

## Errata

**Title & Document Type:** 8683A Signal Generator Operating and Service Manual

**Manual Part Number:** 08683-90023

**Revision Date:** May 1964

### About this Manual

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

### HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

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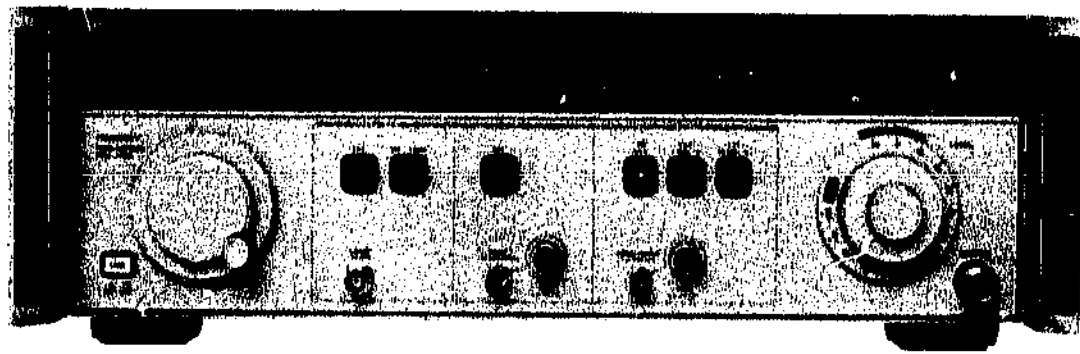
Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.



HP 8683A

# OPERATING AND SERVICE MANUAL

## HP 8683A SIGNAL GENERATOR 2.3—6.5 GHz



 **HEWLETT  
PACKARD**

HP 8683A

## **CERTIFICATION**

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

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

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

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**HP 8683A  
SIGNAL GENERATOR  
2.3—6.5 GHz  
(Including Options 001, 002 and 003)**

**SERIAL NUMBERS**

This manual applies directly to instruments with serial numbers prefixed 2402A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 2323A, 2319A, 2244A, 2208A, 2149A, and 2138A.

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



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

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**Operating Manual Part No. 08683-90025**  
**Microfiche Part No. 08683-90024**

**Printed: May 1984**

## SAFETY CONSIDERATIONS

### GENERAL

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

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

### BEFORE APPLYING POWER

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

### SAFETY EARTH GROUND

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

### WARNINGS

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

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

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

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

Adjustments described in the manual are performed with power supplied to the instrument

while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

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

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

### SAFETY SYMBOLS



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



Indicates hazardous voltages.



Indicates earth (ground) terminal.

### WARNING

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

### CAUTION

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



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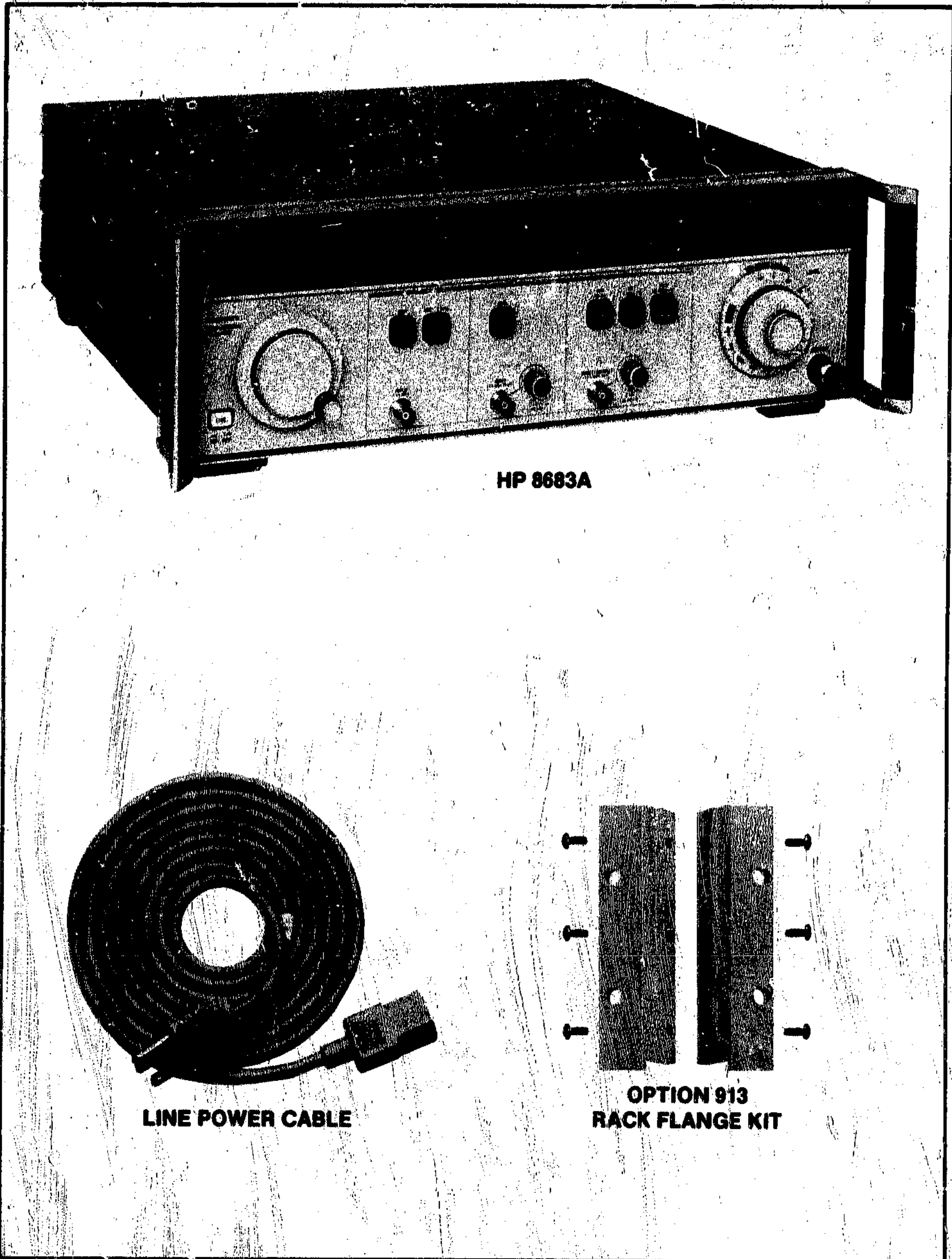
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HP 8683A

LINE POWER CABLE

OPTION 913  
RACK FLANGE KIT

Figure 1-1. HP 8683A Signal Generator with Accessory Supplied and Option Available

## SECTION I GENERAL INFORMATION

### 1-1. INTRODUCTION

This manual contains information required to install, operate, test, and service the Hewlett-Packard Model 8683A Signal Generator. The Signal Generator is shown in Figure 1-1 with all of its externally supplied accessories and the available rack mounting option. This manual also documents Option 001 which increases output power to +10 dBm and Option 003 which adds the capability of operating from 48 to 440 Hz power sources.

