2247	4	1	COIL-MLD 180NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A4A4L7	9100-2247	4		COIL-MLD 180NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A4A4L8				PART OF PRINTED CIRCUIT BOARD		
A4A4L9				PART OF PRINTED CIRCUIT BOARD		
A4A4L10	9100-2247	4		COIL-MLD 180NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2247
A4A4L11	9140-0158	6	1	COIL-MLD 1UM 10% Q=52 .095DX.25LG-NOM	28480	9140-0158
A4A4L12†	9100-2254	3	2	COIL-MLD 390NH 10% Q=35 .095DX.25LG-NOM	28480	9100-2254
A4A4Q1	1854-0019	3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A4Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A4A4Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A4A4Q4†	1854-0431	3	1	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	01928	2N5179
A4A4Q5†	1854-0540	5	4	TRANSISTOR NPN SI TO-72 PD=200MW FT=1GHZ	28480	1854-0540
A4A4Q6†	1854-0540	5		TRANSISTOR NPN SI TO-72 PD=200MW FT=1GHZ	28480	1854-0540
A4A4Q7	1854-0431	3		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	01928	2N5179
A4A4Q8	1854-0431	3		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	01928	2N5179
A4A4Q9	1854-0404	0	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A4A4R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A4A4R2	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C8-1/8-T0-101-F
A4A4R3	0757-0416	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C8-1/8-T0-6190-F
A4A4R4	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C8-1/8-T0-51R1-F
A4A4R5	0757-0416	9		RESISTOR 511 1% .125W F TC=0+-100	24546	C8-1/8-T0-511R-F

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A4R6	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A4A4R7	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A4A4R8	0757-0278	4	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A4A4R9	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4A4R10	0698-3153	9	7	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A4A4R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4A4R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4A4R13	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4A4R14	0698-0083	6		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A4A4R15	0757-0422	5	2	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A4A4R16	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-100-F
A4A4R17	0757-1094	9	8	RESISTOR 1.47M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A4A4R18	0698-3454	9		RESISTOR 36.8 1% .125W F TC=0+-100	24546	C4-1/8-T0-36R8-F
A4A4R19	0757-0398	4	3	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A4A4R20	0764-0033	4	1	RESISTOR 33 5% 2W MO TC=0+-200	28480	0764-0033
A4A4R21	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4A4R22	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A4A4R23	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4A4R24	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4A4R25	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A4A4R26	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A4A4R27	0698-3159	1	10	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A4A4R28	0698-3159	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A4A4R29*	0698-7212	8	2	RESISTOR 100 1% .05W F TC=0+-100 *FACTORY SELECTED PART	24546	C3-1/8-T0-100R-G
A4A4R30†	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A4R31†	0757-0422	5		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A4A4R32	0698-7195	7	1	RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-T00-19R6-G
A4A4U1	1820-0714	4	1	IC PRESCR ECL	28480	1820-0714
A4A5	08660-60005	1	1	BOARD ASSY, VCO & AMPLIFIERS	28480	08660-60005
A4A5C1	0160-3878	6	19	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C3	0121-0452	4	2	CAPACITOR-V TRMR-AIR 1.3-5.4PF 250V	74970	187-0101-009
A4A5C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C6	0160-2250	6	2	CAPACITOR-FXD 5.1PF +-.25PF 500VDC CER	28480	0160-2250
A4A5C7	0160-2264	4		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A4A5C8	0160-2264	4		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A4A5C9	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C10	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C11	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C12	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C13	0160-2264	4		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A4A5C14	0160-2264	4		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A4A5C15	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C16	0160-0576	5	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4A5C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C18	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C19	0160-2264	4		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A4A5C20	0160-2264	4		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A4A5C21	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A4A5C23	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5C24	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A5CR1	0122-0248	8	1	DIODE-VVC 1N5140A 18PF 5% CR/C60-MIN=2.5	04713	1N5140A
A4A5CR2	1901-1034	5	1	DIODE-STABISTOR 90V DO-35	03508	HPD400
A4A5FL1	08660-20038	4	1	FILTER, L.P. 600MHZ	28480	08660-20038
A4A5L1				PART OF PRINTED CIRCUIT BOARD		
A4A5L2	9100-2250	9	6	COIL-MLO 180NH 10% Q=30 .050DX.25LG-NOM	28480	9100-2250
A4A5L3	08660-80004	4	4	INDUCTOR	28480	08660-80004
A4A5L4	08660-80004	4		INDUCTOR	28480	08660-80004
A4A5L5	9100-2250	9		COIL-MLO 180NH 10% Q=30 .050DX.25LG-NOM	28480	9100-2250
A4A5L6	9100-2250	9		COIL-MLO 180NH 10% Q=30 .050DX.25LG-NOM	28480	9100-2250
A4A5L7	08660-80004	4		INDUCTOR	28480	08660-80004
A4A5L8	08660-80004	4		INDUCTOR	28480	08660-80004
A4A5L9	9100-2250	9		COIL-MLO 180NH 10% Q=30 .050DX.25LG-NOM	28480	9100-2250
A4A5L10	9140-0143	9	1	COIL-MLO 1.3UH 10% Q=45 .050DX.25LG-NOM	28480	9140-0143
A4A5L11	08660-60004	7		INDUCTOR	28480	08660-60004
A4A5L12	08660-80004	7		INDUCTOR	28480	08660-80004
A4A5L13	9100-2250	9		COIL-MLO 180NH 10% Q=30 .050DX.25LG-NOM	28480	9100-2250
A4A5L14	9100-2250	9		COIL-MLO 180NH 10% Q=30 .050DX.25LG-NOM	28480	9100-2250

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A5Q1	1854-0540	5		TRANSISTOR NPN SI TO-72 PD=200MW FT=1GHZ	28480	1854-0540
A4A5Q2†	1854-0540	5		TRANSISTOR NPN SI TO-72 PD=200MW FT=1GHZ	28480	1854-0540
A4A5Q3	1854-0540	5		TRANSISTOR NPN SI TO-72 PD=200MW FT=1GHZ	28480	1854-0540
A4A5Q4†	1854-0540	5		TRANSISTOR NPN SI TO-72 PD=200MW FT=1GHZ	28480	1854-0540
A4A5Q5	1854-0540	5		TRANSISTOR NPN SI TO-72 PD=200MW FT=1GHZ	28480	1854-0540
A4A5Q6	1854-0540	5		TRANSISTOR NPN SI TO-72 PD=200MW FT=1GHZ	28480	1854-0540
A4A5Q7	1854-0540	5		TRANSISTOR NPN SI TO-72 PD=200MW FT=1GHZ	28480	1854-0540
A4A5R1	0698-8086	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4A5R2	0698-8086	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4A5R3	0757-0240	1		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A5R4	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A4A5R5	0698-7205	0	2	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-G
A4A5R6	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A5R7	0698-7245	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-G
A4A5R8	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A5R9	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A4A5R10	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A4A5R11	0757-0439	0	11	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A4A5R12	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4A5R13	0757-0439	0		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A4A5R14	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4A5R15	0698-3442	9	12	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A4A5R16	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A4A5R17	0698-3428	1	4	RESISTOR 19.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R7-F
A4A5R18	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A4A5R19	0698-3428	1		RESISTOR 19.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R7-F
A4A5R20	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A4A5R21	0757-0439	0		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A4A5R22	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4A5R23	0757-0439	0		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A4A5R24	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4A5R25	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4A5R26	0698-3480	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4A5R27	0698-3428	1		RESISTOR 19.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R7-F
A4A5R28	0698-3446	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A4A5R29	0698-3428	1		RESISTOR 19.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-19R7-F
A4A5R30	0698-3446	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A4A5R31	0757-0439	0		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A4A5R32	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4A5R33	0757-0439	0		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A4A5R34	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4A5R35	0698-3418	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4A5R36	0698-3418	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4A5R37*	0698-3419	4	8	RESISTOR 178 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-178R-F
A4A5R38*	0698-3441	8	20	RESISTOR 215 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-215R-F
A4A5R39*	0698-3433	8	1	RESISTOR 28.7 1% .125W F TC=0+-100 *FACTORY SELECTED PART	03888	PME55-1/8-T0-28R7-F
A4A5R40*	0698-3431	6	1	RESISTOR 23.7 1% .125W F TC=0+-100 *FACTORY SELECTED PART	03888	PME55-1/8-T0-23R7-F
A4A5R41*	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-178R-F
A4A5R42*	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-215R-F
A4A5T1	08660-60003	1	1	TRANSFORMER, ISOLATOR	28480	08660-60003
*4A6	08660-60007	3	1	BOARD ASSY, PRETUNE	28480	08660-60007
A6A6C1	0160-2055	*		CAPACITOR-FXD .03UF +80-20% 100VDC CER	28480	0160-2055
A6A6C2	0180-0183	2	4	CAPACITOR-FXD 10UF+75-10% 50VDC AL	56289	30D106G050CB2
A6A6C3	0180-0183	2		CAPACITOR-FXD 10UF+75-10% 50VDC AL	56289	30D106G050CB2
A6A6C4	0180-0181	2	5	CAPACITOR-FXD 5UF+75-10% 50VDC AL	56289	30D506G050DD2
A6A6C5	0121-0452	4		CAPACITOR-V TRMR-AIR 1.3-5.4PF 250V	74970	187-0183-009
A6A6C6†	0160-2263	1	1	CAPACITOR-FXD 18PF +-5% 500VDC CER 0+-30	28480	0160-2263
A6A6C7	0160-0174	9	15	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A6A6C8	0180-0197	6		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A6A6C9	0160-3878	4		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A6A6C10	0180-0183	2		CAPACITOR-FXD 10UF+75-10% 50VDC AL	56289	30D106G050CB2
A6A6C11†	0160-3537	4		CAPACITOR-FXD 465PF +-5% 100VDC MICA	28480	0160-3537
A6A6CR1	1901-0033	2	2	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0033
A6A6L1	9140-0178	0	1	COIL-MLD 82UH 10% Q=45 .159D,.375LG-NOM	28480	9140-0178
A6A6L2	9100-1843	2	1	COIL-MLD 300UH 5% Q=45 .190D,.406LG-NOM	28480	9100-1843

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A4Q1	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4A4Q2	1853-0007	7	15	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q3	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q4	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q5	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q6	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q7	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q8	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q9	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q10	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q11	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q12	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q13	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A4Q14	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4A4R1†	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A4R2†	2100-3710	1	2	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	28480	2100-3710
A4A4R3†	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A4A4R4††	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A4R5	0757-0402	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4A4R6	0757-0418	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A4A4R7†	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A4R8	0757-1094	4		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A4A4R9	0757-0481	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A4A4R10	0757-0405	4	6	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A4A4R11	0698-3484	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A4A4R12	0757-1094	4		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A4A4R13	2100-3709	8	2	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-3709
A4A4R14	0757-0800	7	21	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A4A4R15	2100-3715	6	5	RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-3715
A4A4R16	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A4A4R17	0757-0428	1	23	RESISTOR 1.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1021-F
A4A4R18†	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A4A4R19*†	0698-3443	0	10	RESISTOR 287 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-287R-F
A4A4R20	2100-3715	6		RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-3715
A4A4R21	0698-3409	8	1	RESISTOR 2.37K 1% .5W F TC=0+-100	28480	0698-3409
A4A4R22	2100-3715	6		RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-3715
A4A4R23	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A4A4R24	0698-3400	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4A4R25	0757-0270	4		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A4A4R26†	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4A4R27	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A4R28†	2100-3714	5	1	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3714
A4A4R29	0757-0836	5	1	RESISTOR 7.5K 1% .5W F TC=0+-100	28480	0757-0836
A4A4R30	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A4A4R31	0698-3481	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A4A4R32	0698-0085	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A4A4R33†	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4A4R34	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A4R35†	2100-3713	4	3	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-3713
A4A4R36	0698-3482	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A4A4R37	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4A4R38†	0698-3481	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A4A4R39†	0757-0440	7	9	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A4A4R40†	2100-3713	4		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-3713
A4A4R41	0698-3152	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A4A4R42	0698-3158	4	4	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A4A4R43†	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A4A4R44†	2100-3713	4		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-3713
A4A4R45	0698-3483	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A4A4R46	0698-0085	0	15	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A4A4R47††	0757-0417	8	2	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A4A4R48†	2100-3712	3	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	28480	2100-3712
A4A4R49	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A4A4R50	0698-3151	7	8	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A4A4R51†	0757-1280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A4R52†	2100-3709	8		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-3709
A4A4R53	0698-3449	7		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A4A4R54	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4A4R55†	0757-0428	1		RESISTOR 1.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1021-F
A4A4R56†	2100-3710	1		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	28480	2100-3710
A4A4R57	0698-3446	1		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A4A4R58	0698-3152	8	2	RESISTOR 2.49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2491-F
A4A4R59†	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C O	Qty	Description	Mfr Code	Mfr Part Number
A4A7R60†	2100-3711	2	1	RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3711
A4A7R61	0757-0447	4	4	RESISTOR 14.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1422-F
A4A7R62	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-2370-F
A4A7R63	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A4A7R64	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4A7R65	0698-7284	5	1	RESISTOR 100K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1003-G
A4A8U1	1820-2042	3	1	IC DCDR TTL BCD 4-TO-10-LINE	01295	SN5442AJ
A4A7	08660-60006	2	1	BOARD ASSY, PHASE DETECTOR	28480	08660-60006
A4A7C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A7C2	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A7C3	0180-2219	4	5	CAPACITOR-FXD 90UF+75-10% 16VDC AL	56289	30D906G016CC2
A4A7C4†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4A7C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A7C6	0180-2219	4		CAPACITOR-FXD 90UF+75-10% 16VDC AL	56289	30D906G016CC2
A4A7C7	0180-0049	9	6	CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A4A7C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4A7C9	0160-0839	3	1	CAPACITOR-FXD 110PF +-1% 300VDC MICA	28480	0160-0839
A4A7C10	0160-3064	2	1	CAPACITOR-FXD 1000PF +-5% 300VDC MICA	28480	0160-3064
A4A7C11	0160-0182	9	2	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-0182
A4A7C12	0160-0182	9		CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-0182
A4A7C13	0160-2250	6		CAPACITOR-FXD 5.1PF +-.25PF 500VDC CER	28480	0160-2250
A4A7C14	0160-2266	4		CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A4A7C15	0180-1705	4	1	CAPACITOR-FXD 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
A4A7C16	0160-2266	0		CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A4A7C17	0160-2264	2	2	CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A4A7C18	0180-0291	3	14	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A4A7C19	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A4A7C20	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A4A7C21	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4A7C22	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A4A7C23	0180-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4A7C24	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A4A7C25	0180-0183	2		CAPACITOR-FXD 10UF+75-10% 50VDC AL	56289	30D106G050CC2
A4A7C26	0160-2266	0		CAPACITOR-FXD 24PF +-5% 500VDC CER 0+-30	28480	0160-2266
A4A7CR1	1901-0184	0	1	DIODE-STEP RCVY 20V 300PS DO-7	28480	1901-0184
A4A7CR2	5080-0271	2	4	DIODE:SILICON MATCHED QUAD	28480	5080-0271
A4A7CR3	5080-0271	2		DIODE:SILICON MATCHED QUAD	28480	5080-0271
A4A7CR4	5080-0271	2		DIODE:SILICON MATCHED QUAD	28480	5080-0271
A4A7CR5	5080-0271	2		DIODE:SILICON MATCHED QUAD	28480	5080-0271
A4A7CR6	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.049%	28480	1902-0041
A4A7CR7	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.049%	28480	1902-0041
A4A7CR8	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.049%	28480	1902-0041
A4A7CR9	1902-0041	4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.049%	28480	1902-0041
A4A7CR10	1901-0033	2		DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A4A7J1	1250-0834	2	1	CONNECTOR-RF BNC M PC 50-OHM	28480	1250-0834
A4A7L1	9140-0144	0		COIL-MLD 0.7UH 10% Q=45 .095DX.25LG-NOM	28480	9140-0144
A4A7L2	9140-0210	1	2	COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A4A7L3	9140-0210	1		COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A4A7L4	9100-2260	1		COIL-MLD 1.8UH 10% Q=32 .095DX.25LG-NOM	28480	9100-2260
A4A7L5	9100-2254	3		COIL-MLD 390NH 10% Q=39 .095DX.25LG-NOM	28480	9100-2254
A4A7L6	08660-80005	3	2	INDUCTOR	28480	08660-80005
A4A7L7	08660-80005	3		INDUCTOR	28480	08660-80005
A4A7Q1	1854-0019	5		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A7Q2	1854-0019	5		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A4A7Q3	1853-0034	0	4	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A4A7Q4	1855-0049	1	3	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
A4A7Q5	1853-0007	7		TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A4A7Q6	1854-0023	9	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A4A7R1	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A4A7R2	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4A7R3	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A7R4	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A4A7R5	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A7R6	0698-3437	2	5	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A4A7R7	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A4A7R8	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A4A7R9	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A4A7R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A4A7R11	0757-0276	7	1	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-61R9-F
A4A7R12	0698-3438	1		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A4A7R13	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A4A7R14	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A4A7R15	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6A7R16	0757-0288	3		RESISTOR 1K 1% .125W F TC=0+-100	2[illegible]	C4-1/8-T0-1001-F
A6A7R17	0757-0288	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6A7R18†	2100-1481	4	2	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A6A7R19†	0757-0394	8		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-[illegible]-F
A6A7R20	0757-0394	8		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6A7R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6A7R22	2100-1756	9		RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A6A7R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6A7R24	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6A7R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6A7R26	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A6A7R27	0757-0394	8		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6A7R28	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6A7R29†	0698-3435	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A6A7R30	0757-0394	8		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6A7R31†	0698-3435	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A6A7R32	0698-3101	7	1	RESISTOR 2.87K 1% .5W F TC=0+-100	28480	0698-3101
A6A7R33	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6A7R34	0757-0394	8		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6A7T1	08660-60011	1	1	TRANSFORMER, TRIFILAR	28480	08660-60011
A6A7T2	08660-60010	0	1	TRANSFORMER, BIFILAR	28480	08660-60010
A6A8†	08660-60325	8	1	100 MHZ SANDFABS FILTER	28480	08660-60325
A6 †	08660-60327	8	1	BOARD ASSY, REGULATOR	28480	08660-60327
A6C1	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C2	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C3	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C4	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C5	0160-2207	3	1	CAPACITOR-FXD 360PF +-5% 300VDC MICA	28480	0160-2207
A6C6	0180-1706	5	7	CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A6C7	0180-0374	1	5	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A6C8	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C9	0160-2208	4	2	CAPACITOR-FXD 330PF +-5% 500VDC MICA	28480	0160-2208
A6C10	0180-1706	5		CAPACITOR-FXD 47uF+-10% 6VDC TA	56289	150D476X9006B2
A6C11†				NOT ASSIGNED		
A6C12†	0160-2226	4	1	CAPACITOR-FXD 2200PF +-5% 100VDC MICA	28480	0160-2226
A6C13	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A6C14	0180-1706	5		CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A6C15	0180-0369	5	2	CAPACITOR-FXD 6UF+50-10% 150VDC AL	56289	30D105G150BA2
A6C16†				NOT ASSIGNED		
A6C17	0160-2212	8		CAPACITOR-FXD 1000PF +-5% 300VDC MICA	28480	0160-2210
A6C18	0160-0269	5		CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G150BA2
A6C19	0160-0058	0	14	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A6CR1†	1902-3104	4	2	DIODE-ZNR 5.62V 5% DO-7 PD=.4W TC=+.016%	28480	1902-3104
A6Q1†	1853-0213	7	5	TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
	1205-0011	0	3	HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
A6Q2	1853-0451	5	17	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A6Q3	1853-0213	7		TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
	1205-0011	0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
A6Q4	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A6Q5	1853-0213	7		TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
	1205-0011	0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
A6Q6†	1853-0326	3	1	TRANSISTOR PNP SI PD=1W FT=50MHZ	28480	1853-0326
A6R1	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A6R2	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A6R3	0698-3132	4		RESISTOR 2K1 1% .125W F TC=0+-100	24546	C4-1/8-T0-2K10-F
A6R4	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A6R5	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A6R6	0757-0198	8		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A6R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R8†	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R9†	0757-0397	3		RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A6R10†	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A6R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R13	0757-0394	8		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6R14	0698-3141	9	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A6R15	0757-0424	7	19	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A6R16	0757-0394	8		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6R17	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A6R18	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A6R19	0698-3136	8	4	RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A6R20	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5R21	2100-1979	4	1	RESISTOR-TRMR 200 10% WW TOP-ADJ 20-TRN	02660	3810P-201
A5R22	0757-0278	4		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A5R23	0698-3152	4		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A5R24	2100-1799	2	1	RESISTOR-TRMR 500 10% WW SIDE-ADJ 20-TRN	02660	3810P-501
A5R25	0757-0428	1		RESISTOR 1.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1021-F
A5R26†	2100-2852	0	1	RESISTOR-TRMR 1K 10% WW SIDE-ADJ 20-TRN	02660	3810P-102
A5R27	0698-3155	1		RESISTOR 6.04K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6041-F
A5R28†	2100-1739	0	1	RESISTOR-TRMR 5K 10% WW SIDE-ADJ 20-TRN	02660	3810P-502
A5R29†	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A5U1	1820-0014	1	1	IC 304 V REGLTR TO-100	04713	MLM2946
A5U2	1820-0004	7	1	IC 304 V REGLTR TO-100	07263	UA304HC
A5U3†	1826-0017	2	1	IC V REGLTR TO-99	27014	LM205H
A5U4	1820-0207	8	1	IC V REGLTR TO-99	27014	LM305H
A6	08660-60270	8	1	ASSEMBLY,FAN(OPTION 003, 400 HZ ONLY)	28480	08660-60270
A6	08660-60275	7	1	ASSEMBLY, FAN(EXCEPT OPTION 003, 60 HZ)	28480	08660-60275
A6A1	08660-60335	8	1	BOARD ASSY, PRE-REGULATOR	28480	08660-60335
A6A1C1	0180-0141	2		CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A6A1C2	0180-0141	2		CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A6A1C3	0180-0089	7	1	CAPACITOR-FXD 100UF+50-10% 150VDC AL	56289	30D108F150DD2
A6A1C4	0150-0121	5	47	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A6A1C5	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A6A1C6	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A6A1C7	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A6A1C8	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A6A1C9	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A6A1C10†	0160-3879	5	2	CAPACITOR-FXD 1UF +-10% 220VAC(RMS) (OPT 003 ONLY)	28480	0160-3879
A6A1CR1†	1902-3243	8	1	DIODE-ZNR 24.9V 2% DO-7 PD=.4W TC=+.081%	28480	1902-3243
A6A1CR2	1902-3203	8	1	DIODE-ZNR 14.7V 5% DO-7 PD=.4W TC=+.057%	28480	1902-3203
A6A1CR3	1902-3333	5	1	DIODE-ZNR 44.8V 5% DO-7 PD=.4W TC=+.083%	28480	1902-3333
A6A1Q1	1854-0072	8	1	TRANSISTOR NPN 2N3054 SI TO-66 PD=25W	01928	2N3054
A6A1Q2	1853-0052	2	1	TRANSISTOR PNP 2N3740 SI TO-66 PD=25W	04713	2N3740
A6A1Q3	1853-0213	7		TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
A6A1Q4	1854-0063	7	2	TRANSISTOR NPN 2N3055 SI TO-3 PD=115W	28480	1854-0063
A6A1Q5	1853-0059	9	1	TRANSISTOR PNP 2N3791 SI TO-3 PD=150W	04713	2N3791
A6A1Q6	1853-0213	7		TRANSISTOR PNP 2N4236 SI TO-5 PD=1W	04713	2N4236
A6A1Q7	1854-0063	7		TRANSISTOR NPN 2N3055 SI TO-3 PD=115W	28480	1854-0063
A6A1Q8	1854-0065	9	1	TRANSISTOR	28480	1854-0065
A6A1Q9	1854-0361	8	1	TRANSISTOR NPN 2N4239 SI TO-5 PD=800MW	04713	2N4239
A6A1Q10	1853-0313	9	1	TRANSISTOR PNP 2N3771 SI TO-3 PD=150W	01928	2N3771
A6A1R1†	0698-3447	4	11	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A6A1R2	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-261R-F
A6A1R3	0757-0274	5	7	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A6A1R4	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A6A1R5	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-261R-F
A6A1R6	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A6A1R7†	0812-0014	4	1	RESISTOR 5 1% 5W PW TC=0+-90	28480	0812-0014
A6A1R8				NOT ASSIGNED		
A6A1R9				NOT ASSIGNED		
A6A1R10†	0812-0020	7	1	RESISTOR .39 5% 5W PW TC=0+-90	91637	CW2B1-5-T2-39/100-J
A6A1R11	0811-1070	3	1	RESISTOR 2.2 5% 2W PW TC=0+-400	75042	BWH2-2R2-J
A6A1XA20=1	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2=ROWS	28480	1251-2035
				MISCELLANEOUS		
	1200-0043	8	1	INSULATOR-NSTR ALUMINUM	28480	1200-0043
	0340-0182	7	1	INSULATOR-NSTR ALUMINUM	28480	0340-0182
	08660-20173	0	1	HEAT SINK	28480	08660-20173
A6A2†	08660-20185	4	1	FAN (OPTION 003 ONLY)	28480	08660-20185
	08660-20184	3	1	FAN (EXCEPT OPTION 003)	28480	08660-20184
				MISCELLANEOUS		
A6A2Z1	3160-0856	9	1	FAN-TBAX 115-CFM 115V 50/60-HZ 1.5-TMP (EXCEPT OPT 003)	28480	3160-0856
A6A2Z1	3160-0867	8	1	FAN-TBAX 95-CFM 95-120V 47-440-HZ (OPT 003 ONLY)	28480	3160-0867
A6A3	08660-60336	1	1	FAN RELAY ASSEMBLY(DOES NOT INCL A6A3C1)	28480	08660-60336
A6A3C1	0160-3879	5		CAPACITOR-FXD 1UF +-10% 220VAC(RMS) (OPTION 003 ONLY)	28480	0160-3879
A6A3K1	0490-0643	6	1	RELAY 1C 24VDC-COIL 2A 220VAC	28480	0490-0643

See introduction to this section for ordering information
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†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4A5R1	0698-3629	4	1	RESISTOR 270 5% 2W MO TC=0+-200	28480	0698-3629
A7†	8960-0443	†	1	POWER LINE MODULE	28480	8960-0443
A7C1†	0160-4065	5	1	CAPACITOR-FXD .1UF +-20% 250VAC(RMS)	28480	0160-4065
A7R1	0837-0004	5	1	THERMISTOR 01BC 10-OHM TC=-3,8%/C-DEG	28480	0837-0004
A8	08660-60014	2	1	BOARD ASSY, N3 OSCILLATOR (EXCEPT OPT 004)	28480	08660-60014
A8C1	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A8C2	0180-1704	5		CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A8C3	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A8C4	0180-0049	9		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A8C5	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A8C6	0160-3459	9	4	CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A8C7	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A8C8	0150-0121			CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A8C9	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A8C10	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A8C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C12	0160-0384	5	15	CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0384
A8C13	0160-2204	0		CAPACITOR-FXD 100PF +-5% 500VDC MICA	28480	0160-2204
A8C14	0160-4084	8	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A8C15				NOT ASSIGNED		
A8C16	0160-0384	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0384
A8C17	0160-0384	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0384
A8C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR3	0122-0299	4	1	DIODE-VVC 82PF 5% C2/C20-4 IN=2 8V@+20V	28480	0122-0299
A8L1	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A8L2	9140-0114	4	10	COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A8L3	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A8L4	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A8L5	08660-80075	5	5	COIL 650NH	28480	08660-80025
A8L6	9140-0179	1	29	COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A8L7	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A8Q1	1854-0092	2	32	TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A8Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A8Q3	1851-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A8Q4	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A8Q5	1851-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A8Q6	1854-0087	5	4	TRANSISTOR NPN SI PD=360MW FT=75MHZ	28480	1854-0087
A8Q7	1855-0081	1	5	TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A8Q8†	1853-0036	2	54	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q9†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q10†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q11†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q12	1854-0087	5		TRANSISTOR NPN SI PD=360MW FT=75MHZ	28480	1854-0087
A8R1				NOT ASSIGNED		
A8R2	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A8R3	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A8R4	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A8R5	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A8R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R10	0757-0479	2	5	RESISTOR 392K 1% .125W F TC=0+-100	19701	MFMC1/8-T0-3923-F
A8R11	0757-0472	5	9	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A8R12	0757-0465	6	5	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A8R13	0698-3228	9	5	RESISTOR 82.9K 1% .125W F TC=0+-100	28480	0698-3228
A8R14				NOT ASSIGNED		
A8R15	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A8R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R17	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A8R18*†	0698-3157	1	4	RESISTOR 19.6K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1962-F
A8R19	0757-0280	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8R20	0757-0199	3	1	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A8R21	0698-0695	5		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A8R22	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A8R23	0698-4037	0	1	RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A8R24	2100-1760	7	4	RESISTOR-TRMR 5K 5% NM SIDE-ADJ 1-TRN	28480	2100-1760
A8R25†	0698-4002	9	1	RESISTOR 5M 1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A8R26	2100-1758	4	5	RESISTOR-TRMR 2K 5% NM SIDE-ADJ 1-TRN	28480	2100-1758
A8R27	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A8R28	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A8W29				NOT ASSIGNED		
A8R30	0698-3154	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A8R31	0757-0481	6		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A8R32	0751-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A8R33	0698-4082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A8R34	0757-0403	0	2	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A8R35	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A8R36	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R37				NOT ASSIGNED		
A8R38	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R39	0683-8245	9	5	RESISTOR 820M 5% .25W FC TC=-800/+900	01121	CB8205
A8R40	0698-3243	8	11	RESISTOR 178M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A8R41	0757-0442	9		RESISTOR 10M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R42	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A8R43	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A8R44	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A8R45	0698-3150	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A8R46	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A8R47	0757-0403	2	4	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A8R48	0698-3446	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A8R49	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A8R50	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
A8U1	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A8U2	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A8U3†	1820-0751	9	0	IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN74196N
A9	08660-60045	9	1	CABLE ASSY, LOOP BOX	28480	08660-60045
	08660-20175	2	1	SUPPORT, P.C. BOARD	28480	08660-20175
A9W1	8120-1618	8	1	CABLE-FL-RBN 28AWG 28-CNDCT GRA-JKT	28480	8120-1618
A9A1	08660-60037	0	1	BOARD ASSY, DIGITAL PROGRAM	28480	08660-60037
A9A1E1	0360-1636	4	1	CABLE TRANSITION 36-TERM INSUL DSPL TYPE	28480	0360-1636
A9A1R1	0698-7210	7	28	RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R2	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R3	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R4	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R5	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R6	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R7	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R8	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R9	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R10	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R11	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R12	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R13	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R14	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R15	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R16	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R17	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R18	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R19	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R20	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R21	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R22	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R23	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R24	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R25	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R26	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R27	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A9A1R28	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-D
A10	08660-60013	1	1	BOARD ASSY, N5 PHASE DETECTOR (EXCEPT OPT 004)	28480	08660-60013

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10C1	0160-2055	P		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C2	0160-2055	P		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C3	0180-0058	0		CAPACITOR-FXD 56UF+75-10% 20VDC AL	56289	300586025CC2
A10C4	0160-2204	4	3	CAPACITOR-FXD 68UF+-10% 6VDC TA	56289	150D686X9006A2
A10C5	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A10C6	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A10C7	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A10C8	0140-0157	8	5	CAPACITOR-FXD 6700PF +-10% 200VDC POLYE	28480	0160-0157
A10C9	0160-2055	P		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C10	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A10C11	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A10C12	0160-2055	P		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C13	0140-0172	9	2	CAPACITOR-FXD 300PF +-1% 100VDC MICA	72136	DM15F302F0100WV1CR
A10C14	0180-0224	7		CAPACITOR-FXD 35UF+-10% 10VDC TA	56289	150D356X9010B2
A10C15	0160-2055	P		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C16	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A10C17	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A10C18	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A10C19	0160-2055	P		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C20	0160-2055	P		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C21	0160-2055	P		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C22	0160-1539	A	3	CAPACITOR-FXD 820PF +-5% 100VDC MICA	28480	0160-1539
A10C23	0160-2453	L	2	CAPACITOR-FXD .22UF +-10% 80VDC POLYE	28480	0160-2453
A10C24	0170-0040	9	2	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A10CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR3	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PB DO-7	28480	1901-0179
A10CR4	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PB DO-7	28480	1901-0179
A10L1	9100-1629	A		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A10L2	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A10L3	9100-1629	A		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A10L4	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A10L5	9100-1650	1	2	COIL-MLD 680UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1650
A10L6	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A10L7	9100-1652	3	3	COIL-MLD 820UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1652
A10Q1	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A10Q2	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A10Q3	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A10Q4	1855-0049	1		TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
A10Q5	1854-0049	9		TRANSISTOR NPN SI TO-18 PD=500MW	28480	1854-0049
A10Q6	1853-0015	*		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A10Q7	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A10R1	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A10R2	0757-0289	2	5	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MFMC1/8-T0-1332-F
A10R3	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A10R4	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A10R5	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R6	0698-3486	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A10R7	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A10R8	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R11	0698-3490	4	4	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A10R12	0757-0447	A		RESISTOR 14.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1422-F
A10R13	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A10R14	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R15	0757-0421	6		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-8250-F
A10R16	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A10R17	0698-3430	9	3	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A10R18	0698-3447	A		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A10R19	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R20	0757-0421	6		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-8250-F
A10R21	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R22	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R23	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A10R24	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A10R25	0757-0394	J		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A10R26	0757-0394	J		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A10R27	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R28	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R30	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A10R31	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A10R32	0757-0438	3		RESISTOR 2.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2111-F
A10R33	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A10R34	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A10R35	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-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
A10R36	0757-0288	1		RESISTOR 1M 1% .125W F TC=0+-100	28480	C4-1/8-T0-1004-F
A10T1	08660-80001	9	3	TRANSFORMER, SAMPLER	28480	08660-80001
A10U1	1820-1215	8	6	IC FF TTL LS J-K NEG-EDGE-TRIG PRESET	01295	SN74LS113AN
A10U2	1820-1215	8		IC FF TTL LS J-K NEG-EDGE-TRIG PRESET	01295	SN74LS113AN
A10U3	1820-1203	8	4	IC GATE TTL LS AND TPL 3-INP		SN74LS11N
A10U4†	1820-0791	9		IC CNTR TTL DECO NEG-EDGE-TRIG PRESET	01295	SN7490AN
A10U5 †	1820-0791	9		IC CNTR TTL DECO NEG-EDGE-TRIG PRESET	01295	SN7490AN
A10U6†	1820-0751	9		IC CNTR TTL DECO NEG-EDGE-TRIG PRESET	01295	SN7490AN
A10U7	1820-0454	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A11	08660-60019	7	1	BOARD ASSY, SL2 OSCILLATOR (EXCEPT OPT 004)	28480	08660-60019*
A11	08660-20040	0		BOARD ASSY, N2 LOOP-SL1 LOOP COUPLER (OPT 004 ONLY)	28480	08660-20040
A11C1	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A11C2	6180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A11C3	0180-1709	5		CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A11C4	0180-2219	4		CAPACITOR-FXD 90UF+75-10% 16VDC AL	56289	300D906G016CC2
A11C5	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C6	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A11C7	0180-0049	8		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A11C8	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A11C9	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A11C10	0180-2210	0	2	CAPACITOR-FXD 2UF+50-10% 150VDC AL	56289	30D205F150BB2
A11C11	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A11C12	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A11C13	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C14	0160-0386	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0386
A11C15	0170-0082	9	3	CAPACITOR-FXD .01UF +-20% 50VDC POLYE	09411	4801PE10350R5M1
A11C16	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C17	0121-0059	7	4	CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304324 2/8PF NPO
A11C18	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A11C19	0160-0386	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0386
A11C20	0160-0386	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0386
A11C21	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C22	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C23	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C24	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C25	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A11C26	0180-2707	5	5	CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010B2
A11C27	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A11C28	0160-2228	8	1	CAPACITOR-FXD 2700PF +-5% 300VDC MICA	28480	0160-2228
A11CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR13†	0122-0264	8	4	DIODE-VVC 1N5148A 47PF 5% CW/C40-MIN=3.2	04713	1N5148A
A11CR14 †	0122-0262	6	4	DIODE-VVC 1N5147A 39PF 5% CW/C40-MIN=3.2	04713	1N5147A
A11CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A11CR16	1901-0518	8	2	DIODE-SCHOTTKY	28480	1901-0518
A11L1	9100-1629	8		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A11L2	9140-0114	6		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A11L3	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A11L4	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A11L5	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A11L6	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A11L7	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A11L8	08660-80025	5		COIL 65NM	28480	08660-80025
A11L9	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A11L10	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A11L11	9140-0129	1		COIL-MLD 220UH 5% Q=45 .155DX.375LG-NOM	28480	9140-0129
A11L12	9100-0368	6	1	COIL-MLD 330NH 10% Q=28 .095DX.25LG-NOM	28480	9100-0368
A11Q1	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A11Q2	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A11Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A11Q4	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A11Q5	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11Q6	1854-0087	5		TRANSISTOR NPN SI PD=360MW FT=75MHZ	28480	1854-0087
A11Q7†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q8†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q9†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q10†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q11†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q12†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q13†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q14†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q15	1853-0451	5		TRANSISTOR PNP 2N5799 SI TO-18 PD=360MW	01295	2N3799
A11Q16†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q17†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q18†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q19†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11Q20†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A11R1	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A11R2	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A11R3	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A11R4	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A11R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A11R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A11R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A11R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A11R9	0757-0879	2		RESISTOR 392K 1% .125W F TC=0+-100	19701	MF4C1/8-TO-3923-F
A11R10	0757-0472	5		RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2003-F
A11R11	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A11R12	0698-3228	9		RESISTOR 49.9K 1% .125W F TC=0+-100	28480	0698-3228
A11R13	0757-0279	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1211-F
A11R14	0757-0460	1	2	RESISTOR 41.2K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4122-F
A11R15	2100-1760	7		RESISTOR-TRMR 5K 5% WW SIDE-ADJ 1-TRN	28480	2100-1760
A11R16	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1472-F
A11R17	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A11R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A11R19	2100-1759	4		RESISTOR-TRMR 2K 5% WW SIDE-ADJ 1-TRN	28480	2100-1759
A11R20	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-TO-6811-F
A11R21	0757-0280	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5621-F
A11R22	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A11R23	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-TO-196R-F
A11R24	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4221-F
A11R25	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A11R26	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A11R27	0757-0458	7	4	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5112-F
A11R28	0757-0461	2	4	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-6812-F
A11R29	0757-0464	5	4	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-TO-9092-F
A11R30	0757-0467	8	4	RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1213-F
A11R31	0757-0444	7		RESISTOR 1.10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1103-F
A11R32	0698-3241	6		RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1783-F
A11R33	0698-3241	6		RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1783-F
A11R34	0698-3248	5	A	RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2373-F
A11R35	0698-3248	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2373-F
A11R36	0698-3459	8	4	RESISTOR 383K 1% .125W F TC=0+-100	28480	0698-3459
A11R37	0698-3162	0	5	RESISTOR 46.0K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4602-F
A11R38	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4641-F
A11R39	2100-2574	3	4	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
A11R40	0698-3155	1		RESISTOR 8.64K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4641-F
A11R41	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A11R42	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A11R43	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-TO-237R-F
A11R44	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-TO-133R-F
A11R45	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-TO-162R-F
A11R46	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-TO-178R-F
A11R47	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-TO-196R-F
A11R48	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-TO-2610-F
A11R49	0698-3441	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-TO-287R-F
A11R50	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-TO-348R-F
A11R51	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-TO-422R-F
A11R52	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-TO-4640-F
A11R53	0757-0317	7	4	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1331-F
A11R54	2100-2574	3		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
A11R55	0698-3258	5	2	RESISTOR 5.36K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5361-F
A11R56	0698-3152	6		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-TO-2610-F
A11R57	0757-0834	3	4	RESISTOR 5.62K 1% .5W F TC=0+-100	28480	0757-0834
A11R58	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A11R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A11R60	2100-2653	5	4	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	30983	ET50X102

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
A11R41	0757-0290	5		RESISTOR 4.19K 1% .125W F TC=0+-100	19701	MFBC1/8-T0-4191-F
A11R42	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A11R43	0698-0083	6		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A11R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R45	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A11R46	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R47	2100-2933	5		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	30983	ET50X102
A11R48	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A11R49	0757-0449	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A11R70	0698-0083	6		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A11R71	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R72	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A11R73	2100-2921	0	4	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	30983	ET50X202
A11R74	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MFBC1/8-T0-9091-F
A11R75	0698-0083	6		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A11R76	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R77	2100-2521	0		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	30983	ET50X202
A11R78	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A11R79	0698-0083	6		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A11R80	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R81	0683-8245	9		RESISTOR 820K 5% .25W FC TC=-400/+900	01121	CB8245
A11R82	0698-3243	8		RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A11R83	2100-2849	9	2	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	30983	ET50X502
A11R84	0698-3134	8		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1782-F
A11R85	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A11R86	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A11R87	0698-0083	6		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A11R88	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R89	0757-0200	7		RESISTOR 9.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9021-F
A11R90	2100-2522	1	2	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	30983	ET50X103
A11R91	0757-0125	3	2	RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0125
A11R92	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A11R93	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A11R94	0698-3446	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A11R95	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A11R96	0757-0402	1	1	RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A11R97	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MFBC1/8-T0-9091-F
A11R98	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A11R99	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-8250-F
A11R100	0757-0395	1	1	RESISTOR 56.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-56R2-F
A11R101	0698-3438	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A11R102	0698-3446	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A11R103	0698-3438	3		RESISTOR 187 1% .125W F TC=0+-100	24546	C4-1/8-T0-187R-F
A11R104	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A11R105	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R106	0698-3441	4		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A11R107	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11U1	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A11U2	1820-0218	9	2	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN74424N
A11U3	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A12	08660-60018	6	1	BOARD ASSY, RL2 DETECTOR (EXCEPT OPT 004)	28480	08660-60018
A12	08660-28040	0		BOARD ASSY, N2 LOOP-RLI LOOP COUPLER (OPT 004 ONLY)	28480	08660-28040
A12C1	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A12C2	0180-2207	5		CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010B2
A12C3	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A12C4	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A12C5	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A12C6	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A12C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C8	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A12C9	0160-0301	4	5	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A12C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C11	0160-0301	4		CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A12C12	0160-2261	9	4	CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A12C13	0160-2261	9		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0160-2261
A12C14	0160-0174	9		CAPACITOR-FXD .1UF +80-20% 25VDC CER	28480	0160-0174
A12C15	0180-2141	8	1	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A12C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C17	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A12C18	0160-0299	9	2	CAPACITOR-FXD 1800PF +-10% 200VDC POLYE	28480	0160-0299
A12C19	0160-0910	4	1	CAPACITOR-FXD 430PF +-5% 300VDC MICA	28480	0160-0910
A12C20	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174

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
A12C21	0160-0299	7		CAPACITOR-FXD 1600PF +-10% 200VDC POLYE	28480	0160-0299
A12C22	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A12C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A12C24	0160-3534	1	1	CAPACITOR-FXD 510PF +-5% 300VDC MICA	28480	0160-3534
A12C25	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A12E1	0960-2073	7	2	HYBRID,200 MHZ	28480	0960-2073
A12L1	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9100-0179
A12L2	9140-0116	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0116
A12L3	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A12L4	9100-1021	6	2	COIL-MLD 18UH 10% Q=75 .155DX.375LG-NOM	28480	9100-1021
A12L5	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A12L6	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A12L7	9100-1658	9	1	COIL-MLD 1.0MH 5% Q=65 .215DX.56LG-NOM	28480	9100-1658
A12Q1	1853-0015	7		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A12Q2	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A12Q3	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A12Q4	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A12Q5	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A12Q6	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A12Q7	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A12Q8†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A12Q9†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A12Q10†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A12Q11†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A12Q12	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A12R1	0757-0399	5	0	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A12R2	0757-0400	6	3	RESISTOR 90.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-90R9-F
A12R3	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A12R4	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A12R5	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A12R6	0698-3449	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A12R7	0757-0418	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A12R8	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A12R9	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A12R10	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A12R11	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A12R12	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A12R13	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A12R14				NOT ASSIGNED		
A12R15	0757-0289	4	2	RESISTOR 17.8 1% .125W F TC=0+-100	19701	MF4C1/8-T0-17R8-F
A12R16	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R18	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A12R19	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R20	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A12R21	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A12R22	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A12R23	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A12R24	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A12R25	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A12R26	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A12R27	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R30	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A12R31	0683-3955	8	2	RESISTOR 3.9M 5% .25W FC TC=+900/+1100	01121	CB3955
A12R32	0683-2055	7	2	RESISTOR 2M 5% .25W FC TC=+800/+1100	01121	CB2055
A12R33	0683-1055	5	2	RESISTOR 1M 5% .25W FC TC=+800/+900	01121	CB1055
A12R34	0698-3263	2	2	RESISTOR 900K 1% .125W F TC=0+-100	28480	0698-3263
A12R35	0757-0280	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A12R36	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A12R37	2100-2833	5		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	30983	67W-1-102
A12R38	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A12R39	0698-3150	8		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A12R40	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A12R41	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A12R42	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R43	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A12R44	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A12R45	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A12R46	0698-0089	4		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A12R47	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R48	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A12R49	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A12R50	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
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A12R51	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	28546	C4-1/8-T0-1001-F
A12U1	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A12U2	1820-0077	2	2	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A12U3	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A12U4	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A12U5	1820-0068	1	2	IC GATE TTL NAND TPL 3-INP	01295	SN7410N
A12U6	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A12U7	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A12U8	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A12U9†	1820-0791	9		IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN7490N
A13	08660-60012	9	1	BOARD ASSY, A2 OSCILLATOR	28480	08660-60012
A13C1	0180-0058	0		CAPACITOR-FXD 500UF+75-10% 25VDC AL	56289	30D506G025CC2
A13C2	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A13C3	0180-0049	9		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A13C4	0180-2207	5		CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010B2
A13C5	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A13C6	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A13C7	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A13C8	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A13C9				NOT ASSIGNED		
A13C10	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A13C11	0180-0118	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A13C12	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A13C13	0180-2210	9		CAPACITOR-FXD 2UF+50-10% 150VDC AL	56289	30D205F150BB2
A13C14	0180-0174	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A13C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C16	0160-0384	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0384
A13C17	0160-2204	3		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A13C18	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A13C19	0121-0059	7		CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	380[illegible] 2/8PF NPO
A13C20				NOT ASSIGNED		
A13C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C22	0160-0384	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0384
A13C23	0160-0384	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0384
A13C24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C26	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A13C28	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A13C29	0160-0161	6	1	CAPACITOR-FXD .033UF +-10% 200VDC POLYE	28480	0160-0161
A13CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR2				NOT ASSIGNED		
A13CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR8	0122-0264	8		DIODE-VVC 1N5148A 47PF 5% C4/C60=MIN=3.2	04713	1N5148A
A13CR9	0122-0262	6		DIODE-VVC 1N5147A 39PF 5% C4/C60=MIN=3.2	04713	1N5147A
A13CR10				NOT ASSIGNED		
A13CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A13L1	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A13L2	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A13L3	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A13L4	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A13L5	08660-80025	5		COIL 630NH	28480	08660-80025
A13L6	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A13L7	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A13L8	9100-1674	9	1	COIL-MLD 7.5MH 5% Q=60 .240X.74LG-NOM	28480	9100-1674
A13Q1	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A13Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A13Q3	1853-0491	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A13Q4	1854-0087	5		TRANSISTOR NPN SI PD=360MW FT=75MHZ	28480	1854-0087
A13Q5†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A13Q6†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A13Q7†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A13Q8	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A13Q9	1854-0087	5		TRANSISTOR NPN SI PD=360MW FT=75MHZ	28480	1854-0087

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13Q11	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A13Q12	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
*A13Q13†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
*A13Q14†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
*A13Q15†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
*A13Q16†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A13R1	0757-0428	1		RESISTOR 1.62M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A13R2	0757-0428	1		RESISTOR 1.62M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A13R3	0757-0428	1		RESISTOR 1.62M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A13R4	0757-0428	1		RESISTOR 1.62M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A13R5	0757-0428	1		RESISTOR 1.62M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A13R6	0757-0428	1		RESISTOR 1.62M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A13R7	0757-0428	1		RESISTOR 1.62M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
*A13R8†	0757-0428	1		RESISTOR 1.62M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A13R9†	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R15	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R17	0757-0479	2		RESISTOR 392M 1% .125W F TC=0+-100	19701	MFAC1/8-T0-3923-F
A13R18	0757-0472	5		RESISTOR 200M 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A13R19	0757-0465	6		RESISTOR 100M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1005-F
A13R20	0698-3220	9		RESISTOR 49.9M 1% .125W F TC=0+-100	28480	0698-3220
A13R21	0757-0124	4	2	RESISTOR 39.2M 1% .125W F TC=0+-100	28480	0757-0124
A13R22	0757-0442	9	2	RESISTOR 20M 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A13R23	0757-0442	9		RESISTOR 10M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R24	0698-4002	9		RESISTOR 5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A13R25	0757-0442	9		RESISTOR 10M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R26	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A13R27	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A13R28	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A13R29	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A13R30	0757-0439	4		RESISTOR 8.81K 1% .125W F TC=0+-100	19701	MFAC1/8-T0-8811-F
A13R31	0698-3162	0		RESISTOR 46.4M 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A13R32	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A13R33	0698-0085	0		RESISTOR 2.61M 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A13R34	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A13R35	0698-4037	0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A13R36	0698-3438	2		RESISTOR 14.7M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A13R37	2100-1759	4		RESISTOR-TRMR 2K 5% NM SIDE-ADJ 1-TRN	28480	2100-1759
A13R38				NOT ASSIGNED		
A13R39	2100-1760	7		RESISTOR-TRMR 5K 5% NM SIDE-ADJ 1-TRN	28480	2100-1760
A13R40	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A13R41	0757-0279	0		RESISTOR 3.16M 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A13R42	0757-0317	7		RESISTOR 1.33M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A13R43	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A13R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R45	0757-0834	3		RESISTOR 5.42M 1% .5W F TC=0+-100	28480	0757-0834
A13R46	0698-3459	8		RESISTOR 301K 1% .125W F TC=0+-100	28480	0698-3459
A13R47	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A13R48	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A13R49	0698-3260	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A13R50	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A13R51				NOT ASSIGNED		
A13R52	0757-0443	0		RESISTOR 11M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A13R53	0698-3260	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A13R54	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-3480-F
A13R55	0698-3243	8		RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A13R56	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A13R57	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A13R58	0698-3243	8		RESISTOR 178M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A13R59	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A13R60*	0757-0466	7	4	RESISTOR 118M 1% .125W F TC=0+-100 *FACTORY SELECTED PART	24546	C4-1/8-T0-1183-F
A13R61	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-1960-F
A13R62	0683-8205	8		RESISTOR 820M 5% .25W FC TC=+800/+900	01121	CB8245
A13R63	0698-3243	8		RESISTOR 178M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A13R64	0757-0442	9		RESISTOR 10M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A13R65	0757-0447	8		RESISTOR 121M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A13R66	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A13R67	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A13R68	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A13R69	0757-0444	5		RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A13R70	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A13R71†	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A13R72	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A13R73	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A13R74	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A13R75	0698-3441	8		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A13R76	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A13R77	0698-3440	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-3160-F
A13R78	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A13R79	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A13R80	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A13R81	0698-3402	0		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A13R82	0757-0400	9		RESISTOR 90.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-90R9-F
A13R83†	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100 (EXCEPT OPTION 004)	24546	C4-1/8-T0-147R-F
A13R84	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A13R85	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A13U1	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A13U2	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A13U3	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A14	08660-60011	9	1	BOARD ASSY, N2 PHASE DETECTOR (EXCEPT OPT 004)	28480	08660-60011
A14C1	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C2				NOT ASSIGNED		
A14C3	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A14C4	0180-2204	4		CAPACITOR-FXD 60UF+-10% 6VDC TA	56289	150D606X9002B2
A14C5	0180-0228	4		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A14C6	0150-0121	3		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C7	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010D2
A14C8	0150-0121	3		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C9	0160-0157	3		CAPACITOR-FXD 470PF +-10% 200VDC POLYE	28480	0160-0157
A14C10	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C11	0150-0121	3		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C12	0150-0121	3		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C13	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C14	0140-0172	5		CAPACITOR-FXD 3000PF +-1% 100VDC MICA	72136	DM19F302F0100MV1CR
A14C15	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C16	0150-0121	3		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C17	0150-0121	3		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C18	0150-0121	3		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C19	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C20	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C21	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C22	0160-3539	8		CAPACITOR-FXD 820PF +-5% 100VDC MICA	28480	0160-3539
A14C23	0160-2453	1		CAPACITOR-FXD .22UF +-10% 50VDC POLYE	28480	0160-2453
A14C24	0170-0040	9		CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A14C25	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A14C26	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A14CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A14CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A14CR3	1901-1066	3	2	DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-1066
A14CR4	1901-1066	3		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-1066
A14L1	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NON	28480	9100-1629
A14L2	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NON	28480	9140-0114
A14L3	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NON	28480	9100-1629
A14L4	9100-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NON	28480	9140-0179
A14L5	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NON	28480	9140-0114
A14L6	9100-1614	7	2	COIL-MLD 820NH 10% Q=50 .155DX.375LG-NON	28480	9100-1614
A14L7	9100-1650	1		COIL-MLD 680UH 5% Q=40 .190X.445LG-NON	28480	9100-1650
A14L8	9100-1652	3		COIL-MLD 820UH 5% Q=40 .190X.445LG-NON	28480	9100-1652
A14Q1	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A14Q2	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A14Q3	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A14Q4	1855-0049	1		TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
A14Q5	1854-0045	3		TRANSISTOR NPN SI TO-18 PD=500MW	28480	1854-0045
A14Q6	1853-0015	7		TRANSISTOR PNP SI PD=200MW FT=50MHZ	28480	1853-0015
A14Q7	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A14R1	0757-0389	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A14R2	0698-0082	7		RESISTOR 499 1% .125W F TC=0+-100	24546	C4-1/8-T0-4990-F
A14R3	0757-0439	4		RESISTOR 4.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4811-F
A14R4	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A14R5	0757-0419	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
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1aR6	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1aR7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1aR8	0698-5446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A1aR9	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A1aR10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1aR11	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A1aR12	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1aR13	0698-3450	4		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A1aR14	0757-0447	4		RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A1aR15	0698-3438	5		RESISTOR 21.5 1% .125W F TC=0+-100	01000	RNC55-1/8-T0-21R5-F
A1aR16	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A1aR17	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A1aR18	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A1aR19	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1aR20	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1aR21	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A1aR22	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A1aR23	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MFAC1/8-T0-6191-F
A1aR24	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A1aR25	0757-0390	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1aR26	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1aR27	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1aR28	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1aR29	0757-0208	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A1aR30	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A1aR31	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1aR32	0757-0440	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A1aR33	0757-0440	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A1aR34	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A1aR35	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A1aR36	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1aT1	08660-80001	9		TRANSFORMER, SAMPLER	28480	08660-80001
A1aU1	1820-1213	8		IC FF TTL LS J-K NEG-EDGE-TRIG PRESET	01295	SN74LS113AN
A1aU2	1820-1203	4		IC GATE TTL LS AND TPL 3-INP	04713	SN74LS11N
A1aU3	1820-0448	6		IC FF TTL H J-K NEG-EDGE-TRIG	01295	SN74H102N
A1aU4†	1820-1213	8		IC FF TTL LS J-K NEG-EDGE-TRIG PRESET	01295	SN74LS113AN
A1aU5†	1820-0751	9		IC CNTR TTL DECO NEG-EDGE-TRIG PRESET	14324	SN74196N
A1aU6†	1820-0751	9		IC CNTR TTL DECO NEG-EDGE-TRIG PRESET	14324	SN74196N
A1aU7†	1820-0751	9		IC CNTR TTL DECO NEG-EDGE-TRIG PRESET	14324	SN74196N
A1aU8	1820-0054	3		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14	08660-60039	1	1	BOARD ASSY, N2A PHASE DETECTOR (OPT 004 ONLY)	28480	08660-60039
A14C1	0160-2055	9	6	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C2	0180-0058	6	1	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A14C3	0180-2204	8	1	CAPACITOR-FXD 68UF+-10% 6VDC TA	56289	150D686X9006A2
A14C4	0180-0229	6	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015A2
A14C5	0150-0121	5	7	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C7	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C8	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C9	0140-0157	8	1	CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0140-0157
A14C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C11	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C12	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C13	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C15	0140-0172	5	1	CAPACITOR-FXD 3000PF +-1% 100VDC MICA	72136	DM19F302F0100WV1CR
A14C16	0180-0224	7	2	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A14C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C18	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A14C19	0180-0374	3	1	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	196D106X9020B2
A14C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14C22	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A14C23	0160-1539	6	1	CAPACITOR-FXD 820PF +-5% 100VDC MICA	28480	0160-1539
A14C24	0160-2053	1	1	CAPACITOR-FXD .22UF +-10% 60VDC POLYE	28480	0160-2053
A14C25	0170-0040	9	1	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A14C26	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A14CR1	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A14CR2	1901-0179	7	1	DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A14CR3	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A14CR4	1901-0179	7		DIODE-SWITCHING 15V 50MA 750PS DO-7	28480	1901-0179
A14L1	9100-1629	4	2	COIL-MLD 47UH 5% Q=55 .1590X.375LG-NOM	28480	9100-1629
A14L2	9140-0114	4	2	COIL-MLD 10UH 10% Q=55 .1990X.375LG-NOM	28480	9140-0114
A14L3	9100-1629	4		COIL-MLD 47UH 5% Q=55 .1590X.375LG-NOM	28480	9100-1629
A14L4	9100-1650	1	1	COIL-MLD 680UH 5% Q=40 .190X.44LG-NOM	28480	9100-1650
A14L5	9100-1652	3	1	COIL-MLD 820UH 5% Q=40 .190X.44LG-NOM	28480	9100-1652
A14L6	9140-0114	4		COIL-MLD 10UH 10% Q=55 .1590X.375LG-NOM	28480	9140-0114
A14Q1	1853-0034	0	3	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A14Q2	1854-0210	8	2	TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A14Q3	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A14Q4	1853-0015	7	1	TRANSISTOR PNP SI PD=300MW FT=500MHZ	28480	1853-0015
A14Q5	1854-0210	8		TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A14Q6	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A14Q7	1855-0049	1	1	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0049
A14R1	0757-0442	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A14R2	0757-0421	4	8	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-8250-F
A14R3	0757-0280	3	9	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R5	0757-0442	7	3	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R6	0698-3440	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-3830-F
A14R7	0698-0082	7	1	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A14R8	0757-0289	2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MFBC1/8-T0-1332-F
A14R9	0757-0439	6	1	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A14R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A14R11	0757-0442	7		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R12	0757-0420	7	4	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A14R13	0757-0416	7	4	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-5110-F
A14R14	0757-0420	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A14R15	0698-3438	5	1	RESISTOR 21.5 1% .125W F TC=0+-100	03888	MME55-1/8-T0-21R5-F
A14R16	0757-0420	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A14R17	0698-3450	9	1	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A14R18	0757-0467	4	1	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A14R19	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-8250-F
A14R20	0698-3447	4	1	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-4220-F
A14R21	0757-0279	0	3	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R22	0698-3155	1	2	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A14R23	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MFBC1/8-T0-6191-F
A14R24	0757-0279	9		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R25	0757-0279	9		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-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
A14R26	0698-3150	8	1	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A14R27	0757-1098	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A14R28	0757-0398	0	2	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A14R29	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A14R30	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A14R31	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A14R32	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A14R33	0757-0200	7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A14R34	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A14R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A14R36	0757-0440	1	2	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A14R37	0757-0420	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A14R38	0757-0440	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A14R39	0698-0083	0	1	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A14R40	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A14R41	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A14T1	08660-60001	4	1	TRANSFORMER, SAMPLER	28480	08660-60001
A14U1	1820-1213	0	2	IC FF TTL LS J-K NEG-EDGE-TRIG PRESET	01295	SN74LS113AN
A14U2	1820-1213	0		IC FF TTL LS J-K NEG-EDGE-TRIG PRESET	01295	SN74LS113AN
A14U3	1820-1205	8		IC GATE TTL LS AND TPL 3-INP	04713	SN74LS11N
A14U4	1820-0751	4	3	IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN7419AN
A14U5	1820-0751	4		IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN7419AN
A14U6	1820-0751	4		IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN7419AN
A14U7	1820-0374	2	1	IC GATE TTL H AND DUAL 4-INP	01295	SN74H21N

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
A15	08660-60016	M	1	BOARD ASSY, BLI DETECTOR	28480	08660-60016
A15C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A15C2	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A15C3	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A15C4	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A15C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A15C6	0180-3456	4		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0140-2456
A15C7	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	300D506G025CC2
A15C8	0180-2287	9		CAPACITOR-FXD 100UF+-10% 10VDC TA	56289	150D107X9010M2
A15C9	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	300D506G025CC2
A15C10	0160-2261	4		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0140-2261
A15C11	0160-2261	4		CAPACITOR-FXD 15PF +-5% 500VDC CER 0+-30	28480	0140-2261
A15C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A15C13†	0160-2204	0		CAPACITOR-FXD 180PF +-5% 300VDC MICA	28480	0160-2204
A15C14	0160-2055	4		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A15C15	0160-0298	4	2	CAPACITOR-FXD 1500PF +-10% 200VDC POLYE	28480	0160-0298
A15C16	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A15C17	0160-0298	8		CAPACITOR-FXD 1500PF +-10% 200VDC POLYE	28480	0160-0298
A15C18	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A15C19	0180-0291	1		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A15C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A15C21	0160-2208	4		CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A15C22	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A15L1	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A15L2	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A15L3	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A15L4	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A15L5				NOT ASSIGNED		
A15L6	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A15L7	9100-1659	0	1	COIL-MLD 1.6MH 5% Q=55 .215DX.56LG-NOM	28480	9100-1659
A15L8	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A15Q1	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A15Q2	1853-0015	7		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A15Q3	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A15Q4	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A15Q5	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A15Q6	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A15R1	0698-3154	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A15R2	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A15R3	0757-0379	1	1	RESISTOR 12.1 1% .125W F TC=0+-100	19701	MFBC1/8-T0-12R1-F
A15R4				NOT ASSIGNED		
A15R5	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R7	0757-0421	0		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A15R8	0757-0421	0		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A15R9	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A15R10	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A15R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R12	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A15R13	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A15R14	2100-2433	5		RESISTOR-TRMR 1K 10% C BIDE-ADJ I-TRN	10401	ET50X102
A15R15	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A15R16	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A15R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R18	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A15R19	0757-0280	3		RESISTOR 1M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R20	0757-0424	7		RESISTOR 1.1M 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A15R21	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A15R22	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A15R23	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A15R24	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A15R25	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A15R26†	0698-7234	7	1	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-C
A15R27	0757-0419	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A15U1	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A15U2	1820-0077	2		IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A15U3	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A15U4	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A15U5†	1820-0751	9		IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN74196N

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A6U6†	1820-0751	F		IC CNTR TTL DECO NEG-EDGE-TRIG PRESET	01295	SN74176N
A1A6U7	1820-0060	L		IC GATE TTL NAND TPL 3-INP	01295	SN7410N
A1A6U8	1820-0054	S		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U9	1820-0054	S		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U10	1820-0054	S		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6	08660-60089	S	1	BOARD ASSY: N1 PHASE DETECTOR	28480	08660-60089
A1A6C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A6C2	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A1A6C3	0180-2204	4		CAPACITOR-FXD 68UF+-10% 6VDC TA	56289	150D686X9006B2
A1A6C4	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A1A6C5	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1A6C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A6C7	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1A6C8	0160-0297	7		CAPACITOR-FXD 1200PF +-10% 200VDC POLYE	28480	0160-0297
A1A6C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A6C10	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1A6C11	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1A6C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A6C13	0160-0937	2	1	CAPACITOR-FXD 1000PF +-2% 300VDC MICA	28480	0160-0937
A1A6C14	0160-3459	7		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A1A6C15	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1A6C16	0160-0167	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A6C18	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1A6C19	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A1A6C20	0160-2053	7		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A6C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1A6C22	0160-3539	6		CAPACITOR-FXD 820PF +-5% 100VDC MICA	28480	0160-3539
A1A6C23	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1A6C24	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A6C25	0160-3459	9		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3459
A1A6C26	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1A6C27	0160-0134	1	2	CAPACITOR-FXD 220PF +-5% 300VDC MICA	28480	0160-0134
A1A6C28	0160-0134	1		CAPACITOR-FXD 220PF +-5% 300VDC MICA	28480	0160-0134
A1A6C29	0160-0302	5	1	CAPACITOR-FXD .018UF +-10% 200VDC POLYE	28480	0160-0302
A1A6C30	0160-0945	2	2	CAPACITOR-FXD 910PF +-5% 100VDC MICA	28480	0160-0945
A1A6C31	0140-0200	0	1	CAPACITOR-FXD 390PF +-5% 300VDC MICA	72136	DM15F391J0300WVICR
A1A6CR1	1902-3104	6		DIODE-ZNR 5.62V 5% DO-7 PD=.4W TC=(.016%	28480	1902-3104
A1A6CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6CR4	1901-0179	7		DIODE-SWITCHING 15V 50MA 75OPS DO-7	28480	1901-0179
A1A6CR5	1901-0179	7		DIODE-SWITCHING 15V 50MA 75OPS DO-7	28480	1901-0179
A1A6CR6	1902-0025	4	1	DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A1A6L1	9100-1629	9		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A1A6L2	9140-0118	9		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0118
A1A6L3	9100-1629	9		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A1A6L4	9100-1614	7		COIL-MLD 820NH 10% Q=50 .155DX.375LG-NOM	28480	9100-1614
A1A6L5†	9100-2566	8	2	COIL-MLD 150UH 10% Q=55 .156DX.375LG-NOM	28480	9100-2566
A1A6L6†	9100-2566	8		COIL-MLD 150UH 10% Q=55 .156DX.375LG-NOM	28480	9100-2566
A1A6Q1	1853-0034	9		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A1A6Q2	1853-0034	9		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A1A6Q3	1855-0082	2	1	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0082
A1A6Q4	1854-0092	2		TRANSISTOR NPN SI PD=700MW FT=600MHZ	28480	1854-0092
A1A6Q5	1853-0015	7		TRANSISTOR PNP SI PD=360MW FT=500MHZ	28480	1853-0015
A1A6Q6	1854-0085	5		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0085
A1A6R1	0698-3155	1		RESISTOR 6.04K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6041-F
A1A6R2	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-8250-F
A1A6R3	0698-3155	1		RESISTOR 6.04K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6041-F
A1A6R4	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1A6R5	0757-1092	7	1	RESISTOR 287 1% .5W F TC=0+-100	28480	0757-1092
A1A6R6	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A1A6R7	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A1A6R8	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A6R9	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1A6R10	0698-6085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1A6R11	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A6R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A6R13	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A1A6R14	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A1A6R15	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
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A16R16	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A16R17	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A16R18	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A16R19	0757-0447	4		RESISTOR 14.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1422-F
A16R20	0698-3430	5		RESISTOR 2.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-2R5-F
A16R21	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A16R22	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A16R23	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A16R24	0757-0279	8		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A16R25	0698-3153	4		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A16R26	0757-0279	8		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A16R27	0757-0279	8		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A16R28	0698-0084	8		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A16R29	0757-0280	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A16R30	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A16R31	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A16R32	0757-0280	1		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R33	0698-3142	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A16R34	0698-3450	9		RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A16R35	0757-0420	1		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A16R36	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A16R37	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MFF1/8-T0-1332-F
A16R38	2100-1760	7		RESISTOR-TRMR 5K 5E WW SIDE-ADJ 1-TRN	28480	2100-1760
A16R39	0757-0280	1		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R40	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A16R41	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A16R42	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A16R43	0698-3158	4		RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A16R44	0757-0390	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A16R45	0757-0420	1		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A16R46	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A16R47	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A16T1	08660-80001	9		TRANSFORMER, SAMPLER	28480	08660-80001
A16TP1	0360-0124	3	8	CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ PND	28480	0360-0124
A16TP2	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ PND	28480	0360-0124
A16TP3	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ PND	28480	0360-0124
A16TP4	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ PND	28480	0360-0124
A16TP5	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ PND	28480	0360-0124
A16TP6	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ PND	28480	0360-0124
A16TP7	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ PND	28480	0360-0124
A16TP8	0360-0124	3		CONNECTOR-SGL CONT PIN ,04-IN-BSC-SZ PND	28480	0360-0124
A16U1	1820-0058	4	1	IC TYP OP AMP TO-99	24046	TOA 2709Y
A16U2	1820-1213	8		IC FF TTL LS J-K NEG-EDGE-TRIG PRESET	01295	SN74LS113AN
A16U3	1820-1213	8		IC FF TTL LS J-K NEG-EDGE-TRIG PRESET	01295	SN74LS113AN
A16U4	1820-0860	6		IC FF TTL N J-K NEG-EDGE-TRIG	01295	SN74H102N
A16U5†	1820-0751	9		IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN74196N
A16U6†	1820-0751	9		IC CNTR TTL DECD NEG-EDGE-TRIG PRESET	01295	SN74196N
A16U7	1820-1203	0		IC GATE TTL LS AND TPL 3-INP	04713	SN74LS11N
				MISCELLANEOUS A16.		
	08660-20155	8	1	SHIELD, INDUCTOR	28480	08660-20155
A17	08660-60010	8	1	BOARD ASSY, N1 OSCILLATOR	28480	08660-60010
A17C1	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A17C2	0180-2215	5	1	CAPACITOR-FXD 170UF+75-10% 15VDC AL	56289	30D177G015DD2
A17C3	0180-0049	9		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A17C4	0180-1704	5		CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006A2
A17C5	0150-0121	9		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A17C6	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A17C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C8	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A17C9	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A17C10	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A17C11	0180-0141	2		CAPACITOR-FXD 10UF+75-10% 50VDC AL	56289	30D106G050CB2
A17C12	0180-0374	3		CAPACITOR-FXD 1UF+-10% 20VDC TA	56289	150D105X9020B2
A17C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C14	0160-3047	1	1	CAPACITOR-FXD 3260PF +-1% 100VDC MICA	28480	0160-3047
A17C15	0160-0384	9		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0384
A17C16†	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C17	0121-0059	7		CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304328 2/8PF NPO
A17C18	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A17C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C20	0160-0301	4		CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A17C21	0160-3892	6	1	CAPACITOR-FXD 3600PF +-1% 300VDC MICA	28480	0160-3892
A17C22				NOT ASSIGNED		
A17C23	0160-0388	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0388
A17C24	0160-0388	5		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0160-0388
A17C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C26	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C29	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C31	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C32	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A17C33	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C34	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C35	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C36	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C37	0160-0162	5	1	CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A17C38	0140-0210	2	1	CAPACITOR-FXD 270PF +-5% 300VDC MICA	72136	DM15F271J0300WV1CR
A17C39	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR6†	0122-0764	8		DIODE-VVC 1N5148A 47PF 5% C4/C60-MIN=3.2	04713	1N5148A
A17CR7†	0122-0767	4		DIODE-VVC 1N5147A 39PF 5% C4/C60-MIN=3.2	04713	1N5147A
A17CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR17	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17L1	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A17L2	9100-2562	8	2	COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	28480	9100-2562
A17L3	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A17L4	9100-1629	4		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A17L5	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A17L6	08660-80025	3		COIL 550NH	28480	08660-80025
A17L7	9100-1652	3		COIL-MLD 820UH 5% Q=40 .190DX.40LG-NOM	28480	9100-1652
A17L8	9100-2566	0	1	COIL-MLD 270UH 10% Q=55 .156DX.375LG-NOM	28480	9100-2566
A17L9	9100-2568	2	1	COIL-MLD 390UH 10% Q=40 .156DX.375LG-NOM	28480	9100-2568
A17Q1	1854-0042	2		TRANSISTOR NPN SI PD=200MW FT=400MHZ	28480	1854-0042
A17Q2	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A17Q3	1854-0385	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A17Q4	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A17Q5	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A17Q6	1854-0087	5		TRANSISTOR NPN SI PD=360MW FT=675MHZ	28480	1854-0087
A17Q7	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A17Q8	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=400MHZ	28480	1854-0092
A17Q9	1854-0087	5		TRANSISTOR NPN SI PD=360MW FT=675MHZ	28480	1854-0087
A17Q10	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=400MHZ	28480	1854-0092
A17Q11†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q12†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q13†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q14†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q15	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=400MHZ	28480	1854-0092
A17Q16†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q17†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q18†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q19†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17R1	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1621-F
A17R2	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1621-F
A17R3	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1621-F
A17R4	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1621-F
A17R5	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1621-F
A17R6	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1621-F
A17R7	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1621-F
A17R8	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1621-F
A17R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1002-F
A17R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	CC=1/8-TO-1002-F

See introduction to this section for ordering information
*Indicates factory selected value
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A17R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A17R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A17R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A17R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A17R15	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A17R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A17R17	0757-0479	2		RESISTOR 348K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-3483-F
A17R18	0757-0472	5		RESISTOR 200K 1% .125W F TC=0+-100	24546	C8-1/8-T0-2003-F
A17R19	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1003-F
A17R20	0698-3228	9		RESISTOR 48.9K 1% .125W F TC=0+-100	28480	0698-3228
A17R21	0757-0124	6		RESISTOR 39.2K 1% .125W F TC=0+-100	28480	0757-0124
A17R22	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C8-1/8-T0-2002-F
A17R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A17R24	0698-4002	9		RESISTOR 5K 1% .125W F TC=0+-100	24546	C8-1/8-T0-5001-F
A17R25	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A17R26	0698-3441	B		RESISTOR 215 1% .125W F TC=0+-100	24546	C8-1/8-T0-2150-F
A17R27	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C8-1/8-T0-2611-F
A17R28	2100-1760	7		RESISTOR-TRMR 5K 5% WW SIDE-ADJ 1-TRN	28480	2100-1760
A17R29	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A17R30	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A17R31	2100-1759	4		RESISTOR-TRMR 2K 5% WW SIDE-ADJ 1-TRN	28480	2100-1759
A17R32	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A17R33	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C8-1/8-T0-5621-F
A17R34	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C8-1/8-T0-2152-F
A17R35	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C8-1/8-T0-2611-F
A17R36	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C8-1/8-T0-8250-F
A17R37	0698-4037	0		RESISTOR 44.4 1% .125W F TC=0+-100	24546	C8-1/8-T0-44R4-F
A17R38	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A17R39	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C8-1/8-T0-4641-F
A17R40	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A17R41	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C8-1/8-T0-3161-F
A17R42	0757-0838	3		RESISTOR 5.42K 1% .5W F TC=0+-100	28480	0757-0838
A17R43	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A17R44	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C8-1/8-T0-2152-F
A17R45	0757-0402	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1002-F
A17R46	0698-3401	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C8-1/8-T0-2150-F
A17R47	0698-3459	8		RESISTOR 383K 1% .125W F TC=0+-100	28480	0698-3459
A17R48	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C8-1/8-T0-4640-F
A17R49	0757-0835	4	1	RESISTOR 6.81K 1% .5W F TC=0+-100	28480	0757-0835
A17R50	0698-3266	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C8-1/8-T0-2373-F
A17R51	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A17R52	0698-3447	8		RESISTOR 422 1% .125W F TC=0+-100	24546	C8-1/8-T0-422R-F
A17R53	0698-3266	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C8-1/8-T0-2373-F
A17R54	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C8-1/8-T0-348R-F
A17R55	0698-3243	B		RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A17R56	0698-3443	D		RESISTOR 267 1% .125W F TC=0+-100	24546	C8-1/8-T0-267R-F
A17R57	0698-3243	B		RESISTOR 178K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1783-F
A17R58	0698-3132	0		RESISTOR 261 1% .125W F TC=0+-100	24546	C8-1/8-T0-2610-F
A17R59	0757-0466	7		RESISTOR 110K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1103-F
A17R60	0683-8285	9		RESISTOR 8200 5% .25W FC TC=-800/+900	01121	CB8245
A17R61	0698-3243	B		RESISTOR 178K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1783-F
A17R62	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C8-1/8-T0-196R-F
A17R63	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C8-1/8-T0-196R-F
A17R64	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C8-1/8-T0-4640-F
A17R65	0757-0467	8		RESISTOR 121K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1213-F
A17R66	0698-3439	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C8-1/8-T0-178R-F
A17R67	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C8-1/8-T0-5621-F
A17R68	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C8-1/8-T0-4221-F
A17R69	0757-0444	5		RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C8-1/8-T0-9092-F
A17R70	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C8-1/8-T0-348R-F
A17R71	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C8-1/8-T0-162R-F
A17R72	0757-0461	2		RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C8-1/8-T0-6812-F
A17R73	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C8-1/8-T0-121R-F
A17R74	0698-3440	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C8-1/8-T0-316R-F
A17R75	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C8-1/8-T0-133R-F
A17R76	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C8-1/8-T0-5112-F
A17R77	0698-3402	6		RESISTOR 237 1% .125W F TC=0+-100	24546	C8-1/8-T0-237R-F
A17R78	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C8-1/8-T0-101-F
A17R79	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C8-1/8-T0-5621-F
A17R80	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1001-F
A17R81	0698-3150	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C8-1/8-T0-4221-F
A17R82	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C8-1/8-T0-101-F
A17R83	0698-3132	0		RESISTOR 261 1% .125W F TC=0+-100	24546	C8-1/8-T0-2610-F
A17R84	0698-3446	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C8-1/8-T0-316R-F
A17R85	0698-3446	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C8-1/8-T0-316R-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
A1TP86	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A1TP87	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1TP88	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1TP89	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1TP90	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A1TP91	0698-3433	8		RESISTOR 20.7 1% .125W F TC=0+-100	01686	RNES5-1/8-T0-20R7-F
A1TP92	0698-3432	7	1	RESISTOR 20.1 1% .125W F TC=0+-100	01686	RNES5-1/8-T0-20R1-F
A1TP93	0698-3433	8		RESISTOR 20.7 1% .125W F TC=0+-100	01686	RNES5-1/8-T0-20R7-F
A1TP94	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1TP95	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A1TP96	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1TP97	0698-3153	9		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A1TP98	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1TP99	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1U1	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1U2	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A	08660-60015	3	1	BOARD ASSY, SLL MIXER	28480	08660-60015
A1BC1	0160-1704	5		CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A1BC2				NOT ASSIGNED		
A1BC3	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1BC4				NOT ASSIGNED		
A1BC5	0140-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0140-0174
A1BC6				NOT ASSIGNED		
A1BC7	0160-2055	0		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC8	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1BC9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC10	0160-0301	8		CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A1BC11	0160-0301	8		CAPACITOR-FXD .012UF +-10% 200VDC POLYE	28480	0160-0301
A1BC12	0140-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0140-0174
A1BC13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC15	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1BC16	0180-2214	4		CAPACITOR-FXD 90UF+75-10% 16VDC AL	56289	30D906G016CC2
A1BC17	0160-2327	8		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-2327
A1BC18				NOT ASSIGNED		
A1BC19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC20	0180-0141	2		CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A1BC21	0180-1819	3	1	CAPACITOR-FXD 100UF+75-10% 50VDC AL	56289	30D107G050DM2
A1BC22	0180-0141	2		CAPACITOR-FXD 50UF+75-10% 50VDC AL	56289	30D506G050DD2
A1BCR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR2	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A1BE1	0960-2073	7		MIXER,200 MHZ	28480	0960-2073
A1BL1	9100-1629	4		COIL-MLD 87UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A1BL2	9140-0114	4		COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A1BL3	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A1BL4	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A1BL5	9100-1621	6		COIL-MLD 18UH 10% Q=75 .155DX.375LG-NOM	28480	9100-1621
A1BL6	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A1BQ1	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A1BQ2	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A1BQ3	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A1BQ4	1854-0087	5		TRANSISTOR NPN SI PD=360MW FT=175MHZ	28480	1854-0087
A1BQ5†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ6†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ7†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ8†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ9†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ10†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ11†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ12†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ13†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ14	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A1BQ15	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A1BQ16†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ17†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ18	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A1BQ19†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ20†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ21†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ22†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ23†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1BQ24†	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C O	Qty	Description	Mfr Code	Mfr Part Number
A1BR1	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR2	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR3	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR4	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR5	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR6	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR7	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR8	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR9	0757-0	4		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR10	075	4		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR15	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR17	0757-0479	2		RESISTOR 392K 1% .125W F TC=0+-100	19701	MF4C1/8-TO-3923-F
A1BR18	0757-0472	5		RESISTOR 200K 1% .125W F TC=0+-100	24546	C8-1/8-TO-2003-F
A1BR19	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1003-F
A1BR20	0698-3228	9		RESISTOR 99.9K 1% .125W F TC=0+-100	28480	0698-3228
A1BR21	0683-3955	6		RESISTOR 3.9M 5% .25W FC TC=+900/+1100	01121	CB3955
A1BR22	0683-2055	7		RESISTOR 2M 5% .25W FC TC=+900/+1100	01121	CB2055
A1BR23	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A1BR24	0698-3243	2		RESISTOR 909K 1% .125W F TC=0+-100	28480	0698-3243
A1BR25	0698-0083	8		RESISTOR 1.96M 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR26	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR27	0757-0280	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C8-1/8-TO-5621-F
A1BR28	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C8-1/8-TO-4221-F
A1BR29	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C8-1/8-TO-196R-F
A1BR30	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C8-1/8-TO-4221-F
A1BR31	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C8-1/8-TO-316R-F
A1BR32	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C8-1/8-TO-316R-F
A1BR33	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR35	2100-2578	3		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
A1BR36	0698-3155	1		RESISTOR 6.04K 1% .125W F TC=0+-100	24546	C8-1/8-TO-6041-F
A1BR37	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C8-1/8-TO-4640-F
A1BR38	0698-0083	8		RESISTOR 1.96M 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR39	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR40	2100-2574	3		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
A1BR41	0698-3258	5		RESISTOR 9.36K 1% .125W F TC=0+-100	24546	C8-1/8-TO-9361-F
A1BR42	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR43	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR44	2100-2633	5		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	30983	ET50X102
A1BR45	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-TO-6191-F
A1BR46	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A1BR47	0757-0409	9		RESISTOR 90.9 1% .125W F TC=0+-100	24546	C8-1/8-TO-90R9-F
A1BR48	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A1BR49	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR50	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR51	2100-2633	5		RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	30983	ET50X102
A1BR52	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C8-1/8-TO-7501-F
A1BR53	0698-0083	8		RESISTOR 1.96M 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR55	2100-2521	0		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	30983	ET50X202
A1BR56	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-TO-9091-F
A1BR57	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C8-1/8-TO-51R1-F
A1BR58	0698-3151	7		RESISTOR 2.87M 1% .125W F TC=0+-100	24546	C8-1/8-TO-2871-F
A1BR59	0698-3151	7		RESISTOR 2.87M 1% .125W F TC=0+-100	24546	C8-1/8-TO-2871-F
A1BR60	0698-0083	8		RESISTOR 1.96M 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR61	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR62	2100-2521	0		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	30983	ET50X202
A1BR63	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1212-F
A1BR64	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C8-1/8-TO-348R-F
A1BR65	0757-0414	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C8-1/8-TO-511R-F
A1BR66	0698-0083	8		RESISTOR 1.96M 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A1BR67	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A1BR68	2100-2868	9		RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	30983	ET50X502
A1BR69	0698-3136	5		RESISTOR 17.8K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1782-F
A1BR70	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-TO-8251-F
A1BR71	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C8-1/8-TO-3161-F
A1BR72	0698-0083	8		RESISTOR 1.96M 1% .125W F TC=0+-100	24546	C8-1/8-TO-1961-F
A1BR73	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C8-1/8-TO-1002-F
A1BR74	2100-2522	1		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	30983	ET50X103
A1BR75	0757-0123	3		RESISTOR 1a.8K 1% .125W F TC=0+-100	28480	0757-0123

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
A1BR76	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1BR77	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1BR78	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1BR79	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A1BR80	0757-0288	1		RESISTOR 4.89K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-4891-F
A1BR81	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1BR82	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1BR83	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1BR84	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A1BR85	0698-3401	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1BR86	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1BR87	0757-0401	8		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1BU1	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1BU2	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1BU3	1820-0214	9		IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN7442AN
A1A	08660-60017	5	1	BOARD ASSY, BLI OSCILLATOR	28480	08660-60017
A1BC1	0180-0049	9		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A1BC2	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A1BC3†	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1BC4	0180-0226	4		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A1BC5	0140-0945	2		CAPACITOR-FXD 910PF +-5% 100VDC MICA	28480	0140-0945
A1BC6†	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A1BC7	0180-2214	4		CAPACITOR-FXD 60UF+75-10% 16VDC AL	56289	300D606G016CC2
A1BC8	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A1BC9	0160-3059	8		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3055
A1BC10	0160-0161	4	2	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A1BC11	0160-2220	0	1	CAPACITOR-FXD 1200PF +-5% 300VDC MICA	28480	0160-2220
A1BC12	0160-0161	4		CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A1BC13	0160-0386	5		CAPACITOR-FXD 3.1PF +-.25PF 500VDC CER	28480	0160-0386
A1BC14†	0170-0062	9		CAPACITOR-FXD .01UF +-20% 50VDC POLYE	84411	663PE103M5W1
A1BC15	0160-0049	4		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	30D206G050CC2
A1BC16	0160-0163	2		CAPACITOR-FXD 10UF+75-10% 50VDC AL	56289	30D106G050CB2
A1BC17†	0170-0062	9		CAPACITOR-FXD .01UF +-20% 50VDC POLYE	84411	663PE103M5W1
A1BC18	0121-0059	7		CAPACITOR-V TRMR-CER 2-8PF 150V PC-MTG	52763	30432* 2/8PF NPO
A1BC19	0160-2204	0		CAPACITOR-FXD 180PF +-5% 300VDC MICA	28480	0160-2204
A1BC20	0160-0386	5		CAPACITOR-FXD 3.1PF +-.25PF 500VDC CER	28480	0160-0386
A1BC21	0160-0386	5		CAPACITOR-FXD 3.1PF +-.25PF 500VDC CER	28480	0160-0386
A1BC22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC26	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC29	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC31	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC32	0140-0195	2	1	CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM19F131J0300WV1CR
A1BC33	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1BC34	0160-2202	8	1	CAPACITOR-FXD 750PF +-5% 300VDC MICA	28480	0160-2202
A1BC35	0160-2200	6	1	CAPACITOR-FXD 82PF +-5% 300VDC MICA	28480	0160-2200
A1BC36	0160-0729	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1BC37	0160-0157	8		CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A1BC38	0160-0164	7	1	CAPACITOR-FXD .033UF +-10% 200VDC POLYE	28480	0160-0164
A1BC39	0160-2204	0		CAPACITOR-FXD 180PF +-5% 300VDC MICA	28480	0160-2204
A1BCR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR12†	0122-0264	8		DIODE-VVC 1N5148A 47PF 5% C4/C40-MIN=3.2	04713	1N5148A
A1BCR13†	0122-0262	6		DIODE-VVC 1N5147A 30PF 5% C4/C40-MIN=3.2	04713	1N5147A
A1BCR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1BCR16	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A19L1	9100-1629	6		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A19L2	9100-2562	6		COIL-MLD 100UH 10% Q=50 .156DX.375LG-NOM	28480	9100-2562
A19L3	9100-1629	6		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A19L4	9100-1629	6		COIL-MLD 47UH 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A19L5	9100-2572	8	1	COIL-MLD 820UH 10% Q=40 .156DX.375LG-NOM	28480	9100-2572
A19L6	08660-80825	5		COIL 650NH	28480	08660-80825
A19L7	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A19L8	9140-0179	1		COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A19L9	9100-1611	6	2	COIL-MLD 220NH 20% Q=50 .155DX.375LG-NOM	28480	9100-1611
A19L10	9100-1611	4		COIL-MLD 220NH 20% Q=50 .155DX.375LG-NOM	28480	9100-1611
A19Q1	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A19Q2	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A19Q3	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A19Q4	1859-0061	1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A19Q5	1850-0345	6		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A19Q6	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A19Q7	1853-0451	5		TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW	01295	2N3799
A19Q8	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A19Q9	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A19Q10	1854-0022	8	1	TRANSISTOR NPN SI TO-39 PD=700MW	07263	2N706A
A19R1	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R2	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A19R3	2100-1760	7		RESISTOR-TRMR 5K 5% HW SIDE-ADJ 1-TRN	28480	2100-1760
A19R4	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A19R5	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A19R6	0757-0460	3		RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A19R7				NOT ASSIGNED		
A19R8	0757-0441	2		RESISTOR 80.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8012-F
A19R9	2100-1759	4		RESISTOR-TRMR 2K 5% HW SIDE-ADJ 1-TRN	28480	2100-1759
A19R10	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A19R11	0757-0280	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A19R12	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A19R13	0757-0442	5		RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A19R14	0757-0402	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A19R15	0698-3430	4		RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A19R16	0757-0467	8		RESISTOR 121K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A19R17	0698-3430	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A19R18	0757-0466	7		RESISTOR 110K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1103-F
A19R19	0757-0834	3		RESISTOR 5.62K 1% .5W F TC=0+-100	28480	0757-0834
A19R20	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R21	0698-3243	8		RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A19R22	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A19R23	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A19R24	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A19R25	0698-3243	8		RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A19R26	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A19R27	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A19R28	0698-3260	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A19R29	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A19R30	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A19R31	0698-3264	5		RESISTOR 237K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2373-F
A19R32	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A19R33	0757-0446	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A19R34	0698-3459	8		RESISTOR 383K 1% .125W F TC=0+-100	28480	0698-3459
A19R35	0698-3162	0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4642-F
A19R36	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A19R37	0757-0288	1		RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A19R38	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A19R39	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A19R40	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A19R41	0683-8245	9		RESISTOR 820K 5% .25W FC TC=-800/+900	01121	CB8265
A19R42	0698-3243	8		RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A19R43	0698-3446	5		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A19R44	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A19R45	0757-0280	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A19R46	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A19R47	0698-3441	6		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A19R48	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A19R49	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A19R50	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A19R51	0757-0280	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A19R52	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A19R53	0757-0280	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A19R54	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A19R55*†	0757-0194	8	1	RESISTOR 1.33M 1% .5W F TC=0+-100	28480	0757-0194
				*FACTORY SELECTED PART		

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A19R56	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A19R57	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A19R58	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A19R59	0698-3442	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A19R60	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A19R61	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A19R62	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A19R63	0757-0180	2	1	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A19R64	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A19R65	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A19R66	0757-0294	9		RESISTOR 17.8 1% .125W F TC=0+-100	19701	MF4C1/8-T0-17R8-F
A19R67	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A19R68	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A19R69	0757-0279	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A19R70	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A19R71	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A19R72	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A20†	08660-60335	0	1	COMPLETE RECTIFIER ASSEMBLY (INCLUDES CR2 AND CR3)	28480	08660-60335
A20	08660-60364	5	1	RECTIFIER BOARD ASSEMBLY (INCLUDES ALL A20 PARTS EXCEPT C1,C2,C3,C4,K1,W2 & MISC. PART NOT PERMANENTLY ATTACHED TO THE CIRCUIT BOARD)	28480	08660-60364
A20C1	0180-2530	7	1	CAPACITOR-FXD 3900UF+75-10% 50VDC AL	56289	30D392G050CZB
A20C2	0180-2397	4	1	CAPACITOR-FXD .018F+75-10% 25VDC AL	56289	3A018G025A3B
A20C3	0180-2389	0	1	CAPACITOR-FXD 3400UF+75-10% 40VDC AL	00853	3003A2U040B2B
A20C4	0180-2484	2	2	CAPACITOR-FXD 470UF+-20% 50VDC TA	56001	69F3E*1E3
A20C5	0180-2484	2		CAPACITOR-FXD 470UF+-20% 50VDC TA	56001	69F3E*1E3
A20C6	0180-2334	9	1	CAPACITOR-FXD 3900UF+75-10% 75VDC AL	56289	30D392F075BQB
A20C7	0180-2154	1	1	CAPACITOR-FXD 1900UF+75-10% 15VDC AL	56289	3A019G015AL4
A20C8	0180-0058	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	3A050G025CC2
A20C9	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A20C10	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A20C11	0180-0049	9		CAPACITOR-FXD 20UF+75-10% 50VDC AL	56289	3A020G050CC3
A20CR1	1901-0638	3	5	DIODE-PN BRDG 100V 4A	04713	MDA-970-2
A20CR2				NOT ASSIGNED		
A20CR3	1901-0638	3		DIODE-PN BRDG 100V 4A	04713	MDA-970-2
A20CR4	1901-0638	3		DIODE-PN BRDG 100V 4A	04713	MDA-970-2
	1251-2772	1	2	CONNECTOR-SGL CONT BRT .052-IN-BSC-BE	28480	1251-2772
A20CR5	1901-0638	3		DIODE-PN BRDG 100V 4A	04713	MDA-970-2
A20CR6	1901-0638	3		DIODE-PN BRDG 100V 4A	04713	MDA-970-2
	1251-2772	1		CONNECTOR-SGL CONT BRT .052-IN-BSC-BE	28480	1251-2772
A20CR7	1884-0024	3	1	THYRISTOR-SCR VRRM=200	28480	1884-0024
A20CR8†	1901-0050	3	1	DIODE-SWITCHING 60V 200MA 2NS DO-35	28480	1901-0050
A20F1†	2110-0521	9	8	FUSE 10A 32V NORM-BLO 1.25X.25	75915	311010
A20F2†	2110-0269	0	2	FUSEHOLDER-CLIP TYPE.250-FUSE	28480	2110-0269
A20F3†	2110-0523	9		FUSE 10A 32V NORM-BLO 1.25X.25	75915	311010
A20F4†	2110-0523	9		FUSE 10A 32V NORM-BLO 1.25X.25	75915	311010
A20F5†	2110-0523	9		FUSE 10A 32V NORM-BLO 1.25X.25	75915	311010
A20F6	2110-0523	9		FUSE 10A 32V NORM-BLO 1.25X.25	75915	311010
A20F7	2110-0523	9		FUSE 10A 32V NORM-BLO 1.25X.25	75915	311010
A20F8	2110-0523	9		FUSE 10A 32V NORM-BLO 1.25X.25	75915	311010
A20K1†	0490-0556	3	2	RELAY AC 24VDC-COIL 7.5A 115VAC	28480	0490-0556
	0490-0841	0	2	RELAY RETAINER BRT	28480	0490-0841
A20K2	0490-0556	3		RELAY AC 24VDC-COIL 7.5A 115VAC	28480	0490-0556
	0490-0841	0		RELAY RETAINER BRT	28480	0490-0841
A20MP1	1251-2313	4	1	* (PART OF A20P2 THRU P8) (EACH)	28480	1251-2313
A20R1	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A20R2	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A20R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A20R4	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A20R5	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A20R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A20R7†	0757-0795	5	1	RESISTOR 75 1% .5W F TC=0+-100	19701	MF-1/2-T0-75R0-F
A20R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A20RA5	1291-1424	2	1	CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1424
A20XK1	0490-0907	5	2	SOCKET-RLY 15-CONT DIP-SLDR	28480	0490-0907
A20XK2	0490-0907	5		SOCKET-RLY 15-CONT DIP-SLDR	28480	0490-0907