This section of the manual covers the instrument description, options, accessories, specifications, and other basic information. The remaining sections cover the following information.

- Section II Installation
- Section III Operation
- Section IV Performance Tests
- Section V Adjustments
- Section VI Replaceable Parts
- Section VII Manual Changes
- Section VIII Service

Two copies of the operating information are supplied with the Signal Generator. One copy is in the form of an Operating Manual and simply is a copy of the first three sections of the Operating and Service Manual. It should remain with the instrument for use by the operator. The other copy provided is the Operating and Service Manual which should be retained by the technicians responsible for the periodic servicing of the instrument. Additional copies of either manual may be ordered through your nearest Hewlett-Packard sales office. The part numbers are listed on the title page of this manual.

The Operating and Service Manual is also available in microfiche form, and the microfiche part number is also listed on the title page. This number may be used to order the 100 x 150 mm (4 by 6 inch) microfilm transparencies. Each transparency contains up to 98 photo-duplicates of the manual pages and the package includes the latest manual change supplements.

### 1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. These specifications are the performance stan-

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

### 1-3. SAFETY CONSIDERATIONS

This product is a Safety Class I instrument (i.e., provided with a protective earth terminal). The Signal Generator and all related documentation must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information pertinent to the task at hand (installation, performance testing, adjustment, or service) will be found throughout the manual.

### 1-4. INSTRUMENTS COVERED BY THIS MANUAL

This instrument has a two-part serial number in the form of 0000A00000. The number is stamped on the serial number plate attached to the rear panel of the instrument. The first four digits and the letter constitute the serial number prefix, and the last five digits form the suffix. The prefix is the same for all identical instruments, and it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under Serial Numbers on the title page.

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

In addition to change information, the supplement may contain information for correcting

**INSTRUMENTS COVERED BY THIS MANUAL (cont'd)**

errors in the manual. In order to keep your manual as current and accurate as possible, it is recommended that you periodically request the latest Manual Changes supplement. The supplements are identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplements are available from Hewlett-Packard.

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

**1-5. DESCRIPTION**

The Hewlett-Packard Model 8683A is a cavity tuned, microprocessor enhanced, solid-state signal generator with a microwave output frequency range of 2.3 to 6.5 GHz. Its output is leveled and calibrated over the range of 0 dBm to -120 dBm, and power is available down to approximately -130 dBm. Instruments with Option 001 have an output power range of +10 dBm to -130 dBm. Internal amplitude modulation in the form of a 1 kHz square wave or FM in the form of a 1 kHz sawtooth may be individually selected, and the maximum frequency deviation of the FM may be adjusted from the front panel. An external pulse generator may also be used to pulse modulate the microwave output at rates up to 10 kHz. Whether derived from external or internal sources, AM, FM, and pulse modulation may be applied individually or in various combinations. However, interlocks provided by the microprocessor controlled system prevent the selection of two sources for the same type of modulation. For example, external AM and internal FM can be selected at the same time; external FM and internal FM cannot be selected at the same time. When a conflict occurs, the Signal Generator automatically turns off the previously selected mode and turns on the most recently selected mode.

The Signal Generator uses seven-segment digital LED displays to show the output frequency, modulation level, and output level. Smaller LED indicators in each pushbutton key provide an immediate indication of whether or not that particular function is active. Other LED indicators provide warnings when the output is not properly leveled, or when overmodulation is occurring.

The cable offset feature provides a front-panel key for turning the offset on and off, and a rear-panel

control for entering cable length (up to 4.5 metres of RG-214 cable). Using the cable length data and the frequency of the Signal Generator output, the microprocessor computes the cable loss and then, operating through the automatic level control system, increases the output power level to compensate for the calculated losses. When the cable offset is turned on, the power level displayed by the Signal Generator is the computed power level at the end of the selected cable length. When the cable offset is turned off, the power level displayed by the Signal Generator is the level at the OUTPUT connector of the Signal Generator.

The setting of the rear-panel CABLE OFFSET control appears in the LEVEL display when the CABLE OFFSET key is held down. This makes it easy to verify the setting of the control or to adjust it to a new setting. The display resolution is one-tenth of a metre.

The Signal Generator has an extensive set of built-in diagnostic procedures that will rapidly identify most of the troubles that are likely to occur, and many of the procedures are automatically executed when the instrument is turned on. If a malfunction is detected, an error code number or other special display indicates the nature of the fault. The power-up error codes are described in Section III, Operation, and are also included inside the instrument on the top cover.

A second and more extensive set of diagnostic routines can be accessed by removing the top cover and switching the instrument to the diagnostic mode. This mode allows a technician (using the front-panel switches and indicators) to select individual diagnostic routines that will check power supplies, modulator voltages, detector outputs, flip-flop operation, and many other analog and digital functions. No external test equipment is required for the power-up diagnostics or for most of the testing in the diagnostic mode. The diagnostic routines are fully described in Section VIII, Service, and a summary is included inside the instrument on the top cover.

Since a fault in the microprocessor might prevent either of the first two diagnostic modes from operating, a third level of diagnostic procedures is furnished. This level is provided by the signature analysis mode. It requires the use of external test equipment, and it provides an efficient method of troubleshooting digital circuitry. The signature analysis procedures are described in Section VIII, Service.

**1-6. OPTIONS****1-7. Reverse Power Protection (Option 002)**

Option 002 provides 2 kW peak, 10W continuous, and 5 kW- $\mu$ s pulse of reverse power protection at the RF OUTPUT.

**1-8. Electrical 400 Hz Line Frequency Operation (Option 003)**

Option 003 provides the additional capability of operating from 400 Hz power sources. Option 003 instruments can operate from line frequencies of 48 to 440 Hz, but operation at line frequencies greater than 66 Hz is limited to 100 or 120 Vac.

**1-9. Mechanical Rack Flange Kit (Option 913)**

This kit contains all necessary hardware and installation instructions for mounting the Signal Generator in a rack with standard 19-inch EIA (482.5 millimetres) spacing. The Signal Generator cabinet is 5-1/4 inches (133.4 mm) high. Order HP part number 5061-2071.

**1-10. ACCESSORY SUPPLIED**

The accessory supplied with the Signal Generator is shown in Figure 1-1. The line power cable will be supplied in one of several configurations, depend-

ing upon the country of destination for the original shipment from the factory. Refer to Power Cables in Section II of this manual.

**1-11. ACCESSORIES AVAILABLE****1-12. Chassis Slide Mount Kit**

This kit is very useful when the Signal Generator is to be rack mounted. It permits access to internal circuits and components, and access to the rear panel is possible without removing the instrument from the rack. Order HP part number 1494-0018 for the slide mount kit, and part number 1494-0023 for the adapters to be used with non-HP rack enclosures.

**1-13. Chassis Tilt Slide Mount Kit**

This kit is similar to the Chassis Slide Mount Kit but it also allows the instrument to be tilted up or down 90°. Order HP part number 1494-0025 for tilting slides, and part number 1494-0023 for the adapters to be used with non-HP rack enclosures.

**1-14. RECOMMENDED TEST EQUIPMENT**

Table 1-3 lists the test equipment recommended for use in testing, adjusting, and servicing the Signal Generator. If any of the recommended equipment is not available, instruments with equivalent critical specifications may be substituted. Table 1-4 provides a list of recommended service accessories.

Table 1-1. Specifications (1 of 4)

Electrical Characteristics	Performance Limits	Conditions
<b>FREQUENCY</b> Range  Display Resolution  Calibration Accuracy	2.3 GHz to 6.5 GHz  5 MHz  $\leq 4 \text{ GHz} \pm 1.25\%$ $> 4 \text{ GHz} \pm 0.75\%$	See Table 1-2, Supplemental Characteristics  Using 4-digit 7-segment display
<b>SPECTRAL PURITY</b> Harmonics  Spurious Output  Residual FM	$< -25 \text{ dBc}$  $< -80 \text{ dBc}$  $< 5 \text{ kHz peak}$	Up to 18 GHz at maximum specified power  50 Hz to 15 kHz post-detection bandwidth
<b>RF OUTPUT</b> Level Range  Level Accuracy <sup>1</sup>  Display Resolution  Level Flatness	0 dBm to -130 dBm +10 dBm to -130 dBm  $\pm 2.5 \text{ dB}$ $\pm 3.5 \text{ dB}$  0.1 dB  $\pm 1.0 \text{ dB}$	Leveled into 50 ohms Option 001 leveled into 50 ohms  From maximum output to -110 dBm From $< -110 \text{ dBm}$ to -120 dBm  Using a 3 1/2-digit 7-segment display  With indicated power level $> -10 \text{ dBm}$
<b>GENERAL MODULATION SPECIFICATIONS</b> Types Internal AM Internal FM External AM External FM External Pulse Simultaneous AM/FM or FM/Pulse  Metering	1 kHz (nominal) square wave 1 kHz (nominal) sawtooth  3-digit LED display	
<sup>1</sup> Accuracy error includes allowances for metering accuracy, detector linearity, temperature, flatness, harmonics, attenuator accuracy, and measurement error. Accuracy specifications apply only to the top 15 dB of the LEVEL vernier range. Option 002 Reverse Power Protection affects level accuracy $\pm 3 \text{ dB}$ to -110 dBm and $\pm 4 \text{ dB}$ to -120 dBm.		

Table 1-1. Specifications (2 of 4)

Electrical Characteristics	Performance Limits	Conditions
<p><b>AMPLITUDE MODULATION<sup>2</sup></b></p> <p><b>AM Depth</b></p> <p><b>AM Distortion (Total Harmonic Distortion)</b></p> <p><b>AM Rates</b></p> <p><b>Incidental FM</b></p> <p><b>Internal AM</b></p>	<p>0 to 70%</p> <p>&lt;10% at 40% depth and 1 kHz rate.</p> <p>dc to 10 kHz</p> <p>50 Hz to 10 kHz</p> <p>&lt;10 kHz peak-to-peak</p> <p>Fixed 1 kHz (nominal) square wave with a duty cycle of 50 ±5%.</p> <p>On-Off ratio &gt;30 dB at maximum power.</p>	<p>At 1 kHz rate</p> <p>dc coupled 40% AM depth (3 dB bw)</p> <p>ac coupled 40% AM depth (3 dB bw)</p> <p>30% AM depth</p>
<p><b>FREQUENCY MODULATION</b></p> <p><b>Peak Deviation</b></p> <p><b>FM Rates</b></p> <p><b>Incidental AM</b></p> <p><b>Internal FM</b></p> <p><b>Distortion</b></p>	<p>5 MHz</p> <p>dc to 10 MHz</p> <p>100 Hz to 10 MHz</p> <p>&lt;5%</p> <p>Fixed 1 kHz (nominal) sawtooth with variable deviation up to the maximum specified deviation.</p> <p>A 1 kHz (nominal) sawtooth signal with a nominal amplitude of 1V peak is available at the FM INPUT/ OUTPUT connector.</p> <p>&lt;5%</p>	<p>dc coupled (3 dB bw)</p> <p>ac coupled (3 dB bw)</p> <p>With &lt;100 kHz rate and &lt;1 MHz peak deviation</p> <p>With 100 kHz rate and &lt;1 MHz peak deviation.</p>
<p><b>EXTERNAL PULSE INPUT REQUIREMENTS</b></p> <p><b>Rate</b></p>	<p>0 to 10 kHz</p>	<p>See Table 1-2, Supplemental Characteristics</p>
<p><sup>2</sup> Amplitude modulation specifications are valid for pulse modulation OFF and for the LEVEL vernier range of 5 to 15 dB below the maximum vernier setting with output levels at least 5 dB below the specified maximum output power.</p>		

Table 1-1. Specifications (3 of 4)

Electrical Characteristics	Performance Limits	Conditions
<b>EXTERNAL PULSE INPUT REQUIREMENTS</b> (cont'd) Width  Input	>10 $\mu$ s  TTL compatible	dc coupled
<b>RF PULSE OUTPUT</b> Rise and Fall Time  On-Off Ratio	<5 $\mu$ s  >30 dB	At maximum leveled power
<b>GENERAL</b>  Operating Temperature Range  Power Requirements Line Voltage  Line Frequency  Power Dissipation  Conducted and Radiated Interference  Operating and Non-operating Environment  Safety  Net Weight	0°C to 55°C  100, 120, 220 or 240 Vac, +5%, -10%  48 to 66 Hz  Option 003 adds 48 to 440 Hz operation  <200 VA  MIL-STD-461A  Temperature, humidity, shock, and vibration Type Tested to MIL-T-28800B Class IV Requirements.  Meets requirements of IEC 348  16.8 kg (37 lb)	All specified line voltages may be used  Limited to line voltages of 100 or 120 Vac when line frequency is >66 Hz  Conducted and radiated interference is within the requirements of CE03, CS01, CS02, CS06, RE02, RS01, and RS03 of MIL-STD-461A. Also within the requirements of VDE 0871 and CISPR Publication 11.