A20 MISCELLANEOUS

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	0360-0007	1	1	TERMINAL-SLDR LUG PL-NTG FOR-#10-SCR	28480	0360-0007
	0360-0009	3	1	TERMINAL-SLDR LUG PL-NTG FOR-#6-SCR	28480	0360-0009
	1251-0600	0	1	CONNECTOR-SGL CONT PIN 1.14-HN-BSC-SI BG	28480	1251-0600
	0040-0554	*	1	COVER, CAPACITOR	28480	0040-0554
A21	0960-0151	6	1	OSCILLATOR-CRYSTAL 10 MHZ STABILITY (EXCEPT OPTS 001 AND 002)	28480	0960-0151
A21	0960-0150	7	1	OSCILLATOR-CRYSTAL 10 MHZ STABILITY (OPT 001 ONLY) (OMIT A21 ASSY FOR OPT 042)	28480	0960-0150
A22	08660-60320	5	1	SWITCH ASSY, REFERENCE	28480	08660-60320
	08660-20451	3	1	HOUSING, REF, SWITCH	28480	08660-20451
	08660-00809	4	1	COVER, SWITCH HOUSING	28480	08660-00809
A22C1	0160-2437	1		CAPACITOR-FXD MICA 5000PF +80 -20% 200V	28480	0160-2437
A22C2	0160-2437	1		CAPACITOR-FXD MICA 5000PF +80 -20% 200V	28480	0160-2437
A22C3	0160-2437	1		CAPACITOR-FXD MICA 5000PF +80 -20% 200V	28480	0160-2437
A22C4	0160-2437	1		CAPACITOR-FXD MICA 5000PF +80 -20% 200V	28480	0160-2437
A22C5	0160-2437	1		CAPACITOR-FXD MICA 5000PF +80 -20% 200V	28480	0160-2437
A22C6	0160-2437	1		CAPACITOR-FXD MICA 5000PF +80 -20% 200V	28480	0160-2437
A22J1	1250-0901	2		CONNECTOR-RF SMB M BGL-HOLE-FR 50-OHM	28480	1250-0901
A22J2	1250-0901	2		CONNECTOR-RF SMB M BGL-HOLE-FR 50-OHM	28480	1250-0901
A22J3	1250-0901	2		CONNECTOR-RF SMB M BGL-HOLE-FR 50-OHM	28480	1250-0901
A22J4	1250-0901	2		CONNECTOR-RF SMB M BGL-HOLE-FR 50-OHM	28480	1250-0901
A22A1†	08660-60027	7	1	BOARD ASSY, REFERENCE SWITCH	28480	08660-60027
A22A1	08660-60323	6	1	10 MHZ FILTER ASSEMBLY	28480	08660-60323
	08660-60319	0	1	10 MHZ FILTER BOARD ASSEMBLY (INCLUDES ALL A22A1 PARTS EXCEPT W1,W2, AND 1200-0173)	28480	08660-60319
A22A1C1	0160-0575	4	4	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A22A1C2	0160-2264	2		CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A22A1C3	0121-0046	2		CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	504324 9/35PF A+BC
A22A1C4	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A22A1C5	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A22A1C6	0160-2207	5		CAPACITOR-FXD 100UF+-10% 16VDC TA	56289	150D107X9016M2
A22A1C7	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A22A1C8	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A22A1C9	0160-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0160-0575
A22A1K1	0490-0914	6	4	RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10V4	28480	0490-0914
A22A1L1	9100-1629	4		COIL-MLD #TUN 5% Q=55 .155DX.375LG-NOM	28480	9100-1629
A22A1L2	9140-0237	2		COIL-MLD 200UH 5% Q=45 .155DX.375LG-NOM	28480	9140-0237
A22A1Q1	1854-0019	1		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A22A1Q2	1854-0019	1		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A22A1R1	0698-3438	1		RESISTOR 147 1% .125W F TC=0+-100	24546	C8-1/8-T0-147R-F
A22A1R2	2100-3053	5	1	RESISTOR-TRMR 20 20% C SIDE-ADJ (7-TRN	02111	W3P200
A22A1R3	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1001-F
A22A1R4	0397-0117	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1331-F
A22A1R5	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C8-1/8-T0-101-F
A22A1R6	2100-2010	2	1	RESISTOR-TRMR 10 20% C TOP-ADJ 1-TRN	73138	82P#10
A22A1R7	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C8-1/8-T0-101-F
A22A1R8	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1331-F
A22A1R9	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1001-F
A22A1W1	08660-60083	5		CABLE ASSEMBLY, COAX, GRAY	28480	08660-60083
A22A1Y1	0410-0423	2	1	CRYSTAL-QUARTZ 10.0 MHZ +-4.5 PPM	28480	0410-0423
A22A1Z1	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A22A1Z2	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
				A22A1 MISCELLANEOUS		
	1200-0173	5	1	INSULATOR-XSTR DAP-GL	28480	1200-0173
	1251-2194	1	1	CONNECTOR-SGL CONT SKT .021-IN-BSC-SI	28480	1251-2194
A22A2	08660-60026	6	1	BOARD ASSY, REFERENCE AMPLIFIER SWITCH	28480	08660-60026
A22A2C1	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A22A2C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A22A2C3	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A22A2C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A22A2C5	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
†Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A22A2C6	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A22A2C7	0180-0291	3		CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A22A2C8	0140-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0140-2055
A22A2C9	0140-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0140-2055
A22A2CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A22A2CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A22A2K1	0490-0916	6		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A22A2K2	0490-0916	6		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A22A2K3	0490-0916	6		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A22A2L1	9140-0118	8	1	COIL-MLD 560UH 5% Q=45 .190X.84LG-NOM	28480	9140-0118
A22A2L2	9140-0144	0		COIL-MLD 4.7UH 10% Q=45 .098X.25LG-NOM	28480	9140-0144
A22A2Q1	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A22A2Q2	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A22A2Q3	1853-0020	9		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A22A2R1	0698-7227	6	1	RESISTOR 422 1% .05W F TC=0+-100	24546	C3-1/8-T0-422R-G
A22A2R2	0698-7222	1	2	RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A22A2R3	0698-7248	3	1	RESISTOR 1.47K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1471-G
A22A2R4	0698-7238	1	1	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A22A2R5	0698-7222	1		RESISTOR 261 1% .05W F TC=0+-100	24546	C3-1/8-T0-261R-G
A22A2R6	0698-7212	0		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T0-100R-G
A22A2R7	0698-7229	8	1	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A22A2R8	0698-7188	8	2	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A22A2R9	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A23	08660-60048	8	1	WIRING HARNESS, MAIN	28480	08660-60048
A23J1	1251-0085	5	1	CONNECTOR 30-PIN F MICRO RIBBON	28480	1251-0085
A23J1	1251-1908	3	1	CONTACT-CONN MALE CRP .062-IN-CONT-BZ	28480	1251-1908
A23J2	1251-0949	2	1	CONN: R&P CONT: RECT BERG CONN PIN	81312	III-17054P
A23J3	1251-1910	7	1	CONTACT-CONN MALE CRP .062-IN-CONT-BZ	28480	1251-1910
A23J4	1251-2443	9	1	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2443
A23J6	1251-0544	1	2	BODY: R&P CONN: RECT BERG,2F,DIAL PNTH	81312	MRAC428-G7
A23J5	1251-0544	1		BODY: R&P CONN: RECT BERG,2F,DIAL PNTH	81312	MRAC428-G7
A23J6	1251-0547	4	1	BODY: R&P CONN: RECT BERG,6F MIDIAL	81312	MRAC6SR-G7
A23J7	1251-1017	5	2	CONNECTOR 4-PIN MINCH JF	28480	1251-1017
				MISCELLANEOUS A23.		
	08660-20052	4	3	PIN, GUIDE	28480	08660-20052
A24	08660-60044	2		WIRING HARNESS	28480	08660-60044
A24P7	1251-1017	5		CONNECTOR 4-PIN MINCH JF	28480	1251-1017
A24S1	3101-1536	6	1	SWITCH-TGL BASIC DPDT 3A 125VAC SLDR-LUG	28480	3101-1536
A25	08660-60350	0	1	+30V REGULATOR ASSEMBLY	28480	08660-60350
A25C1	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A25CR1	1902-0044	3	1	DIODE-ZNR 1N53638 36V 5% PD=5W TC=+29MV	28480	1902-0044
A25Q1	1854-0744	7	1	TRANSISTOR NPN 2N5028 SI TO-66 PD=40W	04713	2N5028
	1205-0085	8	1	HEAT SINK TO-66-PKG	28480	1205-0085
A25R1	0757-0794	4	1	RESISTOR 68.1 1% .5W F TC=0+-100	28480	0757-0794
A25R2	0757-0198	2	1	RESISTOR 100 1% .5W F TC=0+-100	28480	0757-0198
				A25 MISCELLANEOUS		
	0360-0111	0	1	STANDOFF-RVT-BR .25-IN-LG 6-32THD	00000	ORDER BY DESCR
	2190-0006	1	1	WASHER-LK HLCL NO. 6 .141-.144-ID	28480	2190-0006
	2360-0119	8	1	SCREW-MACH 6-32 .438-IN-LG PAN-MD-POZI	00000	ORDER BY DESCR
	2420-0003	7	1	NUT-HEX-DBL-CHAM 6-32-THD .094-IN-THK	00000	ORDER BY DESCR
				CHASSIS PARTS		
CR1	1901-1001	0	1	DIODE-GTR-TAP RECT 50V 10A	28480	1901-1001
CR2	1906-0065	0	2	DIODE-FW BRDG 100V 10A	28480	1906-0065
CR3	1906-0065	0		DIODE-FW BRDG 100V 10A	28480	1906-0065
F1	2110-0304	0	1	FUSE 1.5A 250V SLO-BLO 1.25X.25 UL REC	28480	2110-0304
F2	2110-0332	8	1	FUSE 3A 125V NORM-BLO .25X.27	28480	2110-0332
F3	2110-0047	2	3	FUSE 1A 125V NORM-BLO .25X.27	71400	GMW-1
F4	2110-0047	2		FUSE 1A 125V NORM-BLO .25X.27	71400	GMW-1
F5	2110-0047	2		FUSE 1A 125V NORM-BLO .25X.27	71400	GMW-1

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
L1	9170-0499	1	1	CORE-TOROID AL=2135nH/T	28480	9170-0499
S1	3101-0033	8	1	SWITCH-SL DPDT-NS STD .5A 125VAC/DC	28480	3101-0033
T1†	9100-3543	7	1	TRANSFORMER,POWER	28480	9100-3543
W1	08660-60061	9		CABLE ASSY, WHITE	28480	08660-60061
W2	08660-60062	6	1	CABLE ASSEMBLY, WHITE	28480	08660-60062
W3	08660-60054	0	1	CABLE ASSEMBLY, WHITE	28480	08660-60054
W4	08660-60046	8	1	CABLE ASSY, INTERFACE	28480	08660-60046
W5	08660-60065	3	1	CABLE ASSY, ORANGE	28480	08660-60065
W6	08660-60056	2	1	CABLE ASSEMBLY,ORANGE	28480	08660-60056
W7	08660-60058	4	1	CABLE ASSY, WHITE/RED	28480	08660-60058
W8	08660-60057	3	1	CABLE ASSY, WHITE/GREEN	28480	08660-60057
W9	08660-60071	1	1	CABLE ASSY, WHITE/BROWN	28480	08660-60071
W10	08660-60052	8	1	CABLE ASSY, RED	28480	08660-60052
W11	08660-60053	4	1	CABLE ASSY, BROWN	28480	08660-60053
W12	08660-60075	5	1	CABLE ASSY, GREEN	28480	08660-60075
W13	08660-60067	5	1	CABLE ASSY, WHITE/RED	28480	08660-60067
W14	08660-60066	4	1	CABLE ASSY, WHITE/BLUE	28480	08660-60066
W15	08660-60059	5	1	CABLE ASSY, WHITE/YELLOW	28480	08660-60059
W16	08660-60061	3	1	CABLE ASSY, WHITE/RED	28480	08660-60061
W17	08660-60074	8	1	CABLE ASSY, WHITE/BROWN	28480	08660-60074
W18	08660-60072	2	1	CABLE ASSY, WHITE/ORANGE	28480	08660-60072
W19	08660-60073	1	1	CABLE ASSY, WHITE/YELLOW	28480	08660-60073
W20	11661-60026	4	1	CABLE ASSY, BLUE/GRAY	28480	11661-60026
W21	11661-60028	6	1	CABLE ASSY, GRAY	28480	11661-60028
W22	08660-60061	9	2	CABLE ASSY, WHITE	28480	08660-60061
W23	08660-60060	8	1	CABLE ASSY, WHITE/ORANGE	28480	08660-60060
W24	08660-60093	7	1	CABLE ASSY	28480	08660-60093
W25	08660-60094	8	1	CABLE ASSY	28480	08660-60094
W26	08660-60095	9	1	CABLE ASSY	28480	08660-60095
W27	08660-60175	6	1	CABLE, VIOLET	28480	08660-60175
				MISCELLANEOUS PARTS		
	0380-0643	3	1	STANDOFF-METRIC LONG STUD MOUNT FOR CONN	28480	0380-0643
	0403-0026	6	2	GLIDE NYLON FITS 0.192 HOLD 0.156MI	28480	0403-0026
	08660-2042	1	1	STRIP, FILLER	28480	08660-2042
	08660-00001	1	1	PANEL, REAR	28480	08660-00001
	08660-00003	3	1	SUPPORT, 44-PIN CONNECTOR	28480	08660-00003
	08660-00004	4	1	SUPPORT, 92-PIN CONNECTOR	28480	08660-00004
	08660-00005	5	1	BRACKET, LEFT INTERFACE	28480	08660-00005
	08660-00007	7	1	SUPPORT, REFERENCE OSCILLATOR	28480	08660-00007
	08660-00021	5	2	FILTER, SIDE	28480	08660-00021
	08660-00024	8	2	COVER, SIDE	28480	08660-00024
	08660-00025	9	1	COVER, BOTTOM	28480	08660-00025
	08660-00026	0	1	COVER, TOP	28480	08660-00026
	08660-00027	1	1	SUPPORT, LOOP BOX, REAR	28480	08660-00027
	08660-00029	3	1	BRACKET, L.P. BOX, LT 30	28480	08660-00029
	08660-00030	4	1	COVER, SL1 OSCILLATOR	28480	08660-00030
	08660-00031	7	1	COVER, SL1 PHASE DETECTOR	28480	08660-00031
	08660-00032	8	1	COVER, N1	28480	08660-00032
	08660-00033	9	1	COVER, N2 (OPT 004)	28480	08660-00033
	08660-00034	0	1	COVER, N3 (OP 004)	28480	08660-00034
	08660-00035	1	1	COVER, SL2 (OPT 004)	28480	08660-00035
	08660-0003A	2	1	SUPPORT, M.F. LOW PASS BOX	28480	08660-0003A
	08660-00037	3	1	COVER, BOTTOM 1.3GHZ MOD.	28480	08660-00037
	08660-00038	4	1	LATCH, M.F. LOW PASS BOX	28480	08660-00038
	08660-00041	9	1	COVER, WIRING HARNESS	28480	08660-00041
	08660-00042	8	1	COVER, N24 (OPT 004)	28480	08660-00042
	08660-00043	1	1	COVER, COUPLING BOARD (OPT 004)	28480	08660-00043
	08660-00044	2	1	COVER, BLANK (OPT 004)	28480	08660-00044
	08660-00061	3	1	BRACKET, CONNECTOR	28480	08660-00061
	08660-00063	5	1	FAN SHIELD	28480	08660-00063
	08660-00065	7	1	CORK PAD	28480	08660-00065
	08660-00085	1	1	PLATE, OSCILLATOR, TOP	28480	08660-00085
	08660-00086	2	1	PLATE, OSCILLATOR, BOTTOM	28480	08660-00086
	08660-20040	0	3	BOARD, P.C. (OPT 004)	28480	08660-20040
	08660-20052	4		PIN, LATCH	28480	08660-20052
	08660-20054	6	2	PIN, PIVOT	28480	08660-20054
	08660-20055	7	1	SCREW, SHOULDER	28480	08660-20055
	08660-20056	8	2	END PLATE, L.P.BOX	28480	08660-20056
	08660-20057	9	2	GUIDE, MOD, PLUG-IN	28480	08660-20057
	08660-20058	0	2	GUIDE, RF PLUG-IN	28480	08660-20058

See introduction to this section for ordering information
*Indicates factory selected value
† Backdating information in Section VII

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C O	Qty	Description	Mfr Code	Mfr Part Number
	08660-20001	5	1	FRAME, FRONT	28480	08660-20001
	08660-20002	6	11	EXTRACTOR, SHIELD	28480	08660-20002
	08660-20074	2	2	FRAME, SIDE	28480	08660-20074
	08660-20167	2	1	BRACKET, RIGHT INTERFACE	28480	08660-20167
	08660-20168	3	1	HEAT SINK	28480	08660-20168
	08660-20169	8	1	HEAT SINK	28480	08660-20169
	08660-20170	7	2	HEAT SINK, .75 X .18"	28480	08660-20170
	08660-20172	9	7	FEET	28480	08660-20172
	08660-20183	2	2	HEAT SINK, .75 X .36"	28480	08660-20183
	08660-20203	7	1	PLATE, OSCILLATOR MOUNTING	28480	08660-20203
	08660-60070	0	1	KIT, RACK MOUNT	28480	08660-60070
	08660-60060	2	1	CABLE ASSY, GRAY	28480	08660-60060
	08660-60063	5	2	CABLE ASSY, GRAY	28480	08660-60063
	0960-0411	3	1	CONDUCTOR ASSEMBLY, PLUG-IN JUMPER	00000	ORDER BY DESCRIPTION
	1250-0780	9	1	ADAPTER-COAX F-BNC M-N	28480	1250-0780
	1251-0084	4	1	CONNECTOR 36-PIN M MICRO RIBBON	28480	1251-0084
	08660-00100	1	4	DAMPING PAD-FOAM	28480	0instr-00100
	5060-0052	4	2	PLATE, FLUTED ALUMINUM	28480	5060-0052
	5020-7823	6	1	BRACKET,7H L.H. RACK MOUNT	28480	5020-7823
	5020-7824	7	1	BRACKET,7H R.H. RACK MOUNT	28480	5020-7824
	5060-0222	1	2	HANDLE ASSEMBLY, 5H SIDE	28480	5060-0222
	5060-0256	1	1	ENT, BOARD ASSY,24 CONTACT	28480	5060-0256
	5060-0258	3	1	ENT, BOARD ASSY,24 CONTACT	28480	5060-0258
	5060-0276	5	2	ENT, BOARD ASSY,15 PIN	28480	5060-0276
	5060-0277	6	1	ENT, BOARD ASSY,18 PIN	28480	5060-0277
	5060-0747	9	5	FOOT ASSY,FM	28480	5060-0747
	5060-8735	7	2	RETAINER HANDLE ASSEMBLY GRAY (STD)	28480	5060-8735
	8120-1348	5	1	CABLE ASSY 18AWG 3-CNDCT BLK-J47	28480	8120-1348

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-4. Code List of Manufactures

Mfr Code	Manufacturer Name	Address	Zip Code
00000	ANY SATISFACTORY SUPPLIER		
00853	SANGAMO ELEC CO S CAROLINA DIV.	PICKENS SC	29671
01121	ALLEN-BRADLEY CO	MILWAUKEE WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75222
01928	RCA CORP SOLID STATE DIV	SOMERVILLE NJ	08876
02111	SPECTROL ELECTRONICS CORP	CITY OF IND CA	91749
02660	AMPHENOL CORP AMPHENOL CONN DIV	BROADVILLE IL	60153
03508	GE CO SEMICONDUCTOR PROD.DEPT	SYRACUSE NY	13201
03888	KDI PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85062
04801	GE CO ELEK CAP & BAT PROD DEPT	LAMO SC	29463
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
18324	SIGNETICS CORP	SUNNYVALE CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD MA	01880
24484	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
56289	MEPCO/ELECTRA CORP	SAN DIEGO CA	92121
59730	STETTNER-TRUSH INC	CAZENOVIA NY	13035
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS MO	63107
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC CT	06226
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
74970	JOHNSON E F CO	WABASCA MN	56293
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA PA	19108
75915	LITTELFUSE INC	DES PLAINES IL	60016
81312	WINCHESTER ELEK DIV LITTON IND INC	DANVILLE CT	06779
84411	TRW CAPACITOR DIV	OGALLALA NE	69153
91637	DALE ELECTRONICS INC	COLUMBUS NE	68601
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75222
03888	KDI PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85062
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94042
18324	SIGNETICS CORP	SUNNYVALE CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24484	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71744	CHICAGO MINIATURE/ORNAN	CHICAGO IL	60640
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC CT	06226

BACK DATING MANUAL CHANGES

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains manual change instructions for backdating this manual for HP Model 8660A Synthesized Signal Generators that have serial number prefixes that are lower than the prefix listed on the title page. This section also contains instrument modification suggestions and procedures that are recommended to improve the performance and reliability of the generator.

7-3. MANUAL CHANGES

7-4. To adapt this manual to your instrument, refer to Table 7-1 and make all of manual changes listed opposite the instrument's serial number or prefix. The manual changes are listed in serial number sequence and should be made in the sequence listed. For example, Change A should be made after Change B; Change B should be made after Change C, etc. Table 7-2 is a summary of changes by component.

7-5. If the instrument's serial number or prefix is not listed on the title page of this manual or in Table 7-1, it may be documented in a yellow MANUAL CHANGES supplement. For additional important information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL in Section 1.

Table 7-1. Manual Changes by Serial Number (1 of 2)

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1109A	AR thru A	1219A00221 thru 1219A00230	AR thru I
1140A	AR thru B	1219A00231 thru 1219A00240	AR thru J
1141A	AR thru C	1219A00241 thru 1219A00250	AR thru K
1142A00141 thru 1142A00150	AR thru D	1219A00251 thru 1219A00260	AR thru L
1142A00151 thru 1142A00160	AR thru E	1225A	AR thru M
1201A00161 thru 1201A00170	AR thru F	1231A	AR thru N
1201A00171 thru 1201A00180	AR thru G	1239A	AR thru O
1201A00181 thru 1201A00220	AR thru H	1242A	AR thru P

Table 7-1. Manual Changes by Serial Number (2 of 2)

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1246A	AR thru Q	1519A and 1528A	AR thru AE
1317A	AR thru R	1539A	AR thru AF
1330A	AR thru S	1551A	AR thru AG
1334A	AR thru T	1620A	AR thru AH
1343A	AR thru U	1629A	AR thru AI
1349A	AR thru V	1633A	AR thru AJ
1352A	AR thru W	1636A	AR thru AK
1404A	AR thru X	1638A	AR thru AL
1420A	AR thru Y	1651A	AR thru AM
1425A	AR thru Z	1708A	AR, AQ, AP, AO, AN
1445A	AR thru AA	1714A, 1734A	AR, AQ, AP, AO
1451A	AR thru AB	1750A	AR, AQ, AP
1504A	AR thru AC	1812A	AR, AQ
1508A	AR thru AD	1814A	AR

Table 7-2. Summary of Changes by Component (1 of 7)

Change	A1A1	A1A6	A1A8	A4A1	A4A2	A4A3	A4A4	A4A6	A4A7
A								C11,R55,R19, R51,R59,R43, R18,R38,R47, R39	
B				L3,R14					
C									
D									
E	Ass'y Part No.	Ass'y Part Nos.	Ass'y Part Nos.				Q4,Q6		R18,R19, R29,R31
F						U1			C4
G		C16			R11				
H		C1,R1			C11				
I									
J					CR1				
K								C6,R7	
L					R37,R43, C26,R39, C22,C11, Z1				
M								R1,R19,R26, R28,R33,R35, R38,R40,R43, R44,R47,R48 R51,R52,R55, R56,R59,R60, R65,C23	
N									
O									
P									

NOTE

Be sure to check the serial number of your instrument against Table 7-1 to see which changes apply.

Table 7-2. Summary of Changes by Component (2 of 7)

Change	A5	A6A1	A7	A11	A13	A15	A16	A17	A19	A20	A23
A											
B	C11,C16 R10,Q6	CR1,Q12									
C											W24,W25, W26
D						R26			C3,C6		
E							L5,L6 (Z1,Z2)				
F											
G										F2,F3,F4, F5	
H											
I	R26,R28 R29										
J											
K											
L		C10									
M			C1								
N						C13					
O				CR13, CR14	R8,R9			CR6, CR7	CR12, CR13		
P											

NOTE

Be sure to check the serial number of your instrument against Table 7-1 to see which changes apply.

Table 7-2. Summary of Changes by Component (3 of 7)

Change	A3A1	A4	A4A2	A4A4	A4A5	A4A6
Q						R33,R51,R55, R2,R3,R4
R						
S						
T						
U			R2	C41,L12		
V						
W						
X						
Y					Q2,Q4	R35,R52,R56, R60
Z				Q5,R30,R31		
AA						
AB	U5 thru U11, CR1, CR2					
AC						
AD		J11, J14				
AE				C10		
AF						C6
AG			R11*			
AH						
AI	Ass'y Part No. (Opt. 005)					
AJ	Ass'y Part No.					
AK						
AL						
AM	Ass'y Part No.					
AN						
AO						
AP						

*Instrument modification recommended, see paragraph 7-7.

NOTE

Be sure to check the serial number of your instrument against Table 7-1 to see which changes apply.

Table 7-2. Summary of Changes by Component (4 of 7)

Change	A4A8	A5	A6A1	A6A2	A6A3	A7
Q						C1
R						
S						
T						
U						
V			C10, Z	Ass'y Part No.		
W						Ass'y Part No.
X			R7*, R10*			
Y						
Z						
AA						
AB						
AC						
AD	Ass'y Part No.					
AE		Q1 thru Q10, U3, CR1, R8 thru R10	R1			
AF		Ass'y Part No.				
AG						
AH						C16
AI						
AJ						
AK						
AL						
AM						
AN						
AO		C12				
AP						

*Instrument modification recommended, see paragraph 7-7.

NOTE

Be sure to check the serial number of your instrument against Table 7-1 to see which changes apply.

Table 7-2. Summary of Changes by Component (5 of 7)

Change	A8	A9	A10	A11	A12	A13
Q						
R						
S	Q8 thru Q11			Q7 thru Q14, Q16 thru Q20	Q8 thru Q11	Q5 thru Q8, Q13 thru Q16
T						
U	R18, R25					
V						
W						
X						
Y						
Z	U3		U4 thru U6		U9	
AA		Ass'y Support				
AB						
AC						
AD						
AE						
AF						Ass'y Part No. R83
AG						
AH						

*Instrument modification recommended, see paragraph 7-7.

NOTE

Be sure to check the serial number of your instrument against Table 7-1 to see which changes apply.

Table 7-2. Summary of Changes by Component (6 of 7)

Change	A14	A15	A16	A17	A18	A19
Q						
R						
S				Q11 thru Q14, Q16 thru Q19	Q5 thru Q13, Q16,Q17,Q19 thru Q24	
T						
U						
V						
W						
X						
Y						
Z	U4 thru U7	U5, U6	U5, U6			R55
AA						
AB						
AC						
AD						
AE						
AF						
AG						
AH				C16		
AI						
AJ						
AK						C14, C17
AL						
AM						
AN						
AO						
AP						

NOTE

Be sure to check the serial number of your instrument against Table 7-1 to see which changes apply.

Table 7-2. Summary of Changes by Component (7 of 7)

Change	A20	A20X	A22A1	T1	A25	
Q	MP3					
R						
S						
T						
U						
V						
W						
X	F3*,F4*,F5*					
Y						
Z						
AA						
AB	F1*		J5,C1 thru C9, K1,L1,L2,Q1, Q2,R1 thru R9, W1,Y1,Z1,Z2			
AC						
AD	K1, R7					
AE	C1 thru C11,C4 thru C7,F1 thru F8*,K1,K2 MP1,R1 thru R8	A5, K1, K2		CR1,CR2,CR3		
AF						
AG						
AH						
AI						
AJ						
AK	CR8					
AL					Ass'y Part No.	
AM						
AN						
AO						
AP						

*Instrument modification recommended, see paragraph 7-7.

NOTE

Be sure to check the serial number of your instrument against Table 7-1 to see which changes apply.

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Table 6-3 and Service Sheet 4:

Change A4A6 component values as follows:

C11 to 0160-3534 C-F 510 pF	R43 to 0698-0082 R-F 464 ohms
R55 to 0698-0084 R-F 2150 ohms	R18 to 0698-3437 R-F 133 ohms
R19 to 0698-3443 R-F 287 ohms	R38 to 0698-3443 R-F 287 ohms
R51 to 0757-0274 R-F 1210 ohms	R47 to 0757-0417 R-F 562 ohms
R59 to 0757-0439 R-F 6810 ohms	R39 to 0757-0442 R-F 10K ohms

CHANGE B

Table 6-3 and Service Sheet 2:

Delete A4A1L3 and A4A1R14. Replace with jumper wire.

Table 6-3 and Service Sheet 24:

Change A6A1CR1 to 1902-3256 diode 23.7V.
Add A5C11 0160-2207 300 pF from A5U2 pin 4 to ground.
Add A5C16 0140-0198 200 pF from A5U1 pin 4 to ground.
Change A5R10 to 0698-3442 R-F 237 ohms 1% 1/8W.
Change A5Q6 to 1853-0037.
Change A6A1Q10 to 1854-0063.

CHANGE C

Table 6-3 and Service Sheet 1:

Delete A23W24, A23W25 and A23 W26.

CHANGE D

Table 6-3 and Service Sheet 17:

Change A19C3 and A19C6 to 0160-0174 C-F .47 μF 25V.

Table 6-3 and Service Sheet 15:

Delete A15R26.

CHANGE E

Table 6-3 and Service Sheet 7:

Change part numbers of inductive shields (Z1 and Z2) on A16L5 and A16L6 to 08660-20082

Table 6-3

Change A1A1, Digital Control Mother Board Assembly part no. to 08660-60035.

Table 6-3 and Service Sheet 5:

Change A4A7 resistor values as follows:
R19, R29 and R31 to 0698-3132 R-F 261 ohms
R18 to 2100-1788 R-V 500 ohms.

Table 6-3 and Service Sheet 20:

Delete A1A6 part numbers from Table 6-3. Refer to Table 7-2 for parts information and replace the schematic with the schematic shown in Figure 7-1.

Table 6-3 and Service Sheet 21-a Delete A1A8 part numbers from Table 6-3. Refer to Service Sheet 21-a in Section VIII and Table 7-2 for A1A8 schematic and parts information.

Table 6-3 and Service Sheet 3:

Change A4A4Q4 to 1853-0345 and A4A4Q6 to 1854-0431.

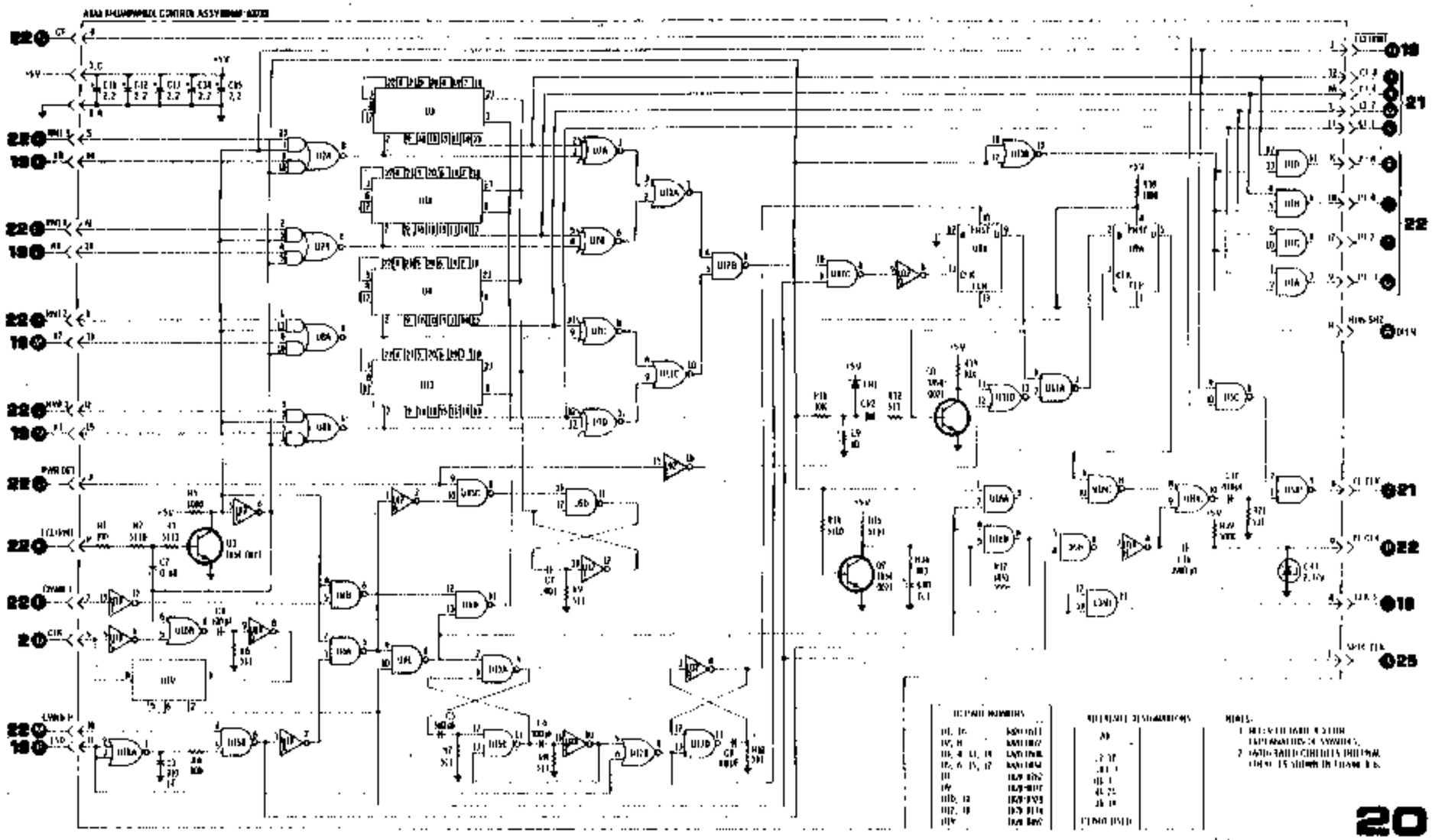


Figure 7-1. Thumbwheel Control Schematic (Change E)

CHANGE F

Table 6-3 and Service Sheet 3:
Change A4A3U1 part number to 1820-0387.

Table 6-3 only
Change A4A7C4 part number to 0160-3277.

CHANGE G

Table 6-3 and Service Sheet 24:
Delete A20F2, A20F3, A20F4 and A20F5.

Table 6-3 and Service Sheet 2:
Change A4A2R11 to 0698-3404 R-F 300 ohm 1%.

Table 6-3 and Service Sheet 20:
Change A1A6C16 to 0160-3457 C-F 2000 pF.

CHANGE H

Table 6-3 and Service Sheet 2:
Change A4A2C11 to 140-0192 C-F 68 pF 300V and A4A2R20 to 0698-3466 R-F 383 ohms

Table 6-3 and Service Sheet 20:
Add A1A6C1 0180-0197 C-F 2.2 μF from the junction of R1 and R2 to ground.
Change A1A6R1 to 0757-0438 R-F 5110 ohms.

CHANGE I

Table 6-3 and Service Sheet 24:
Change A5 resistors as follows
R26 to 2100-1799 R-V 500 ohms 10%, R28 to 2100-2852 R-V 1000 ohms 10% and R29 to 0698-3157 R-F 19.6K ohms 1% .125W.

CHANGE J

Table 6-3 and Service Sheet 2:
Change A4A2CR1 to 1902-0049 diode 6.19V.

CHANGE K

Table 6-3 and Service Sheet 4:
Change A4A6C6 to 0160-2263 C-F 18 pF 500V and A4A6R7 to 0757-0274 R-F 1210 ohms 1%.

CHANGE L

Table 6-3 and Service Sheet 2:
Change A4A2 component values as follows:

R37 to 0698-0084 R-F 2150 ohms	R39 to 0757-0278 R-F 1780 ohms
R43 to 0757-0280 R-F 1000 ohms	C22 to 0180-2205 C-F 0.33 μF
C26 to 0180-1745 C-F 1.5 μF	C11 to 0140-0190 C-F 39 pF

Delete A4A2Z1, inductive bead, from the base lead of A4A2Q2.

Table 6-3 and Service Sheet 24:
Change A6A1C10 to 0160-0013 C-F .1 μF (OPT 003 only).

CHANGE M

Table 6-3 and Service Sheet 24:
Delete A7C1 from the power line module and the parts list.

CHANGE M (Cont'd)

Table 6-3 and Service Sheet 4:

Delete A4A6R65 and A4A6C23.

Change A4A6 resistor values as follows:

R55 to 0698-3150 R-F 2370 ohms	R33 to 0698-3132 R-F 261 ohms
R1 to 0698-3438 R-F 137 ohms	R26 to 0698-3440 R-F 196 ohms
R38 to 0698-3444 R-F 316 ohms	R19 to 0698-3445 R-F 348 ohms
R5 to 0757-0317 R-F 1330 ohms	R43 to 0757-0416 R-F 511 ohms
R47 to 0757-0418 R-F 619 ohms	R59 to 0757-0440 R-F 7500 ohms
R48 to 2100-1788 R-V 500 ohms	R52 to 2100-1788 R-V 500 ohms
R28 to 2100-1984 R-V 100 ohms	R35 to 2100-1984 R-V 100 ohms
R56 to 2100-1986 R-V 1000 ohms	R40 to 2100-2061 R-V 200 ohms
R44 to 2100-2061 R-V 200 ohms	R60 to 2100-2497 R-V 2000 ohms

CHANGE N

Table 6-3 and Service Sheet 15:

Delete A15C13 from TP7 to ground.

CHANGE O

Table 6-3:

Change part no. of A11CR13 to 0122-0263 and tolerance to 10%
Change part no. of A11CR14 to 0122-0261 and tolerance to 10%
Change part no. of A13CR8 to 0122-0263 and tolerance to 10%
Change part no. of A13CR9 to 0122-0261 and tolerance to 10%
Change part no. of A17CR6 to 0122-0263 and tolerance to 10%
Change part no. of A17CR7 to 0122-0261 and tolerance to 10%
Change part no. of A19CR12 to 0122-0263 and tolerance to 10%
Change part no. of A19CR13 to 0122-0261 and tolerance to 10%

CHANGE P

Table 6-3 and Service Sheet 24:

Change A20C7 to 0180-2100 C-F 1200 μF.

Table 6-3 and Service Sheet 15:

Change R27 to L5 Coil: Fixed 10 UH 9140 0114
Change R1 to 7500 ohms 0757 0440
Add R4 1000 ohms 0757-0280 from the base of Q6 to pin 6 of U4B.

CHANGE Q

Table 6-3, Page 6-43:

Delete A20MP3

Table 6-3 and Service Sheet 4:

Change A4A6 resistor values as follows:

R33 to 287 ohms part number 0698-3443
R51 to 1.21K ohms part number 0757-0274
R55 to 2.15K ohms part number 0757-0084
R59 to 6.19K ohms part number 0698-0290
R2 to 2000 ohms part number 2100-2497
R3 to 1.21K ohms part number 0757-0274
R7 to 1.96K ohms part number 0698-0083

Delete "factory select" from the following A4A6 resistors: R18, R26, R33, R38, R43, R47, R51, R55, R59.

CHANGE Q (Cont'd)

Table 6-3 and Service Sheet 24:
Change A7C1 to 0.1 UF, 0160-3229.

CHANGE R

Page 6-45, Table 6-3:
Add: 08660-00006 Bracket, Interface, right
Delete: 08660-00061 Connector, Bracket
08660-20167 Bracket; Interface, right

CHANGE S

Page 6-22, Table 6-3:
Change A8Q8 through A8Q11 to 1853-0066 TSTR: S1 PNP 80131 1853-0066

Page 6-26, Table 6-3:
Change A11Q7 through A11Q14 and A11Q16 through A11Q20 to 1853-0066 TSTR: S1 PNP 80131 1853-0066

Page 6-28, Table 6-3:
Change A12Q8 through A12Q11 to 1853-0066 TSTR: S1 PNP 80131 1853-0066

Page 6-30, Table 6-3:
Change A13Q5 through A13Q8 and A13Q13 through A13Q16 to 1853-0066 TSTR: S1 PNP 80131 1853-0066

Page 6-37, Table 6-3:
Change A17Q11 through A17Q14 and A17Q16 through A17Q19 to 1853-0066 TSTR: S1 PNP 80131 1853-0066

Page 6-39, Table 6-3:
Change A18Q5 through A18Q13 and A18Q16 through A18Q20 to 1853-0066 TSTR: S1 PNP 80131 1853-0066

Page 6-40, Table 6-3:
Change A18Q21 through A18Q24 to 1853-0066 TSTR: S1 PNP 80131 1853-0066

CHANGE T

Page 6-46, Table 6-3:
Delete:
08660-20168, 1, Heat Sink .62 x .75-inches, 28480, 08660-20168
08660-20169, 1, Heat Sink .75 x .38-inches, 28480, 08660-20169
08660-20170, 1, Heat Sink .75 x .18-inches, 28480, 08660-20170
08660-20183, 1, Heat Sink .75 x .35 inches, 28480, 08660-20183

CHANGE U

Page 5-6, paragraph 5-19:
Add to step d, "The 100 MHz signal should be > +10 dBm."
Change Step e to "Disconnect the Spectrum Analyzer and enable the 100 MHz phase lock loop by returning the INT/EXT switch to INT or by reconnecting the external standard.
Delete step f.

CHANGE U (Cont'd)

Page 6-14, Table 6-3:
Change A4A2R2 to 0757-0401, RSTR: FXD 100 OHM, 1%, 1/8W F, 28480, 0750-0401

Page 6-16, Table 6-3:
Delete A4A4C41, 0121-0448, C: VAR, TRMR, CER, 2.5--5.0 PF, 28480, 0757-0401
Delete A4A4L12*, 9140-2254

Page 6-23, Table 6-3:
Change A8R18 to 0698-3157 RESISTOR MTL FLM FXD 19.6K 1% 1/8W, 28480, 0698-3157
Change A8R25 to 0757-0200, RESISTOR MTL FLM FXD 5.62K ohms 1% 1/8W 28480, 0750-0200

Service Sheet 2:
Change the value of A4A2R2 to 100 ohms.

Service Sheet 3:
Change the circuit diagram as shown by the partial schematic in Figure 7-2.

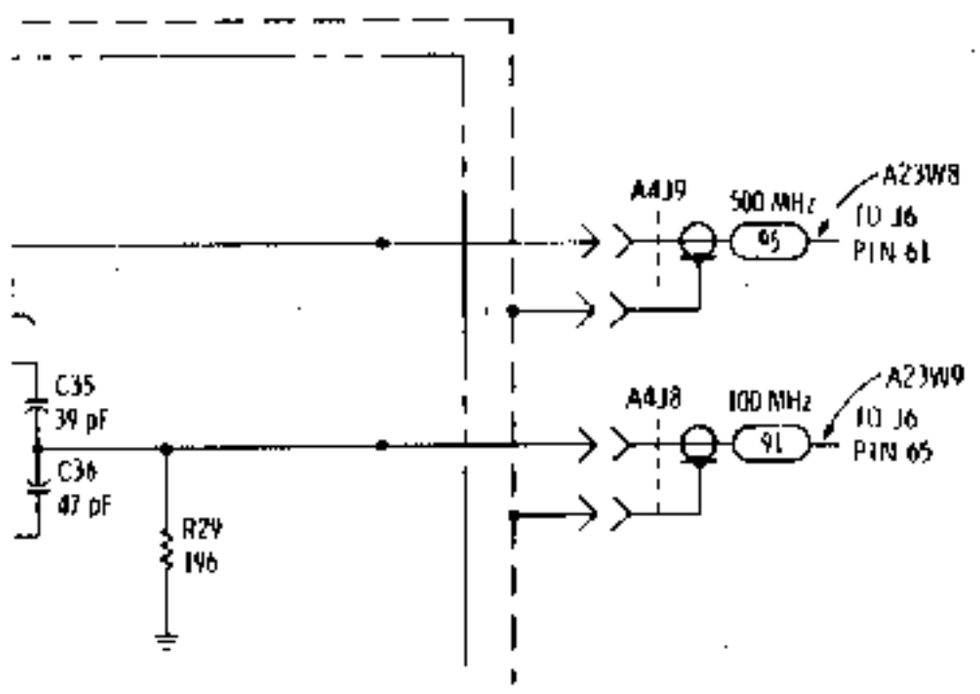


Figure 7-2. Service Sheet 3: Reference VCO and Divider Partial Schematic (Change U)

Service Sheet 12:
Change the value of A8R18 to 19.6K ohms, A8R25 to 5620 ohms.

CHANGE V

Page 6-22, Table 6-3:
Change A6A1C10 to 0160-0015, C: PAPER MY 0.47 UF 10% 200 VDCW, 56289, 160P47492.
Change A6A1Z 08660-20173 to 08660-20050.
Change A6A2 HP and Mfr Part Number from 3160-0056 to 3160-0232, and from 3160-0087 to 3160-0253.

Page 6-45, Table 6-3:
Add 08660-00008.
Delete 0403-0026, 2, GLIDE, 28480, 0403-0026.

Page 6-46, Table 6-3:
Delete 08660-0063, 1 FAN SHIELD, 28480, 08660-00063.
Delete 08660-00065, CORK PAD, 28480, 08660-00065.
Delete 20172, 2 FEET, 28480, 08660-20172.

CHANGE V (Cont'd)

Service Sheet 24:
Delete reference designator A6A1C10, 0.47 capacitor (400 Hz operation).
Change the value of A6A1C10 to 0.47.
Delete from 400 Hz operation (Option 003).

CHANGE W

Page 6-22, Table 6-3:
Change the HP Part Number of A7 to 5060-1188.

Service Sheet 24:
Change the diagram as shown by the partial schematic in Figure 7-3.

CHANGE X

Page 6-22, Table 6-3:
Change A6AR7 to 0811-1849, R-F 0.75 ohms 5%.
Change A6AR10 to 0812-0021 R-F 0.47 ohms 5%.

Page 6-4', Table 6-3:
Change A20F3, F4, and F5 to 2110-0332.

NOTE

See paragraph 7-12 for recommended instrument modifications.

Service Sheet 24:
Change the value of A20F3, F4, and F5 to 3A.

NOTE

Refer to paragraph 7-12 for recommended instrument modifications.

Change the value of A6R7 to 0.75 ohms.
Change the value of A6R10 to 0.47 ohms.

CHANGE Y

Service Sheet 6, Table 6-3:
Change A4A5Q4 to 08660-80012, TSTR: Selected from 2N5179, 08660-80012.
Change A4A5Q2, A4A5Q3, A4A5Q5 and A4A5Q6 to 08660-80013, TSTR: NPN, selected from 2N5179, 08660-80013

Service Sheet 4, Table 6-3:
Change A4A6R35 to 2100-2061, R-V 200 ohm 10%.
Change A4A6R52 to 2100-1986, RSTR: VAR CER 1000 ohm 10% 1/2W, 2100-1986.
Change A4A6R56 to 2100-2497, RSTR: VAR FLM 2000 ohm 10% 1/2W, 2100-2497.
Change A4A6R60 to 2100-2216, RSTR: VAR FLM 5K ohms 10%, 2100-2216.

NOTE

Change potentiometers only as needed for adjustment and transistors should be replaced only in case of failures.

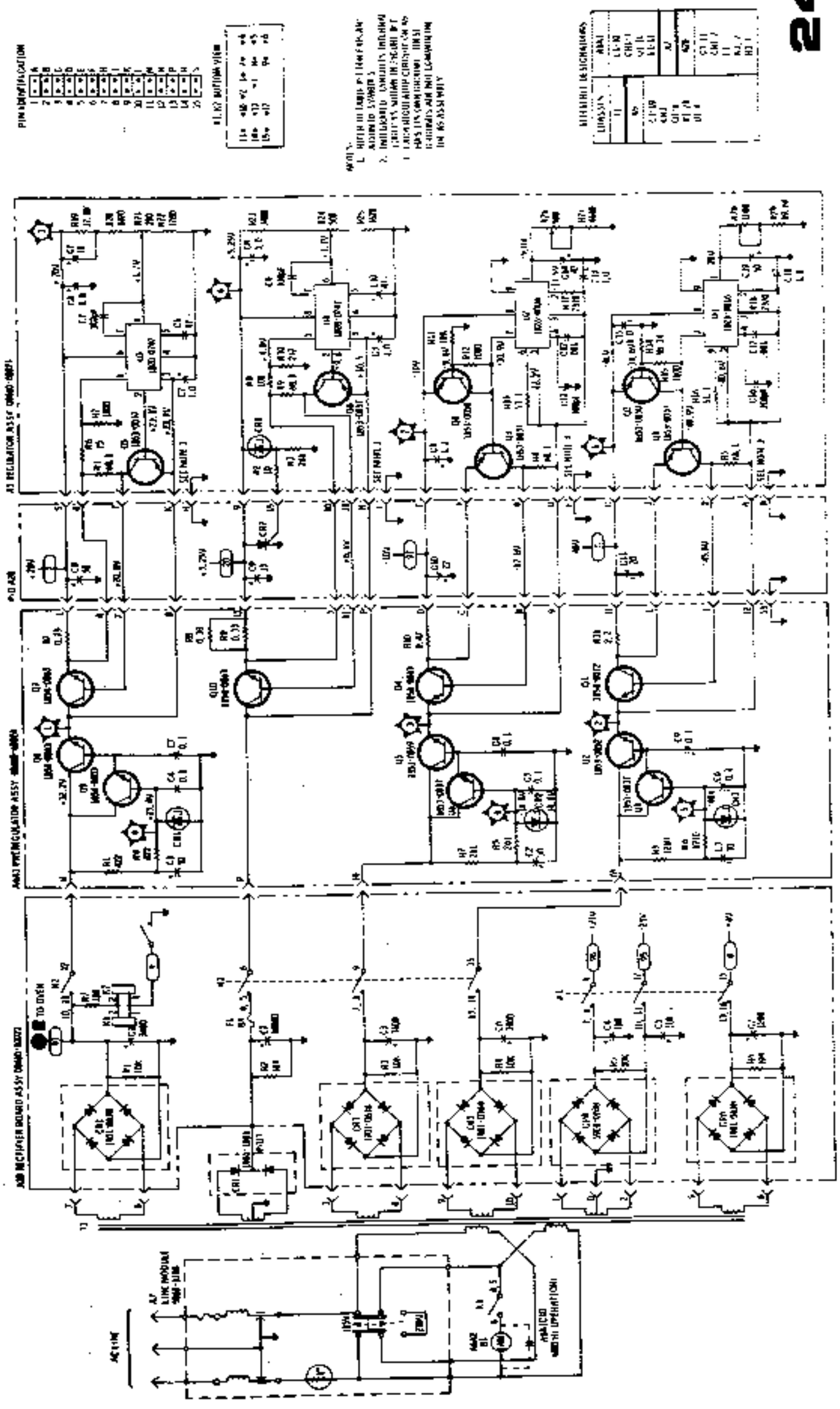


Figure 7-3. Power Supply Schematic (Service Sheet 24) (Change W)

CHANGE 2

Page 6-16, Table 6-3:
Change A4A4Q5 to 1854-0540, TRANSISTOR NPN S1, 04713, MM8006.
Change A4A4R30 to 0698-3438, RESISTOR MET FLM 147 ohm 1% 1/8W, 28480, 0698-3438.
Change A4A4R31 to 0757-0421, RESISTOR MET FLM 825 ohm 1% 1/8W, 28480, 0757-0421.

Page 6-23, Table 6-3:
Change A8U3 to 1820-0450 IC, DGTL, TTL, 18324, N8290A.

Page 6-25, Table 6-3:
Change A10U4 through A10U6 to 1820-0450, IC, DGTL, TTL, 18324, N8290A.

Page 6-29, Table 6-3:
Change A12U9 to 1820-0450, IC, DGTL, TTL, 18324, N8290A.

Page 6-32, Table 6-3:
Change A14U5 through A14U7 to 1820-0450, IC, DGTL, TTL, 18324, N8290A.

Page 6-34, Table 6-3:
Change A14U4 to 1820-0450, IC, DGTL, TTL, 18324, N8290A.

Page 6-35, Table 6-3:
Change A15U5 and A15U6 to 1820-0450, IC, DGTL, TTL, 18324, N8290A.

Page 6-36, Table 6-3:
Change A16U5 and A16U6 to 1820-0450, IC, DGTL, TTL, 18324,N8290A.

Page 6-43, Table 6-3:
Change A19R55 to 0757-0280, RSTR: MET FLM 1K ohm, 28480, 0757-0280.

Page 8-11, Figure 8-5:
Change part number to 1820-0450.

Service Sheet 3:
Change the part number of A4A4Q5 to 1854-0540.
Change the value of A4A4R30 to 147 ohms.
Change the value of A4A4R31 to 825 ohms.

Service Sheet 7:
Change part number for A16U5 and A16U6 to 1820-0450.

Service Sheet 9:
Change part number for A14U5, A14U6, and A14U7 to 1820-0450.

Service Sheet 9A:
Change part number for A14U4, A14U5, and A14U6 to 1820-0450.

Service Sheet 11:
Change part number for A10U4, A10U5, and A10U6 to 1820-0450.

Service Sheet 12:
Change part number for A8U3 to 1820-0450.

Service Sheet 13:
Change part number for A12U9 to 1820-0450.

CHANGE Z (Cont'd)

Service Sheet 15:
Change the part numbers for A15U5 and A15U6 to 1820-0450.

Service Sheet 17:
Change the value of A19R55 to 1000 ohms.

CHANGE AA

Page 6-24, Table 6-3:
Delete A9 assembly, SUPPORT, PC BOARD, Part No. 08660-20175.

CHANGE AB

Page 5-8, paragraph 5-20 and page 5-9, paragraph 5-21:
Instruments 1620A and lower contain the A22A1 subassembly and not the bandpass filter. Therefore, it is necessary to delete these paragraphs.

Page 6-44, Table 6-3:
Change the A22 parts list as listed in the following information and in the table.

Table 7-3. Replaceable Parts (Part of Change AB)

Reference Designation	HP Part Number	Qty	Descripton	Mfr Code	Mfr Part Number
A22	08660-60043	1	Switch Assembly, Reference	28480	08660-60043
A22A1	08660-60027	1	Board Assembly: Reference SW	28480	08660-60027
A22A1C1	0160-2055		Capacitor-FXD 0.01 UF ±20% 50 WVDC CER	56289	C023F101F103Z S22-CDH
A22A1C2	0160-2055		C: FXD CER 0.01 UF +80 −20% 100 VDCW	56289	C023F101F103Z S22-CDH
A22A1C3	0160-2055		C: FXD CER 0.01 UF +80 −20% 100 VDCW	56289	C023F101F103Z S22-CDH
A22A1C4	0160-2055		C: FXD CER 0.01 UF +80 −20% 100 VDCW	56289	C023F101F103Z S22-DCH

Add A22C6 0160-2437 C: FXD CER 5000 PF +80 −20% 200 VDCW 72982 2425-000-X5V-502P.
Delete A22A1C5 through A22A1C9.
Delete A22A1K1.
Delete A22A1L1 and A22A1L2.
Delete A22A1Q1 and A22A1Q2.
Delete A22A1R1 through A22A1R9.
Delete A22A1W1.
Delete A22A1Y1.
Delete A22A1Z1 and A22A1Z2.

Service Sheet 2:
Change the diagram with the partial schematic shown in Figure 7-4.
Change A22C2 to A22C6.

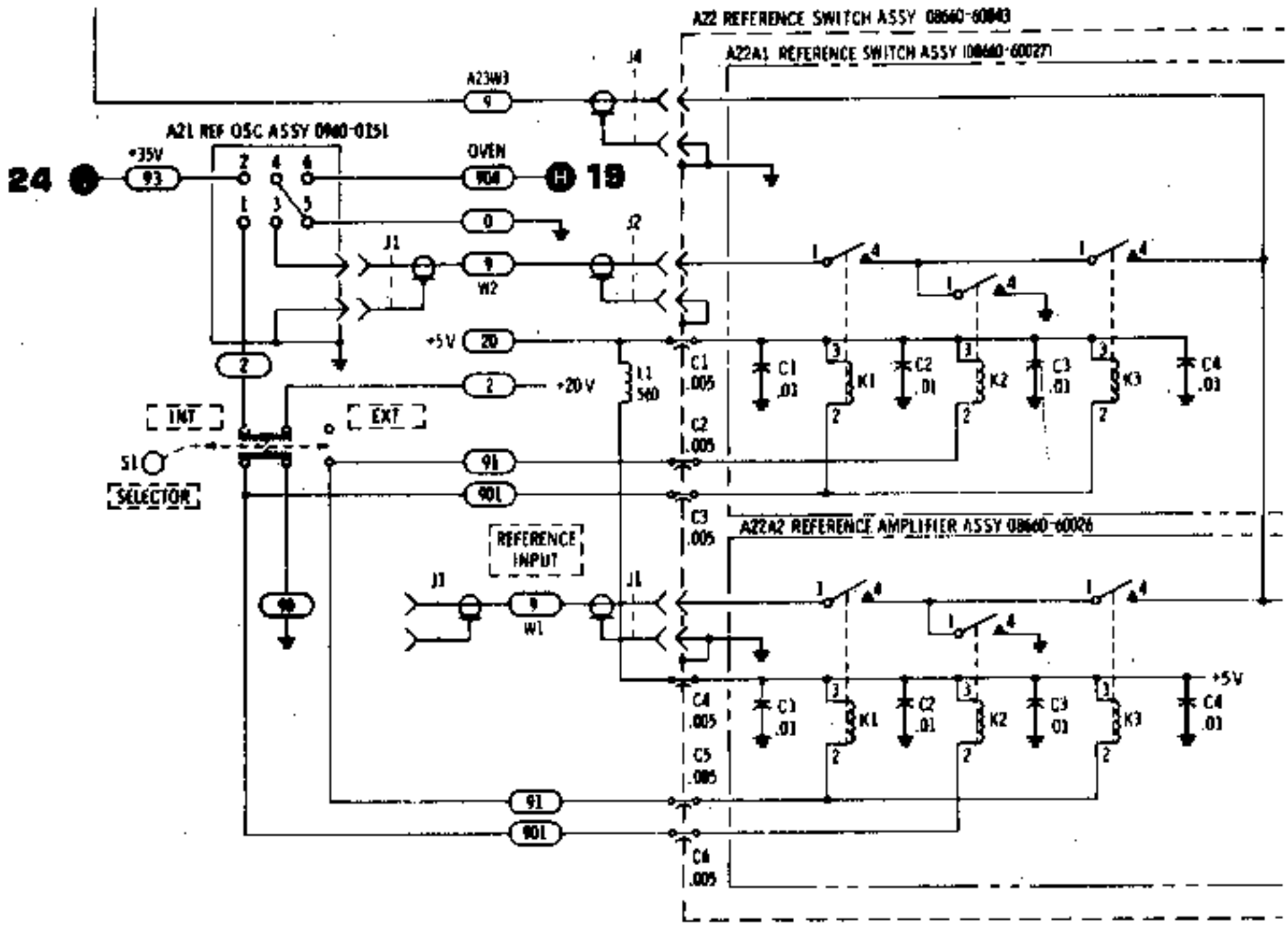


Figure 7-4. Service Sheet 2: Reference Circuit Partial Schematic (P/O Change AB)

Page 6-10 and 6-11, Table 6-3:

Change the A3A1 Assembly parts list as follows:

A3A1, 08660-60028, 1, Front Board Assembly, Digital Interface. 28480, 08660-60028.
A3A1U5, 1820-0214, IC TTL BCD TO DEC DECODER, 01295, SN7442N.
Delete A3A1U11.
A3A1U6, 1820-0328, IC TTL 2- INPUT NOR GATE, 04713, SN7402N.
A3A1U7, 1820-0328, ICC TTL QUAD 2-INPUT NOR GATE, 04713, NS7402N.
A3A1U8 and U9, 1820-0207, IC TTL MONOSTABLE MULTIVIBRATOR, 28480, 1820-0207.
A3A1U10, 1820-0072, IC: TTL DUAL 2W-2-INPUT AND/OR GATE, 01295, 1820-0072.
A3A1VR1 to A3A1CR1.
A3A1CR1 to A3A1CR2.

Page 6-43, Table 6-3:

NOTE

Refer to paragraph 7-12 for recommended instrument modification.

Service Sheet 22:

Replace the schematic with the schematic shown in Figure 7-5.

CHANGE AC

Page 6-45, Table 6-3:

Delete 4324-0080, 4, Pad Silicon Sponge
Add 08660-00028.

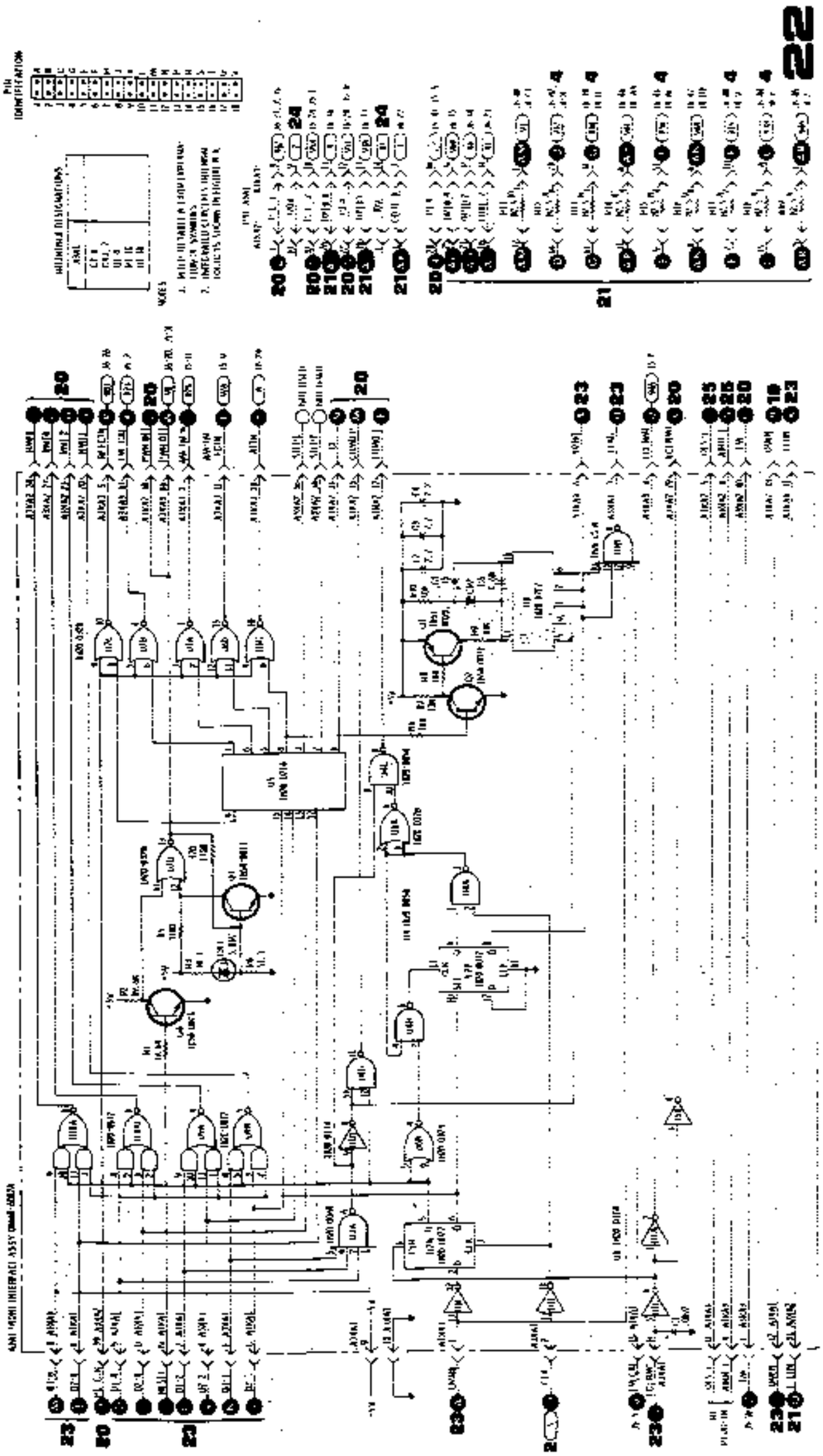


Figure 7-5, Service Sheet 22: Front Interface Board Schematic (Change AB)

CHANGE AC (Cont'd)

Page 6-46, Table 6-3:
Delete 08660-00085, 1 Plate Oscillator Top, 28480, 08660-00085.
Delete 08660-00086, 1 Plate Oscillator Bottom, 28480, 08660-00086.
Delete 08660-21203, 1 Plate Oscillator Mounting, 28480, 08660-20203.

CHANGE AD

Page 5-6, paragraph 5-19, 100 MHz Output Adjustment:
Delete the following after step e.

Page 6-12, Table 6-3:
Change the description of A4J11 to "RF Bulkhead Connector". Add A4J14.

Page 6-20, Table 6-3:
Delete A4A8, 08660-60325, 100 MHz Band Pass Filter, 28480, 08660-60325.

Page 6-43, Table 6-3:
Change A20K1 and A20K2 to 0490-0908.
Change A20R7 to 0757-0198, 100 ohms.

Page 6-45, Table 6-3:
Delete W6, 08660-60326, Cable Assembly 100 MHz Band Pass Filter input, 28480, 08660-60326.

Service Sheet 3:
Change the diagram as shown in Figure 7-6.

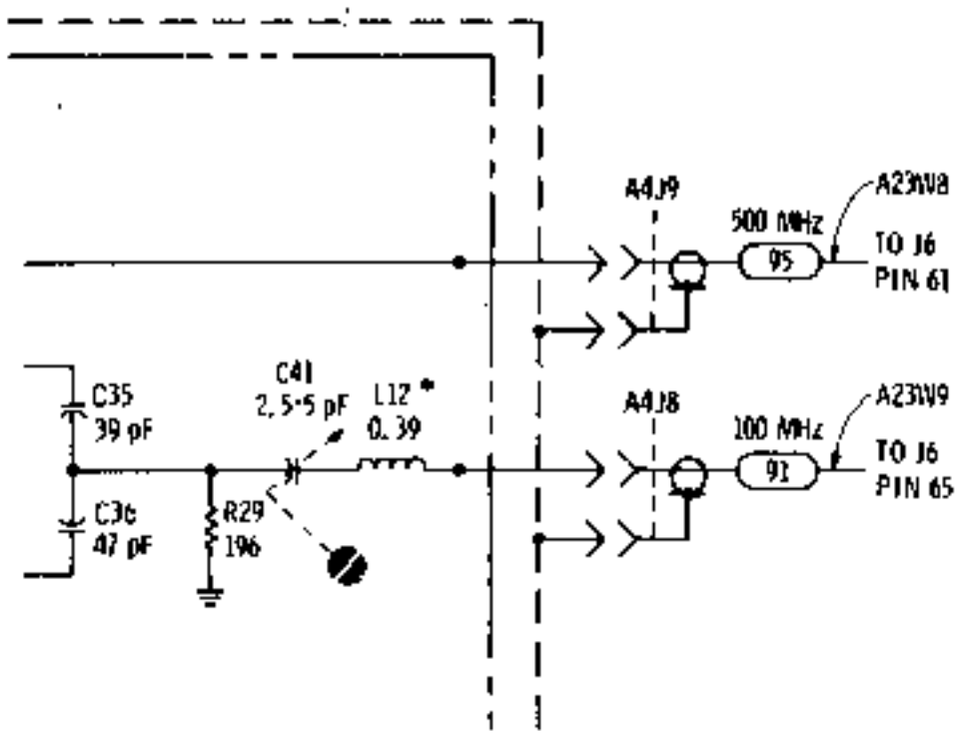


Figure 7-6. Service Sheet 3: Reference VCO and Divider Partial Schematic (Change AD)

Service Sheet 24:
Change the value of A20R7 to 100 ohms.

CHANGE AE

Page 5-1, Table 5-1:
Delete A4A4C10, Reference VCO Assembly.

Page 6-15, Table 6-3:
Change A4A4C10* to A4A4C10, CAPACITOR—FXD 10 PF ±5% 500 WVDC CER

Page 6-21, Table 6-3:
Delete 1205-0011, HEAT DISSIPATOR SGL TO-5/TO-39 PKG.
Delete A6R1, 0811-3410, RESISTOR, .165 1% 25W, 28480, 0698-0082.
Change A5Q1, Q3, and Q5 to 1853-0037, TRST: S1 PNP, 04713, SS2109.
Change A5R10 to 0698-0082, RSTR: 464 ohms, 1% 1/8W, 28480, 0698-0082.
Change A5U3 to 1826-0247, IC VOLTAGE REGULATOR, 12040, LM 305.

Page 6-21, Table 6-3 (cont'd):
Change A6Q1 to A6A1Q1.
Change A6Q2 to A6A1Q2.
Change A6Q4 to A6A1Q4.
Change A6Q5 to A6A1Q5.
Change A6Q7 to A6A1Q7.
Change A6Q8 to A6A1Q8.
Change A6Q10 to A6A1Q10.
Change A6A1CR1 to 1902-3262, DIODE—BREAKDOWN: 24.9V 5% 400 MW, 56289, 160P47492-PMD
Change A6A1Q3 and A6A1Q6 to 1853-0037, TRST: S1 PNP, 1853-0037, SS2109.
Change A6A1Q9 to 1854-0003, TRST: S1 NPN (selected from 2N1711), 28480, 1854-0003.
Add A6A1R8 and A6A1R9, 0812-0019, R: FXD WW 0.33 ohm 5% 3W, 28480, 0812-0019.

Page 6-43, Table 6-3:
Change the A20 Assembly parts lists as shown by the Table 7-4.
Delete A20, 1, 08660-60316.
Delete A20F6, A20F7, and A20F8.
Delete A20R8.
Delete A20XK1 and A20XK2.

Page 6-45, Table 6-3:
Delete CR1, 1901-1001, DIODE MULT SILICONE DUAL (P/O T1).
Delete CR2 and CR3, 1906-0065, DIODE—FW BRDG 100V 10A.
Change the description of T1 to "TRANSFORMER POWER".
Add T1CR1, 1901-1001, DIODE PACKAGE, 28480, 1901-1001.

Service Sheet 3:
Change A4A4C10* to A4A4C10.

Service Sheet 24:
Change the diagram as shown in Figure 7-7.

CHANGE AF

Page 5-1, Table 5-1:
Delete A4A6C6, HF Loop.

Page 6-18, Table 6-3:
Change A4A6C* to A4A6C6.

Table 7-4. Replaceable Parts (P/O Change AE) (1 of 2)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A20	08660-60021	1	Board Assy: Rectifier	28480	08660-60021
A20C1	0180-2369	2	C: FXD AL ELECT 3600 UF +75 —10% 40 VDCW	56289	36D362G040AB2B-DQB
A20C2	0180-1968	1	C: FXD ELECT 18000 UF +75 —10% 40 VDCW	56289	32D183G015BB2B-DQB
A20C3	0180-2369		C: FXD AL ELECT 3600 UF +75 —10% 40 VDCW	56289	36D183G040AB2B-DQB
A20C4	0180-0094	2	C: FXD ELECT 100 UF +75 —10% 25 VDCW	56289	30D107G025DD2-DSM
A20C5	0180-0094		C: FXD ELECT 100 UF +75 —10% 25 VDCW	56289	30D107G025DD2-DSM
A20C6	0180-2334	1	C: FXD AL ELECT 3900 UF +50 —10% 75 VDCW	56289	36D392F075BB2B-DQB
A20C7	0180-2154	1	C: FXD ELECT 1900 UF +75 —10% 15 VDCW	28480	0180-2154
A20C8	0180-0058		C: FXD AL ELECT 50 UF +75 —10% 25 VDCW	56289	30D506G025CC2-DSM
A20C9	0180-0229		C: FXD ELECT 33 UF 10% 10 VDCW	28480	0180-0229
A20C10	0180-0228		C: FXD ELECT 22 UF 10% 15 VDCW	56289	150D22X9015B2-DYS
A20C11	0180-0049		C: FXD ELECT 20 UF +75 —10% 50 VDCW	56289	30D206G050CC2-DSM
A20CR4	1901-0638		DIODE ASSY: S1 FULL WAVE BRIDGE	28480	1901-0638
A20CR5	1901-0364	1	DIODE ASSY: S1 200 PIV/ CELL	28480	1901-0364
A20CR6	1901-0638		DIODE ASSY: S1 FULL WAVE BRIDGE	28480	1901-0638
A20CR7	1884-0024	1	THYRISTOR: 7.4A 200 PIV	04713	SCR 246
A20F1	2110-0036	1	FUSE: CARTRIDGE 8A 125V	75915	312008
A20F2	2110-0332	2	FUSE 3A	71400	GMW 3
A20F3	2110-0047	6	FUSE: CARTRIDGE 1A	71400	TYPE GMW-1
A20F4	2110-0047		FUSE: CARTRIDGE 1A	71400	TYPE GMW-1
A20F5	2110-0047		FUSE: CARTRIDGE 1A	71400	TYPE GMW-1
A20K1	0490-0908	2	RELAY: 4 FORM C 5 AMP	24796	R40-E1-X4-V800
A20K2	0490-0908		RELAY: 4 FORM C 5 AMP	24796	R40-E1-X4-V800
A20MP1	0490-0861	2	RELAY RETAINER: 4/2 FORM C RELAYS	24796	R40-P33
A20R1	0757-0442		R: FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R2	0757-0442		R: FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R3	0757-0442		R: FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442

Table 7-4. Replaceable Parts (P/O Change AE) (2 of 2)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A20R4	0757-0442		R: FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R5	0757-0442		R: FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R6	0757-0442		R: FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A20R7	0757-0198	1	R: FXD MET FLM 100 OHM 1% 1/2W	28480	0757-0198

CHANGE AF (Cont'd)

Page 6-20, Table 6-3:
Change A5 to 08660-60023.

Page 6-21, Table 6-3:
Delete A6, 08660-60275.
Delete A6A3C1, 0160-3679.
Delete A6A3K1, 0490-0643.
Delete A6A3R1, 0698-3629.
Change A7 to 5060-1188.

Page 6-29, Table 6-3:
Delete A13, 08660-60339.
Delete "EXCEPT OPTION 004" from A13.

Page 6-31, Table 6-3:
Delete "EXCEPT OPTION 004" from A13R83.

Service Sheet 4:
Change A4A6C6* to A4A6C6, 18 pF.

Service Sheet 24:
Change the schematic as shown in Figure 7-8.
Change A5 to 08660-60023.

CHANGE AG

Page 6-14, Table 6-3:

NOTE

Refer to paragraph 7-16 for modifications.

CHANGE AH

Page 6-36, Table 6-3:
Change A17C16 to 0170-0082, C: FXD DY 0.01 UF 20% 50 VDCW.

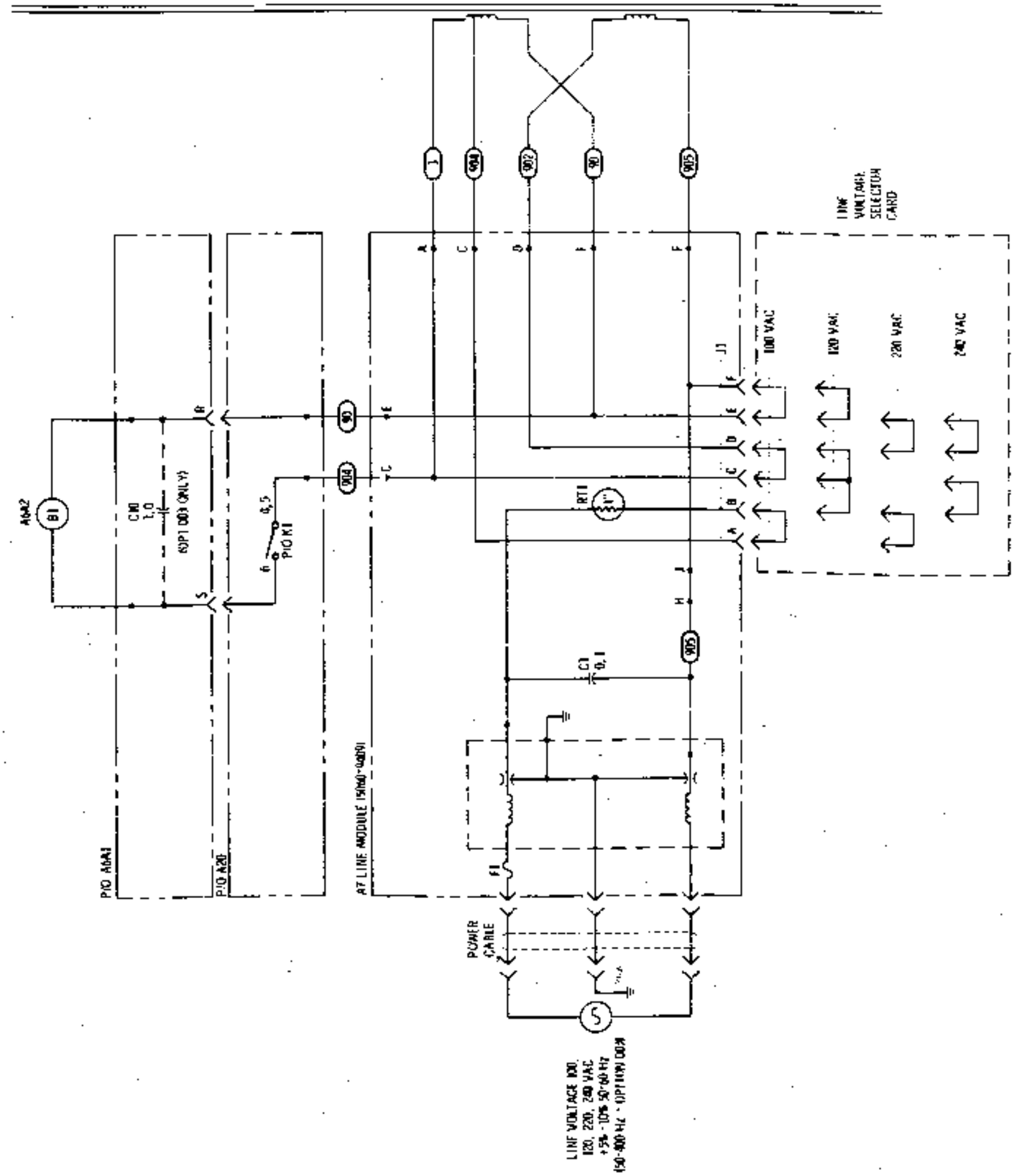
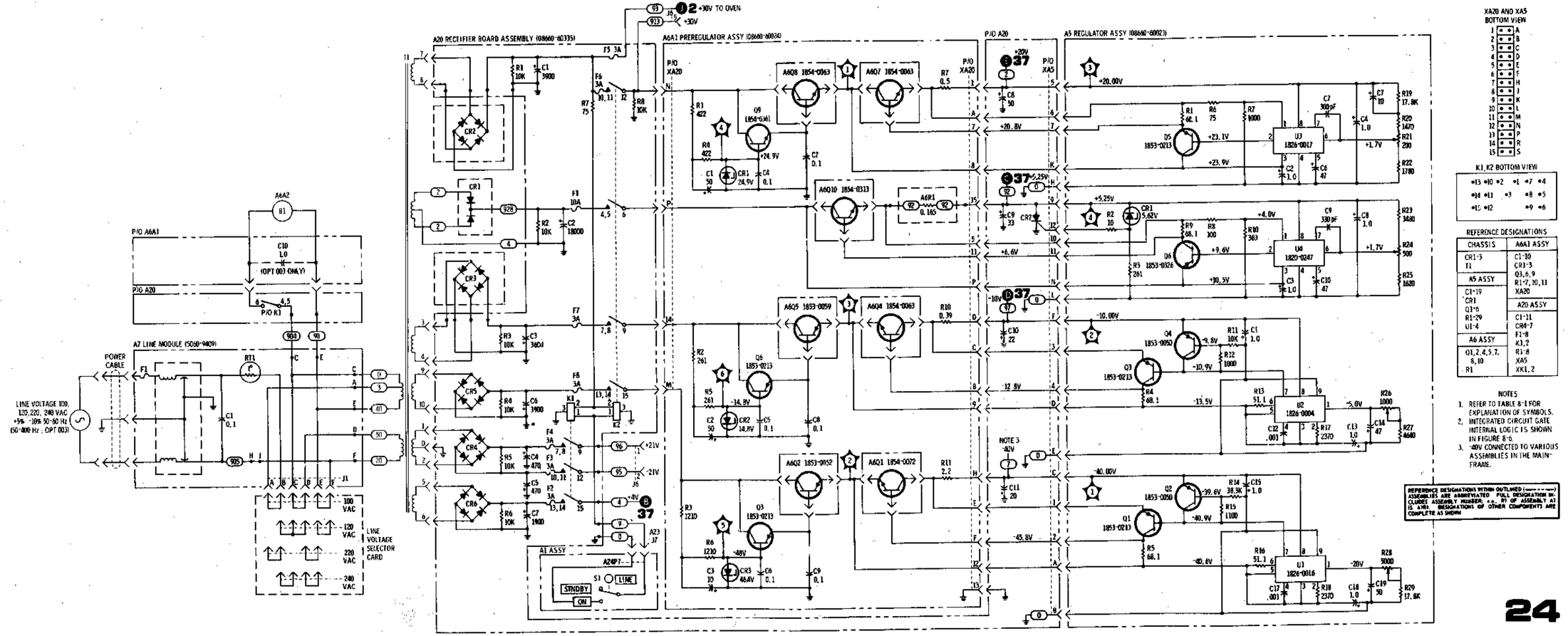


Figure 7-7. Service Sheet 24: Power Supply Schematic (P/O Change AE)



24

Figure 7-8. Service Sheet 24: Power Supply Schematic (P/O Change AF)

CHANGE A1

Table 6-3:
Change the A3A1 Assembly (OPT 005) parts list as shown in the table (Part of Change A1).

Figure 8-63A:
Change to the component location diagram (Part of Change A1).

Figure 8-64 A (Service Sheet 22A):
Change the schematic diagram as shown (Part of Change A1).

Table 7-5. Replaceable Parts (Part of Change A1)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			OPTION 005 ONLY		
A3A1	08660-60284	1	HP-IB OUTPUT ASSEMBLY	28480	08660-60284
A3A1C1	0180-0197	5	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C2	0180-0197		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C3	0160-0301	1	CAPACITOR-FXD .012UF +-10% 200VDC POLYE	56289	292P12392
A3A1C4	0180-0373	1	CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	150D684X9035A2
A3A1C5	0180-1746	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1CR1	1901-0040	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A1Q1	1854-0071	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3A1Q2	1853-0020	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A3A1R1	0698-3160	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3162-F
A3A1R2	0757-0442	9	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3A1R3	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3A1R4	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3A1R5	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3A1R6	0757-0394	1	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-TO-51R1-F
A3A1R7	0698-3435	1	RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-TO-38R3-F
A3A1R8	0757-0279	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3161-F
A3A1R9	0757-0278	3	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1781-F
A3A1R10	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1781-F
A3A1R11	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1781-F
A3A1R12	0757-0199	9	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A3A1R13	0757-0199		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A3A1R14	0757-0199		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A3A1R15	0757-0199		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A3A1R16	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A3A1R17	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A3A1R18	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A3A1R19	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A3A1R20	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A3A1U1	1820-0054	3	IC-DIGITAL SN7400N TTL QUAD 2 NAND	01295	SN7400A
A3A1U2	1820-0328	1	IC-DIGITAL SN7402V TTL QUAD 2 NOR	01295	SN7402A
A3A1U3	1820-0511	3	IC-DIGITAL SN7408N TTL QUAD 2 AND	01295	SN7408A
A3A1U4	1820-0214	1	IC-DIGITAL SN7442N TTL 4 BCD-TO-DEC	01295	SN7442N
A3A1U5	1820-0134	1	IC-DIGITAL 9300DC TTL D-TYPE PRL-IN	07263	9300DC
A3A1U6	1820-0579	1	IC-DIGITAL SN74123N TTL DUAL	01295	SN74123N
A3A1U7	1820-0076	1	IC-DIGITAL SN7476N TTL DUAL J-K	01295	SN7476N
A3A1U8	1820-0372	1	IC-DIGITAL SN74H11N TTL H TPL 3 AND	01295	SN74H11N
A3A1U9	1820-0054		IC-DIGITAL SN7400N TTL QUAD 2 NAND	01295	SN7400N
A3A1U10	1820-0174	3	IC-DIGITAL SN7404N TTL HEX 1	01295	SN7404N
A3A1U11	1820-0065	1	IC-DIGITAL SN7470N TTL J-K	01295	SN7470N
A3A1U12	1820-0535	1	IC-DIGITAL SN75451BP TTL DUAL 2 AND	01295	SN75451BP
A3A1VR1	1902-3059	1	DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=+.051%	15818	CD 35586
			A3A1 MISCELLANEOUS		
	1251-2361	AR	CONTACT-CONN MALE DPSLDR	00779	86091-2

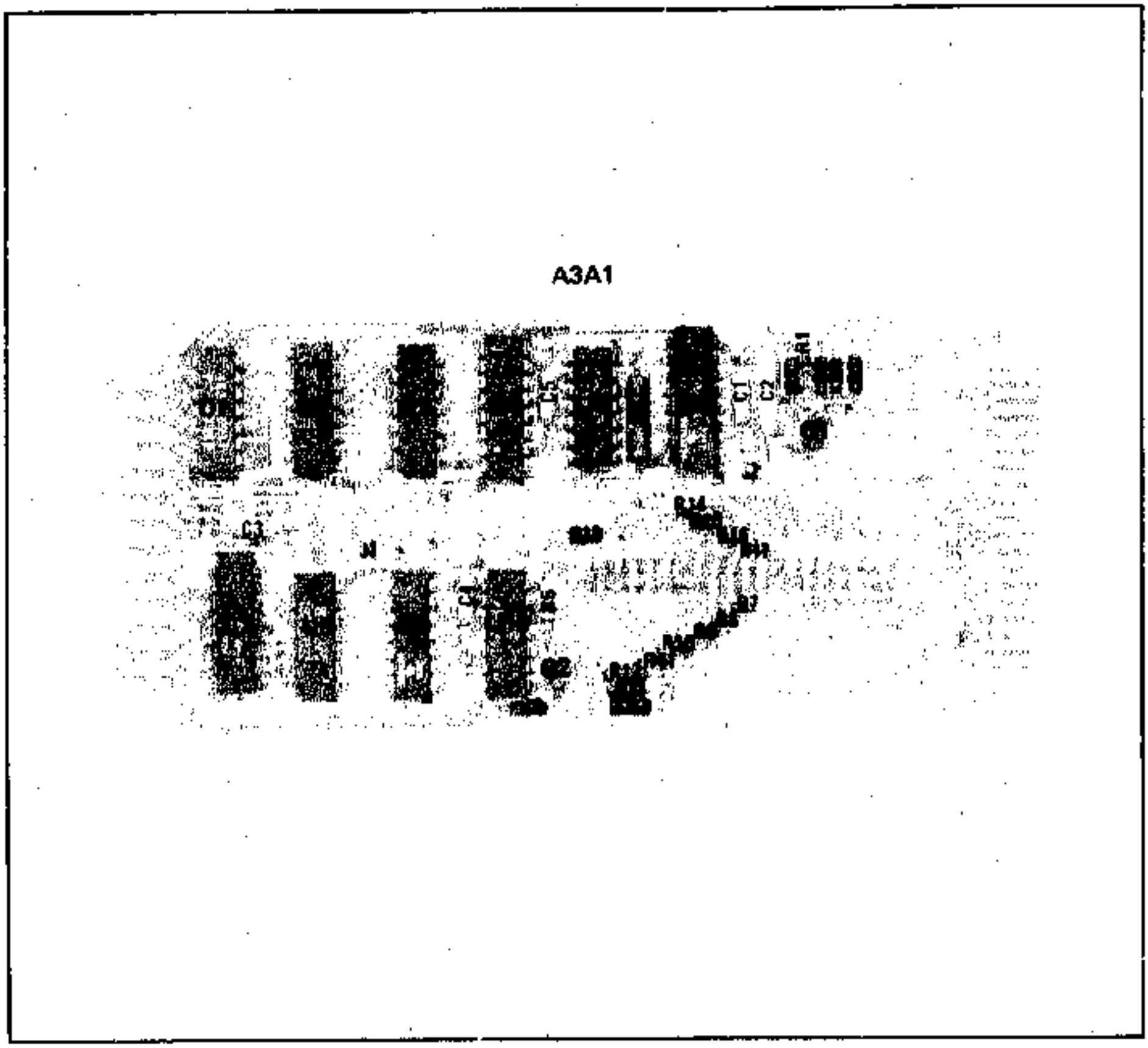


Figure 7-9. HP-IB (Option 005) Output Assembly (A3A1) Component Locations (Part of Change AI)

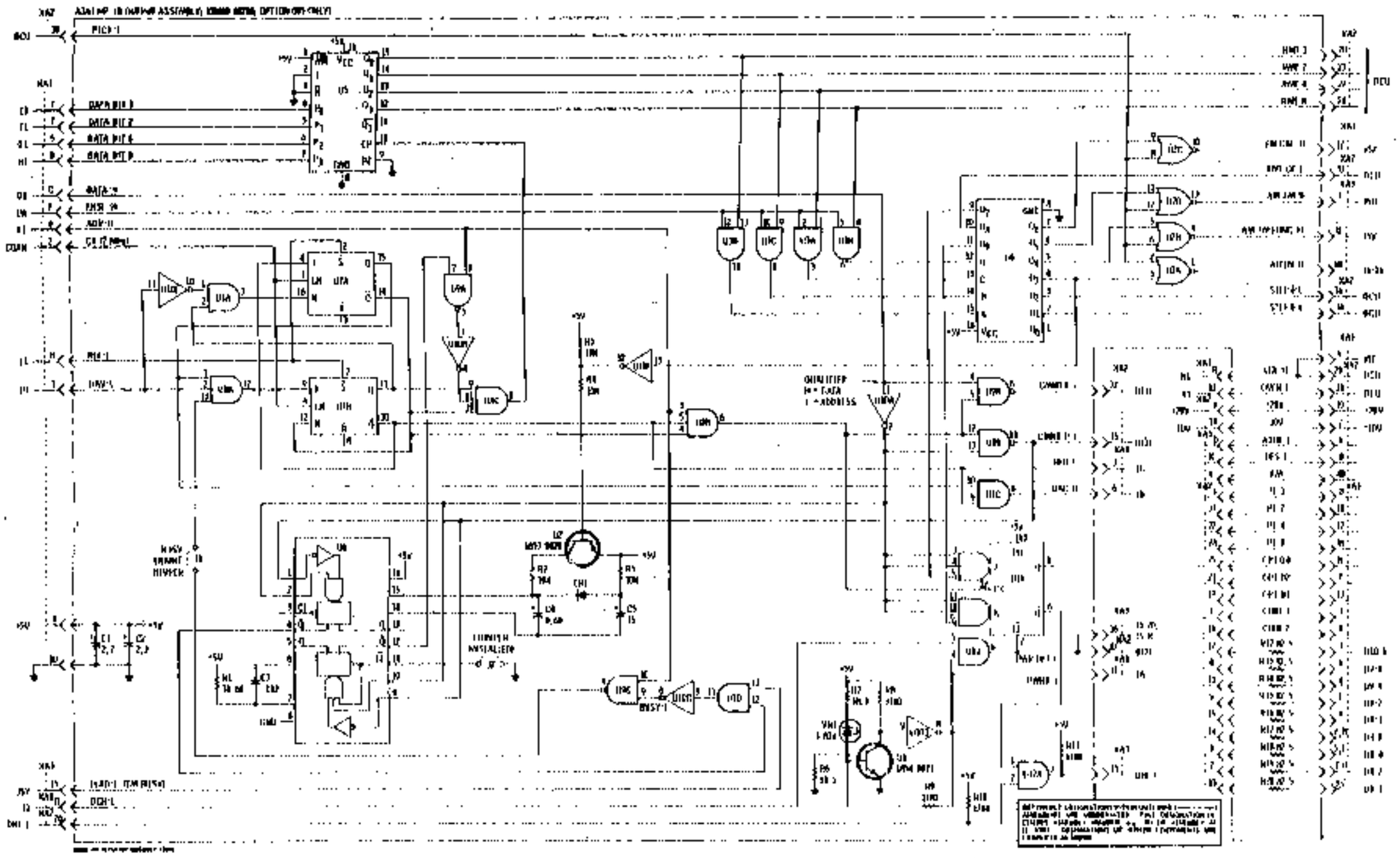


Figure 7-10. HP-IB (Option 005) Output Assembly Schematic (Part of Change A1)

CHANGE AJ

Table 6-3:
Change the A3A1 Assembly parts list as shown in the table (Part of Change AJ).

Figure 8-63:
Change to the component location diagram (Part of Change AJ).

Figure 8-64 (Service Sheet 22):
Change the schematic diagram as shown (Part of Change AJ).