Table 1-1. Specifications (4 of 4)

Electrical Characteristics	Performance Limits	Conditions
<p><b>GENERAL (cont'd)</b>  <b>Dimensions:</b>  <b>Full envelope</b>  <b>Height x Width x Depth</b></p>	<p>145 H x 457 W x 495.5 mmD                      (5.75 H x 18 W x 19.5 inches D)</p>	<p>Note: For ordering cabinet accessories, the module sizes are 5 1/4 H, 1 MW, and 17 D.</p>
<p style="text-align: center;"><b>TOP</b></p> <p style="text-align: center;">Note: dimensions in millimetres and (inches)</p> <p style="text-align: center;"><b>SIDE</b></p>		



Table 1-2. Supplemental Characteristics (1 of 2)

Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted performance parameters.

### FREQUENCY

**Frequency Stability:** As a function of time, frequency stability is <30 kHz/minute 20 minutes after turn-on and <100 kHz/hour 60 minutes after turn-on (at a constant ambient temperature). Typically, frequency drift with respect to any passive load change is <5 kHz. The drift with respect to changes of 10 dB on the LEVEL vernier is <10 kHz, and the drift with respect to mode changes (CW to FM or FM to CW) is <20 kHz. Stability as a function of temperature is <15 MHz change over the range of 0°C to 55°C, and stability as a function of line voltage is <20 ppm for transient line changes from +5% to -10%.

Tuning is accomplished via a rotary tuning control requiring approximately 20 turns to cover the full band in the normal tuning mode and approximately 200 turns to cover the full band in the fine-tuning mode. The tuning range extends approximately 200 MHz above and 50 MHz below the specified frequency range.

### SPECTRAL PURITY

**SSB Broadband Noise Floor:** At maximum specified output level, the noise floor is <-150 dBc.

**Residual AM (averaged rms):** <0.1% in a 300 Hz to 15 kHz post-detection bandwidth.

**SSB Phase Noise (averaged rms):** <-72 dBc in a 1 Hz bandwidth offset 10 kHz from the carrier.

### RF OUTPUT

Reverse power must not exceed 1 watt average nor 100 watts peak. Pulse energy (pulse power x pulse width) must not exceed 1 mW-s.

Reverse Power with Option 002 must not exceed 2kW peak, 10W continuous, or 5 kW- $\mu$ s pulse.

Typically, the output impedance is 50 ohms and the SWR is <2.0.

**Auxiliary Output:** The signal at the rear-panel Type-N connector is typically >-15 dBm into 50 ohms; it is

derived from the oscillator output before reaching the amplitude modulation or pulse modulation circuits. Therefore, the auxiliary output signal may be a CW signal or may include frequency modulation, but it cannot be amplitude modulated or pulse modulated. The source impedance is approximately 50 ohms.

**RF Power Level Display:** The output level may be displayed in dBm or dB REL (relative to a user selected reference level). A CABLE OFFSET feature permits automatic correction of the power level so that the indicated level represents the level at the end of a known length of RG-214 cable.

### AMPLITUDE MODULATION

**External AM Sensitivity:** Variable, and nominally is 100% AM per volt peak into 600 ohms with AM vernier at full cw position.

**AM Display Accuracy:**  $\pm 5\%$  of full scale for depths up to 50% at a 1 kHz rate. The OVERMOD indicator may turn on in the top 5 dB of the specified LEVEL vernier range.

**Maximum Allowable Input Level:**  $\pm 5V$  peak.

### FREQUENCY MODULATION

**External FM Sensitivity:** On both the 1 MHz/V and 10 MHz/V ranges, peak deviation (with FM vernier fully cw) is approximately 100% of selected range per volt peak. Nominal input impedance is 50 $\Omega$ . FM sensitivity is lower at the low end of the frequency range; in the 1 MHz/V range, it typically is about 600 kHz/V.

**Phase Lock Input:** Rear-panel BNC connector with a typical sensitivity of -5 MHz/V. The input impedance is nominally 1 k $\Omega$ . The phase lock input sensitivity is lower at the low end of the frequency range.

**FM Display Accuracy (10 MHz/V range):**  $\pm 10\%$  of full scale for deviations up to 5 MHz at a 100 kHz rate.

**Maximum Allowable Input Level:** 5V peak.

Table 1-2. Supplemental Characteristics (2 of 2)

**PULSE MODULATION**

The EXT mode permits the pulse rate to be determined by an external source. The external signal must be a positive-going signal of >1.0V, and it must have a width of >20 ns. Nominal input impedance is 50Ω.

The input is TTL compatible.

**SIMULTANEOUS MODULATION**

During simultaneous Pulse Modulation and Amplitude Modulation, the 3 dB AM bandwidth for 40% AM depth can be approximated by  $BW = 100$  times pulse duty cycle (in Hz).

**OVERMODULATION INDICATOR**

The OVERMOD indicator lights and the MODULATION display shows 99.9 when external AM inputs cause more than 99.8% AM, when FM causes more than approximately 6 MHz deviation, or when any dc superimposed on the external FM signal results in positive or negative peak input amplitudes in excess of 1.2V. The AM and FM vernier controls may be pulled out to provide ac coupling and remove unwanted dc offsets from the INPUT signal.

**RECORDER OUTPUTS**

Two rear-panel BNC connectors provide analog output voltages suitable for driving X-Y recorders or strip chart recorders. One output provides a 0 to 10V FREQUENCY signal representing the specified tun-

ing range, and the other output provides a RELATIVE VERNIER LEVEL signal representing the 0 to 25 dB range of the LEVEL vernier.

**SERVICE MODES**

An internally selected diagnostic service mode provides a series of microprocessor controlled test routines that will rapidly measure and display power supply voltages and various analog voltages. These routines will also verify normal operation of most of the digital circuitry involved. Many of these same tests are automatically performed when power is applied to the instrument, and diagnostic codes are displayed to indicate the nature of any malfunction detected.