Table 7-6. Replaceable Parts (Part of Change AJ)

Reference Designation	HP Part Number	C O	Qty	Description	Mfr Code	Mfr Part Number
A3A1	08660-60278	0	1	FRONT INTERFACE ASSEMBLY, ECO	28480	08660-60278
A3A1C1	0160-0154	5	1	CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A3A1C2	0160-0197	8	3	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C3	0160-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C8	0160-0197	8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A3A1C5	0160-1746	9	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A3A1C6	0160-0373	2	1	CAPACITOR-FXD .68UF+-10% 35VDC TA	56289	130D684X9035A2
A3A1CR1	1902-3099	0	1	DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=-.051%	28480	1902-3099
A3A1CR2	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3A1Q1	1855-0020	4	1	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A3A1Q2	1854-0071	7	3	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3A1Q3	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3A1Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3A1R1	0698-3157	3	2	RESISTOR 14.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1432-F
A3A1R2	0698-3157	3		RESISTOR 14.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1432-F
A3A1R3	0698-3439	0	1	RESISTOR 30.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-30R1-F
A3A1R4	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3A1R5	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A3A1R6	0757-0442	0	5	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R7	0757-0442	0		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R8	0757-0442	0		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R9	0757-0442	0		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R10	0757-0442	0		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3A1R11	0757-0399	5	9	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R12	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R13	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R14	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R15	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R16	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R17	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R18	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R19	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A3A1R20	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A3A1U1	1820-0174	0	1	IC INV TTL HEX	01295	SN7404N
A3A1U2	1820-0077	2	1	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A3A1U3	1820-0049	2	1	IC GATE TTL NAND DUAL 4-INP	01295	SN7420N
A3A1U4	1820-0054	5	1	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A3A1U5	1820-0214	9	1	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN7442AN
A3A1U6	1820-0520	6	1	IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A3A1U7	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN74S02N
A3A1U8	1820-0207	0	1	IC MV TTL MONOSTBL RETRIG/RESET	04713	MC8601P
A3A1U9	1820-0072	7	2	IC GATE TTL AND-OR-INV DUAL 2-INP	01295	SN7450N
A3A1U10	1820-0072	7		IC GATE TTL AND-OR-INV DUAL 2-INP	01295	SN7450N
A3A1U11	1820-0328	6		IC GATE TTL NOR QUAD 2-INP	01295	SN74S02N
A3A1XA1	1251-1626	2	2	CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1626
A3A1XA2	1251-2341	4	1	CONTACT-CONN MALE DPSLDR (NO CONTACTS)	28480	1251-2341
A3A1XA3	1251-2663	9	2	CONNECTOR-PC EDGE 10-CONT/ROW 2-ROWS	28480	1251-2663
A3A1XA4	1251-1626	2		CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1626
A3A1XA5	1251-2663	9		CONNECTOR-PC EDGE 10-CONT/ROW 2-ROWS	28480	1251-2663

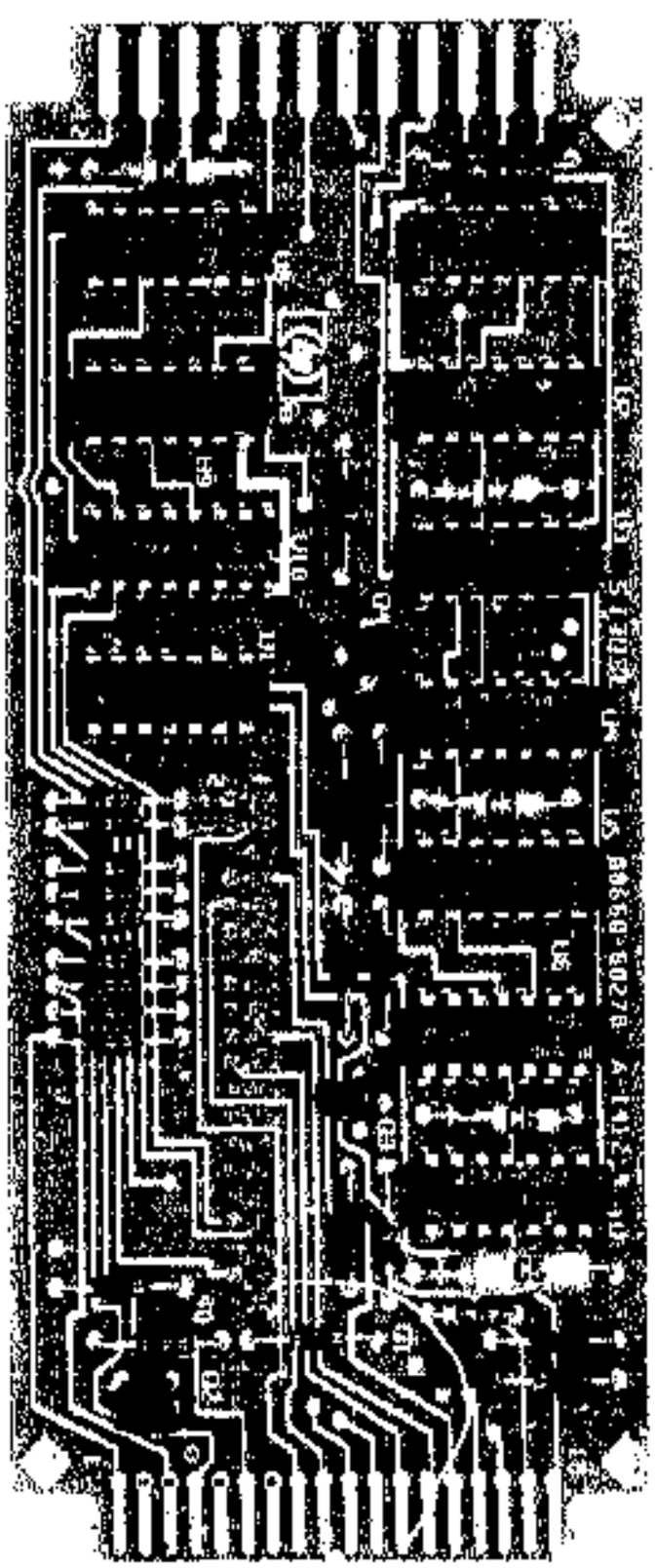


Figure 7-11. A3A1 Front Interface Board Component Locations (Part of Change AJ)

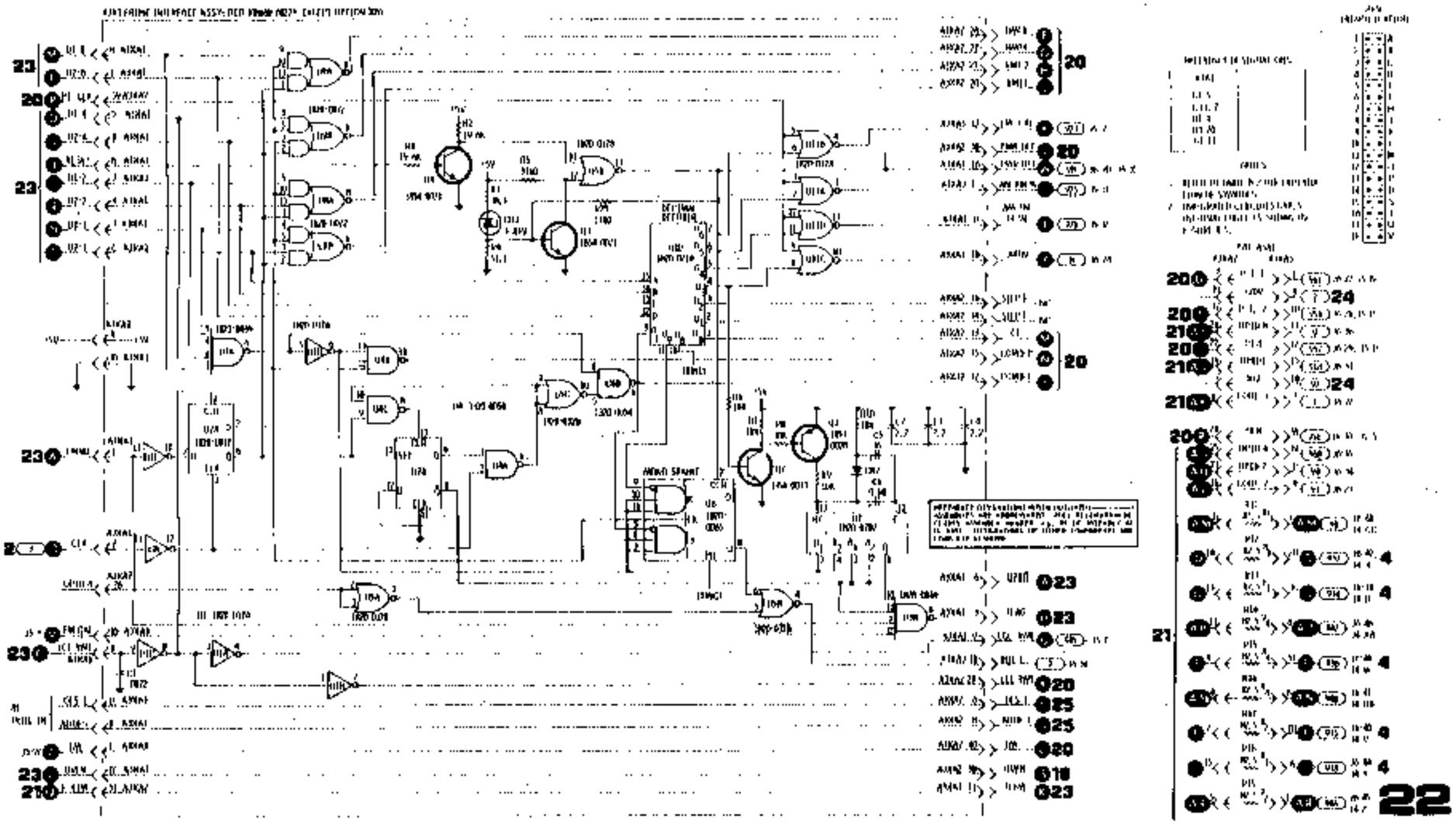


Figure 7-12. Front Interface Board Schematic (Part of Change AJ)

BACK DATING MANUAL CHANGES CON'T

CHANGE AK

Table 6-3:
Change A19C14 and C17 to 0160-4084 CAPACITOR-FXD 0.1UF ±20% 50WVDC CER.
Delete A20CR8.

Figure 8-47 (Service Sheet 17):
Change A19C14 and C17 to 0.1 μF.

Figure 8-71 (Service Sheet 24):
Delete the diode A20CR8 that has the cathode connected to A20K1 and K2 pins 2, and anode connected to A20K1 and K2 pins 1.

CHANGE AL

Table 6-3:
Delete the A25 Assembly

Figure 8-71 (Service Sheet 24):
Delete the A25 +30V Regulator Assembly.

CHANGE AM

Table 6-3:
Change the A3A1 Assembly parts list as shown in the table (Part of Change AM).

Figure 8-63:
Change to the component location diagram (Part of Change AM).

Figure 8-64 (Service Sheet 22):
Change the schematic diagram as shown (Part of Change AM).

Table 7-7. Replaceable Parts (Part of Change AM)

Reference Designation	HP Part Number	Qty	Description
A3A1	08660-60340	1	ASSEMBLY, FRONT INTERFACE (EXCEPT OPTION 005)
A3A1C1	0160-0154	1	CAPACITOR-FXD; 2200 pF +-10% 200WVDC POLYE
A3A1C2	0180-2208		CAPACITOR-FXD; 220 UF +-10% 10VDC TA
A3A1C3	0180-1746		CAPACITOR-FXD; 15 UF +-10% 20VDC TA-SOLID
A3A1C4	0180-0373		CAPACITOR-FXD; 0.68 UF +-10% 35VDC TA
A3A1C5	0180-0197		CAPACITOR-FXD; 2.2 UF +-10% 20VDC TA
A3A1C6	0180-0197		CAPACITOR-FXD; 2.2 UF +-10% 20VDC TA
A3A1C7	0180-0197		CAPACITOR-FXD; 2.2 UF +-10% 20VDC TA
A3A1CR1	1901-0539		DIODE-SCHOTTKY
A3A1CR2	1901-0040		DIODE-SWITCHING 30V 50NA 2NS DO-35
A3A1Q1	1853-0020		TRANSISTOR PNP SI PD=300 MW FT=150 MHZ
A3A1Q2	1854-0071		TRANSISTOR NPN SI PD=300 MW FT=200 MHZ
A3A1Q3			NOT ASSIGNED
A3A1Q4	1854-0071		TRANSISTOR NPN SI PD=300 MW FT=200 MHZ
A3A1R1	0698-3157		RESISTOR 19.6K 1% .125W F TC=0+-100
A3A1R2	0698-3157		RESISTOR 19.6K 1% .125W F TC=0+-100
A3A1R3	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100
A3A1R4	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100
A3A1R5	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100
A3A1R6	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100
A3A1R7	0757-0442		RESISTOR 10K 1% .125W F TC=0+- 100
A3A1R8	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100
A3A1R9	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100
A3A1R10	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100
A3A1R11	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100
A3A1R12	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100
A3A1R13	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100
A3A1R14	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100
A3A1R15	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100
A3A1R16	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100
A3A1U1	1820-0174		IC SN74 04N INV
A3A1U2	1820-0077		IC SN74 74 N FLIP-FLOP
A3A1U3	1820-0069		IC SN74 20 N GATE
A3A1U4	1820-0054		IC SN74 00 N GATE
A3A1U5	1820-0328		IC SN74 02 N GATE
A3A1U6	1820-0065		IC SN74 70 N FLIP-FLOP
A3A1U7	1820-0207		IC MV
A3A1U8	1820-0072		IC SN74 50 N GATE
A3A1U9	1820-0072		IC SN74 50 N GATE
A3A1U10	1820-0214		IC SN74 42 N DECODER
A3A1U11	1820-0328		IC SN74 02 N GATE
A3A1U12	1820-1056		IC SN74 132 N COUNTER
			A3A1 MISCELLANEOUS
	1251-2361		CONN-PC

A3A1

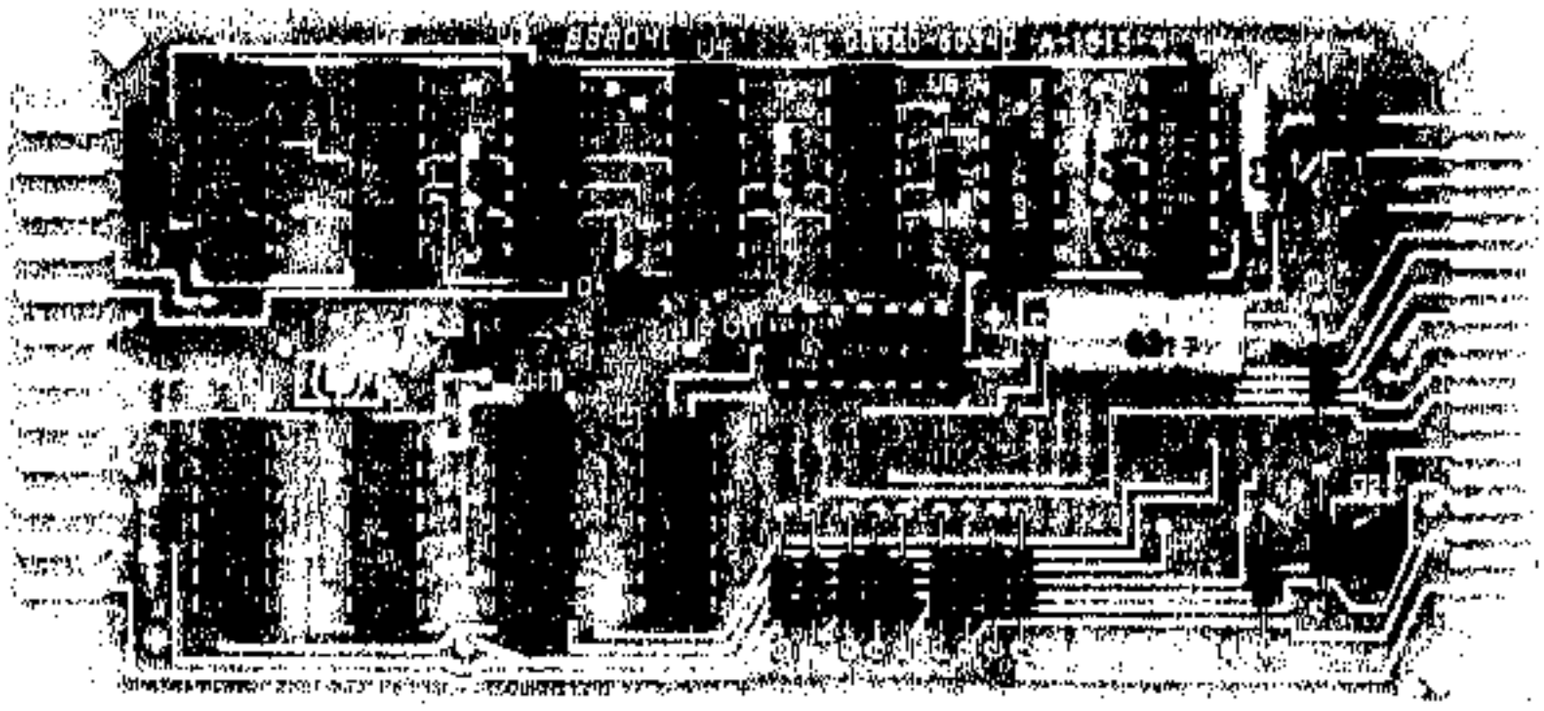


Figure 7-13. Option 005 A3A1 Component Locations (Part of Change AM)

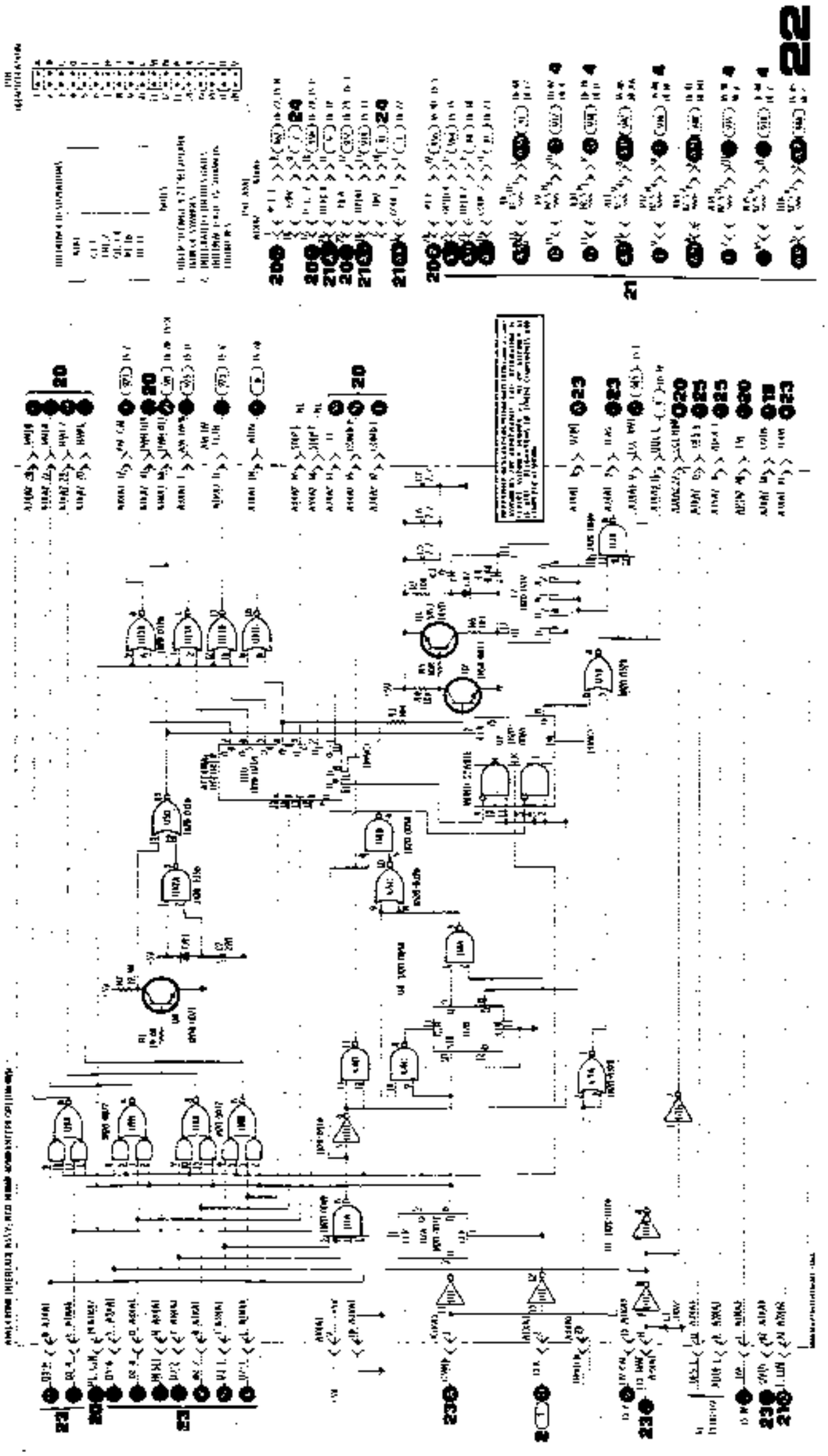


Figure 7-14. Front Interface Board Schematic (Part of Change AM)

CHANGE AN

Table 6-3:
Change the A1A6 Assembly parts list as shown in the table (Part of Change AN).

Figure 8-56:
Change the component locations diagram (Part of Change AN).

Figure 8-57:
Change the schematic diagram (Part of Change AN).

CHANGE AO

Table 6-3:
Change A5C12 to 0160-2218 CAPACITOR-FXD 1000 PF ±5% 300 WVDC MICA.

Figure 8-71 (Service Sheet 24):
Change A5C12 to .001.

CHANGE AP

Paragraph 1-49, item b:
Change Accessory Kit part number to 5001-0161.

CHANGE AQ

Table 6-3:
Change A20 to 08660-60316.
Change A20CR5 to 1901-0364 DIODE FW BRDG 200V 1A.

Figure 8-71 (Service Sheet 24):
Change the A20 Schematic Assembly Part No. to 08660-60316.

CHANGE AR

Table 6-3:
Add to the A1A5 Assembly:
DS1 2140-0427 LAMP-IN CAND 5VDC 60MA T-1-BULB
DS2 2140-0427 LAMP-IN CAND 5VDC 60MA T-1-BULB
Q1 1854-0071 TRANSISTOR NPN SI PD=300MW FT=200MHZ
Q2 1854-0071 TRANSISTOR NPN SI PD=300MW FT=200MHZ
R1 0757-0416 RESISTOR 511 1% .125W F TC=0±100
R2 0757-0416 RESISTOR 511 1% .125W F TC=0±100
U2 1820-0511 IC-DIGITAL SN7408N TTL QUAD 2 AND

Table 7-8. Replaceable Parts (P/O Change AN)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1A6	08660-60030	2	1	BOARD ASSEMBLY, CONTROL	28480	08660-60030
A1A6C1	0160-2204	0	5	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A1A6C2	0160-3456	6	3	CAPACITOR-FXD 1000PF +-10% 100VDC CER	28480	0160-3456
A1A6C3	0160-2209	5	5	CAPACITOR-FXD 56PF +-5% 300VDC MICA	28480	0160-2209
A1A6C4	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A1A6C5	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A1A6C6	0180-3286	0	1	CAPACITOR-FXD 68UF+-10% 6VDC TA	56289	150D686X9006B2
A1A6C7	0180-0197	8	5	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C8	0180-0197	0		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C9	0180-0197	0		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C10	0180-0197	0		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C11	0180-0197	0		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A1A6C81	1901-0040	1	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6C82	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1A6Q1	1854-0071	7	1	TRANSISTOR NPN SI PD=300MW FT=250MHZ	28480	1854-0071
A1A6R1	0757-0416	7	6	RESISTOR 5K1 1% .125W F TC=0+-100	24546	C8-1/8-T0-511R-F
A1A6R2	0757-0416	7		RESISTOR 5K1 1% .125W F TC=0+-100	24546	C8-1/8-T0-511R-F
A1A6R3	0757-0416	7		RESISTOR 5K1 1% .125W F TC=0+-100	24546	C8-1/8-T0-511R-F
A1A6R4	0757-0416	7		RESISTOR 5K1 1% .125W F TC=0+-100	24546	C8-1/8-T0-511R-F
A1A6R5	0757-0416	7		RESISTOR 5K1 1% .125W F TC=0+-100	24546	C8-1/8-T0-511R-F
A1A6R6	0757-0433	9	2	RESISTOR 16K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1602-F
A1A6R7	0757-0416	7		RESISTOR 5K1 1% .125W F TC=0+-100	24546	C8-1/8-T0-511R-F
A1A6R8	0757-0442	9		RESISTOR 16K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1602-F
A1A6R9	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	C8-1/8-T0-1001-F
A1A6U1	1820-0511	9	2	IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A1A6U2	1820-0072	7		IC GATE TTL AND-OR-INV DUAL 2-INP	01295	SN7450N
A1A6U3	1820-0568	4	4	IC RGTR TTL BFR 16-BIT	18324	N8203N
A1A6U4	1820-0568	4		IC RGTR TTL BFR 16-BIT	18324	N8203N
A1A6U5	1820-0054	5	4	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U6	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U7	1820-0202	1	1	IC GATE TTL EXCL-OR QUAD 2-INP	01295	SN7486N
A1A6U8	1820-0072	7		IC GATE TTL AND-OR-INV DUAL 2-INP	01295	SN7450N
A1A6U9	1820-0077	2	1	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A1A6U10	1820-0328	4	4	IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A1A6U11	1820-0328	4		IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A1A6U12	1820-0174	0	2	IC INV TTL HEX	01295	SN7404N
A1A6U13	1820-0568	4		IC RGTR TTL BFR 16-BIT	18324	N8203N
A1A6U14	1820-0568	4		IC RGTR TTL BFR 16-BIT	18324	N8203N
A1A6U15	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U16	1820-0511	9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A1A6U17	1820-0054	5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A1A6U18	1820-0174	0		IC INV TTL HEX	01295	SN7404N
A1A6U19	1820-0492	5	1	IC CNTR TTL BIN ASYNCHRO NEG-EDGE-TRIG	18324	N8291A

See introduction to this section for ordering information
*Indicates factory selected value

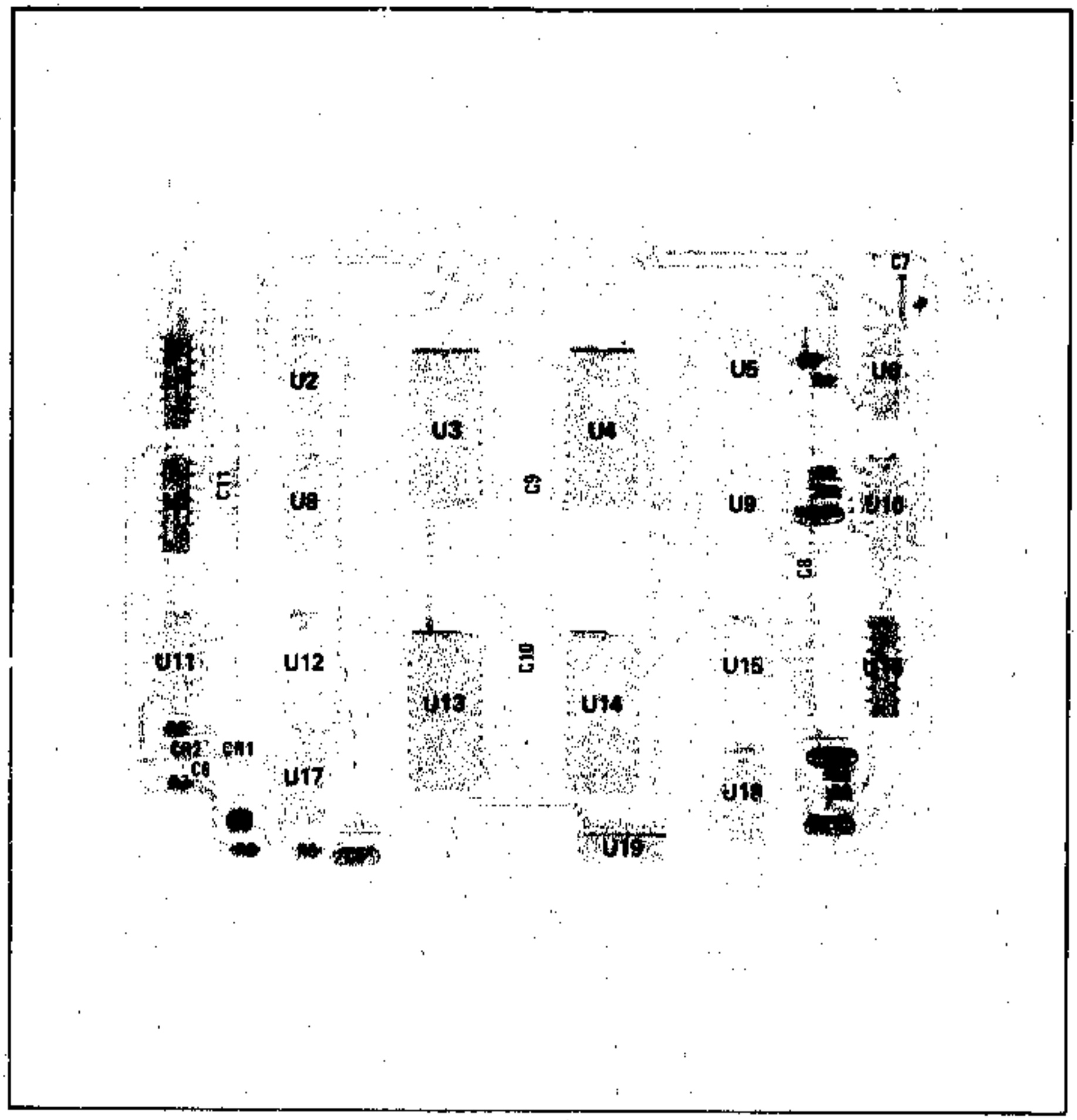


Figure 7-15. A1A6 Thumbwheel Control Board Component Locations (Part of Change AN).

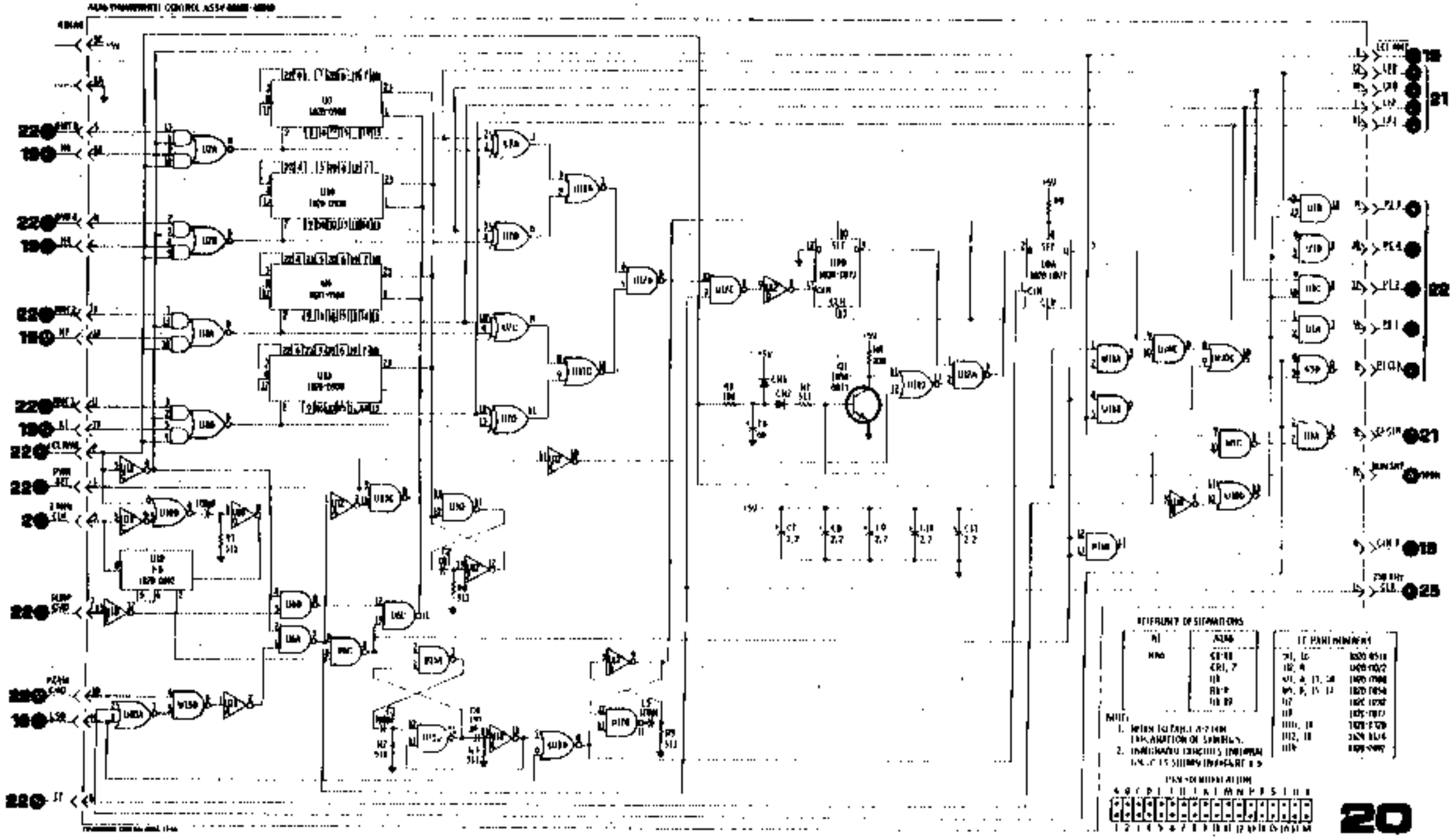


Figure 7-16. Thumbwheel Control Board Schematic (Part of Change AN)

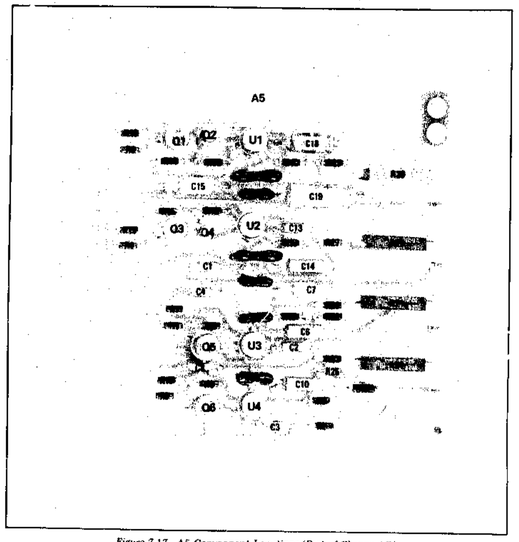


Figure 7-17. A5 Component Locations (Part of Change AO)

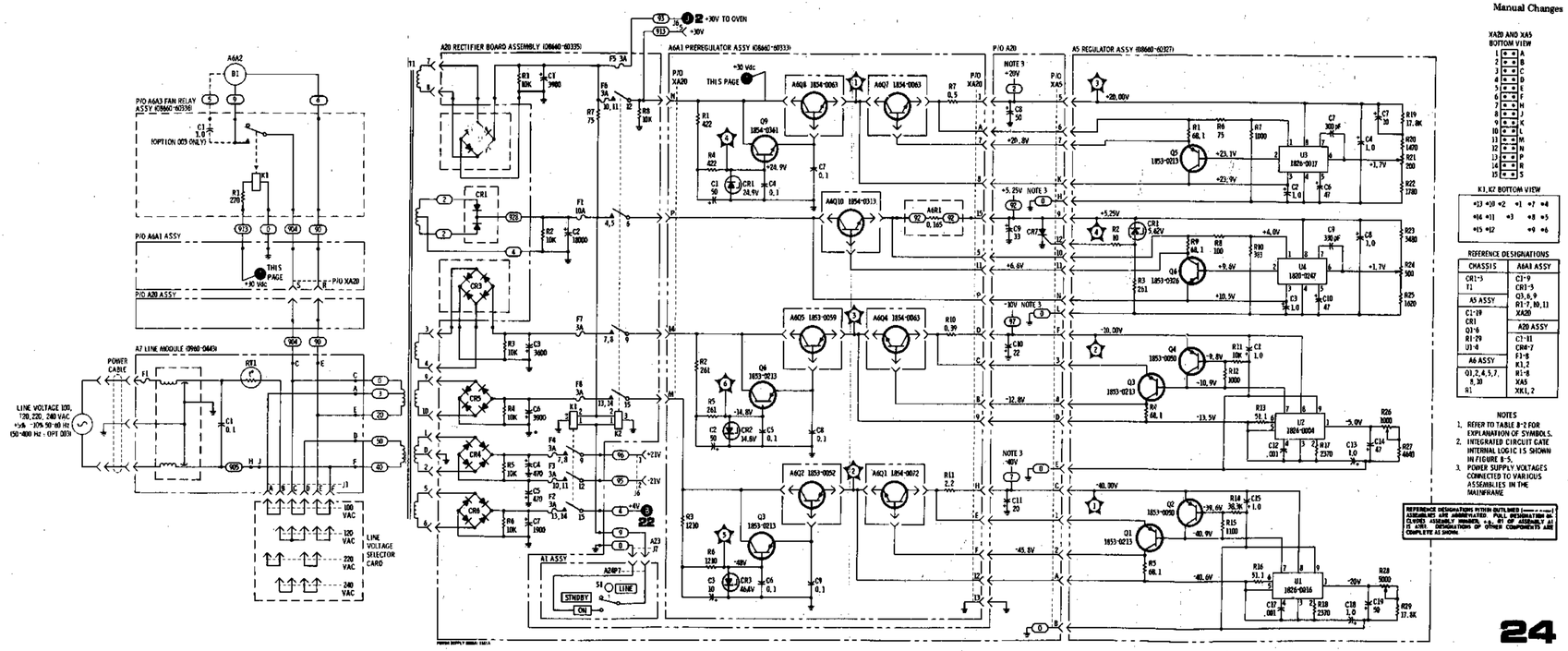


Figure 7-18. Power Supply Schematic (Part of Change AO)

A20 BOTTOM VIEW

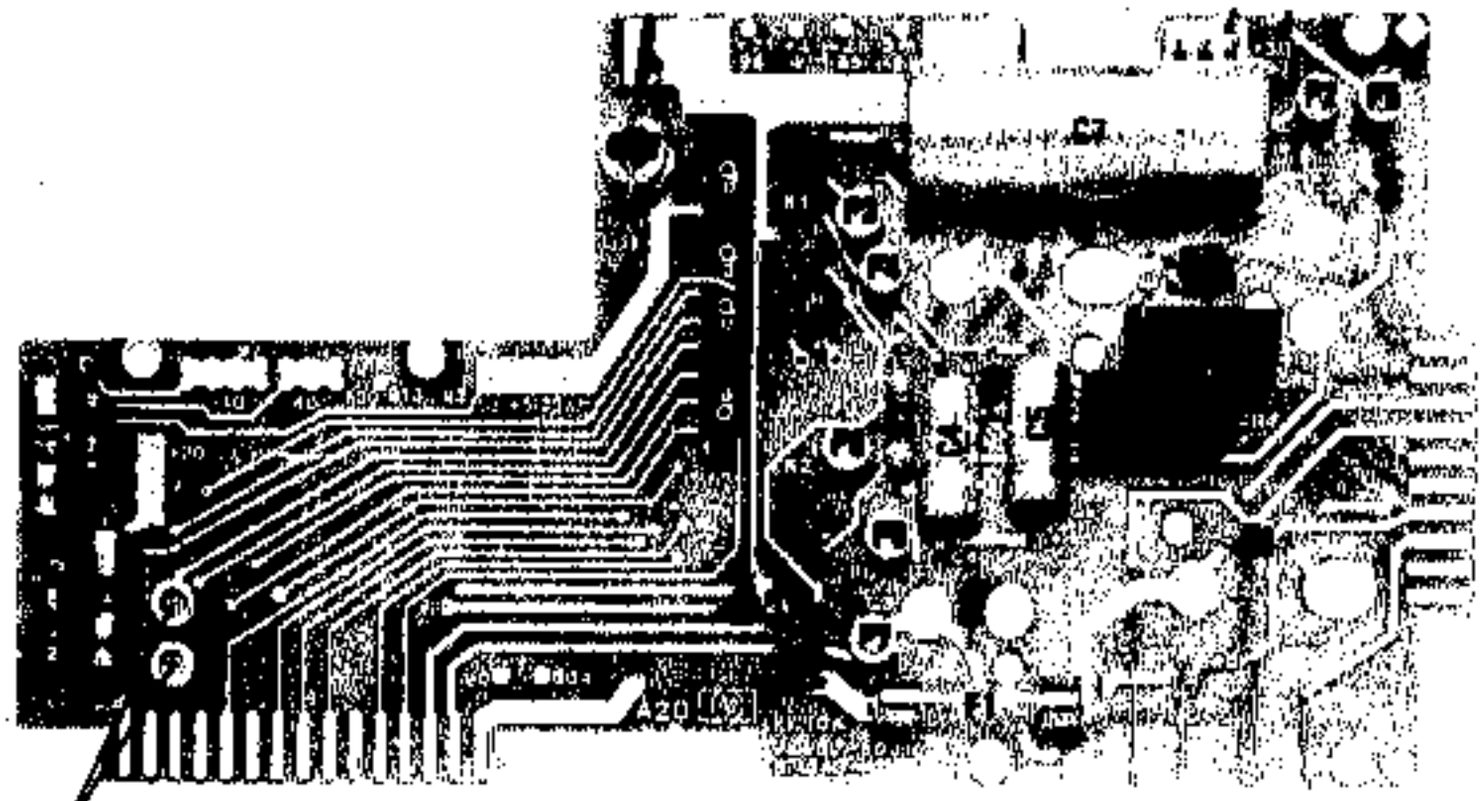


Figure 7-19. A20 Bottom Component Locations (Part of Change AQ)

7-7. Hewlett-Packard has developed certain recommended instrument modifications that can be used to improve the performance and reliability of earlier versions of the instrument. In some cases, replacing certain parts requires a modification to make these instruments compatible with parts now in use (if the original part is no longer available). These modifications are outlined in the following procedures and are keyed to instruments by serial number or serial number prefix.

7-8. HIGH FREQUENCY SECTION ADJUSTMENT - Serial Prefix 1225A And Below

REFERENCE:

Service Sheets 4, 5 and 6.

DESCRIPTION:

The High Frequency Section contains a voltage controlled oscillator which provides eleven discrete output frequencies from 350 to 450 MHz in 10 MHz steps. The output of the voltage controlled oscillator is phase locked to a 10 MHz reference derived from the master oscillator in the reference section. The output from the HF section is used in the RF section plug-in or in the internal extension plug-in module. These checks verify proper operation of the High Frequency Section circuits.

EQUIPMENT:

Electronic Counter	HP 5245M/5253B
Digital Voltmeter	HP 3440A/3443A
Pulse Generator	HP 222A
Spectrum Analyzer	HP 140/8554B/8552/8553
Oscilloscope (with 10:1 divider probes)	HP 180A/1801A/1821A
Signal Generator/Sweeper	HP 8601A

PROCEDURE:

Preliminary: Remove the covers from the A4A7 phase detector assembly and the A4A6 pretune assembly. Tighten the screws holding the A4A5 voltage controlled oscillator assembly cover.

1. Phase Detector Response Adjustments.

a. Disconnect the coaxial cable from VCO INPUT A4A7J1. Connect the PULSE OUTPUT of the pulse generator to A4A7J1. Set the pulse generator for 100 kHz pulse rate, .035 pulse width, .5 volt amplitude and + polarity.

b. Connect the Spectrum Analyzer RF INPUT to the phase error output of the A4A7 assembly (white wire going from the A4A7 assembly to the A4A6 assembly). Set the analyzer controls as follows:

CENTER FREQUENCY	5 MHz
SCAN WIDTH PER DIVISION	1 MHz
SCAN TIME PER DIVISION	1 ms
Gain and attenuation	as required

c. Adjust EFFiciency control A4A7R18 for a flat response to approximately 5 MHz with very slight peaking (1 dB ± 1 dB). See the waveform in Figure 7-20 for typical response.

d. Disconnect the pulse generator and the Spectrum Analyzer.

7-8. HIGH FREQUENCY SECTION ADJUSTMENT (Cont'd)

2. Balance Adjustment.

a. Connect the digital voltmeter to the phase error output of the A4A7 assembly (white wire going from the A4A7 assembly to the A4A6 assembly).

b. Adjust the BALance control (A4A7R22) for a reading of 0 volts ± .05 volt. Disconnect the digital voltmeter.

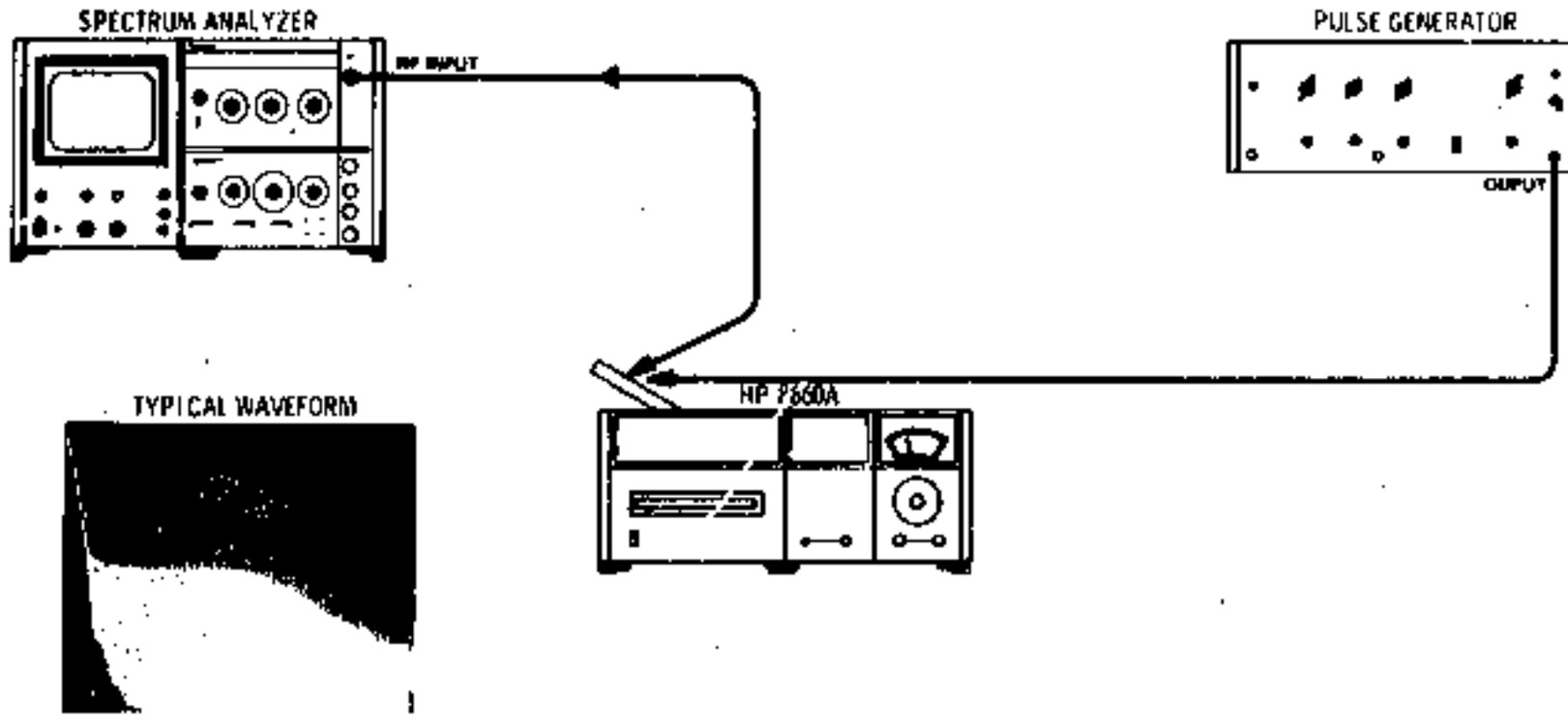


Figure 7-20. Phase Detector Response Adjustment Test Setup

3. Voltage controlled oscillator adjustment. (See Figure 7-21.)

a. With the output cable of the A4A5 assembly disconnected from the VCO OUTPUT, connect the digital voltmeter to the A4A6 FREQuency control output (white lead).

b. Adjust the A4A6 "0" control (A4A6R13) for a digital voltmeter reading of −34 volts (voltage should be adjustable from about −33 to −35 volts).

c. Connect the electronic counter to the A4A5 voltage controlled oscillator output, A4A5J1. Remove the cover from the A4A5 assembly.

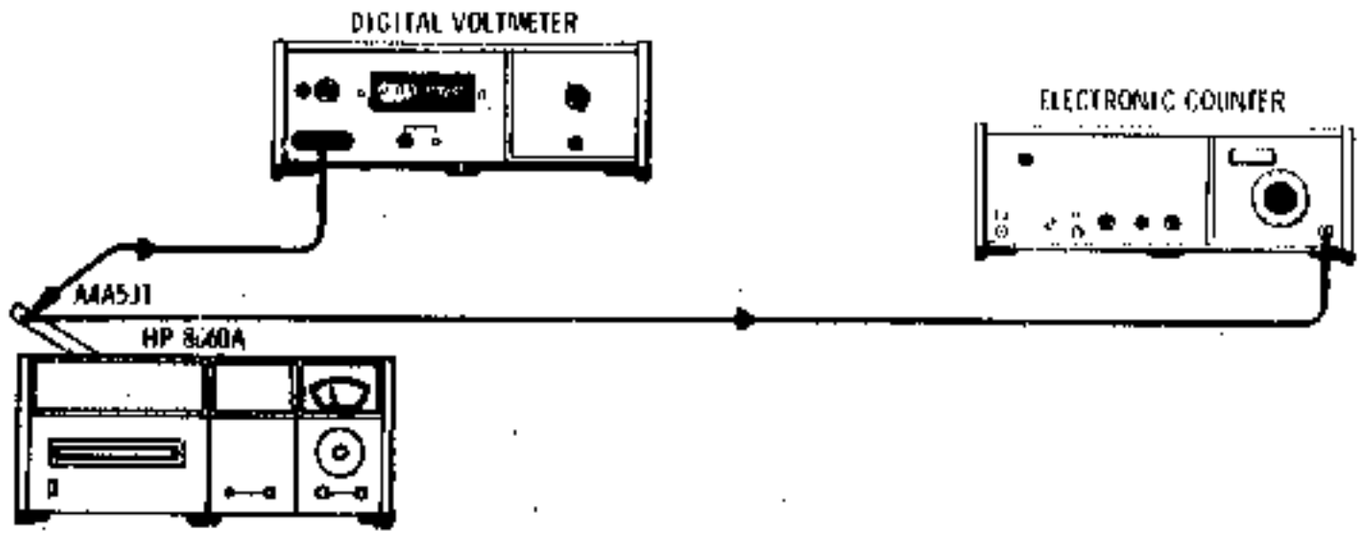


Figure 7-21. Voltage Controlled Oscillator Adjustment Test Setup

7-8. HIGH FREQUENCY SECTION ADJUSTMENT (Cont'd)

d. Replace the A4A5 cover and hold firmly against the casting. The counter should display 450 MHz ± 1 MHz. If the correct reading is obtained proceed to step f. If the frequency reading is not correct proceed to step 3.

e. Adjust capacitor C3 (on A4A5) for a 450 MHz ± 1 MHz counter reading. Replace the A4A5 cover and hold firmly in place to take this reading.

f. Disconnect the electronic counter and reconnect the voltage controlled oscillator output to the phase detector. Fasten the A4A5 cover in place.

g. Connect the digital voltmeter to the lead labeled ϕ from the A4A7 assembly to the A4A6 assembly. Connect the electronic counter to A4A5J2 (350-450 MHz OUTPUT).

h. Set the thumbwheels for the frequencies shown in Table 5-4 and set the digital to analog controls on the A4A6 assembly for ϕ ± 0.1 volt for each frequency listed. Note that the counter displays the output frequency listed for each thumbwheel frequency setting.

Table 7-9. Pretune Adjustments

Thumbwheels settings	Adjust Control	Counter Readout
0000000000	A4A6R13 "0"	450.000000 MHz
0010000000	A4A6R60 "1"	440.000000 MHz
0020000000	A4A6R56 "2"	430.000000 MHz
0030000000	A4A6R52 "3"	420.000000 MHz
0040000000	A4A6R48 "4"	410.000000 MHz
0050000000	A4A6R44 "5"	400.000000 MHz
0060000000	A4A6R40 "6"	390.000000 MHz
0070000000	A4A6R35 "7"	380.000000 MHz
0080000000	A4A6R28 "8"	370.000000 MHz
0090000000	A4A6R22 "9"	360.000000 MHz
0100000000	A4A6R15 "10"	350.000000 MHz

i. If any of the controls listed in Table 7-9 cannot be adjusted to 0 volts, adjust A4A6R20 profile to obtain additional range. Repeat all pretune adjustments until satisfactory results are obtained. Disconnect the digital voltmeter and the electronic counter.

4. Loop Gain Adjustment. (See Figure 7-22.)

a. With all thumbwheel digits set to 0 connect the Spectrum Analyzer RF INPUT to A4A5J2 (350-450 MHz OUTPUT) and set the analyzer controls as follows:

7-8. HIGH FREQUENCY SECTION ADJUSTMENT (Cont'd)

CENTER FREQUENCY	450 MHz
BANDWIDTH	30 kHz
SCAN WIDTH PER DIVISION	5 MHz
SCAN TIME PER DIVISION	5 ms

b. Disconnect the reference input to A4A7J2 and reconnect it together with the RF output of the Signal Generator/Sweeper.

c. Set the Signal Generator/Sweeper to 11.5 MHz CW at −35 dBm and symmetrical sweep width to 3 MHz. The analyzer display should be approximately as shown in the typical waveform shown in Figure 7-11. Adjust the A4A6 GAIN control (A4A6R2) for the response shown.

d. Disconnect the Analyzer and the Generator/Sweeper. Reconnect the reference signal to A4A7J2.

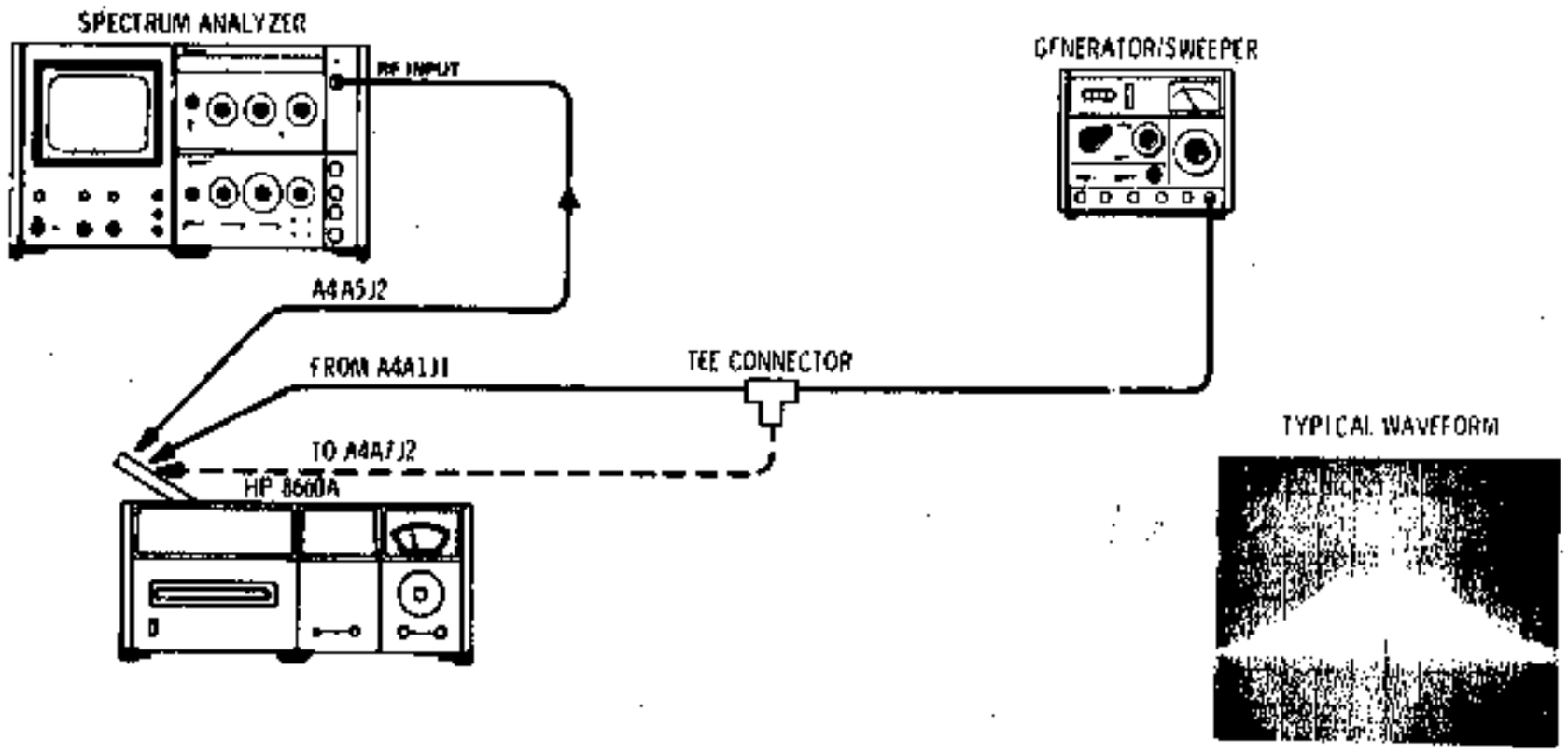


Figure 7-22. Loop Gain Adjustment Test Setup

5. 10 MHz Trap Adjustment. (See Figure 7-23.)

a. Disconnect the coaxial cable from A4A5J1.

b. Disconnect the 10 MHz reference signal from A4A7J2 and reconnect it using a TEE connector. Connect the 10 MHz reference signal from the other TEE port to the ϕ input of the A4A6 pretuning assembly (white wire from the A4A7 assembly).

c. Connect the Spectrum Analyzer RF INPUT to the A4A6 FREQuency control output (white-black-violet wire). Set the analyzer controls as follows:

CENTER FREQUENCY	10 MHz
BANDWIDTH	30 kHz
SCAN WIDTH PER DIVISION	200 kHz
VIDEO FILTER	OFF
INPUT ATTENUATION	0 dB
SCAN TIME PER DIVISION	1 ms
REF LEVEL	−30 dBm

d. Adjust A4A6C5 for minimum 10 MHz amplitude.

7-8. HIGH FREQUENCY SECTION ADJUSTMENT (Cont'd)

e. Remove the input to the ϕ input from A4A6 and the TEE connector. Reconnect the reference signal to A4A5J1 and disconnect the Spectrum Analyzer.

f. Replace all High Frequency Section covers.

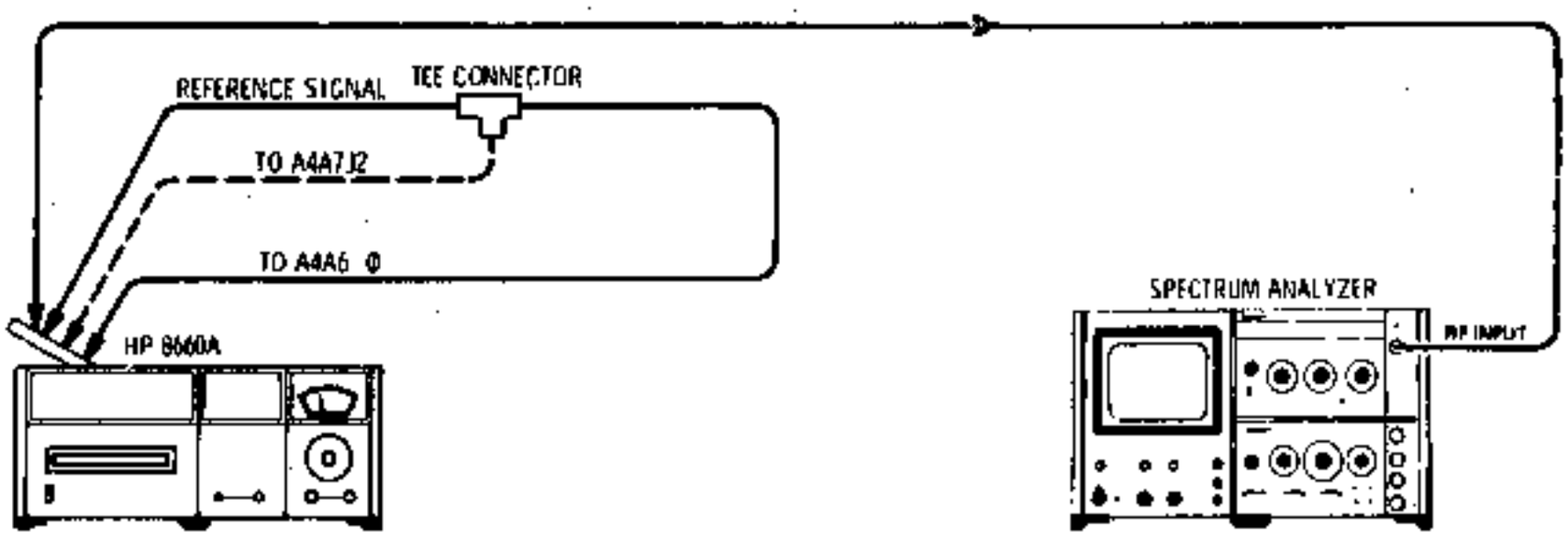


Figure 7-23. 10 MHz Trap Adjustment Test Setup

6. Output Frequency and Amplitude Check. (See Figure 7-24.)

a. Connect the Spectrum Analyzer RF INPUT to A4A5J2. Set the analyzer controls as required to view the 450 MHz signal. (All thumbwheels are set to 0). The output should be +13 dBm to +15 dBm.

_____ dBm

b. Switch thumbwheel digits 9 and 8 from 00 through 10. The frequency should decrease in 10 MHz steps (amplitude remains at +13 dBm minimum).

440 MHz ____dBm	430 MHz ____dBm	420 MHz _____ dBm
410 MHz ____dBm	400 MHz ____dBm	390 MHz _____ dBm
380 MHz ____dBm	370 MHz ____dBm	360 MHz _____ dBm
350 MHz ____dBm		

Figure 7-24. Output Amplitude Check Test Setup

7-9. Operating Temperature Improvement (Serial Prefix 1349A and below).

7-10. On instruments with serial number prefix 1349A and below, the Field Update Kit, HP Part Number 08660-60273 (50—60 Hz fan) or 08660-60274 (50—400 Hz fan), contains parts required to update these instruments with several production improvements. The fan change will lower the operating temperature within the instrument.

7-11. Power Supply Improvement (Serial Prefix 1620A and below).

7-12. On instruments with serial number prefix 1620A and below, the reliability of the fuses is assured by replacing the 1 amp fuses F3, F4 and F5 with 3 amp fuses (part number 2110-0332). Refer to Figure 7-25 and proceed as follows:

a. Remove the bottom cover from the instrument.

b. Locate the Power Supply Board (A20), and remove fuses F4, F5 and F6. Replace with new 3 amp fuses.

c. Replace the left side cover of the instrument.

7-13. Power Supply Fuse Replacement. (Serial Prefix 1620A and below.)

7-14. On instruments with serial prefix 1620A and below, whenever F1 (8 amp 125V) blows, replace with 10 amp, 32V Normal Blow (2110-0523).

7-15. A4A2 Reference Phase Detector Improvement (Serial Prefix 1620A and below.)

7-16. On instruments with serial number 1620A and below, the reliability of the Reference Input Amplifier can be improved by changing A4A2R11 (261 ohms, 0.5 watt) to 220 ohms, 2 watts (Part No. 0698-3628).

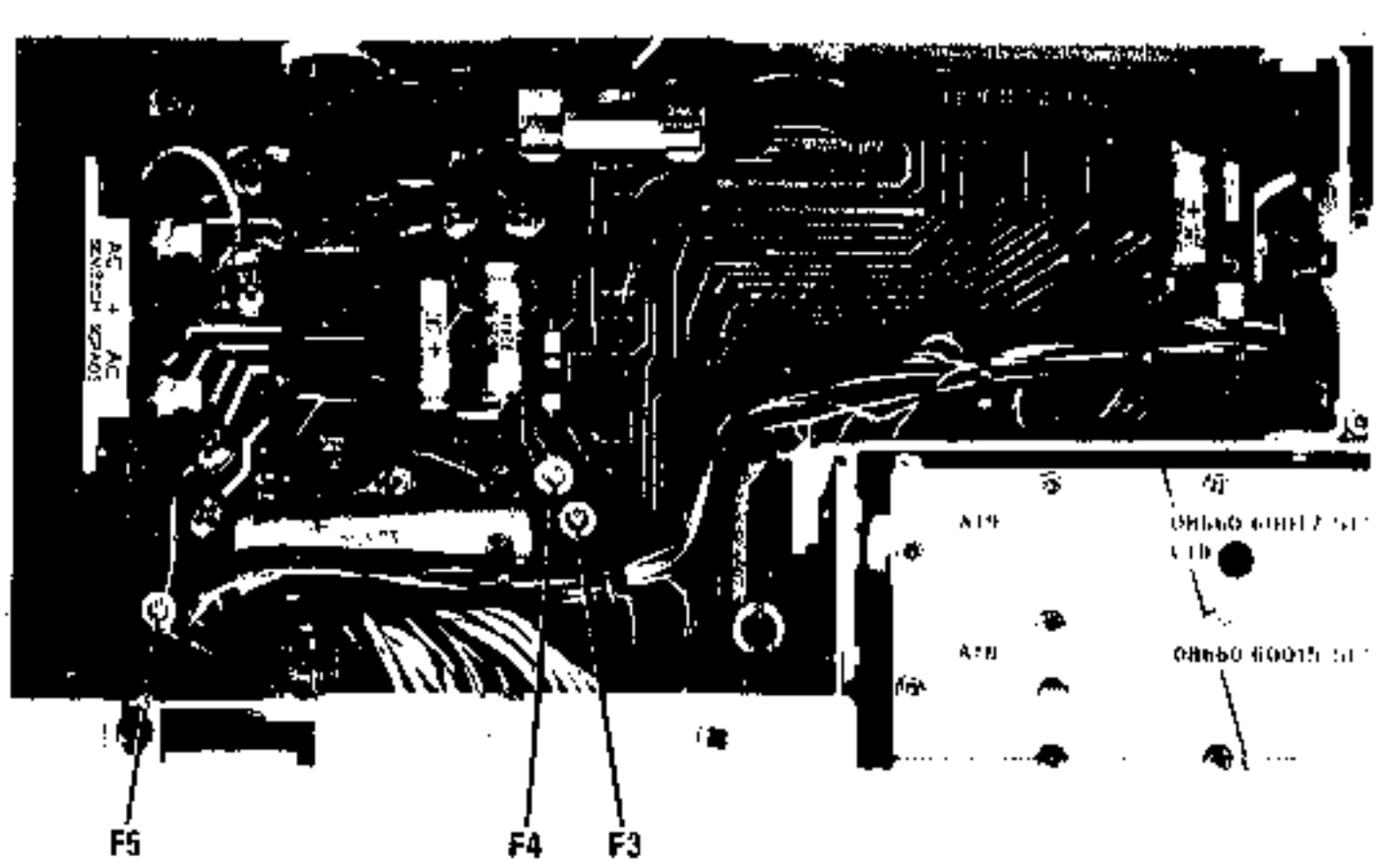


Figure 7-25. Power Supply Fuses

SERVICE INFORMATION

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section provides instructions for testing, troubleshooting and repairing the Hewlett-Packard Model 8660A Synthesized Signal Generator.

8-3. PRINCIPLES OF OPERATION

8-4. Figure 8-1, Simplified Block Diagram, and the following discussion illustrates the basic principles of operation of the Model 8660A. More detailed information about principles of operation for the phase locked loops and the Digital Control Unit appears on Service Sheets 1 and 18 respectively. In addition, detailed information to the circuit level is provided on individual service sheets.

8-5. General. The Model 8660A was designed to produce precise digitally controlled output frequencies utilizing synthesizer techniques. Unlike conventional signal generators, the output frequency is not ± some percentage factor; the output from the Model 8660A is exactly that selected. The output frequency range is determined by the RF Section plug-in being used.

8-6. All of the phase lock loops are phase locked, directly or indirectly, to a very stable temperature controlled internal 10 MHz source or to an external standard.

8-7. Reference Section. A 100 MHz voltage controlled oscillator which is phase locked to an internal reference, or an external standard, serves as a master oscillator. The internal reference is a 10 MHz temperature controlled crystal oscillator. The external standard may be 5 or 10 MHz at 0.2 to 2 volts rms. All of the outputs from the reference section are derived from the 100 MHz master oscillator.

8-8. The reference section provides the following outputs:

a. 500 MHz to the RF Output Section.

b. 100 MHz to the RF Output Section. This 100 MHz is coupled out of the RF Output Section for use in other circuits.

c. 20 MHz to the Modulator Section. This 20 MHz is coupled out of the Modulator Section for use in the RF Output Section and the Microwave Extension Module.

d. 10 MHz to the High Frequency Loop phase detector.

e. 2 MHz to the Digital Control Unit to be used as a clock.

f. 400 kHz to the N1 loop for a reference signal.

g. Separate 100 kHz signals to the N2 and N3 loops for reference signals.

NOTE

In the following discussion the terms digit 1, digit 2, through digit 10 are used to refer to the ten digits of frequency selection. Digit 1 refers to the least significant digit (1 Hz increments). Digit numbers progress from right to left until digit 10 refers to the most significant digit (1 GHz Increment).

8-9. High Frequency Loop. The HF loop contains a voltage controlled oscillator which provides eleven discrete outputs between 350 and 450 MHz in 10 MHz steps when the Model 86601A RF Section is used. When other RF Sections are used the output of the HF loop will still step in 10 MHz increments, but there will be more than, or less than, eleven steps.

8-10. Pretuning tunes the voltage controlled oscillator to a point within the capture range of the phase lock loop and the phase detector then causes the loop to be phase locked to the 10 MHz reference signal at the exact frequency selected.

8-11. When the Model 86601A RF Section is used the output of the HF loop is applied to the RF Output Section. When a higher frequency RF Section is used, the output of the HF loop is applied to the Frequency Extension Module.

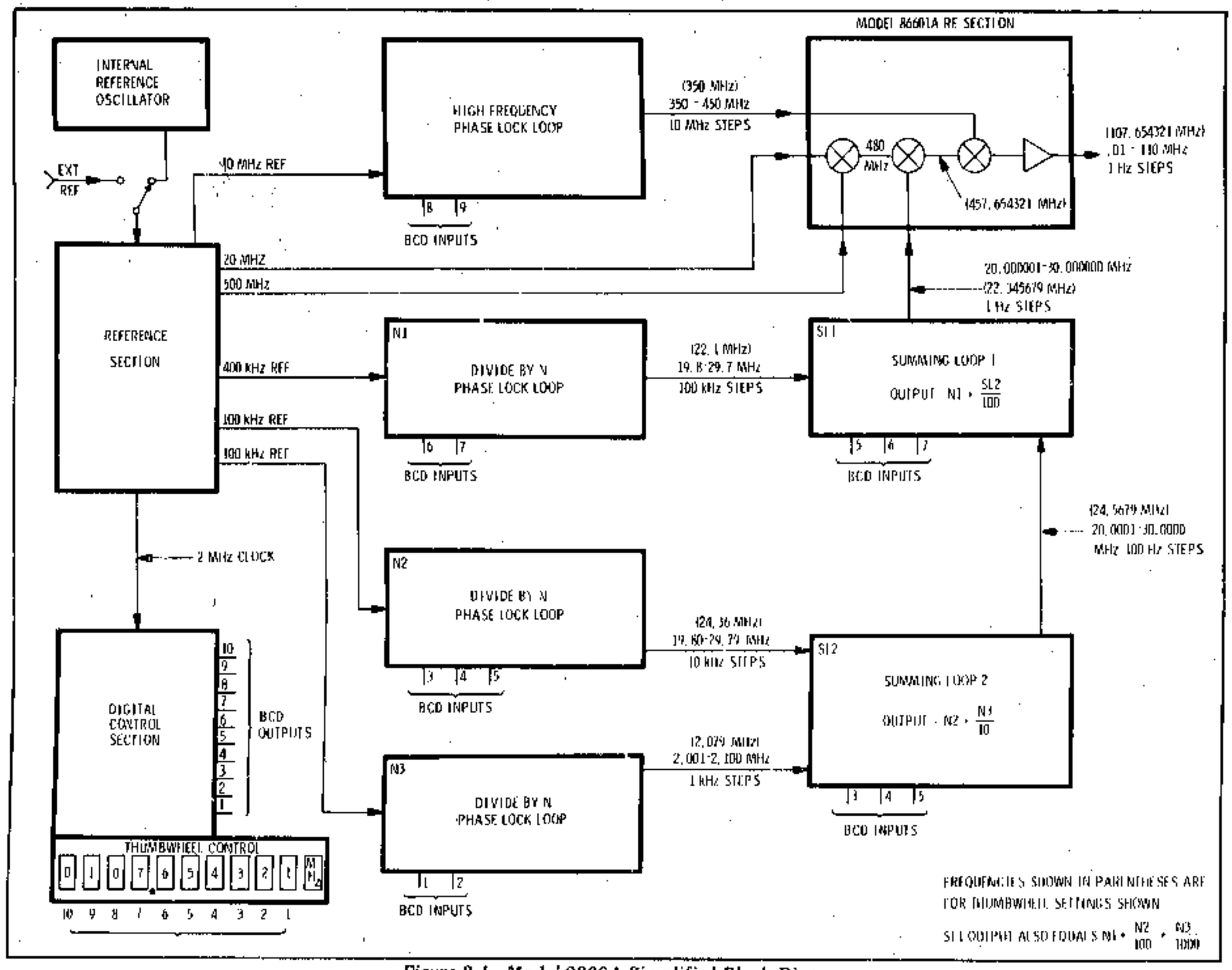


Figure 8-1. Model 8660A Simplified Block Diagram

8-12. N1 Phase Lock Loop. The N1 loop provides an output to Summing Loop 1 that is between 19.8 and 29.7 MHz in 100 kHz steps. The N1 voltage controlled oscillator is roughly pretuned by a digital to analog converter which is controlled by thumbwheel digits 6 and 7.

8-13. The N1 sampling phase detector is driven by pulses derived from the N1 voltage controlled oscillator through a programmable divider and a pulse shaper. The programmable divider is controlled by thumbwheel digits 6 and 7. When the loop is phase locked the 400 kHz reference input is sampled at a 100 kHz rate. The error signal from the phase detector is summed with the digital to analog converter output to precisely control the voltage controlled oscillator frequency.

NOTE

In option 004 instruments the N2A programmable divider is used. The N2 loop output is then between 20.01 and 30.00 MHz.

8-14. N2 Phase Lock Loop. The N2 loop provides an output to Summing Loop 2 that is between 19.80 and 29.79 MHz in 10 kHz steps. The N2 voltage controlled oscillator is roughly pretuned by a digital to analog converter which is controlled by thumbwheel digits 4 and 5.

8-15. The N2 sampling phase detector is driven by pulses derived from the N2 voltage controlled oscillator through a programmable divider and a pulse shaper. The programmable divider is controlled by thumbwheel digits 3, 4 and 5. When the loop is phase locked the 100 kHz reference signal input is sampled at a 10 kHz rate. The error signal from the phase detector is summed with the digital to analog converter output to precisely control the voltage controlled oscillator.

8-16. N3 Phase Lock Loop. The N3 loop provides an output to Summing Loop 2 that is between 2.001 and 2.100 MHz in 1 kHz steps. The N3 voltage controlled oscillator is roughly pretuned by a digital to analog conveter which is controlled by thumbwheel digit 2.

8-17. The N3 sampling phase detector is driven by pulses derived from the N3 voltage controlled oscillator through a programmable divider and a pulse shaper. The programmable divider is controlled by thumbwheel digits 1 and 2. When the loop is phase locked the 100 kHz reference signal is sampled at a 10 kHz rate. The error signal from the phase detector is summed with the digital to analog converter output to precisely control the voltage controlled oscillator frequency.

NOTE

In option 004 instruments SL2 is not used.

8-18. Summing Loop 2. SL2 provides an output to SL1 that is between 20.0001 and 30.0000 MHz in 100 Hz steps. The SL2 voltage controlled oscillator is roughly pretuned by a digital to analog converter which is controlled by thumbwheel digits 3, 4 and 5.

8-19. The output from the SL2 voltage controlled oscillator is also applied to a mixer where it is mixed with the output of the N2 loop. The output of this mixer is applied to one input of a digital phase detector through a pulse shaper. The other input to the digital phase detector is the divided by ten output of the N3 loop assembly in pulse form. When SL2 is phase locked the frequency ratio of the two inputs to the phase detector is always 1:1; the mixer output frequency must exactly match the divided by ten output of the N2 loop assembly (the pulses are received alternately).

NOTE

In option 004 instruments the SL1 output is from 20.0001 to 30 MHz.

8-20. Summing Loop 1. SL1 provides an output to the RF Output Section that is between 20.000001 and 30 MHz in 1 Hz steps. The SL1 voltage controlled oscillator is roughly pretuned by a digital to analog converter which is controlled by thumbwheel digits 5, 6 and 7.

8-21. The output from the SL1 voltage controlled oscillator is also applied to a mixer where it is mixed with the output of the N1 loop. The output of this mixer is applied to one input of a digital phase detector through a pulse shaper. The other input to the digital phase detector is the divided by one hundred output of the SL2 voltage controlled oscillator in pulse form. When SL1 is phase locked the frequency ratio of the two inputs to the phase detector is 1:1; the mixer output frequency must exactly match the divided by one hundred output of the SL2 voltage controlled oscillator (the pulses are received alternately).

8-22. RF Section. An RF Output Section is required in order to produce a useable RF output. Figure 8-1 shows a simplified diagram of the HP Model 86601A used in the system. All plug-in sections are covered by separate manuals.

8-23. Digital Control Unit. The thumbwheel switches provide dc grounds representative of the number to which they are set, in BCD 8 4 2 1 format. The 37 lines of parallel BCD information is converted to four-line serial BCD information and stored in a temporary storage register. When the instrument is first turned on (or when the thumbwheel settings are changed) the information in the temporary storage register is transferred to the center frequency register which then provides the parallel BCD information required to control the frequency of the various loops in the mainframe.

8-24. The interface boards in the mainframe provide the necessary circuits to permit the mainframe and the plug-in units to be controlled by a remote device through a rear panel connector.

8-25. HP-IB System (Option 005). The HP-IB (Hewlett-Packard Interface Bus) system uses seventeen lines to effect data transfer between the instruments connected to the bus. The data inputs from the HP-IB contain 8 data lines, DIO1 through DIO8. The 8660A does not use DIO8, but includes it in the bus and terminates it in a dummy load.

8-26. The control lines also contain eight lines to control the operation of the system. Three of the control lines, DAV-L, DAC-L, and RFD-L are used in the three-wire hand shake procedure. The HP-IB is an asynchronous device, so the control lines are connected to inhibit the faster instruments from controlling the data flow. The slowest instrument in the system determines the data cycle period.

8-27. Instrument Addressing. On the HP-IB, only one instrument may talk (send data) at any given time, although many instruments may listen (receive data), and some instruments may not interact with the bus at all. A controller (e.g. calculator) determines which instruments will talk, or listen, or remain inactive. The controller assigns functions to the various instruments by sending data over the eight lines to all instruments. Any instrument becomes a listener when its address is placed on the bus, and will remain a listener until an "unlisten" command is transmitted. Talkers stop functioning whenever another talk address is placed on the line.

8-28. Multiple Response Enable (MRE) line. The MRE line is driven by the controller to function as an "address mode/data mode" selector. When the line goes low, all instruments will listen to the eight data lines and interpret the information, transmitted by the controller, as addresses. When the line goes high, information on the eight data lines is interpreted as data. The instruments will talk, listen, or remain inactive as determined by the address time during the MRE low period.

8-29. Information (addresses, measurement results, or other data) is transferred on the data lines under control of the three-wire handshake technique, whose functional description is outlined in the Operation section of this manual.

8-30. RECOMMENDED TEST EQUIPMENT

8-31. Test equipment and accessories required to maintain the Model 8660A are listed in Table 1-2. If the equipment listed is not available equipment that meets the minimum specifications shown may be substituted.

8-32. TROUBLESHOOTING

8-33. Troubleshooting procedures contained in this manual involves repairing the instrument to the component level. Troubleshooting trees, in addition to aiding in the detection of faulty circuit boards or assemblies, also refers the technician to Service Sheets to be used if repairs are to be accomplished to the component level. Circuit descriptions and test procedures for this maintenance level are located on the page facing the schematic diagram of the circuit to be repaired.

8-34. If the cause of a malfunction is found and remedied in any circuit containing adjustable components, the applicable adjustment procedure in Section V of the manual should be performed.

8-35. Troubleshooting Guide. Table 8-1 is included in this section as an aid in local troubleshooting.

8-36. REPAIR

8-37. Line Voltage Requirements. During use, testing and and adjustment, the 8660A must be connected to a power source of approximately 200 watts at 110 volts, 120 volts, 200 volts or 240 volts ac ±10%, single phase. For 100V or 120V operation, the line fuse is 3 amp slo-blo; for 200V or 240V operation, the line fuse is 1.5 amp slo-blo. If adjustment of the dc voltage regulators is required, connect the 8660A through an adjustable

Table 8-1. 8660A Local System Troubleshooting Guide

Guide Sequence	Mode of Operation	Malfunction	Troubleshooting Information Location
1	Local	RF Section output level defective.	Refer to the RF Section troubleshooting in the RF Section service manual.
2	Local	CTR Frequency Readout and RF Section output defective.	Refer to Mainframe General Troubleshooting tree in the 8660A manual.
3	Local	CTR Frequency Readout correct; RF Section output is defective.	Refer to RF Section troubleshooting tree in the RF Section Service manual.
4	Local	CTR Frequency Readout is defective; RF Section output is correct.	Refer to 8660A Mainframe DCU troubleshooting tree in 8660A manual.
5	Local	Any Step operation defective. CTR Frequency Readout and RF output are correct.	Refer to the 8660A Mainframe DCU troubleshooting tree in the 8660A manual.
6	Local	Any Manual Tune operation defective; CTR Frequency RF outputs are correct.	Refer to the 8660A Mainframe DCU troubleshooting tree in the 8660A manual.
7	Local	Any sweep operation defective; CTR Frequency Readout and RF output are correct.	Refer to the 8660A Mainframe DCU troubleshooting tree in the 8660A manual.
8	Local	AM or FM modulation defective; CTR Frequency Readout and RF Section output correct.	Refer to the RF Section troubleshooting tree in the RF Section Service manual.
9	Local	Pulse Modulation defective; CTR Frequency Readout and RF Section output correct.	Refer to the RF Section troubleshooting tree in the RF Section Service manual.
10	Remote	Any function defective.	Check in LOCAL operation; repair if necessary. Then recheck the REMOTE operation; if still defective, refer to the appropriate Remote tree.

auto-transformer. When the line voltage is changed ±10%, the line voltage can be adjusted to check the 8660A regulators.

8-38. Servicing Aids on Printed Circuit Boards. Servicing aids on printed circuit boards include test points, transistor and integrated circuit reference designators, adjustment callouts and assembly stock numbers. Figure 8-2 illustrates the proper method to identify pin numbers on the circuit boards.

8-39. Circuit Board Extenders. Circuit board extenders are provided with the intstrument. The extenders enable the technician to extend plug-in boards clear of the assembly to provide easy access

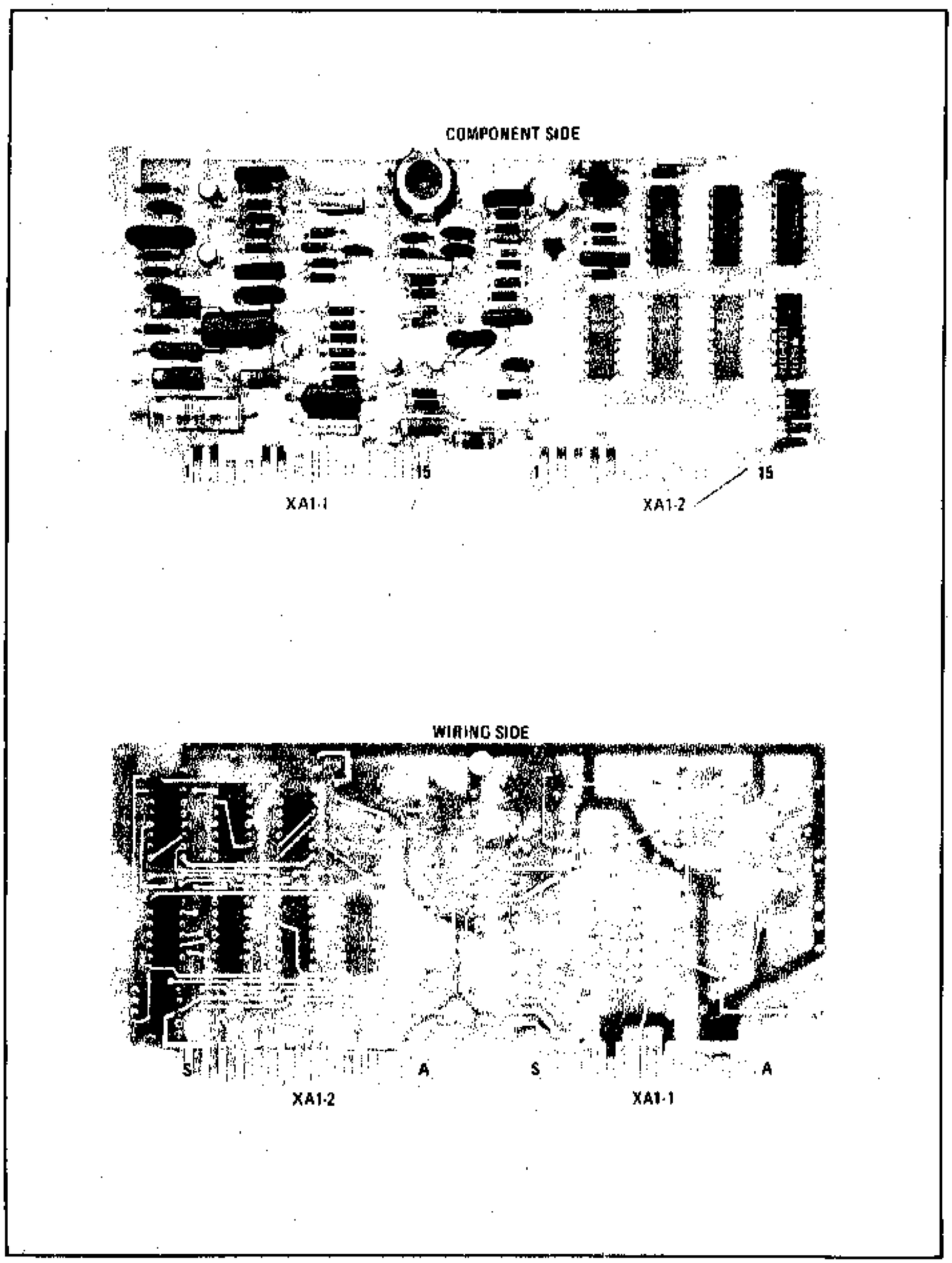


Figure 8-2. Printed Circuit Board Connector Identification

to components and test points. See Figure 8-3 for a typical example of extender board use.

NOTE

Extending some circuit boards, particularly those containing oscillators, may cause a change in operating frequency. Except as required for troubleshooting purposes, do not adjust variable components while the circuit boards are extended.

8-40. Diagram Notes. Table 8-2, Schematic Diagram Notes, provides information relative to symbols and values shown on schematic diagrams.

8-41. Part Location Aids. The locations of chassis mounted parts and major assemblies are shown in Figure 8-4. The location of individual components mounted on printed circuit boards or other assemblies are shown on the appropriate schematic page or the page opposite it. The part reference designator is the assembly designation plus the part designation (e.g. A10R1 is R1 on the A10 assembly). For specific component descriptions and ordering information refer to the parts list in Section VI of this manual.

8-42. Table 8-3 lists all assemblies and provides location information for photos, schematics, etc.

8-43. Integrated Circuits. Many types of integrated circuits are used throughout the Model 8660A. In order to avoid duplicating information on the individual schematics, all IC outlines and pin numbers are shown in Figure 8-5.

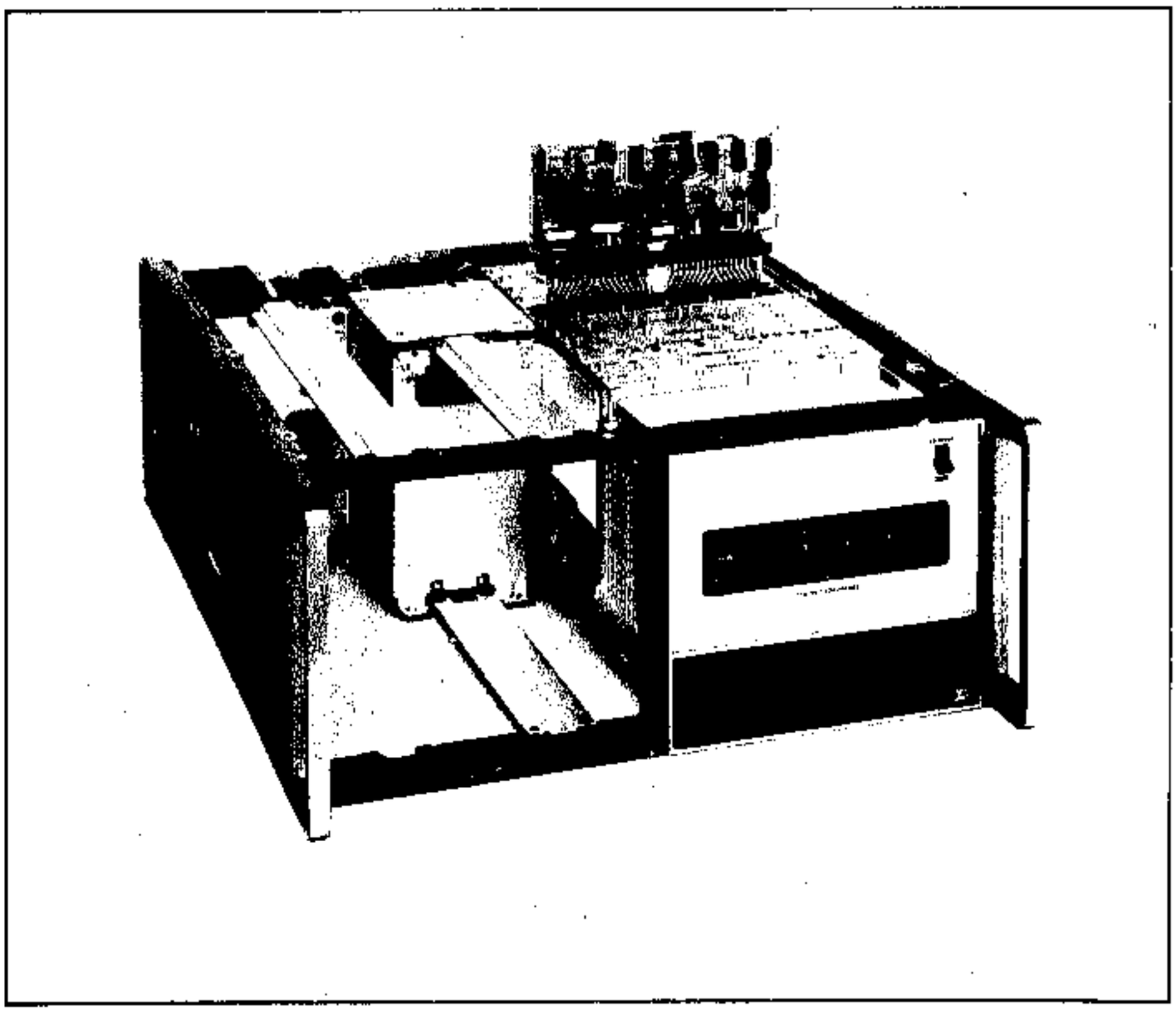


Figure 8-3. Model 8660A With Circuit Board Extended for Maintenance

Table 8-2. Schematic Diagram Notes

SCHEMATIC DIAGRAM NOTES

Inductance is in microhenries, Resistance is in ohms and Capacitance is in microfarads unless otherwise noted.

P/O — part of

Screwdriver Adjustment

Panel Control

Encloses Front Panel designations

Encloses Rear Panel designations

Circuit assembly borderline

Other assembly borderline

CW — Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.

Numbers in stars on circuit assemblies show locations of test points.

Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number the narrower stripe. Example; (947) denotes white base, yellow wide stripe, violet narrow stripe.

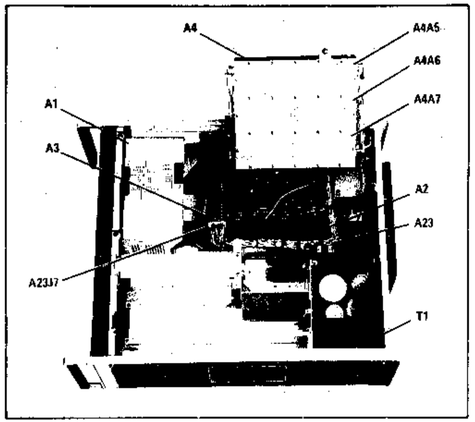
A 2 — Indicates an output from a schematic that goes to an input identified as A on Service Sheet 2.

6 K — Indicates an input to a schematic that comes from an output identified as K on Service Sheet 6.

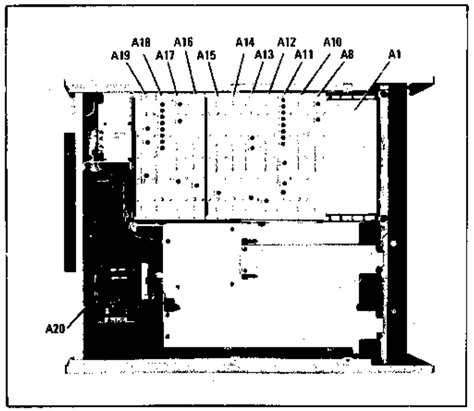
Indicates Circuit ground

Table 8-3. Assembly Locations

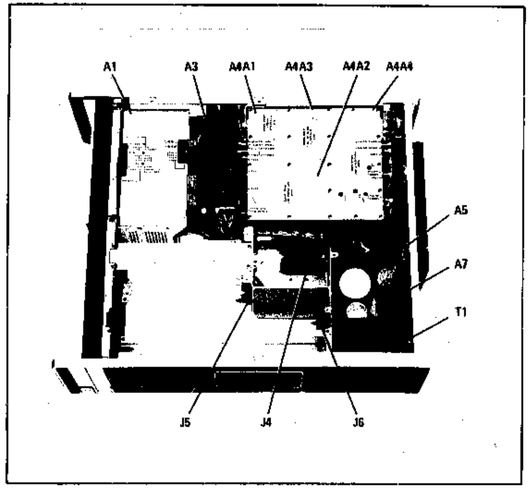
Assembly Numbers and Description	Service Sheet Number	Photo Figure 8-
A1 Digital Control Unit	19, 20, 21	4, 49, 50, 51, 53, 54, 56, 58, 60
A2 Loop Mother Board		4,77
A3 Interface Assembly	22, 23	4, 63,65
A4 HF Loop Assembly	2, 3, 4, 5, 6	4, 12, 13, 15, 16, 18, 20. 22
A5 Voltage Control Assembly	24	4, 69
A6 Regulator Assembly	24	4, 68
A7 AC Line Module	24	4
A8 N3 Oscillator	12	4,36
A9 Cable Loop Board	25	4, 79
A10 N3 Phase Detector	11	4, 34
A11 SL2 Oscillator	14	4, 40
A12 SL2 Phase Detector	13	4, 38
A13 N2 Oscillator	10	4, 32
A14 N2 Phase Detector	9, 9a	4, 28, 30
A15 SL1 Phase Detector	15	4, 42
A16 N1 Phase Detector	7	4, 24
A17 N1 Oscillator	8	4, 26
A18 SL1 Mixer	16	4, 44
A19 SL1 Oscillator	17	4, 46
A20 Rectifier Assembly	24	4, 70
A21 Reference Oscillator	2	4, 10
A22 Reference Switch Assembly	2	4, 11
HP-IB Input Assembly	22A	63A
HP-IB Output Assembly	23A	65A



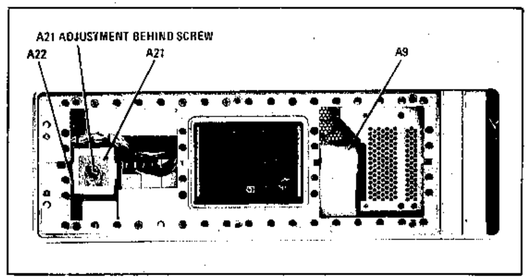
A4 INVERTED



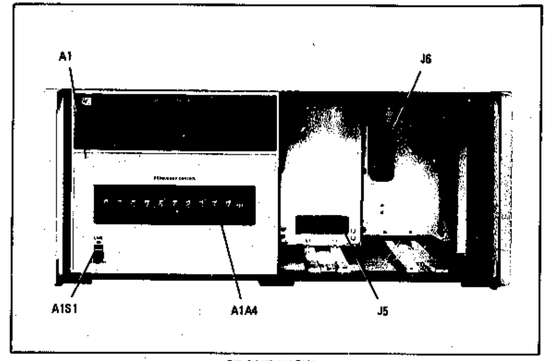
BOTTOM VIEW



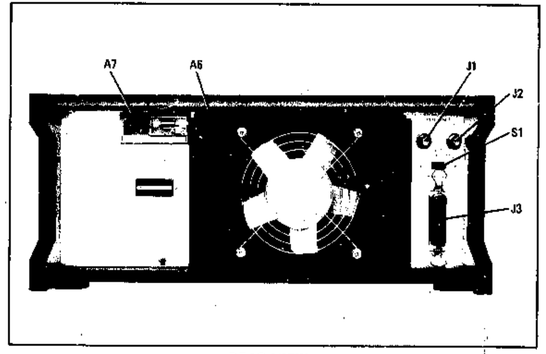
TOP VIEW



LEFT VIEW



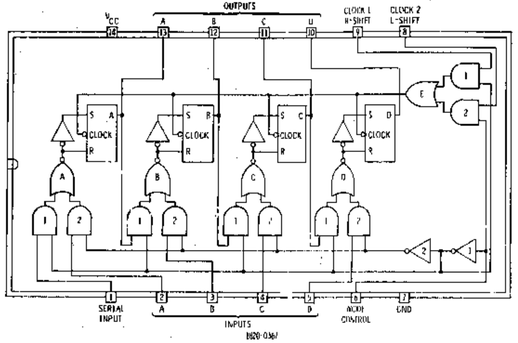
FRONT VIEW

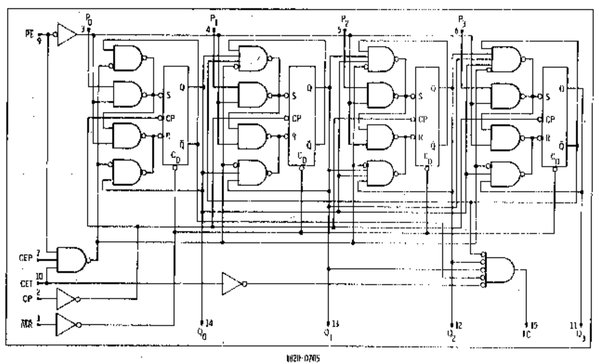


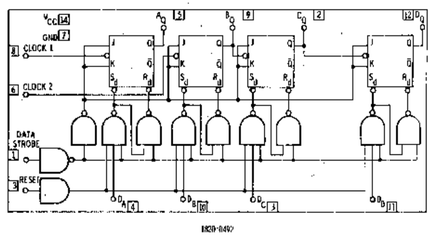
REAR VIEW

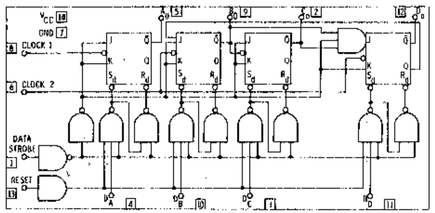
Figure 8-4. Assembly Locations

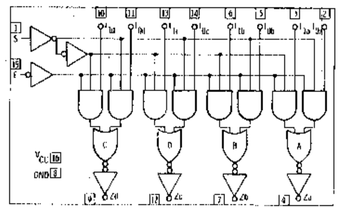
INTERNAL VIEWS

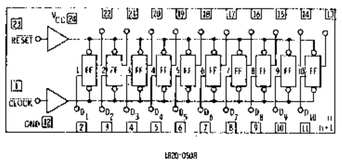


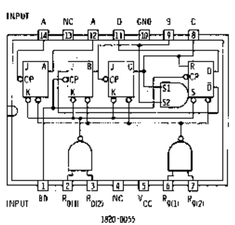


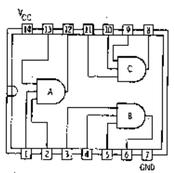


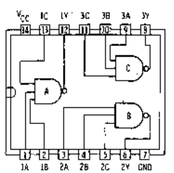


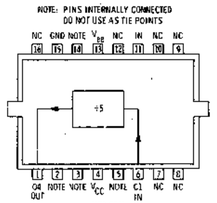


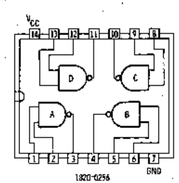


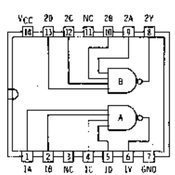


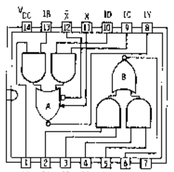


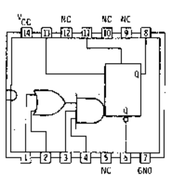


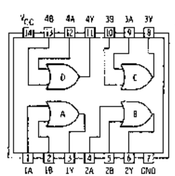


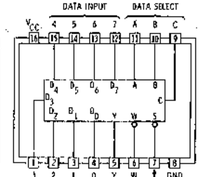


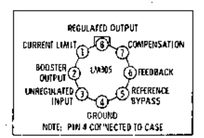


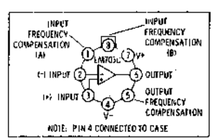


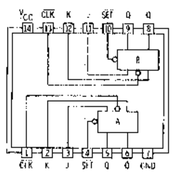


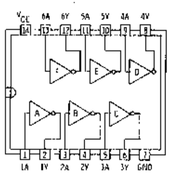


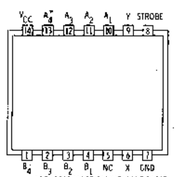


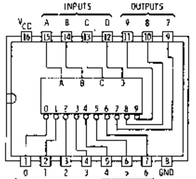


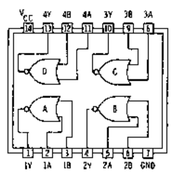


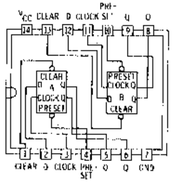


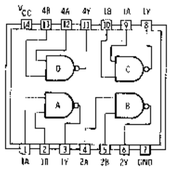


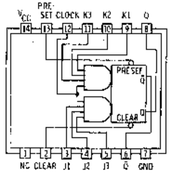


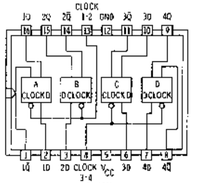












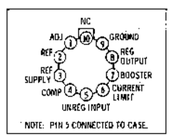


Figure 8 5. Integrated Circuits Used in Model 8660A

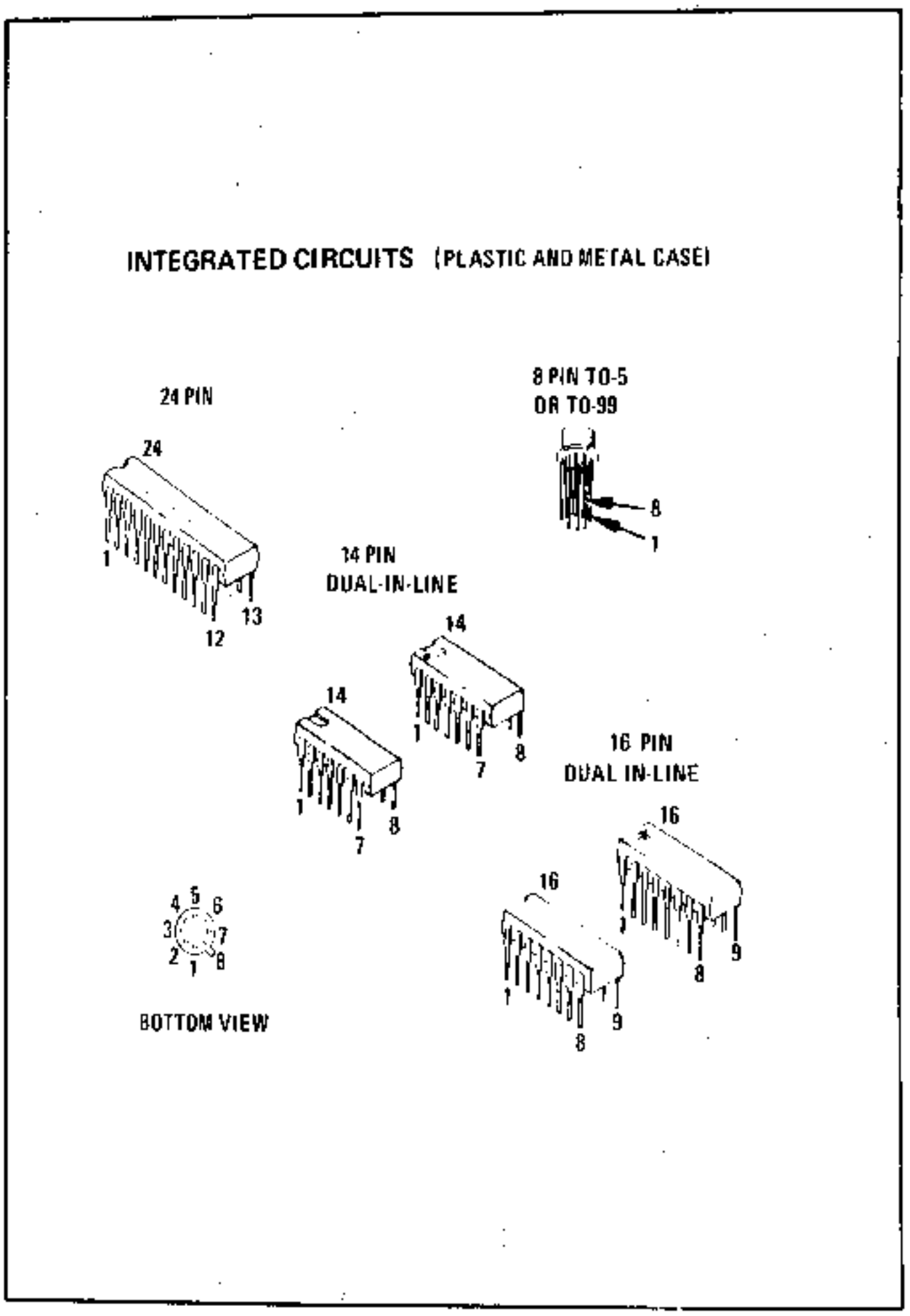
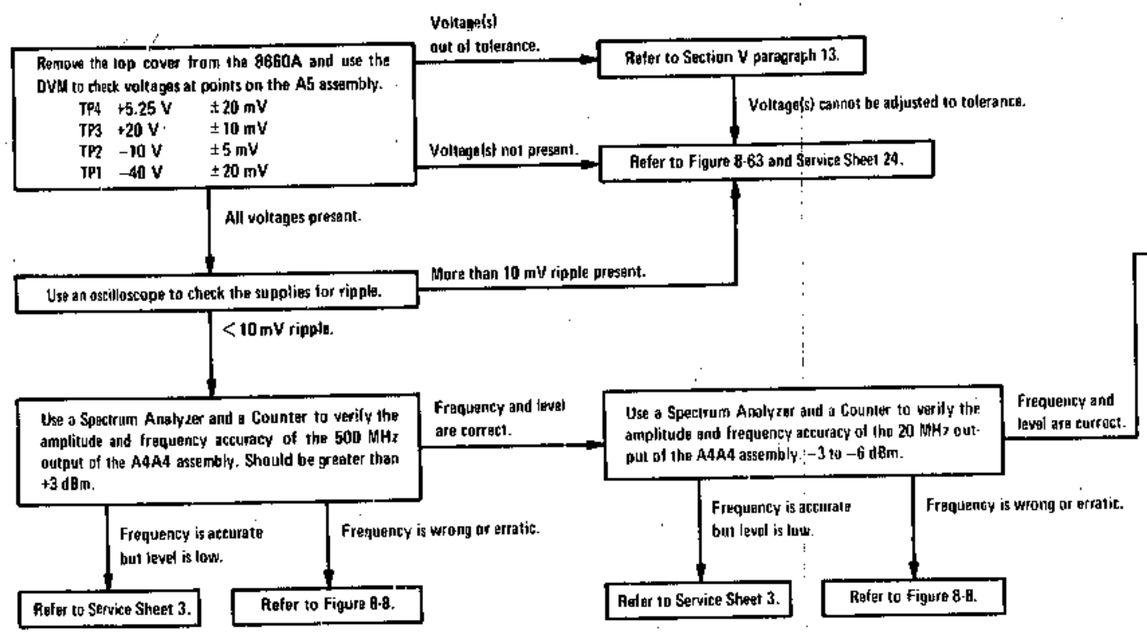


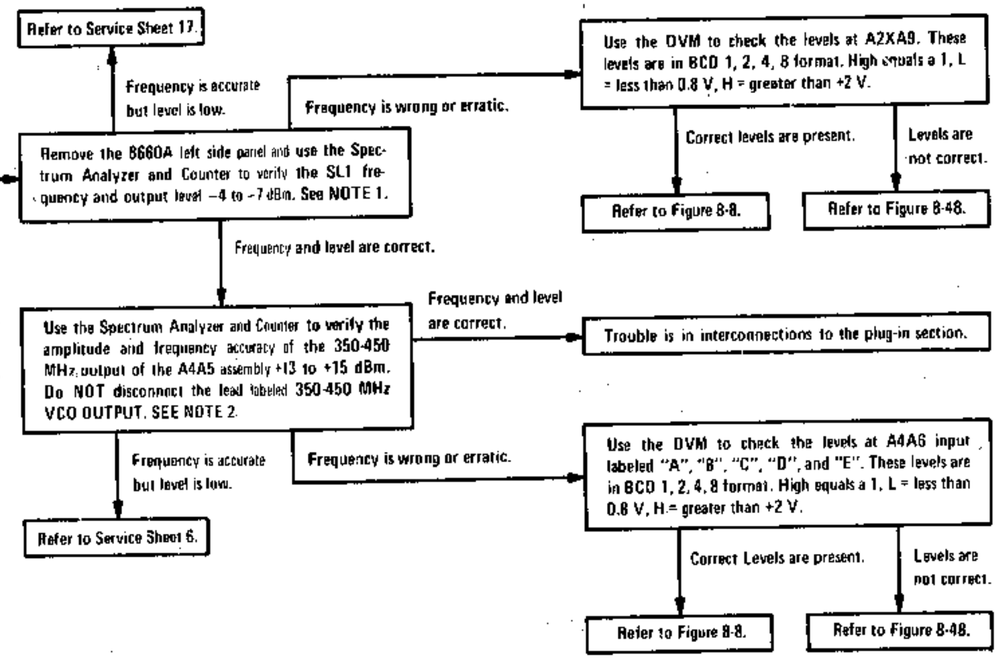
Figure 8-6. Integrated Circuit Packaging

TROUBLE-SHOOTING TREE

NOTE

This procedure is based on the assumption that the cause of trouble has been isolated to the Model 8660A by performing the tests specified in the Modulation or RF Section Manual.



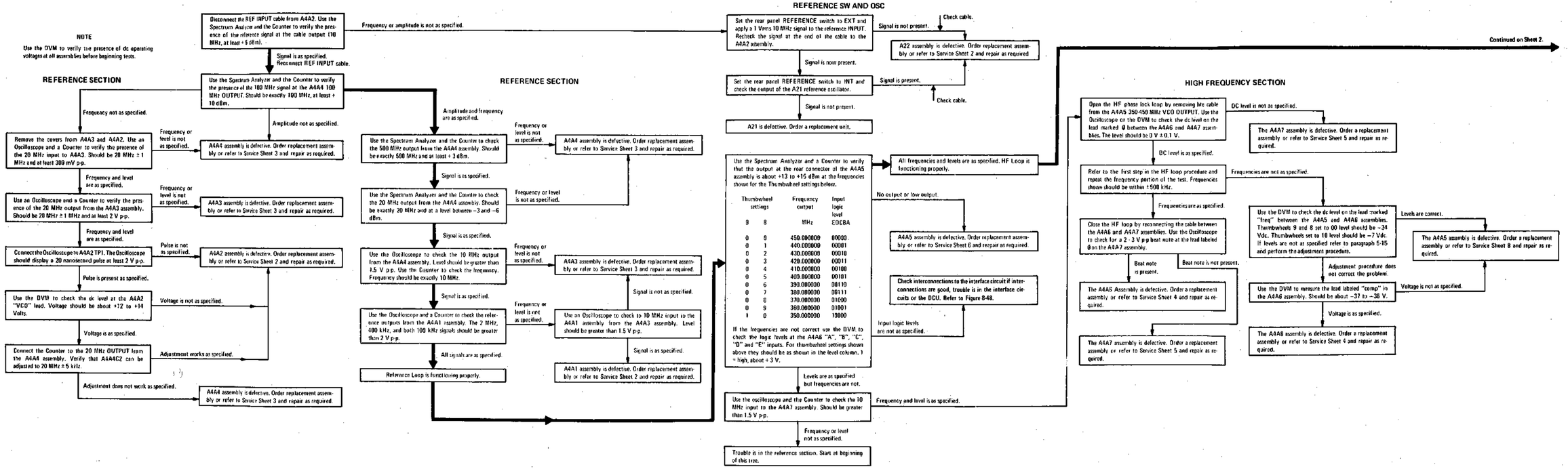


NOTES

1. The correct frequency output of SL1 may be determined by subtracting the last seven digits of the programmed frequency from 30.000000 MHz. EXAMPLE: Programmed frequency is 107.654321 MHz. Subtract 7.654321 from 30.000000. SL1 frequency is 22.345679 MHz.

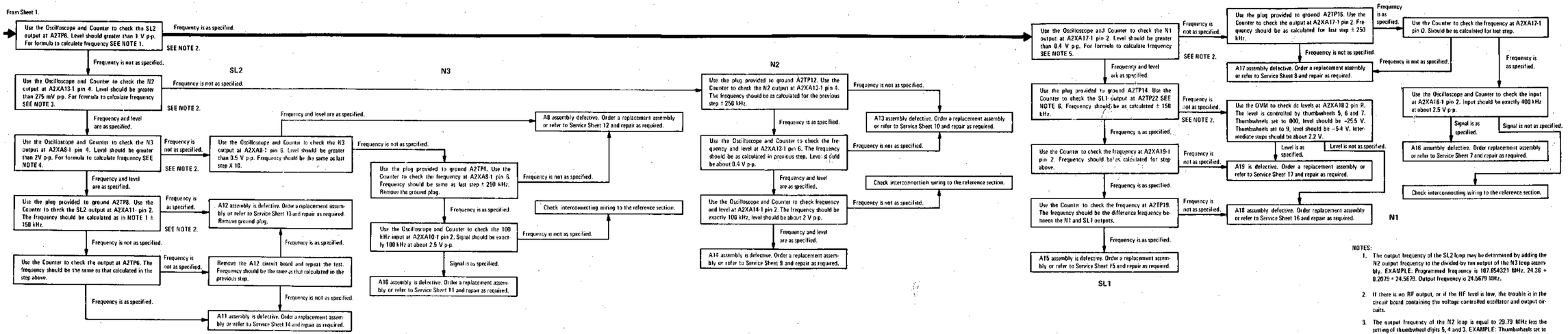
2. Determine output frequency by subtracting digits 8 and 9 (10 MHz and 100 MHz steps) from 450 MHz. EXAMPLE: Programmed frequency is 107 MHz. Subtract 100 from 450. HF Loop output is 350 MHz.

Figure 8-7. Basic Troubleshooting Tree



IC INFORMATION AND BASIC TROUBLESHOOTING TREE

Figure 8-8. RF Loops Troubleshooting Tree (Sheet 1 of 2)



NOTES:

1. The output frequency of the SL2 loop may be determined by adding the N2 output frequency to the divided-by-ten output of the N3 loop assembly. EXAMPLE: Programmed frequency is 107.654321 MHz, 24.36 + 0.2079 = 24.5679. Output frequency is 24.5679 MHz.
2. If there is no RF output, or if the RF level is low, the trouble is in the circuit board containing the voltage controlled oscillator and output circuits.
3. The output frequency of the N2 loop is equal to 29.79 MHz less the setting of thumbwheel digits 5, 4 and 3. EXAMPLE: Thumbwheels set to 107.654321 MHz, 29.79 - 5.43 = 24.36. Output frequency is 24.36 MHz.
4. The output frequency of the N3 loop is equal to 2.10G MHz less the setting of thumbwheel digits 2 and 1. EXAMPLE: Thumbwheels set to 107.654321 MHz, (2.100 - .021 = 2.079). Output frequency is 2.079 MHz.
5. The output frequency of the N1 loop is equal to 29.7 MHz less the setting of thumbwheel digits 7 and 6. EXAMPLE: Thumbwheels set to 107.654321 MHz, 29.7 - 7.6 = 22.1. Output Frequency is 22.1 MHz.
6. The output frequency of the SL1 loop may be determined by subtracting the last seven digits of the programmed frequency from 30.000000 - 7.654321 = 22.345679. Output frequency is 22.345679 MHz.

Figure 8-8. RF Loops Troubleshooting Tree (Sheet 2 of 2)

TROUBLE-SHOOTING TREE

SERVICE SHEET 1

BLOCK DIAGRAM

General

The Hewlett-Packard Model 8660A is a signal generator which utilizes synthesizer techniques to produce precise rf output signals. These signals may be selected in increments as small as one Hz.

Each step in the generation of the output frequency is controlled by phase lock loops. This ensures that the output frequency is exactly that selected by front panel (or remote) controls.

All of the seven phase lock loops (five loops in option 004) are referenced to a single source. This source may be the internal temperature controlled crystal oscillator or an external frequency standard of 5 or 10 MHz.

The Model 8660A mainframe does not provide a direct rf output, except for the reference signal which may be used as a time base for external equipment. The signals generated within the mainframe are used in plug-in modules which utilize mixing techniques to provide the selected output rf signals.

Reference Loop

The reference loop consists of four circuit boards mounted in the A4 assembly. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided by Service Sheets 2 and 3.

All of the signals generated within the Model 8660A mainframe are derived from the 100 MHz master oscillator in the reference loop. The master oscillator is a voltage controlled oscillator which is phase locked to a stable reference. The 100 MHz oscillator is located in the A4A4 assembly.

Also included in the A4A4 assembly are divide-by-five and multiply-by-five circuits. The outputs from the A4A4 assembly are 500 MHz, 100 MHz, and 20 MHz. The 20 MHz output from the A4A4 assembly is sampled in the reference loop phase detector to provide a phase correction signal to the master oscillator. The 20 MHz signal is also applied to the A4A3 assembly where it is divided by two to provide a 10 MHz signal for use in the A4A1 reference dividers and in the high frequency phase lock loop.

The reference loop input circuit (A4A2) converts the signal from the reference oscillator into sharp short-duration pulses to open a sampler gate which samples the 20 MHz signal from the A4A4 assembly. The sampled signal is used to generate an error signal which biases the varactor in the 100 MHz voltage controlled oscillator in the A4A4 assembly to maintain the phase locked condition.

The A4A1 assembly divides the 10 MHz input from the A4A3 assembly by five to provide a 2 MHz clock for the digital control unit. The 2 MHz signal is divided by five to provide a 400 kHz signal to the phase detector in the N1 loop. The 400 kHz is twice divided by two to provide 100 kHz signals to the phase detectors in the N2 and N3 loops.

SERVICE SHEET 1 (cont'd)

High Frequency Loop

The HF loop consists of three circuit boards mounted in the A4 assembly. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided by Service Sheets 4, 5 and 6.

The HF loop provides digitally controlled rf signals between 350 and 450 MHz in precisely selected 10 MHz increments.

The sampling phase detector (A4A7) compares the voltage controlled oscillator (A4A5) output to a 10 MHz signal from the reference loop and provides an output to phase lock the voltage controlled oscillator to the reference signal. The phase detector assembly contains a pulse generator, a sampler and a signal processing circuit.

The frequency of the voltage controlled oscillator (A4A5) is roughly pretuned by a digital to analog converter located in the A4A6 assembly. The error signal from the A4A7 assembly is summed with the output of the digital to analog converter to maintain the phase locked condition. The A4A5 assembly also contains two identical three-stage amplifiers. These amplifiers serve as buffers to isolate any extraneous signals at their outputs from the oscillator. One of the amplifiers provides an output to the rf plug-in; the other output goes to the HF loop sampling phase detector.

The A4A6 pretuning circuit consists of a digital to analog converter which roughly pretunes the voltage controlled oscillator to the 10 MHz increment between 350 and 450 MHz selected by thumbwheel digits 8 and 9 of the front panel (or remote) controls. The pretuning cannot, by itself, set the voltage controlled oscillator frequency accurately; it does set the frequency within the capture range of the loop.

The A4A6 assembly also contains a summing circuit which sums the negative dc level from the digital to analog converter with the current from a +20 volt source and the output of the phase detector. The output from the summing circuit precisely controls the frequency of the voltage controlled oscillator.

Divide By N Loop N1

The purpose of the N1 loop is to generate digitally controlled rf signals in the range of 19.8 to 29.7 MHz in selectable 100 kHz increments. The voltage controlled oscillator is phase locked to a 400 kHz reference signal which is derived from the master oscillator in the reference loop. The output of the N1 loop is applied to summing loop 1.

The N1 loop circuits are mounted on two circuit boards, A16 and A17. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided by Service Sheets 7 and 8.

The A16 phase detector assembly contains a programmable divider, a sampling phase detector and a signal processing circuit.

The programmable divider divides by a number determined by thumbwheel digits 6 and 7 of the front panel (or remote) controls. The terminal count of the programmable divider is always 297. The actual number of cycles counted is determined by the count

SERVICE SHEET 1 (cont'd)

programmed into the divider prior to the start of each count cycle. The output of the programmable divider is always 100 kHz when the loop is locked.

The output frequency of the N1 loop may be determined by subtracting the thumbwheel 7 and 6 information from 29.7 MHz. As an example, if thumbwheels 7 and 6 are set for 3.4 MHz, the N1 output frequency will be 26.3 MHz (29.7 - 3.4).

The sampling phase detector uses the 100 kHz pulses from the programmable divider to sample the 400 kHz reference signal and provides an error output to the summing circuit in the A17 assembly.

The signal processing circuit consists of an operational amplifier with lead and lag compensation.

The A17 assembly contains a digital to analog converter, a voltage controlled oscillator and a summing circuit.

The digital to analog converter converts the digital inputs from thumbwheels 6 and 7 to a dc level which roughly pretunes the voltage controlled oscillator to a frequency within the capture range of the loop.

The summing circuit sums the current from the negative digital to analog converter source with current from a +20 volt source and the error signal from the phase detector to precisely control the voltage controlled oscillator frequency.

Divide By N Loop N2

The purpose of the N2 loop is to generate digitally controlled rf signals in the range of 19.80 to 29.79 MHz in selected 10 kHz increments.

NOTE

In option 004 instruments the N2 loop output is from 20.01 to 30.00 MHz in 10 kHz increments.

The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section. The output of the N2 loop is applied to summing loop 2 (Summing loop 1 in option 004 instruments).

The N2 loop circuits are mounted on two circuit boards, A13 and A14. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided by Service Sheets 9 (9A for option 004 instruments) and 10.

Operation of the N2 loop is virtually the same as operation of the N1 loop. The reference input is 100 kHz and the output of the programmable divider is always 10 kHz when the loop is locked. The digital inputs are from thumbwheel digits 3, 4 and 5 (or remote controls) and range from 000 to 999.

The programmable divider count always terminates in a count of 2979 (3000 in option 004 instruments). The output frequency in MHz of the oscillator may be calculated by subtracting the programmed digital input from thumbwheel digits 5, 4 and 3 from 2979 (3000 for option 004 instruments) and dividing the results by 100. Example: with thumbwheel digits 5, 4 and 3 set to 222 the output frequency will be 27.57 MHz ($\frac{2979-222}{100}$).

SERVICE SHEET 1 (cont'd)

Divide By N Loop N3

NOTE

The N3 loop is not included in option 004 instruments.

The purpose of the N3 loop is to generate digitally controlled rf signals in the range of 20.01 to 21.00 MHz in selectable 10 kHz increments. The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section. The output from the N3 phase lock loop is divided by ten and the resulting 2.001 to 2.100 MHz (1 kHz steps) signal is applied to summing loop 2.

The N3 loop circuit is mounted on 2 circuit boards, A8 and A10. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided by Service Sheets 11 and 12.

Operation of the N3 loop is virtually identical to operation of the N1 and N2 loops. The reference signal is 100 kHz and the output of the programmable divider is always 10 kHz when the loop is phase locked. The digital inputs are from thumbwheel digits 1 and 2, and range from 00 to 99.

The programmable divider count always terminates in a count of 2100. The output frequency in MHz of the voltage controlled oscillator may be calculated by subtracting the programmed digital input from thumbwheel digits 2 and 1 from 2100 and dividing the result by 100. Example; with thumbwheel digits 2 and 1 set to 34, the output frequency of the voltage controlled oscillator will be 20.66 MHz ($\frac{2100-34}{100}$). Since the voltage controlled oscillator output is divided by 10, the output to summing loop 2 will be 2.066 MHz.

Summing Loop 2

NOTE

Summing Loop 2 is not included in option 004 instruments.

The purpose of SL2 is to generate digitally controlled rf signals in the range of 20.0001 to 30.0000 MHz in selectable 100 Hz increments. The output frequency of the SL2 voltage controlled oscillator is equal to the sum of the N2 output and the divided-by-ten output of the N3 assembly. The inputs to the digital phase detector are the divided-by-ten output of the N3 assembly and the output from a mixer which detects the difference frequency of the N2 output and the SL2 voltage controlled oscillator. The output of SL2 is applied to SL1.

The SL2 circuits are mounted on two circuit boards, A11 and A12. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided by Service Sheets 13 and 14.

The SL2 phase detector A12 is completely digital; it compares the relative positions (in time) of two sets of pulses and provides an error signal to correct phase errors or a dc level to correct frequency errors. One of the inputs to the phase detector is divided by ten output of the N3 A8 assembly. The other input to the phase detector is the difference frequency between the N2 loop output and the SL2 voltage controlled oscillator. When the loop is locked, both phase

SERVICE SHEET 1 (cont'd)

detector input signals are at the same frequency (1:1 ratio). When the ratio between the two signals is not 1:1 the difference is detected by a sense circuit which disables the phase detector. The phase detector output goes low if the SL2 voltage controlled oscillator frequency is low; the output goes high if the SL2 voltage controlled oscillator frequency is high. The pretuning circuit and the voltage controlled oscillator are contained in the A11 assembly.

The pretuning circuit is a digital to analog converter controlled by thumbwheel digits 3, 4 and 5. The digital to analog converter for the thumbwheel digit three is physically located on the A12 assembly. The pretuning circuit roughly presets the voltage controlled oscillator to a frequency within the capture range of the loop. A summing circuit sums the negative current from the digital to analog converter circuit with a current from a +20 volt source and the output of the SL2 digital phase detector to precisely set the output frequency of the voltage controlled oscillator. The output from the voltage controlled oscillator is applied to SL1 and to a mixer in the A12 assembly.

The output frequency of SL2 is equal to the N2 frequency plus the divided by ten input from the N3 circuit.

Summing Loop 1

The purpose of SL1 is to generate digitally controlled rf signals in the range of 20.000001 to 30.0 MHz in selectable increments as small as 1 Hz. The output frequency of the SL1 voltage controlled oscillator is equal to the sum of the N1 output and the divided-by-one hundred output of SL2. The inputs to the digital phase detector are the divided-by-one hundred output of the SL2 assembly and the output from a mixer which detects the difference frequency of the N1 output and the SL1 voltage controlled oscillator. The output of SL1 is applied to the RF Section plug-in.

NOTE

In option 004 instruments the output is from 20.0001 to 30.0 MHz in selectable increments as low as 100 Hz. The voltage controlled oscillator is phase locked to the divided by one hundred output of the N2 loop.

The SL1 circuits are mounted on three circuit boards, A15, A18 and A19. Schematics, a more comprehensive circuit analysis, and troubleshooting information are provided on Service Sheets 15, 16 and 17.

Operation of SL1 is the same as operation of SL2 except that the phase detector inputs are the divided by one hundred output of SL2 and the difference frequency between the output of N1 and the SL1 oscillator. The output frequency is equal to N1 + $\frac{SL2}{100}$ or N1 + $\frac{\frac{N2}{100} + \frac{N3}{1000}}{100}$.

MAIN TROUBLESHOOTING TREE

SERVICE SHEET 1 (cont'd)

NOTE

In option 004 instruments the phase detector inputs are the divided by one hundred output of N2 and the difference frequency between the N1 output and the frequency of the SL1 voltage controlled oscillator output. The output frequency is equal to N1 + $\frac{N2}{100}$.

RF Section

The RF Section plug-in processes the outputs from the mainframe to provide the desired output frequency.

Information relative to operation and service of the RF Section is provided in separate manuals.

Digital Control Unit

Service Sheet 18 provides a logic diagram of the digital control unit and the interface circuits

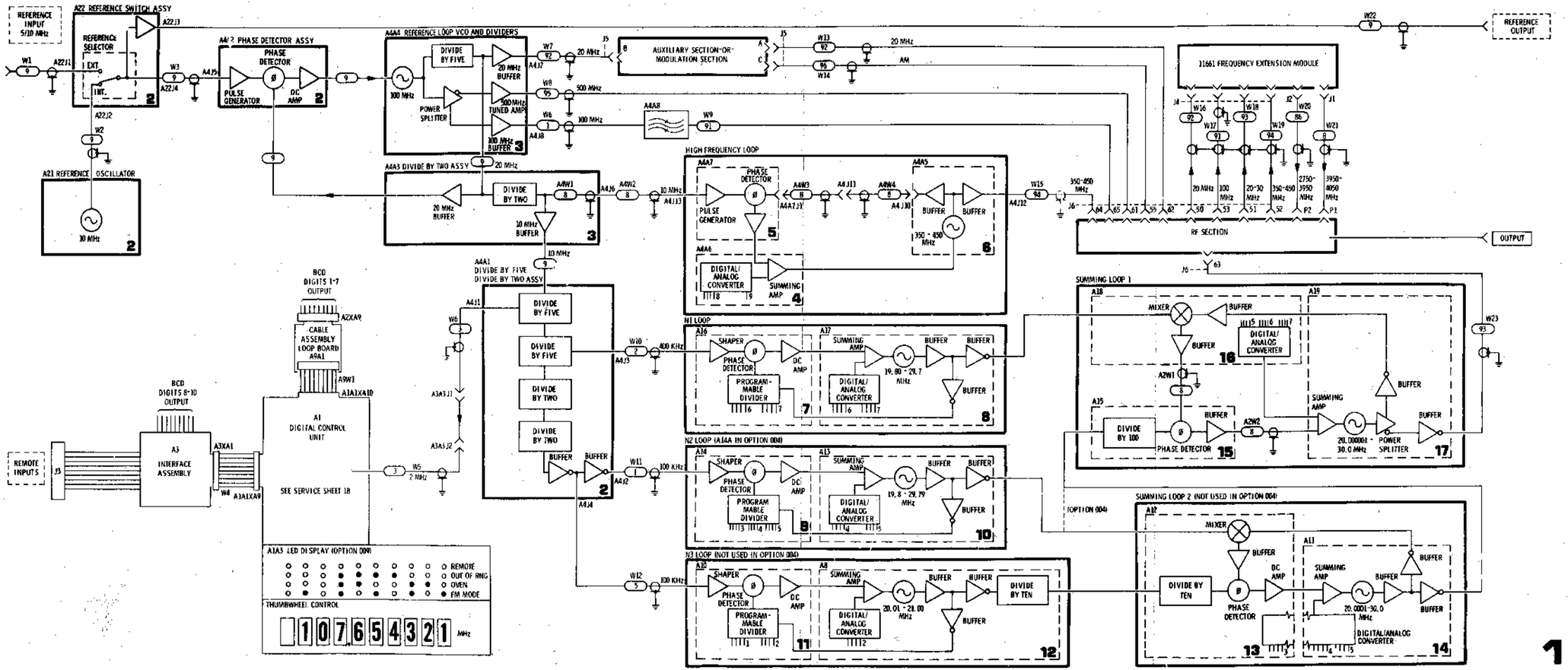


Figure 8-9. Model 8660A Block Diagram

SERVICE SHEET 2

P/O REFERENCE LOOP CIRCUITS

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

When repairing the reference loop only one of the four covers should be removed at any given time. Operating the instrument with the voltage controlled oscillator cover removed may cause faulty or erratic performance after required repairs have been completed.

NOTE

After making repairs in any part of the reference loop circuits the adjustment procedures specified in Section V paragraph 5-19 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Test Oscillator
10:1 Oscilloscope probes (2)
Electronic Counter
Oscilloscope

REFERENCE LOOP GENERAL

The reference loop consists of four circuit boards located in the A4 assembly. This service sheet provides information about circuit operation and test procedures for the reference oscillator, reference amplifier and relays, the phase detector and the divide-by-five and divide-by-two circuits. Schematic diagrams, text and troubleshooting information for the voltage controlled oscillator and divide-by-two circuits appear on Service Sheet 3.

The accuracy and stability of all the signals generated in the Model 8660A mainframe are traceable to the reference loop outputs.

The reference loop provides output frequencies of 500 MHz, 100 MHz, 20 MHz, 10 MHz, 2 MHz, 400 kHz, and 100 kHz. These signals are used in other circuits in the mainframe and in the plug-in sections. All of the reference section outputs are derived from a 100 MHz master oscillator which is phase locked to a stable reference source. The reference signal may be supplied by the internal reference oscillator or by an external reference standard. The reference signal may be 1, 2, 2.5, 5 or 10 MHz at a level of 0.2 to 2 volts rms.

1 REFERENCE OSCILLATOR, AMPLIFIER AND RELAYS

The Model 8660A (except for option 002 instruments) contains a 10 MHz temperature controlled crystal oscillator which is used as a reference source. Also included are switching relays and a buffer

SERVICE SHEET 2 (cont'd)

amplifier. The buffer amplifier serves to isolate the reference oscillator when its output is used as a reference source for external equipment.

TEST PROCEDURE

Test 1-a. Connect the oscilloscope to the Model 8660A rear panel REFERENCE OUTPUT connector. If the internal reference is being used the oscilloscope should display a 10 MHz signal at about 4 volts peak to peak. If an external reference is used the oscilloscope should display the reference frequency at about the same level as the reference signal input.

If the signal is present proceed to test 1-b. If the signal is not present proceed to test 1-c.

Test 1-b. Disconnect the coaxial cable from A4J5 (REF INPUT) and connect the oscilloscope to the end of the cable. If the internal reference is being used the oscilloscope should display a 10 MHz signal at about 5 volts peak to peak. If an external reference is used the oscilloscope should display the input reference signal.

If the signal appeared in test 1-a, but does not appear in test 1-b, the cable between the A4A2 assembly and the reference relay/amplifier is probably defective.

If the correct signal is observed in test 1-b, proceed to TEST PROCEDURE 2.

Test 1-c. If the signal was not present in test 1-a, tilt the A4 assembly out of the frame, disconnect the coaxial cable from the reference oscillator assembly and connect the reference oscillator output to the oscilloscope. The oscilloscope should display a 10 MHz signal at about 7 volts peak to peak.

If the signal is not present, check for dc levels as follows: terminal 1, +20 volts, terminal 2, +35 volts (oven voltage) and terminal 6, +5.2 volts (when present indicates thermostat is open, temperature stabilized). If the voltages are correct the reference oscillator assembly (A21) is defective.

NOTE

The reference oscillator assembly is not considered a field repairable unit. Replacement is recommended.

If the signal is present at the reference oscillator output check the SELECTOR switch, the relay assembly (A22A1) and the reference amplifier (A22A2).

PHASE DETECTOR ASSEMBLY (A4A2) GENERAL:

The phase detector consists of three basic circuits; a pulse generator, a sampler and a circuit to process the error signal.

The pulse generator converts the reference signal to very sharp, short duration pulses. These pulses are used to forward bias the sampler gate diodes.

SERVICE SHEET 2 (cont'd)

The sampler gate provides a means of comparing the pulses generated from the reference signal to the 20 MHz signal from the A4A3 assembly. An error signal is developed to control the voltage controlled oscillator in the A4A4 assembly when a phase error exists.

2 PULSE GENERATOR

The pulse generator consists of Q1 through Q5, U1, T1 and associated components.

The reference input to Q1 may be 1, 2, 2.5, 5 or 10 MHz. Q1 and Q2 act as an amplifier for low level signals and as a limiter for high level signals. Q3 acts as a limiter to ensure that the input to NAND gate U1A is always the same when the input reference signal is 0.2 to 2 volts rms. The output from Q3 is essentially a square wave with a slow rise time and a fast fall time; it is clipped, top and bottom, and is approximately 5 volts peak to peak.

U1, C11 and R20 are used as a pulse shaper. The output of U1A is differentiated by C11 and R20 and inverted by U1B. The sharp pulses (20 to 25 nanoseconds) are inverted by U1D to provide positive-going pulses to drive Q4/Q5.

Q4/Q5 comprise a complementary emitter-follower pair; its purpose is to provide a low impedance drive to T1.

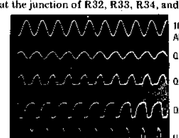
TEST PROCEDURE 2

Test 2-a. Composite waveform SS2-1 and trace 2 of composite waveform SS2-2 illustrate the development of the 10 MHz pulses derived from the internal reference signal. These pulses are used to drive the sampling phase detector diode gates. Observing the individual waveforms on an oscilloscope should enable the technician to quickly isolate a malfunction in the circuit to an individual stage or to the reference oscillator/switching circuits.

There are no loops or feedback circuits in the pulse generator circuit. It is safe to assume when a correct waveform is observed that all preceding portions of the circuit are operating properly.

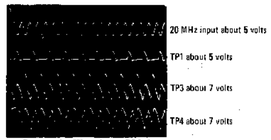
3 SAMPLER

Sampler diodes CR4 and CR5 are normally reverse biased. When the sampling pulse appears across the secondary of T1 it is coupled through C18 and C19 to forward bias CR4 and CR5. Since the gate pulses are equal in amplitude but opposite in polarity, they will cancel at the junction of R32, R33, R34, and C20.



Composite Waveform SS2-1

SERVICE SHEET 2 (cont'd)



Composite Waveform SS2-2

While CR4 and CR5 are forward biased the sampling gate is open and the 20 MHz signal from the A4A3 assembly is sampled. If the 20 MHz input from the A4A3 assembly is not phase locked to the pulses derived from the reference signal an ac signal will appear on the base of Q7. The polarity of the signal at any given time depends on the polarity of the 20 MHz signal from the A4A3 assembly when the last sample was taken. The amplitude of the ac signal at any given time depends on what portion of the 20 MHz sine wave the last sample was taken from.

Each time CR4 and CR5 are forward biased the charge on C20 will change unless the phase relationship is the same as it was in the previous sample. The time constant of C20 and R34 is long and since the time between samples is never more than one microsecond, C20 cannot discharge appreciably between sampling pulses.

The reverse bias levels for CR4 and CR5 are maintained at the same levels (opposite polarities) by voltage divider networks.

TEST PROCEDURE 3

Test 3-a. An oscilloscope loads the sampling circuit at TP3 and TP4 to a point where accurate analysis of the signal is not possible. However, observing the waveforms and comparing them to the typical waveforms shown in composite waveform SS2-2 will provide an adequate indication that the circuit is, or is not, functioning properly. The important points to observe are the two-to-one frequency ratio between the 20 MHz signal and the pulses, and the time coincidence of the positive-going and negative-going pulses at TP3 and TP4 with the pulses at TP1.

4 ERROR SIGNAL AMPLIFIER

When a phase difference between the reference signal and the 20 MHz input exists, a signal appears on C20. This signal is amplified and used to correct the frequency of the voltage controlled oscillator in the A4A4 assembly.

Q7 and Q9 provide a high impedance input for the sampler output. Q8 and Q10 comprise a differential amplifier. Emitter-follower Q11 provides the output to the A4A4 assembly.

TEST PROCEDURE 4

Test 4-a. Connect an oscilloscope to the A4A2 output labeled VCO. With the input 10 MHz reference disconnected from A4J5, (REF INPUT) connect a test oscillator (output 0 dBm, 3 kHz) to A4A2TP2. (The exact frequency is unimportant - 3 kHz was chosen arbitrarily.)

SERVICE SHEET 2 (cont'd)

Vary the output level of the test oscillator and note that the A4A2 output level displayed on the oscilloscope varies.

NOTE

If the A4A2 output does not vary when the test oscillator output is varied, use the oscilloscope to check back through the stages for a point in the circuit where the level does change with a change in the output level of the test oscillator. The following stage is probably defective.

5 REFERENCE DIVIDE-BY-FIVE AND DIVIDE-BY-TWO ASSEMBLY A4A1

The A4A1 assembly divides the 10 MHz input from the A4A3 assembly four times; two times by five and two times by two. The assembly provides a 2 MHz clock signal to the digital control unit, 100 kHz signals to the N2 and N3 loops and 400 kHz to the N1 loop.

Q3 and CR1 reduce the +20 volt input to +5 volts for operation of all circuits in the assembly. This method of providing power is used to minimize the effect of ac ripple on the power supply.

Q1 isolates the circuit from the 10 MHz source. Q2 amplifies the 10 MHz input and NAND gate U1A shapes it into pulses to drive U2. U2 provides a divided-by-five 2 MHz output at pin 8 which is used as a clock signal in the digital control unit. The 2 MHz output is also available at pin 11 of U2 and is used to drive U3.

U3 divides the 2 MHz input from pin 11 of U2 by five and provides outputs of 400 kHz at pins 8 and 11. The 400 kHz output at U3 pin 8 is used as the phase detector reference in the N1 loop. The 400 kHz at pin 11 of U3 is coupled to U3 pin 14 and divided by two. The 200 kHz output of U3 at pin 12 is coupled back to U2 pin 14 through NAND gate U1C and again divided by two. The 100 kHz output from U2 pin 12 is coupled through NAND gate U1B to the phase detector in the N2 loop. The 100 kHz signal is also coupled through NAND gate U1D to the phase detector in the N2 loop.

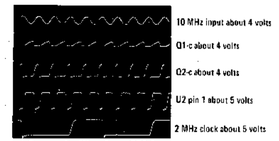
TEST PROCEDURE 5

Composite waveform SS2-3 illustrates the development of pulses from the 10 MHz reference input and the 2 MHz clock output to the digital control unit.

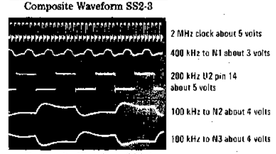
Composite waveform SS2-4 illustrates the development of the 400 kHz and 100 kHz N loop reference signals from the 2 MHz clock signals.

Block Diagram
SERVICE SHEET 1

SERVICE SHEET 2 (cont'd)



Composite Waveform SS2-3



Composite Waveform SS2-4

There are no loops or feed back paths in the circuit. It is safe to assume that when the proper waveform is observed at any point that preceding stages are functioning properly.

Observing the waveforms at the test points specified should enable the technician to quickly isolate the cause of a malfunction to a specific stage or component.

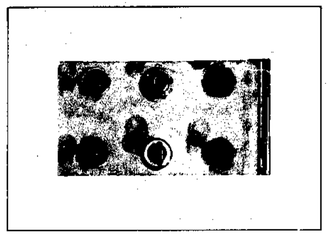


Figure 8-10. A21 Reference Oscillator Assembly

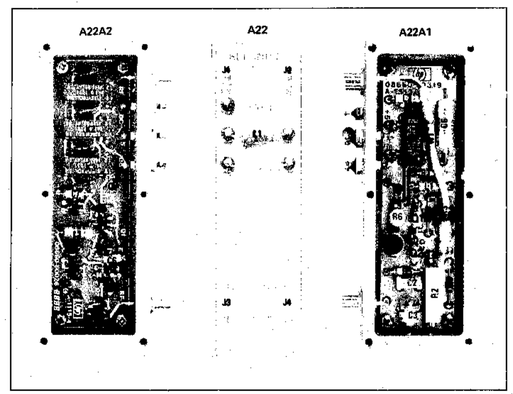


Figure 8-11. A22 Assembly Component Locations

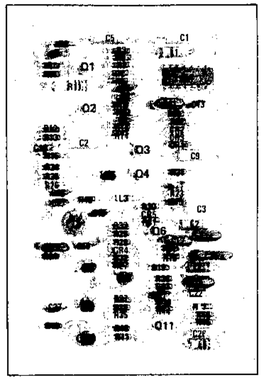


Figure 8-12. A4A2 Reference Phase Detector Component Locations

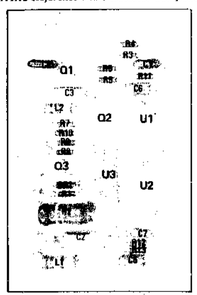
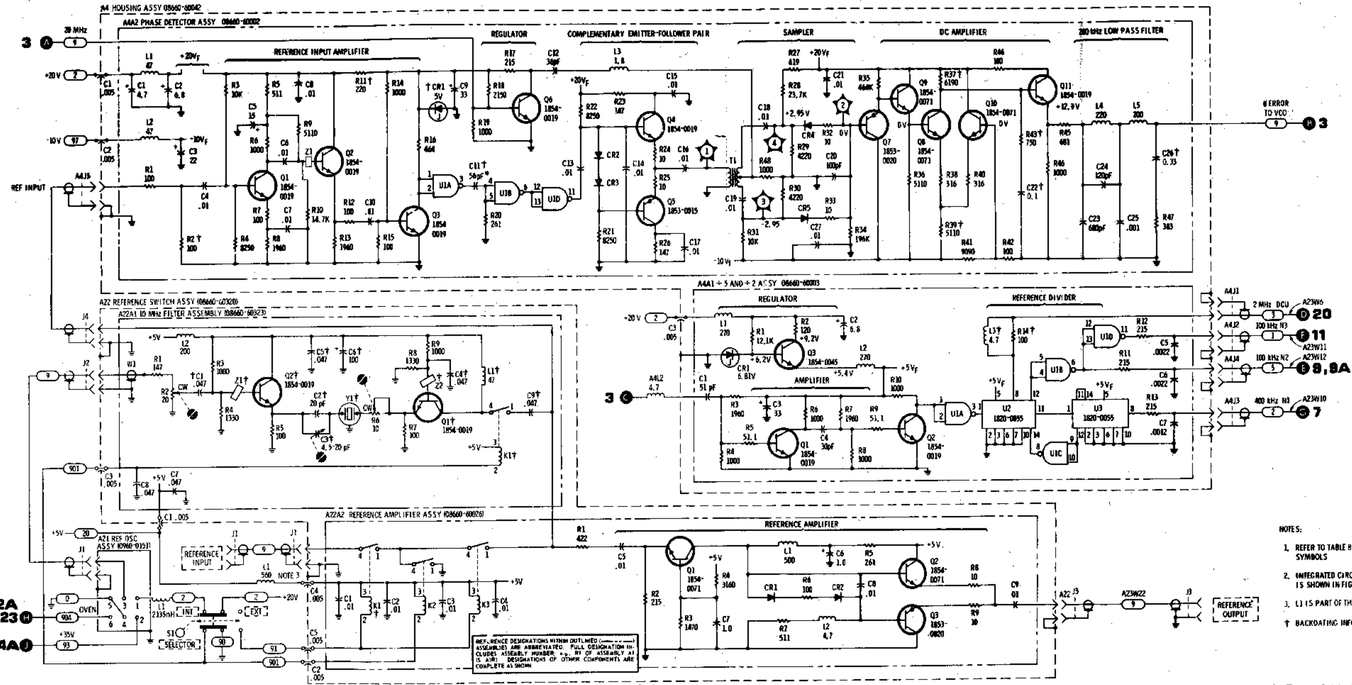


Figure 8-13. A4A1 Reference Divider Component Locations



REFERENCE DESIGNATIONS	
A4	A21
C1-3 J1-5	A22
A4A1	C1-6 J1-8
C1-7 CR1 L1-3 Q1-3 R1-18 U1-3	A22A1
A4A2	A22A2
C1-27 CR1-5 L1-5 Q1-31 R1-48 T1 U1	C1-9 CR1, 2 K1-3 L1, 2 Q1-3 R1-9 CHASSIS J1, 3 S1

NOTES:

1. REFER TO TABLE 8-2 FOR EXPLANATION OF SYMBOLS
2. 1 INTEGRATED CIRCUITS INTERNAL LOGIC IS SHOWN IN FIGURE 8-5.
3. L1 IS PART OF THE A22 ASSEMBLY.

↑ BACKDATING INFORMATION IN SECTION VII.

Figure 8-14. Reference Circuit Schematics

SERVICE SHEET 2

SERVICE SHEET 3

P/O REFERENCE LOOP CIRCUITS

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

When repairing the reference loop only one of the four covers should be removed at any given time. Operation of the instrument with the voltage controlled oscillator cover removed may cause faulty or erratic performance after required repairs have been completed.

NOTE

After making repairs in any part of the reference loop circuits the adjustment procedures specified in Section V paragraph 5-19 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Oscilloscope
Electronic Counter
10:1 probes (2)

REFERENCE LOOP GENERAL

The reference loop consists of four circuit boards located in the A4 assembly. Service Sheet 2 provides information about circuit operation and test procedures for the reference oscillator, reference amplifier and relays, the phase detector and the divide-by-five and divide-by-two circuits. Schematic diagrams, text and troubleshooting information for the voltage controlled oscillator and divide-by-two circuits appear on this service sheet.

The accuracy and stability of all the signals generated in the Model 8660A mainframe are traceable to the reference loop circuits.

The reference loop provides output frequencies of 500 MHz, 100 MHz, 20 MHz, 10 MHz, 2 MHz, 400 kHz, and 100 kHz. These signals are used in other circuits in the mainframe and in the plug-in sections. All of the reference section outputs are derived from a 100 MHz master oscillator which is phase locked to a stable reference source. The reference signal may be supplied by the internal reference oscillator or by an external reference standard. The reference signal may be 1, 2, 2.5, 5 or 10 MHz at a level of 0.2 to 2 volts rms.

OSCILLATOR, POWER SPLITTER, 500 MHz AMP and 100 MHz AMP

Q3 and associated components comprise a 100 MHz voltage controlled oscillator. Varactor CR1 is biased by the output of the A4A2 phase detector to assure that the oscillator is phase locked to the reference signal at 100 MHz.

The oscillator output is capacitively coupled to the base of Q4 which functions as a power splitter.

SERVICE SHEET 3 (cont'd)

Q9 and associated components provide isolation from the +20 volt power supply for the oscillator and power splitter to minimize effects of ac power supply ripple or line variations.

The collector output of Q4 is capacitively coupled to A8, a 100 MHz tuned amplifier which functions as a buffer stage. The times five function is accomplished by Q7 which is tuned to 500 MHz. The 500 MHz output from the Q7 tank circuit is capacitively coupled to Q6, another 500 MHz tuned amplifier which also provides isolation.

The emitter output of Q4 is capacitively coupled to the base of Q5 which functions as a 100 MHz tuned amplifier buffer stage. This output is used in the Microwave Extension Module (accessory number 11661A).

TEST PROCEDURE

NOTE

If the signal frequency is close to that specified in the following tests but is erratic, or not exact, the trouble is probably in the Phase Detector circuit. Refer to Service Sheet 2.

Test 1-a. With the A4A4 assembly cover removed use the counter and oscilloscope (separately) to check the 500 MHz output. The counter should indicate exactly 500 MHz and the oscilloscope should display a sine wave at about 0.2 volt peak to peak.

If the signal is present proceed to test 1-d. If the signal is not present proceed to test 1-b.

Test 1-b. Connect the oscilloscope and the counter (separately) to Q4-c. The counter should indicate exactly 100 MHz and the oscilloscope should display a sine wave at about 0.25 volts.

If the signal is present, but was not present in test 1-a, check Q6, Q7, Q8 and associated components. If the signal is not present, proceed to test 1-c.

Test 1-c. Connect the oscilloscope and the counter (separately) to Q4-b. The counter should indicate exactly 100 MHz and the scope should display a sine wave at about 0.4 volts.

If the signal is present, but was not present in previous tests, Q4 is probably defective. If the signal is not present check Q3, Q9 and associated components.

Test 1-d. Use the oscilloscope and the counter (separately) to check the 100 MHz output. The counter should indicate exactly 100 MHz and the oscilloscope should display a sine wave at about 0.5 volts.

If the signal is not present, but was present in test 1-a, check Q5 and associated components. If the signal is present, proceed to Test Procedure

SERVICE SHEET 3 (cont'd)

20 MHz OUTPUTS

A third 100 MHz signal is capacitively coupled from the oscillator tank circuit to the base of 100 MHz tuned amplifier Q2. The output of Q2 is used to drive a divide-by-five circuit (U1) which provides the 20 MHz output. The 20 MHz output is used to drive the divide-by-two circuit in the A4A3 assembly. The 20 MHz signal is also coupled to 20 MHz tuned amplifier Q1 for use in circuits external to the reference loop.

TEST PROCEDURE

Test 2-a. Connect the oscilloscope to the 20 MHz output from Q1. The display should be similar to that shown in the center trace of composite waveform SS3-1. Proceed to test 2-b.

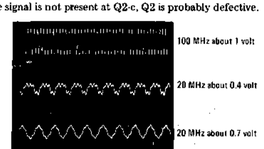
Test 2-b. Connect the oscilloscope to the 20 MHz output which goes to the A4A3 assembly. The display should be similar to that shown in the lower trace of composite waveform SS3-1.

If the correct signal is present, but was not present in test 2-a, check Q1 and associated components.

If the signal is not present proceed to test 2-c.

Test 2-c. Connect the oscilloscope to Q2-c. The oscilloscope display should be similar to the top trace in composite waveform SS3-1. If the signal is present, but was not present in test 2-b, U1 is probably defective.

If the signal is not present at Q2-c, Q2 is probably defective.



Composite Waveform SS3-1

DIVIDE-BY-TWO CIRCUIT A4A3

The A4A3 assembly provides 10 MHz outputs to the HF Loop (A4A7) phase detector, and to the divide-by-five and divide-by-two circuits (A4A1). It also provides a 20 MHz output for use in the reference loop phase detector A4A2.

Q1 and Q2 amplify the 20 MHz signal from the A4A4 assembly and applies it to U1 which divides by two. The +5 volts required for operation of U1 is derived from the +20 volt supply by R4 and CR1 to minimize effects of power supply ac ripple and line variations.

SERVICE SHEET 3 (cont'd)

The output from U1 is capacitively coupled out to the HF loops as a reference signal. It is also coupled through Q3 to 10 MHz tuned amplifier Q4. The 10 MHz output from Q4 is used in the divide-by-five and divide-by-two circuits (A4A1).

The 20 MHz output of Q2 is also coupled through tuned amplifier Q5 to the A4A2 phase detector assembly.

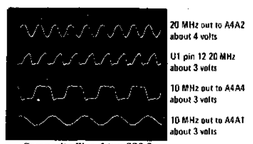
TEST PROCEDURE

Test 3-a. Connect the oscilloscope to the 10 MHz output to the A4A1 assembly. The oscilloscope display should be about as shown in the bottom trace of composite waveform SS3-2. Verify that the frequency is exactly 10 MHz with the counter.

If the signal is not present proceed to test 3-b. If the signal is present, proceed to test 3-d.

Test 3-b. Connect the oscilloscope to the 10 MHz output which goes to the A4A4 assembly. The oscilloscope display should be about as shown in the next-to-the-bottom trace of composite waveform SS3-2. Verify that the frequency is exactly 10 MHz with the counter.

If the signal is present, but was not present in test 3-a, check Q3, Q5 and associated components. If the signal is not present proceed to test 3-c.



Composite Waveform SS3-2

Test 3-c. Connect the oscilloscope to U1 pin 12. The oscilloscope display should be similar to the second from the top trace in composite waveform SS3-2.

NOTE

The counter may be used to verify that the frequency is approximately 20 MHz. However, this point in the circuit is critical; the additional load on the circuit will probably disturb the phase lock loop balance.

If the display is correct, but was not correct in previous tests, U1 is probably defective. If the display is not correct, check Q1, Q2 and associated components.

Reference Loop
SERVICE SHEET 2

SERVICE SHEET 3 (cont'd)

Test 3-d. Connect the oscilloscope and the counter (separately) to the 20 MHz output to the A4A2 assembly. The oscilloscope display should be similar to that shown in the top trace of composite waveform SS3-2. The counter readout should be exactly 20 MHz.

If the correct signal is not present check Q4 and associated components.

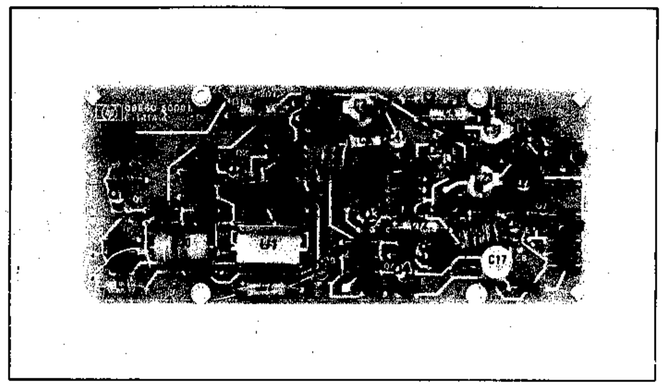


Figure 8-15. A4A4 Reference VCO Component Locations

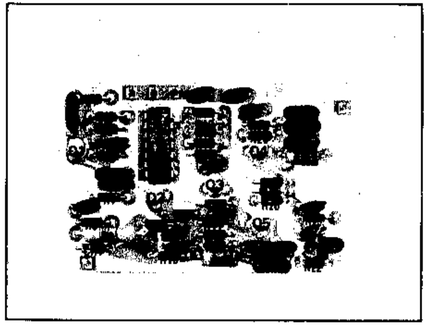


Figure 8-16. A4A3 Reference Divide-by-two Component Locations

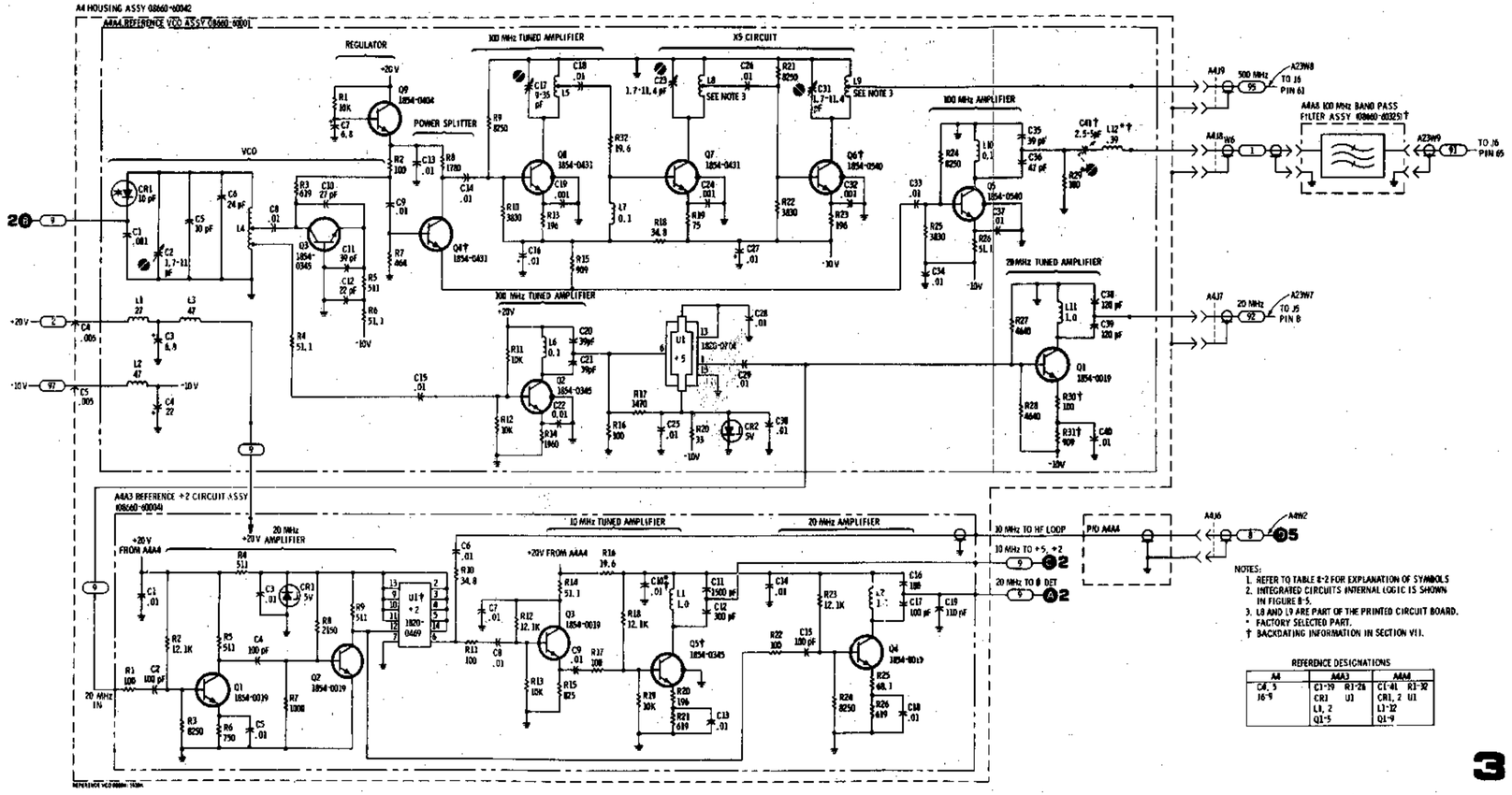


Figure 8-17. Reference VCO and Divider Schematics

SERVICE SHEET 3

3

SERVICE SHEET 4

PRETUNING ASSEMBLY (A4A6)

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A4A6 assembly, a part of the three-assembly High Frequency Loop, is shown schematically and described on this service sheet. The other two assemblies, A4A5 and A4A7, are shown schematically and described on Service Sheets 5 and 6.

NOTE

After making repairs in any parts of the HF Loop circuits the adjustment procedure specified in Section V paragraph 5-22 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Digital Voltmeter

HIGH FREQUENCY LOOP GENERAL INFORMATION

The purpose of the HF loop is to provide a precise digitally controlled output frequency between 350 and 450 MHz in 10 MHz increments. This output is used in the internal extension module and in the plug-in RF Sections to provide the desired output signal.

PRETUNING CIRCUIT

Q1 through Q11, U1 and associated components comprise a digital to analog converter which pretunes the A4A5 voltage controlled oscillator. The pretuning circuit cannot, by itself, set the oscillator frequency precisely; it does set the frequency within the capture range of the loop.

Integrated circuit U1 is a decoder which converts the BCD input from thumbwheel digit 8 to individual select lines which turn on one of nine transistors connected in a resistive network. The transistor which is turned on effectively grounds one point in the resistive network. The voltage level output to the voltage controlled oscillator depends on which transistor is turned on. The voltage varies from about −7 volts (350 MHz) to about −34 volts (450 MHz).

A single input line, representative of BCD '1' from thumbwheel digit 9 drives Q1 to turn on Q11. Q11, the tenth transistor switch in the pretuning network, grounds the lowest resistance point in the network; it pretunes the voltage controlled oscillator to 350 MHz.

TEST PROCEDURE

Test 1-a. With the digital voltmeter connected to the junction of R15, R18 and R19 set the thumbwheels as shown in table 8-3. The voltages shown in the table are typical; the actual voltage levels will depend on the characteristics of the varactor used in the voltage controlled oscillator.

If changing the setting of thumbwheel digit 8 through its range does not result in a change in the dc level at the junction of R15, R18 and R19, U1 may be defective.

Test 1-b. Use the digital voltmeter to check the A, B, C and D inputs to U1 from thumbwheel digit 8. These inputs are binary 1 2 4 8 positive true logic. (Example: with thumbwheel digit 8 set to a 3, U1 pins 15 and 14 should be high, about +4 volts, and pins 12 and 13 should be low, about 0.3 volt). If the A, B, C and D

Reference Loop VCO
SERVICE SHEET 3

SERVICE SHEET 4 (cont'd)

inputs to U1 are correct, use the digital voltmeter to check the U1 output. (Example: if thumbwheel digit 8 is set to a 3, Inputs A and B will be high and U1 pin 4 will go low.

Operation of transistors Q2 through Q11 may be checked by checking the dc level at their collectors which are connected to the transistor shell. The numbers plated on the circuit board next to the potentiometers correspond to thumbwheel digits 8 and 9. Thumbwheel digit 8 controls Q2 through Q10 and thumbwheel digit 9 drives Q1 to control Q11. The metallic shell (collector) of the transistor selected goes low (0.1 volt or less).

SUMMING CIRCUIT

Common base current source Q13 sums the output of the digital to analog converter, current from a +20 volt source (R13) and the error signal from the A4A7 sampling phase detector. The output of the digital to analog converter is partially controlled by common base current source Q14. Conduction of Q14 is controlled by a temperature sensitive stabistor diode on the voltage controlled oscillator circuit board. The current from Q14 is injected into the pretuning network to provide correct compensation for the voltage controlled oscillator drift characteristics. Q12 provides a means of coupling the error signal from the phase detector through C7 to the voltage controlled oscillator in the A4A5 assembly.

TEST PROCEDURE

Test 2-a. Connect the digital voltmeter to the A4A6 output labeled FREQ on the circuit board. Set the thumbwheel digits as shown in Table 8-4. The voltages shown are typical; actual voltage levels depend on the characteristics of the varactor in the voltage controlled oscillator.

If the voltages were correct in test 1-a, but are not in test 2-a, check Q12, Q13 and associated components.

Table 8-4. Pre-tuning DC Levels

DC Level Locked	DC Level Unlocked	MHz Locked
34.22	34.26	450.145
29.35	29.37	440.143
25.2	25.30	430.141
21.6	21.80	420.129
18.6	18.77	410.136
15.9	16.12	400.134
13.6	13.82	390.132
11.6	11.82	380.129
9.9	10.08	330.127
8.4	8.55	360.125
7.1	7.20	350.121

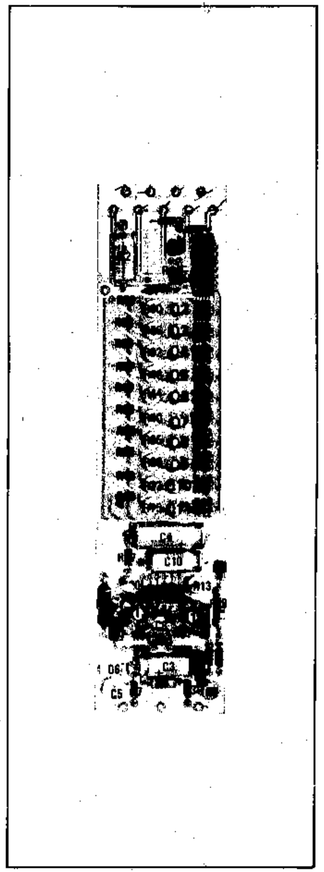


Figure 8-18. IIF Loop Pretuning Component Locations

SERVICE SHEET 4

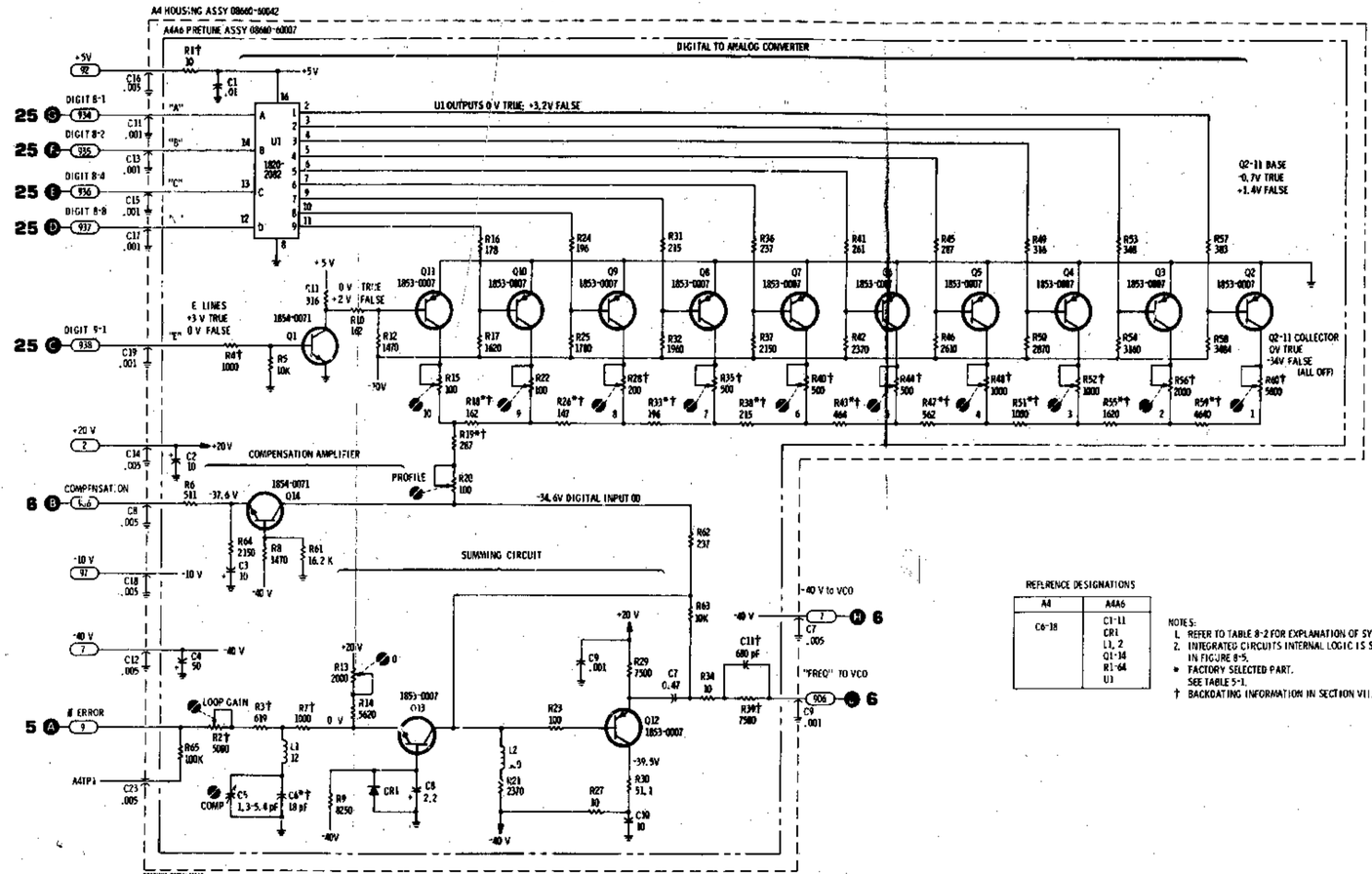


Figure 8-19. HF Loop Pretuning Circuit Schematic

SERVICE SHEET 5

SAMPLING PHASE DETECTOR (A4A7)

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A4A7 assembly, a part of the three-assembly High Frequency Loop, is shown schematically and described on this service sheet. The other two assemblies, A4A5 and A4A6, are shown schematically and described on Service Sheets 4 and 6.

NOTE

After making repairs in any part of the HF Loop circuits the adjustment procedure specified in Section V paragraph 5-22 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Oscilloscope (with 10:1 divider probes)
Test Oscillator
Digital Voltmeter

HIGH FREQUENCY LOOP GENERAL INFORMATION

The purpose of the HF loop is to provide a precise digitally controlled output frequency between 350 and 450 MHz in 10 MHz increments. This output is used in the internal extension module and in the plug-in RF Sections to provide the desired output signal.

The sampling phase detector compares the voltage controlled oscillator output to a 10 MHz signal from the reference section. The output of the phase detector circuit is a beat note or a varying dc level. The phase detector assembly contains a pulse generator, a sampler, and a signal processing circuit.

■ PULSE GENERATOR

Q1 and Q2 comprise a non-saturating, limiting amplifier. It provides a constant amplitude square wave (about 6 volts) derived from the 10 MHz reference signal. The circuit is designed to minimize the sensitivity of the output ac swing to power supply ripple.

The output of Q2 is applied to Q3 which converts the signal to a stable current waveform. A two-to-one stepdown transformer (T1) is used in conjunction with Q3 to provide the additional current required to drive the step-recovery diode CR1.

When Q3 conducts heavily CR1 is reverse biased by the signal which appears across the secondary winding of T1. When Q3 is turned off the collapsing inductive field of the T1 primary winding and the resonant circuit of L5 and C10 cause a flyback action which drives CR1 into conduction. L4 and C9 also enhance the flyback action.

NOTE

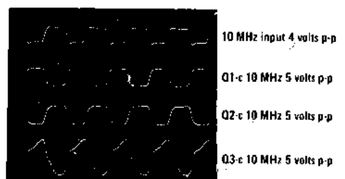
One of the characteristics of a step-recovery diode, also called a charge-storage diode, is that the junction transition capacitance accumulates a charge while the diode is forward biased.

SERVICE SHEET 5 (cont'd)

When the pulse which forward biased CR1 has ended, CR1 is again reverse biased; however, current will flow in the reverse direction until the charge stored in CR1 is depleted. When the charge stored in CR1 is depleted current flow stops abruptly; the sharp current transition causes L6 and L7 to develop large narrow voltages spikes of about 6 volts amplitude and one nanosecond in duration. The pulse is positive-going at L7 and negative-going at L6. These pulses are coupled through C10, C11 and balun T2 to forward bias the diodes in the sampler bridge. Balun T2 improves amplitude balance of the pulses.

TEST PROCEDURE ■

Test 1-a. Composite waveform SS5-1 illustrates the correct waveforms for the three stages of the pulse generator.



Composite Waveform SS5-1

NOTE

Since an oscilloscope would load the remainder of the pulse generator circuit, and due to the short duration of the gate pulse, waveform analysis is not practicable. If the waveforms are as shown in SS5-1 and the loop does not phase lock, proceed to test procedure ■.

■ SAMPLER AND SIGNAL PROCESSOR

The sampler is a matched quad diode gate which is normally reverse biased. When the step-recovery diode generates the gate pulse all four of the sampler gate diodes are simultaneously forward biased. When the sampler gate diodes are forward biased a sample of the signal from the A4A5 voltage controlled oscillator is taken and stored in C13.

Q4 and Q5 comprise a differential amplifier. The non-inverting input (G2) is derived from the sampling circuit. The output is applied to emitter-follower Q6 which provides a low impedance phase error output. The output of Q6 is also fed back to the differential amplifier inverting input (G1) to close the loop at unity gain. The holding capacitor, C13 is connected directly between the two inputs to Q4; this bootstraps C13 to extend the sampler's frequency response.

CR8 and CR9 provide reverse bias voltages for the sampling gate diodes. These bias voltages are balanced and centered on the output signal to

HF Loop Pretuning
◆ SERVICE SHEET 4

SERVICE SHEET 5 (cont'd)

improve sampler efficiency.

R18 controls the response of the sampler by varying the amount of back-bias for the bridge; it is adjusted for maximum frequency response with minimum peaking.

R22 controls the quiescent output level to the summing circuit in A4A6; it should be adjusted for zero output with the input from the voltage controlled oscillator disconnected.

If the voltage controlled oscillator output is harmonically related to the reference signal the output of the phase detector is proportional to the sine of the difference in phase of the two signals. If the voltage controlled oscillator frequency is not harmonically related to the reference signal, the output of the phase detector is a beat note at the difference frequency.

TEST PROCEDURE ■

Test 2-a. Disconnect the input to the sampler gate from the A4A5 voltage controlled oscillator and substitute a 1 MHz, 10 dBm signal from the test oscillator. Connect the oscilloscope to the phase error output (labeled Ø on the circuit board). Varying the output level of the test oscillator should cause the oscilloscope display to follow the amplitude change.

If the oscilloscope display is not as specified proceed to test 2-b.

If the display is correct and the display for test 1-b was correct, check the step-recovery diode and associated components.

Test 2-b. With the oscilloscope connected as it was in test 2-a, inject the 1 MHz signal at Q4-G2. If the signal is now displayed on the oscilloscope and varies as the output of the test oscillator is varied, check the step-recovery diode, the sampler gate diodes and associated components.

If the signal is not displayed check Q4, Q5, Q6 and associated components.

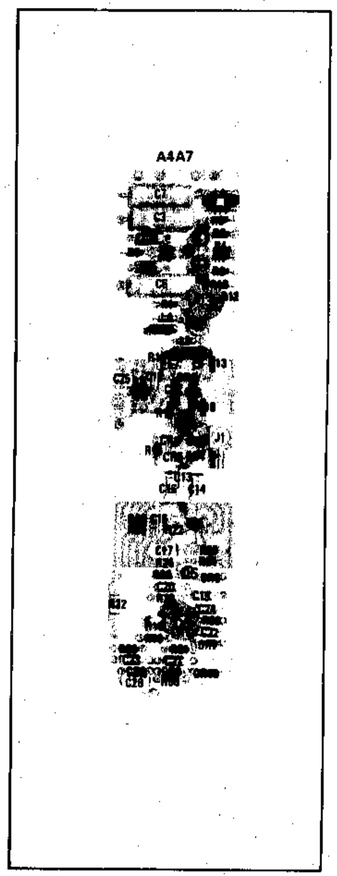
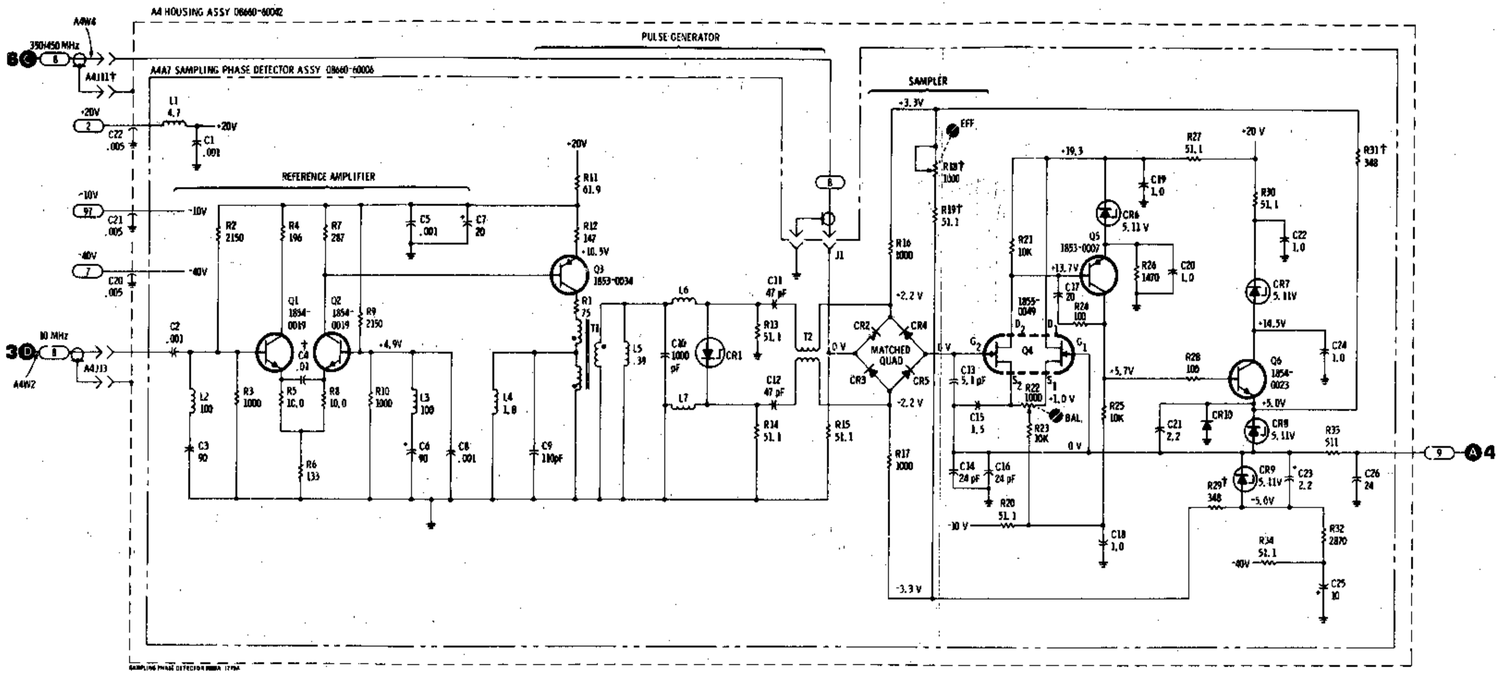


Figure 8-20. A4A7 HF Loop Phase Detector Component Locations

SERVICE SHEET 5



REFERENCE DESIGNATIONS

A4	A4A7
C19 - 21 J11, 13	C1-26 CR1-10 L1-7 Q1-6 R1-34 T1, 2

NOTES:
1. REFER TO TABLE 8-2 FOR EXPLANATION OF SYMBOLS
† BACKDATING INFORMATION IN SECTION VII.

Figure 8-21. Sampling Phase Detector Schematic

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SERVICE SHEET 6

VCO AND AMPLIFIERS (A4A5)

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A4A5 assembly, a part of the three-assembly HF Loop, is shown schematically and described on this service sheet. The other two assemblies, A4A6 and A4A7, are shown schematically and described on Service Sheets 4 and 5.

NOTE

After making repairs to any part of the HF Loop circuits the adjustment procedures specified in Section V paragraph 5-22 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Spectrum Analyzer
Electronic Counter

HIGH FREQUENCY LOOP GENERAL INFORMATION

The purpose of the HF Loop is to provide a precise digitally controlled output frequency between 350 and 450 MHz in 10 MHz increments. This output is used in the Microwave Extension Module and in the plug-in RF Section to provide the desired output signal.

VCO AND AMPLIFIERS

Transistor A4 and associated components comprise a voltage controlled oscillator. The output frequency, when the loop is phase locked, is always a 10 MHz harmonic between 350 and 450 MHz. C3 is adjusted to set the high frequency end of the band. C1 is part of the loop filter in the control path and also provides an ac ground for the varactor at the bias point.

The oscillator output (about .5 volts rms) is coupled through an isolation transformer to two identical three-stage buffer amplifiers. The isolation transformer splits the power equally to the two amplifiers and also eliminates feedthrough of extraneous signals from one amplifier to the other. The amplifiers provide outputs that are about 1 volt rms into 50 ohms.

Additional isolation from extraneous signals is provided by separate power supply inputs to the two amplifiers, extensive decoupling between stages, multiple grounding points for individual stages and separation of ground planes for individual stages.

CR2 is a stabistor used for temperature compensation for the voltage controlled oscillator. The forward voltage drop of the stabistor changes with the voltage controlled oscillator temperature and controls a current source (A4A6Q14) in the pretuning assembly.

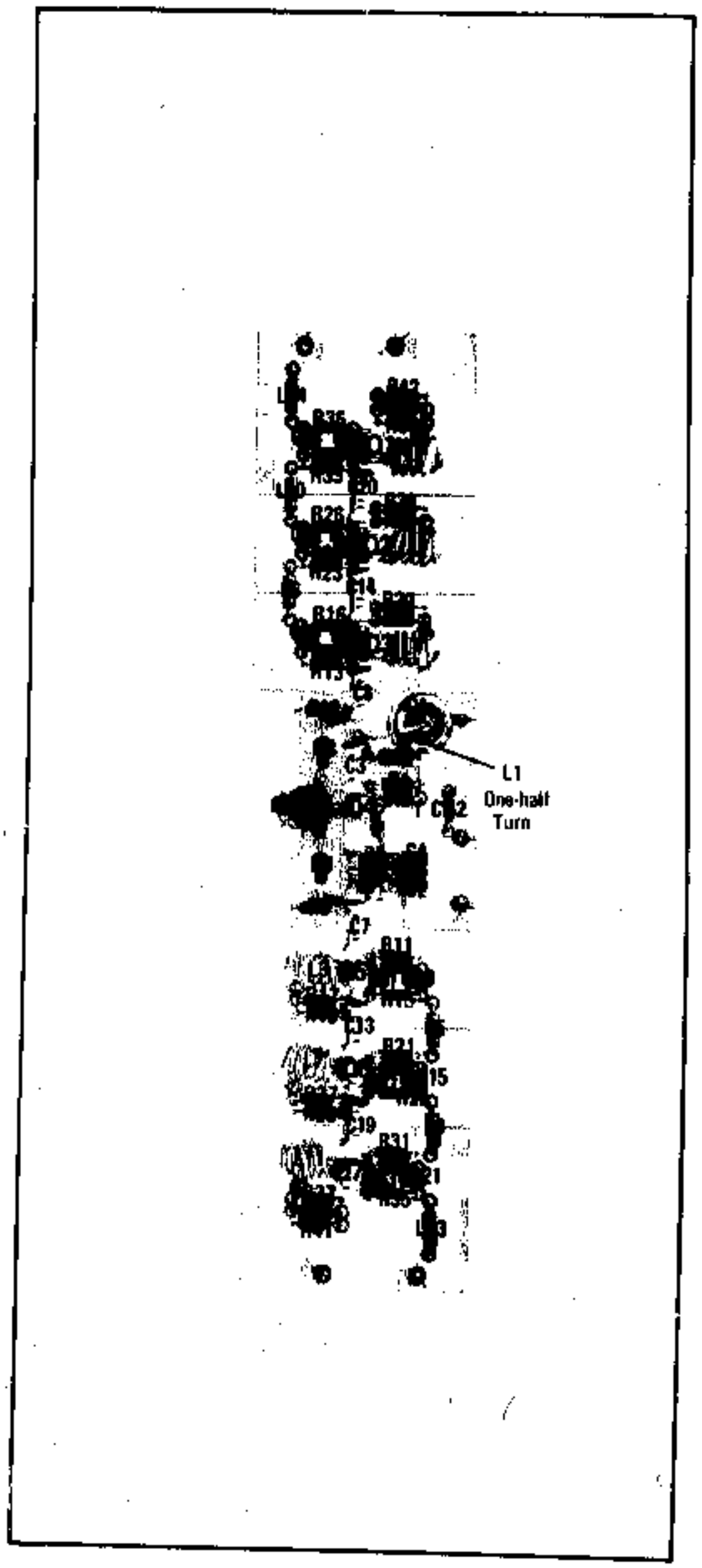

Figure 8-22. A4A5 HP Loop VCO Component Locations

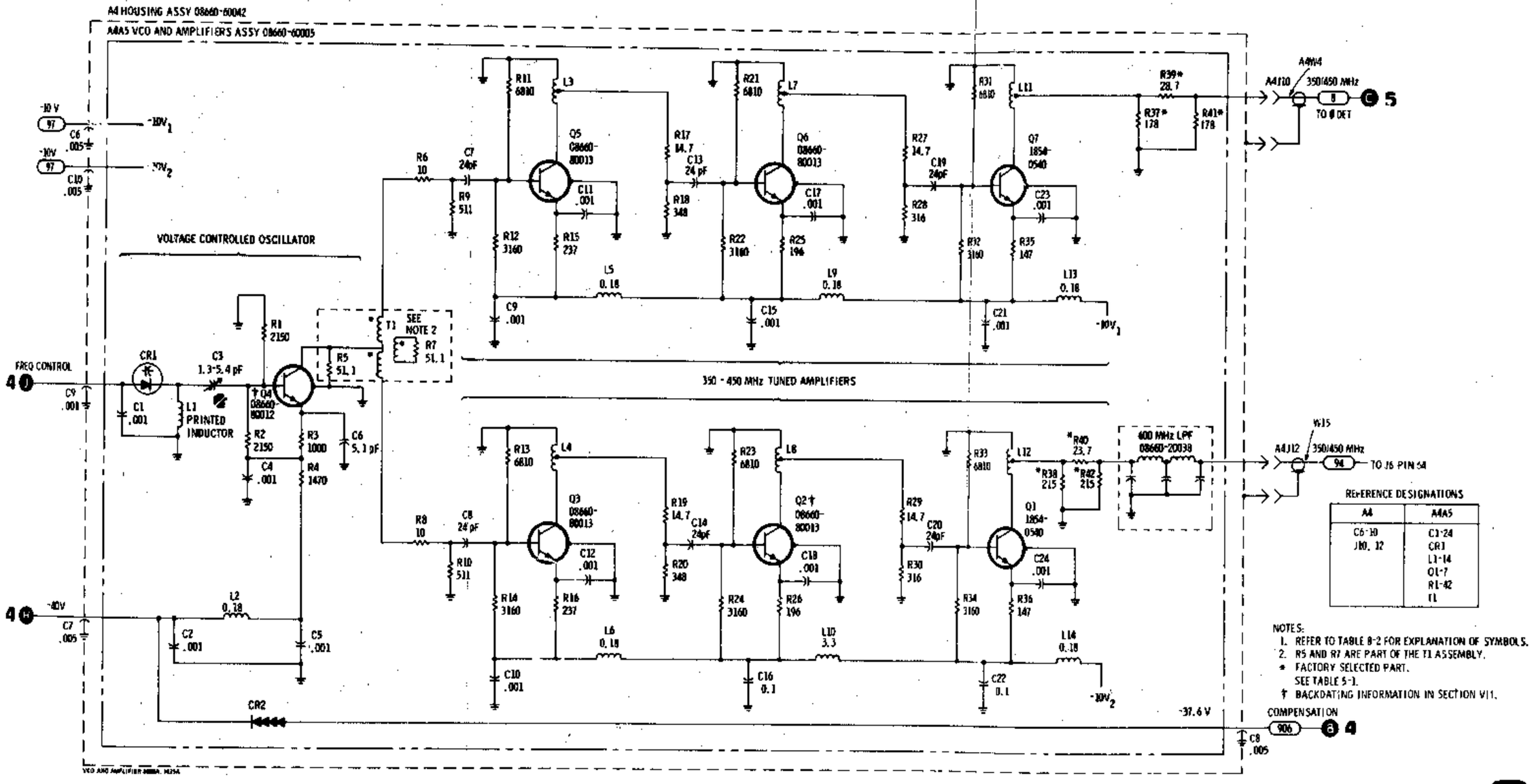

Figure 8-23. VCO and Amplifiers Schematic

SERVICE INFORMATION

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SERVICE SHEET 7

N1 PHASE DETECTOR ASSEMBLY A16

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees

The A16 assembly, a part of the two-assembly N1 phase lock loop is shown schematically and described on this service sheet. The N1 Oscillator assembly, A17, is shown schematically and described on Service Sheet 8.