A second service mode permits the use of a signature analyzer when troubleshooting the microprocessor and its associated circuitry.

An edge connector providing RS-232 type signals is available for connecting the microprocessor to an HP 2600 series terminal. With this arrangement, a single diagnostic routine simultaneously displays the voltages measured at 28 different points in the instrument. Any voltage that is out of tolerance is identified by underlining or by reverse video on the terminal display. Another routine displays the actual voltage transitions measured at the outputs of 32 flip-flops so an inoperative flip-flop can easily be identified.

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

Instrument	Critical Specification	Recommended Model	Use <sup>1</sup>
50 MHz Reference Attenuator	Attenuation: 30 dB Accuracy: 30 dB $\pm$ 0.05 dB at 50 MHz	11708A (Supplied with HP 8484A Power Sensor)	P, A, T
50 Ohm Feed-Thru Termination	Accuracy: $\pm$ 1%	HP 10100C	P, T
70 MHz Modulator/Demodulator	Distortion: <1% Must be capable of demodulating 10 MHz FM rates at 50 MHz deviation on a 70 MHz carrier.	HP 3717A	P
Amplifier	Gain: 20 dB at 20 kHz	HP 465A	P
Audio Analyzer	Internal Distortion: <1% at 10 kHz Provides 100 kHz source and 100 kHz distortion measurement. Must be capable of measuring 11 mV rms.	HP 8903A	P, A, T
Digital Voltmeter	Range: 0 to 30 Vdc Resolution: 0.01 Volt	HP 3455A	P, A, T
Diode Detector	Video Bandwidth: >5 MHz Frequency Range: 2.3 GHz to 6.5 GHz	HP 8470B Opt 012	P, A, T
Frequency Counter	Range: 2.3 GHz to 6.5 GHz	HP 5342A	P, A, T
Frequency Counter	Dual Channel, Differential Measurements	HP 5345A	P
Gain-Phase Meter	Frequency Range: 1 Hz to 13 MHz	HP 3575A Opt. 001	A
Logic Probe	Suitable for TTL and CMOS testing	HP 545A	T
Mixer <sup>2</sup>	Frequency Range: 2.3 GHz to 6.5 GHz	RHG DM1-18	P, A, T
Modulation Analyzer	Frequency: 12.5 MHz Filters: 300 Hz high-pass and 15 kHz low-pass Residual AM <0.1%. Must be capable of FM measurement in presence of AM, must be capable of average and peak responding modulation measurements, and must provide demodulated AM and FM outputs.	HP 8901A	P, A, T
Oscilloscope	>200 MHz bandwidth	HP 1725A	P, A, T
Power Meter	Range: +10 dBm to -60 dBm Resolution: 0.1 dB Must be compatible with HP 8481A and HP 8484A Power Sensors.	HP 436A	P, T

<sup>1</sup> P = Performance Tests; A = Adjustments; T = Troubleshooting  
<sup>2</sup> RHG Electronics Laboratory, Inc., 161 East Industry Court, Deer Park, N.Y. 11729, Tel. (516) 242-1100, TWX 510-227-6083.

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

Instrument	Critical Specification	Recommended Model	Use <sup>1</sup>
Power Sensor	Range: +10 dBm to -30 dBm Frequency: 2.3 GHz to 6.5 GHz Must be compatible with HP 436A Power Meter.	HP 8481A	P, T
Power Sensor	Range: -30 dBm to -60 dBm Frequency: 2.3 GHz to 6.5 GHz Must be compatible with HP 436A Power Meter.	HP 8484A	P, T
Pulse Generator	Rise and Fall Time: < 10 ns Pulse Width: ≤100 ns PRF: 0 to 1 MHz Pulse Amplitude: 3V to 5V peak	HP 8013B	P, A, T
Signal Generator	Frequency Range: 2.3 GHz to 6.5 GHz Output Power: +10 dBm	HP 8683B	P
Signature Analyzer	Minimum Pulse Width of 10 ns Data Probe Input Impedance: 50 kΩ Start, Stop, and Clock Input Impedance: 50Ω	HP 5004A	T
Spectrum Analyzer (Low Frequency)	20 kHz to 100 kHz measurement of -110 dBm signals.	HP 3580A	P, A, T
Spectrum Analyzer	Frequency Range: 2.3 GHz to 18.0 GHz Sensitivity: +10 dBm to -86 dBm Resolution: 100 kHz Zero scan capability at 0.2 ms/division Log and linear vertical scaling Video and free-run triggering	HP 8565A	P
Test Oscillator	Frequency Range: 50 Hz to 10 MHz Output: 1 volt into 50 ohms 1 volt into 600 ohms	HP 651B	P, A, T
<sup>1</sup> P = Performance Tests; A = Adjustments; T = Troubleshooting			

Table 1-4. Service Accessories

Accessory*	Specification	Suggested Model
Torque Wrench (SMA Connectors)	15±0.3 inch-pounds	Utica Tool Co.** "A" Series Preset Wrench, Model #CHA-5, 15±0.3 inch-pounds (requires 5/16-inch open-end wrench)
Open-End Wrench (SMA Connectors)	5/16-inch	Utica Tool Co. Open End Standard, Model #OP102, 5/16-inch
Torque Wrench (SMC Connectors)	4±0.3 inch-pounds	Utica Tool Co.** "A" Series Preset Wrench, Model #CHA-5, 4±0.3 inch-pounds (requires 1/4-inch open-end wrench)
Open-End Wrench (SMC Connectors)	1/4-inch	Utica Tool Co. Open End Standard, Model #OP82, 1/4-inch
Pliers (External Retaining Rings)		Model #P-102X90 Industrial Retaining Ring Co., 57 Cordier Street, Irvington, N.J. 07111
Extender Boards (Two Required)	36 contacts (2 x 18)	HP 08684-60018
Foam Pad	Conductive polyurethane foam, 12 x 12 x 0.25 inches	HP 4204-0094
<p>* Refer to Section VIII, Service, for applications.                      **Utica Tool Company, Inc., Orangeburg, SC 29115 or the nearest Utica Tool Company distributor.</p>		

## SECTION II INSTALLATION

### 2-1. INTRODUCTION

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

### 2-2. INITIAL INSPECTION

#### WARNING

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

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

### 2-3. PREPARATION FOR USE

#### 2-4. Power Requirements

#### WARNING

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

Signal Generators require a power source of 115 (90 to 126) Vac or 230 (198 to 252) Vac, 48 to 66 Hz, single phase. Signal Generators with Option 003

have the additional capability of operating with line frequencies of 48 to 440 Hz. However, operation at line frequencies >66 Hz is limited to a nominal line voltage of 100 or 120 Vac. The power consumption of both versions is <200 VA.