When trouble has been isolated to the A16 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs in any part of the N1 loop circuits the adjustment procedures specified in Section V paragraph 5-23 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

N1 LOOP GENERAL INFORMATION

The purpose of the N1 loop is to generate digitally contolled rf signals in the range of 19.8 to 29.7 MHz in selectable 100 kHz increments. The voltage controlled oscillator is phase locked to a 400 kHz reference which is derived from the master oscillator in the reference section. The rf output from the N1 loop is applied to Summing Loop 1.

PROGRAMMABLE DIVIDER CIRCUIT

The integrated circuits in the A16 assembly, except for U1, are all used to count down the input from the N1 voltage controlled oscillator. When there is no BCD input (all inputs low) and the loop is locked, the input from the voltage controlled oscillator will be 29.7 MHz; the programmable divider will divide by 297 and provide a 100 kHz output at TP3. U5 and U6 are preset by thumbwheel digits 6 and 7 and programmed to vary between start counts of 00 to 99. Operation of the circuit is as follows:

Assume that initially there are no BCD input to decade dividers U5 and U6 and they have been preset to zero. Assume also that U2A pin 6 ($\overline{Q}$) and U2B pin 8 ($\overline{Q}$) are both low, U4 pin 6 ($\overline{Q}$), U3A pin 6 ($\overline{Q}$) and U3B pin 8 ($\overline{Q}$) are all high.

AND gate U7A functions as a Schmitt trigger to change the incoming positive half cycles of the sine wave from the voltage controlled oscillator to positive-going pulses. These pulses clock U5 when AND gate U7B is enabled. U5 pin 12 provides a divided-by-ten output to clock U6 and also provides A and B (BCD 1 and 2) outputs. The A and B outputs of U5 have no effect on U4 until AND gate U7C pin 8 goes high (AND gate U7C will be discussed later in this text).

U6 pin 12 provides a divided-by-one hundred output to clock U2A and also provides A and D (BCD 1 and 8) outputs to AND gate U7C. The A and D outputs have no effect on AND gate U7C until after U2B pin 8 ($\overline{Q}$) goes high at the count of 200.

The D output of U6 (pin 12) goes high on the count of 8 (80 input pulses to U5). This output has no effect on U2A because U2A is clocked on negative-going pulses only.

The D output of U6 (pin 12) goes low at the count of 10 (100 input pulses to U5) and clocks U2A. This causes U2A pin 6 ($\overline{Q}$) to go high. When the D output of U6 (pin 12) again goes low at the count of 10 (200 input pulses to U5), U2A is again clocked and the $\overline{Q}$ output goes low to clock U2B. When U2B pin 8 ($\overline{Q}$) goes high it provides a high input to AND gate U7C pin 11.

Ninety input cycles after U2B pin 8 ($\overline{Q}$) goes high (290 input cycles), U6 A and D outputs (BCD 1 and 8) go high and enable AND gate U7C and provide a high to J input 3 of U4; U4 still cannot be clocked because U4 J pins 4 and 5 are still low.

Three input cycles after U4 pin 3 goes high (293 input cycles), the A and B outputs of U5 (BCD 1 and 2) go high and enable the J input to J-K flip-flop U4.

The 294th input cycle will clock U4 at pin 12 because all J and K inputs are high. When clocked, U4 $\overline{Q}$ goes low and AND gate U7B is no longer enabled; the count, as far as U5, U6 and U2 are concerned, is ended. When U4 $\overline{Q}$ goes low it also sets U3A and U3B; the Q outputs go low and the Q outputs go high. When U3A pin 6 ($\overline{Q}$) goes low it is used to preset U5 and U6 to the start count programmed by thumbwheel digits 6 and 7 or by remote control; U2A and U2B Q outputs are set low. When U5, U6, U2A and U2B are preset the J input to U4 is no longer enabled since the count is no longer at the 'sense' count of 293.

When U3B pin 9 (Q) goes high the leading edge is used to generate the sampling pulse. The first pulse to the sampling phase detector is initiated by the 294th input cycle. Since three more cycles are required to restart the count cycle, following sampler pulses are 297 cycles apart.

The 295th input cycle will clock U4 and since U4 K is high, U4 $\overline{Q}$ will go high. This $\overline{Q}$ high is applied to the K input of U3A (pin 2) and to pin 4 of AND gate U7B. AND gate U7B will not be enabled because U3B pin 8 ($\overline{Q}$) is holding AND gate U7B pin 5 low.

The 296th input cycle will clock U3A because the K input is now high. U3A pin 6 ($\overline{Q}$) will go high. This high Q output is applied to AND gate U7B pin 5 and the next count cycle is enabled through AND gate U7B.

When there is a preset input programmed into U5 and U6 pins 3, 4, 10 and 11 the terminal count is still 297. However, the count starts at the number programmed into the BCD inputs. As an example, if the BCD input into U5 and U6 is 99, the first cycle would cause the same digital circuit changes that the 100th cycle caused in the discussion above (U2A would be clocked). The frequency division would be 297 - 99, equal to division by 198. The phase lock loop operation would result in an input frequency to the programmable divider of 19.8 MHz. When divided by 198, the divider output at TP3 would again be 100 kHz.

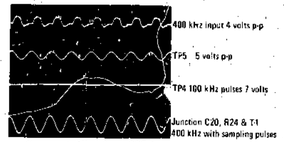
The output from U3B at TP3 is always 100 kHz when the voltage controlled oscillator is phase locked to the reference signal.

Q6 and CR1 provide Vcc to U3 to minimize the effect of power supply ac ripple and line variations.

TEST PROCEDURE

Composite waveform SS7-1 illustrates the proper timing relationship between the 400 kHz reference input, the pulse output from the

pulse generator and the sampling point on the 400 kHz reference signal when the loop is phase locked.



Composite Waveform SS7-1

NOTE

In the following tests all thumbwheels are set to 0 unless otherwise noted.

Test 1-a. Use the electronic counter to check for 400.000 kHz at TP5.

If the 400.000 kHz signal is displayed on the counter, verify that the sine wave at TP5 is as shown in trace 2 of composite waveform SS7-1. If the signal is as shown proceed to test 1-b.

If the 400 kHz signal cannot be counted or does not appear as shown on the composite waveform for TP5, check the reference input at XA16-1-2. The reference input signal should be about 4 volts peak-to-peak and 400 kHz as shown in trace 1 of composite waveform SS7-1. If the correct waveform is observed, but was not observed at TP5, check Q1, Q2 and associated components. If the correct waveform is not present, check the cabling to the reference loop and, if necessary, the reference loop (See Service Sheet 3).

If trouble is found and corrected, perform the adjustment procedures specified in paragraph 5-16 to verify proper operation of the loop.

Test 1-b. Connect one oscilloscope channel and the counter to TP4 and the other oscilloscope channel to the junction of C20, R24 and T1. If the loop is locked the waveforms will be as shown in traces 3 and 4 of composite waveform SS7-1 and the counter will display 100.000 kHz.

Note that the waveform shown by trace 3 of the composite waveform may appear as shown even if the counter does not indicate 100.000 kHz. This is because the frequency sensitivity of the oscilloscope is not as exact as the frequency sensitivity of the counter.

If the programmable divider and the pulse shaper are working properly but the loop is not locked, trace 4 as shown in composite

waveform SS7-1 may still show the pulses, but the signal between the pulses will be erratic.

Test 1-c. If the pulses are not present at TP4 or the junction of C20, R24 and T1 and the counter counts randomly or not at all, connect the oscilloscope to TP3. The oscilloscope should display a waveform similar to that shown in trace 3 of the composite waveform SS7-1 at about half the amplitude.

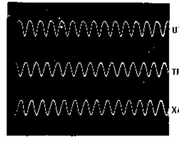
If the pulses are not present at TP3 proceed to test 1-d.

If the pulses are present at TP3 but were not present at TP4, check Q4, Q5 and associated components. After repairs are made recheck test procedure 1-b.

If the pulses are now present at TP4 and the junction of C20, R24 and T1, but the four-cycle sine wave is not present as shown in trace 4 of composite waveform SS7-1, rotate R38 through its range to see if the proper waveform can be obtained. If the frequency displayed on the counter does change as R38 is rotated but phase lock cannot be achieved, check Q3, the sampling diodes and associated components.

Test 1-d. If the pulse is not present at TP3 in test 1-c connect the oscilloscope to AND gate U7B pin 6. The waveform should be as shown in the top trace of composite waveform SS7-2. If the correct signal is observed proceed to test 1-e.

If the correct signal is not observed connect the oscilloscope to TP1. The waveform should be as shown in the center trace of composite waveform SS7-2. If the signal is present, but was not present at AND gate U7B pin 6, use the digital voltmeter to check the voltage at pins 4 and 5 of AND gate U7B. The digital voltmeter should indicate about 4 volts. If the voltages are present AND gate U7B is defective.

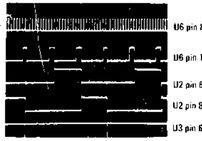


Composite Waveform SS7-2

If the voltages are not present at AND gate U7B pins 4 and 5, ground pin 2 of U4. If the signal now appears at AND gate U7B pin 6, U3 and U7B are functioning properly. The trouble is probably in the gating circuit to U4. Proceed to test 1-e.

If the signal is not present at TP1, use the oscilloscope to check the input from the voltage controlled oscillator at XA16-2-15. The signal should be as shown in the lower trace in composite waveform SS7-2. If the signal is present AND gate U7A is probably defective. If the signal is not present, the A17 assembly or interconnections are defective.

Test 1-e. It is assumed in this test that the signal from the N1 voltage controlled oscillator is present at U5 pin 8. Composite waveform SS7-3 illustrates the correct waveforms at the points shown. All signals are about 4.5 volts.

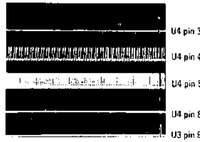


Composite Waveform SS7-3

If none of the waveforms are present, U5 is probably defective.

Note that the reset pulse in trace 5 is in time coincidence with the 'missing' pulse in trace 1 and that the reset pulse resets traces 2 and 4.

Test 1-f. Composite waveform SS7-4 illustrates the correct waveforms at the points shown. All signals are about 4.5 volts in amplitude. Sync the oscilloscope to TP3 for this test.



Composite Waveform SS7-4

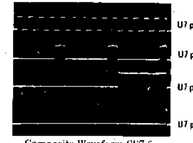
Note that U4 pin 8 goes high only when all of the J inputs (U4 pins 3, 4 and 5) are high.

If the waveforms for traces 2 and/or 3 are not present, U5 is probably defective.

If the waveforms for traces 1, 4 and 5 are not present, proceed to test 1-g.

Test 1-g. Composite waveform SS7-5 illustrates the correct waveforms at the points shown. All signals are about 4.5 volts in amplitude. Sync the oscilloscope to TP3 for this test.

HF Loop VCO
SERVICE SHEET 6



Composite Waveform SS7-5

If the inputs to AND gate U7C are not as shown, U6 or U2 may be defective.

If the inputs are as shown but there is no output at AND gate U7C pin 8, U7 is defective.

PULSE AMPLIFIER

The positive-going output from U3B pin 9 is used to generate the pulse required to open the sampler gate. Common base amplifier Q5 and emitter follower Q4 amplifies and couples the pulse to T1. CR2 and CR3 are used to minimize flyback action. CR2 also bypasses the negative-going pulse around the transformer primary to ensure that only the positive-going pulse is coupled to the transformer secondary.

A 400 kHz signal from the reference loop is applied to the secondary center tap of T1. L5 and C8 (along with C7 in the reference loop A4A1 assembly) comprise a low pass filter with a cut off frequency of about 500 MHz. The TTL input from the reference loop is reshaped into a sine wave by the low pass filter. L6 and C13 comprise a tuned circuit which bypasses unwanted signals and further filters the sine wave.

Sampler diodes CR4 and CR5 are normally reverse biased. When the sampling pulse appears across the secondary of T1 it is coupled through C20 and C21 to forward bias CR4 and CR5. Since the gate pulses are equal in amplitude but opposite in polarity, they will cancel at TP6.

While CR4 and CR5 are forward biased the sampling gate is open and the 400 kHz reference signal is sampled.

This type of sampling phase detector may be phase locked at virtually any point on the sine wave curve. Ideally, the zero crossover point of the sine wave should be used to improve the lock and hold-in capability of the loop.

If the divided down output of the voltage controlled oscillator in the A17 assembly (100 kHz pulses) is not phase locked to the 400 kHz reference signal an ac signal is developed at TP6. The polarity of the signal at any given time depends on the polarity of the 400 kHz reference signal at the time the last sample was taken. The amplitude of the signal at any given time depends on what portion of the sine wave the last sample was taken from. Each time CR4 and CR5 are forward biased the signal derived from the 400 kHz reference signal at T1 terminals 4 and 6 are coupled through the sampling gate to control the charge on C22.

When the sampling gate pulse ends, CR4 and CR5 are again reverse biased and the sampling gate is closed. Since Q3 is a high impedance device, the charge will remain on C22 until the next sampling pulse. The error signal from Q3 is applied to the summing amplifier in the A17 assembly through operational amplifier.

Test point 8 may be grounded to open the phase lock loop. Since the emitter of A17Q4 in the A17 assembly is also almost exactly at dc ground level, grounding this test point will not affect the pretuning circuit. With the loop open both the pretuning and the error signal may be checked.

SERVICE SHEET 7 (cont'd)

TEST PROCEDURE

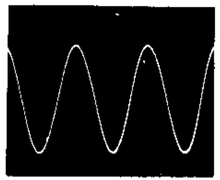
Test 2-a. Connect the oscilloscope to TP6. If the 400 kHz signal is present one of the sampling gate diodes (CR4 or CR5) is probably shorted. If the gate pulses are present one of the sampling gate diodes is probably open (negative-going pulses CR5, positive-going pulses, CR4). Proceed to test 2-b.

Test 2-b. With the oscilloscope connected to TP6, ground TP8. The signal displayed should be similar to that shown in waveform SS7-6, at about 3 volts. The frequency of the signal will be determined by the difference detected by the sampling gate (typically 200 to 400 Hz).

If the signal is present at TP6, connect the oscilloscope to U1 pin 6. The sine wave should be about the same as that shown for TP6 except that the sampling points will not be as obvious.

If the signal is present at U1 pin 6 the error amplifier and the sampling circuits are functioning properly.

If the signal is not present at U1 pin 6, but was present at TP6, check U1 and associated components. After repairs are made repeat the test and remove the ground from TP8.



Waveform SS7-6

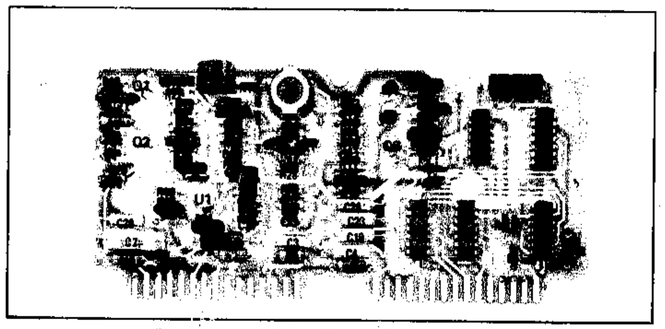


Figure 8-24. A16 N1 Phase Detector Component Locations

SERVICE SHEET 7

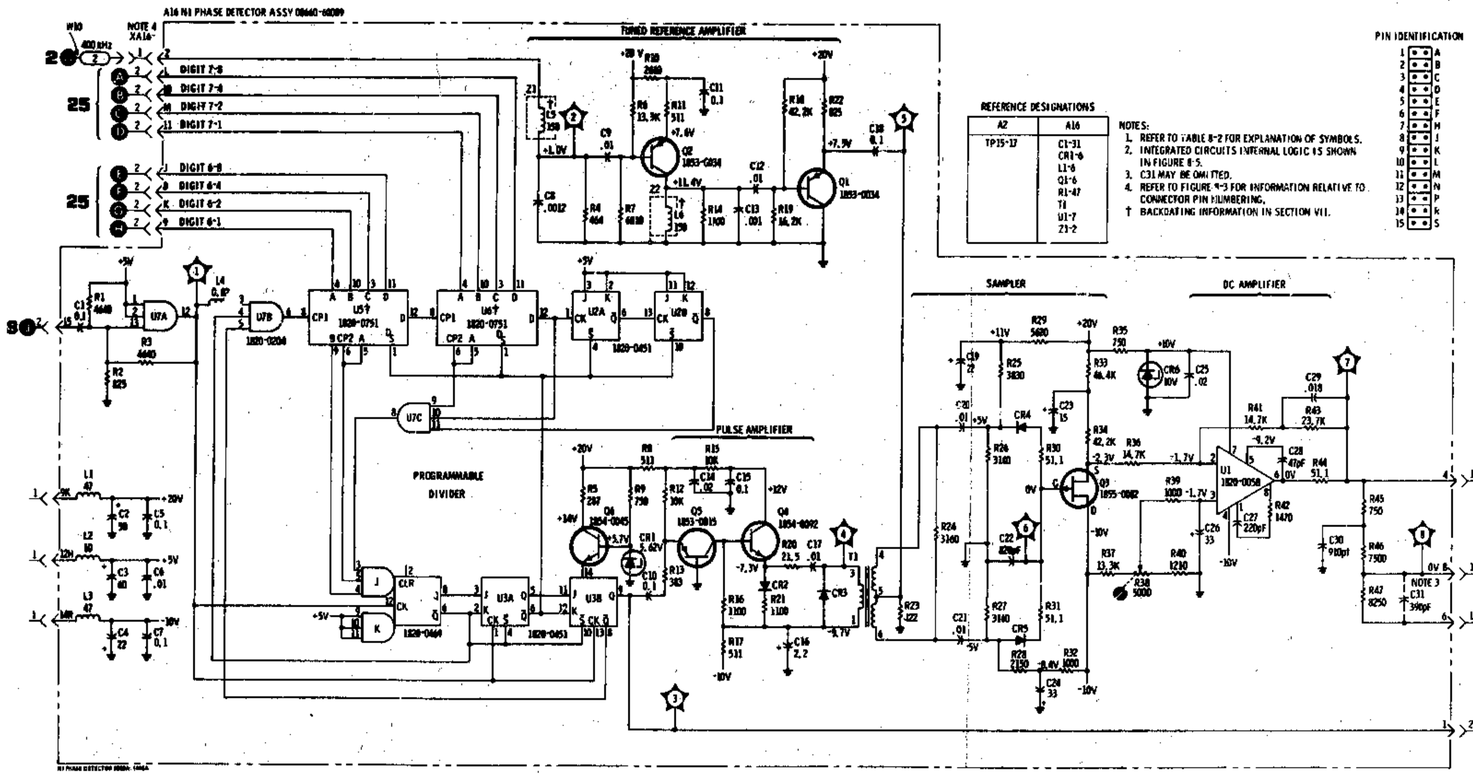


Figure 8-25. N1 Phase Detector Schematic

SERVICE SHEET 8

N1 PRETUNING AND OSCILLATOR ASSEMBLY A17

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A17 assembly, a part of the two-assembly N1 phase lock loop is shown schematically and described on this service sheet. The N1 Phase Detector Assembly, A16, is shown schematically and described on Service Sheet 7.

When trouble has been isolated to the A17 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs in any part of the N1 loop circuits the adjustment procedures specified in Section V paragraph 5-23 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Digital Voltmeter
Electronic Counter
Oscilloscope (with 10:1 divider probes)

N1 LOOP GENERAL INFORMATION

The purpose of the N1 loop is to generate digitally controlled rf signals in the range of 19.8 to 29.7 MHz in selectable 100 kHz increments. The voltage controlled oscillator is phase locked to a 400 kHz reference which is derived from the master oscillator in the reference section. The rf output from the N1 loop is applied to Summing Loop 1.

VOLTAGE CONTROLLED OSCILLATOR

Q3, Q5 and associated components comprise a voltage controlled oscillator. Two varactors (CR6 and CR7) are used in parallel to provide a high Q as well as the wide capacitance range required.

FET Q5 acts as a source follower in the feedback circuit; it provides high impedance at the gate and a low impedance at the source. The gain of the FET is held at less than unity to minimize the miller effect which might reflect capacitance back into the oscillator tank circuit.

Q1 amplifies the signal from the FET and applies it to two separate amplifiers. Q10 and Q15 provide the output to drive the SL1 mixer and Q8 drives the programmable divider in the A16 assembly.

TEST PROCEDURE

Test 1-a. Connect the electronic counter to XA17-1-2 and set thumbwheel digits six and seven as shown in table 8-4. The counter readout should be as shown in the table. (Make allowances for counter accuracy).

SERVICE SHEET 8 (cont'd)

If the counter does not display a frequency at, or close to, that specified, connect the oscilloscope to TP3. The oscilloscope should display a sine wave at about .3 volts peak-to-peak. If the sine wave is present at TP3 but there is no signal at XA17-1-2, check Q10, Q15 and associated components.

If there is no signal at TP3 check the bias level at TP2. The bias level should be about as shown in Table 8-5 for the front panel frequency setting. If the bias level is within the range of approximately −3.4 to −30 volts, and there is no signal at TP3 check Q1, Q3, Q5 and associated components. If the bias voltage is not within the range shown, proceed to 2-b.

If the counter displays the correct readout for some, but not all, of the front panel settings, proceed to 2-a.

PRETUNING CIRCUIT

The frequency of the voltage controlled oscillator is roughly preset by the digital to analog converter (U1, U2, Q11 through Q14 and Q16 through Q19). The digital to analog converter cannot, by itself, set the oscillator frequency precisely; it does set the frequency within the capture range of the phase lock loop, The inputs to U1 and U2 are BCD bits coded 8, 4, 2 and 1. When any of the BCD inputs are high they cause the output of the NAND gate to which they are connected to go low; the transistor connected to the NAND gate output is switched on.

When all of the BCD inputs are low Q9 is biased to provide approximately −25 volts at TP1 (Q7-e). With this dc level at TP1 the oscillator is roughly preset to 29.7 MHz.

When any one or more of the BCD inputs go high the transistor associated with it saturates and the current through Q9 is reduced. The reduction in current flow through Q9 changes the bias on Q7 and causes the voltage at TP1 to go less negative (closer to dc ground level). Finally, when the BCD input is 99, the voltage at TP1 is approximately −5.2 volts and the oscillator frequency is roughly preset to 19.8 MHz.

Q4 is a summing amplifier which combines the output of the digital to analog converter and the signal from the N1 phase detector. The summing point (Q4-e) sums the current from three sources; a current source from the +20 volts supply through R31, R32 and R33, a negative source from the digital to analog converter (TP1) and the error signal from the N1 phase detector. The voltage at the summing point is always zero volts.

When TP1 is at approximately −25 volts (all inputs low), most of the current from the +20 volts source flows through Q7; very little current flows through Q4. Under these conditions the voltage at Q4-c is about −30 volts. As the voltage at TP1 decreases (gets closer to dc ground level), less current flows through Q7, more current flows through Q4, and the Q4 collector voltage goes less negative.

CR3 through CR5, CR8 through CR15 and associated resistors are used to shape the voltage applied to the voltage controlled oscillator so that the frequency will be linear with the applied voltage. When all

SERVICE SHEET 8 (cont'd)

BCD inputs are low, Q4-c is at about −30 volts, the junction of R43 R48 is about −27.5 volts and all of the diodes in the resistive network are reverse biased. As the voltage at TP1 decreases (gets closer to −5.2 volts), current through Q4 increases and the Q4 collector voltage goes less negative. As the Q4 collector voltage decreases first CR3, then CR4 etc. are forward biased. As the diodes are forward biased resistors are added in parallel with R38 and R39 to shape the rate at which the voltage decreases at Q4-c.

Q2 and Q6 are emitter followers which couple the output of Q4 to the varactors. Q2 provides a high impedance for the output of the summing amplifier collector. R46, L7 and C14 comprise a 400 kHz trap to attenuate (15 to 20 dB) any 400 kHz ripple which may be present from the reference signal used in the phase detector. R51, L8, C20, C21 and C16 comprise a low pass filter with a cutoff frequency of about 200 kHz.

TEST PROCEDURE

Table 8-4 represents typical voltage levels for test points 1 and 2 and exact frequencies at XA17-1-2 for given settings of thumbwheel digits six and seven when the loop is locked.

NOTE

While the voltages shown for TP2 are typical (they will vary from instrument to instrument due to differences in varactor characteristics), they are representative of normal ratio of TP2 to TP1 voltages.

Test 2-a. With the digital voltmeter connected to TP1 rotate thumbwheel digits six and seven to settings shown in Table 8-5. The voltage level should approximately follow those shown in Table 8-5.

If the voltage at TP1 does not vary at all, first verify the presence of input digital information to the NAND gates, then check Q7, Q9 and associated components.

If the voltage at TP1 does not vary as shown, or some position (or positions) of the thumbwheels do not produce a change, first verify the presence of the input to the NAND gate/transistor combination affected, then check the NAND gate and the transistor.

If the voltages at TP1 are approximately as shown in Table 8-5 proceed to Test 2-b.

Test 2-b. Connect the digital voltmeter to TP2 and the counter to XA17-1-2. If the voltage at TP2 does not change about as shown in Table 8-4 for specified thumbwheel settings, or does not change at all, check Q2, Q4, Q6 and associated components.

If the voltage at TP2 varies approximately as shown in Table 8-5, but the frequency at XA17-1-2 does not step (or there is no rf output), refer to Test Procedure 1 and check the oscillator circuits.

If the voltage at TP2 varies approximately as shown in Table 8-5 and the frequency readout of the counter approximately follows the table (± 20-30 kHz) check Q8 and associated components.

N1 Phase Detector
SERVICE SHEET 7

SERVICE SHEET 8 (cont'd)

Table 8-5. N1 Oscillator Test Point Measurements

Front Panel Frequency MHz	Frequency At TP3 kHz	Voltage at TP1	Voltage at TP2
0000.000000	29700.000	−25.2v	−29.2v
0000.100000	29600.000	−25.0v	−28.7v
0000.200000	29500.000	−24.8v	−28.2v
0000.300000	29400.000	−24.6v	−27.7v
0000.400000	29300.000	−24.4v	−27.1v
0000.500000	29200.000	−24.2v	−26.6v
0000.600000	29100.000	−24.0v	−26.2v
0000.700000	29000.000	−23.8v	−25.7v
0000.800000	28900.000	−23.6v	−25.2v
0000.900000	28800.000	−23.4v	−24.7v
0001.000000	28700.000	−23.2v	−24.3v
0002.000000	27700.000	−21.2v	−20.2v
0003,000000	26700.000	−19.2v	−16.6v
0004,000000	25700.000	−17.2v	−13.6v
0005.000000	24700.000	−15.2v	−11.9v
0006.000000	23700.000	−13.2v	−8.9v
0007.000000	22700.000	−11.2v	−7.1v
0008.000000	21700.000	−9.2v	−5.6v
0009.000000	20700.000	−7.1v	−4.3v
0009.900000	19800.000	−5.3v	−3.4v

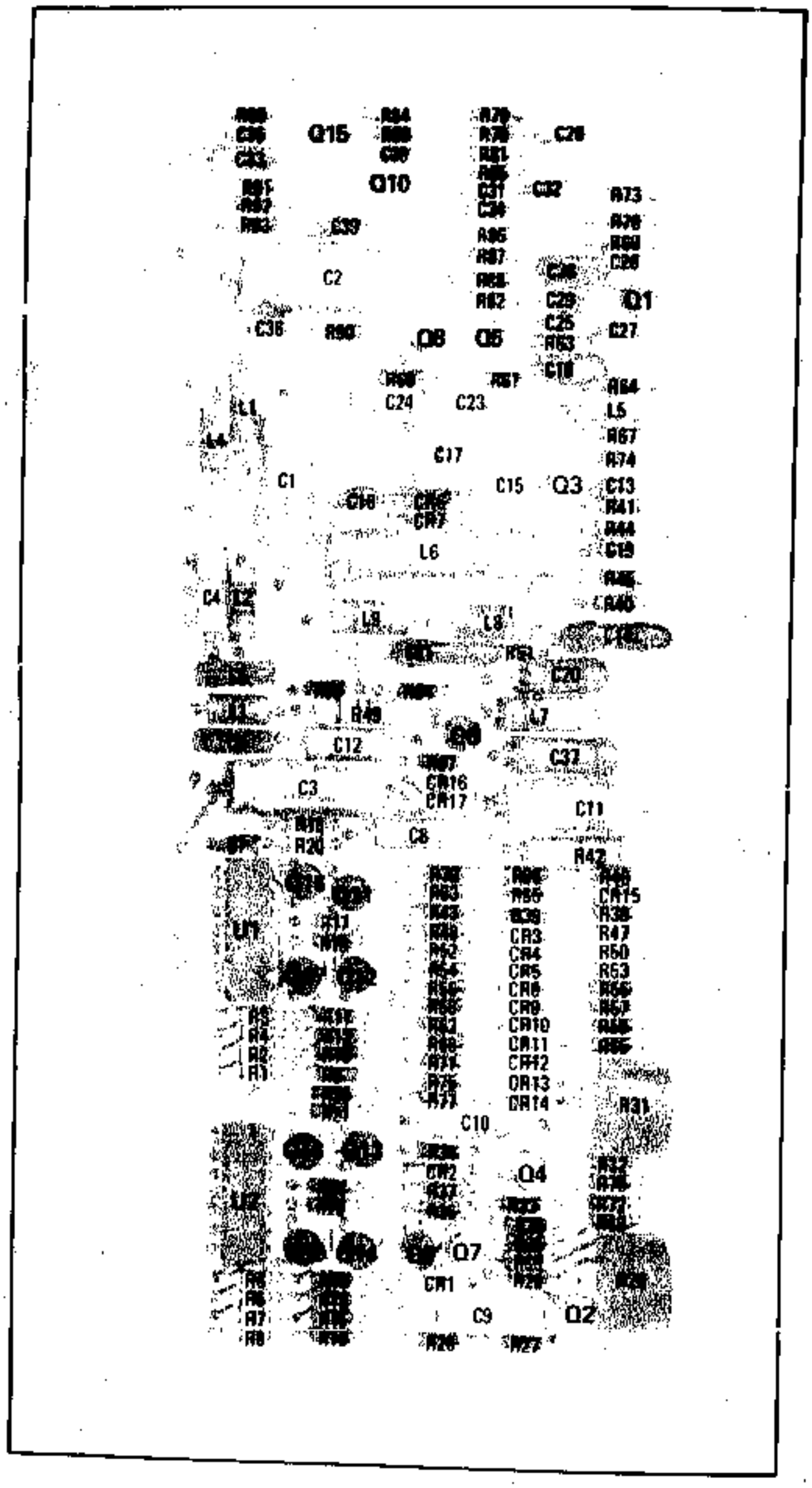


Figure 8-26. A17 N1 VCO Component Locations

SERVICE SHEET 8

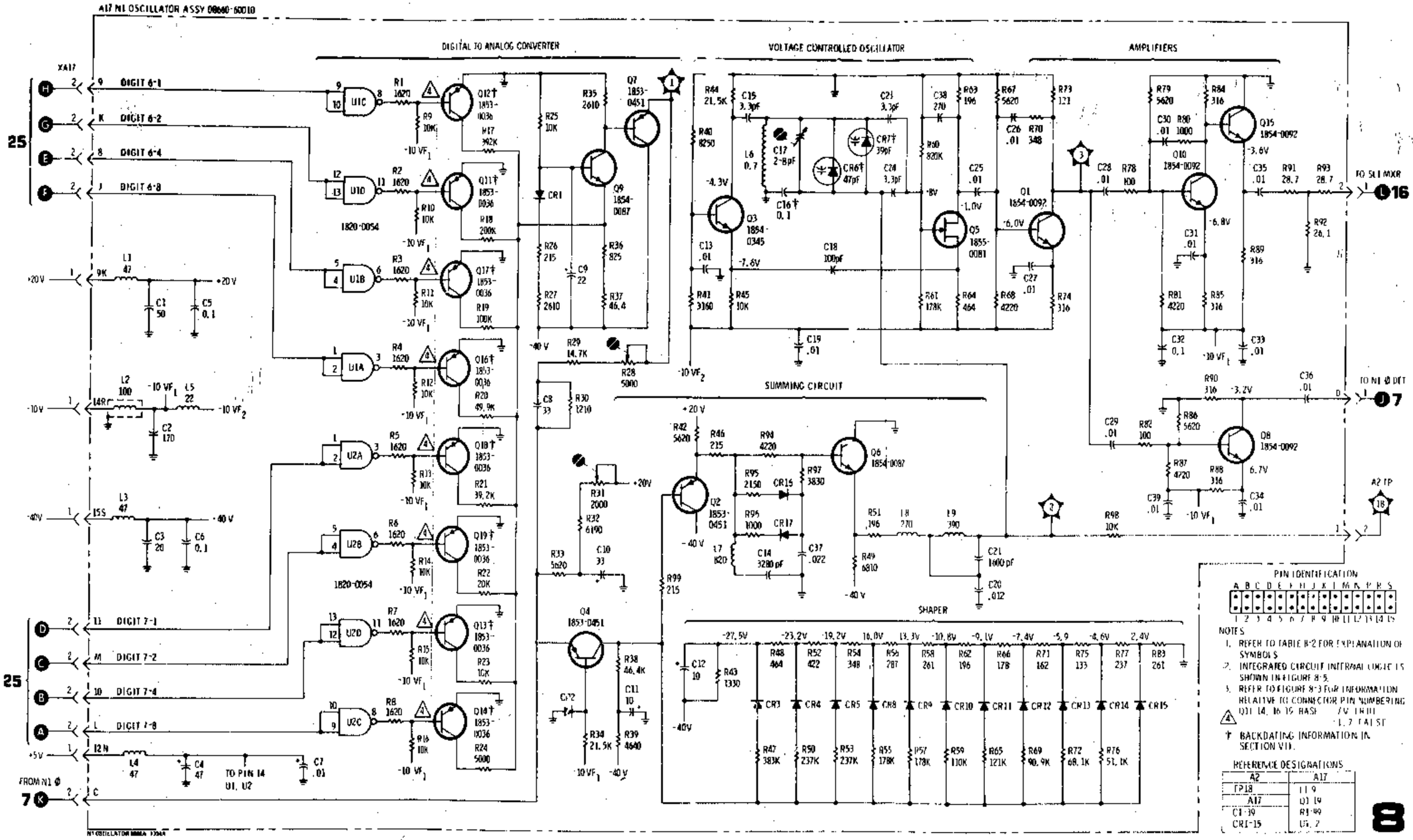


Figure 8-27. N1 VCO Schematic

SERVICE SHEET 9

N2 PHASE DETECTOR ASSEMBLY A14

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A14 assembly, a part of the two-assembly N2 phase lock loop is shown schematically and described on this service sheet. The N2 Oscillator assembly, A13, is shown schematically and described on service sheet 10.

When trouble has been isolated to the A14 assembly it hsould be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs in any part of the N2 loop circuits the adjustment procedures specified in Section V paragraph 5-24 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (see Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

N2 LOOP GENERAL INFORMATION

The purpose of the N2 loop is to generate digitally controlled rf signals in the range of 19.80 to 29.79 MHz in selectable 10 kHz increments. The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section. The rf output from the N2 loop is applied to Summing Loop 2.

[redacted] PROGRAMMABLE DIVIDER CIRCUIT

All of the integrated circuits in the A14 assembly are used to count down the input from the N2 voltage controlled oscillator.

When there is no BCD input to U5, U6 and U7 (all inputs low) the input from the oscillator will be 29.79 MHz; the programmable divider will divide by 2979 to provide a 10 kHz output. U5, U6 and U7 may be preset by thumbwheel digits 3, 4 and 5 and programmed to vary between counts of 1980 and 2979. Operation of the circuit is as follows:

Assume that initially there are no BCD inputs to U5, U6 and U7 (divide-by-ten decades) and they have all been preset to zero.

At the start of every count cycle, regardless of the BCD input, U1A pin 6 ($\overline{Q}$) and U1B pin 8 ($\overline{Q}$) are both low; U3 pin 6 ($\overline{Q}$), U4A pin 6 ($\overline{Q}$) and U4B pin 8 ($\overline{Q}$) are all high.

NAND gate U8C functions as a Schmitt trigger and provides pulses derived from the N2 voltage controlled oscillator output to clock U7 when AND gate U2B is enabled. U7 provides a divide-by-ten output to clock U6 and also provides A and C (binary 1 and 4) outputs to J inputs of JK flip-flop U3. The A and C outputs have no effect on U3 until the count down reaches 2975.

U6 provides a divide-by-ten output to clock U5 and also provides A, B and C (binary 1, 2 and 4) outputs to AND gates U2A and U2C. The A, B and C outputs have no effect on the circuit until the count down of 2970 is reached.

U5 provides a divide-by-ten output to clock U1A and also provides A and D outputs to NAND gate U8A. The A and D (binary 1 and 8) outputs have no effect on the circuit until the count down has reached 2900.

The D output of U5 (pin 12) goes low on the 1000th pulse input to U7 pin 8 and clocks U1A. One thousand input cycles later U1A is again clocked and the negative-going $\overline{Q}$ output

SERVICE SHEET 9 (cont'd)

of U1A (pin 6) clocks U1B. When U1B $\overline{Q}$ goes high it provides a high to AND gate U2A. The count down has reached 2006.

When the count down reaches 2900,U5 A and D outputs are high. NAND gate U8A pin 3 goes low and NAND gate U8B pin 6 goes high.

When the count down reaches 2970, U6 A, B and C outputs are high. The B and C outputs are applied to AND gate U2C pins 10 and 11, and since U2C pin 9 has been high since the count of 2900, U2C pin 8 goes high. The U6A output is applied to AND gate U2A, and since the other two inputs to U2A are high, U2A pin 12 goes high and is applied to U3 J input pin 3.

When the count down reaches 2975, U7 A and C high outputs are applied to U3 J input pins 4 and 5. Since U3 J pin 3 is now held high, the next input pulse from U8C will clock U3. Count coincidence at 2975 cycles has been achieved.

When the count down reaches 2976, U3 is clocked and the U3 $\overline{Q}$ output goes low. When U3 $\overline{Q}$ goes low, AND gate U2B is no longer enabled; the count, as far as U7, U6, U5 and U1 are concerned is ended. When U3 $\overline{Q}$ goes low it also sets U4A and U4B; the $\overline{Q}$ outputs go low and the $\overline{Q}$ outputs go high. When the $\overline{Q}$ output of U4B goes low it presets U7, U6, U5 and U1. When U7, U6, U5 and U1 are preset the J inputs to U3 are inhibited since the count is no longer at the coincident count of 2975.

When the U4B Q output goes high the leading edge of the pulse is used to generate the sampler pulse. The first pulse to the sampling phase detector is initiated by the 2976th input cycle. Since three more cycles are required to restart the count cycle, following sampler pulses will be 2979 cycles apart.

When the count down reaches 2977, U3 is again clocked and since the K input is high and the J input is low, $\overline{Q}$ will go high. This $\overline{Q}$ high is applied to the K input of U4A and to pin 4 of AND gate U2B. U2B will not be enabled because U4B $\overline{Q}$ is holding AND gate U2B pin 5 low.

When the count down reaches 2978 U4A is clocked because the K input is high. U4A $\overline{Q}$ goes high and is applied to the K input of U4B.

On the 2979th input cycle, U4B is clocked and the $\overline{Q}$ output goes high. When U4B $\overline{Q}$ goes high the preset pulse is ended and AND gate U2B is enabled. The next input cycle will initiate the count cycle.

When there is a preset input programmed into U7, U6 and U5, the terminal count is still 2979. However, the count down starts at the number programmed into the BCD inputs. As an example, if the binary input to U7, U6 and U5 is 999, the first input cycle would cause the same digital circuit changes that the 1000th input cycle caused in the discussion above (U1A would be clocked for the first time). The frequency division would be 2979 minus 999, equal to division by 1980. The phase lock loop operation would result in an input frequency to the programmable divider of 19.80 MHz. When the 19.80 MHz is divided by 1980 the divider output would again be 10 kHz.

SERVICE SHEET 9 (cont'd)

The output from U4B is always 10 kHz when the oscillator is phase locked.

TEST PROCEDURE [redacted]

Composite Waveform SS9-1 illustrates the proper timing relationship between the 100 kHz reference input, the pulse output from the pulse generator and the sampling point on the 100 kHz reference signal when the loop is phase locked.

NOTE

All thumbwheels are initially set to zero.

Test 1-a. Use the counter and the oscilloscope to check for a 100.000 kHz sine wave at approximately 5 volts p/p at TP5. The display should be similar to that shown in the second trace from the top in composite waveform SS9-1.

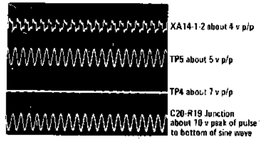
If the correct signal is present, proceed to test 1-b.

If the counter readout is 100.000 kHz but the sine wave is distorted, check Q1, Q2 and associated components.

If the signal is not present, connect the counter and the oscilloscope to XA14-1-2. The counter readout should be 100.000 kHz and the oscilloscope display should be similar to that shown in the top trace of composite waveform SS9-1.

If the correct signal is observed but was not observed at TP5, check Q1, Q2 and associated components.

If the signal is not present at XA14-1-2 check interconnections to the reference loop and, if necessary, the reference loop.



Composite Waveform SS9-1

Test 1-b. Connect the oscilloscope and the counter to TP4. The counter readout should be 10.000 kHz and the oscilloscope should display positive-going pulses as shown in composite waveform SS9-1 at about 7 volts amplitude.

If the signal is not present proceed to test 1-c. If the signal is present, connect the oscilloscope to the junction of R19 and C20. The oscilloscope display should be similar to that shown in the lower trace of composite waveform SS9-1.

SERVICE SHEET 9 (cont'd)

If the programmable divider and the pulse generator are working properly but the loop is not phase locked, the oscilloscope may still show the signals, but the relationship between the pulses and the sine wave will not be the same as shown in composite waveform SS9-1. If the voltage controlled oscillator and the summing circuits in the A13 assembly are known to be functioning properly proceed to test procedure [redacted].

Test 1-c. If the pulses are not present at TP5, and the counter counts randomly or not at all, connect the oscilloscope to TP3. The oscilloscope should display pulses at approximately 10 kHz and about 3.5 v p/p.

If the pulses are present at TP3, but were not present at TP4, check Q6, Q7 and associated components.

If the pulses are not present at TP3 proceed to test 1-d.

Test 1-d. If the pulse is not present at TP3 connect the oscilloscope to U2B pin 6. The waveform should be similar to that shown in the top trace of composite waveform SS9-2. If the signal is as shown proceed to test 1-e.

If there is no signal present at AND gate U2B pin 6 connect the oscilloscope to TP1. The waveform should be similar to that shown in the center trace of composite waveform SS9-2. If the signal is now present, use the digital voltmeter to check the voltage at AND gate U2B pins 4 and 5. The digital voltmeter should indicate about +3.7 volts; if it does, U2B is defective.

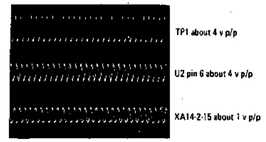
If the voltages are not present at AND gate U2B pins 4 and 5, ground U3B pin 2. If the voltages now appear at AND gate U2B pins 4 and 5 and the signal appears at U2B pin 6, U2B is functioning properly; the trouble is probably in the gating circuits to U3.

If the voltage is present at AND gate U2B pin 4 with U3 pin 2 grounded, but is not present at U2B pin 5, U4 is probably defective.

If the voltages are not present at AND gate U2B pins 4 or 5 with U3 pin 2 grounded, U3 is probably defective.

If the signal is not present at TP1, use the oscilloscope to check the voltage controlled oscillator input at XA14-2-15. The display should be similar to the lower trace in composite waveform SS9-2. If the signal is present NAND gate U8C is probably defective. If the signal is not present check interconnections to the A13 assembly and, if necessary, the A13 assembly.

SERVICE SHEET 9 (cont'd)



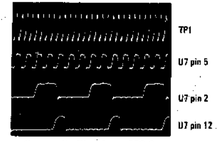
Composite Waveform SS9-2

Test 1-e. It is assumed in this test that the signal input is present at U7 pin 8 only because U3 pin 2 is grounded. Composite waveforms SS9-3 through SS9-7 illustrate the correct waveforms for the integrated circuits in the programmable divider loop. All waveforms are about 4.5 volts in amplitude. Follow the numerical sequence of the waveforms; when an IC output is missing the trouble is found. Replace the defective component, remove the ground from U3 pin 2, and repeat test 1-b.

Composite waveform SS9-8 illustrates the proper waveforms for U3 under normal operating conditions.

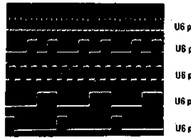
NOTE

Composite waveforms SS9-7 and SS9-8 waveform pictures were taken with the oscilloscope being triggered from TP3 and the oscilloscope sweep magnified X10.

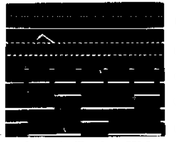


Composite Waveform SS9-3

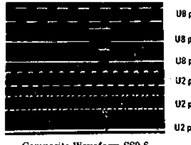
SERVICE SHEET 9 (cont'd)



Composite Waveform SS9-4



Composite Waveform SS9-5



Composite Waveform SS9-6

N1 VCO
SERVICE SHEET 8

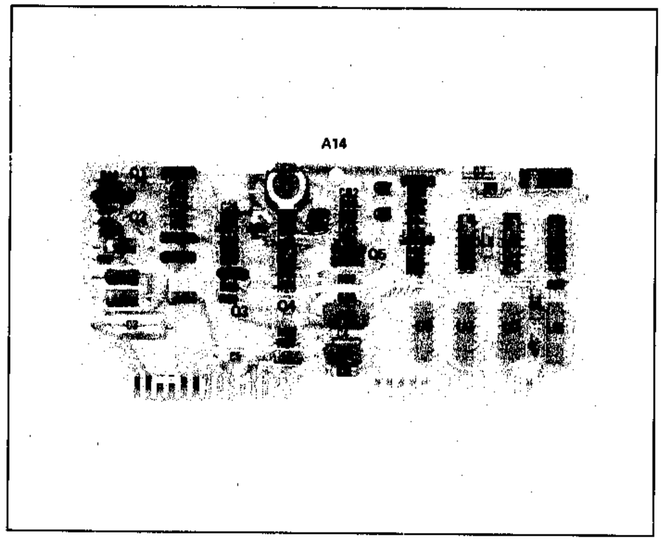


Figure 8-28. A14 N2 Phase Detector Component Locations

SERVICE SHEET 9 *(1 of 2)*

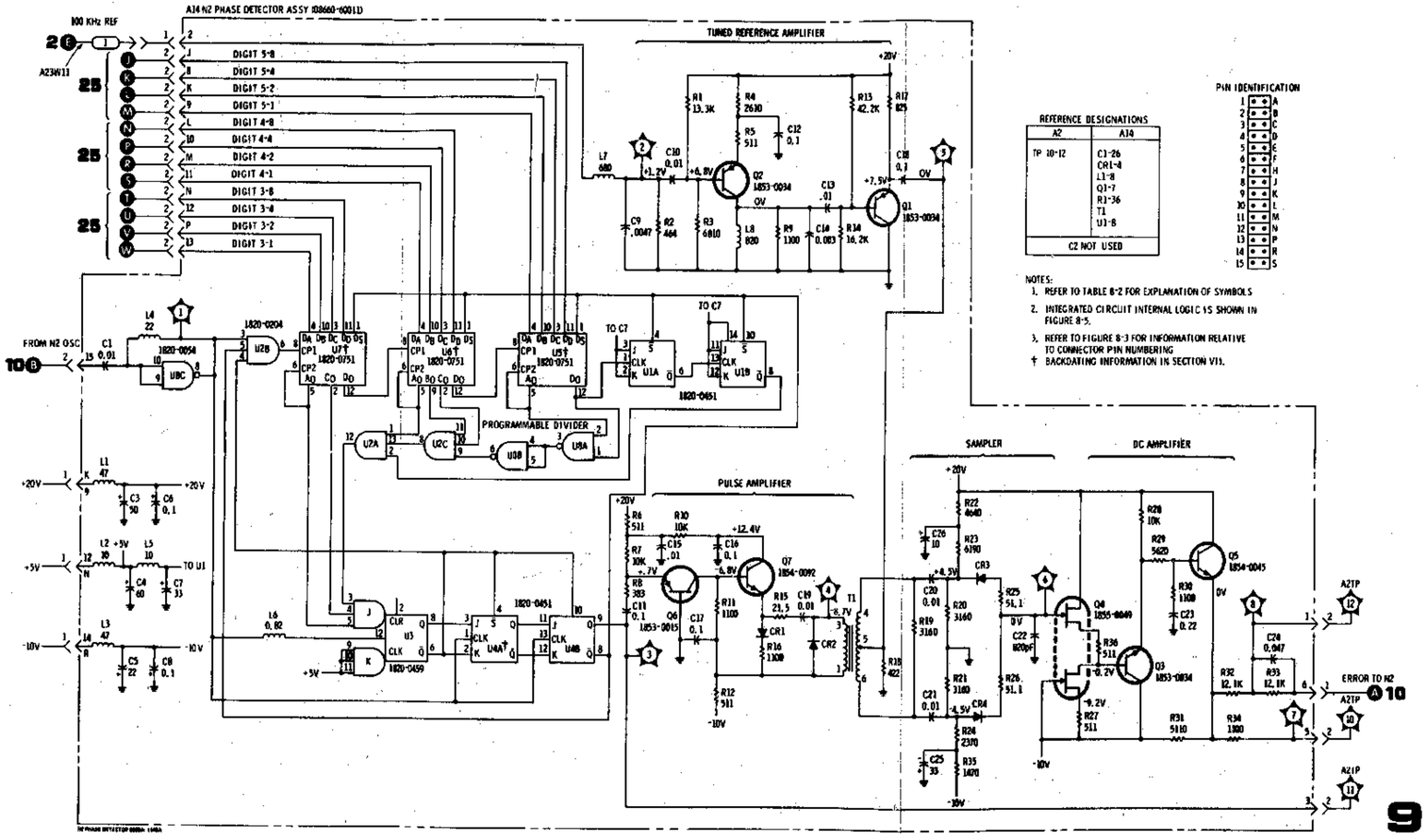
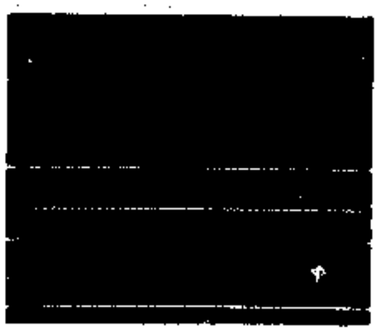
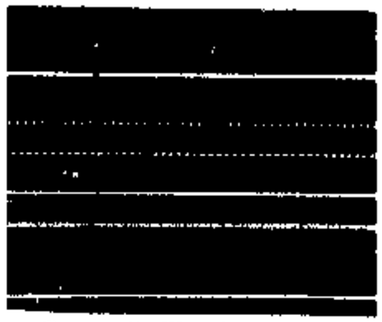


Figure 8-29. N2 Phase Detector Schematic



Composite Waveform SS9-7



Composite Waveform SS9-8

SAMPLING PHASE DETECTOR

The positive-going output from U4B pin 9 is used to generate the pulse required to open the sampler gate. Common base amplifier Q6 and emitter follower Q7 amplifies and couples the pulse to T1. CR1 and CR2 are used to minimize transformer flyback action. CR2 also bypasses the negative-going pulse around the transformer primary to ensure that only the positive-going pulse is coupled to the transformer secondary.

A 100 kHz signal from the reference loop is applied to the secondary center tap of T1. L7 and C9 (along with C3 in the reference loop A4A1 assembly) comprise a low pass filter; it has an impedance of about 450 ohms and a cutoff frequency of about 150 kHz. The TTL input from the reference loop is reshaped into a sine wave by the low pass filter. L8 and C14 comprise a tuned circuit which bypasses unwanted high frequency signals and further filters the sine wave.

Sampler diodes CR3 and CR4 are normally reverse biased. When the sampling pulse appears across the secondary of T1 it is coupled through C20 and C21 to forward bias CR3 and CR4. Since the gate pulses are equal in amplitude but opposite in polarity, they will cancel at TP6.

While CR3 and CR4 are forward biased the sampling gate is open and the 100 kHz reference signal is sampled.

SERVICE SHEET 9 (cont'd)

This type of sampling phase detector may be phase locked at virtually any point on the sine wave curve. Ideally, the zero volt crossover point of the sine wave should be used to improve the lock and hold in capability of the loop.

If the divided down output of the voltage controlled oscillator in the A13 assembly (10 kHz pulses) is not phase locked to the 100 kHz reference signal an ac signal is developed at TP6. The polarity of the signal at any given time depends on the polarity of the 100 kHz sine wave at the time the last sample was taken. The amplitude of the signal at any given time depends on what portion of the sine wave the last sample was taken from. Each time CR3 and CR4 are forward biased the signal derived from the 100 kHz reference signal at T1 terminals 4 and 6 are coupled through the sampling gate to control the charge on C22.

When the sampling gate pulse ends, CR3 and CR4 are again reverse biased and the sampling gate is closed. Since Q4 is a high input impedance device, the charge will remain in C22 until the next sampling pulse. The error signal from Q4 is applied to the summing amplifier in the A13 assembly through emitter followers Q3 and Q5.

Test Point 8 may be grounded to open the phase lock loop. Since the emitter of A13Q12 in the A12 assembly is also exactly at dc ground level, grounding this test point will not affect the pretuning circuit. With the loop open both the pretuning and the error signal may be checked.

TEST PROCEDURE

Test 2-a. Connect the oscilloscope to TP6. If the 100 kHz reference signal is present one of the sampling gate diodes (CR3 or CR4) is probably shorted. If the gate pulses are present one of the sampling gate diodes is probably open (Negative-going pulses CR4 - positive going pulses CR3). Proceed to test 2-b.

Test 2-b. With the oscilloscope connected to TP6, ground TP8. The signal displayed should be similar to that shown in Composite Waveform SS9-9, at about 4 volts. The frequency of the signal will be determined by the frequency difference detected by the sampling gate (typically 200 to 400 Hz).

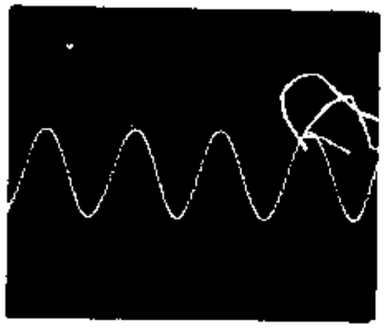
If the signal is present at TP6, connect the oscilloscope to Q5-3. The sine wave should be about the same as that shown for TP6 except that the sampling points will not be as obvious.

If the signal is present at Q5-e the error amplifier and the sampling circuits are functioning properly.

If the signal is not present at Q5-e and was present at TP6, check Q3, Q4, Q5 and associated components. After repairs are made repeat the test and remove the ground from TP8.

NOTE

Operation of the circuit shown on Service Sheet 9-a is essentially the same as that shown on Service Sheet 9. Reference designations differ. The count down is always 3000.



Waveform SS9-9

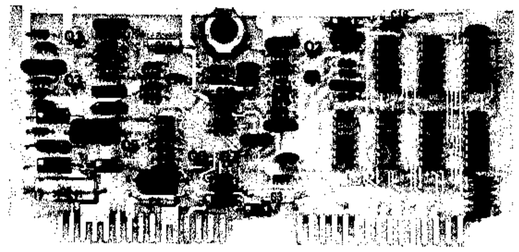


Figure 8-30. A14a N2a Phase Detector Component Locations

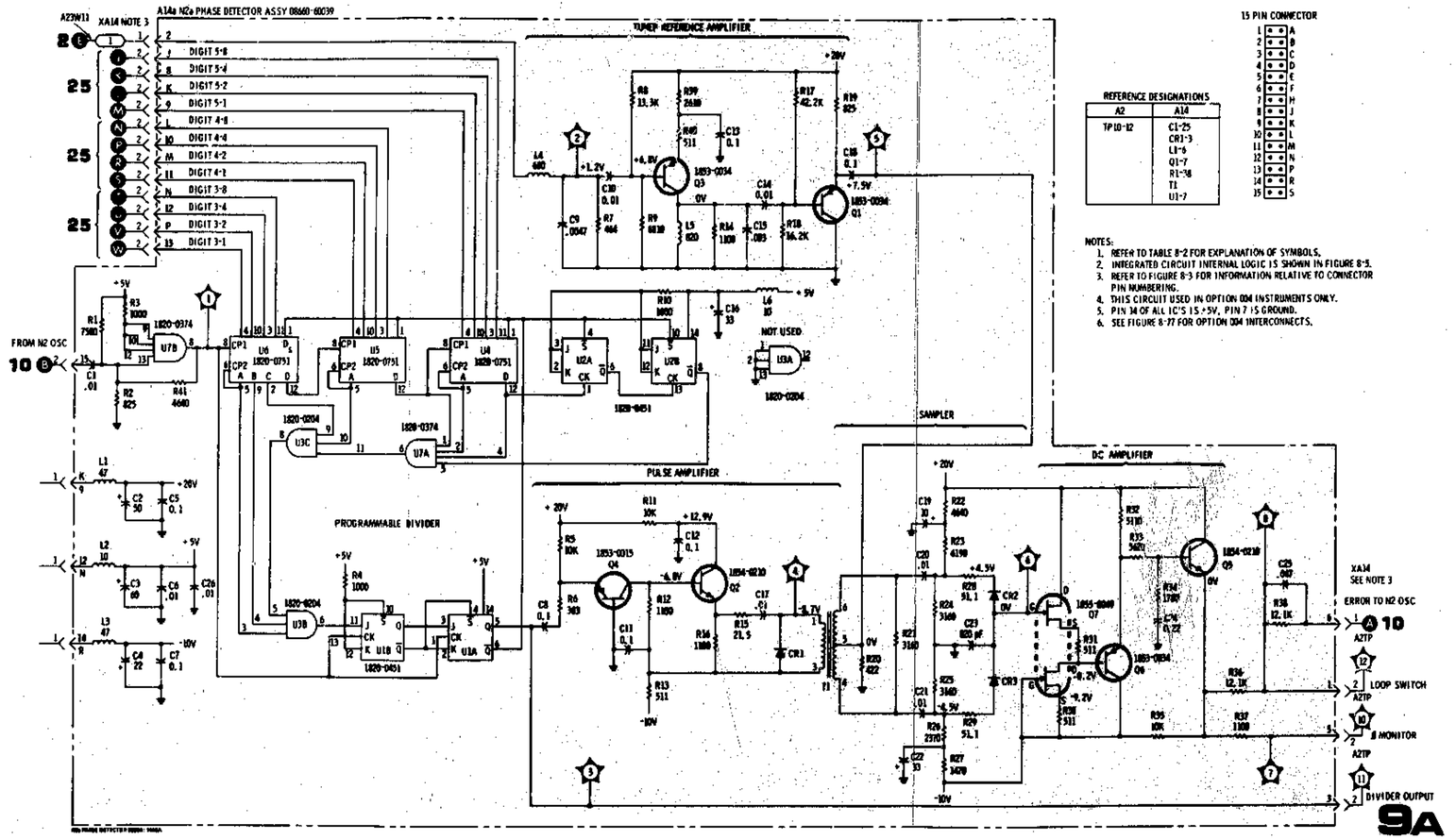


Figure 8-31. N2a Phase Detector Schematic

SERVICE SHEET 10

N2 OSCILLATOR ASSEMBLY A13

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A13 assembly, a part of the two-assembly N2 phase lock loop is shown schematically and described on this service sheet. The N2 Phase Detector assembly, A14, is shown schematically and described on service sheet 9.

When trouble has been isolated to the A13 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the N2 loop circuits the adjustment procedures specified in Section V paragraph 5-24 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Electronic Counter

N2 LOOP GENERAL INFORMATION

The purpose of the N2 loop is to generate digitally controlled rf signals in the range of 19.80 to 29.79 MHz in selectable 10 kHz increments. The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section. The rf output of the N2 loop is applied to Summing Loop 2.

VOLTAGE CONTROLLED OSCILLATOR

Varactors CR8 and CR9, transistors Q2 and Q9 and associated components comprise a voltage controlled oscillator. Two varactors are used in parallel to provide high Q as well as the wide capacitance range required. C18 provides isolation for the dc levels required to bias the varactors. C17 provides the feedback required to sustain oscillation. The resonant tank circuit is coupled to Q9 by means of capacitive divider C22 and C23. The FET acts as a source follower in the feedback circuit; it provides a high impedance at the gate and a low impedance at the source. The gain of the FET amplifier for the output signal is less than one; this minimizes the miller effect which might otherwise reflect capacitance back into the oscillator tank circuit.

Q1 amplifies the signal and applies it to U1A which functions as a Schmitt trigger. U1D inverts the output from U1A and applies it to the programmable divider in the A14 assembly. U1C inverts the output from U1A and applies it to the divide-by-one hundred circuit in Summing Loop 2.

TEST PROCEDURE

NOTE

Do not use long coax leads from the counter to TP3. The capacitive loading may attenuate the signal below a useable level.

SERVICE SHEET 10 (cont'd)

Test 1-a. Connect the counter to TP3 and set thumbwheel digits 3, 4 and 5 as shown in Table 8-6. The counter readout should be as shown in the table. (Make allowances for counter accuracy.)

NOTE

If the frequency readouts listed in Table 8-6 are not approximately as shown check the voltage levels shown for TP2 in Table 8-6. If the voltage levels are incorrect proceed to test procedure

If the signal is present use the oscilloscope to check the outputs at XA13-1 pins 4 and 6 with all thumbwheels set to zero. The signal at XA13-1-4 should be about 0.8 volt p/p and the signal at XA13-1-6 should be about 0.3 volt.

If the signal is present at TP3 but is not present at XA13-1 pins 4 and 6 check UI.

Test 1-b. If the signal is not present at TP3 use the oscilloscope to check the signal at the collector of Q1. The signal should be about 1 volt in amplitude.

If the signal is not present at Q1-c use the oscilloscope to check the signal at the Q1 base. If the signal is now present (about 0.3 volt), Q1 is probably defective.

If the signal is not present at Q1 base, check Q2, Q9 and associated components.

PRETUNING CIRCUIT

The frequency of the voltage controlled oscillator is roughly preset by the digital to analog converter (U2, U3, transistors connected to the outputs of the NAND gates and associated components). The digital to analog converter cannot, by itself, set the oscillator frequency precisely; it does set the frequency within the capture range of the loop. The inputs to U2 and U3 are BCD bits coded 8, 4, 2 and 1. When any of the BCD inputs are high they cause the output of the NAND gate with which they are associated to go low; the transistor associated with the NAND gate is switched on.

When all of the BCD inputs are low Q4 is biased to provide approximately −25 volts at TP1 (Q3-e). With this dc level at TP1 the oscillator is roughly preset to 29.79 MHz.

When any one or more of the BCD inputs go high the transistor associated with it saturates and draws current through R34 and R35. The change in bias for Q4 causes the voltage at TP1 to go less negative (closer to ground level). Finally when the binary input is 99, the voltage at TP1 is approximately −5.2 volts and the oscillator frequency is roughly preset to 19.80 MHz.

Q12 is a summing amplifier which combines the output of the digital to analog converter and the signal from the N2 phase detector. The summing point (Q12-e) sums the current from three sources; a current source from the +20 volt supply through R28, R30 and R37, a negative source from the digital to analog converter (TP1) and the signal from the N2 phase detector. The voltage at the summing point is always zero volts.

When TP1 is at approximately −25 volts (no BCD input), most of the current from the +20 volt supply flows through Q4 and Q3; very little flows through Q12. Under these conditions the voltage at Q12-c is about −30 volts. As the voltage at

N2a Phase Detector
SERVICE SHEET 9A
(2 of 2)

SERVICE SHEET 10 (cont'd)

TP1 decreases (gets closer to ground level) less current flows through Q4 and Q3, more current flows through Q12, and the Q12 collector voltage decreases.

CR4 through CR7, CR11 through CR16 and associated resistors are used to shape the voltage applied to the varactors in the voltage controlled oscillator circuit so that the frequency will be linear with the voltage change. The voltage at the junction of R42 and R47 is about −27.5 volts. When there is no BCD input (Q12-c is about −30 volts) all of the diodes in the shaper are reverse biased. As the voltage at TP1 decreases (gets closer to −5.2 volts) current through Q12 increases and the Q12 collector voltage also decreases. As the Q12-c voltage decreases first CR4, then CR5, etc. are forward biased. As the diodes are forward biased resistors are added in parallel with R31 and R32 to shape the voltage curve to the varactors.

Q11 and Q10 are emitter followers which couple the output of Q12 to the varactors. Q11 provides a high impedance for the output of the summing amplifier, Q12.

TEST PROCEDURE

Test 2-a. Use the digital voltmeter to check the voltages at TP1 and TP2. These dc levels should be about as shown in Table 8-6 for the thumbwheel settings shown.

If the voltages at TP1 are about right, but those at TP2 are not, check Q12, Q11, Q10 and associated components.

If the voltages at TP1 are not approximately as shown in Table 8-6, check the components in the digital to analog converter.

NOTE

Also check the BCD input lines for the correct levels. With thumbwheel digits 4 and 5 set to a zero all eight input lines should be low. With thumbwheel digits 4 and 5 set to a 1 inputs at XA13-2 pins 11 and 9 should be high, etc..

Table 8-6. N2 Frequency versus Voltage Chart

Thumbwheel Settings	Counter Readout	TP1 Volts	TP2 Volts
0000000000	29.790000 MHz	−25	−31
0000011100	28.680000 MHz	−23	−26
0000022200	27.570000 MHz	−21	−21
0000033300	26.460000 MHz	−18.5	−16.8
0000044400	25.350000 MHz	−16.4	−13.4
0000055500	24.240000 MHz	−14.2	−10.6
0000066600	23.130000 MHz	−12	−8.3
0000077700	22.020000 MHz	−9.8	−6.4
0000088800	20.910000 MHz	−7.7	−4.8
0000099900	19.800000 MHz	−5.4	−3.6

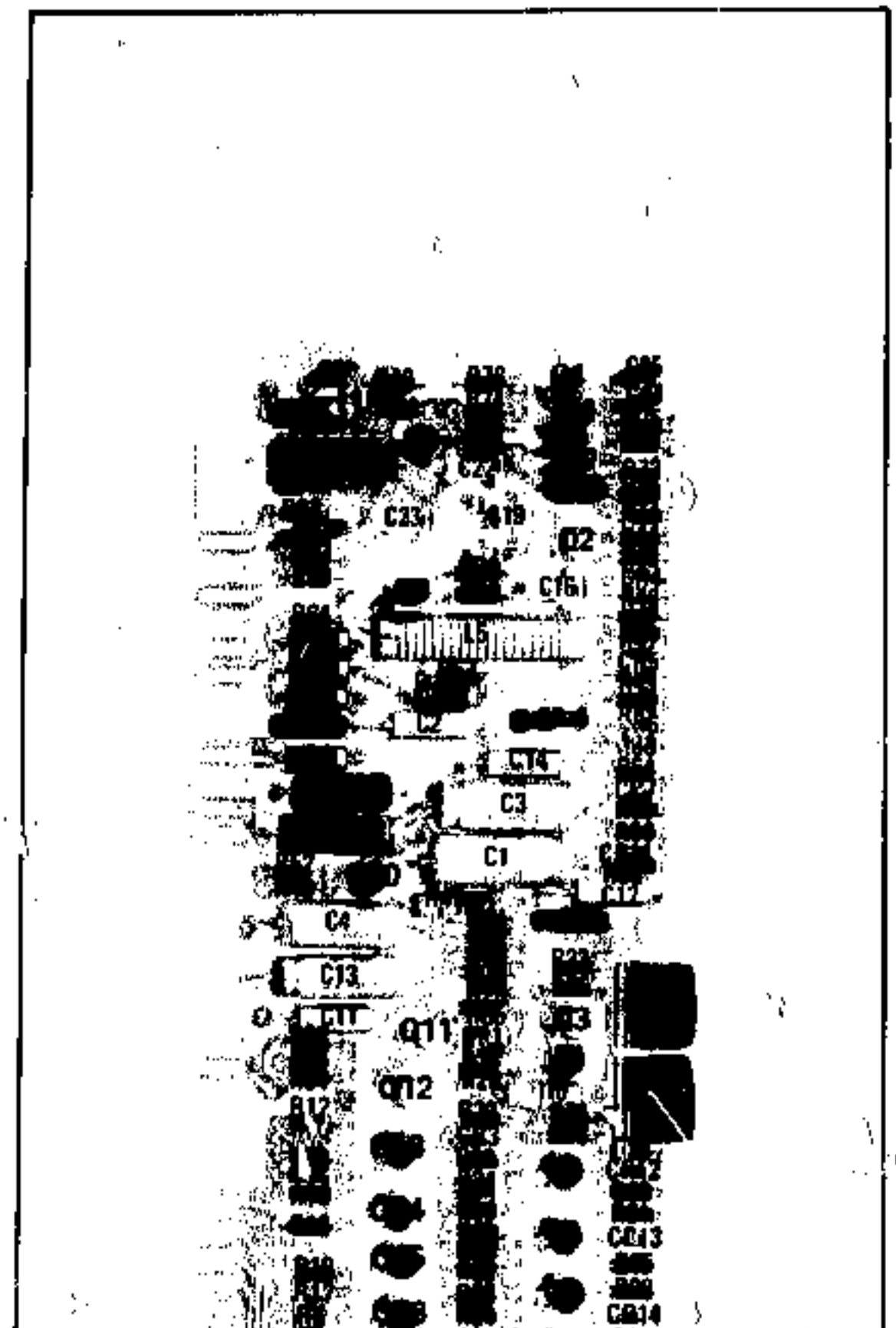


Figure 8-32. A13 N2 VCO Component Locations

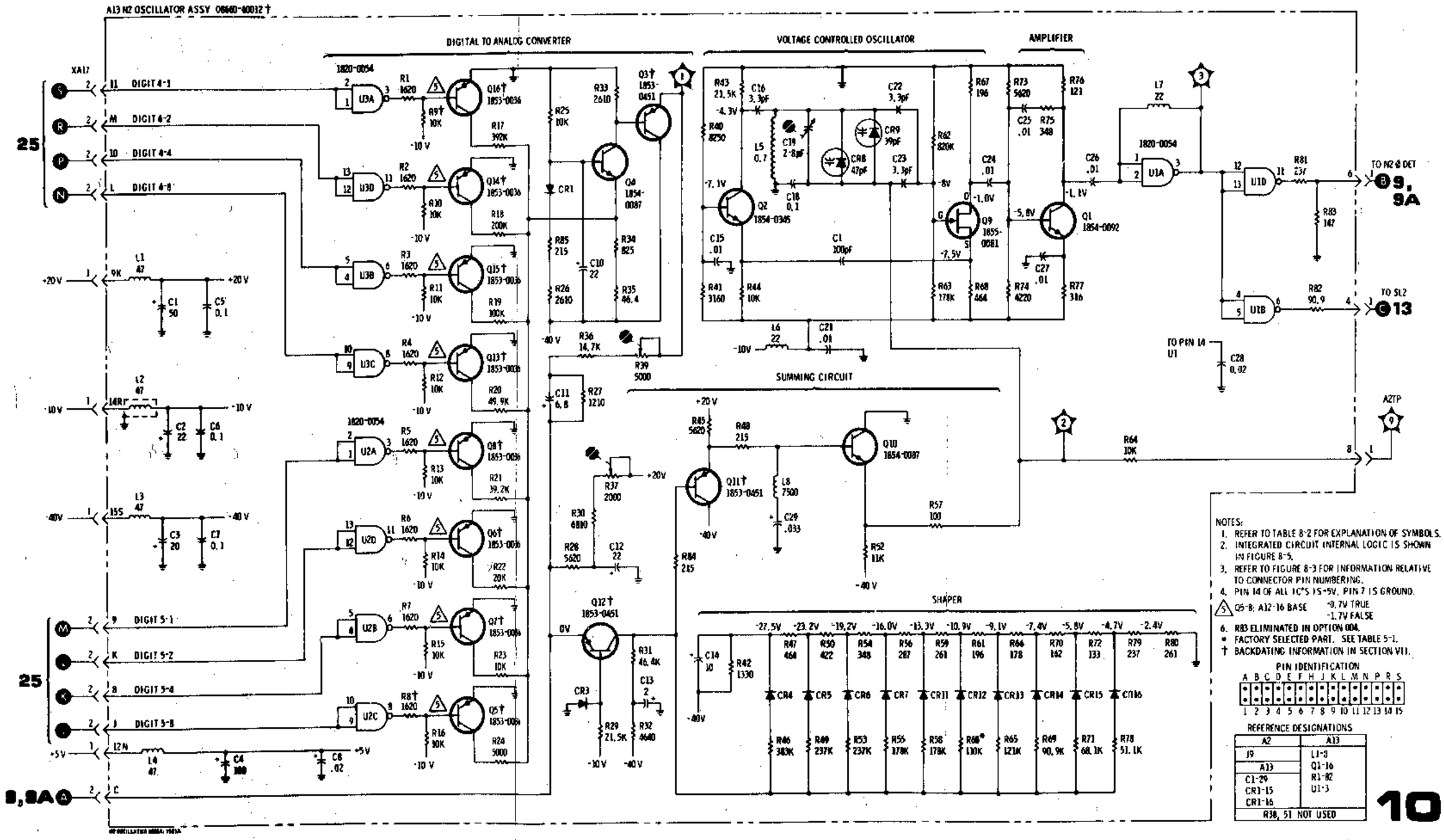


Figure 8-33. N2 VCO Schematic

SERVICE SHEET 11

N3 PHASE DETECTOR ASSEMBLY A10

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A10 assembly, a part of the two-assembly N3 phase lock loop is shown schematically and described on this service sheet. The N3 oscillator assembly, A8, is shown schematically and described on Service Sheet 12.

When trouble has been isolated to the A10 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the N3 loop circuits the adjustment procedures specified in Section V paragraph 5-25 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

N3 LOOP GENERAL INFORMATION

The purpose of the N3 loop is to generate digitally controlled rf signals in the range of 20.01 to 21.00 MHz in selectable 10 kHz increments. The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section.

The rf output of the N3 voltage controlled oscillator is divided by ten before being applied to the SL2 assembly. The output to SL2 is 2.001 to 2.100 MHz in 1 kHz increments.

N3 PROGRAMMABLE DIVIDER CIRCUIT

All of the integrated circuits in the A10 assembly are used to count down the input from the N3 voltage controlled oscillator.

When there are no BCD inputs to U5 and U6 (all inputs low), the input from the oscillator will be 21.00 MHz when the oscillator is phase locked; the programmable divider will divide by 2100 to provide a 10 kHz output at TP3. U5 and U6 are preset by front panel thumbwheel digits 1 and 2 and programmed to vary between start counts of 00 and 99. Operation of the circuit is as follows:

Assume that initially all BCD inputs are low and U4, U5 and U6 have been preset to zero. Assume also that U2A pin 6 ($\overline{Q}$) and U2B pin 8 ($\overline{Q}$) are both low. U1B pin 8 ($\overline{Q}$) and U1A pin 6 ($\overline{Q}$) are both high.

NAND gate U7C couples the input from the N3 oscillator to the clock input of U5. U5 provides a divided-by-ten output to clock U6 and also provides a, B and C (BCD 1, 2 and 4) outputs. The A, B and C outputs are not used until the count of 2097 has been reached.

U6 provides a divided-by-ten output to clock U4 and also provides A and D (BCD 1 and 8) outputs to AND gates U3A and U3C. The A and D outputs are not used until the count has reached 2090.

U4 provides a divided-by-ten output to clock U2A. At the count of 1000 U4 clocks U2A and the U2A $\overline{Q}$ output at pin 6 goes high. At the count of 2000 U4 again clocks U2A and the negative-going $\overline{Q}$ output at pin 6 clocks U2B. When U2B is clocked $\overline{Q}$ at pin 8 goes high and ic applied to pins 2 and 13 of AND gate U3A.

At the count of 2090 the high A and D outputs of U6 are applied to AND gates U3A and U3C. Since U3A pins 2 and 13 are both high, U3A is enabled and it places a high on pin 11 of AND gate U3C.

SERVICE SHEET 11 (cont'd)

At the count of 2097 the high A, B and C outputs of U5 are applied to AND gates U3B and U3C to provide a high at the J input of U1B at pin 11.

At the count of 2098 U1B is clocked, U1B $\overline{Q}$ (pin 8) goes low and sets U1A. U1A $\overline{Q}$ (pin 6) goes low and presets U2, U4, U5 and U6; they are held in preset until the count is completed.

When U1A is set Q (pin 5) goes high and initiates the sampling pulse. The first pulse to the sampling phase detector is initiated by the 2098th input cycle. Since two more cycles are required to restart the count cycle, following sampler pulses are 2100 cycles apart when there is no BCD input.

At the count of 2099 U1B is again clocked and $\overline{Q}$ (pin 8) goes high. The high at pin 8 is applied to the K input of U1A (pin 2).

At the count of 2100 U1A is clocked and pin 6 $\overline{Q}$ goes high to end the preset pulse. The next input to U5 initiates the next count cycle.

When there is a BCD input programmed into U5 and U6 pins 3, 4, 10 and 11 the terminal count is still 2100. However, the count starts at the number programmed into the BCD inputs. As an example, if the BCD input to U5 and U6 is 99, the first input cycle would cause the same digital circuit changes that the 100th input cycle caused in the discussion above (U4 would be clocked). The frequency division would be 2100-99, equal to division by 2001. The phase lock loop operation would result in an input frequency to the programmable divider of 20.01 MHz. When divided by 2001, the divider output at TP3 would again be 10 kHz.

The output from U1A pin 5 is always 10 kHz when the oscillator is phase locked regardless of the oscillator frequency.

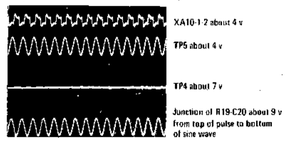
TEST PROCEDURE

Composite Waveform SS11-1 illustrates the proper timing relationship between the 100 kHz reference input, the pulse output from the pulse generator and the sampling point on the 100 kHz reference signal when the loop is locked.

NOTE

All thumbwheels are initially set to zero.

Test 1-a. Use the counter and the oscilloscope to check for a 100.000 kHz sine wave at approximately 4 volts p/p at TP5. The display should be similar to that shown in the second trace from the top of composite waveform SS11-1.



Composite Waveform SS11-1

SERVICE SHEET 11 (cont'd)

If the counter readout is 100.000 kHz but the sine wave is distorted, check Q1, Q2 and associated components.

If the signal is not present, connect the counter and the oscilloscope to XA10-1-2. The counter readout should be 100.000 kHz and the oscilloscope display should be similar to that shown in the top trace of composite waveform SS11-1.

If the correct signal is present at XA10-1-2, but was not present at TP5, check Q1, Q2 and associated components.

If the signal is not present at XA10-1-2 check interconnections to the reference loop and, if necessary, the reference loop.

Test 1-b. Connect the oscilloscope and the counter to TP4. The counter readout should be 100.000 kHz and the oscilloscope should display positive-going pulses as shown in composite waveform SS11-1 at about 7 volts amplitude. If the signal is not present, proceed to test 1-c.

If the signal is present, connect the oscilloscope to the junction of R19 and C20. The oscilloscope display should be similar to that shown in the lowest trace of composite waveform SS11-1.

If the programmable divider and the pulse generator are working properly but the loop is not phase locked, the oscilloscope may still display the signals at the junction of R19 and C20, but the relationship between the pulses and the sine wave will not be the same as shown in composite waveform SS11-1. If the voltage controlled oscillator and the summing circuit in the A8 assembly are known to be functioning properly, proceed to test procedure .

Test 1-c. If the pulses are not present at TP4, and the counter counts randomly or not at all, connect the oscilloscope to TP3. The oscilloscope display should be a series of pulses at approximately 10 kHz and about 3.5 volts in amplitude.

If the pulses are present at TP3, but were not present at TP4, check Q6, Q7 and associated components.

If the pulses are not present at TP3, proceed to test 1-d.

Test 1-d. If the pulse is not present at TP3 connect the oscilloscope to NAND gate U7C pin 8. The oscilloscope should display a slightly distorted sine wave at about 21 MHz and about 3 volts in amplitude.

If the signal is not present at U7C pin 8, connect the oscilloscope to XA10-2-15. The 21 MHz signal should be about 0.1 volt in amplitude. If the signal is present, U7 is probably defective. If the signal is not present check interconnections to the A8 assembly and, if necessary the A8 assembly.

Test 1-e. It is assumed in this test that the signal input is present at U5 pin 8. Composite waveforms SS11-2 through SS11-6 illustrate the correct waveforms for the integrated circuit points shown.

NOTE

These waveforms were taken with the oscilloscope triggered from TP3.

SERVICE SHEET 11 (cont'd)

Follow the numerical sequence of the waveforms shown; when an IC output is missing the trouble is found. Replace the defective component and repeat test 1-b.

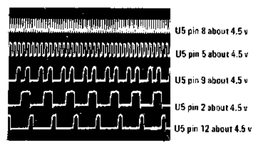
NOTE

If the output from U5 is not present proceed to test 1-f before replacing U5.

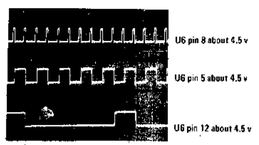
Test 1-f. Composite waveform SS11-7 illustrates correct waveforms for a properly operating U1. In this test the oscilloscope was again triggered by TP3 and the sweep delay of the oscilloscope was used to center the pulses shown.

If the waveforms in composite waveform SS11-7 cannot be observed (because an adequate oscilloscope is not available or other reasons) measure the voltage at U1 pin 6, it should be about +3.7 volts; U1 pin 5 should be at about +100 millivolts. If the voltages are not as specified, ground U1 pin 10. The voltages should then be: U1 pin 6 about +130 millivolts and U1 pin 5 about +3.8 volts. If the voltages are as specified in either case and there is no output from U5, U5 is probably defective.

If there is no change in the dc levels at U1 pins 5 and 6 with U1 pin 10 grounded U1 is probably defective.

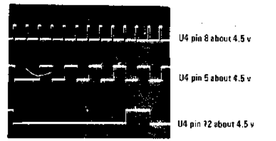


Composite Waveform SS11-2

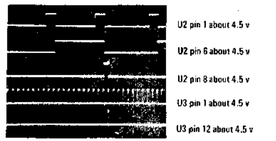


Composite Waveform SS11-3

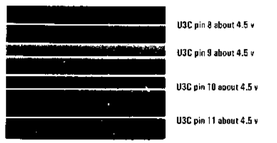
SERVICE SHEET 11 (cont'd)



Composite Waveform SS11-4



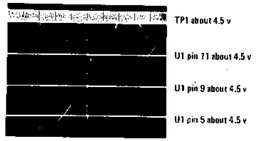
Composite Waveform SS11-5



Composite Waveform SS11-6

N2 VCO
SERVICE SHEET 10

SERVICE SHEET 11 (cont'd)



Composite Waveform SS11-7

SAMPLING PHASE DETECTOR

The positive-going output from U1A Q (pin 5) is used to generate the pulse required to open the sampler gate. Common base amplifier Q6 and emitter follower Q7 amplifies and couples the pulse to T1. CR1 and CR2 are used to minimize transformer flyback action. CR2 also bypasses the negative-going pulse around the transformer primary to ensure that only the positive-going pulse is coupled to the transformer secondary.

A 100 kHz signal from the reference loop is applied through Q2 and Q1 to the secondary center tap of T1. L5 and C8 (along with C4 in the reference loop A4A1 assembly) comprise a low pass filter; it has an impedance of about 450 ohms and a cutoff frequency of about 150 kHz. The TTL input from the reference loop is reshaped into a sine wave by the low pass filter. Q2 and Q1 amplify the signal to the level required in the sampling phase detector. L7 and C13 comprise a tuned circuit which bypasses unwanted high frequency signals and further filters the sine wave.

Sampler diodes CR3 and CR4 are normally reverse biased. When the sampling pulse appears across the secondary of T1 it is coupled through C20 and C21 to forward bias CR3 and CR4. Since the gate pulses are equal in amplitude but opposite in polarity, they will cancel at TP6.

While CR3 and CR4 are forward biased the sampling gate is open and the 100 kHz reference input signal is sampled.

This type of sampling phase detector may be phase locked to virtually any point on the sine wave slope. Ideally, the zero crossover point of the sine wave should be used to improve the lock and lock hold capabilities of the loop.

If the divided down output of the voltage controlled oscillator (10 kHz pulses) is not phase locked to the 100 kHz reference signal an ac error signal will be developed at TP6. The polarity of the error signal at any given point in time depends on the polarity of the 100 kHz reference signal at the time the last sample was taken. The amplitude of the error signal at any given time depends on what part of the sine wave the last sample was taken from. Each time CR3 and CR4 are forward biased the 100 kHz reference signal at T1 terminals 4 and 6 are coupled through the sampling gate to control the charge on C22.

When the sampling gate pulse ends CR3 and CR4 are again reverse biased and the sampling gate is closed. Since Q4 is a high impedance input device, the charge will remain on C22 until the next sampling pulse. The current through Q4 is controlled by the difference in Gate-source voltage of the lower FET. Operation of the dual FET sets the output level at the lower FET drain to exactly the level at the upper FET gate. The output is coupled through two emitter followers to the summing amplifier in the A8 assembly.

SERVICE SHEET 11 (cont'd)

TEST PROCEDURE

Test 2-a. Connect the oscilloscope to TP6. If the 100 kHz reference signal is present one of the sampling gate diodes (CR3 or CR4) is probably shorted. If the gate pulses are present one of the sampling gate diodes is probably open (Negative-going pulses CR4 - positive-going pulses CR3). Proceed to test 2-b.

Test 2-b. With the oscilloscope connected to TP6, ground TP8. The oscilloscope should display a low frequncy sine wave (about 4 volts) that varies in frequency. The frequency of the signal will be the difference frequency detected by the sampling gate.

If the signal is present at TP6, connect the oscilloscope to Q5-e. The sine wave should be the same as seen at TP6.

If the signal is present at Q5-e the error amplifier and the sampler circuit are functioning properly.

If the signal is not present at Q5-e and was present at TP6, check Q3, Q4, Q5 and associated components.

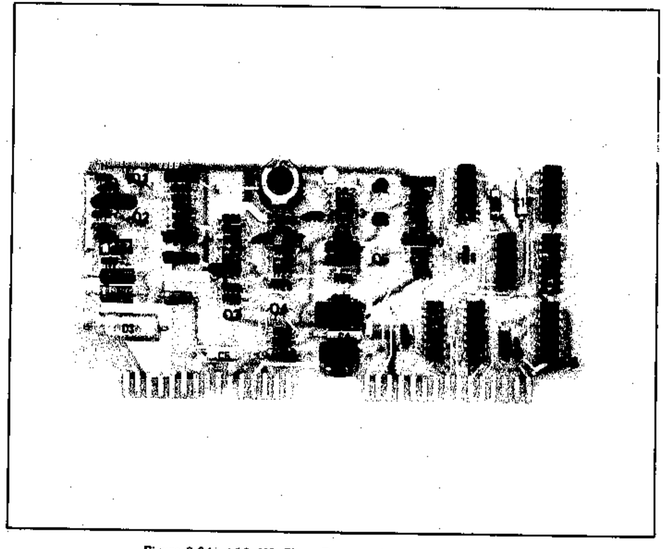


Figure 8-34. A10 N3 Phase Detector Component Locations

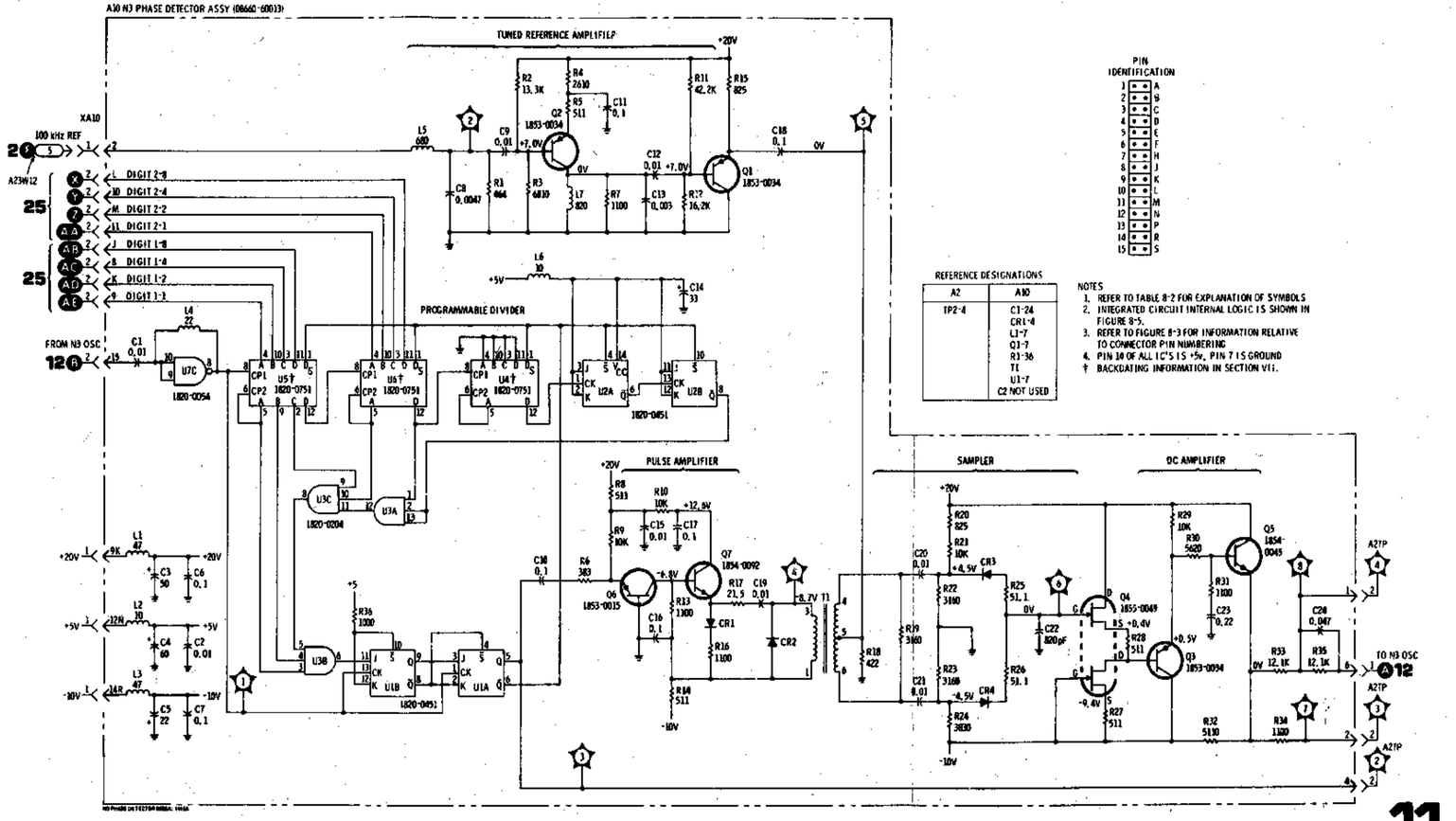


Figure 8-35. N3 Phase Detector Schematic

SERVICE SHEET 12

N3 OSCILLATOR ASSEMBLY A8

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A8 assembly, a part of the two-assembly N3 phase lock loop is shown schematically and described on this service sheet. The N3 Phase Detector assembly, A10, is shown schematically and described on Service Sheet 11.

When trouble has been isolated to the A8 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the N3 loop circuits the adjustment procedures specified in Section V paragraph 5-25 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Digital Voltmeter
Electronic Counter

N3 LOOP GENERAL INFORMATION

The purpose of the N3 loop is to generate digitally controlled rf signals in the range of 20.01 to 21.00 MHz in selectable 10 kHz increments. The voltage controlled oscillator is phase locked to a 100 kHz reference which is derived from the master oscillator in the reference section. The rf output of the N3 voltage controlled oscillator is divided by ten before it is applied to summing Loop 2. The output from the N3 assembly to SL2 is 2.001 to 2.100 MHz in selectable 1 kHz increments.

[redacted] VOLTAGE CONTROLLED OSCILLATOR

Q2, Q7 and associated components comprise a voltage controlled oscillator. C14 and C17 provide isolation for the dc levels required to bias the varactor. C13 provides the feedback required to sustain oscillation. The resonant tank is coupled to Q7 by capacitive divider C16 and C17. The FET acts as a source follower in the feedback circuit; it provides a high impedance at the gate and a low impedance at the source. The gain of the FET for the output signal at the drain is held at less than unity to minimize the miller effect which might otherwise reflect capacitance back into the oscillator tank circuit.

Q1 amplifies the voltage controlled oscillator output and applies it to U1A which functions as a Schmitt trigger. U1D provides the output to the N3 programmable divider in the A10 assembly. U1B and U3 provide a divided by ten output to Summing Loop 2.

SERVICE SHEET 12 (cont'd)

TEST PROCEDURE [redacted]

NOTE

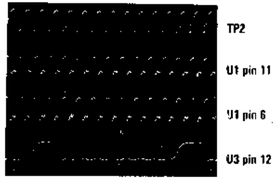
Do not use long coax leads from the counter to N3 test points. The capacitive loading may attenuate the signal below a useable level.

Test 1-a. Connect the counter to TP2. With all thumbwheel digits set to zero the counter readout should be 21.00 MHz. Set thumbwheel digits 1 and 2 to the settings specified in Table 8-7. Frequency readouts on the counter should follow those specified in the table. (Make allowances for counter accuracy).

NOTE

If the frequency readouts listed in Table 8-7 are not approximately as shown, check the voltage levels shown for TP3 in the table. If the voltage levels are incorrect proceed to test procedure [redacted].

If the signal is present use the oscilloscope to check the signal at points shown in composite waveform SS12-1. Signals shown are about 4 volts in amplitude.



Composite Waveform SS12-1

If the signal is present at TP2 but is not present at U1 pin 11, U1 is probably defective; if the signal is not present at U3 pin 12, U1 or U3 may be defective.

If the signal is not present at TP2 use the oscilloscope to check for the signal at Q1-b. If the signal is present at Q1-b check Q1 and NAND gate U1A. If the signal is not present check Q2, Q7 and associated components.

[redacted] PRETUNING CIRCUIT

The frequency of the voltage controlled oscillator is roughly preset by the digital to analog converter (U2 and Q8 through Q11). The digital to analog converter cannot, by itself, set the oscillator frequency precisely; it does set the frequency within the capture range of the phase lock loop. The inputs to U2 are BCD bits coded 1, 2, 4 and 8. When any one of the BCD inputs are high they cause the output of the NAND gate to which they are connected to go low; the transistor connected to the NAND gate output is switched on.

When all of the BCD inputs are low Q6 is biased to provide approximately −8.5 volts at TP1 (Q5-e). With this dc level at TP1 the oscillator is roughly preset to 21 MHz (how close depends on adjustment of R24 and R26).

When any one or more BCD inputs go high the transistor associated with it saturates and the current through Q6 is reduced. The reduction of current through Q6 changes the bias on Q5 and causes the voltage at TP1 to go less negative (closer to dc ground level). Finally, when the BCD input is 9, the voltage at TP1 is approximately −6.7 volts and the oscillator is roughly preset to 20.01 MHz (again depending on adjustment of R24 and R26).