#### WARNINGS

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

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

### ⚠ 2-5. Line Voltage and Fuse Selection

#### CAUTION

*Before plugging this instrument into the Mains (line) voltage, be sure that the correct operating voltage and fuse have been selected.*

A rear-panel line-power module permits operation from 90 to 126 Vac sources or from 198 to 252 Vac sources. The number visible in the window on the module indicates the nominal line voltage (100, 120, 220 or 240 Vac) to which the instrument must be connected. Verify that the line voltage selection card and the fuse are matched to the power source to be used. Refer to Figure 2-1, Line Voltage and Fuse Selection. Table 2-1 lists the ratings and HP part numbers for the replaceable fuses.

#### WARNING

*For protection against fire hazards, the line fuse should be a 250V normal-blow fuse with the correct current rating.*

Operating voltage is shown in module window.

**SELECTION OF OPERATING VOLTAGE**

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

**WARNING**

*Do not operate this instrument with frequencies greater than 66 Hz. Line frequencies greater than 66 Hz with line voltages greater than 126.5 Vac will cause a potential shock hazard that could result in personal injury (leakage current at these settings may exceed 3.5 mA). In addition, damage to the instrument may result.*

Figure 2-1. Line Voltage and Fuse Selection

Table 2-1. Fuse Ratings and Part Numbers

Line Voltage	Rating	Part Number
100/120V	3A, 250V	2110-0003
220/240V	1.5A, 250V	2110-0043

**2-6. Power Cable**

**WARNING**

*Before connecting this instrument, the protective earth terminal of the instrument must be connected to the protective conductor of the (Mains) power cord. The Mains plug shall be inserted only 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.*

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument is determined by the country of destination. Refer to Figure 2-2 for the part numbers of the power cables and plugs available.

**2-7. Mating Connectors**

**Coaxial Connectors.** The front-panel RF OUTPUT connector and the rear-panel AUXILIARY OUTPUT connectors require 50-ohm Type N male mating connectors. All other input and output signal connectors require 50-ohm BNC male mating connectors. Both types must be compatible with the specifications of US MIL-C-39012.

**2-8. Operating Environment**

The operating environment should be within the following limitations:

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

**2-9. Bench Operation**

The instrument cabinet has plastic feet and fold-away tilt stands for convenience in bench operation. The plastic feet are designed to ensure proper stacking with other instruments in similar housings, and the tilt stands raise the front of the Signal Generator for easier viewing of the front panel.

**2-10. Rack Mounting**

**WARNING**

*The Signal Generator weighs 16.8 kg (37 lbs); therefore, care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting.*

Rack mounting information is provided with the rack mounting kits. If a kit was not ordered as an option with the Signal Generator, it may be purchased through the nearest Hewlett-Packard office. Refer to Mechanical Options in Section I for the part number.

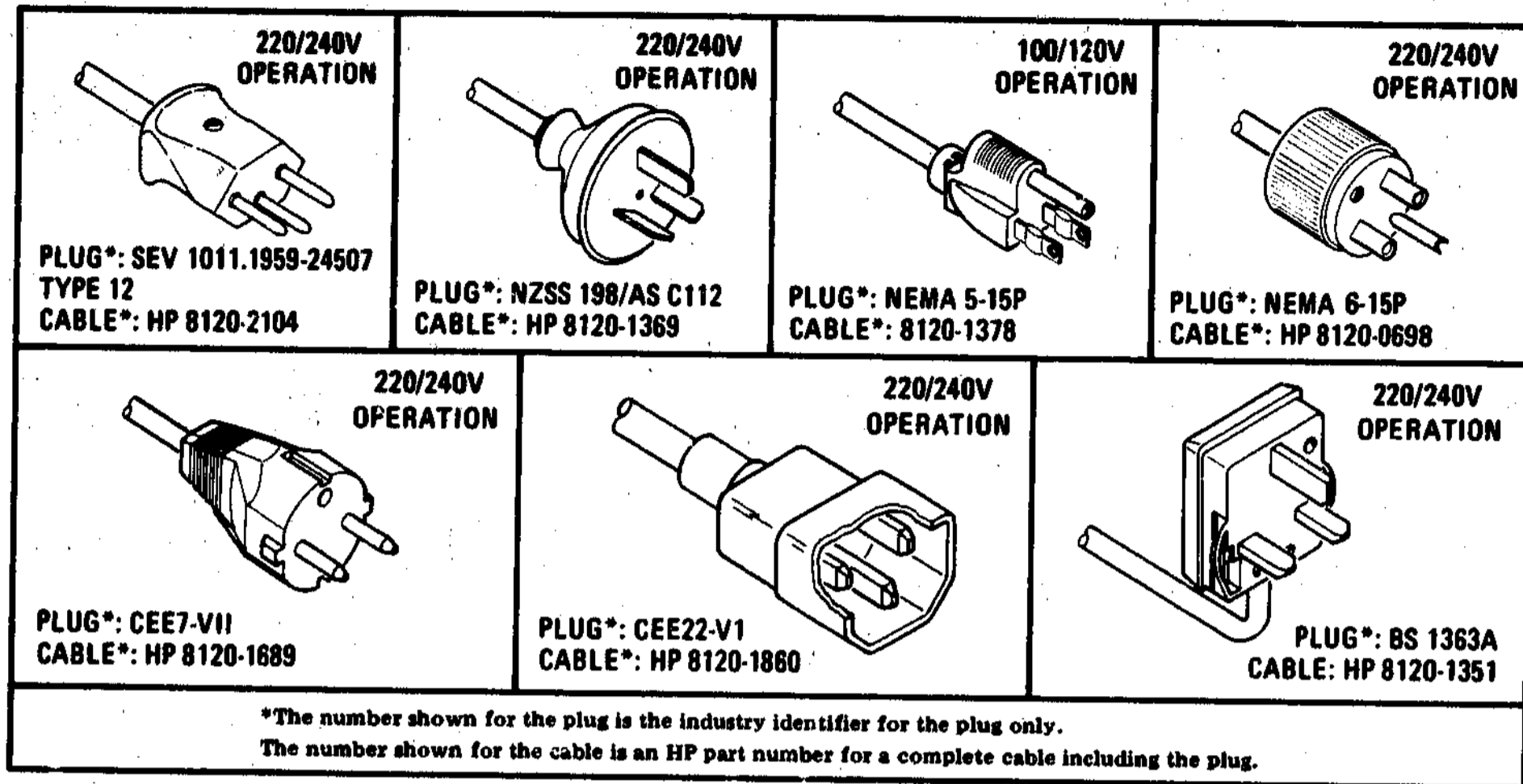


Figure 2-2. Power Cable and Plug Part Numbers

**2-11. STORAGE AND SHIPMENT**

**2-12. Environment**

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

Temperature ..... -62°C to +85°C  
 Humidity ..... <95% Relative  
 Altitude ..... <15 300 metres (50 000 feet)

**2-13. Packaging**

**Original Packaging.** Containers and material identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, please complete one of the blue repair tags located at the end of this manual and attach it to the instrument. Be sure to include the type of service required, return address, model number, and full serial number. Mark the container **FRAGILE** to assure careful handling. In any correspondence concerning a Hewlett-Packard instrument, refer to the instrument by model number and include the full serial number.

**Other Packaging.** The following general instructions should be followed for repackaging with commercially available packaging materials.

- a. Complete one of the blue service tags located at the end of this manual and attach it to the instrument. Be sure to indicate the type of service required, return address, model number, and full serial number. Then wrap the instrument in heavy paper or plastic.
- 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 or 3 to 4 inch layer) around bottom, top, and all sides to provide a firm cushion and to prevent movement within the container.
- d. Seal the shipping container securely.
- e. Mark the shipping container **FRAGILE** to assure careful handling.



# OPERATION



**SIMPLIFIED FRONT PANEL FEATURES**

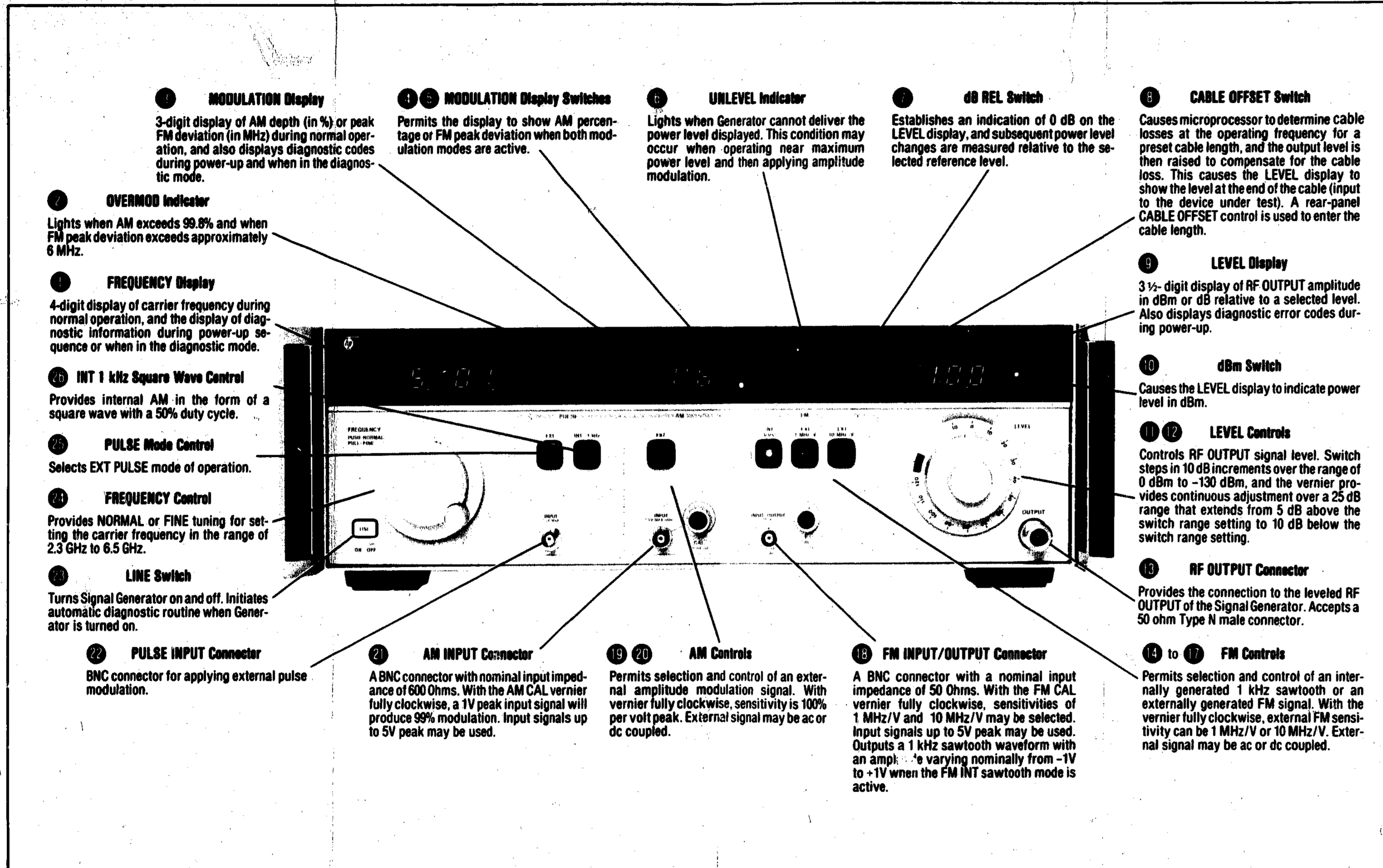


Figure 3-1. Simplified Front Panel Features

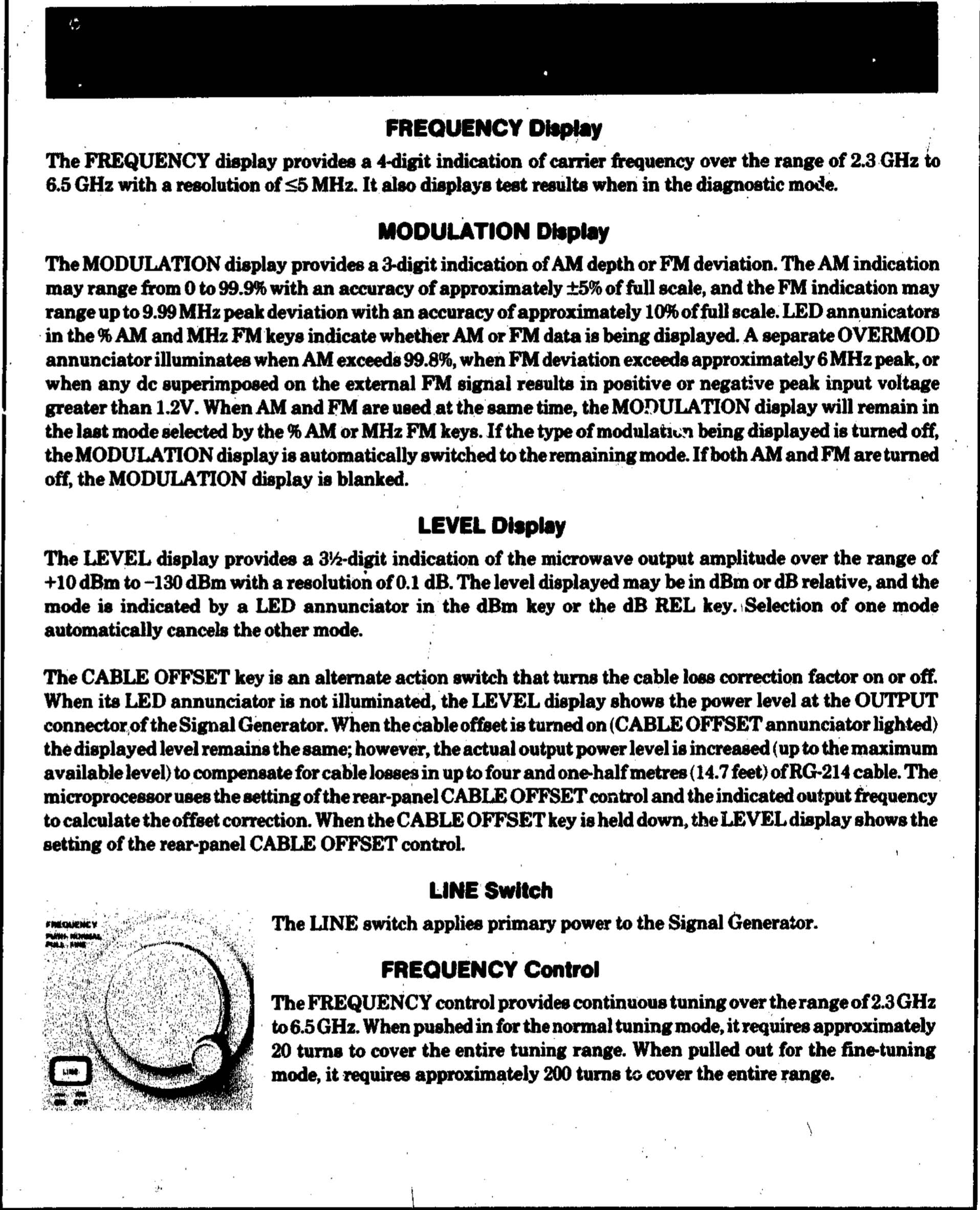


Figure 3-2. Display and Control Features (1 of 3)

## PULSE MODE

### EXT PULSE Control

When the EXT pulse mode is selected the rate, delay and width will be determined by the pulse generator connected to the INPUT connector.



### Int 1 kHz Square Wave Control

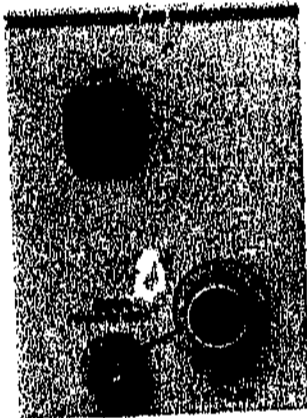
Selection of the INT 1 kHz mode provides internally generated amplitude modulation in the form of a square wave with a 50% duty cycle and an on/off ratio of >30 dB. The 1 kHz internal square wave cannot be used in conjunction with the external pulse modulation mode.