Q3 is a summing amplifier which combines the output of the digital to analog converter and the error signal from the N3 Phase Detector. The summing point (Q3-e) sums the current from three sources; a current source from the +20 volt power supply through R19, R25 and R26, a negative source from the digital to analog converter (TP1), and the error signal from the phase detector. The voltage at the summing point is always zero volts when the loop is locked.

The output from Q3 is coupled through Q4 and Q12 to control the bias on varactor CR5 and the frequency of the voltage controlled oscillator.

TEST PROCEDURE [redacted]

Test 2-a. Use the digital voltmeter to check the voltages at TP1 and TP3. These dc levels should be about as shown in Table 8-7 for the thumbwheel settings shown.

NOTE

These voltages are typical. They will vary from instrument to instrument because of differences in individual varactor characteristics.

If the voltages at TP1 are about right, but those at TP3 are not, check Q3, Q4, Q12 and associated components.

If the voltages at TP1 are not approximately as shown in Table 8-7, check the components in the digital to analog converter.

NOTE

Also check the dc levels at the BCD input lines.

N3 Phase Detector
SERVICE SHEET 11

SERVICE SHEET 12 (cont'd)

Table 8-7. N3 Frequency Versus Voltage Chart

Thumbwheel Settings	Counter Readout	TP1 Voltage	TP3 Voltage
0000000000	21.000000 MHz	−8.5 V	−3.7 V
0000000011	20.890000 MHz	−8.3 V	−3.6 V
0000000022	20.780000 MHz	−8.1 V	−3.5 V
0000000033	20.670000 MHz	−7.9 V	−3.4 V
0000000044	20.560000 MHz	−7.7 V	−3.3 V
0000000055	20.450000 MHz	−7.5 V	−3.2 V
0000000066	20.340000 MHz	−7.3 V	−3.1 V
0000000077	20.230000 MHz	−7.1 V	−3.0 V
0000000088	20.120000 MHz	−6.9 V	−2.9 V
0000000099	20.010000 MHz	−6.7 V	−2.8 V

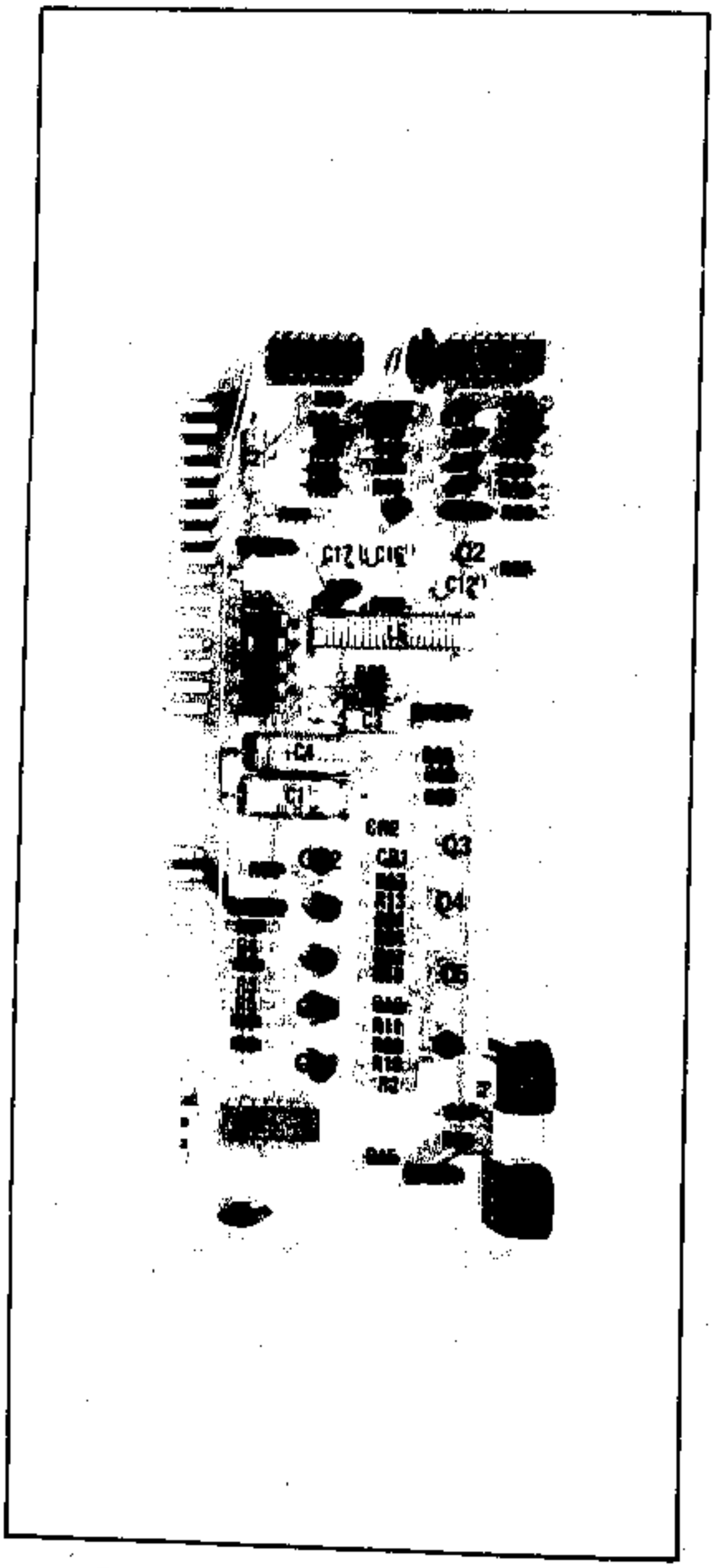
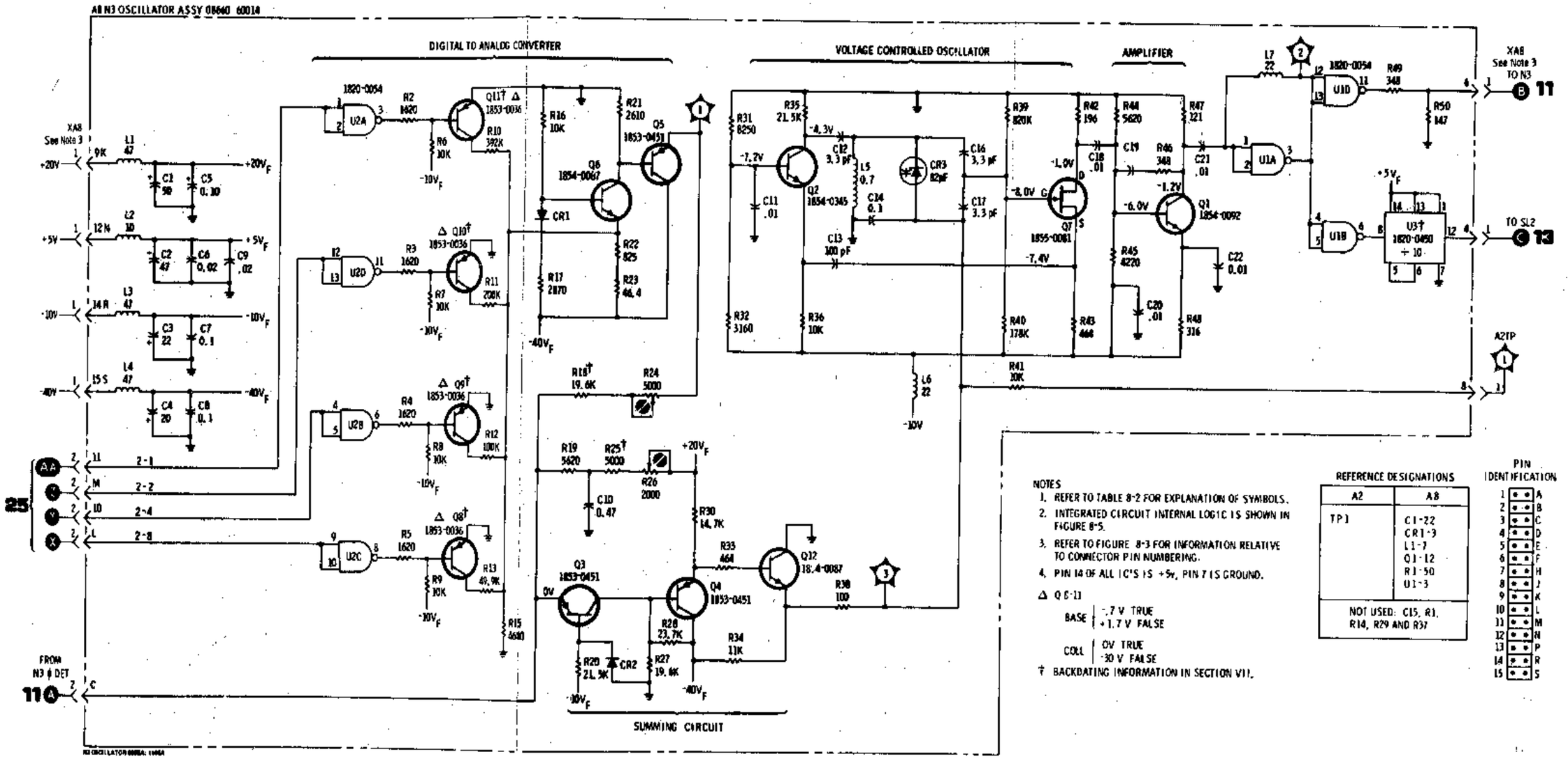


Figure 8-36. A8 N3 VCO Component Locations

SERVICE SHEET 12



NOTES

1. REFER TO TABLE 8-2 FOR EXPLANATION OF SYMBOLS.
2. INTEGRATED CIRCUIT INTERNAL LOGIC IS SHOWN IN FIGURE 8-5.
3. REFER TO FIGURE 8-3 FOR INFORMATION RELATIVE TO CONNECTOR PIN NUMBERING.
4. PIN 14 OF ALL IC'S IS +5v, PIN 7 IS GROUND.

Δ Q6-11

BASE	-.7 V TRUE +1.7 V FALSE
COLL	0V TRUE -30 V FALSE

† BACKDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

A2	A8
TP1	C1-22 CR1-3 L1-7 Q1-12 R1-50 U1-3
NOT USED: C15, R1, R14, R29 AND R37	

PIN IDENTIFICATION

1	A
2	B
3	C
4	D
5	E
6	F
7	H
8	J
9	K
10	L
11	M
12	N
13	P
14	R
15	S

Figure 8-37. N3 VCO Schematic

SERVICE SHEET 13

SUMMING LOOP 2 PHASE DETECTOR A12

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A12 assembly, a part of the two-assembly SL2, is shown schematically and described on this service sheet. The SL2 Oscillator Assembly (A11) is shown schematically and described on service sheet 14.

When trouble has been isolated to the A12 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the SL2 circuits the adjustment procedures in Section V paragraph 5-26 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 2 GENERAL

The purpose of Summing Loop 2 (SL2) is to generate digitally controlled rf signals in the range of 20.0001 to 30.0000 MHz in selectable 100 Hz increments. The difference frequency between the SL2 voltage controlled oscillator and the input from the N2 loop is phase locked to the divided-by-ten output of the N3 assembly. The output of SL2 is applied to SL1.

The portion of the pretuning circuit that appears on service sheet 13 (U8 and Q8 through Q11) is explained in the text for service sheet 14.

PHASE DETECTOR

There are three signal inputs to the phase detector assembly. They are the output of the N2 voltage controlled oscillator, the divided by ten output of the N3 voltage controlled oscillator and the output of the SL2 voltage controlled oscillator.

The N2 and SL2 signals are mixed and the difference frequency is used as one input to the digital phase detector. The second input to the digital phase detector is the divided by ten input from the N3 assembly.

The output of the N3 voltage controlled oscillator is divided by ten in the N3 assembly and again divided by ten by U9, Q12 and NAND gate U7A shape the resulting pulses which vary in frequency (depending on programming to the N3 loop) from 0.2001 to 0.2100 MHz. The pulses at TP2 are negative-going.

SERVICE SHEET 13 (cont'd)

The inputs from the N2 loop and the SL2 voltage controlled oscillator are applied to double balanced mixer E1 R and L ports. The difference signal from the X port is amplified by Q5 and Q4 and shaped by Q3, Q7 and NAND gates U4B and U4C. When the loop is phase locked the negative-going pulses at TP3 are at the same frequency as those at TP2. The pulses do not appear in time coincidence; they are received alternately.

U7B, U7D, U4A and U4D comprise a coincidence gate which inhibits signals that appear simultaneously at TP2 and TP3. Normally, when signals are not present, TP2 and TP3 are both high. When a signal appears at TP2, U7B pin 6 and U4D pin 13 go high. If there is no signal at TP3 U5D pin 12 is also high; U4D pin 11 goes low, and U1B pin 6 goes high. The positive pulse at TP5 drives the clock generator and the sense circuit or phase detector. When a signal appears at TP3, U4A pin 3 and U7D pin 12 go high. If there is no signal at TP2, U7D pin 13 is also high; U7D pin 11 goes low, and U7C pin 8 goes high. The positive pulse at TP9 drives the clock generator and the sense circuit or the phase detector. When signals appear at TP2 and TP3 at the same time U7D pin 13 and U4D pin 12 go low, U7D pin 11 and U4D pin 11 remain high, and the signals cannot reach TP5 or TP9.

U1A, U1C, U1D and U5C comprise a clock generator which clocks U2A and U2B each time a signal appears at TP5 or TP9. With no signals present TP5 and TP9 are low. When a positive pulse appears at TP9 U1A pin 3 goes low, U1D pin 11 goes high and a negative-going pulse appears at TP6. When a positive pulse appears at TP5 operation of the circuit is the same except that U1C pin 8 goes low (rather than U1A pin 3). Since a clock pulse is generated for each input, the pulse frequency at TP6 is the sum of the frequencies at TP5 and TP9.

Since the sense circuit does not function when the loop is locked, operation of the phase detector will be discussed first.

When the loop is phase locked U2A $\overline{Q}$ is held high to enable U3A and U3D. Assume that initially U2B $\overline{Q}$ is high, U3B pin 6 is low and U3C pin 8 is nigh. When a positive-going signal from TP9 appears at U3A pin 1, U3A pin 3 goes low and causes a change in state of flip-flop U3B/U3C; U3B pin 6 goes high and U3C pin 8 goes low. The high at U2B pin 12 sets the flip/flop and the positive-going trailing edge of the clock pulse causes U2B Q to go high. The following positive pulse from TP5 is applied to U3D pin 12. U3D pin 11 goes low and changes the state of flip/flop U3B/U3C. U3B pin 6 goes low and the clock pulse causes U2B $\overline{Q}$ to again go high. This sequence continues as long as the signals at TP5 and TP9 are received alternately.

The signals at TP5 and TP9 are applied to the sense circuit even when the loop is phase locked. They have no effect on the circuit because of the relationship of the Q and $\overline{Q}$ outputs of U2B to the incoming signals.

When U2B Q is high NAND gates U6A and U6C are enabled. When the signal from TP5 appears at U6C pin 9, U6C pin 8 goes low; flip/flop U5A/U5B does not change state because U5B pin 3 is low. The signal at U6B has no effect because U2B $\overline{Q}$ and U6B pin 4 are low.

SERVICE SHEET 13 (cont'd)

When U2B $\overline{Q}$ is high NAND gates U6B and U6D are enabled. When the signal at TP9 appears at U6D pin 13, U6D pin 11 goes low; flip/flop U5A/U5B does not change state because U5B pin 3 is low. The signal at pin 1 of U6A has no effect on the circuit because U2B Q and pin 2 of U6A are low.

When two or more consecutive pulses from either input (TP5 or TP9) occur between pulses from the other input the sense circuit functions to disable the phase detector until the frequency error is corrected.

As an example of circuit operation assume that two pulses from TP9 (SL2 signal) are received between two pulses from TP5 (N3 signal) indicating that the SL2 frequency is high. When the first pulse from TP9 is received U3A pin 3 goes low, U3B pin 6 goes high to set U2B and the clock pulse causes U2B $\overline{Q}$ to go high. When the second consecutive pulse is received from TP9 U6A has been enabled by the high Q output of U2B. U6A pin 3 goes low and causes flip/flop U5A/U5B to change state. When the D input of U2A goes low the clock pulse causes U2A $\overline{Q}$ to go low and inhibit U3A and U3D. If a third SL2 signal is received prior to receipt of an N3 signal U6A pin 3 will again go low but will have no effect on flip/flop U5A/U5B because U5A pin 13 is low.

When an N3 pulse is received U2B Q is still high and U6C pin 8 will go low to change the state of flip/flop U5A/U5B. When the D input of U2A goes low the clock pulse causes U2A $\overline{Q}$ to go high and enable U3A and U3D. The propagation time of the signal through the sense circuit is long enough for the pulse from N3 (TP5) to have ended before U3D is enabled so the state of flip/flop U3B/U3C does not change.

The next pulse from SL2 will again cause U6A pin 3 to go low and change the state of flip/flop U5A/U5B. With the D input to U2A high again, the clock pulse again causes U2A $\overline{Q}$ to go low and inhibit U3A and U3D. The signal applied to U3A has no effect on flip/flop U3B/U3C because U3B pin 5 is low.

The sense circuit continues operation in the manner described above until two consecutive N3 pulses are received between two SL2 signals. When this occurs the first pulse causes U6C pin 8 to go low and change the state of flip/flop U5A/U5B. With the D input to U2A low the clock pulse will cause U2A $\overline{Q}$ to go high and enable U3A and U3D. Again, because of propagation time through the sense circuit the pulse will have ended before U3D in enabled. The second consecutive N3 pulse again causes U6C pin 8 to go low but, because U5B pin 3 is low, no change in state occurs in flip/flop U5A/U5B. Since U3D is now enabled, U3D pin 11 goes low and causes flip/flop U3B/U3C to change state. With the D input to U2B low, the clock pulse causes U2B $\overline{Q}$ output to go high. Phase lock has been achieved and the loop will remain locked as long as pulses at the same frequency appear alternately at TP5 and TP9.

When the SL2 frequency is low U2B Q is low. When the SL2 frequency is high U2B Q is high.

DC amplifier Q2, Q1, Q6 and associated components filter the Q output of U2B and applies it to a summing circuit in the A11 assembly to precisely control the voltage controlled oscillator.

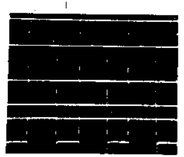
SERVICE-SHEET 13 (cont'd)

TEST PROCEDURE

Test 1-a. Connect the oscilloscope input to test points shown by composite waveform SS13-1. This composite waveform illustrates correct waveforms and timing relationships for the points tested. All signals are about 4 volts in amplitude.

NOTE

The oscilloscope was triggered from TP1 for these tests.



Composite Waveform SS13-1

If the pulses are not present at TP2 proceed to test 1-b.

If the pulses are not present at TP3 proceed to test 1-c.

If the pulses are present at TP2 and TP3, but opposite polarity pulses are not present at TP5 and/or TP9, check the NAND gates between TP2 and TP5 or TP3 and TP9 as appropriate.

If the positive-going pulses are present at TP5 and TP9, but negative-going pulses are not present at TP6 for each of the pulses, check NAND gates U1A, U1C, U1D and U5C as appropriate.

If the pulses are approximately as shown in the top five traces of composite waveform SS13-1 but there is no square wave at TP7, use the oscilloscope to check the signal at NAND gate U3B pin 6. The display should be the same as that shown for TP7. If the signal is present, U2B is probably defective.

If the signal is not present at U3B pin 6 use the oscilloscope to check the signals at NAND gates U3D pin 11 and U3A pin 3. The signals should appear as they did at TP5 and TP9 except that they are inverted. If the signals are present U3B or U3C may be defective. If the signal is present at one of the NAND gate outputs but not at the other, replace U3.

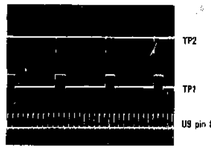
If the signal is not present at U3D pin 11 or U3A pin 3, use the digital voltmeter to check the dc level at U2A pin 6. The dc level should be about +4 volts. If U2A pin 6 is at about +4 volts, U3 is defective.

If the +4 volts is not present at U2A pin 6, ground U2A pin 1. If the voltage at U2A pin 6 does not go to about +4 volts, U2 is defective.

SERVICE SHEET 13 (cont'd)

If trouble still has not been found, connect the counter to TP3 and the digital voltmeter and the oscilloscope to NAND gate U5A pin 12. The counter readout should be about 210 kHz and U5A pin 12 should be low (about +60 millivolts). If the counter readout is lower or higher than 210 kHz and U5A pin 12 is high, slowly rotate A11R19 through its range while observing the counter and the oscilloscope. As the counter readout passes through the 210 kHz point the oscilloscope display should show a change in dc level; if it does not, U5 or U6 is probably defective.

Test 1-b. If there is no signal at TP2, or the signal is not approximately as shown in the top trace of composite waveform SS13-2, connect the oscilloscope first to TP1, then to U9 pin 8. TP1 and U9 pin 8 signals should be as shown in composite waveform SS13-2. All signal levels are about 4 volts.



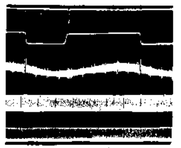
Composite Waveform SS13-2

If the signal is as shown at TP1, U7A or Q12 may be defective.

If the signal is as shown at U9 pin 8 but does not appear at TP1, U9 is probably defective.

If the signal does not appear at U9 pin 8 check the interconnections to the N3 loop and, if necessary, the N3 loop.

Test 1-c. If there is no signal at TP3, or the signal is not approximately as shown in the top trace of composite waveform SS13-3, connect the oscilloscope, in turn, to the points shown in composite waveform SS13-3.



Composite Waveform SS13-3

SERVICE SHEET 13 (cont'd)

If the signal shown in the second trace from the top of composite waveform SS13-3 is not as shown check Q3, Q7, U4B, U4C and associated components.

If the signal does not appear at Q4-c but the signal at TP4 is present check Q5, Q4 and associated components.

If the signal is not present at TP4 check for signals shown at TP10 and TP11. If both signals are present mixer E1 is probably defective. If either TP10 or TP11 signals are not present, trouble is in the N2 Loop or the SL2 voltage controlled oscillator.

Test 1-d. To check operation of the dc amplifier connect the digital voltmeter to TP8 and rotate A11R19 through its range. The digital voltmeter readout should vary from about −1.5 volt to about +1.5 volt. If the voltage does not vary as A11R19 is adjusted, check Q2, Q1, Q6 and associated components.

N3 VCO
◀ SERVICE SHEET 12

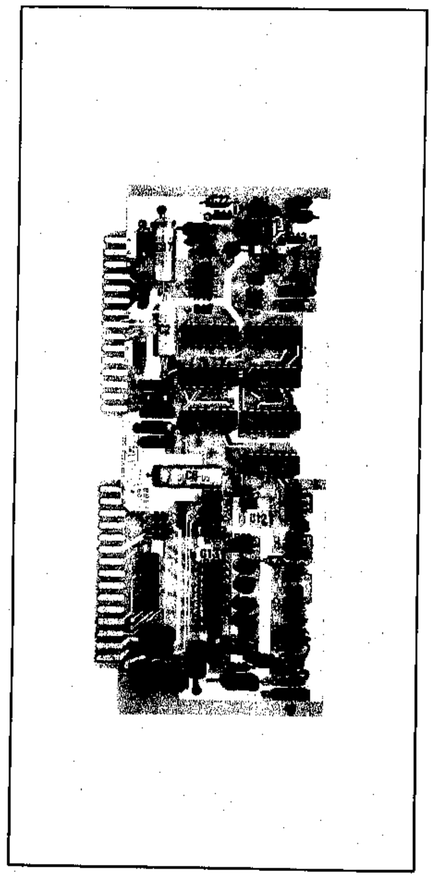


Figure 8-38. A12 SL2 Phase Detector Component Locations

SERVICE SHEET 13

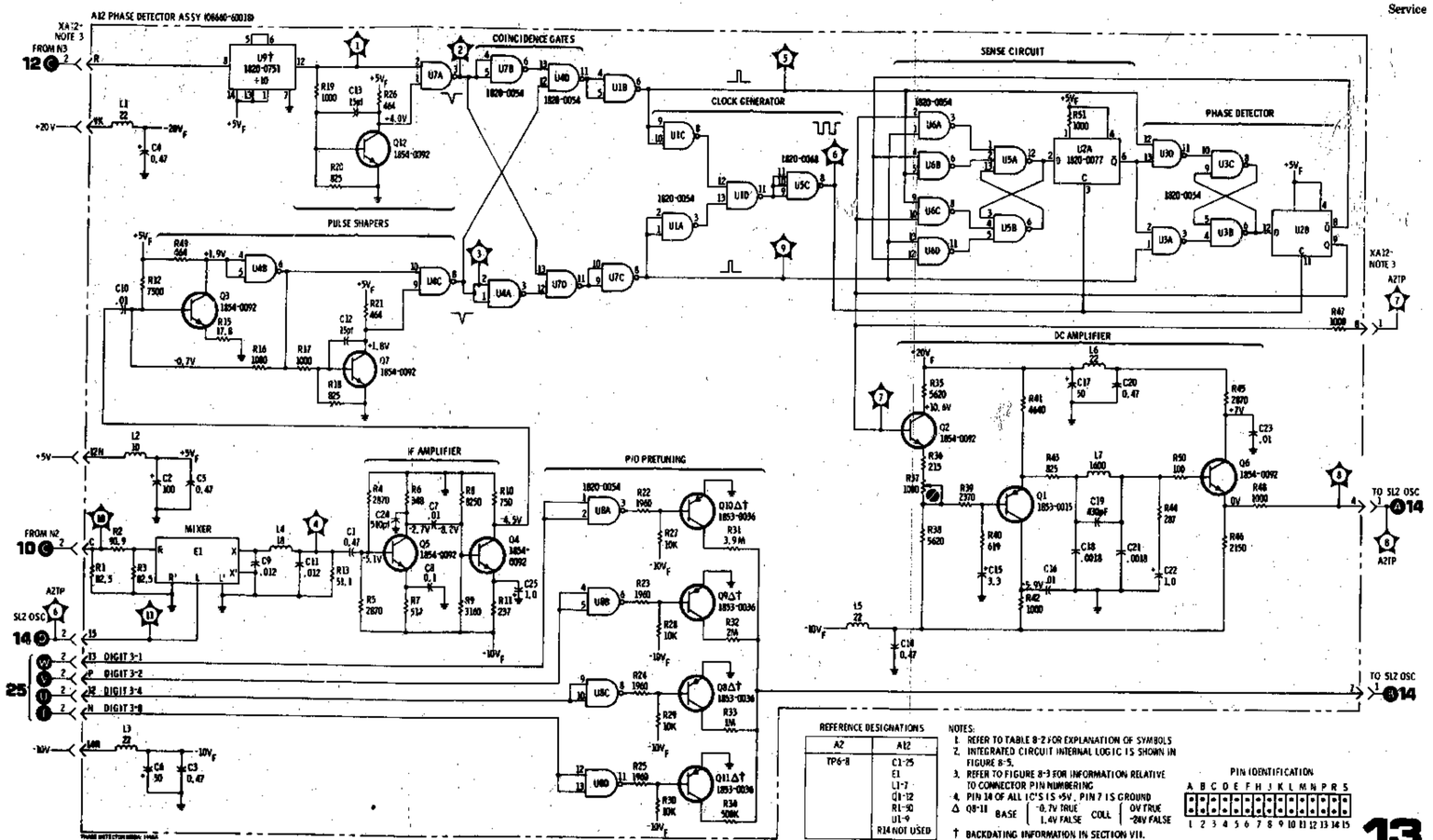


Figure 8-39. SL2 Phase Detector Schematic

SERVICE SHEET 14

SUMMING LOOP 2 OSCILLATOR A11

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A11 assembly, a part of the two-assembly SL2, is shown schematically and described on this service sheet. The SL2 Phase Detector assembly (A12) is shown schematically and described on service sheet 13.

When trouble has been isolated to the A11 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the SL2 circuits the adjustment procedures in Section V paragraph 5-26 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 2 GENERAL

The purpose of Summing Loop 2 (SL2) is to generate digitally controlled rf signals in the range of 20.0001 to 30.0000 MHz in selectable 100 Hz increments. The difference frequency between the SL2 voltage controlled oscillator and the input from the N2 loop is phase locked to the divided-by-ten output of the N3 assembly. The output of SL2 is applied to SL1.

■ PRETUNING AND OSCILLATOR

The A11 assembly contains a voltage controlled oscillator, a digital to analog converter and a circuit to combine the pretuning dc level with the output from the phase detector. The frequency of the voltage controlled oscillator is roughly preset by the pretuning signal from the digital to analog converter circuit. The pretuning signal cannot, by itself, set the oscillator precisely; it does set the frequency within the capture range of the phase lock loop.

U2 is a decoder which converts the BCD information from digit 5 to turn on one of nine transistors in a resistive network. Quad NAND gate U3 turns on one or more transistors (Q17 through Q20) when there is a BCD input from digit 4. Quad NAND gate U8 in the A12 assembly turns on one or more transistors (A12Q8 through A12Q11 also in the A12 assembly) when there is a BCD input from digit 3.

When there is no BCD input (all inputs low), the voltage at TP3 is approximately −25 volts and the oscillator is roughly preset to

SERVICE SHEET 14 (cont'd)

30.0000 MHz. As the digital to analog transistors are switched on the voltage at TP3 decreases (becomes less negative). When the BCD inputs are at 999 the voltage at TP3 is about −5 volts and the oscillator is roughly preset to 20.0001 MHz.

Q4 is a summing amplifier which combines the output of the digital to analog converter and the signal from the SL2 phase detector. The summing point (Q4-e) sums the current from three sources; a current source from the +20 volt supply through R19, R20 and R21, a negative source from the digital to analog converter (TP3) and the signal from the SL2 phase detector. The voltage at the summing point is always zero volts when the loop is locked.

When TP3 is at approximately −25 volts (all BCD inputs low), most of the current from the +20 volt source flows through Q5, very little flows through Q4. Under these conditions the voltage at Q4-c is about −30 volts. As the voltage at TP3 decreases (gets closer to dc ground level) less current flows through Q5, more flows through Q4 and the voltage at Q4-c decreases.

CR2 through CR11 and associated resistors are used to shape the voltage curve applied to the voltage controlled oscillator tuning varactors to ensure that the frequency change is linear with the applied voltage. The voltage at the junction of R52 and R53 is about −27.5 volts. When all BCD inputs are low (Q4-c is at about −30 volts) all of the diodes in the shaper are reverse biased. As the voltage at TP3 decreases (gets closer to −5 volts), current through Q4 increases and the Q4 collector voltage decreases. As the Q4-c voltage decreases first CR11, then CR10, etc are forward biased. As the diodes are forward biased resistors are added in parallel with R37 and R38 to shape the voltage curve to the varactors. Q15 provides a low impedance output to drive the varactors.

Q1 drives U1A which functions as a Schmitt trigger. U1B inverts the signal and applies it to the SL1 phase detector. U1D also inverts the signal and applies it to the SL2 phase detector.

TEST PROCEDURE ■

Test 1-a. Connect the counter to TP4. With all thumbwheels set to zero the counter readout should be 30.000000 MHz. Set thumbwheel digits 3, 4 and 5 to the settings specified in Table 8-8. Frequency readouts should follow those specified in the table. (Make allowances for counter accuracy).

NOTE

If the frequency readout listed in Table 8-8 are not as shown, check the voltage levels shown for TP5 in the table. If the voltages are incorrect proceed to test procedure ■.

If the signal is present use the oscilloscope to check the signals at points shown by composite waveform SS14-1.

SERVICE SHEET 14 (cont'd)

Composite Waveform SS14-1

If the signal is present at TP4 but is not present at XA11-1-2 or XA11-1-6, U1 is probably defective.

If the signal is not present at TP4, use the oscilloscope to check for the signal at Q1-b. If the signal in present at Q1-b, check Q1 and NAND gate U1A. If the signal is not present at Q1-b check Q2, Q3 and associated components.

TEST PROCEDURE ■

Test 2-a. Use the digital voltmeter to check the voltages at TP3, TP2 and TP5. These dc levels should be about as shown in Table 8-8 for the thumbwheel settings shown.

NOTE

These voltages are typical. They will vary from instrument to instrument because of differences in individual varactor characteristics.

If the voltage at TP3 does not change when thumbwheel digit 5 is changed to any position, U2 is probably defective. (Verify presence of BCD inputs). If the voltage at TP3 reaches about −25 volts when any thumbwheel digit 5 position is set (other than 0) the transistor associated with that number is probably open.

When the voltage at TP3 does not change with a change of the setting of thumbwheel digit 4, U3 or the associated transistors may be defective.

When the voltage at TP3 does not change with a change in the setting of thumbwheel digit 3, A12U8 or associated transistors may be defective. (This portion of the digital to analog converter is located in the A12 assembly).

If the voltages are approximately correct at TP3 but are not correct at either TP2 or TP5, check Q4, Q15 and associated components.

The counter is connected to TP4 for readouts specified in Table 8-8.

SL2 Phase Detector
◀ SERVICE SHEET 13

SERVICE SHEET 14 (cont'd)

Table 8-8. SL2 Frequency Versus Voltage Chart

Thumbwheel Settings	Counter Readout	TP3	TP2	TP5
0000000000	30.000000 MHz	−25.1 V	−31.6 V	−30.9 V
0000011100	28.890000 MHz	−22.8 V	−25.5 V	−24.8 V
0000022200	27.780000 MHz	−20.5 V	−20.5 V	−19.9 V
0000033300	26.670000 MHz	−18.3 V	−16.4 V	−15.7 V
0000044400	25.560000 MHz	−16. V	−13. V	−12.4 V
0000055500	24.450000 MHz	−13.8 V	−10.3 V	−9.6 V
0000066600	23.340000 MHz	−11.7 V	−8. V	−7.3 V
0000077700	22.230000 MHz	−9.5 V	−6.2 V	−5.5 V
0000088800	21.120000 MHz	−7.3 V	−4.6 V	−4. V
0000099900	20.010000 MHz	−5.3 V	−3.4 V	−2.8 V

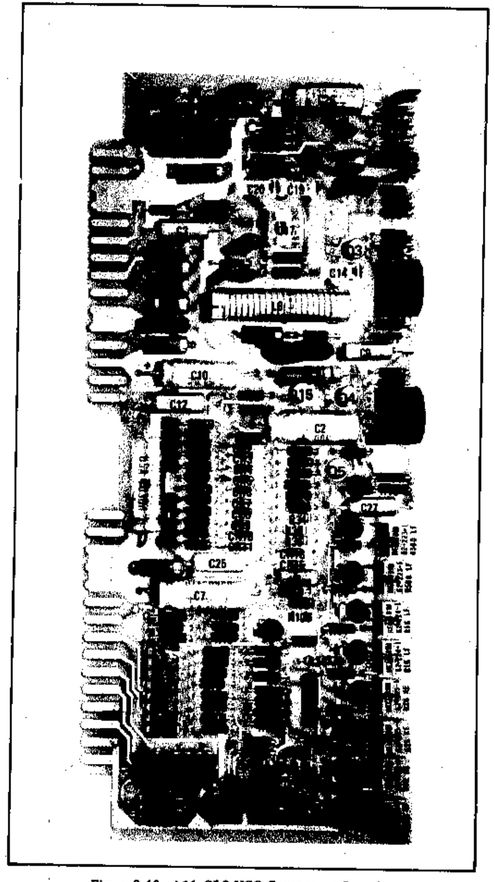


Figure 8-40. A11 SL2 VCO Component Locations

SERVICE SHEET 14

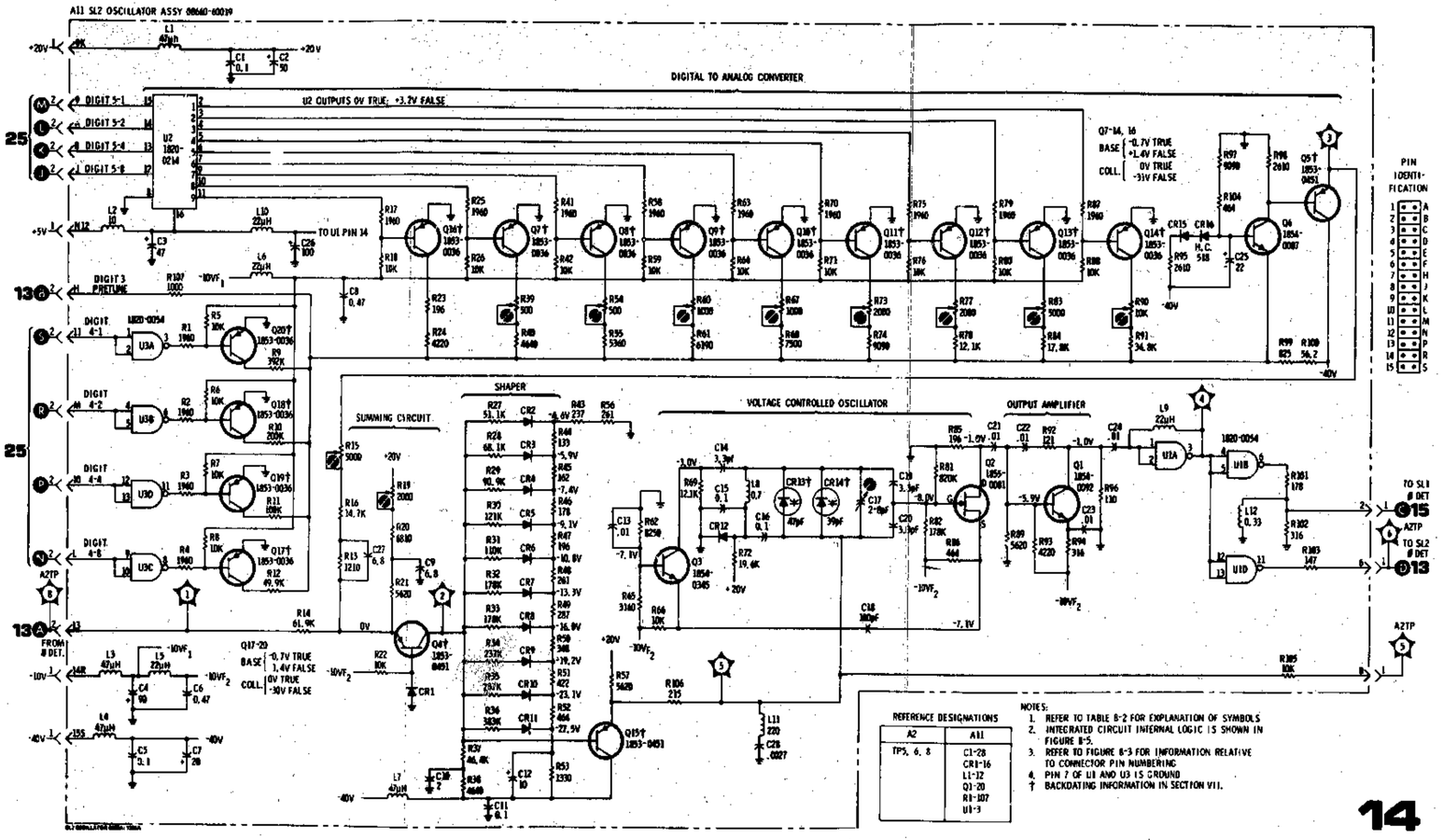


Figure 8-41. SL2 VCO Schematic

SERVICE SHEET 15

SUMMING LOOP 1 PHASE DETECTOR A15

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A15 assembly, a part of the three-assembly SL1, is shown schematically and described on this Service Sheet. The SL1 Oscillator Assembly (A19) is shown schematically and described on service sheet 17. The SL1 Mixer and D/A Converter Assembly (A18) is shown schematically and described on Service Sheet 16.

When trouble has been isolated to the A15 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the SL1 circuits the adjustment procedures in Section V paragraph 5-27 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 1 GENERAL

The purpose of Summing Loop 1 (SL1) is to generate digitally controlled rf signals in the range of 20.000001 to 30.000000 MHz in selectable increments as low as 1 Hz. The SL1 voltage controlled oscillator is phase locked to the divided by one hundred output of the SL2 loop and the difference frequency of the N1 loop and the SL1 oscillator. The output of SL1 is applied to the RF Section plug-in.

■ PHASE DETECTOR ASSEMBLY A15

There are two signal inputs to the phase detector assembly. One is the input from the SL2 loop which is shaped by U10D and divided by 100 by U6 and U5. The output of U5 is again shaped by Q5 and U4A to provide negative-going pulses at TP2. The other input to the phase detector is from the SL1 mixer and is the difference frequency between the N1 oscillator and the SL1 voltage controlled oscillator. Q6, U4B, Q4 and U4C shape the signal and provides negative-going pulses at TP3.

The pulse frequency at TP2 and TP3 varies (depending on programming) from 0.200001 to 0.300000 MHz. When the phase lock loop is locked the pulse frequency is the same at TP2 and TP3. The sampling ratio is 1:1.

U9A, U3B, U4D and U9B comprise coincidence gates which inhibit signals which appear simultaneously at TP2 and TP3. Normally, when signals are not present, TP2 and TP3 are both high.

When a signal appears at TP2, U9A pin 3 and U3B pin 4 go high. If there is no signal at TP3, U3B pin 5 is also high; U3B pin 6 goes low and U3C pin 8 goes high. The positive pulse at TP4 drives the clock generator and the sense circuit or the phase detector.

When a signal appears at TP3, U4D pin 11 and U9B pin 5 go high. If there is no signal at TP2, U9B pin 4 is also high; U9B pin 6 goes low and U9D pin 11 goes high. The positive pulse at TP8 drives the clock generator and the sense circuit or the phase detector.

When signals appear simultaneouly at TP2 and TP3, U9B pin 4 and U3B pin 5 go low: U9B pin 6 and U3B pin 6 remain high and the signals cannot reach TP4 or TP8.

U7C, U9C, U3D and U3A comprise a clock generator which clocks U2A and U2B each time a signal appears at TP4 or TP8. With no signals present TP4 and TP8 are low. When a positive pulse appears at TP8, U9C pin 8 goes low, U3D pin 11 goes high and a negative-going pulse appears at TP5. When a positive pulse appears at TP4 operation of the circuit is the same except that U7C pin 8 (rather than U9C pin 8 goes low. Since a clock

SERVICE SHEET 15 (cont'd)

pulse is generated for each input, the clock pulse frequency at TP5 is the sum of the pulse frequencies at TP4 and TP8. U2A and U2B are clocked by the positive-going trailing edge of the negative clock pulses.

Since the sense circuit does not function when the loop is locked, operation of the phase detector will be described first.

When the loop is phase locked U2A $\overline{Q}$ is held high to enable U1A and U1B. Assume that initially U2B $\overline{Q}$ is high U1D pin 11 is low and U1C pin 8 is high. When a positive pulse from TP8 appears at U1A pin 1, U1A pin 3 goes low and causes a change in state of flip/flop U1D/U1C: U1D pin 11 goes high and U1C pin 8 goes low. The high at U1D pin 11 sets the D input to U2B and the clock pulse causes U2B Q to go high. The following positive pulse at TP4 is applied to U1B pin 5, U1B pin 6 goes low and changes the state of flip/flop U1D/U1C. U1D pin 11 goes low and the clock pulse causes U2B $\overline{Q}$ to again go high. This sequence continues as long as the pulses at TP4 and TP8 alternate.

The signals at TP4 and TP8 are applied to the sense circuit even when the loop is phase locked. They have no effect on the circuit because of the relationship between the Q and $\overline{Q}$ outputs of U2B to the incoming signals.

When U2B is high, NAND gates U8A and U8C are enabled. When the signal from TP4 appears at U8C pin 9, U8C pin 8 goes low; flip/flop U7A/U7B does not change state because U7B pin 3 is low. The signal at U8B pin 4 has no effect because U2B $\overline{Q}$ and U8B pin 5 are low.

When two or more consecutive pulses from either input (TP4 or TP8) occur between pulses from the other input, the sense circuits function to disable the phase detector until the frequency error has been corrected.

As an example of circuit operation, assume that two pulses from TP8 are received between two pulses from TP4, indicating that the SL1 frequency is too high. When the first pulse from TP8 is received U1A pin 3 goes low, U1D pin 11 goes high to set the D input to U2B and the clock pulse causes U2B Q to go high. When the second consecutive pulse is received from TP8, U8A has been enabled by the high Q output of U2B. U8A pin 3 goes low and causes flip/flop U7A/U7B to change state. When the D input to U2A goes high, the clock pulse causes U2A $\overline{Q}$ to go low and inhibit NAND gates U1A and U1B. If a third pulse from TP8 is received prior to receipt of a signal from TP4, U8A pin 3 will again go low but will not affect flip/flop U7A/U7B because U7A pin 13 is low.

When a pulse is received from TP4, U2B Q is still high and U8C pin 8 will go low and change the state of flip/flop U7A/U7B. When the D input to U2A goes low the clock pulse will cause U2A $\overline{Q}$ to go high and enable U1A and U1B. The propagation time of the signal through the sense circuit is long enough for the pulse from TP4 to have ended before U1B is enabled so the state of flip/flop U1D/U1C does not change.

The next pulse from TP8 will again cause U8A pin 3 to go low and change the state of flip/flop U7A/U7B. With the D input of U2A high again, the clock pulse causes U2A $\overline{Q}$ to go low and inhibit U1A and U1B. The signal applied to U1A has no effect on flip/flop U1D/U1C because U1D pin 12 is low.

The sense circuit continues operation in the manner described above until two consecutive pulses are received at TP4 between two pulses at TP8. When this occurs the first pulse causes U8C pin 8 to go low and change the state of flip/flop U7A/U7B. With the D input to U2A low the clock pulse will cause U2A $\overline{Q}$ to go high and enable NAND gates U1A and U1B. Because of the propagation time through the sense circuit, the pulse will have ended before U1B is enabled. The second consecutive pulse from TP4 again causes U8C pin 8 to go low, but because U7B pin 3 is now low, no change in state occurs in flip/flop U7A/U7B. Since U1B is enabled, U1B pin 6 goes low and causes flip/flop U1D/U1C to change state. With the D input of U2B low, the clock pulse will cause U2B $\overline{Q}$ output to go high.

SERVICE SHEET 15 (cont'd)

Phase lock has been achieved and the loop will remain locked as long as pulses at the same frequency are received alternately at TP4 and TP8.

When the SL1 frequency is too low, U2B Q is low. When the SL1 frequency is too high, U2B Q is high.

DC amplifier Q1, Q2, Q3 and associated components filter the Q output of U2B and applies it to a summing circuit in the A19 assembly to precisely control the voltage controlled oscillator.

TEST PROCEDURE ■

Test 1-a. Connect the oscilloscope input to test points shown by composite waveform SS15-1. This composite waveform illustrates correct waveforms and timing relationships for the points tested. All signals are about 4 volts in amplitude.

NOTE

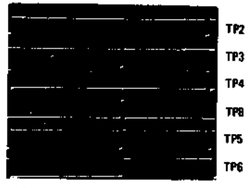
The oscilloscope was triggered from TP1 for all waveforms.

If the pulses are not present at TP2 proceed to test 1-b.

If the pulses are not present at TP3 proceed to test 1-c.

If the pulses are present at TP2 and TP3, but opposite polarity pulses are not present at TP4 and/or TP8, check the NAND gates between TP2 and TP4 or TP3 and TP8 as appropriate.

If the positive-going pulses are present at TP4 and TP8, but negative-going pulses are not present at TP5 for each of the pulses, check NAND gates U3A, U3D, U7C, and U9C as appropriate.



Composite Waveform SS15-1

If the pulses are approximately as shown in the top five traces of composite waveform SS15-1 but there is no square wave at TP6, use the oscilloscope to check the signal at NAND gate U1D pin 11. The display should be the same as that shown for TP6. If the signal is present, U2B is probably defective.

If the signal is not present at U1D pin 11 use the oscilloscope to check the signals at NAND gates U1A pin 3 and U1B pin 6. The signals should appear as they did at TP4 and TP8 except that they are inverted. If the signals are present, U1C or U1D may be defective. If the signal is present at one of the NAND gates but not at the other, replace U1.

If the signal is not present at U1A pin 3 or U1B pin 6, use the digital voltmeter to check the dc level at U2A pin 6. If U2A pin 6 is about +4 volts, U1 is defective.

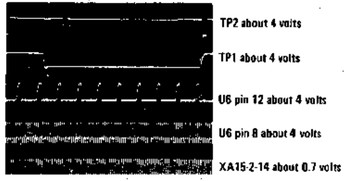
If the +4 volts is not present at U2A pin 6, ground U2A pin 1. If the voltage at U2A pin 6 does not go to about +4 volts, U2 is defective.

SL2 VCO
◆ SERVICE SHEET 16

SERVICE SHEET 15 (cont'd)

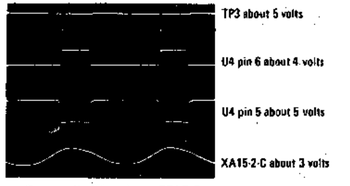
If the cause of trouble still has not been found, connect the counter to TP3 and the digital voltmeter and oscilloscope to NAND gate U7A pin 12. The counter readout should be about 300.000 kHz (all thumbwheels set to zero) and U7A pin 12 should be low (about +70 millivolts). If the counter readout is lower or higher than 300 kHz and U5A pin 12 is high, slowly rotate A15R14 through its range while observing the counter and the oscilloscope. As the counter readout passes through the 300 kHz point the oscilloscope display should show a change in level; if it does not, U7 or U8 is probably defective.

Test 1-b. If there is no signal at TP2 or the signal is not approximately as shown in the top trace of composite waveform SS15-2, connect the oscilloscope first to TP2, then U6 pin 12, U6 pin 8 and finally to XA15-2-14. In making the checks in the order shown, the point at which the correct signal is first observed is followed by the defective circuit. If the signal is not present at XA15-2-14, check the interconnections to the SL2 loop and, if necessary, the SL2 loop.



Composite Waveform SS15-2

Test 1-c. If there is no signal at TP3 or the signal is not approximately as shown in the top trace of composite waveform SS15-3 connect the oscilloscope first to U4 pin 6, then to U4 pin 4 or 5 and finally to XA15-2-C.



Composite Waveform SS15-3

In making the checks in the order shown, the point at which the signal is first observed is followed by the defective circuit If the signal is not present at XA15-2-C check the interconnections to the A18 assembly and, if necessary, the A18 assembly.

Test 1-d. To check operation of the dc amplifier connect the digital voltmeter to Q3-e, ground TP7, and rotate A15R14 through its range. The digital voltmeter readout should vary from about −1.5 volts to about +1.5 volts. If the voltage does not vary as A15R14 is adjusted, check Q1, Q2, Q3 and associated components.

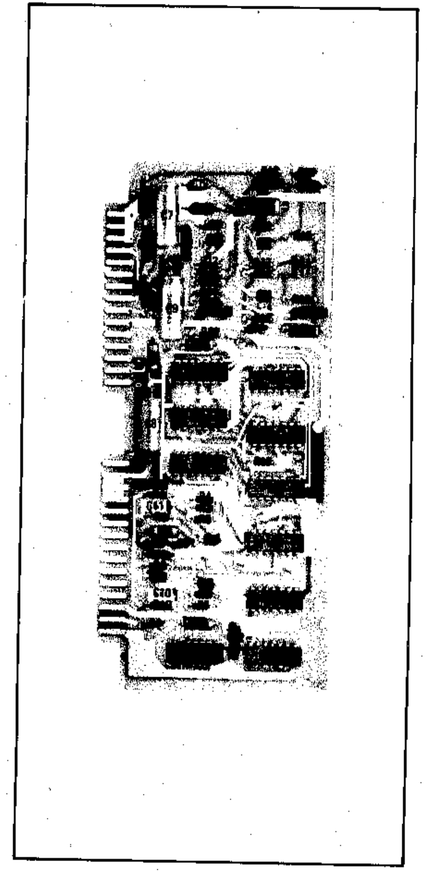


Figure 8-42. A15 SL1 Phase Detector Component Locations

SERVICE SHEET 15

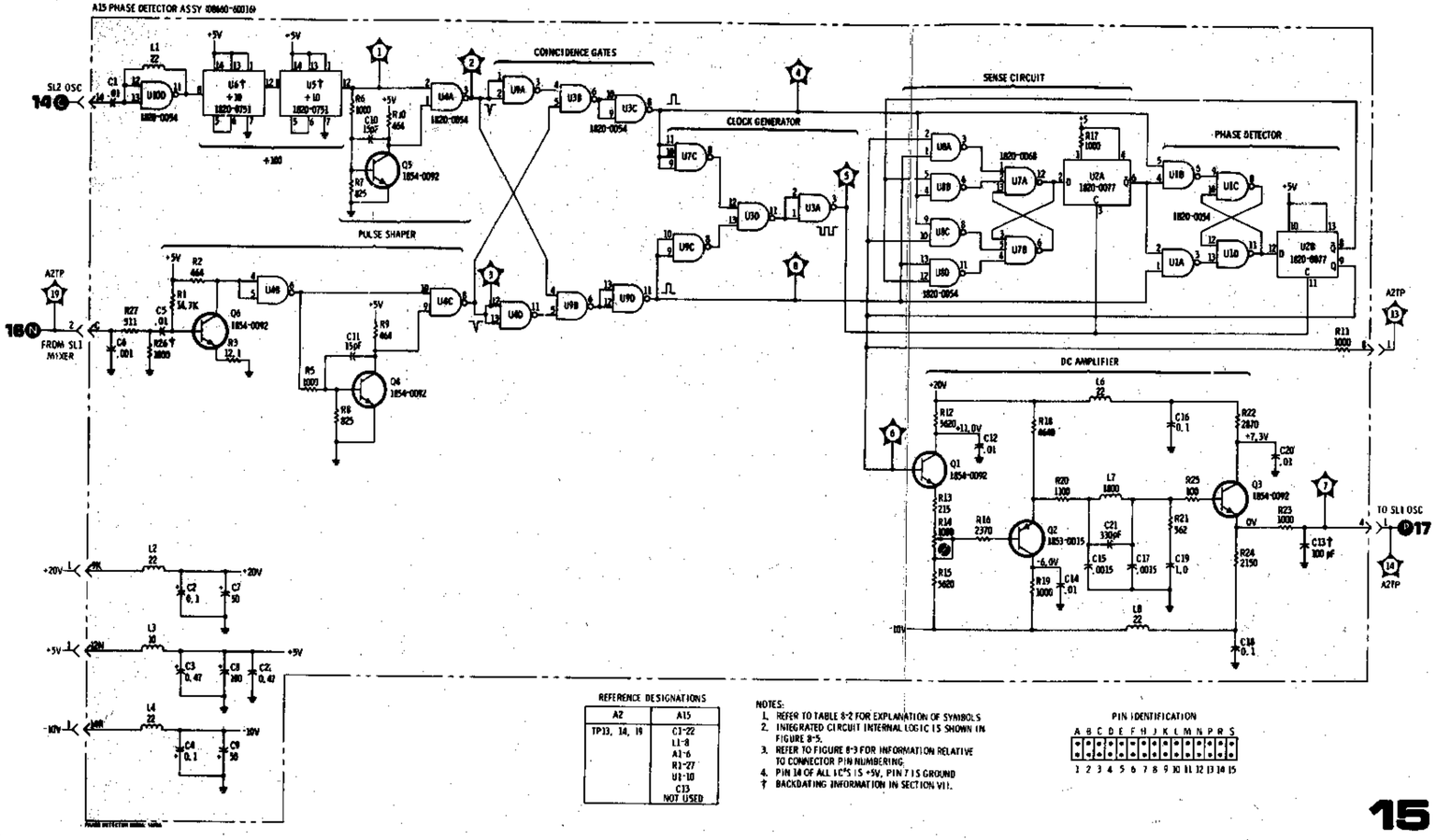


Figure 8-43. SL1 Phase Detector Schematic

SERVICE SHEET 16

SUMMING LOOP 1 MIXER AND D TO A CONVERTER A18

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A18 assembly, a part of the three-assembly SL1, is shown schematically and described on this service sheet. The SL1 Phase Detector Assembly (A15) is shown schematically and described on Service Sheet 15. The SL1 Oscillator Assembly (A19) is shown schematically and described on Service Sheet 17.

When trouble has been isolated to the A18 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the SL1 circuits the adjustment procedures in Section V paragraph 5-27 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 1 GENERAL

The purpose of Summing Loop 1 (SL1) is to generate digitally controlled rf signals in the range of 20.000001 to 30.000000 MHz in selectable increments as low as 1 Hz. The SL1 voltage controlled oscillator is phase locked to the divided by one hundred output of the SL2 loop and the difference frequency of the N1 loop and the SL1 oscillator. The output of SL1 is applied to the RF Section output plug-in.

MIXER AND AMPLIFIERS

E1 is a double balanced mixer which mixes the output of the SL1 voltage controlled oscillator with the output of the N1 loop and provides an output which is the difference frequency of the two inputs.

Q14 and Q1 amplify the input from the SL1 voltage controlled oscillator.

Q2, Q15, Q13 and associated components amplify the output from the mixer before applying it to the phase detector circuit in the A15 assembly.

TEST PROCEDURE

Test 1-a. With all thumbwheel digits set to zero use the counter and the oscilloscope to check for the following (approximately sine wave) signals:

TP5 300.000 kHz at about 4 volts p/p
TP4 (oscilloscope only) 300 kHz at about 0.1 volt p/p
TP3 29.700000 MHz at about 0.5 volt p/p
Q1-e 30.000000 MHz at about 1.1 volt p/p
TP2 30.000000 MHz at about 0.5 volts p/p

SL1 Phase Detector
SERVICE SHEET 15

SERVICE SHEET 16 (cont'd)

DIGITAL TO ANALOG CONVERTER

U3 is a decoder which converts the BCD inputs from digit 7 to an output that will turn on one of nine transistors in a resistive network. Quad NAND gates U2 and U1 turn on one or more transistors connected to their outputs in a resistive network. U2 and U1 are controlled by digits 6 and 5 respectively.

The current flow through Q4 and the bias for Q3 is determined by which of the transistors in the resistive network are saturated. The dc level at TP1 is determined by which transistors are on. This dc level is applied to a summing circuit in the A19 assembly and used to roughly pretune the voltage controlled oscillator. When the BCD input is 000 the dc level at TP1 is about −25 volts. When the BCD input is 999 the dc level is about −5 volts.

TEST PROCEDURE

Test 2-a. Connect the digital voltmeter to TP1 and the counter to TP5. Refer to Table 8-9 for thumbwheel settings, counter readouts, and approximate voltage levels.

NOTE

The voltage readings are typical and may vary greatly from that shown due to differences in varactor characteristics. The important point to note is the ratio of change as the thumbwheel settings are changed.

If the voltage ratio changes about as shown but the frequency requirements are not met, trouble is probably in the oscillator assembly or the phase detector assembly.

Table 8-9. SL1 Frequency Versus Voltage Chart

Thumbwheel Settings	Frequency TP5	Voltage TP1
0000000000	300.000 kHz	−25.5 V
0001110000	290.000 kHz	−23.4 V
0002220000	280.000 kHz	−21.0 V
0003330000	270.000 kHz	−18.8 V
0004440000	260.000 kHz	−16.6 V
0005550000	250.000 kHz	−14.3 V
0006660000	240.000 kHz	−12.1 V
0007770000	230.000 kHz	−9.9 V
0008880000	220.000 kHz	−7.7 V
0009990000	210.000 kHz	−5.4 V
0009999999	200.000 kHz	−5.4 V

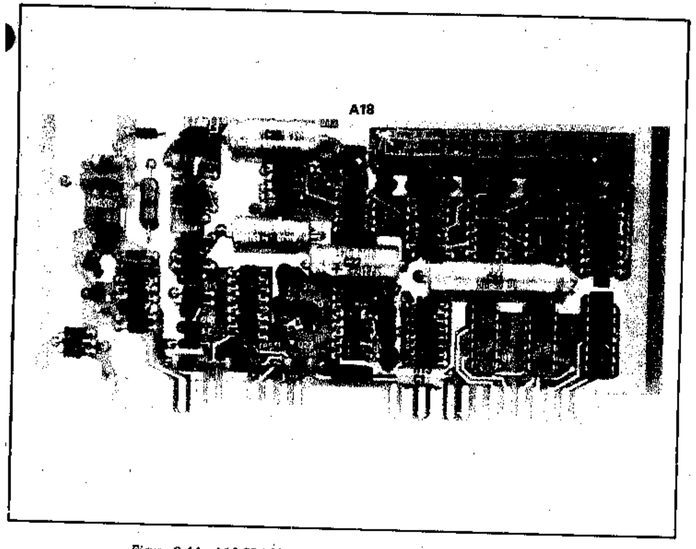


Figure 8-44. A18 SL1 Mixer and D/A Converter Component Locations

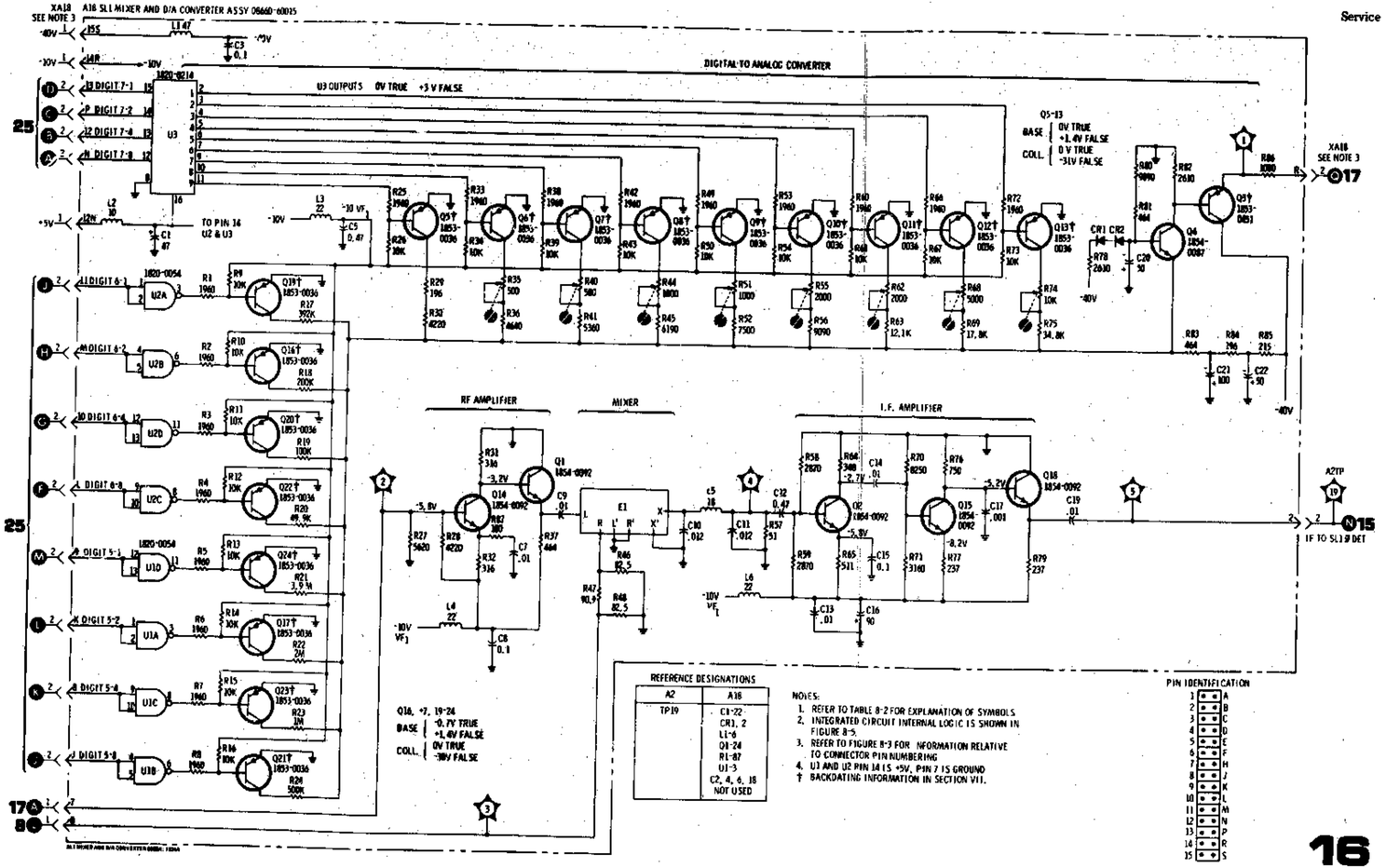


Figure 8-45. SL1 Mixer and D/A Converter Schematic

SERVICE SHEET 18

SERVICE SHEET 17

SUMMING LOOP 1 OSCILLATOR A19

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

The A19 assembly, a part of the three-assembly SL2, is shown schematically and described on this service sheet. The SL1 Mixer and D/A converter Assembly (A18) is shown schematically and described on Service Sheet 16. The SL1 Phase Detector Assembly (A15) is shown schematically and described on Service Sheet 15.

When trouble has been isolated to the A19 assembly it should be removed and reinstalled using two extender boards. This will provide easy access to test points and components.

NOTE

After making repairs to any part of the SL1 circuits the adjustment procedures in Section V paragraph 5-27 should be performed to ensure proper operation of the instrument.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter
Electronic Counter

SUMMING LOOP 1 GENERAL

The purpose of Summing Loop 1 (SL1) is to generate digitally controlled rf signals in the range of 20.000001 to 30.000000 MHz in selectable increments as low as 1 Hz. The SL1 voltage controlled oscillator is phase locked to the divided by one hundred output of the SL2 loop and the difference frequency of the N1 loop and the SL1 oscillator. The output of SL1 is applied to the RF Section plug-in.

SUMMING AMPLIFIER

Q6 is a summing amplifier which combines the output of the digital to analog converter and the signal from the SL1 phase detector. The summing point (Q6-e) sums the current from three sources; a current source from the +20 volt supply through R9, R10 and R11, a negative source from the digital to analog converter through R3, R7 and R68, and the signal from the SL1 phase detector through R6. The dc level at the summing point is held at zero volts.

When the input at XA19-2-J is about −25 volts (all BCD inputs to A18 low) most of the current from the +20 volt source flows through A18Q3; very little flows through Q6. Under these conditions the voltage at Q6-c is about −30 volts. As the voltage at XA19-2-J decreases (becomes less negative), less current flows through A18Q3, more flows through Q6, and the voltage at Q6-c decreases (becomes less negative).

CR1 through CR10 and associated resistors are used to shape the voltage curve applied to the voltage controlled oscillator tuning varactors to ensure that frequency change is linear with voltage change. The voltage at the junction of R32 and R39 is about −27.5 volts. When all BCD input to the A18 assembly are low, Q6-c is about −30 volts and all of the diodes in the shaper are reverse biased. As the voltage from the digital to analog converter decreases (gets closer to −5 volts) current through Q6 increases and the Q6 collector voltage decreases. As the Q6-c voltage decreases first CR10, then CR9, etc. are forward biased. As the diodes are forward biased resistors are added in parallel with R35 and R38 to shape the voltage curve to the varactors. Q7 provides a low impedance output to drive the varactors.

TEST PROCEDURE

Test 1-a. Connect the digital voltmeter to TP1 and set the thumbwheel digits as shown in Table 8-10.

NOTE

The voltage readings are typical and may vary greatly from that shown due to differences in varactor characteristics. The important point to note is the ratio of change as the thumbwheel settings are changed.

If the voltage at TP1 does not change as the thumbwheel settings are changed check the input from the digital to analog converter (A18) at XA19-2-J. If the voltage levels at this point do not change as the thumbwheel settings are changed, trouble is probably in the A18 assembly.

If the voltage level from the digital to analog converter does change, but the level at TP1 does not, check Q6, Q7 and associated components.

VOLTAGE CONTROLLED OSCILLATOR AND AMPLIFIERS

Q5, Q4 and associated components comprise a voltage controlled oscillator. C17, C20 and C21 provide isolation for the dc levels required to bias the varactors. C19 provides the feedback necessary to sustain oscillation. The resonant tank circuit is coupled to Q4 by capacitive divider C20 and C21. The FET acts as a source follower in the feedback circuit; it provides a high impedance at the gate and a low impedance at the source.

Q3 is a power splitter which drives two two-stage amplifiers. One amplifier output is applied to the RF Section plug-in and the other is applied to the mixer in the A18 assembly.

TEST PROCEDURE

Test 2-a. Connect the oscilloscope to TP3 then to TP4. The sine wave at both test points should be about 0.3 volts p/p.

If the signal is not present at either TP3 or TP4 connect the oscilloscope to Q3-b. The signal level should be about 0.2 volts p/p. If the signal is present at Q3-b but was not present at TP3 or TP4, Q3 is probably defective. If the signal is not present at Q3-b, check Q5, Q4 and associated components.

Test 2-b. Connect the counter to TP3 or TP4 and check for correct frequencies at the thumbwheel settings shown in Table 8-10.

Table 8-10. Varactor Bias Versus Frequency SL1

Thumbwheel Settings	Frequency TP3 or TP4	Voltage TP1
0000000000	30.000000 MHz	−30.7 V
0001110000	28.890000 MHz	−25.3 V
0002220000	27.780000 MHz	−21.2 V
0003330000	26.670000 MHz	−17.2 V
0004440000	25.560000 MHz	−13.4 V
0005550000	24.450000 MHz	−10.6 V
0006660000	23.340000 MHz	−8.2 V
0007770000	22.230000 MHz	−6.3 V
0008880000	21.120000 MHz	−4.7 V
0009990000	20.010000 MHz	−3.3 V
0009999999	20.000001 MHz	−3.2 V

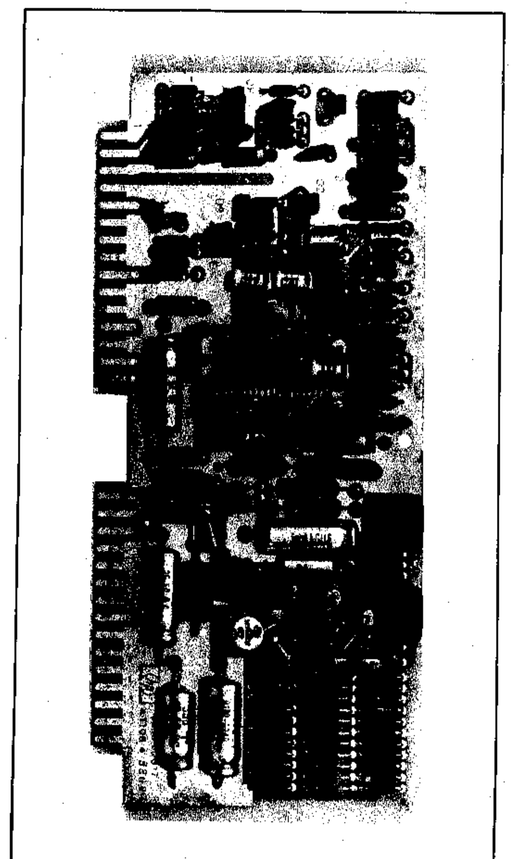


Figure 8-46. A19 SL1 VCO Component Locations

SERVICE SHEET 17

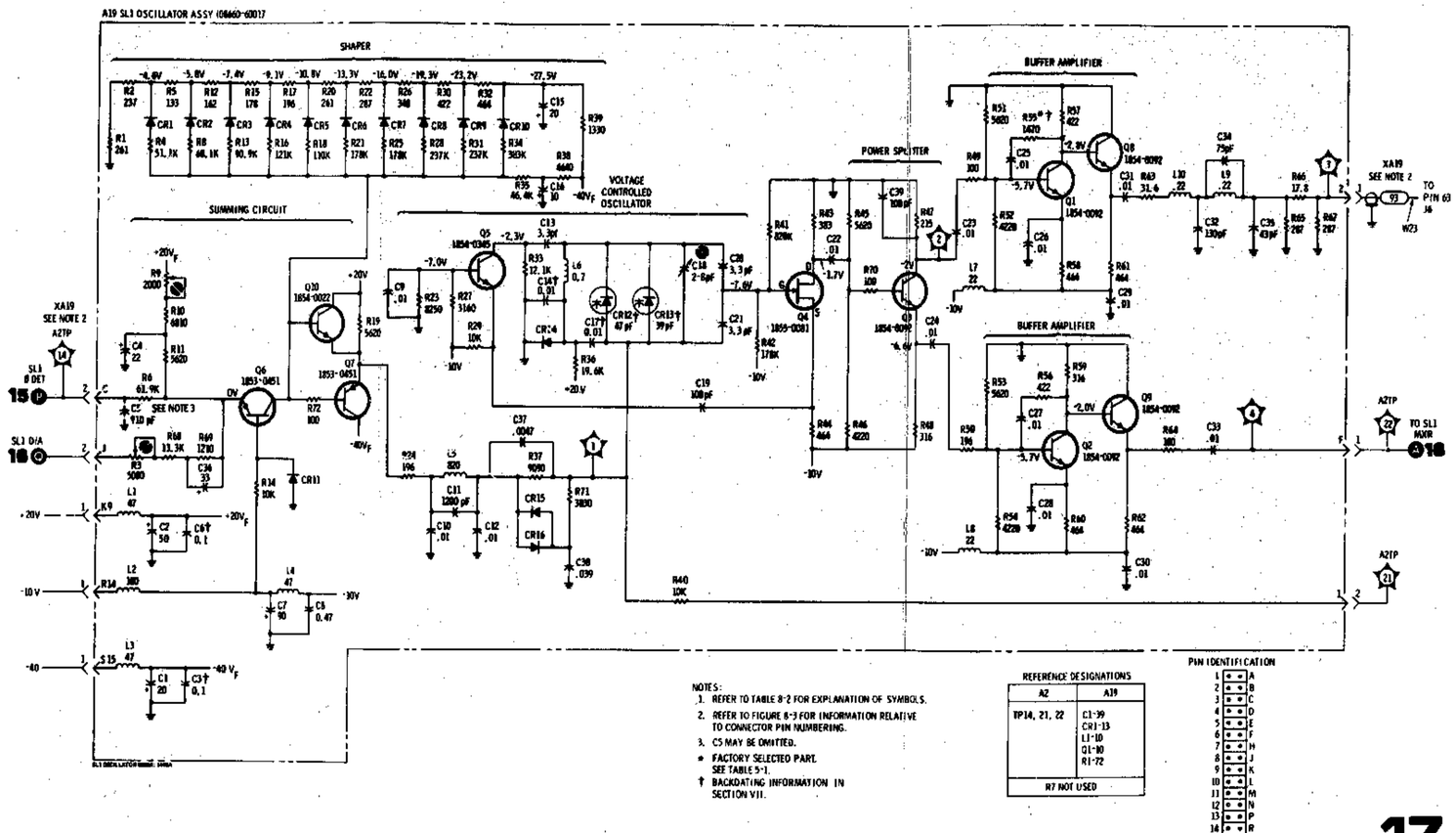


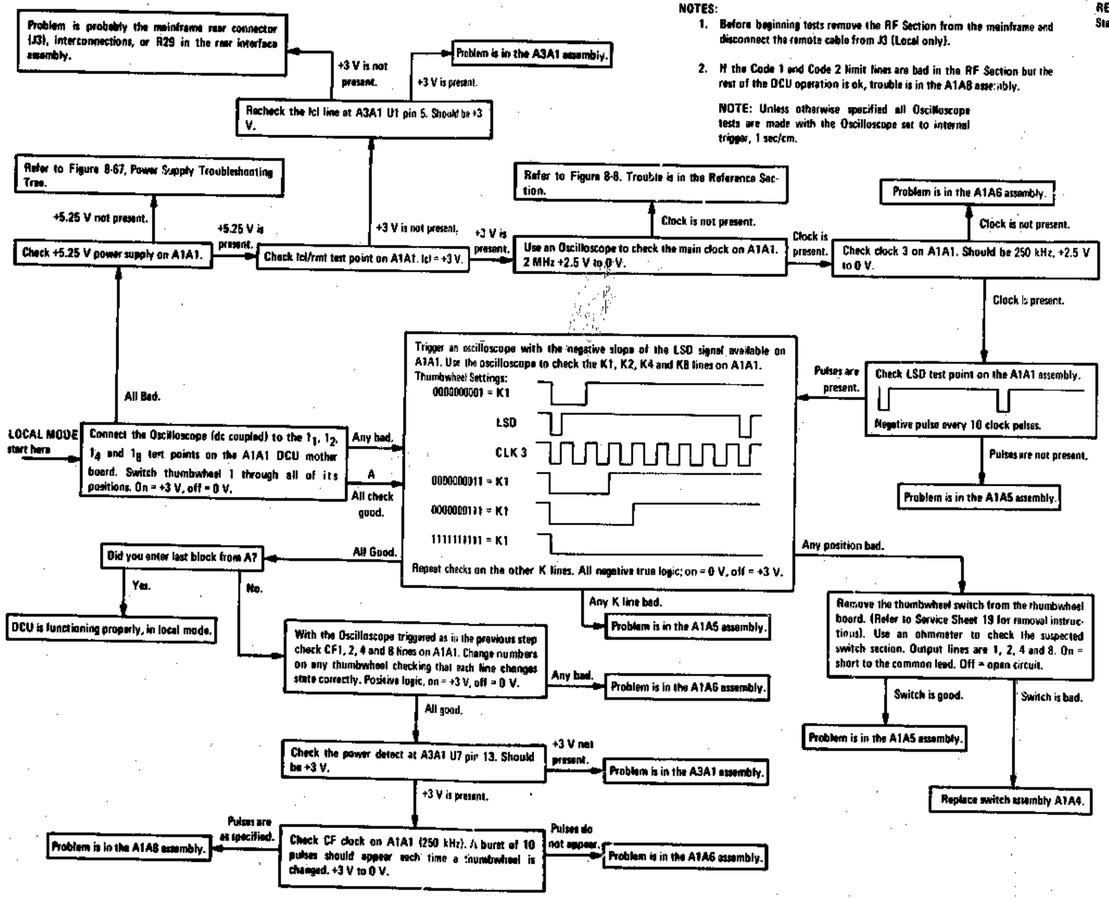
Figure 8-47. SL1 VCO Schematic

17

NOTES:

1. Before beginning tests remove the RF Section from the mainframe and disconnect the remote cable from J3 (Local only).
2. If the Code 1 and Code 2 limit lines are bad in the RF Section but the rest of the DCU operation is ok, trouble is in the A1A8 assembly.

NOTE: Unless otherwise specified all Oscilloscope tests are made with the Oscilloscope set to internal trigger, 1 sec/cm.



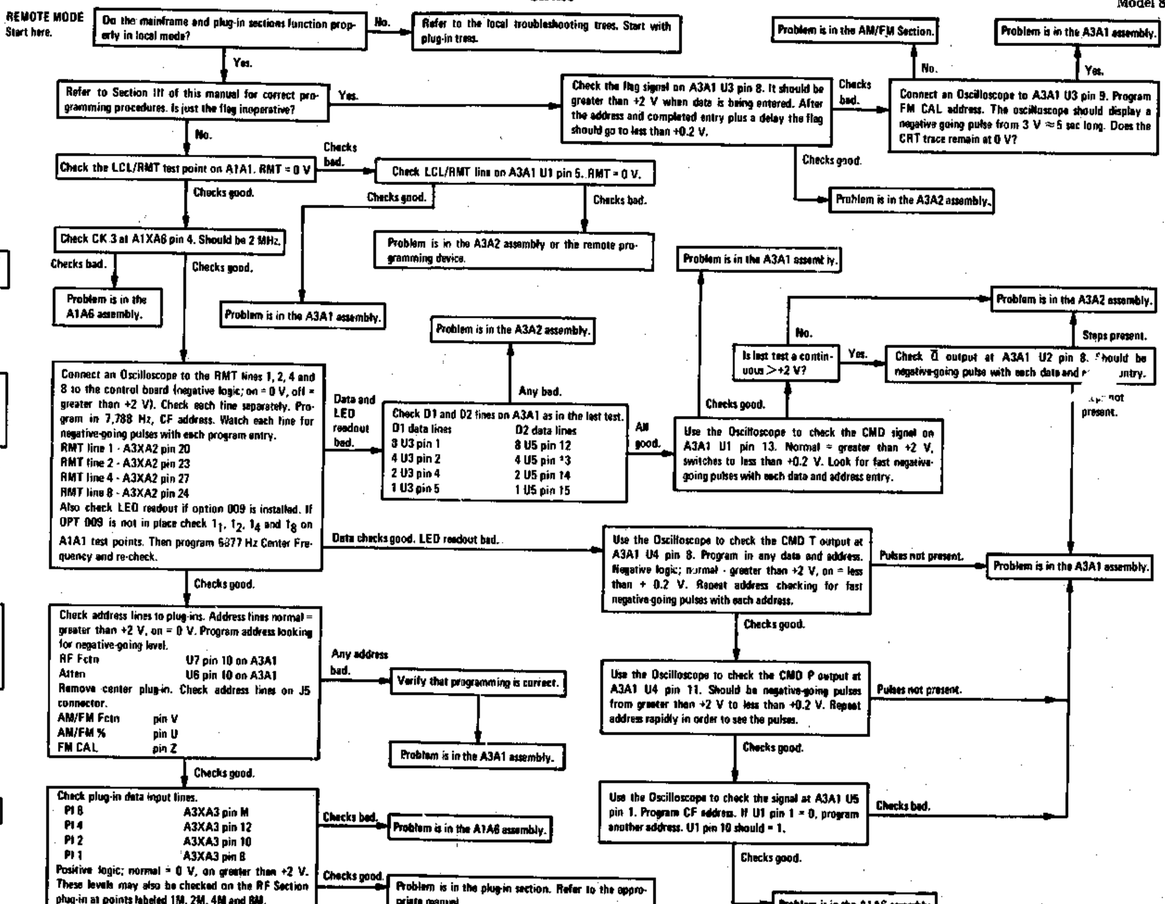


Figure 8-48. DCU and Interface Troubleshooting Tree

SL1 VCO
◆SERVICE SHEET 17

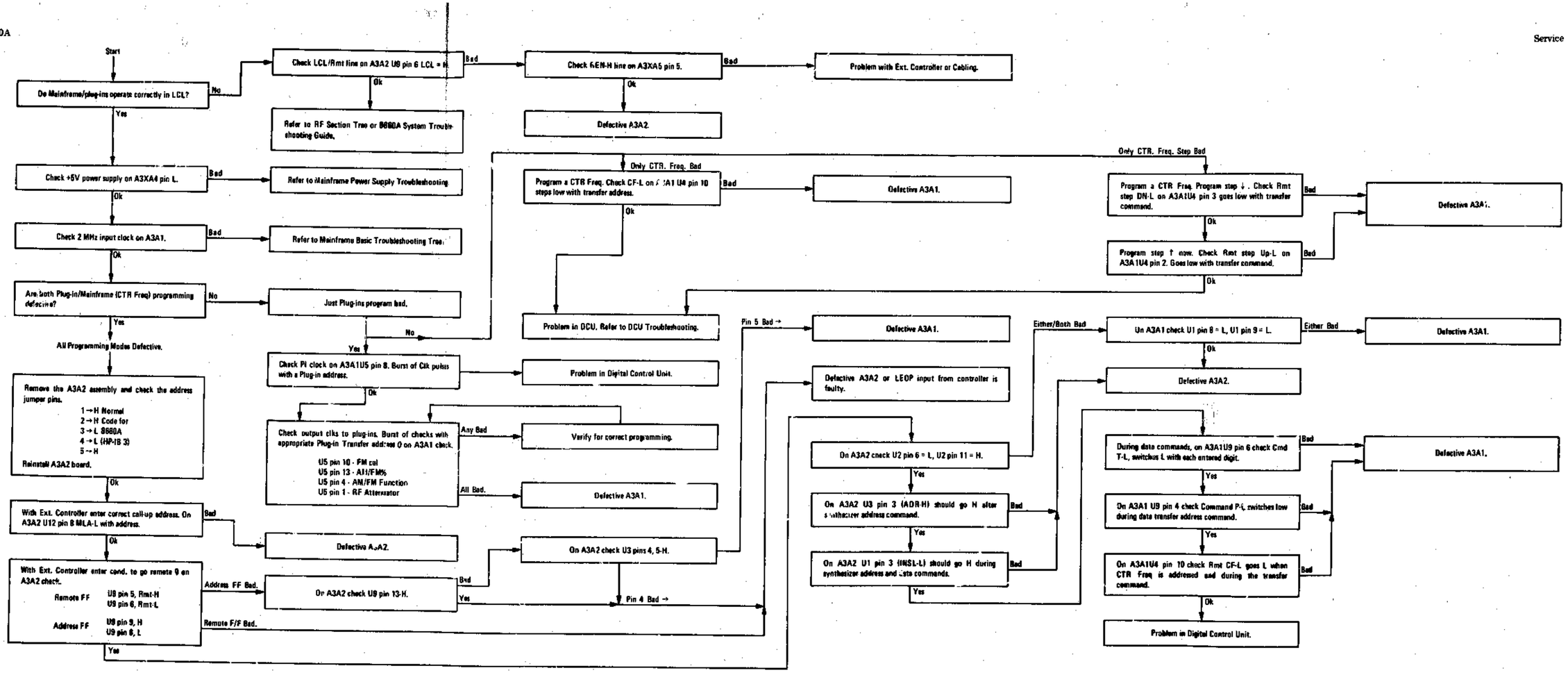


Figure 8-48A. HP-IB (Opt. 005) Remote Troubleshooting Tree

SERVICE SHEET 18

DCU AND INTERFACE DIAGRAM

GENERAL

In local operation the DCU (Digital Control Unit) controls only the output frequency of the RF Section plug-in in use.

In remote operation the center frequency, output level, and modulation are all controlled by the remote programming device through the Digital Control Unit.

THUMBWHEEL CIRCUITS

Thumbwheel digits 1 through 9 each provide BCD 1, 2, 4 and 8 inputs to the four one-of-ten selector circuits. Thumbwheel digit 10 provides only a BCD 1 or 0 to the BCD 1 one-of-ten selector circuit.

The one-of-ten selector circuits convert the 37 lines of parallel information from the thumbwheel switches to four-line, ten-bit serial BCD information.

The decade divider which drives the one-of-ten selectors is driven by a 250 kHz clock in the local mode. This results in a four-line, ten-bit serial output at a 25 kHz rate.

Two additional outputs are provided by the thumbwheel circuits. When all of the outputs of the decade divider are low (BCD 0000) thumbwheel switch 1 (the Least Significant Digit, 1 Hz resolution) is being sampled and a negative-going pulse is provided to the control circuits to signal that a new sampling cycle is being initiated. A negative-going pulse is also provided when the decade divider output state is a 6 (0110). The "6" output is not used below output frequencies of 1.3 GHz. The count of 6 circuit is not shown in the logic diagram.

For a complete description of the thumbwheel circuits refer to Service Sheet 19.

CONTROL CIRCUIT

The inputs to the AND/NOR gates (Multiplexer II) preceding the temporary storage register consist of the serial BCD inputs from the thumbwheel circuit or serial BCD information from an external programming device.

The inputs to multiplexer II are selected by the LCL/RMT (local/remote) input. In the local mode the LCL/RMT input is an open line (high) and the upper AND gates in the AND/NOR multiplexer circuits are enabled; the BCD information from the thumbwheel circuits is coupled through to the temporary storage register. The LCL/RMT input is inverted and applied to the lower AND gates in the AND/NOR multiplexers; in the local mode the inverter output is low and it inhibits the lower AND gates.

In the remote mode the LCL/RMT input is low, the upper AND gates are inhibited and the lower AND gates are enabled to couple the remotely programmed data to the temporary storage register.

SERVICE SHEET 18 (cont'd)

The inputs and outputs of the temporary storage register are continuously monitored by a comparator which functions as an exclusive OR gate in the local mode. In the local mode, after the thumbwheel selected frequency is entered into the center frequency register, and in option 009 instruments the LED readout register, and the thumbwheel information is not being changed, the inputs and outputs of the temporary storage registers are identical. When the inputs and outputs of the temporary storage register are the same, the comparator output is low and the error gate is inhibited; the CF clock signal cannot be coupled through to the center frequency register. Whenever the thumbwheel settings are changed the comparator detects the difference between the temporary storage register inputs and outputs and provides a high output to enable the error gate. The CF clock is then coupled through the error gate to initiate the transfer cycle and enter the new frequency into the center frequency register.

In the remote mode the serial BCD input to the temporary storage register is received from the interface circuit two digits at a time. The BCD information is clocked into the temporary storage register by temporary command pulses which also originate in the interface circuits. When all required BCD information has been stored in the temporary storage register, a permanent command from the interface circuits causes the BCD information to be transferred to a final storage register. In the remote mode, the information in the temporary storage register may be transferred to storage registers controlling the center frequency, the rf output level, and the type and level of modulation.

For a complete description of control circuit functions refer to Service Sheet 20.

CENTER FREQUENCY CIRCUIT

In the present configuration of the Model 8660A the inputs from multiplexer III to the center frequency register consist of the output from the temporary storage register. The leads labeled Note 1 are not presently used, but may be used in conjunction with possible future plug-in RF Sections.

The center frequency register converts the four-line serial BCD data inputs from multiplexer III to 37 lines of parallel data.

The outputs of the center frequency register determine the output frequency of six of the phase lock loops in the mainframe. In the three "N" loops digital to analog converters provide pretuning to bring the oscillators within the capture range of the phase lock loops. The digital data is also used to drive a programmable divider in the phase lock loop to bring the frequency to exactly the frequency selected.

The SL1 and SL2 loops use the digital data from the center frequency register only to provide pretuning to their oscillators by means of digital to analog converters. In these loops the phase lock circuit is completely digital.

SERVICE SHEET 18 (cont'd)

The high frequency loop also uses the digital data from the center frequency register to provide pretuning only. This loop is phase locked to a harmonic of a precise 10 MHz signal.

Some of the outputs (24 lines) from the center frequency register are also used in frequency error detect circuits which will be described later in this text.

For a more detailed description of the center frequency circuits refer to Service Sheet 21.

FREQUENCY LIMIT SELECTOR

The frequency limit selector detects which RF Section plug-in is in use and enables the appropriate gates in the frequency error detector.

When the Model 86601 RF Section is used, the inputs labeled OPI (output plug-in) -1, OPI-2, OPI-4 and OPI-8 are all open circuits (high), and the output of NAND gate U6B is low. The output of NAND gate U12B is high and the output of INVERTER U17B is low.

The output of U17B is used in the frequency detect circuit. The output labeled HPN causes the correct decimal point light on the thumbwheel switch to illuminate. This output is also used to inhibit the lower AND gates in the AND/OR gates in multiplexer III. The output of the INVERTER which is part of multiplexer III enables the upper AND gates in the AND/OR gates in multiplexer III.

When the Model 86602 RF Section is used OPI-2, OPI-4 and OPI-8 will be open circuit (high) and OPI-1 will be ground (low). In this case the output of NAND gate U6A will be low and the output of NAND gate U6B will be high. Operation of the circuit is the same as it was for the Model 86601A except that different gates are selected in the frequency detect circuit.

Possible future RF Sections may provide different inputs to NAND gates U6A and U6B, in which case the outputs of both would be high. The output of NAND gate U12B would then go low. The $\overline{\text{HPN}}$ output would cause a different decimal point on the thumbwheel switch to illuminate. The output of INVERTER U17B would be high and the lines labeled Note 1 would provide the inputs to the center frequency register.

FREQUENCY DETECT CIRCUITS P/O A1A8

The major purpose of the frequency detect circuit is to advise the operator that he has selected a frequency that is not within the frequency range of the RF Section in use.

When the Model 86601 RF Section is in use the OUT-OF-RANGE light will flash if a frequency below 10.000 kHz or above 109.999999 MHz is selected.

When the Model 86602 RF Section is in use the OUT-OF-RANGE light will flash if a frequency below 1 MHz or above 1.299999999 GHz is selected.

SERVICE SHEET 18 (cont'd)

The frequency detect circuits also provide Code 1 and Code 2 outputs which are used in the RF Section to aid in leveling the output amplitude across the frequency range.

For a more detailed description of the frequency detect circuits refer to Service Sheet 21.

INTERFACE CIRCUITS (REMOTE MODE)

The inputs to the interface circuits from the remote programming device consist of two parallel BCD digits at a time. These two digits are stored in eight "D" type flip/flops by a command pulse from the remote programming device.

When the two four-bit digits are data inputs the ONE-OR-TWO-PULSE generator generates two pulses that are in time coincidence with the gating controls to multiplexer I. These two pulses clock the output of multiplexer I into the temporary storage register through multiplexer II. The information stored in the temporary storage register has been converted from parallel data to serial data. The two-digit, one command inputs are repeated until all the information required is stored serially in the temporary storage register.

When all required data has been stored the next programmed digit 1 input should be 0000 and the inputs to the address gate will all be high. The output of the address gate will be low and the ONE-OR-TWO-PULSE generator will produce a single output pulse. The digit 2 input is an address which is decoded in a one-of-ten selector. The address selector enables the appropriate gate to direct a train of 10 clock pulses to the selected final register.

In the remote mode the temporary register is cleared after the information is clocked out. This prevents erroneous information from being stored.

For a more detailed description of the interface circuits refer to Service Sheets 22 and 23.

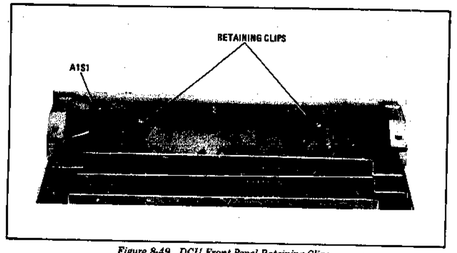


Figure 8-49. DCU Front Panel Retaining Clips

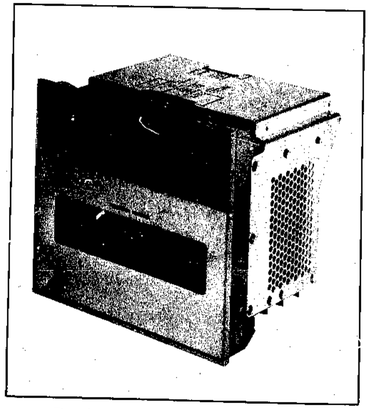


Figure 8-50. A1 DCU Removed from the Mainframe

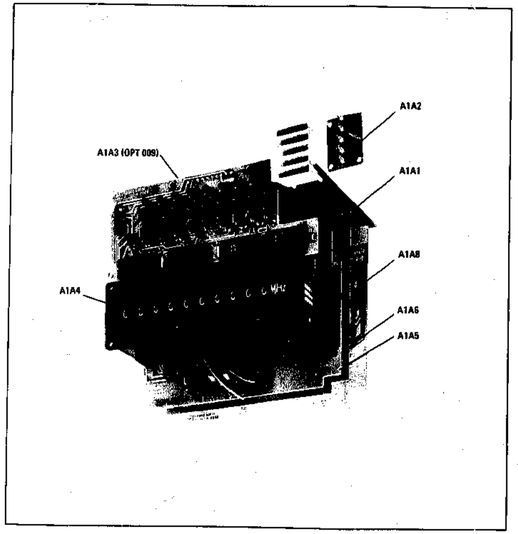


Figure 8-51. DCU with Covers and Front Panel Removed

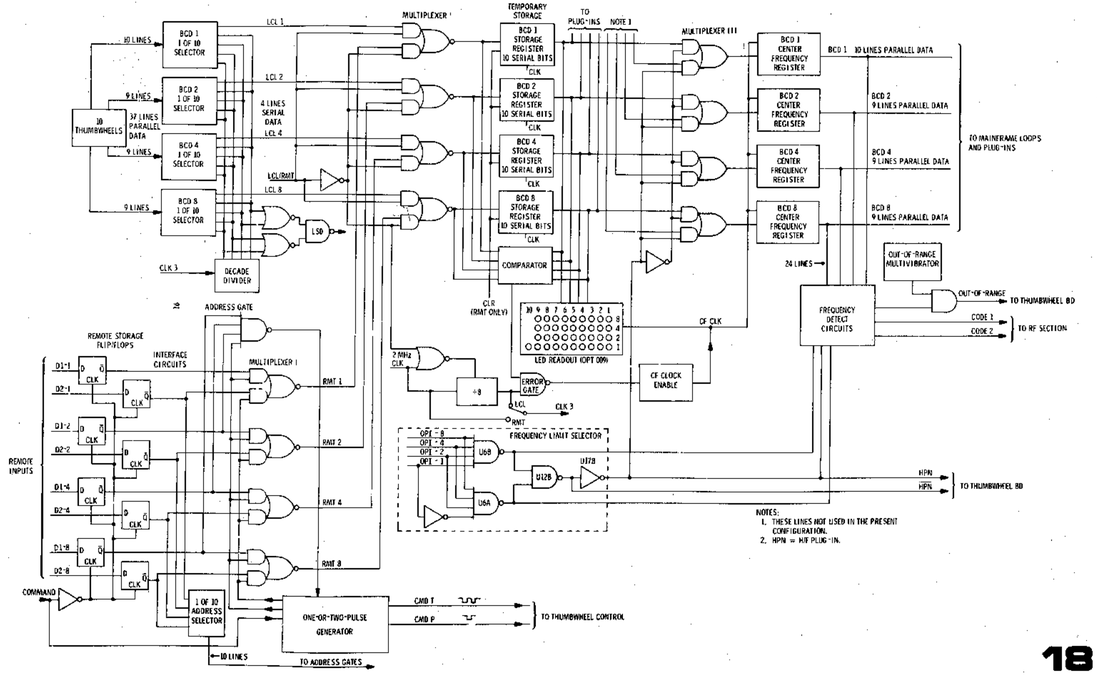


Figure 8-52. DCU Logic Diagram

SERVICE SHEET 19

THUMBWHEEL SWITCHES AND CIRCUIT BOARD

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

When the cause of a malfunction has been isolated to the thumbwheel board or switches they must be removed and reinstalled using an extender board in order to facilitate maintenance.

NOTE

The Digital Control Unit (DCU) must be removed from the mainframe in order to extend any of the DCU circuit boards. See Figures 8-49, 8-50 and 8-51 for views of the DCU removed from the mainframe.

The thumbwheel switches and thumbwheel board may be extended for maintenance as follows:

1. Disconnect all connectors from the DCU to the mainframe circuits.
2. Remove the DCU from the mainframe by removing four screws, two at the top front edge and two at the bottom front edge.
3. Remove the bottom cover from the DCU.
4. With duck-bill pliers release the tension of the spring clips on the decimal point light pipes and slide the sleeves off the incandescent lamps.
5. Slide the mother board back out of the DCU frame being sure that the thumbwheel switch sockets and, in OPT 909 instruments, the LED display socket disengage uniformly.
6. Remove the four spring slips from the thumbwheel switch assembly and pull the assembly from the front panel.
7. Remove the thumbwheel board, reunite it with the switch assembly, and reinstall on the mother board using an extender board.
8. Place the mother board back in position in the DCU frame and reconnect the connectors to the main frame.
9. Proceed to Test Procedures.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter

THUMBWHEEL CIRCUIT BOARD GENERAL

The major purpose of the thumbwheel board is to convert parallel BCD data stored in the ten thumbwheel switches to four-line serial

SERVICE SHEET 19 (cont'd)

information. The four-line serial BCD data is used to drive four storage registers on the thumbwheel control circuit board.

THUMBWHEEL SWITCHES

The 10 thumbwheel switches ground output lines which correspond to the inverted BCD equivalent of the selected number. Ground (or zero volts) equals 1 and approximately +5 volts equals 0. As an example, selecting the number 7 on any thumbwheel will result in binary lines 1, 2 and 4 being at ground and binary line 8 will be at approximately +5 volts.

DECADE DIVIDER U4

Decade divider U4 is driven by the negative-going edge of clock pulses which are derived from the master oscillator in the reference section. These clocks pulses are at 2 MHz when the instrument is operated in the remote (RMT) mode and 250 kHz in the local (LCL) mode. The BCD output of U4 is used to gate and strobe the data selectors, enable selector gates and to provide a least significant digit (LSD) output to the thumbwheel control circuits.

The D_n inputs to the data selectors (U5, U6, U7 and U8) are selected by the A, B and C outputs of U4. As an example, U4 outputs AB=3 (0011) selects data selector inputs D_3. The D output of U4 is used to strobe the data selectors to hold their W outputs high during U4 counts of 8 and 9.

DATA SELECTORS U5, U6, U7 and U8

Data selector U5 (bit 8), U6 (bit 4), U7 (bit 2) and U8 (bit 1) detect a ground at the selected input as a low and approximately +5 volts as a high. The data selectors invert the logic from the thumbwheel switches; a low at the selected D_n input will cause a high to appear at the W output.

U5, U6, U7 and U8 are one-of-eight selectors. Added gates enable the overall circuits associated with the data selectors to provide the capability of one-in-ten selection.

D TYPE FLIP/FLOPS U10 and U11

The dual D type flip/flops U10 and U11 provide storage and the low level BCD outputs required to drive the multiplexer in the control circuit. They also eliminate any switch bounce which might occur in the thumbwheel switches. The output flip/flops are clocked on the positive-going edge of the clock pulse to allow adequate time for the digital data to propagate through the data selectors and gates.

The Q outputs of U10A, U10B, U11A and U11B correspond to BCD bits 8, 4, 2 and 1 respectively. Logic levels are low = 1 and high = 0. The BCD information is 10 bit serial and the ten-count cycle appears at a 25 kHz rate (LCL).

The following paragraphs describe operation of the circuit referenced to the output state of U4.

SERVICE SHEET 19 (cont'd)

ZERO STATE U4 OUTPUT BCD 0000

The beginning of the count cycle when the A, B, C and D outputs of U4 are all low is termed the ZERO state. NOR gates U9A and U9C outputs go high and NAND gate U13D output goes low to provide a negative-going 'start of cycle' signal to the control circuits. In the ZERO state the D_0 inputs (pin 4) of the data selectors sample the BCD state of the least significant digit (LSD), thumbwheel digit one.

If thumbwheel switch 1 is set to 8 or 9 and U5 D_0 is being sampled, D_0 is grounded, U5 pin 6 (W) and pin 5 of U3B are high. Since the D output of U4 is low in the ZERO state, the output of AND gate U12D is low and the output of NAND gate U3A is high. With both inputs to NAND gate U3B high a low is applied to the D input of flip/flop U10A. The next excursion of the clock pulse switches the Q output of U10A low.

If the digit 1 thumbwheel is set to any number except 8 or 9 and U5 D_0 is being sampled, D_0 of U5 sees approximately +5 volts (high), U5 pin 6 (W) and pin 5 of U3B are low. The high output of NAND gate U3B is applied to the D input of U10A and the clock pulse switches the Q output of U10A high.

Data selectors U6 and U7 function in the ZERO state the same as U5 to process BCD bits 4 and 2. Their outputs are processed through NAND gates U3D/U3C and U1A/U1B.

Data selector U8 functions in the ZERO state the same as U5, U6 and U7 to process BCD bit 1. Gating is as follows: AND gate U12A output is low because U4 A and D outputs are both low in the ZERO state. The output of NAND gate U1C is high. AND gate U12D is holding one input of NAND gate U1D low so both inputs and the output of AND gate U12B are high. NAND gate U13B and flip/flop U11B are controlled by the W output of U8 (pin 6).

U4 DECIMAL 1 THROUGH 7 (BCD 0001 - 0111)

Operation of the data selectors and the gates is the same for BCD bits 0001 through 0111 as they were for 0000 except that the A, B and C outputs of U4 select a different D_n input to the data selectors A = D_1, B = D_2, AB = D_3, etc.).

U4 OUTPUT DECIMAL 8 (BCD 1000)

When the D output of U4 is high the S (STROBE) inputs of the data selectors are high and the W outputs (pin 6) are forced to a high state. Since the inputs to NOR gate U9D are low, both inputs to AND gate U12D are high and U12D provides a high to NAND gates U3A, U3D, U1A and U1D. When the digit 9 thumbwheel is set to 8 or 9 the input to pin 2 of U3A goes low, U3A output goes high and since the other input to U3B is high, U3B output goes low. The clock pulse then causes the Q output of U10A to go low. When the digit 9 thumbwheel is set to any number other than 8 or 9, the input to pin 2 of U3A is high, the output of U3A is low and the output of U3B is high. The clock pulse sets the Q output of flip/flop U10A high.

SERVICE SHEET 19 (cont'd)

When the digit 9 thumbwheel is set to 4, 5, 6 or 7 the input to pin 12 of U3D is low and the output of U3D is high. With both inputs to NAND gate U3C high, the output is low and the clock pulse will cause the Q output of U10B to go low. When the digit 9 thumbwheel is set to 0, 1, 3, 8 or 9 the input to U3D pin 12 is high and the U3D output is low. NAND gate U3C output is high and the clock pulse will cause the Q output of U10B to go high.

When the digit 9 thumbwheel is set to 2, 3, 6 or 7 the input to NAND gate U1A pin 2 is low and the U1A output is high. With both inputs to NAND gate U1B high the output is low and the clock pulse will cause the Q output of U11A to go low. When the digit 9 thumbwheel is set to 1, 4, 5, 8 or 9 the input to NAND gate U1A pin 2 is high and the U1A output is low. NAND gate U1B output is high and the clock pulse will cause the Q output of U11A to go high.

When the digit 9 thumbwheel is set to 1, 3, 5, 7 or 9 the input to pin 12 of U1D is low and the high output is applied to pin 4 of AND gate U12B. The pin 5 input to U12B is supplied by AND gate U12A and NAND gate U1C. Since the U4 count is 8, U4 output A is low, AND gate U12A output is high, NAND gate U13B output is low and the Q output of U11B goes low with the clock pulse. With the digit 9 thumbwheel set to 2, 4, 6, 8 or 0, pin 12 of U1D is high and the output is low. AND gate U12B output is low, NAND gate U13B is high and the clock pulse will cause the Q output of flip/flop U11B to go high.

U4 OUTPUT DECIMAL 9 (BCD 1001)

When the digit 10 thumbwheel is set to 1, pin 10 of NAND gate U1C is low and the output is high. The output of NAND gate U1D is also high because the output of NOR gate U9D went low when output A of U4 went high at the count of 9. The output of AND gate U12D goes low and the output of NAND gate U1D goes high. With both inputs to AND gate U12B high, its output is high and the output of NAND gate U13B is low. The next clock pulse causes the Q output of flip/flop U11B to go low. When the digit 10 thumbwheel is set to 0, pin 10 of NAND gate U1C is held high by the thumbwheel and U1C pin 9 is held high by AND gate U12A because U4 outputs A and D are both high. The low output of NAND gate U1C causes the output of AND gate U12B to go low, the output of NAND gate U13B goes high and the Q output of flip/flop U11B goes high when the clock pulse appears.

When AND gate U12A output is high (U4 A and D are high) NAND gate U13C couples the clock pulse through to the 2 (U11A), 4 (U10B) and 8 U10A) flip/flops to preset the Q outputs to high. This prevents generation of an invalid output for the digit 10 thumbwheel.

LEAST SIGNIFICANT DIGIT OUTPUT

At the beginning of the count cycle when the A, B, C and D outputs of U4 are all low, the outputs of NOR gates U9A and U9C are high and the output of NAND gate U13D goes low. This negative-going signal is used as a 'start of count' signal to the control circuits.

DCU Logic
◆ SERVICE SHEET 18

SERVICE SHEET 19 (cont'd)

COUNT OF SIX OUTPUT

A negative-going output pulse is provided by NAND gate U13A when U4 reaches the count of 6. This signal can be generated only when U5 B and C outputs are high and U4 A and D outputs are low. It is planned to use this signal in future microwave frequency output sections.

DECIMAL POINT

The two decimal points are located between the fifth and sixth thumbwheels (UHF) and the sixth and seventh thumbwheels (HF). They are controlled by U2A, U2B, Q1 and Q2 in local operation. The decimal points are inhibited in remote operation.

SERVICE INFORMATION CON'T

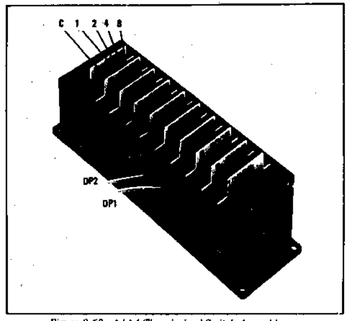


Figure 8-53. A1A4 Thumbwheel Switch Assembly

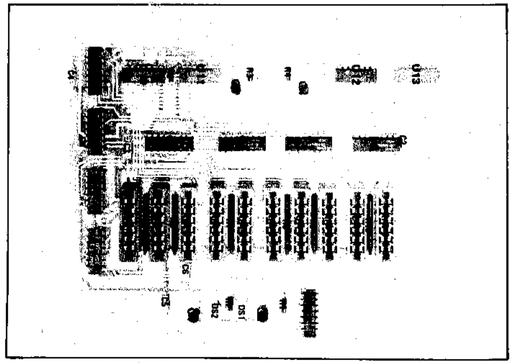


Figure 8-54. A1A6 Thumbwheel Board Component Locations

SERVICE SHEET 19

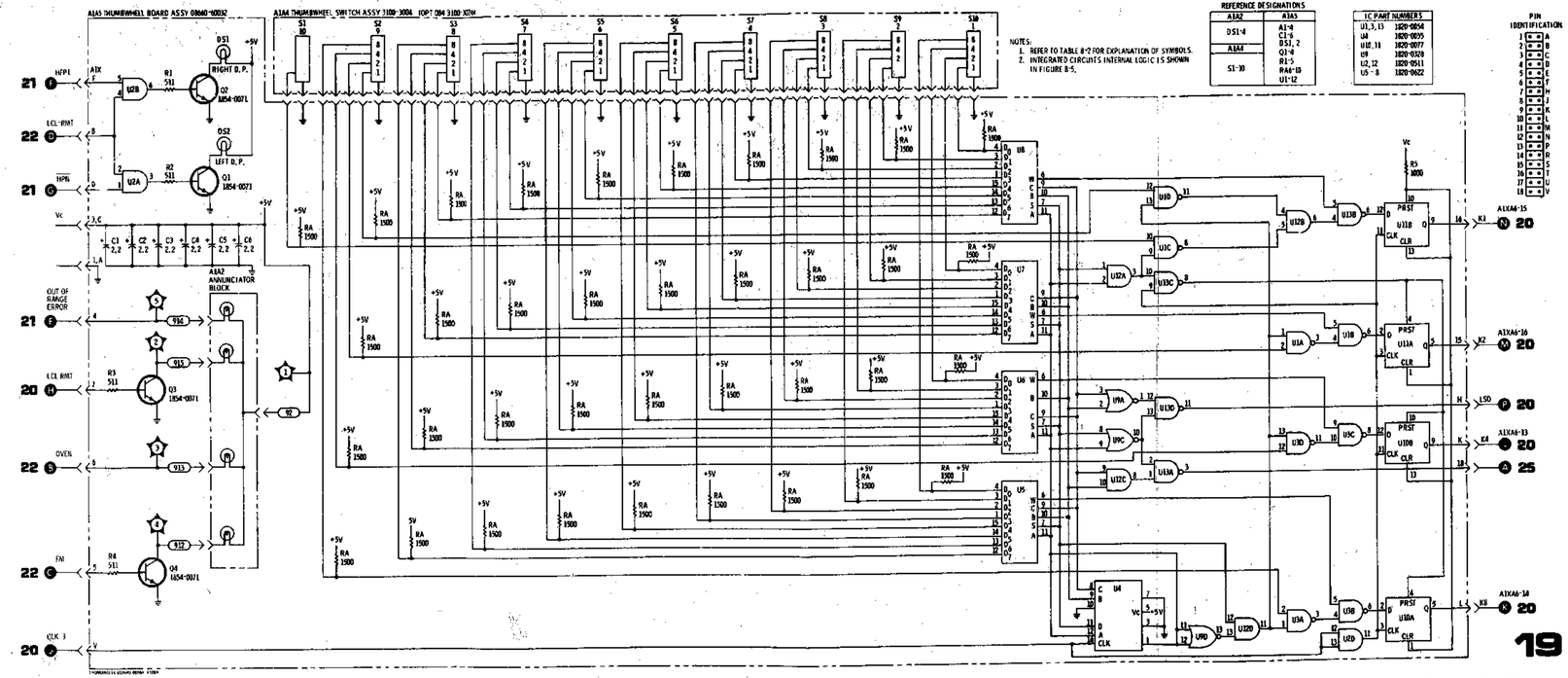


Figure 8-55. Thumbwheel Board Schematic

SERVICE SHEET 20 (Serial prefix 1142A and below).

THUMBWHEEL CONTROL CIRCUIT

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

When the cause of a malfunction has been isolated to the thumbwheel control circuit it should be removed from the DCU and reinstalled using an extender board. This will provide easy access to test points and components.

The thumbwheel control circuit board may be extended for maintenance as follows:

1. Remove the RF Section and Modulator (or Auxiliary) Section plug-ins and the mainframe left and bottom panels.
2. Remove the bottom DCU cover by removing four flat-head screws and lifting the cover free of the circuit boards.
3. Remove the thumbwheel control board and reinstall it with an extender board.

TEST EQUIPMENT REQUIRED (See Table 1-2)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter

GENERAL

The main purpose of the thumbwheel control circuit is to provide serial BCD information to the center frequency circuit, to A1XA7 for possible future use in microwave output sections, the LED indicators and/or the interface circuits. It also provides clock signals to shift registers, the plug-in modules and the thumbwheel circuit, and a signal to control the LCL-RMT indicator.

LOCAL OPERATION

In local operation the LCL-RMT (local-remote) line A1XA6, pin P is held high and the inputs to the storage registers are controlled by the lower AND gates in the AND/NOR multiplex gates. The high level at pin P is inverted by U12C and used to inhibit the upper AND gates in the AND/NOR multiplex gates and NAND gates U6A and U6B.

In local operation the input BCD 8, 4, 2 and 1 lines (pins 14, 13, 16 and 15) from the thumbwheel circuit board are the inputs to the storage registers U3, U14, U4 and U13. The BCD input levels to the multiplexer are 0 V = 1 and about +3.5 V = 0. The logic is inverted by the multiplexer.

The 2 MHz clock input from the reference section at pin 5 is divided by eight in U19, a binary divider (in the LCL mode) and is then applied to pin 10 of NAND gate U6C. The clock is coupled through NAND gate U6C because U6C pin 9 is held high by U6A and the inverted LCL signal. Since the output of NAND gate U6B is also held high by the inverted LCL signal the clock is coupled through NAND gate U6D to clock the storage registers. The clock output of U6C is also used to drive AND gate U16D which provides the clock to drive the decade divider in the thumbwheel circuit.

SERVICE SHEET 20 (Cont'd)

The clock signal from U6C is also applied to AND gates U16A and U16B. U16B is inhibited by the inverted LCL signal. U16A is enabled by the LCL signal and the clock is applied to pin 10 of AND gate U16C. Since the Q output of U9A is low (except when an error has been detected by the comparator), U16C is inhibited and cannot pass the clock signal.

EXCLUSIVE OR gates U7A, U7B, U7C, and U7D, NOR gates U11A and U11C, and NAND gate U17B comprise a comparator circuit. The EXCLUSIVE OR gates sample the input and output signals of the storage registers. If there is no frequency change between successive sampling cycles, both inputs to the EXCLUSIVE OR gates are the same and the outputs are low; the outputs of NOR gates U11A and U11C are high and the output of NAND gate U17B is low. With NAND gate U17C pin 10 low the clock signal at U17C pin 9 cannot be coupled through to clock U9B. Under these conditions flip/flop U9A Q output is low and the center frequency registers in the center frequency circuit cannot be clocked.

When a frequency change has been entered into one or more of the thumbwheel switches, one or more of the EXCLUSIVE OR gates detect the difference between successive sampling cycles and provides a high output. This causes the output of NOR gates U11A or U11C (or both) to go low and the output of NAND gate U17B to go high. The positive excursion of the clock pulse now causes the output of NAND gate U17C to go low and U12D inverts the pulse to clock flip/flop U9B. Since the D input of flip/flop U9B is grounded, the Q output which is normally high, goes low. Flip/flop U9B then, acts as an error detector.

When NAND gate U17A pin 1 goes low the output and the D input of U9A goes high. U9A cannot be clocked until the decade divider in the thumbwheel circuit reaches the BCD 000 state (least significant digit). U9A is clocked as follows: U15A, U15D and U18E comprise a one-shot that is triggered by each clock pulse from the output of NAND gate U6C. The output of this one-shot is applied to one input of NOR gate U11B; the other input to U11B is the least significant digit (LSD) signal from the thumbwheel circuit. When the two negative-going inputs to U11B are in time coincidence (every tenth clock cycle) the output of U11B goes positive and clocks flip/flop U9A. When the Q output of U9A goes high the clock is coupled through AND gate U16C to pin 8 or NOR gate U10C. Since pin 9 of NOR gate U10C is held low by the inverted LCL input through U16B, the clock signal is coupled through to NAND gates U5A and U5B. Pin 5 of NAND gate U5B is held low by the output of NOR gate U10D because the pin 11 input of U10D is held high by the LCL input; U5B cannot pass the clock pulse. NAND gate U5A pin 2 is held high by the output of U5C because pin 9 of U5C is held low by the inverted LCL level; NAND gate U5A couples the center frequency (CF) clock signal to the center frequency registers on the center frequency board and to the LED registers to transfer the information now in the storage registers.

The signal from NOR gate U11B which was used to clock U9A also triggers one-shot U17D/U12B to preset the Q output of U9B to a high. If there are no more errors detected before the next output pulse from U11B, U9A Q output goes low with the pulse to inhibit the CF clock pulses at U16C. Each time a change is made in the thumbwheel switch settings a burst of ten clock pulses transfer the information in the storage register to the center frequency register.

SERVICE SHEET 20 (Cont'd)

U11D, along with the PWR DET input through inverter U12E and the LCL signal through Q1, causes the CF clock to be applied to the CF register when the instrument is first turned on. Without this provision it would be possible to set the CF registers to a frequency other than that selected by the thumbwheels, before the power supplies have stabilized.

When the power supplies have stabilized, both inputs to NOR gate U11D are low and the output is high. If the comparator has not detected an error since the last LSD pulse U9B Q and U17A pin 1 are high, U17A pin 3 is low and the next LSD pulse will cause U9A Q to go low and end the CF clock.

REMOTE OPERATION

In remote operation the LCL-RMT input at A1XA6 pin P is held low and the inputs to the storage registers are controlled by the upper AND gates in the AND/NOR multiplex gates. The low level at input P is inverted by U12C and used to enable the upper AND gates in the AND/NOR multiplex gates and NAND gates U6A and U6B.

In remote operation the RMT lines (pins S, N, T and U) from the interface circuits are the inputs to the storage registers.

The comparator and error detection circuits do not function when the instrument is operated in the remote mode. In remote operation Q1 is turned off and the high level at pin 11 of NOR gate U11D results in the Q output of U9A going high until the mode of operation is changed to LCL.

The data inputs from the remote programming device consists of two four-line BCD (8, 4, 2 and 1) bits. These inputs are stored in eight flip/flops in the interface circuits and transferred serially into the thumbwheel control circuit storage registers at the rate of two digits for each remote command pulse. The data inputs must be received in order with the least significant digit (LSD) received first.

The data inputs are stored in the thumbwheel control circuit storage registers until all data required to perform the programmed function is received. The amount of data required is determined by the function being programmed; it will vary from no required data input (shut off modulation) to five inputs consisting of two four-line BCD bits each (new center frequency). The data inputs are followed by a four-bit BCD 15 input which enables the address selection; this, in turn, is followed by a four-bit BCD address code which clocks the shift register addressed and transfers the information from the storage register to the final storage register.

Tables 3-3, 3-4 and 3-5 provide information relative to input programming and address information.

Each temporary command received from the interface circuits at INVERTER U18F pin 13 consists of two negative-going pulses. In remote operation the LCL-RMT input is low and the output of inverter U12C goes high to enable U6B and U6A. With NAND gate U6B pin 4 high, the output of U6B is controlled by the input to U6B pin 5 and the temporary command pulses are coupled through to NAND gate U6D pin 12. Both inputs to NAND gate U6A are high so

SERVICE SHEET 20 (Cont'd)

U6A output is low and NAND gate U6C output is high. Since NAND gate U6D pin 13 is high the command pulses are coupled through U6D to clock the shift registers.

When all of the information required for the function being programmed has been stored in the storage register a negative-going transfer command is received form the interface circuit at NAND gate U15B pin 4. The transfer command causes the output of U15B to go high and the low output of INVERTER U18A causes the output of NAND gate U6A to go high.

When the output of NAND gate U6A goes high the clock is coupled through NAND gate U6C and AND gate U16D to the decade divider in the thumbwheel circuit. The clock is also processed through NAND gate U5A or U5B (depending on address programmed) to the plug-in, the center frequency register and, in option 009, the LED readout circuit.

NOTE

In the remote mode U19 does not divide the input clock by 8. The output of inverter U18D strobes all outputs of decade divider U19 to a high; the next excursion of the 2 MHz clock then causes all U19 outputs to go low. The output clock signal at U19A pin 2 remains at 2 MHz.

Coupling the clock through NAND gates U5A or U5B is accomplished as follows; While NAND gate U6C is enabled the clock signal is applied to AND gates U16A, U16B and U16D. AND gate U16A output is low because pin 1 is connected to the low RMT input and the low output from AND gate U16C is used to enable NOR gate U10C. Pin 5 of AND gate U16B is held high by the inverted RMT input so the clock signal is coupled through to pin 9 of NOR gate U10C and on to the output of NOR gate U10C. If the center frequency command from the interface circuits which is applied to pin 10 of NAND gate U5C is low, the output of U5C is high and NAND gate U5A couples the clock through to the center frequency shift register and, in option 009 instruments, the LED storage register. If the center frequency command from the interface circuit applied to NAND gate U5C is high, the output of U5C goes low because U5C pin 9 is held high by the inverted RMT signal; NAND gate U5A is inhibited. The high from the center frequency command is also applied to pin 3 of INVERTER U18B, inverted and applied to pin 12 of NOR gate U10D. The input to pin 11 of NOR gate U10D is held low by the input RMT signal so the output of U10D goes high to enable AND gates U1D, U1B, U1C, U1A and NAND gate U5B. The clock pulse is coupled out to the interface circuit through NAND gate U5B and addressed to the appropriate storage register.

The transfer command is a short pulse and, by itself, would hold the output of NAND gate U6A high only for the duration of the pulse. However, the first clock pulse to the decade divider in the thumbwheel circuit causes the LSD signal applied to NOR gate U10A pin 3 to go high; U10A output goes low, and NAND gate U15B

Thumbwheel Board
◀ SERVICE SHEET 19

SERVICE SHEET 20 (Cont'd)

output remains high. INVERTER U18A output remains low and NAND gate U6A output remains high to allow the clock pulses to continue through NAND gate U6C until the LSD pulse from the thumbwheel circuit again goes low at NOR gate U10A pin 3.

The output at pin 3 of NAND gate U6A remains high for five microseconds to allow ten clock pulses to pass through NAND gate U6C. Pin 12 of NAND gate U6D is held high during this period because the inverted temporary command line (normally high) is holding the output of NAND gate U6B high. The clock pulses from the output of NAND gate U6B are coupled through NAND gate U6D to clock the storage register.

In remote operation it is necessary to clear the storage registers after the stored information is clocked out because invalid information may have been clocked into the registers. This is accomplished as follows: The five microsecond positive-going transfer pulse at pin 3 of NAND gate U6A is inverted by U12A and applied to pin 10 of NAND gate U15C and the output of U15C goes high for 5 microseconds. In the quiescent state of one-shot U5D/U12F, pin 13 of INVERTER U12F is held low by R1 and U12F pin 12 provides a high to pin 12 of NAND gate U5D. The 5 microsecond pulse does not affect flip/flop U5D/U12F until the signal at NAND gate U5D pin 13 goes low at the end of the pulse period. When the pulse goes low the input to INVERTER U12F goes high and the output goes low. The time constant of C1 and R1 determines the pulse width of the negative-going pulse (approximately 70 nanoseconds) at the output of INVERTER U12F. The low level clears the storage registers to zero and prepares them to accept the next information clocked in.

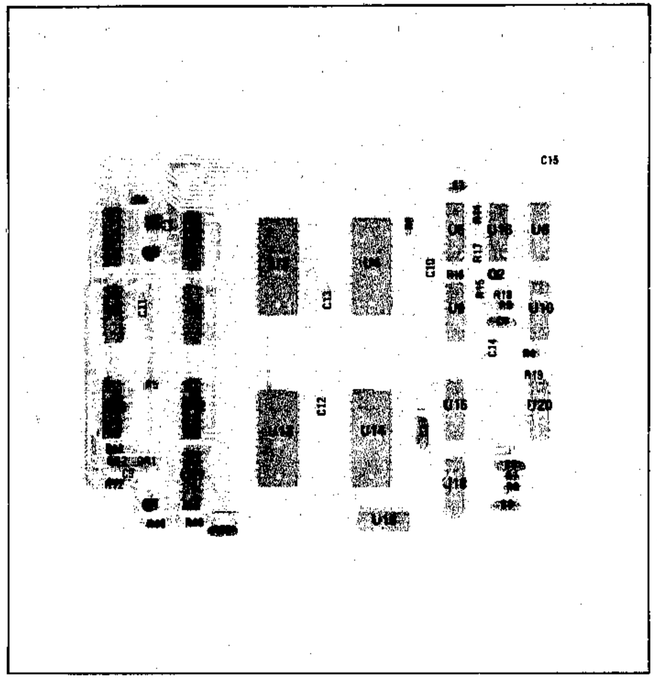


Figure 8-56. A1A6 Thumbwheel Control Board Component Locations

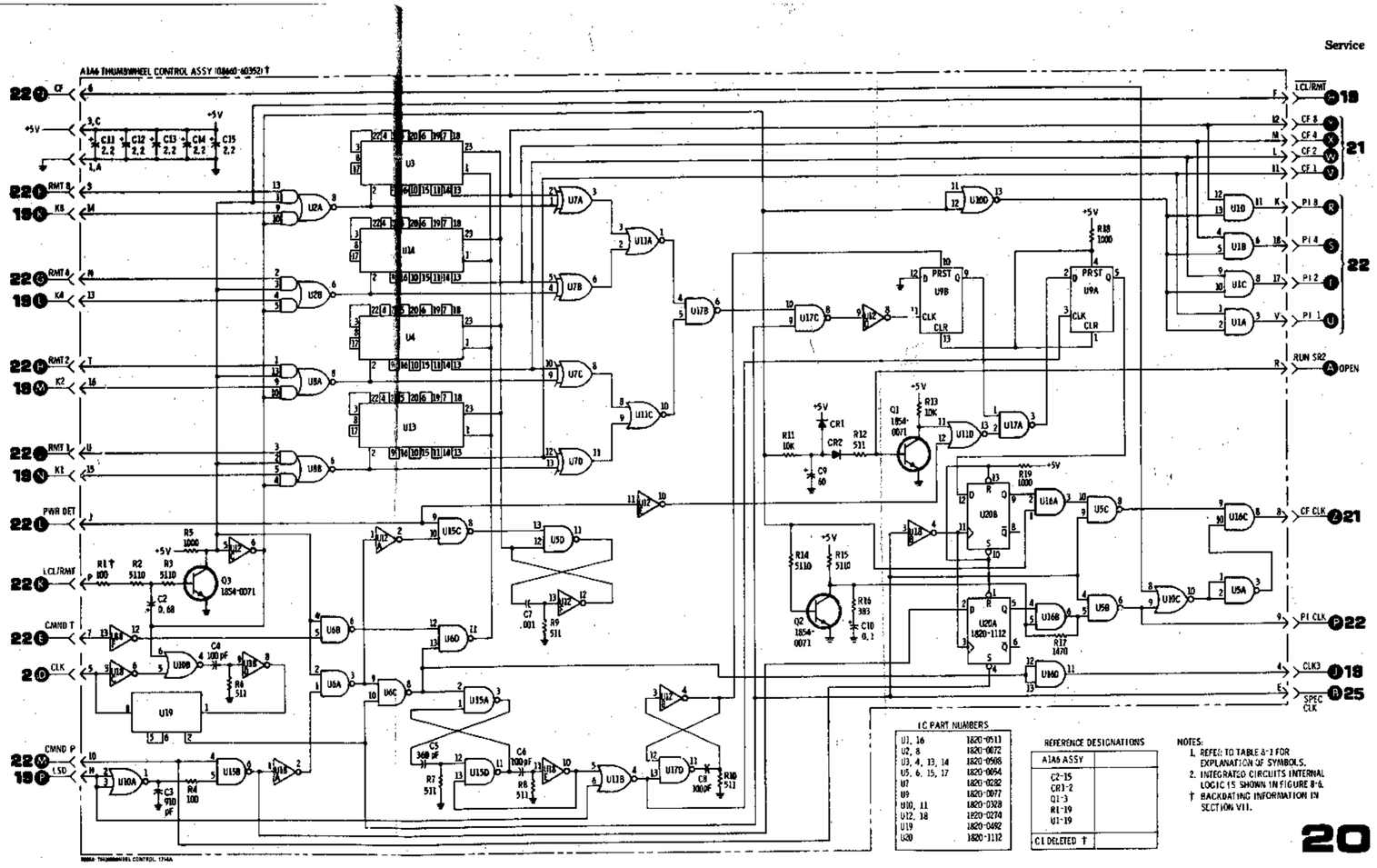


Figure 8-57. Thumbwheel Control Board Schematic

SERVICE SHEET 20

SERVICE SHEET 21. (Serial prefix 1201A and above.)

CENTER FREQUENCY CIRCUIT BOARD

Operation of most of the circuits shown on Service Sheet 21 is almost identical (except for integrated circuit U numbers) to the explanation in the text for Service Sheet 21a.

The only major difference between the two Service Sheets is the BCD SERIAL TO BCD PARALLEL CONVERSION. For Service Sheet 21 only, this is called 'parallel dump'.

PARALLEL DUMP

When the center frequency is changed the 10-bit four-line information is passed through U4 to pins 9 (BCD 1), 12 (BCD 2), 7 (BCD 4) and 4 (BCD 8). The BCD outputs of U4 are applied in parallel to the "D" type flip/flops associated with their weighting (BCD 1 goes to pin 2 of 10 flip/flops BCD 2 goes to pin 3 of 9 flip/flops, etc.).

U22, U23A/B and U24 function as a 1 of 10 select circuit which is in time coincidence with the BCD inputs.

When the least significant digit (digit 1) is present, U22 clocks U1 and the U1Q outputs will follow the U1D inputs. If digit 1 has not been changed there will be no change in the U1 Q outputs.

When the BCD inputs for digit 2 are present U22 clocks U3 and the circuit operation is the same as that described for U1.

Operation of the circuit for each digit is the same. The "D" type flip/flops are clocked only when the BCD data for their particular digit is present.

The advantage of this circuit over earlier circuits is that only those phase lock loops which must provide a different frequency lose lock. In earlier instruments all of the phase lock loops, except the reference loop, lost lock each time the frequency was changed.

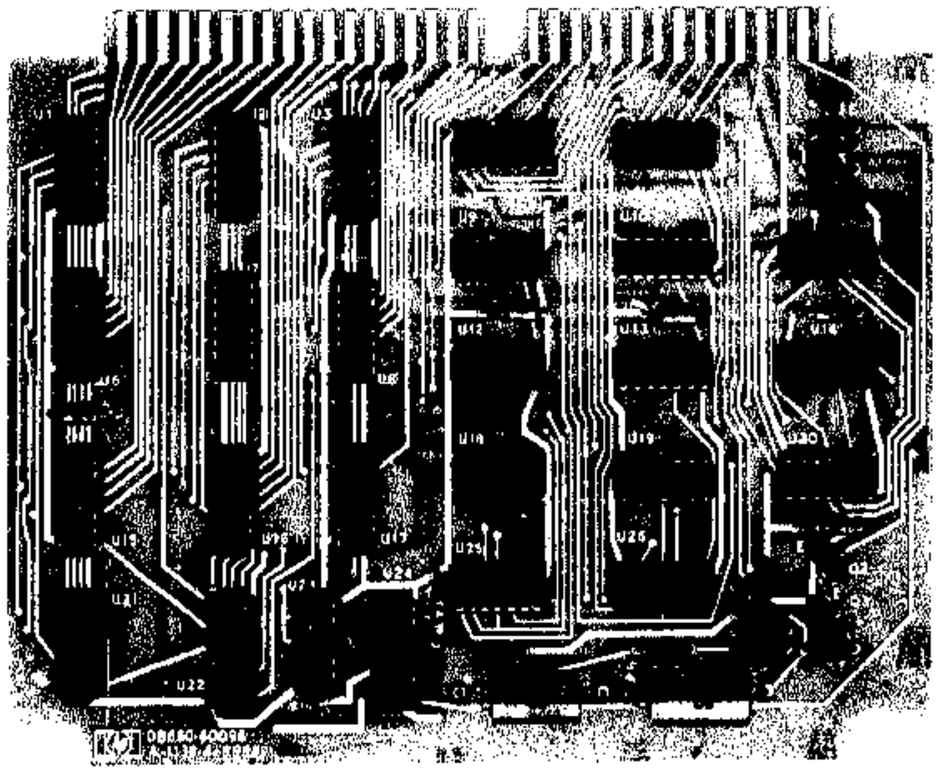


Figure 8-58. A1A8 Center Frequency Assembly Component Locations

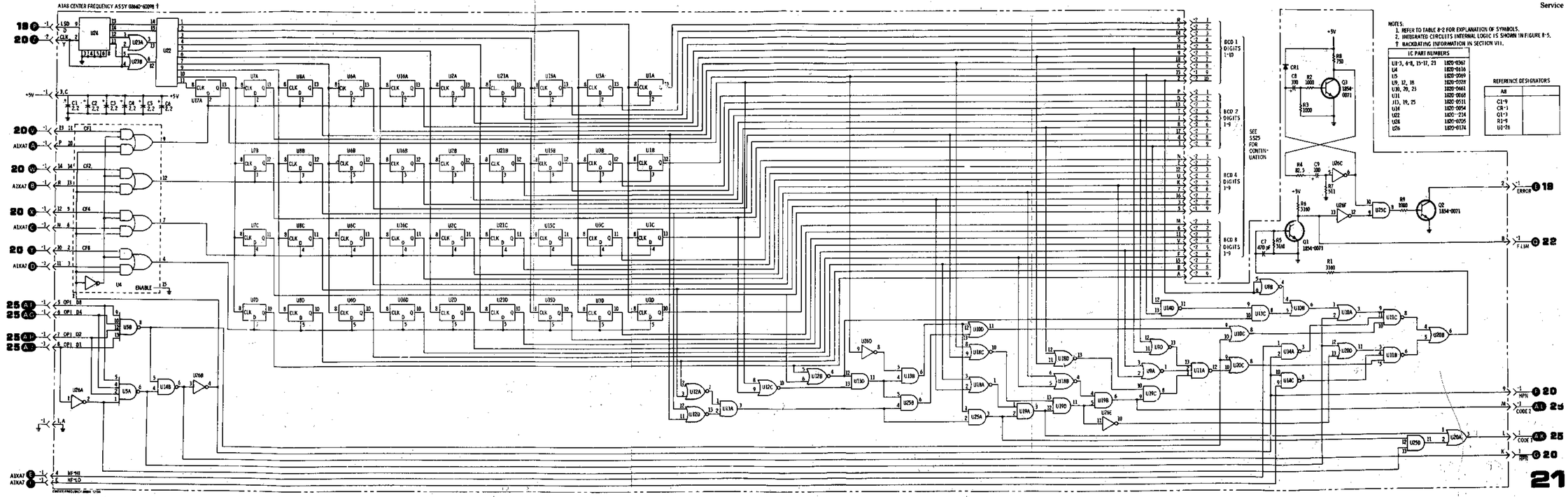


Figure 8-59. Model 8660A Center Frequency Schematic

SERVICE SHEET 21

SERVICE SHEET 21a (Serial prefix 1142A and below)

CENTER FREQUENCY CIRCUIT BOARD

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

When the cause of a malfunction has been isolated to the center frequency circuit the circuit board should be removed from the DCU and reinstalled using two extender boards. This will provide easy access to test points and components.

The center frequency circuit board may he removed as follows:

1. Remove the left side and bottom covers from the Model 8660A.
2. Remove the plug-in section from the modulation drawer.
3. Remove the four screws which hold the bottom cover on the DCU.
4. Remove the center frequency circuit board and reinstall it using two extender boards.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter

GENERAL

The main purpose of the center frequency circuit is to convert the input four line 10 bit serial BCD information to nine four line 4 bit parallel BCD information for digits 1 through 9 and a single line BCD 1 or 0 for digit 10. Frequency limit detect circuits provide an error signal when the programmed frequency is not within the range of the RF Section being used. The frequency detect circuits also provide outpus (code 1 and code 2) which are used in the RF sections to aid in amplitude leveling the RF output across the output frequency range.

BCD SERIAL TO BCD PARALLEL CONVERSION

The four-line serial inputs to pins 13, 14, 12 and 10 are from the thumbwheel control circuit. The pin P, R, N and 11 BCD inputs are provided for possible future use.

NAND gates U6A, U6B, U12B and INVERTER U17B control the input lines to the multiplexer, the code 1 frequency limits, and some of the frequency limit detector circuits.

SERVICE SHEET 21a (Cont'd)

The inputs to NAND gates U6A and U6B are either open lines (represen ative of BCD 15) with the 110 MHz RF Section in place, or three open lines and digit 1 (pin 8) grounded (representative of BCD 14) with the 1.3 GHz RF Section in place. With BCD 15 present at NAND gate U6B inputs the output of U6B is low, U12B output is high, and U17B output is low. The U17B low output inhibits the lower AND gates in MULTIPLEXER U5, and the multiplexer inverter enables the upper AND gates. When the center frequency is changed a train of 10 clock pulses transfer the information stored in the center frequency storage registers in the thumbwheel control circuit to serial-to-parallel shift registers U1, U2, U3 and U4.

When BCD 14 is present at NAND gate U6B inputs, the U6B output goes high, but the output of U6A goes low. Operation of U12B, U17B and multiplexer U5 is the same as it was when BCD 15 was present.

The multiplex control circuit also provides for possible future RF Sections operating in the microwave frequency range (in which case the multiplexer inputs would come from a different source). If these plug-in sections are used the input to U6A/U6B would be a BCD input other than 14 or 15. In this case the outputs of both U6A and U6B would be high, the output of U12B would be low and the output of U17B would be high; the lower AND gates in the multiplexer would be enabled, the upper AND gates would be inhibited and the inputs to U1, U2, U3 and U4 would be the signals on input pins P, R, N, and 11.

ERROR SIGNAL GENERATION

Q3, U17C and associated components comprise a 2.5 Hz multivibrator. When a frequency has been selected which is not within the range of the plug-in RF Section in use. the output from the multivibrator is coupled through NAND gate U16C to cause a light to flash on the annunciator block.

Normally, when the instrument is operating within its frequency capability, the output of OR gate U15B is low, Q1 is off (collector high) and the low output of INVERTER U17F inhibits AND gate U16C. When either input to OR gate U15B goes high Q1 is turned on, AND gate U16C is enabled and the positive excursions of the 2.5 Hz multivibrator signal turns on Q2 to cause the OUT OF RNG indicator to flash.

When the HP Model 86602A 1.3 GHz RF Section is used, the output of NAND gate U6A is low, pin 2 of OR gate U8A and pin 12 of OR gate U15D are held low. Pin 4 of INVERTER U17B is low and it holds pin 2 and 10 of NAND gates U12A and U12C low. The high output of NAND gates U12A and U12C holds pin 11 of NAND gate U9C and pin 4 of NAND gate U9B high. Pin 10 of OR gate U8C and pin 9 of

SERVICE SHEET 21a (Cont'd)

OR gate U15C are held high by the output of NAND gate U6B. The high output of OR gates U8C and U15C holds pin 10 of NAND gate U9C and pin 5 of NAND gate U9B high. Under these conditions the error signal generation is controlled by the second input to OR gate U8A (high frequency limit) and U15D (low frequency limit).

When a frequency below 1 GHz is selected BCD 1 of digit 10 is low, the outputs of NOR gate U7B and OR gate U8B are high. The output of OR gate U8A is also high, all inputs to NAND gate U9C are high so the input to OR gate U15B pin 4 is low. If the input to OR gate U15B pin 5 is also low the frequency is within limits and the error signal is not generated.

When a signal above 1 GHz is selected BCD 1 of digit 10 is high and the output of NOR gate U7B applies a low to pin 4 of OR gate U8B. The output of U8B now depends on the input at pin 5. The upper frequency limit of the 1.3 GHz RF Section is 1.299999999 GHz. If the programmed frequency is 1.3 GHz, BCD 1 and 2 of digit 9 are high, the output of NAND gate U12D, AND gate U11C and OR gates U8B and U8A are all low. The output of NAND gate U9C and OR gate U15B will go high and enable the error generator circuit. If any frequency above 1.3 GHz is programmed the output of NOR gate U10B will go low and cause the output of AND gate U11C to go low and enable the error generator.

When the frequency selected is above 1 MHz, but below 1.3 GHz, OR gate U15D output is high because the output of INVERTER U17E is held high by the low output of AND gate U14D.

If any one of the digit 7 (1 MHz steps) BCD outputs are high the output of AND gate U14D will be low. If digit 8 BCD 1 or 2 are high, the output of NOR gate U13C will go low to hold the output of AND gate U14D low. If both inputs to NOR gate U13C are low the output will be high and the output state of AND gate U14A (and the pin 12 input to AND gate U14D) is low. If both inputs to NOR gate U13A are low the output will be high and the output of AND gate U14A will be determined by the input at pin 2. The inputs to AND gate U16A are controlled by digits 8, 9 and 10. If any one or more of the digit 9 or 10 BCD outputs are high the output of AND gate U11B (and the output of NAND gate U16A) will be low. If all of the digit 9 and 10 BCD outputs are low the output of AND gate U11B and the pin 1 input of AND gate U16A will be high; the output state of U16A will depend on the input at pin 2.

The output of AND gate U11A is controlled by the digit 8 BCD outputs of the storage registers. If the BCD outputs are all low, the outputs of NOR gates U10A, U10D and AND gate U11A will all be high. If a BCD output has not been found before this, U14D output will be high and the error generator will be enabled. If a high BCD output if found for digit 8, AND gate U11A output will be low and the error generation circuit is inhibited.

When the 110 MHz RF Section is used, operation of NAND gates U9B and U9C and OR gate U15B is the same as it is for the 1.3 GHz RF Section except that they are controlled by the outputs of OR gates U8C and U15C.

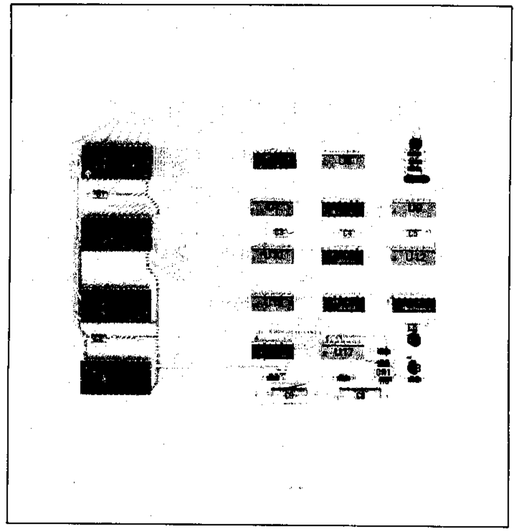


Figure 8-60. A1A8 Center Frequency Board Component Locations

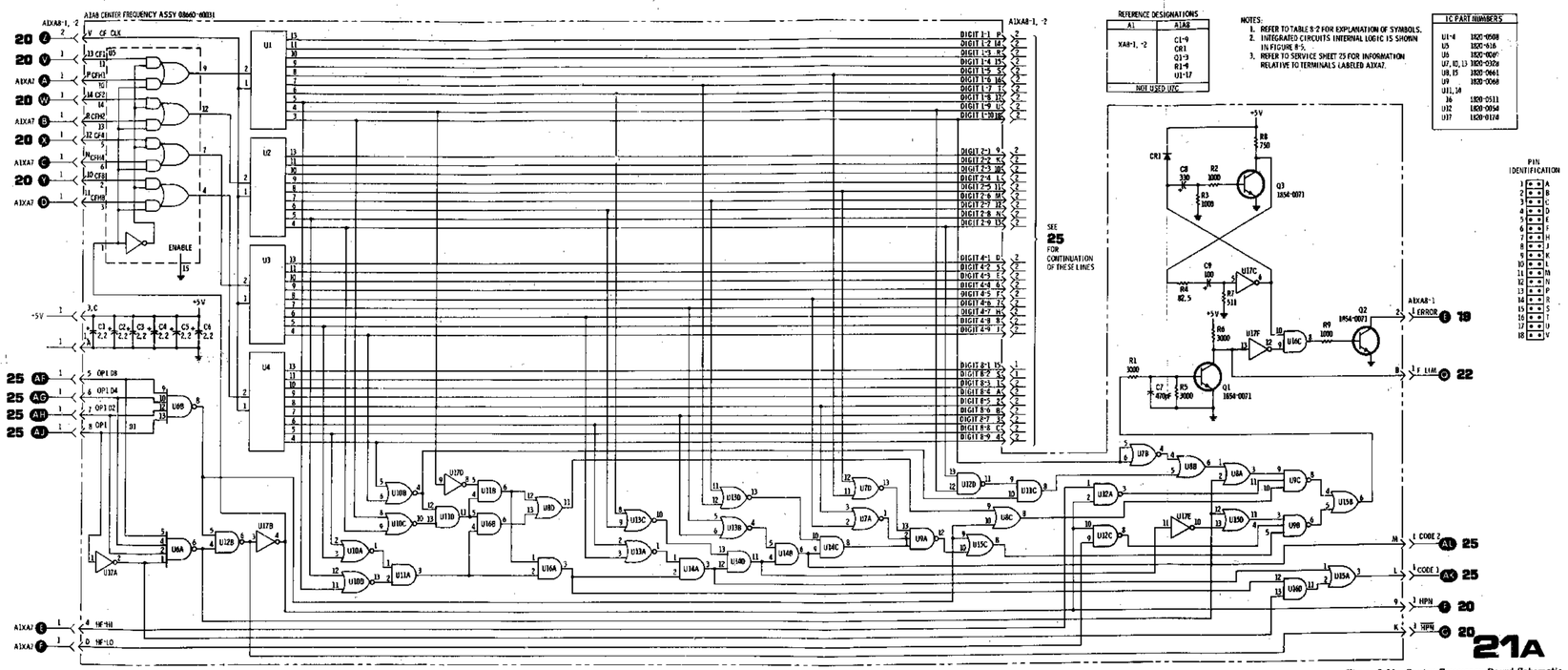


Figure 8-61.. Center Frequency Board Schematic

SERVICE
SHEET 21a

SERVICE SHEET 22

FRONT INTERFACE CIRCUIT BOARD A3A1

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

When the defect has been traced to the front interface board, access to the component side of the circuit board may be improved by removing the four screws which hold the digital control unit in place and sliding it forward to the extent of the interconnecting cables.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter

GENERAL

The major purpose of the interface circuits is to assure compatability between the digital control unit, the phase lock loops, the plug-in sections and the programming information from the remote programming device (via J3).

FRONT INTERFACE CIRCUIT - REMOTE MODE

DATA INPUT

The multiplexer, U9 and U10, converts the eight-line two-digit parallel BCD input to four-line serial information. The serial BCD data is stored in the temporary storage register in the digital control unit.

When a command pulse is received at A3XA1 pin 1 it is inverted by U1F and applied to the "D" input of flip/flop U2A. Pin 1 of U2A is held high by the inverted low AUTO-MAN input at A3XA1 pin B so U2A is enabled. (A low at U2A pin 1 would hold the Q output high regardless of other inputs).

The 2 MHz clock, which is always present is inverted and applied to the clock input of U2A. Since the inverted command pulse is high the first clock pulse to U2A will cause the Q output to go high. The Q output enables the upper AND gates in U10A, U10B, U9A and U9B. The outputs of the multiplexer follow the selected inputs (in this case, digit 1). Several other circuits function simultaneously with this change of state to determine where and how the input will be used.

If the BCD inputs are data (BCD 0 - 9), the output of NANL gate U3A is high because at least one of the inputs is low. U1D inverts the output of U3A to inhibit U4D which is the permanent command gate. The high output of U3A enables U4C which is the temporary command gate.

When U2A $\overline{Q}$ output goes low with the clock pulse it presets U2B; U2B Q goes high and $\overline{Q}$ goes low. The low at U2B $\overline{Q}$ resets the one-shot (U1A and U1B) on the rear interface board to end the command pulse. This assures that the command pulse will end and the "D" input to U2A will go low before the next clock pulse appears.

SERVICE SHEET 22 (cont'd)

When U2B Q goes high it enables NAND gate U4A. NAND gate U4A provides a negative-going clock pulse to NOR gate U6A which provides, in turn, a positive pulse to NAND gate U4C. Since NAND gate U4C pin 9 is held high by the output of NAND gate U3A, the output of NAND gate U4C clocks the digit 1 BCD information into the temporary storage register.

When the next clock pulse appears the "D" input to U2A is low. The Q output goes low and the $\overline{Q}$ output goes high. The lower AND gates in U10A, U10B, U9A and U9B are now enabled and the upper AND gates are inhibited. The multiplexer outputs are the same as the digit 2 inputs.

When U2A Q goes low the output of NOR gate U6B goes high to enable NAND gate U4B. Since the Q output of U2B is still high when the second clock pulse appears this clock is coupled through U4A, U6A and U4C to clock digit 2 into the temporary storage unit in the digital control unit.

Since NAND gate U4B pin 5 is now held high by NOR gate U6B the clock pulse at U4B pin 4 causes the output of U4B to go low and clear flip/flop U2B. When U2B is cleared the Q output goes low to inhibit U4A, the $\overline{Q}$ output goes high to enable the command one-shot on the rear interface board, and the circuit is quiescent until the next command pulse is received.

ADDRESS INPUT

When all four digit 1 lines are high (BCD 15), NAND gate U3A output is low. This low level inhibits the temporary command gate U4C; through inverter U1D it also enables the permanent (transfer) command gate U4D. When the input command pulse appears (U2A "D" input goes low), the first clock pulse will cause U2A Q to go high and $\overline{Q}$ to go low. The high Q output causes the output of NAND gate U4D to go low.

The digit 2 inputs have been simultaneously applied to BCD to decimal decoder U5. When the digit 2 address is 0000 (center frequency) pin 1 of U5 goes low to address the information stored in the temporary storage register to the center frequency register.

The outputs from U5 pins 2 and 3 are not used in the Model 8660A.

When the digit 2 address data causes U5 to produce a low to the input of one of the NOR gates connected to the U5 outputs, a train of ten clock pulses transfer the data stored in the temporary storage register to the selected final register.

The outputs from the multiplexer are not used during the address function.

Operation of U2B is the same during the address function as it is during the data function.

When the next clock pulse appears the state of U2A and U2B will change and the circuit is quiescent until the next command pulse appears.

POWER DETECT CIRCUIT

Q3 and U7D comprise a power detect circuit. The pin 11 input to NOR gate U7D is low unless the reset input to Q4 is grounded. When

Center Frequency
◀ SERVICE SHEET 21a

SERVICE SHEET 22 (Cont'd)

the +5V power supply is approximately less than +4.75 volts, Q3 turns off, and NOR gate U7D pin 12 input goes high, and the U7D output goes low. When the PWR DET output is low, the center frequency register and the modulation register are cleared. (This clears the temporary storage resistors only. The output is set to −140 dB by the RF Section.) This prevents incorrect programming when the instrument is first turned on and the power supplies have not yet stabilized. When a ground is applied to the remote reset line, Q4 turns off, NOR gate U7D pin 11 goes high, while the U7D output goes low. The result is the same as when the +5V power supply is low.

FLAG CIRCUIT

The flag circuit provides a busy signal to the remote programming device. Whenever any one or more of the inputs to U3B are low the output is high. This output is inverted on the rear interface board and applied to rear panel connector J3 pin 17.

There are several factors which determine the duration of the flag signal.

When data is being programmed into the temporary storage register in the digital control unit the duration of the flag signal is a maximum of about about 1.5 microseconds. It starts when the command pulse causes U3B pin 12 to go low. U2B $\overline{Q}$ almost immediately goes low to end the command pulse. The command line now goes high, but U2B $\overline{Q}$ is now holding U3B pin 13 low so the flag pulse continues. When the second clock pulse causes U2B to be cleared, U2B $\overline{Q}$ goes high and the flag pulse is ended. One/shot U8 cannot be triggered because the high ouput of U3A is inverted and applied to pins 3 and 4 of U8.

When the plug-in programmable attenuator in the RF Section plug-in is being addressed one/shot U8 is triggered when U2B $\overline{Q}$ goes low on the second clock pulse (U8 pins 3 and 4 are now held high by the inverted low at U3A pin 6). One/shot U8 pin 6 goes low and the flag signal is extended to about 50 milliseconds. The low output from U5 pin 4 turns off Q2 and the Q2 high output turns off Q1. The time constant of one/shot U8 is determined by R10, C5 and C6.

When any address other than the programmable attenuator is programmed, one/shot U8 extends the flag signal to about 3 or 4 milliseconds. Operation of the circuit is the same as when the attenuator is addressed except that Q1 and Q2 are on and the time constant of the one/shot is determined by R9 and C6.

When the FM modulator is being calibrated a 5 second pulse appears at A3XA3 pin 15 which is applied to U3B pin 9 to produce an output pulse that is 5 seconds in duration.

LOCAL MODE

In the local mode the AUTO-MAN input is high. Inverter U1C inverts this level to hold the clear input to U2A low and the Q output high. This inhibits all of the circuits on the front interface board except U1C, U1A and U1B. U1A and U1B again invert the AUTO-MAN input to provide a LCL-RMT fan-out of ten to the plug-ins and the digital control unit.

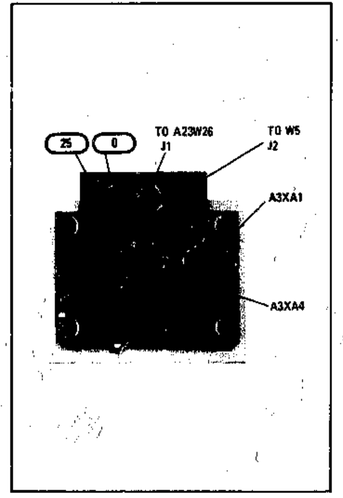


Figure 8-62. Interface Mother Board

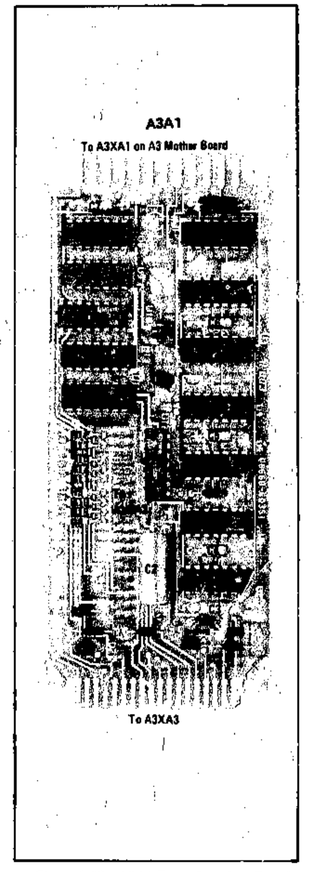
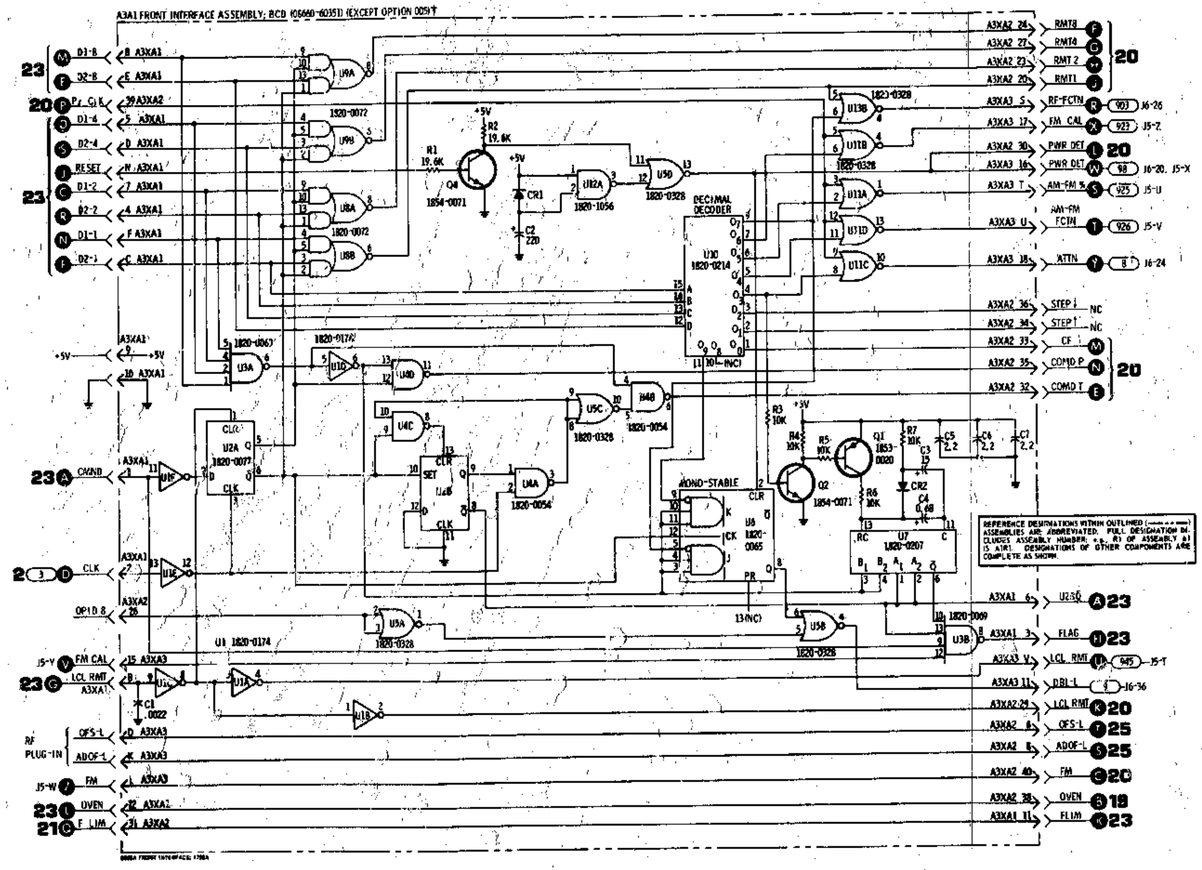


Figure 8-63. A3A1 Front Interface Board Component Locations



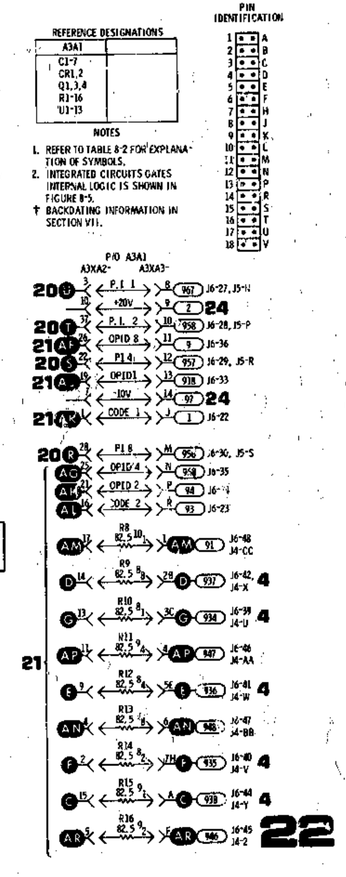


Figure 8-64. Front Interface Board Schematic

SERVICE SHEET 22

SERVICE SHEET 22a

HP-IB OUTPUT ASSEMBLY A3A1

General

The HP-IB Output Board accepts inputs from the HP-IB input board, the DCU and the mainframe. The HP-IB Output Board converts these inputs to data which is used to program the mainframe, the plug-in sections and the HP-IB Input assembly.

Four-State Machine U7A/B

A schematic representation of the four-state machine designated as U7A and U7B is located at the middle left side of the schematic.

Initially, with U7A/B in the quiescent state (state 11), the flip-flops are ready for DAV (Data Valid) to go low to signify that there is data input. When DAV goes low, it is inverted by U10E, and applied to AND gate U1A. The other input to U1A is held high at this time by U7B Q, causing the K input of U7A to go high.

The next clock pulse will cause U7A to change state; Q goes low and $\overline{Q}$ goes high, and the ASM proceeds to state 10. In state 10, the incoming data is stored in U5 and the RFD state remains active.

There is no qualifier following state 10 so the next clock pulse will move the ASM to state 00, where the command pulse to transfer the data is generated.

There is no qualifier following state 00, so the next clock pulse will move the ASM to state 01. This is the DAC (Data Accepted) state.

Qualifier DAV-H and BUSY-L follow state 01. When the output of DAV-H and BUSY-L is low, the ASM is held in state 01. When the qualifier output goes high, the ASM and the flip-flops return to state 11 and are ready for the next data input.

Flip-flops U7A/B control the three-wire handshake procedure within the instrument.

Jumper J1, when installed on the board, couples the internally generated BUSY signal to delay the RFD response. Without J1, the operator must make allowances in programming for the necessary settling time delays in the Model 8660A.

Delay One Shot U6

A delay circuit containing U6, in conjunction with Q1 and associated components, inhibits the start of the RFD period when certain programming steps are initiated. This is required because the programming time required for different functions varies.

SERVICE SHEET 22a (Cont'd)

As an example of circuit operation, assume that a change of frequency is programmed. Q2 will turn on, and R2 and C5 then determines the 5 millisecond operating time of the one shot. The one shot output is from pin 4 to U1 pin 12.

When an attenuation function is programmed, Q2 turns off, and R5, C4 and C2 determine the 50 millisecond operating time of the one shot.

There is also a 5 second delay built into the Model 8660A DCU for use in the FM CAL operation. The HP-IB interface utilizes this signal to delay RFD for 5 seconds when FM CAL is programmed. This delay input is the FLAG-L (BUSY) signal.

Shift Register U5

U5 is a conventional 4-bit shift register which is operated in the preset mode, and functions as a temporary storage register.

When the inputs to U5 are data, the U5 outputs are directly applied to the DCU.

When the inputs to U5 are an address, ENSL-H (Enable Select) goes high to enable the U3 NAND gates, and the address data is coupled to one-of-ten selector U4. When the U5 register is processing an address, the clock input (CP) at pin 10 is inhibited for 100 microseconds by one shot U6 pin 12 output. This prevents controller change of address until sufficient time has passed for the 8660A state machine process. Install J2 to disable this operation in the 8660A.

One-of-Ten Selector U4

U4 determines which programming function (address) has been selected, and in conjunction with PICK-L (Plug-In Clock), couples the address data to the appropriate register.

Power Detect Circuit

The power detect circuit, Q1 and associated components, inhibits circuit operation on initial turn on until the power supply has reached a stable condition. Initialization follows removal of the low level pulse, setting the frequency to 1 MHz, and attenuation to −140 dB.

Double Line

Whenever Decoder U4 simultaneously detects Frequency X1 in a high or low state, and Frequency X2 in an opposite state, then these pulses are sent to flip-flop U11. When U11 is clocked, the $\overline{Q}$ output goes to U12A which determines whether the double line is active or inactive.

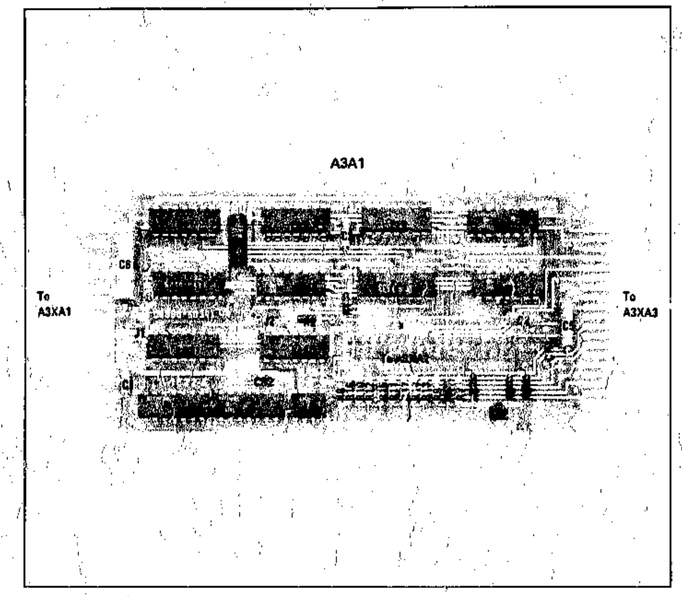


Figure 8-63A. HP-IB (Option 005) Output Assembly (A3A1) Component Locations

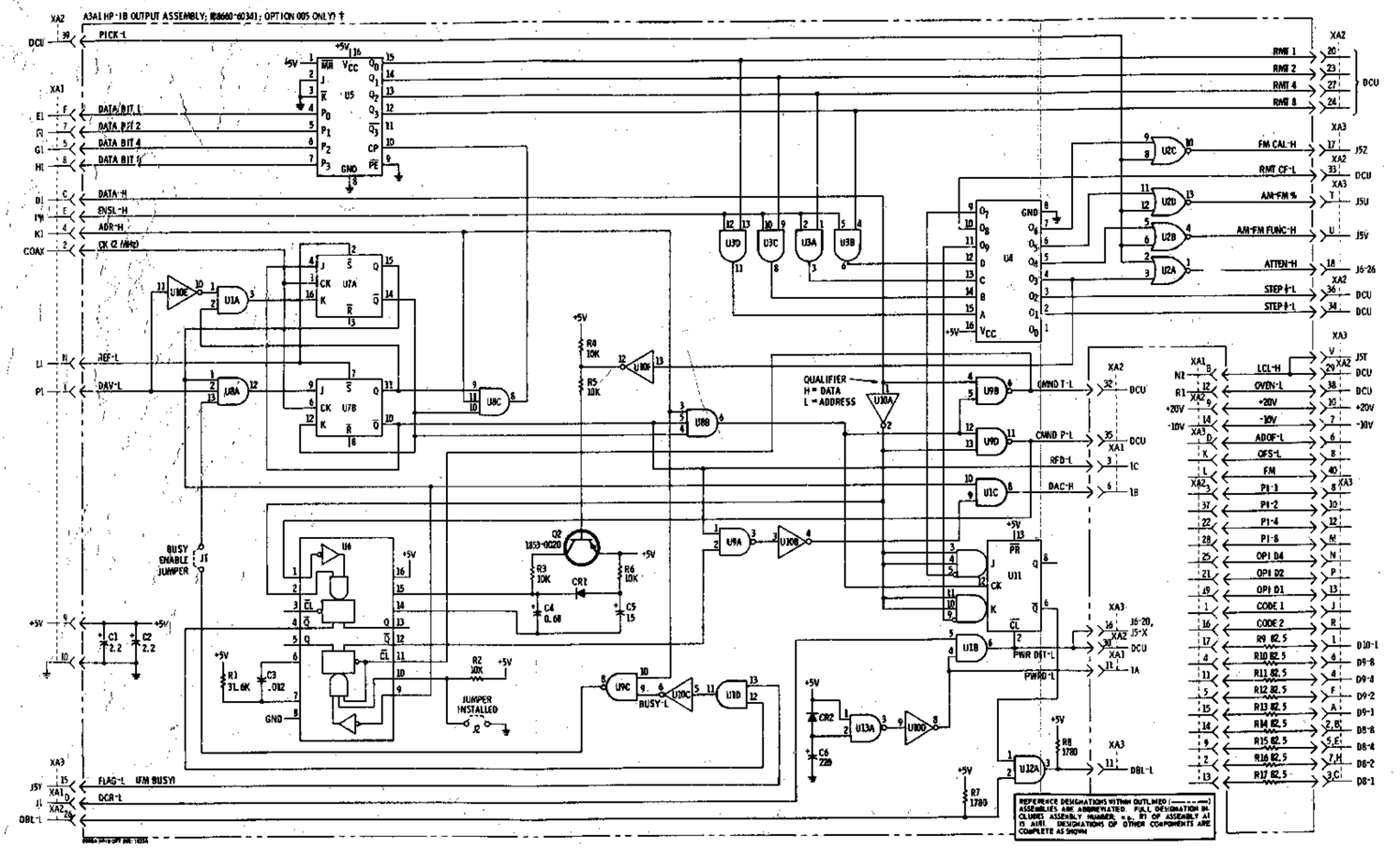


Figure 8-64A. HP-IB (Option 005) Output Assembly Schematic

NOTES

1. REFER TO TABLE 8-1 FOR EXPLANATION OF SYMBOLS.
† BACKDATING INFORMATION IN SECTION VII.

REFERENCE DESIGNATIONS

NO PREFIX	A3A1
XA1-3	C1-6
	CR1,2
	J1,2
	Q2
	R1-17
	U1-13

I.C. NUMBERS

U1	1820-0054
U2	1820-0328
U3	1820-0511
U4	1820-0214
U5	1820-0134
U6	1820-0579
U7	1820-0076
U8	1820-0372
U9	1820-0054
U10	1820-0174
U11	1820-0065
U12	1820-0535
U13	1820-1056

SERVICE SHEET 23

REAR INTERFACE CIRCUIT BOARD

Normally, causes of malfunctions in the Model 8660A will be isolated to a circuit board or assembly as a result of performing the tests specified in the troubleshooting trees.

When trouble has been traced to the rear interface circuit board it will be necessary to swing the A4 assembly out of the frame to provide access to the wiring side of the circuit board.

TEST EQUIPMENT REQUIRED (See Table 1-3)

Oscilloscope (with 10:1 divider probes)
Digital Voltmeter

GENERAL

The major purpose of the interface circuits is to assure compatability between the digital control unit, the phase lock loops, the plug-in sections and the programming information from the remote programming device (via J3).

REAR INTERFACE CIRCUIT

The BCD inputs from the remote input (J3) are applied to the "D" inputs of two quad latch flip/flops (U2 and U4). When a negative-going command pulse appears at the input to U3A the outputs of U1D and U1C clock U2 and U4.

Since the $\overline{Q}$ outputs of U2 and U4 provide the front interface drive signals the negative-true input BCD data (low = 1, high = 0) is inverted. This data is stored in U2 and U4 until the next command pulse.

NAND gates U1A and U1B comprise a one-shot with a maximum time constant of .75 microsecond. Normally NAND gate U1B pin 6 is high because R21 is holding pin 4 of U1B low and pin 1 of NAND gate U1A is held high by the command line. Pin 5 of NAND gate U1B is normally held high by the $\overline{Q}$ output of flip/flop U2B on the front interface board. When a negative-going command pulse appears the output of NAND gate U1A at pin 3 goes high and is coupled through C4 to cause the output (pin 6) of NAND gate U1B to go low. The time constant of C4/R21 limits the negative-going pulse to a maximum duration of 0.75 microseconds to allow adequate time for a flip/flop in the front interface circuit to be clocked once by the 2 MHz clock (0.5 microsecond time base). To assure that two or more clock pulses do not appear in the front interface circuit while the command pulse is present, the input to NAND gate U1B pin 5 is caused to go low (output, pin 6 goes high) when the first clock pulse is received in the front interface circuit.

Q1, Q2 and NAND gate U3D comprise an error detect circuit. The input to NAND gate U3D pin 12 is from the reference oscillator (A21) assembly. When the oven temperature has not stabilized this level will be low. When either input to U3D is low the output will be high, Q1 will be turned on, and an error signal (low) will be applied to J3 pin 3 to inform the remote programming device that the Model 8660A is not ready to receive data. The input to pin 12 of NAND gate U3D is also applied to the digital control unit to light a lamp on the annunciator block when the oven temperature has not stabilized.

SERVICE SHEET 23 (cont'd)

The input to pin 13 of U3D is from one of two sources. The F LIM input from A3XA4 pin 11 originates in the digital control unit center frequency circuit and is a low when the selected output frequency is not within the range of the RF Section in use. The second input to control NAND gate U3D pin 13 is the "GHz" input at A3XA5 pin D. This input is a high when selected frequency is not within the range of the 1.3 GHz RF Section or the internal Microwave Extension Module. A high input to the base of Q2 will cause Q2 to turn on and the output of NAND gate U3D will again go high to turn on Q1.

NAND gate U3C inverts the FLAG signal, which is generated in the front interface circuit, and applies it to J3 pin 17 as a busy signal to the remote programming device.

R25 and R29 hold the AUTO line (A3XA5 pin 5) high when the instrument is operated in the local mode. When J3 pin 5 is grounded by the remote programming device, this line goes low and the instrument is in the remote mode.

R26 and R30 hold the RESET line (A3XA5 pin J) high when no error is present in the remote programming device. When an error is present J3 pin 24 goes low and causes the PWR DET circuit on the front interface board to clear the center frequency storage register and shut off the modulation.

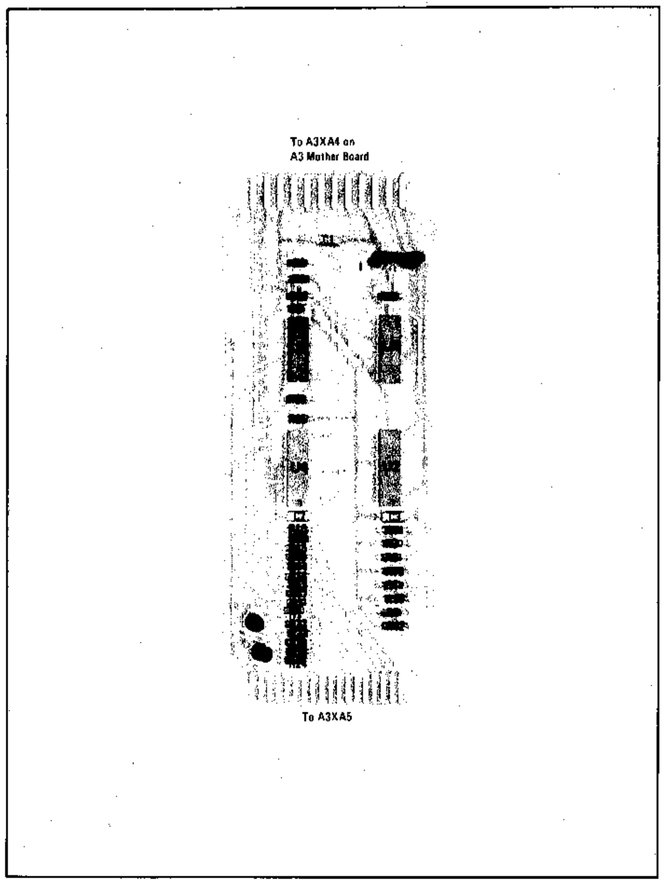


Figure 8-65. A3A2 Rear Interface Board Component Locations

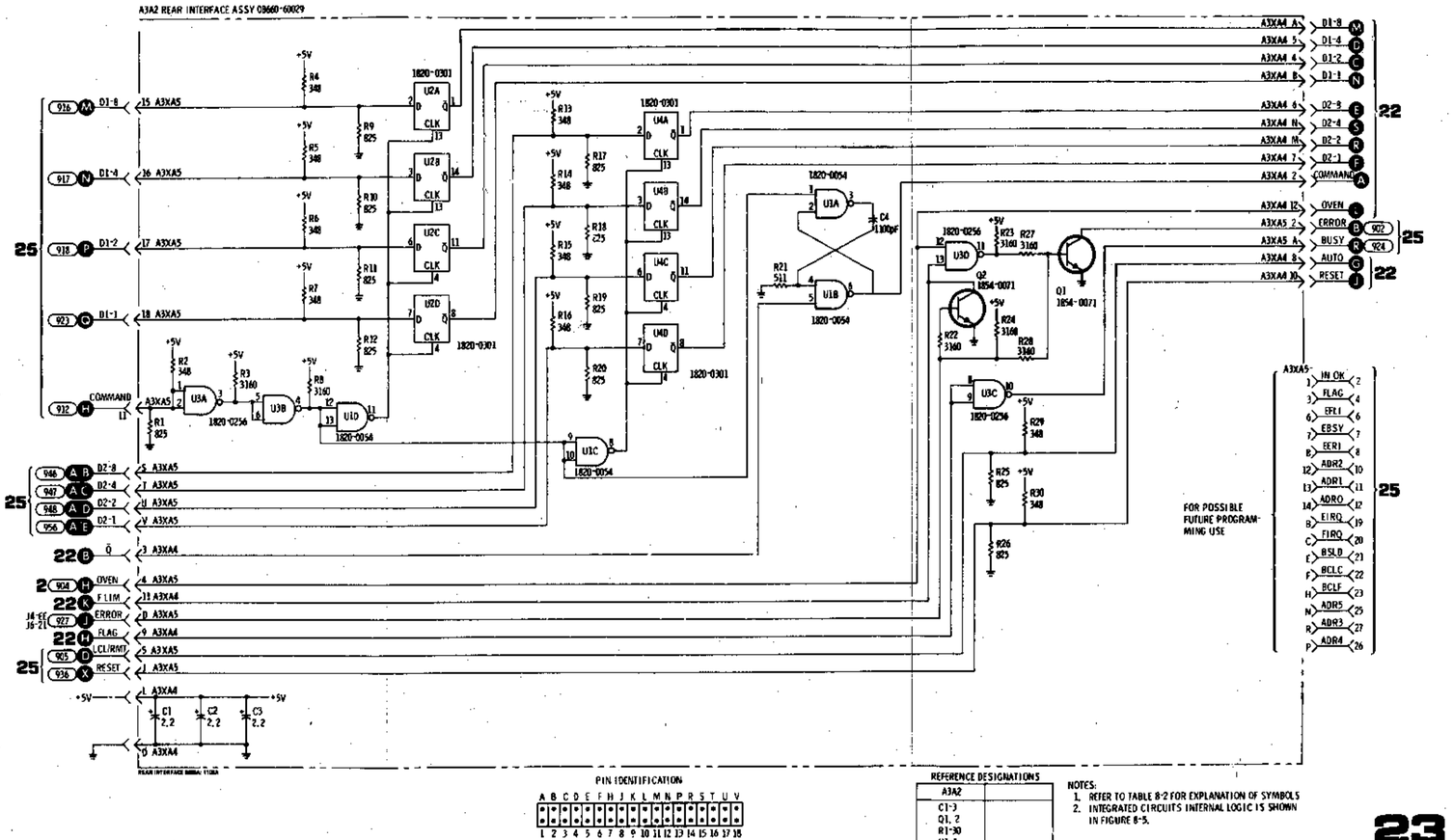


Figure 8-66. Rear Interface Board Schematic

SERVICE SHEET 23a

HP-IB INPUT ASSEMBLY A3A2

General

Basically, the HP-IB input assembly accepts the data from the bus, detects the programming action taking place and provides outputs that determine the operational parameters for the Model 8660A.

Voltage Dividers (U8, U14) and Schmitt Triggers (U7, U13)

U8 and U14 are resistive arrays which contain eight two-resistor voltage dividers each. Each voltage divider consists of (typical values) 3000 ohms to +5V and 6200 ohms to ground. These dividers bias the input lines to about +3V when the lines are not being driven by data. These dividers are used to keep the load on the bus, which is wire ANDed to all instruments, constant. Note that the lines which are not used in the Model 8660A (DI 08, EOI-L and SRQ-L) are also terminated in loads to preserve the constant loading of the HP-IB bus.

The HP-IB input lines are negative true logic. These lines are high in the quiescent state and are pulled low in the assertive state (0V = H). One of the reasons for using negative true logic is that TTL "sees" an open circuit as a high. If positive true logic were used, a discontinuity or a disconnected connector would simulate a high and the input lines would see this as the assertive state.

U7 and U13 are Schmitt triggers. These Schmitt triggers improve the quality of the data inputs, provide buffering and invert the input logic levels. Buffering is required to limit the load on the controller to one standard load (approx. 1.6 milliamperes sink current) for each controlled instrument. Following the data lines it may be seen that they are again inverted to negative true logic. Again, the data bits cannot be directly used from the input lines because of excessive loading.

Address Decoder U12

One of the characteristics of a NAND gate is that all of the inputs must be high in order for the output to be low. Therefore, all of the inputs to U12 must be high before the output MLA-L (My Local Address-Low) can be in the assertive state. As may be seen by evaluating the circuits which provide the inputs to U12, only one set of input data bits will cause the output of U12 (MLA-L) to go to the assertive state. For the Model 8660A this is an HP-IB character 3.

If more than one Model 8660A is used in the system, additional 8660A's would require a different address. This involves a different set of address bits from the controller and changing the address jumpers to accept the new HP-IB character.

Remote Flip/Flop U9A

When the REN (Remote Enable) input goes low the input is inverted by Schmitt trigger U13A and applied to the D input of U9A.

Rear Interface
◀SERVICE SHEET 23

SERVICE SHEET 23a (Cont'd)

U9A, however, cannot change state until it is clocked by a combination of MLA-L, DAC-H, DAV-L and MRE-L. This is because it is desired to keep the Model 8660A in the local mode until it is addressed by the bus. U9A is clocked as follows:

a. When MLA-L goes low it is inverted by U11F and applied to one one input of AND gate U10D.

b. The second input to AND gate U10D is the inverted DAC-H output of NAND gate U2B which is low until the data is accepted.

c. The high output of AND gate U10D is applied to one input of AND gate U10B. The second input to U10B is from AND gate U10A.

d. The inputs to AND gate U10A are the inverted MRE-L (Multiple Response Enable) and the inverted DAV-L (Data Valid) inputs.

e. Since MRE is an address funciton, it will go low first.

f. Finally, DAV goes low, is inverted and is applied to the clock input of U9A. It is the negative-going DAV signal which supplies the positive-going pulse to clock U9A.

When MLA-L is low and U9A is clocked the U9A Q output goes high and the Q output goes low. Note that the Q output of U9A is labeled LCL-H.

When the LCL line goes low the Model 8660A goes to the remote mode and the front panel controls (except for STBY/ON) are inhibited.

Address Flip/Flop U9B

When MLA-L goes low it is also used to set the "D" input to U9B high. This is accomplished as follows: the pin 10 input of U3C is high, and until an "unlisten" command appears, so is the pin 9 input. The high output of U3C enables the "D" input of U9B.

U9B is clocked in the same manner as U9A, by a combination of MRE and DAV.

The Q output of U9B is applied to one input of AND gate U3A. The second input to U3A is MRE, which is now in the quiescent state (high), so the output of U3A (ADR-H) is also high.

Unlisten Gate U5

When all of the inputs to U5 go high the address flip/flop is reset and the incoming data has no effect on the Model 8660A.

DCR-L Gate U4 (Device Clear)

When all of the inputs to U4 go high the output goes low. The low output has the same effect on the Model 8660A as the power detect circuit. The instrument is initialized with frequency (8660B) and attenuation set to predetermined values.

The remaining gates and inverters are conventional and should pose no problem to the average technician.

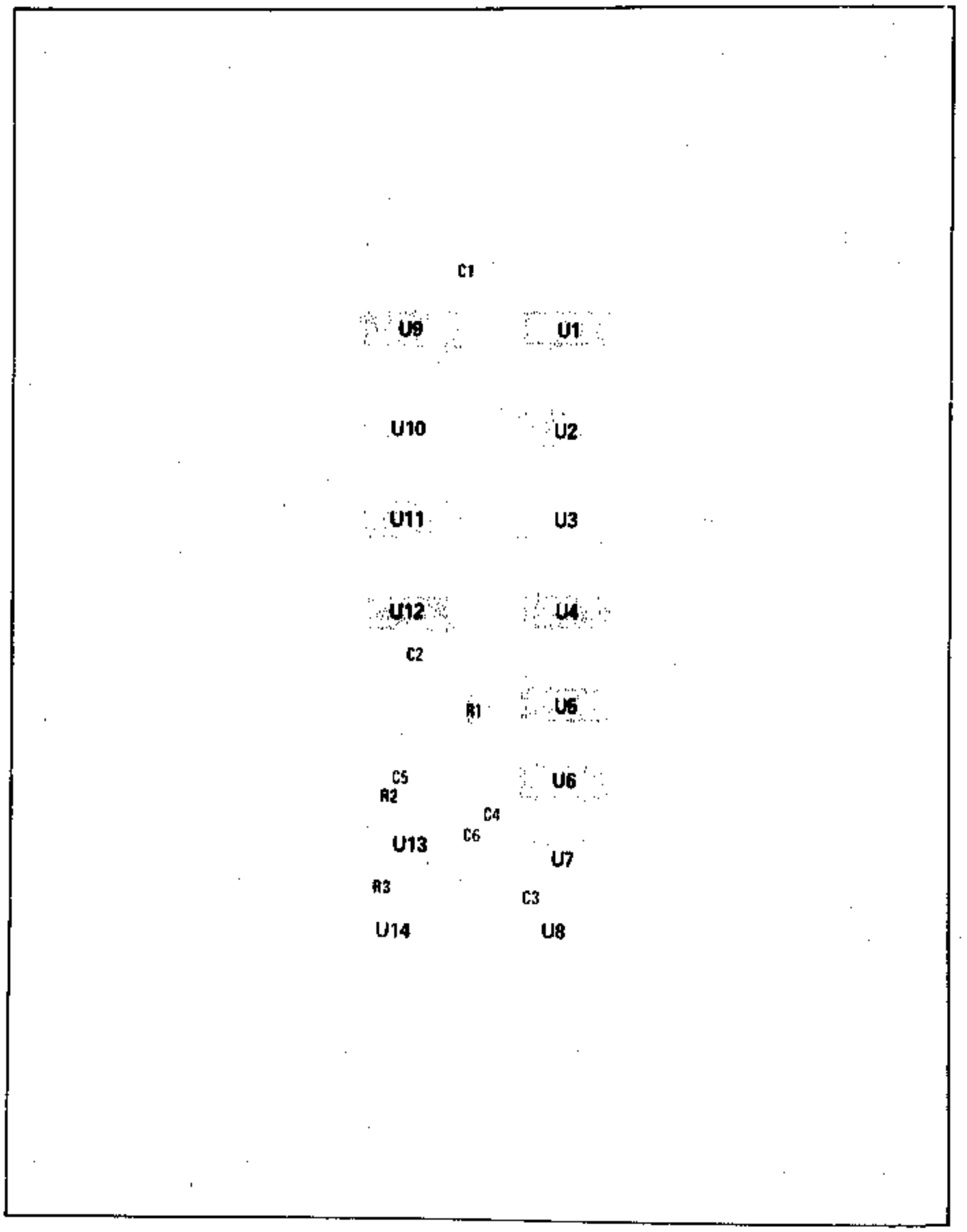


Figure 8-65A. HP-IB Input Assy (A3A2) Component Locations

SERVICE
SHEET 23a

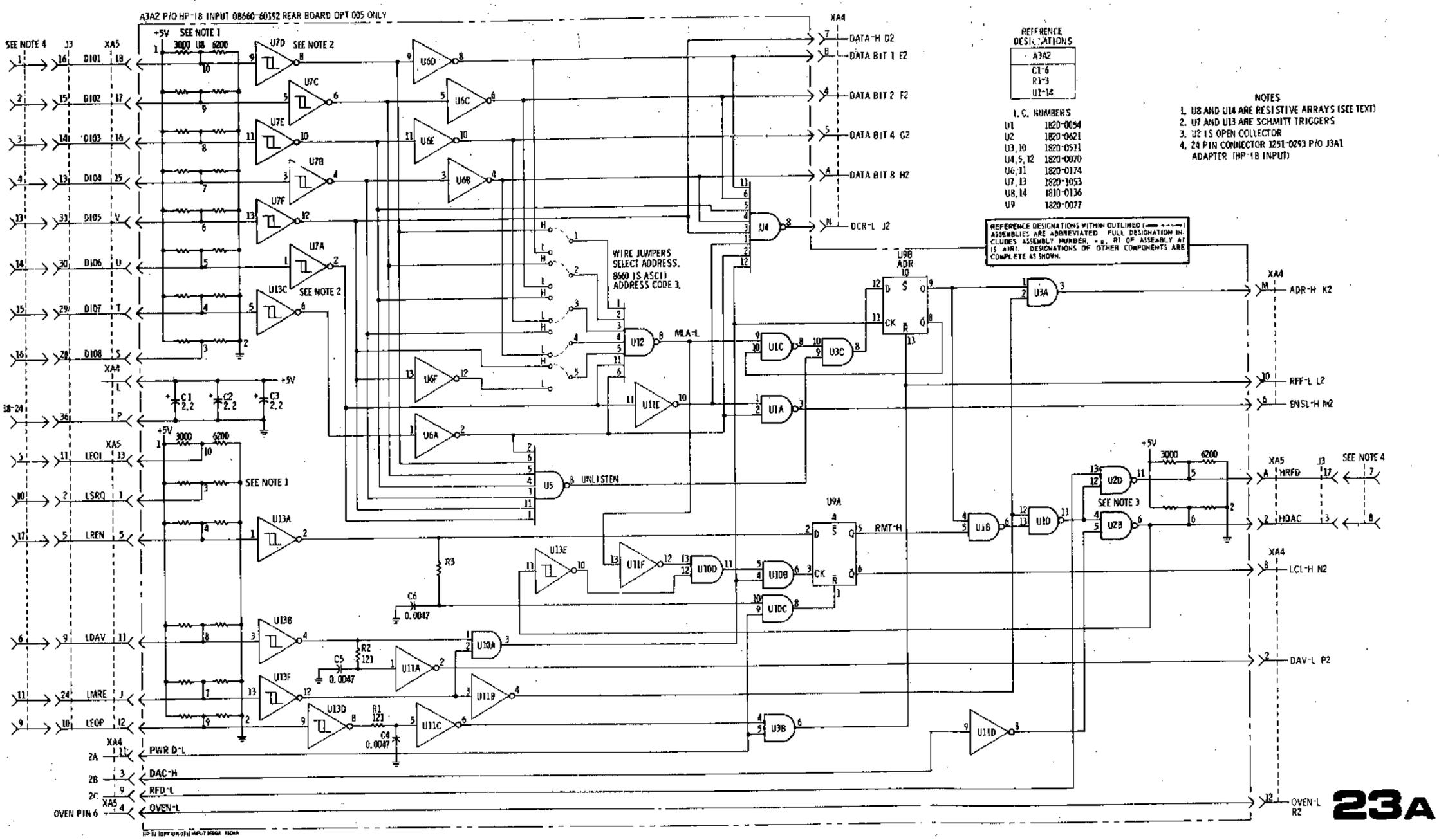
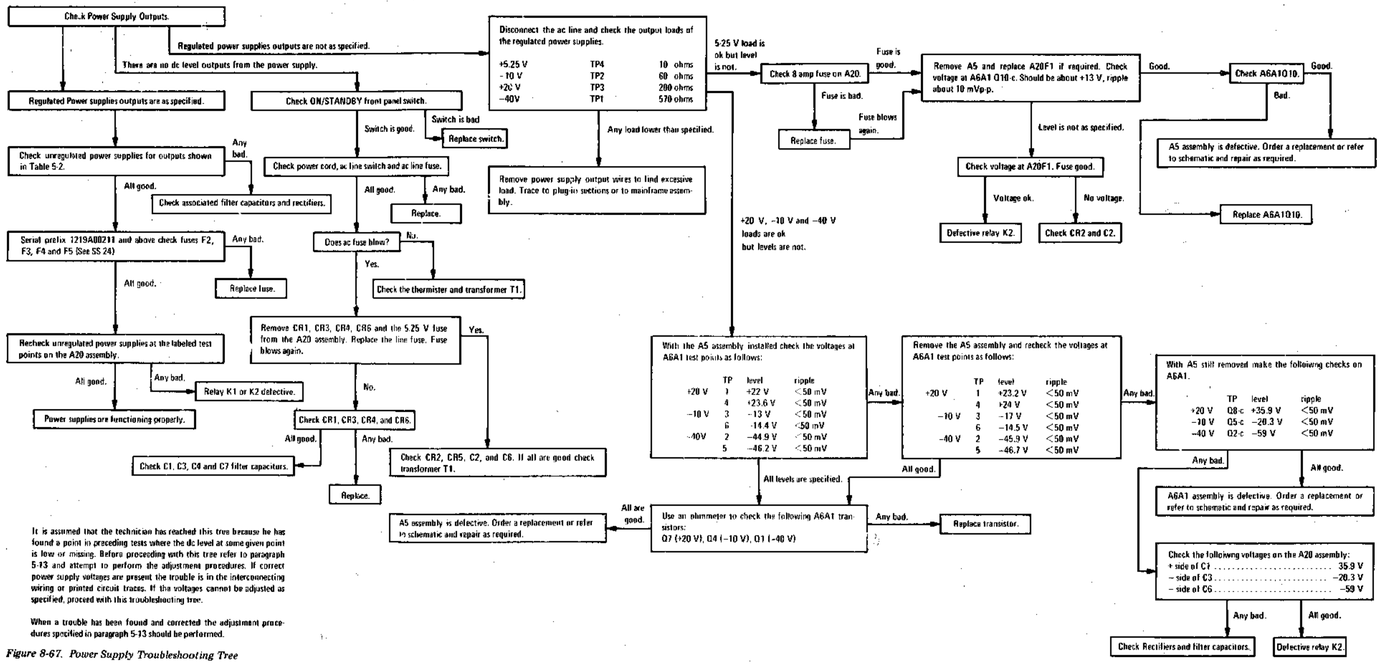


Figure 8-66A. HP-IB (Option 005) Input Assembly Schematic

23A



It is assumed that the technician has reached this tree because he has found a point in preceding tests where the dc level at some given point is low or missing. Before proceeding with this tree refer to paragraph 5-13 and attempt to perform the adjustment procedures. If correct power supply voltages are present the trouble is in the interconnecting wiring or printed circuit traces. If the voltages cannot be adjusted as specified, proceed with this troubleshooting tree.

When a trouble has been found and corrected the adjustment procedures specified in paragraph 5-13 should be performed.

Figure 8-67. Power Supply Troubleshooting Tree

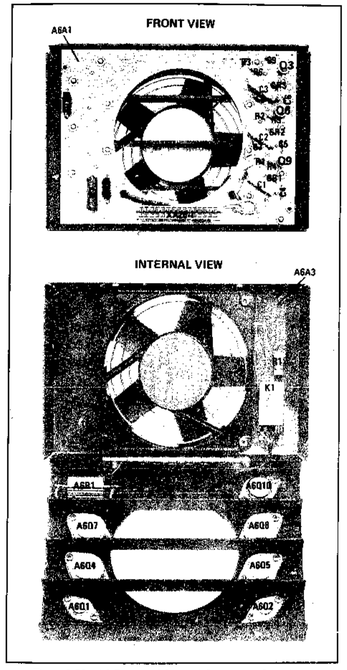


Figure 8-68. A6 Front and Internal Component Locations

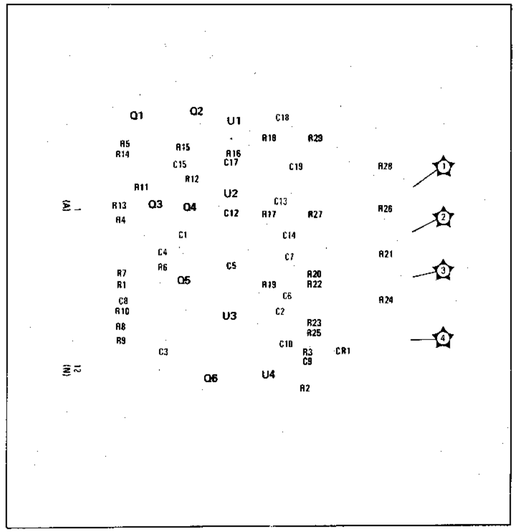


Figure 8-69. A5 Component Locations

HP-IB Input Assembly
SERVICE SHEET 23a

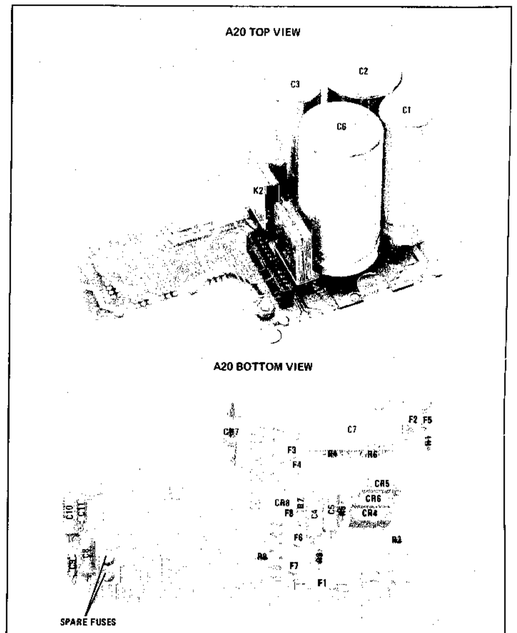
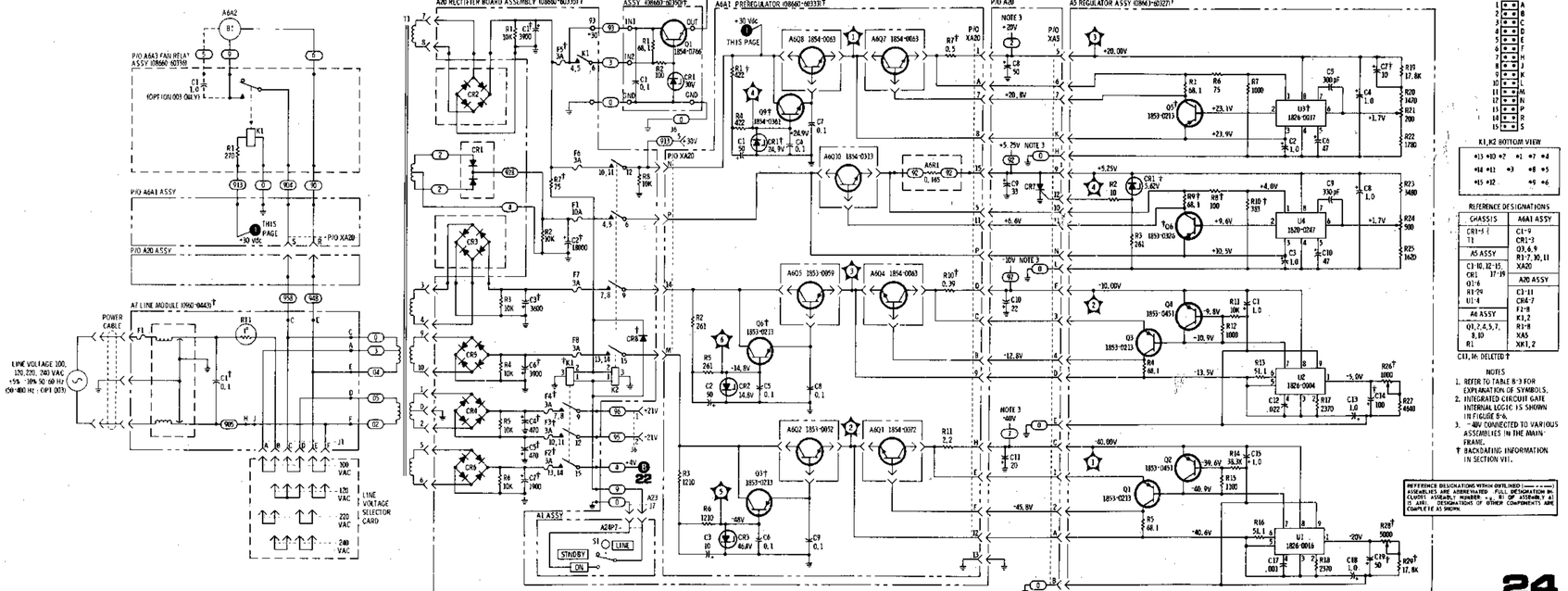


Figure 8-70. A20 Top and Bottom Component Locations



XA20 AND XA5 BOTTOM VIEW

K1,K2 BOTTOM VIEW

REFERENCE DESIGNATIONS	
CHASSIS	A6A1 ASSY
CR1-7	C1-9
T1	CR1-3
	Q3, 6, 9
A5 ASSY	R1-7, 10, 11
C1-10, 12-15,	R13-15
CR1 17-19	XA20
Q1-6	
R1-29	A20 ASSY
U1-4	C1-11
	CR4-7
A6 ASSY	F2-8
Q1, 2, 4, 5, 7, 8, 10	K1, 2
R1	R1-8
	XA5
	XR1, 2

C13, 16 DELETED †

NOTES
1. REFER TO TABLE 8-3 FOR EXPLANATION OF SYMBOLS.
2. INTEGRATED CIRCUIT GATE INTERNAL LOGIC IS SHOWN IN FIGURE 8-6.
3. -40V CONNECTED TO VARIOUS ASSEMBLIES IN THE MAIN FRAME.

† BACKDATING INFORMATION IN SECTION VII.

Figure 8-71. Power Supply Schematic

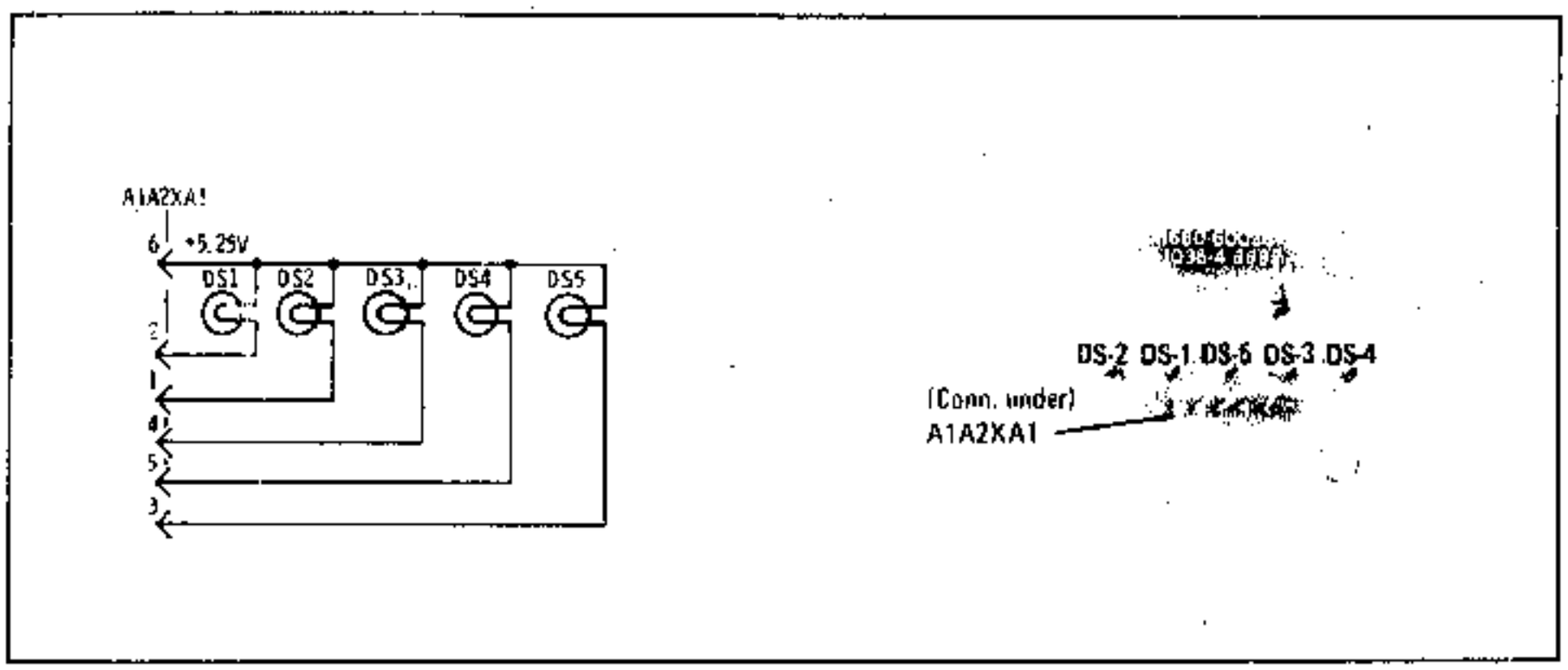


Figure 8-72. A1A2 Annunciator Assembly and Schematic

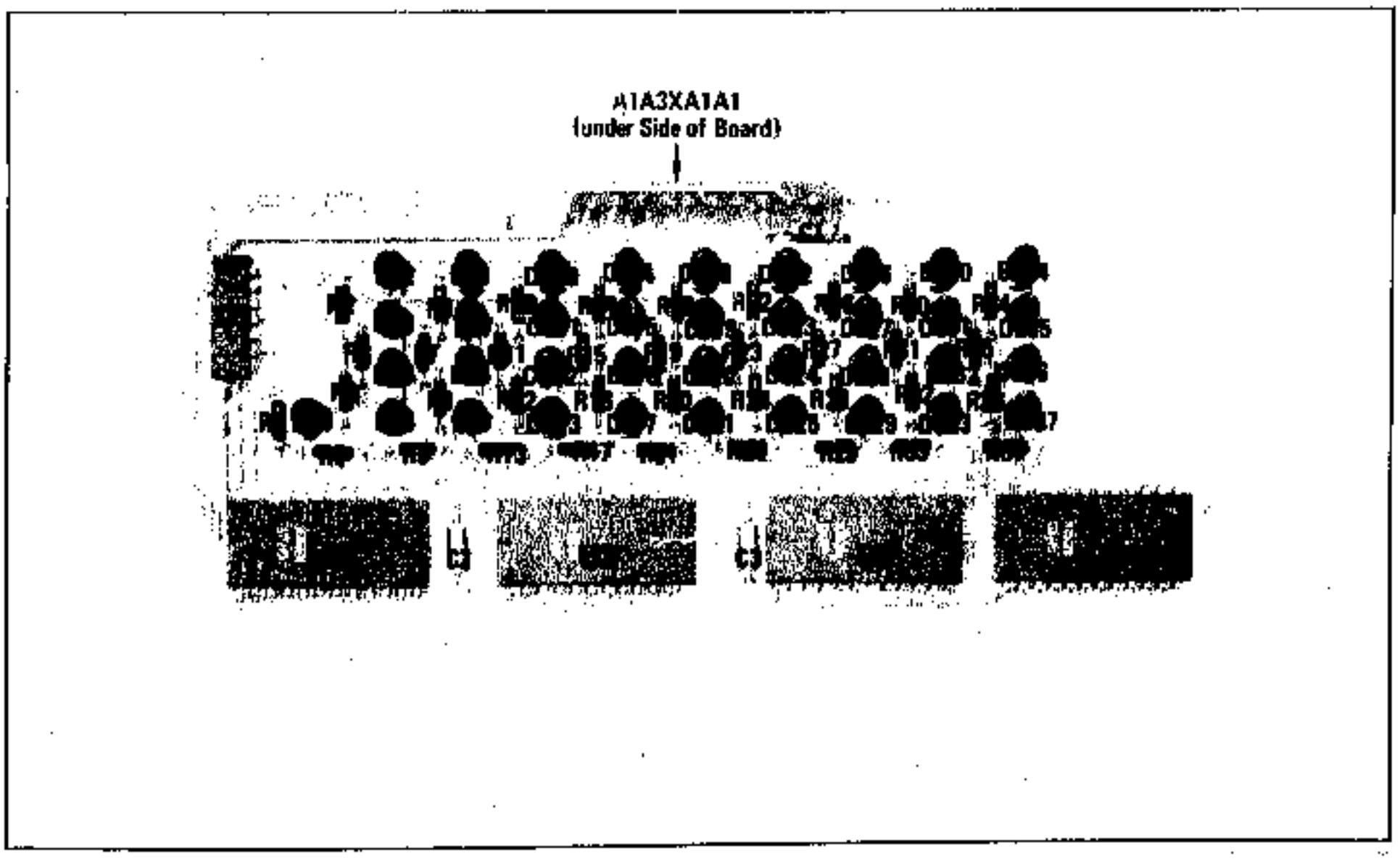


Figure 8-73. A1A3 LED Readout Component Locations

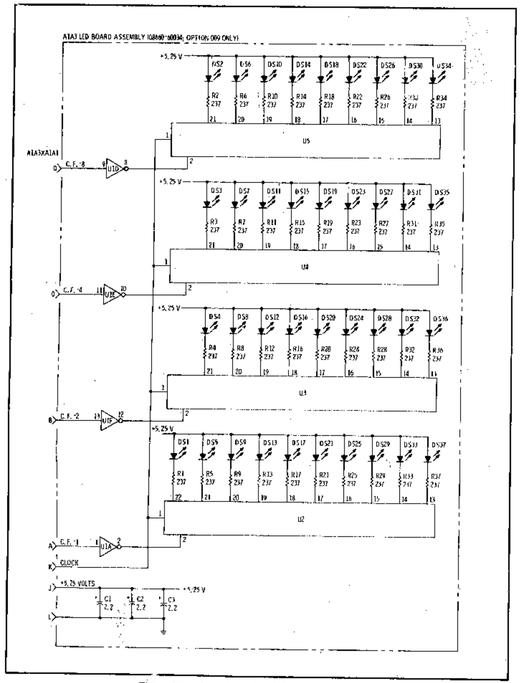


Figure 8-74. LED Assembly Schematic Option 009

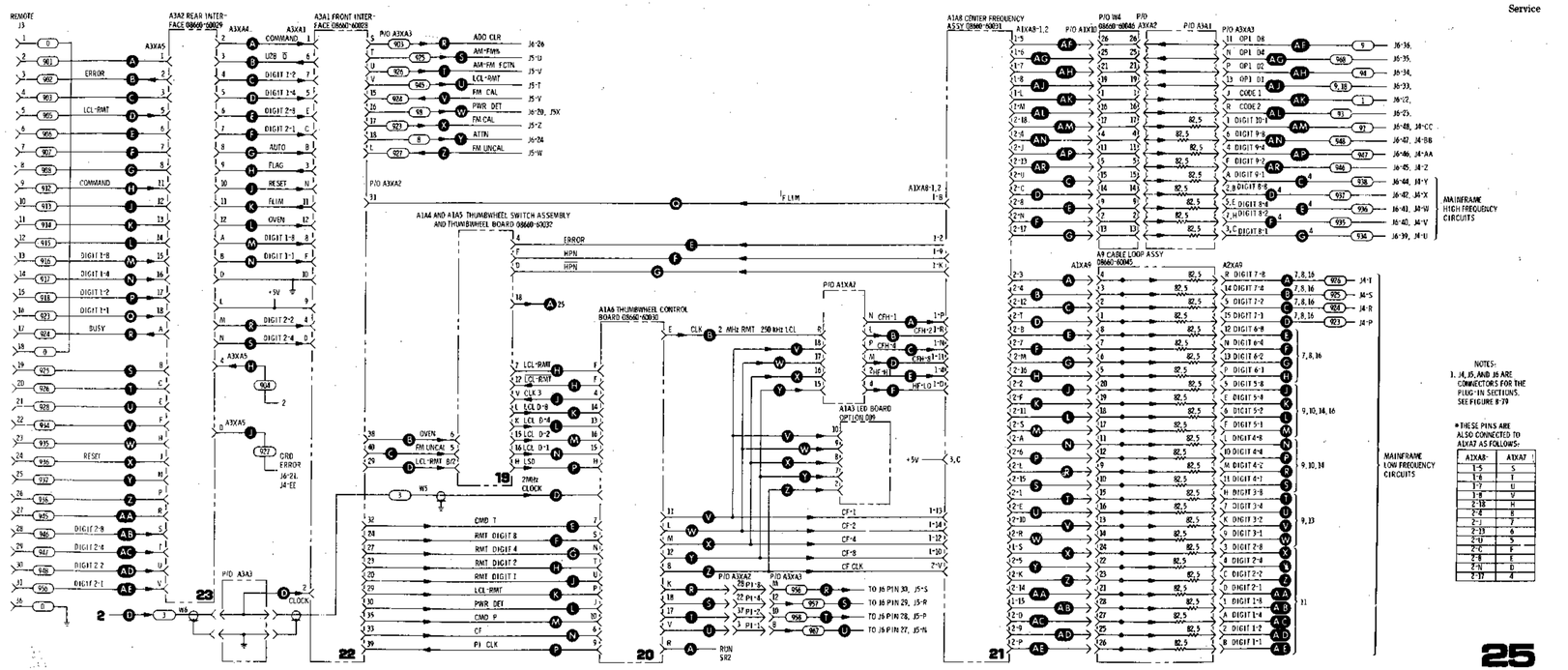
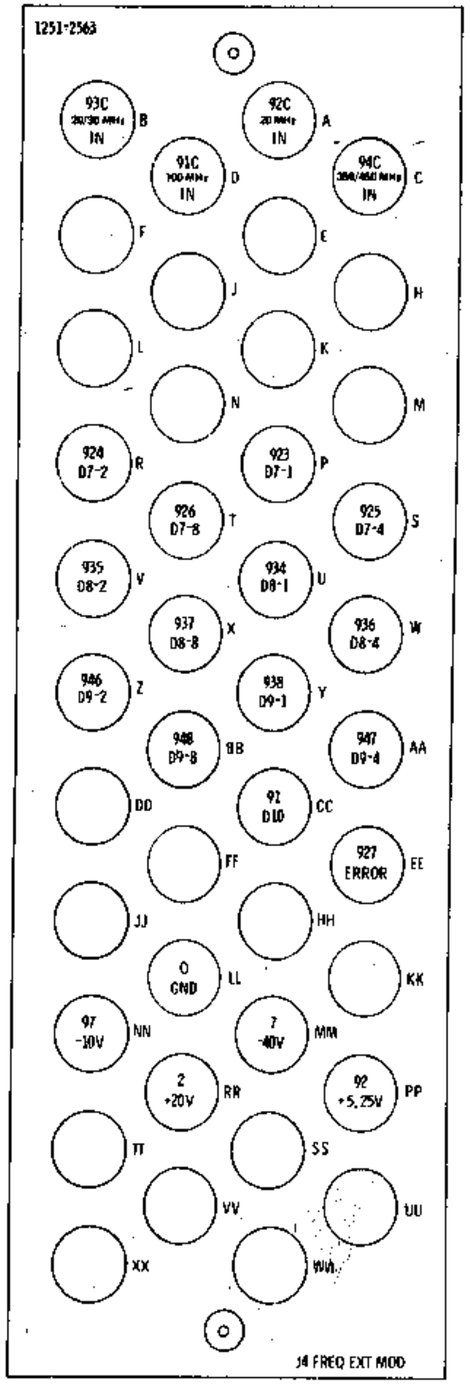
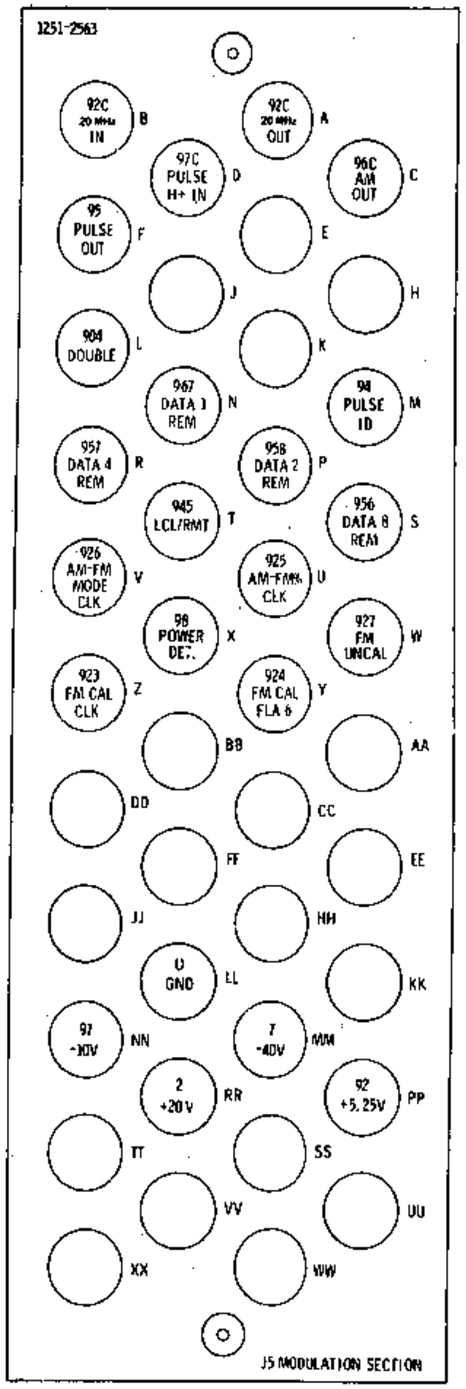
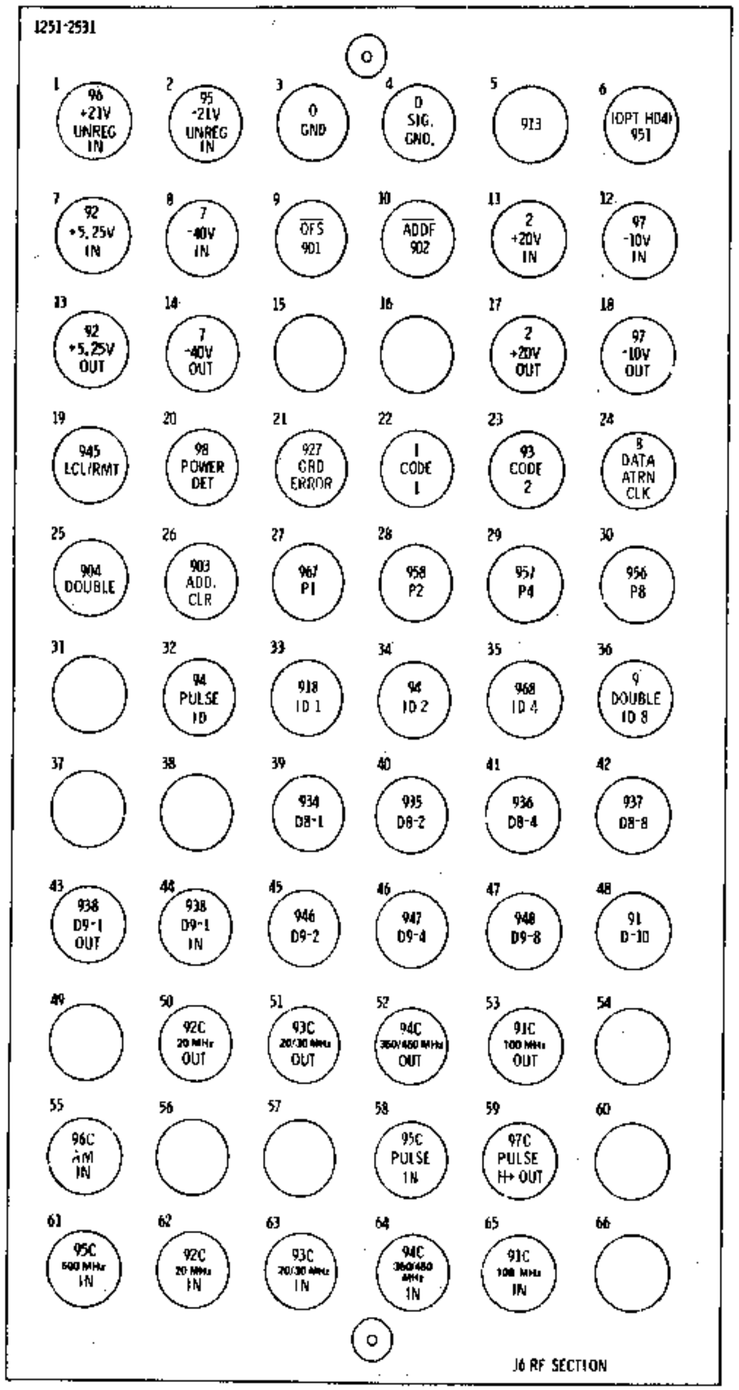


Figure 8-75. DCU and Interface Wiring Diagram







NOTES:

1. PART NUMBERS SHOWN FOR CONNECTORS DO NOT INCLUDE PINS.
2. COAX PINS ARE HP PART NUMBER 1251-2041. REGULAR PINS ARE HP PART NUMBER 1251-1908.
3. A TOOL KIT, WINCHESTER CATALOG NUMBER 107K4 IS REQUIRED TO INSTALL THE REGULAR PINS.
4. A TOOL KIT, WINCHESTER CATALOG NUMBER 107-0600 AND A TOOL LOCATOR WINCHESTER CATALOG NUMBER 107-0602 IS REQUIRED TO INSTALL COAX PINS.

Figure 8-76. Plug-In Connectors

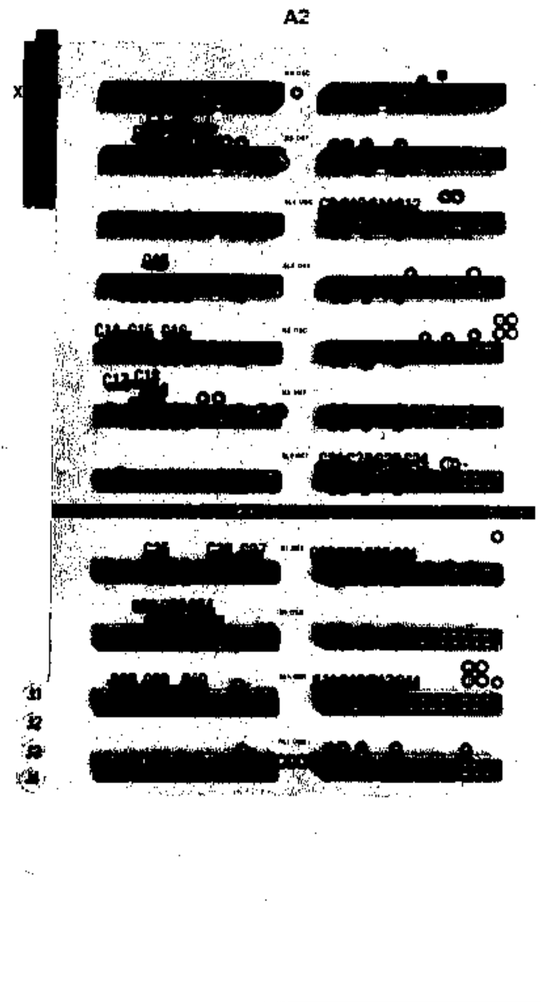


Figure 8-77. A2 Mother Board Component Locations

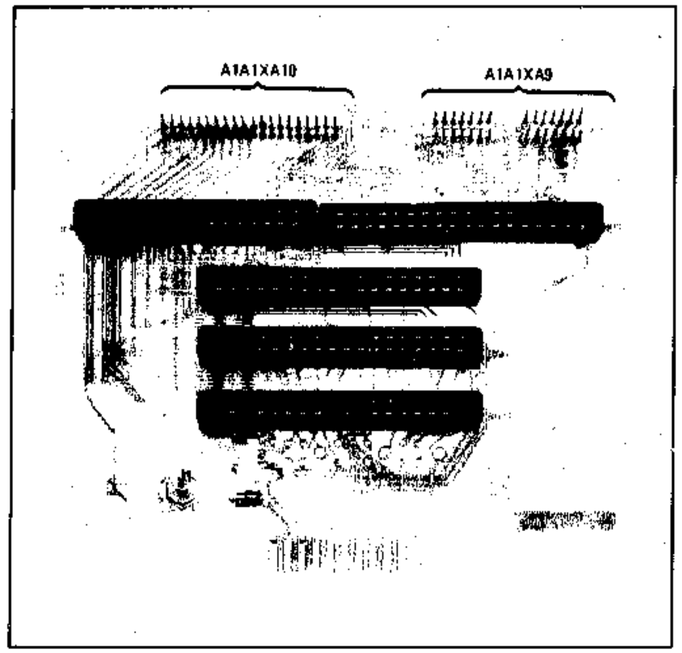


Figure 8-78. A1A1 Mother Board DCU Component Locations

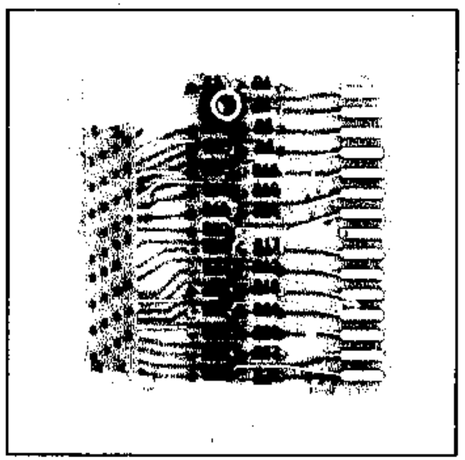


Figure 8-79. A9 Cable Loop Assy

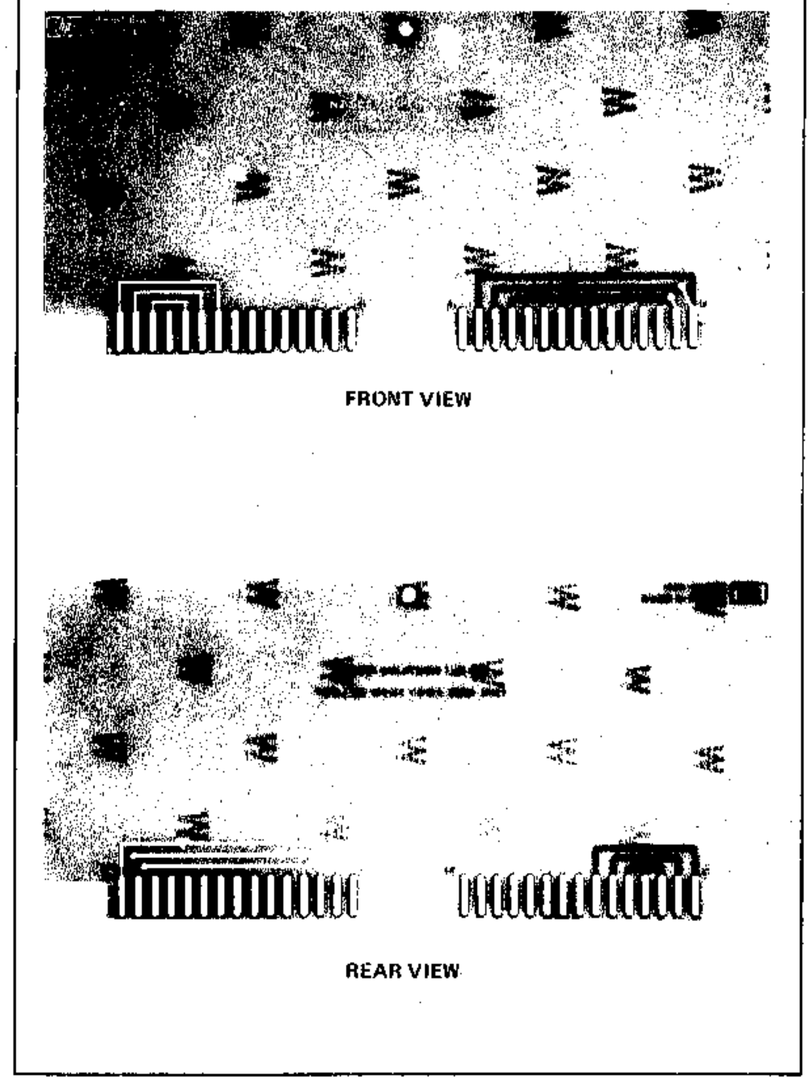


Figure 8-80. Interconnection Assembly (Opt. 004)

MANUAL CHANGES

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number: 8660A
Date Printed: Jan. 1983
Part Number: 08660-[illegible]

[illegible]

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after printing the manual.

To use this supplement, first, make all ERRATA corrections and then all appropriate serial number related changes indicated in the tables below.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
[illegible]	1
[illegible]	1-2
[illegible]	1-3
[illegible]	1-4
[illegible]	1-5
[illegible]	1-6
[illegible]	1-7
[illegible]	1-8
[illegible]	1-9
[illegible]	1-10
[illegible]	1-11
[illegible]	1-12
[illegible]	1-13
[illegible]	1-14
>> [illegible]	1-15
>> [illegible]	1-16

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES

>> NEW ITEM

NOTE:
Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies, quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

[illegible]

HEWLETT PACKARD

[illegible]

Page 1-[illegible], Paragraph 1-[illegible]:
Add the following note after the paragraph:

NOTE

If this instrument is not shipped from the factory as part of a complete signal generator system (mainframe, modulation section, and RF section), it may be necessary to perform the adjustments in Section V before all performance specifications will be met.

Page 2-[illegible], Paragraph 2-9:
Add the following as paragraph 2-9A:

2-9A. Two fuses are supplied with each instrument. One of the fuses will have the proper rating for 100/120 Vac line (mains) operation; the other fuse will have the proper rating for 220/240 Vac line (mains) operation.

One fuse will be installed in the instrument at the time of shipment. The rating of the installed fuse will be determined according to the line voltage specified by the customer. If the voltage is not specified, the rating of the installed fuse will be selected according to the country of destination.

Page 2-[illegible], Paragraph 2-11:
Change the second sentence to read as follows: "For 110-120V line, use a 4A slo-blo fuse, HP Stock No. 2110-0635. For 220-240V line, use a 2A slo-blo fuse, HP Stock No. 2110-0313."

Page 2-2, Paragraph 2-22:
Change to read as follows:

2-22. The 8660A Option 908 is supplied with a rack mounting kit. This kit contains all the necessary hardware and installation instructions for mounting the instrument in a rack with 19-inch spacing (see Figure 2-3). The HP Part Number for this kit is 08660-60347.

Page 2-3, Table 2-[illegible]:
Add the [illegible] to Table 5-1 from the table in this supplement.

Page [illegible], Paragraph [illegible] ([illegible]):
[illegible] as follows:
[illegible] the cover from the A4A4 Assembly. Connect the Spectrum Analyzer RF INPUT to the test point (0). This test point should have a [illegible] (0) attached. Set the analyzer controls as follows: [illegible] to (white/black/violet).

Page [illegible], Paragraph [illegible] ([illegible]):
[illegible] PER DIVISION to 0.5 MHz.

Page [illegible], Figure [illegible]:
[illegible] to read as follows:
[illegible] A4J12; middle cable A4J6; and bottom ([illegible]) [illegible].

[redacted] to 08660-60098 (CD3).
[redacted] 1251-2035 to 1251-6052 CD8.

[redacted] through A1A8U26. If your instrument has
[redacted] or higher, substitute the list in this supplement
[redacted] A1A8U1-A1A8U26 (part of 08660-60098 Center
[redacted]ly).

[redacted]:
[redacted] to 1820-1300 CD6 IC SHF-RGTR TTL E-S PAL-IN PAL-OUT

[redacted]:
[redacted] to 1060-2201 CD7 CAPACITOR-FXD 51PF +-5% 300VDC MICA.
[redacted] part number to 0160-3064 CD2.

[redacted]:
[redacted] (*) to A4A2A2 to indicate a factory selected value.
[redacted] if replacement is needed, the recommended part is shown in
[redacted].

[redacted] add the following:
[redacted]369 CD0 Qty 1 TRANSFORMER, RF CHOKE.

[redacted]:
[redacted] and A4A4U6 HP Part Numbers to 1854-0345 (CD6).

[redacted]:
[redacted] to 0698-7222 CD1 RESISTOR 26 1% .05W F TC=0+-100.
[redacted] (*) to A4R5C7, C8, C13, C14, C19, and C20.
[redacted] A4A5U1 to 0160-0965 CD2 CAPACITOR-FXD 1000 PF +-20% 100VDC CER.

ERRATA (cont'd)

Page 6-19, Table 6-3:
Change [illegible] and A4A5Q7 to 1854-0345 (CD8) TRANSISTOR NPN 2N5179 SI TO-72 [illegible].

Page 6-20, Table 6-3:
Change A4A6R2, R56 to 2100-3818 (CD0) RESISTOR TRMR 5K 10%.
Change A4A6R13, R32 to 2100-3817 (CD9) RESISTOR TRMR 2K 10%.
Change A4A6R15, R20, R22 to 2100-3822 (CD6) RESISTOR TRMR 100 10%.
Change A4A6R28 to 2100-3821 (CD5) RESISTOR TRMR 200 10%.
Change A4A6R35, R40, R44 to 2100-3820 (CD4) RESISTOR TRMR 500 10%.
Change [illegible] TO 2100-3819 (CD1) RESISTOR TRMR 1K 10%.

Page 6-21, Table 6-3:
Change A4A7R30 to 2100-3816 (CD8) RESISTOR TRMR 10K 10%.
Change A4A7U1 to 1820-0214 CD9 IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE SN7442N [illegible].

Page 6-22, Table 6-3:
Add an asterisk (*) to A4A7R23 to indicate a factory selected value.

Page 6-23, Table 6-3:
Change A5J1/A20-1 part number to 1251-6052 CD8.
Change A6B1 part number and description to:
08660-60280 CD4 Qty 1 FAN ASSEMBLY (EXCEPT OPTION 003).
08660-60281 CD5 Qty 1 FAN ASSEMBLY (OPTION 003 ONLY).
Replace both A6A2B1's with the following:
A6A2B1 08660-20184 CD3 FAN-TBAX 115-CFM 115-128V 50/60-HZ (EXCEPT OPTION 003).
A6A2B1 08660-20185 CD4 FAN-TBAX 95-CFM 95-128V 47-440-HZ. (OPTION 003 ONLY).

Page 6-25, Table 6-3:
Change A8R1 to 8120-1727 (CD4) same description.

Page 6-33, Table 6-3:
Add an asterisk (*) to A13R81 to indicate a factory selected value.

Page 6-36, Table 6-3:
Change A14U7 HP Part Number 1820-2888 (CD7).

Page 6-46, Table 6-3:
Change A20K1 and K2 as follows:
0490-1348 CD0 RELAY 4A 24VDC-COIL 7.5A 115VAC.

Page 6-70, Table 6-3:
Under CHASSIS PARTS add the following:
08660-80030 CD4 Qty 1 SPRING-TORSION .031 WIR

ERRATA (cont'd)

<u>Page [illegible], Table [illegible]:</u>
[illegible], change the part number for the Guide Pin to [illegible]; Qty 6.
Under [illegible] add the following:
0340-[illegible] (C??) INSULATOR, TRANSISTOR, ALUMINUM.
3050-[illegible] (C??) WASHER-FLT METC NO.8 .172-IN-ID.
Under Chassis Parts make the following changes:
Change F1 part number and description to:
2110-0365 (C07) FUSE 4A 250V SLO-BLO 1.25 X .25 UL (FOR 100-125V OPERATION).
Add this second part number and description under F1:
2110-0303 (C09) FUSE 2A 250V SLO-BLO 1.25 X .25 UL (FOR 220-240V OPERATION.

<u>Page [illegible], Figure 8-9 (Service Sheet 1):</u>
At lower center of schematic, at A4J2, change W11 color code 1 to W12 color code 5.
At A4J4, change W12 color code 5 to W11 color code 1.

<u>Page [illegible], Figure 8-14 (Service Sheet 2):</u>
>> On the [illegible] Assembly, change the value of C11 to 51p (51 pF is the value typically selected for C11.)
Add an asterisk (*) to [illegible] to indicate a factory selected value.
At center right of Service Sheet, at A4J2 change N3 to N2.
At A4J4, change N2 to N3.

<u>Page [illegible], Figure 8-17 (Service Sheet 3):</u>
Change [illegible] and [illegible] part numbers to 1854-0345.

<u>Page 8-20, Service Sheet 4 (Text):</u>
In Table 8-4 under DC Level Unlocked add a dash to all voltages to indicate negative voltage values.

<u>Page 8-21, Service Sheet 4 (Schematic):</u>
On the right side of the schematic at the (J)6 off-page indicator, change the color code to (907).

<u>Page [illegible], (Service Sheet 5):</u>
Add an asterisk (*) to A4A7R23 to indicate a factory selected value.

<u>Page [illegible], Figure 8-23 (Service Sheet 6):</u>
Add an asterisk (*) to C7, C8, C13, C14, C19, and C20.
Change Q2, Q3, Q4, Q5 and Q6 to 1854-0940.
Change Q1 and Q7 to 1854-0431.
Change A4A5Q1 and A4A5Q7 HP Part Numbers to 1854-0345.

<u>Page [illegible], (Service Sheet 7):</u>
Replace Figure 8-24 with the figure located in this Manual Changes supplement.

<u>Page [illegible], Figure 8-29 (Service Sheet 9):</u>
In upper-left corner of schematic, change A23W11 cable designator to simply W12, and change color code indicator from 1 to 5.

ERRATA (cont'd)

Page [illegible], Service Sheet [illegible] (Schematic):
[illegible] corner of the schematic at the off-page indicator, [illegible], change [illegible] to W12 and cable color code to 5 .
Change [illegible] part number to 1420-20[illegible].

Page [illegible] (Service Sheet 10):
[illegible] (*) to A1[illegible] to indicate a factory selected value.

Page [illegible], Service Sheet 11 (Schematic):
In the upper-left corner of the schematic, change A23W12 to W11 and change the color code indicator from 5 to 1 .

Page [illegible], Service Sheet 24 (Schematic):
Change [illegible] reference designators to XA20-1 (3 places).
In the upper-left corner of the schematic add a (94) color code wire from [illegible] ([illegible] Motor) to chassis ground. This is a Safety Ground Wire and MUST be added to all instruments with Serial Prefixes up to and including 2121A. This is added to the instruments starting with Serial Prefix 2242A.

CHANGE 1

Page 6-[illegible], Table 6-3:
[illegible] the A[illegible] Option 005 replaceable parts list provided in this [illegible] supplement (F/O Change 1).

Page [illegible], Table 6-3:
[illegible] the A[illegible] Option 005 replaceable parts list provided in this [illegible] Changes supplement (F/O Change 1).

Page 8-1[illegible], Figure 8-[illegible] (Service Sheet 1):
Change W7 to W17 and show the grounding of the shield at the J4 connector of the 11661 Frequency Extension Module. W7 is the white/brown 91 wire near upper right-hand corner of the figure.

Page 8-[illegible], Figure 8-63A:
Change to the component locations diagram provided in this Manual Changes supplement (F/O Change 1).

Page 8-[illegible], Figure 8-64A (Service Sheet 22A):
Change to the schematic diagram provided in this Manual Changes supplement (F/O Change 1).

Page 8-[illegible], Figure 8-65A:
Change to the component locations diagram provided in this Manual Changes supplement (F/O Change 1).

Page 8-[illegible], Figure 8-66A (Service Sheet 23A):
Change to the schematic diagram provided in this Manual Changes supplement (F/O Change 1).

CHANGE 2

Page 6-1[illegible], Table 6-3:
Add [illegible] 08660-20370 (CD7) FILTER, HIGH PASS 300 MHz.

Page 8-2[illegible], Figure 8-2[illegible] (Service Sheet 6):
Add FL2 300 MHz HPF between the justion of R39, R41 and A4J10. (See illustration FL2 in this supplement).

CHANGE 3

Page 6-24, Table 6-3:
Change [illegible] to 08660-80023 (CD5) COIL 600 nH ±5% Q=150.

Page 6-27, Table 6-3:
Change [illegible] to 08660-80023 (CD5) COIL 600 nH ±5% Q=150.

Page 6-[illegible], Table 6-3:
Change [illegible] to 08660-80023 (CD5) COIL 600 nH ±5% Q=150.

Page 6-40, Table 6-3:
Change [illegible] to 08660-80023 (CD5) COIL 600 nH ±5% Q=150.

Page 6-4[illegible], Table 6-3:
Change [illegible] to 08660-80023 (CD5) COIL 600 nH ±5% Q=150.

Page 8-[illegible], Figure 8-27 (Service Sheet 8):
[illegible]

Page 8-[illegible], Figure 8-3[illegible] (Service Sheet 10):
[illegible]

Page 8-[illegible], Figure 8-37 (Service Sheet 12):
[illegible]

Page 8-[illegible], Figure 8-4[illegible] (Service Sheet 14):
[illegible]

Page 8-[illegible], Figure 8-47 (Service Sheet 17):
Change [illegible] to 0.6[illegible].

CHANGE 4

Page iii, Illustrations:
Add Figure 3-3. HPIB Address Switch (S1).....3-11.

Page 3-11/3-12:
Add following HP-IB information:
To gain access to the HP-IB Address Switch, remove top cover and lift the Phase Lock High Frequency Loop Assembly.
Add Figure 3-3 from this supplement.

Page 6-18, Table 6-3 (See Change 1):
Change A7A2 from 08660-60367 to 08660-60372, HP-IB INPUT ASSEMBLY.
Add S1 3101-2136 SW-SL 5-SPDT-NS.

Page 8-69, Figure 8-69A (Component Locations) (See Change 1):
Add arrow pointing to space on board above R5/U14 and below U13 and add note: S1 mounted on circuit side.

Page 8-69, Figure 8-69A (See Change 1):
Add an "S1" reference designation where wire jumpers now exist at input to U13.
Delete notation: WIRE JUMPERS SELECT ADDRESS.
Add solid line switch connections between 1 and H, 2 and H, 3 and L, 4 and L, and 5 and H.

CHANGE 5

Page 6-16, Table 6-3:
Change A4A3C15 to 0140-0210 (CD1) CAPACITOR FXD 270 PF 5%.
Change A4A3C17 to 0140-0193 (CD0) CAPACITOR FXD 82 PF 5%.
Delete A4A3C19.
Add A4A3CR2 1901-0025 (CD2) DIODE 100V 200 MA.

Page 8-19, Figure 8-16:
Change designator C19 to CR2.

Page 8-19, Figure 8-17 (Service Sheet 3):
Change A4A3C15 to 270 pF.
Change A4A3C17 to 82 pF.
Delete A4A3C19 and in its place add CR2 with anode to ground.

CHANGE 6

Page 6-16, Table 6-3:
Change A4A2R26 to 0757-0442 (CD9) RESISTOR 10K 1% .125W F TC=0±100.

Page 6-22, Table 6-3:
Add A9C20 0160-3165 (CD4) CAPACITOR FXD .047 UF 2% 50 VDC.
Add A9C21 0160-0575 (CD4) CAPACITOR FXD .047 UF 20% 50 VDC.

Page 8-17 (Service Sheet 2):
Change A4A2R26 to 10k ohms.

Page 8-70 Service Sheet 24 (Component Locations):
Replace a portion of Figure 8-69 with partial figure in this supplement.

Page 8-71, (Service Sheet 24):
Add A9C20, .047 uF, connected between the collector of Q4 and ground.
Add A9C21, .047 uF, connected between the collector of Q2 and ground.

CHANGE 7

Page 6-1, Table 6-1:
Add the following under AGAIN MISCELLANEOUS:
08660-60375 CD2 Qty 1 GROUND CABLE #18 AWG (GREEN/YELLOW).
Page 6-11, Figure 6-2 (Service Sheet 2A):
In the upper-left corner of the schematic add a (54) color code wire from A4A1A1 (Fan Motor) case to chassis ground. This is a Safety Ground Wire and must be re-connected if the Fan Assembly is removed.

CHANGE 8

NOTE

This change does not affect information in the manual.

CHANGE 9

Page 6-12, Table 6-1:
Change A1A1 and A2 part number and description as follows:
A1A1 0698-0083 CD0 RESISTOR 2.61K 1% .12W.
A1A2 0757-0424 CD7 RESISTOR 1.1K 1% .12W.
Page 8-33, Service Sheet 9A (schematic):
On the left edge of the schematic net. 173, change the values of A1A1A1 to 2610 ohms and A1A2 to 1100 ohms.

CHANGE 10

Page 6-17, Table 6-1:
Change A4A1 part number to 08660-60375 CD8.
Change A4A1C28 part number and description to:
0160-0976 CD5 Qty 1 CAPACITOR-FXD .1 UF 50 VDC CER.
Change A4A1C37 part number and description to:
0160-2264 CD2 CAPACITOR-FXD 20 PF CER.
Change A4A1C36 part number and description to:
0160-2906 CD3 CAPACITOR-FXD 27 PF MICA.
Change A4A1L10 part number and description to:
9140-0519 CD3 Qty 1 INDUCTOR RF-CH-MLD 220 UH 5%.
Change A4A1L12 part number and description to:
9140-0524 CD0 Qty 1 INDUCTOR RF-CH-MLD 560 UH 5%.
Page 6-18, Table 6-1:
Change A4A1R16 part number and description to:
0757-0280 CD5 Qty 1 RESISTOR 1K 1% .12W.
Change A4A1R20 part number and description to:
0757-1000 CD7 Qty 1 RESISTOR 51.1 1% .5W.
Add A4A1R33 0757-1094 CD9 RESISTOR 1.47K 1% .12W.
Add A4A1R34 0757-0416 CD7 RESISTOR 511 1% .12W.
Change A4A1U1 part number and Description to:
1820-0854 CD4 Qty 1 MC12009.

CHANGE 10 (cont'd)

<u>Page 8-19, Service Sheet 3 (component locations)</u>:
Replace Figure 8-15 with figure from this supplement.
<u>Page 8-19, Service Sheet 3 (schematic)</u>:
Replace part of Figure 8-17 with partial figure from this supplement.
In Reference Designations table, under A4A4, change to read R1-R34.
Change the part number of A4A4 Reference VCO Assy to 08660-60375.

CHANGE 11

NOTE

This change does not affect information in the manual.

CHANGE 12

<u>Page 6-17, Table 6-3</u>:
Under A4A4, add A4A4E1 9170-0029 (CD3) Qty 1 BEAD FERRITE.
<u>Page 8-19, Service Sheet 3 (component locations)</u>:
Replace Figure 8-15 with figure from this supplement.
<u>Page 8-19, Service sheet 3 (schematic)</u>:
Replace part of Figure 8-17 with partial figure from this supplement.
Add A4A4E1 to Table of Reference Designations.

CHANGE 13

<u>Page 6-24, Table 6-3</u>:
Change A7R1 part number to 0837-0306 CD4, description remains the same.

>> CHANGE 14

<u>Page 6-19, Table 6-3</u>:
Change the part number of A4A6 to 08660-60831 (CD1).
Add A4A6CR2-11 1902-0943 (CD5) DIODE-ZNR 2.4V 5% DO-35 PD=.4W TC=-.037% 28480 1902-0943.
Change the part number of A4A6Q2-13 to 1853-0360 (CD5) TRANISTOR PNP 2N3799A SI TO-18 PD=360MW 04713 2N3799A.
Delete A4A6R10, R16, R24, R31, R36, R41, R45, R49, R53, and R57.
Change the part number of A4A6R11 to 0698-0084 (CD9) RESISTOR 2.15K 1% .125W F TC=0+-100 24546 C4-1/8-T0-2151-F.
Change the part numbers of A4A6R12, R17, R25, R32, R37, R42, R46, R50, R54, and R58 to 0698-3156 (CD2) RESISTOR 14.7K 1% .125W F TC=0+-100 24546 C4-1/8-T0-1472-F.

>> CHANGE 14 (cont'd)

Page 6-23, Service Sheet 4 (schematic):
On upper left portion of schematic, change A4A6 PRETUNE ASSY (08660-60007) part number to (08660-60831).
Replace resistors R37, 33, 49, 45, 41, 36, 31, 24, and 16 with CR2-10, respectively. Show all diodes with cathodes going to U1.
Change part numbers of C2-13 to 1853-0360.
Change the values of R12, 17, 25, 32, 37, 42, 46, 50, 54, and 58 to 14.7K.
Replace R10 with CR11. Show with cathode going to collector of Q1.
Change the value of R11 to 2.15K.
On lower left portion of schematic, change PRETUNE 8660A: 1551A to PRETUNE 8660A: 2446A.

>> CHANGE 15

Page 6-22, Table 6-3:
Delete A5C20 and A5C21 (added in Change 6).
Page 6-21, (Service Sheet 2A):
Remove C20, connected between the collector of Q4 and ground.
Remove C21, connected between the collector of Q2 and ground.

>> CHANGE 16

Page 6-16, Table 6-3:
Delete A4A3C12
Change A4A3C16 and C19 to 0140-0197 CD4 CAPACITOR-FXD 180PF +-5% 300VDC MICA.
Change A4A3C17 to 0160-2204 CD0 CAPACITOR-FXD 100PF +-5% 300VDC MICA.
Page 6-19, Service Sheet 3 (schematic):
On the A4A3 Assembly:
Change the value of C16 to 180 pF
Change the value of C17 to 100 pF
Change C12 to C19, 180 pF

Table 6-3. Replaceable Parts (Part of Errata)

Reference Designation	HP Part Number	C D	Description	Mfr Part Number
A1A16U1	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U2	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U3	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U4	1820-0616	5	IC MUXR/DATA-SEL TTL 2-TO-1-LINE QUAD	9322PC
A1A16U5	1820-0069	2	IC GATE TTL NAND DUAL 4-INP	SN7420N
A1A16U6	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U7	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U8	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U9	1820-0328	6	IC GATE TTL NOR QUAD 2-INP	SN7402N
A1A16U10	1820-0661	6	IC GATE TTL OR QUAD 2-INP	SN7432N
A1A16U11	1820-0068	1	IC GATE TTL NAND TPL 3-INP	SN7410N
A1A16U12	1820-0328	6	IC GATE TTL NOR QUAD 2-INP	SN7402N
A1A16U13	1820-0511	9	IC GATE TTL AND QUAD 2-INP	SN7408N
A1A16U14	1820-0054	5	IC GATE TTL NAND QUAD 2-INP	SN7400N
A1A16U15	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U16	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U17	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U18	1820-0328	6	IC GATE TTL NOR QUAD 2-INP	SN7402N
A1A16U19	1820-0511	9	IC GATE TTL AND QUAD 2-INP	SN7408N
A1A16U20	1820-0661	0	IC GATE TTL OR QUAD 2-INP	SN7432N
A1A16U21	1820-0367	3	IC SHF-RGTR TTL R-S PRL-IN PRL-OUT 4-BIT	SN7495AN
A1A16U22	1820-0214	9	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	SN7442AN
A1A16U23	1820-0661	0	IC GATE TTL OR QUAD 2-INP	SN7432N
A1A16U24	1820-0785	3	IC CNTR TTL DECD SYNCHRO POS-EDGE-TRIG	MC8316P
A1A16U25	1820-0511	9	IC GATE TTL AND QUAD 2-INP	SN7408N
A1A16U26	1820-0174	8	IC INV TTL HEX	SN7404N

A16

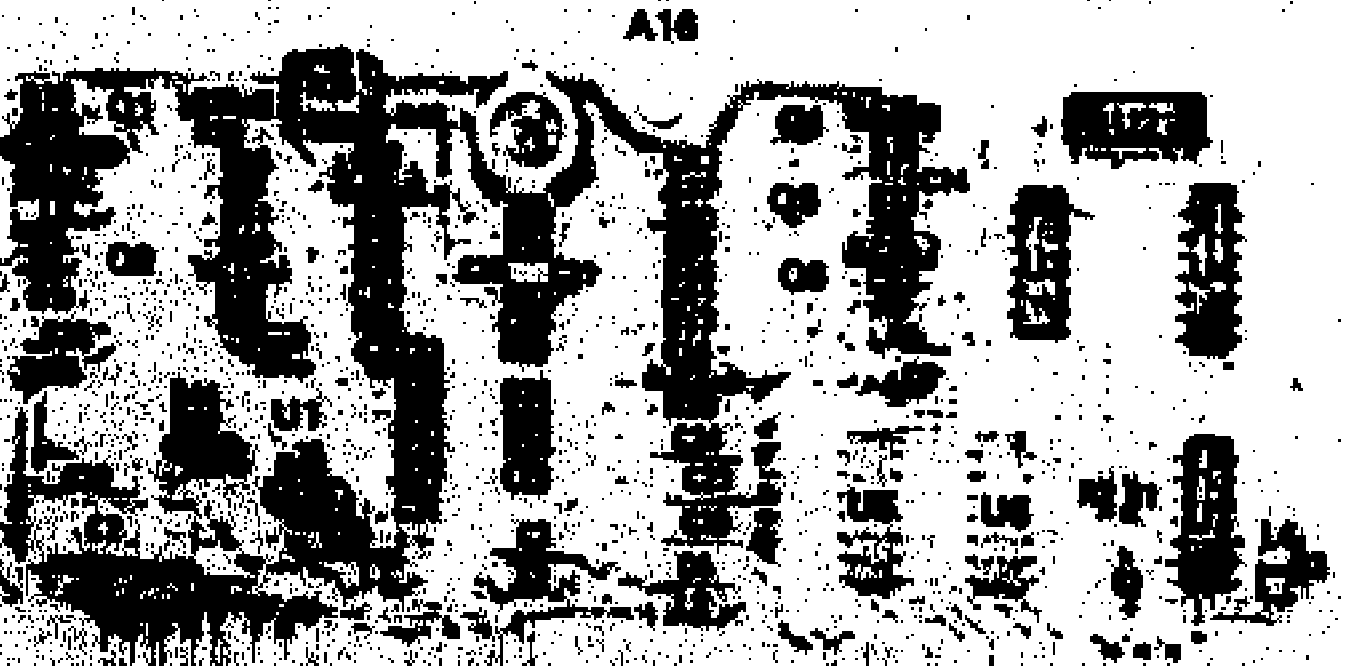


Figure 8-[illegible]. A16[illegible] Component Locations (P/O Errata)

Table 6-3. Replaceable Parts (P/O Change 1)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
[illegible]	[illegible]	[illegible]	[illegible]	OPTION [illegible] ONLY [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	CAPACITOR-FXD [illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	DIODE-SWITCHING [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	DIODE-[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	DIODE-SWITCHING [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	TRANSISTOR PNP [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	RESISTOR [illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	IC [illegible] TTL [illegible]	[illegible]	[illegible]
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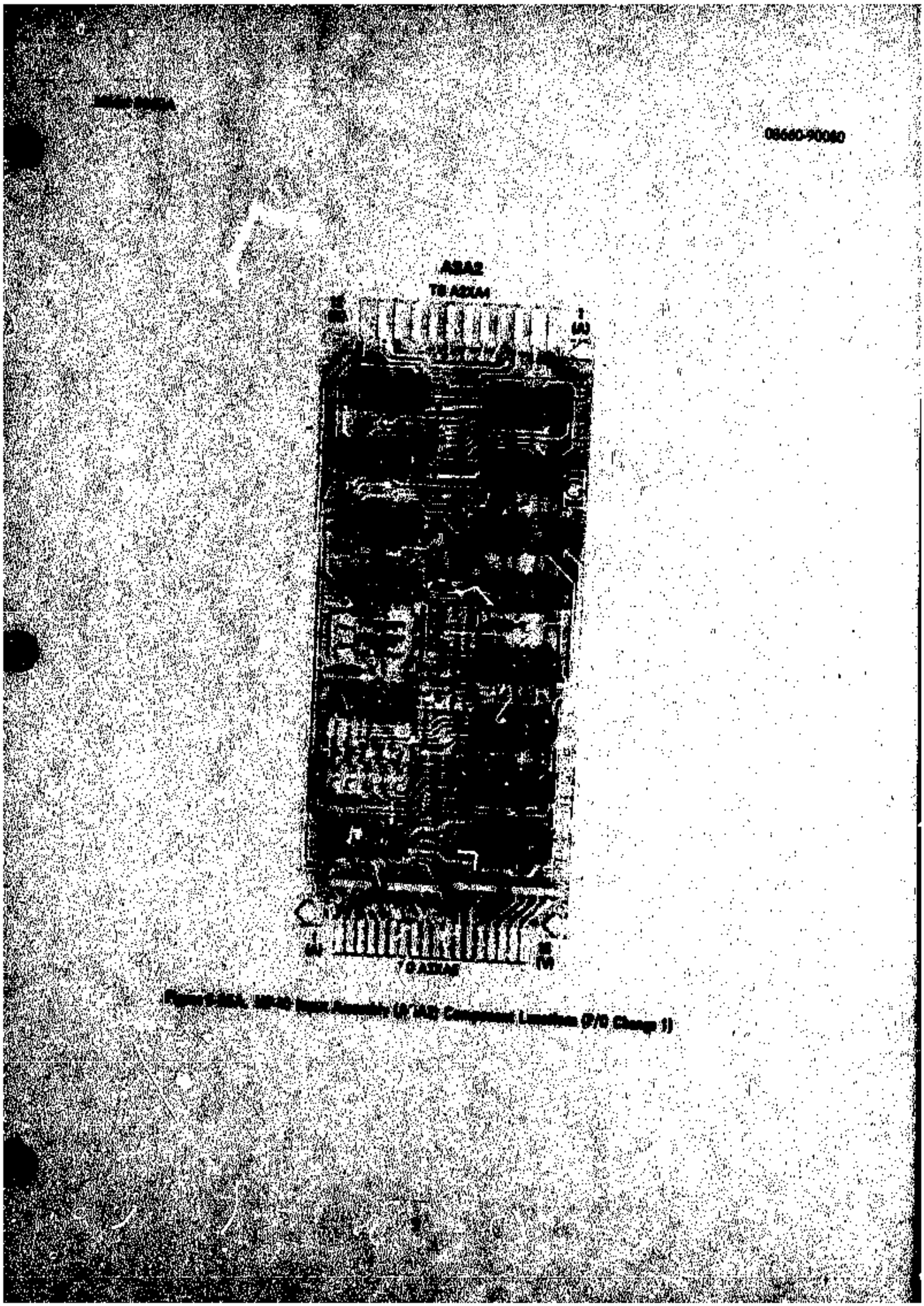

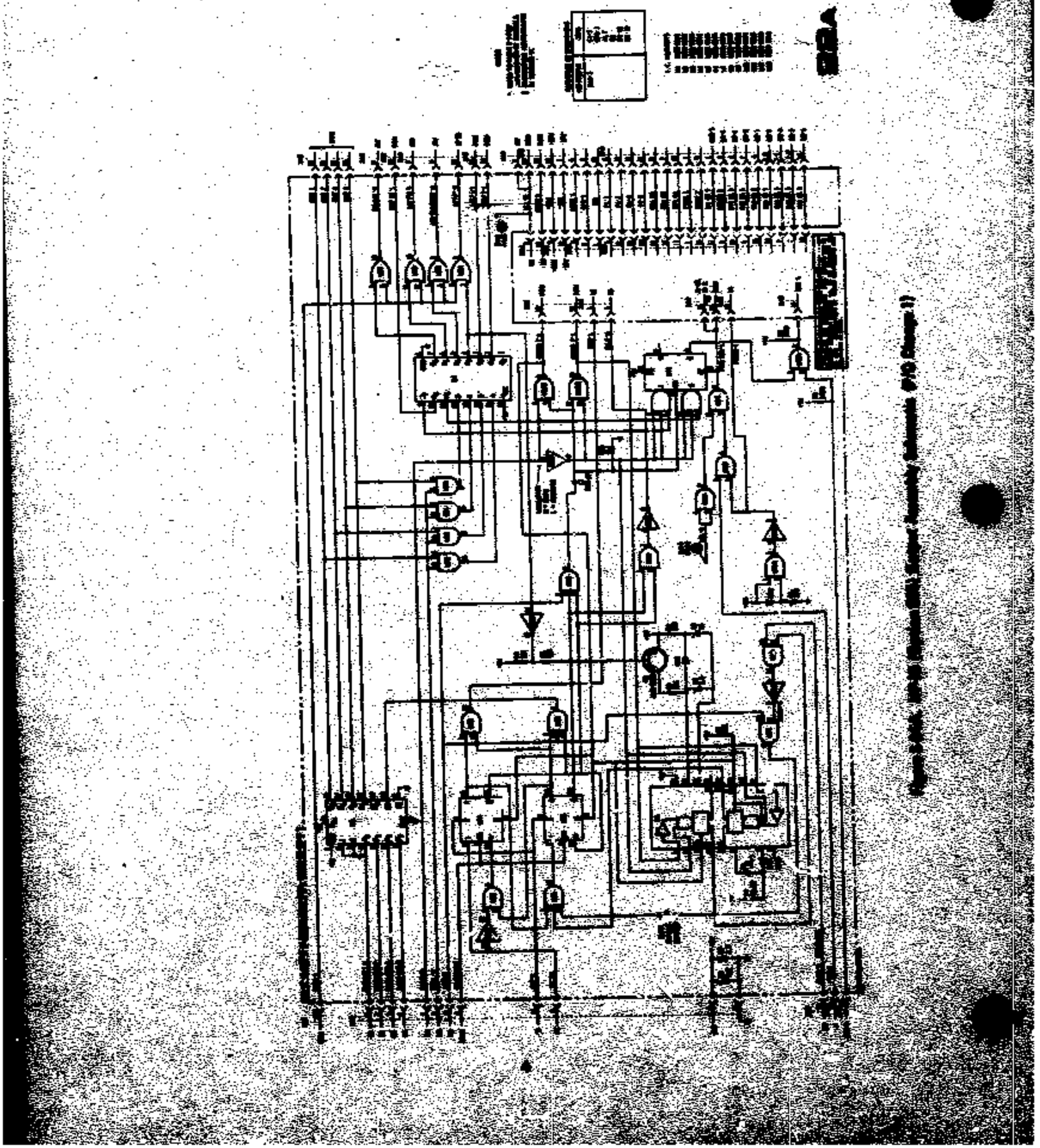

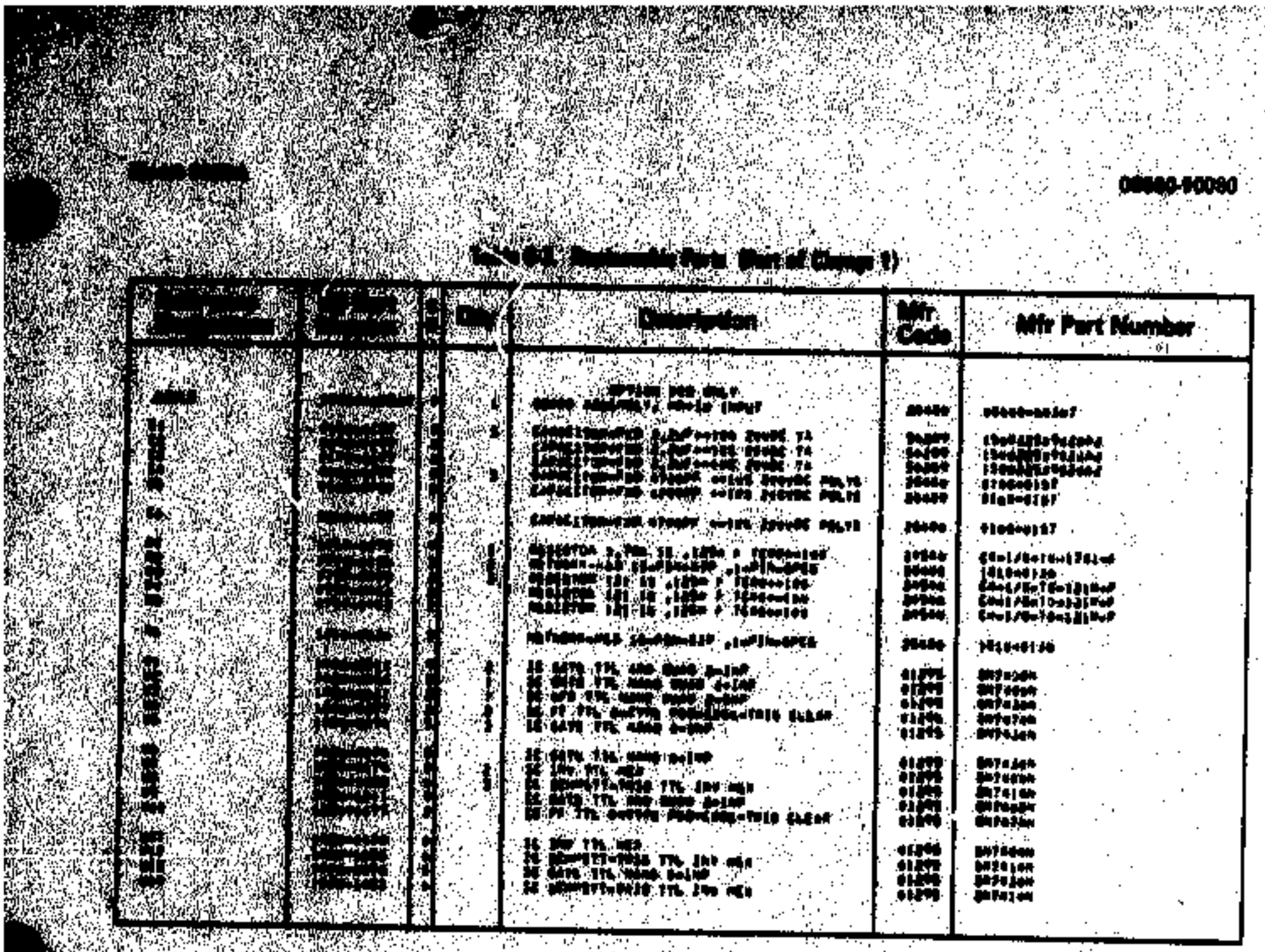

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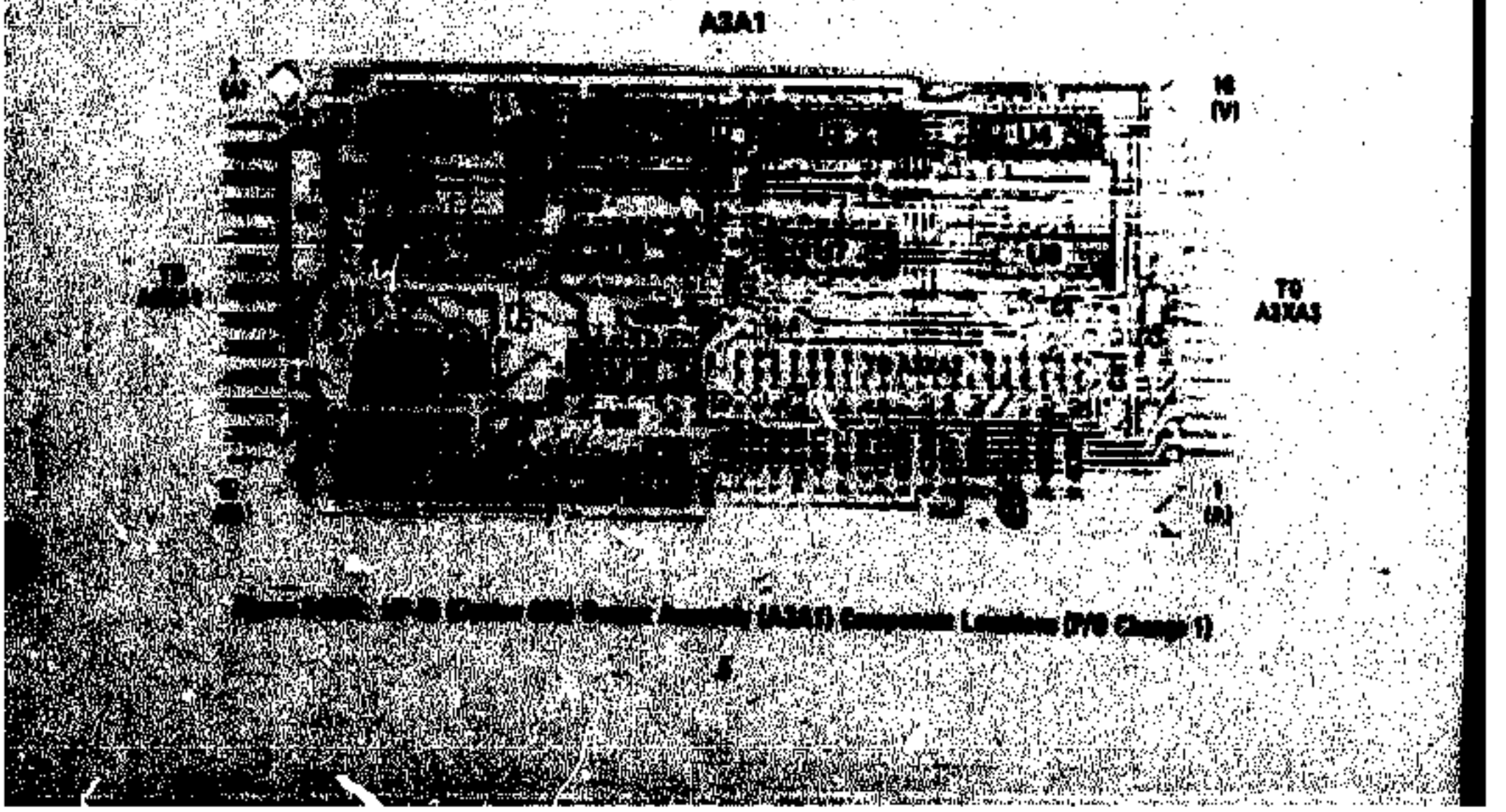
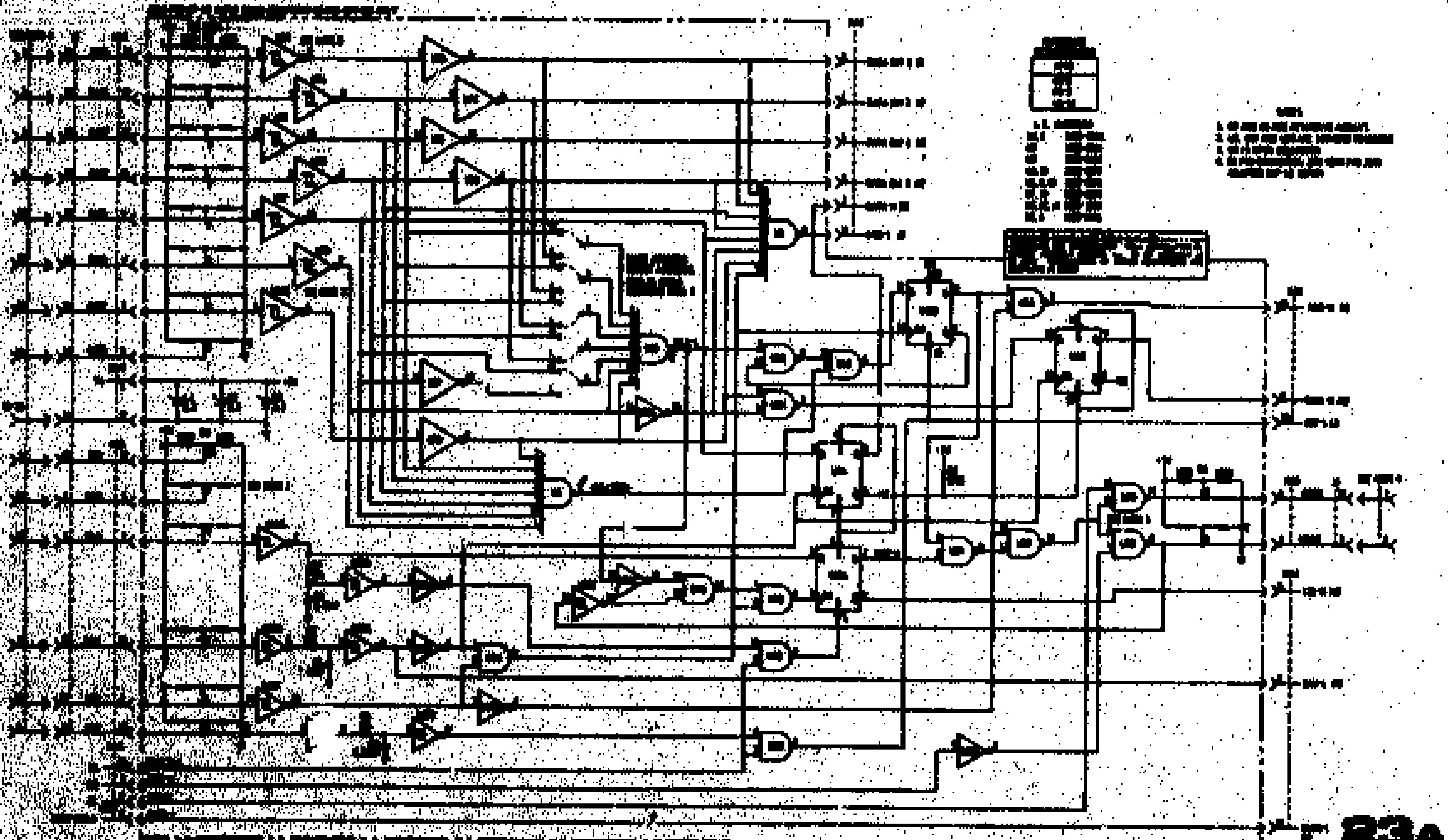
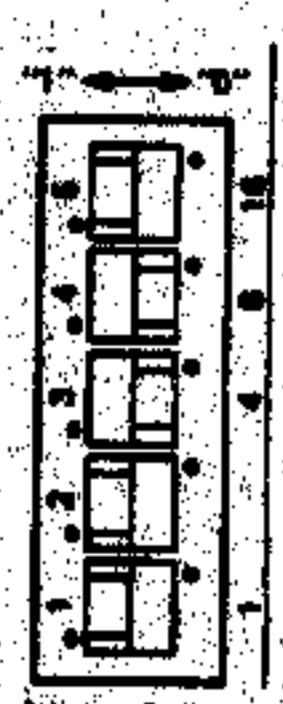
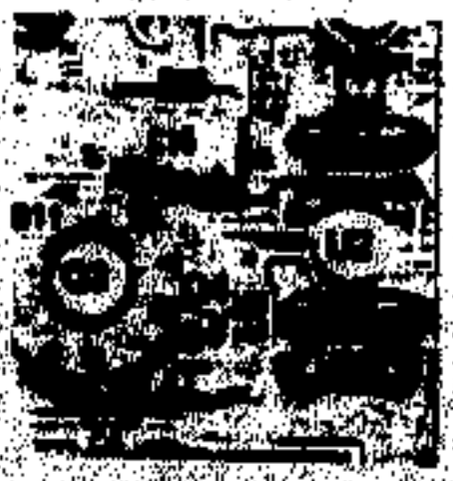




23A

Figure [illegible] Assembly Schematic (P/O Change 1)





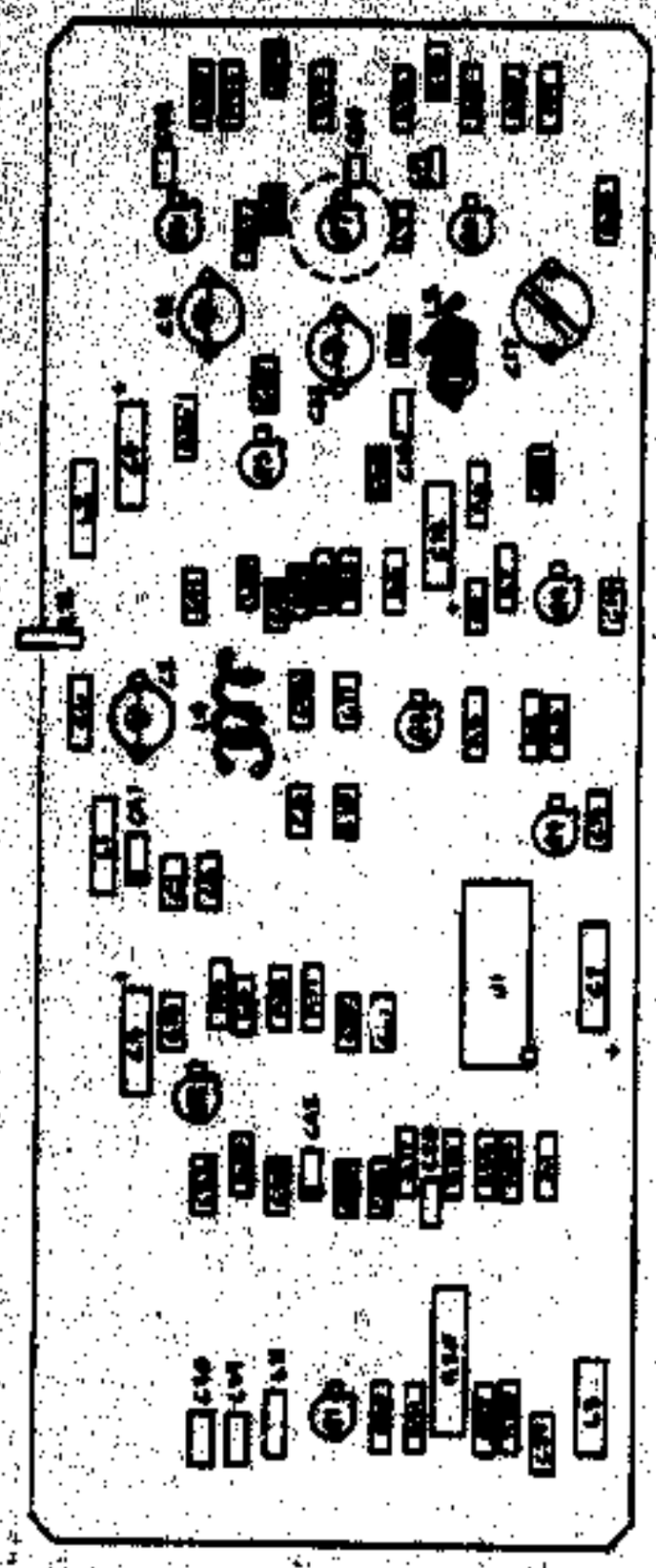
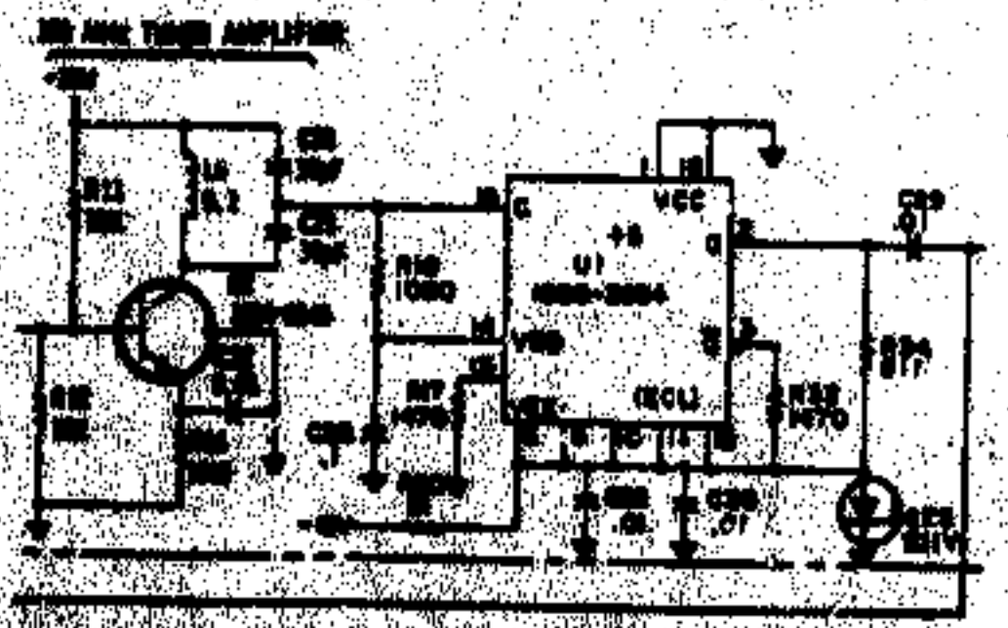


Figure 6-16. A4A4 Reference VCO Component Locations (P/O CHANGE 10)



P/O Figure 6-17. Reference VCO and Phase Detector Diagram (P/O CHANGE 10)

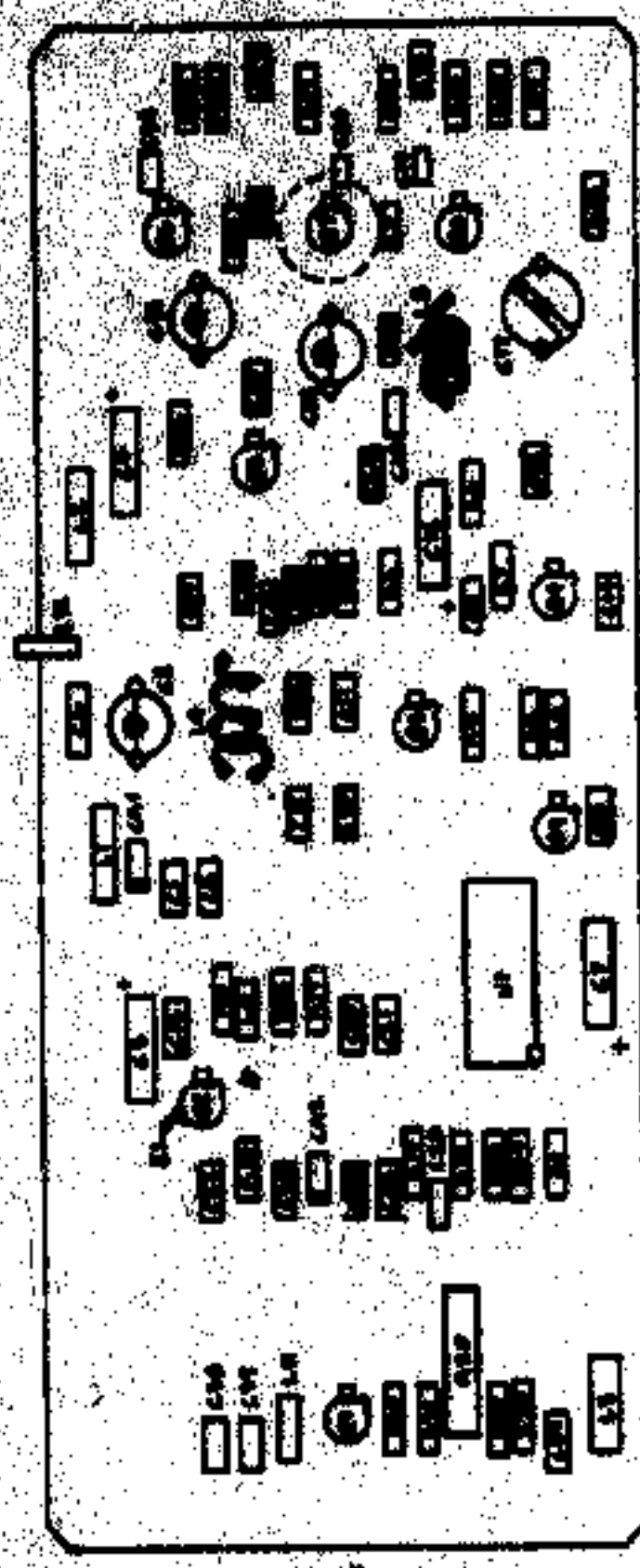
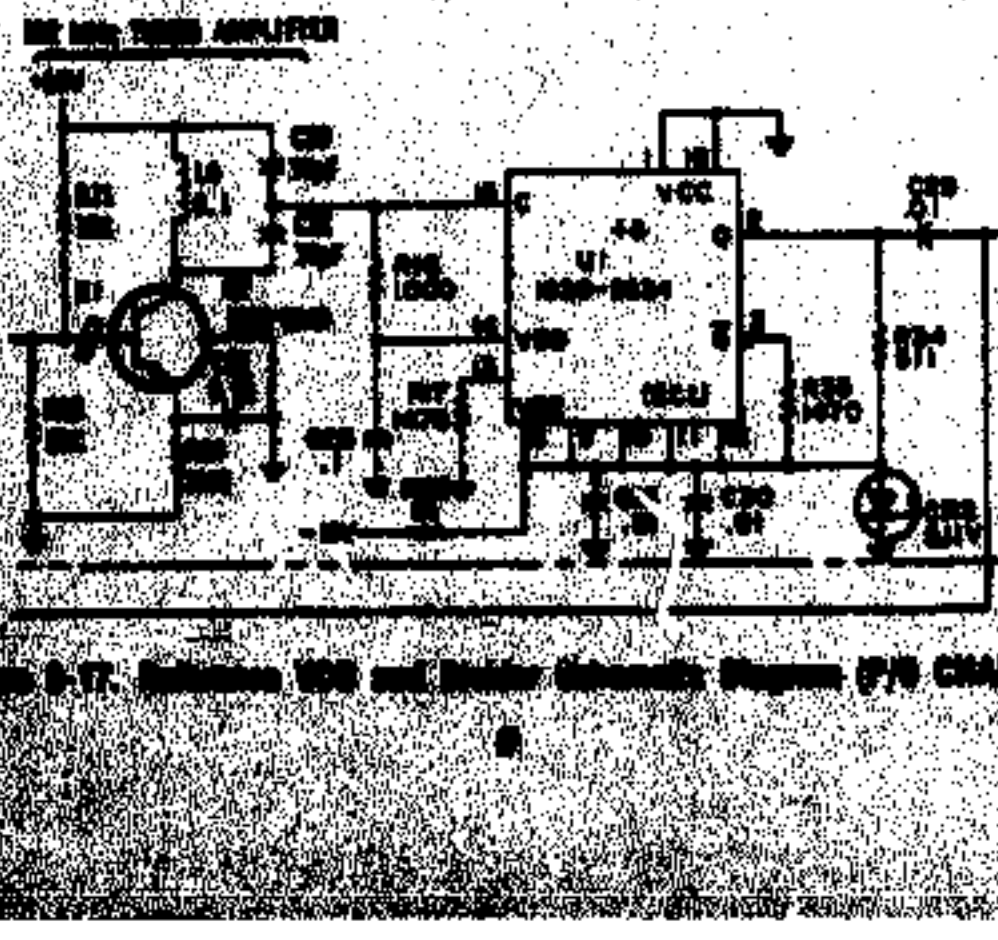


Figure 6-16. AAA Reference VCO Component Locations (P/O CHANGE 12)



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