### PULSE INPUT Connector

The PULSE INPUT connector is used in the EXT PULSE mode to connect an external modulating pulse to the Signal Generator. When the EXT mode is selected, the LED annunciator lights to indicate that the EXT PULSE mode is active and an external signal is required for pulse modulation. The input is TTL compatible and the maximum input level is  $\pm 5V$  peak.

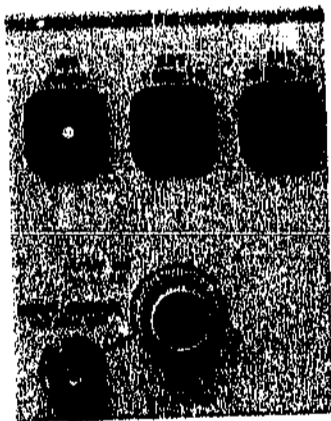
### AM Controls

AM controls are provided for the selection and control of an external modulating signal. With the AM vernier control set fully clockwise, the AM sensitivity is nominally 100% per volt peak at the AM INPUT connector. The vernier permits reduction of the amplitude modulation down to <1%. The AM EXT annunciator will light when the external AM mode is selected. When the vernier control knob is pushed in, the external modulating signal is dc coupled; when the knob is pulled out, the signal is ac coupled. The input impedance is 600 ohms. Amplitude modulation may be combined with pulse modulation and/or frequency modulation.



### FM Controls

FM controls are provided for the selection of an internal 1 kHz sawtooth, and selection of external FM with a deviation sensitivity of 1 MHz/V or 10 MHz/V. An annunciator in each key lights to indicate which mode has been selected. Since the three modes are mutually exclusive, the selection of one mode will automatically cancel any previously selected mode. Actuation of an FM control key with a lighted annunciator will turn off all frequency modulation. When the vernier control knob is pushed in, the external modulation signal is dc coupled; when the knob is pulled out, the signal is ac coupled. The vernier permits deviation control from the maximum specified deviation down to less than 1 MHz. The input impedance is 50 $\Omega$ . Frequency modulation may be combined with pulse modulation and/or amplitude modulation.



When operating in the FM INT sawtooth mode, the 1 kHz sawtooth that generates the frequency modulation is also available at the FM INPUT/OUTPUT connector. It has a rate of 1 kHz, and varies approximately from -1V to +1V. The FM vernier control has no effect on this signal. When using this sawtooth output, the external load impedance should be greater than 1 k $\Omega$ .

Figure 3-2. Display and Control Features (2 of 3)

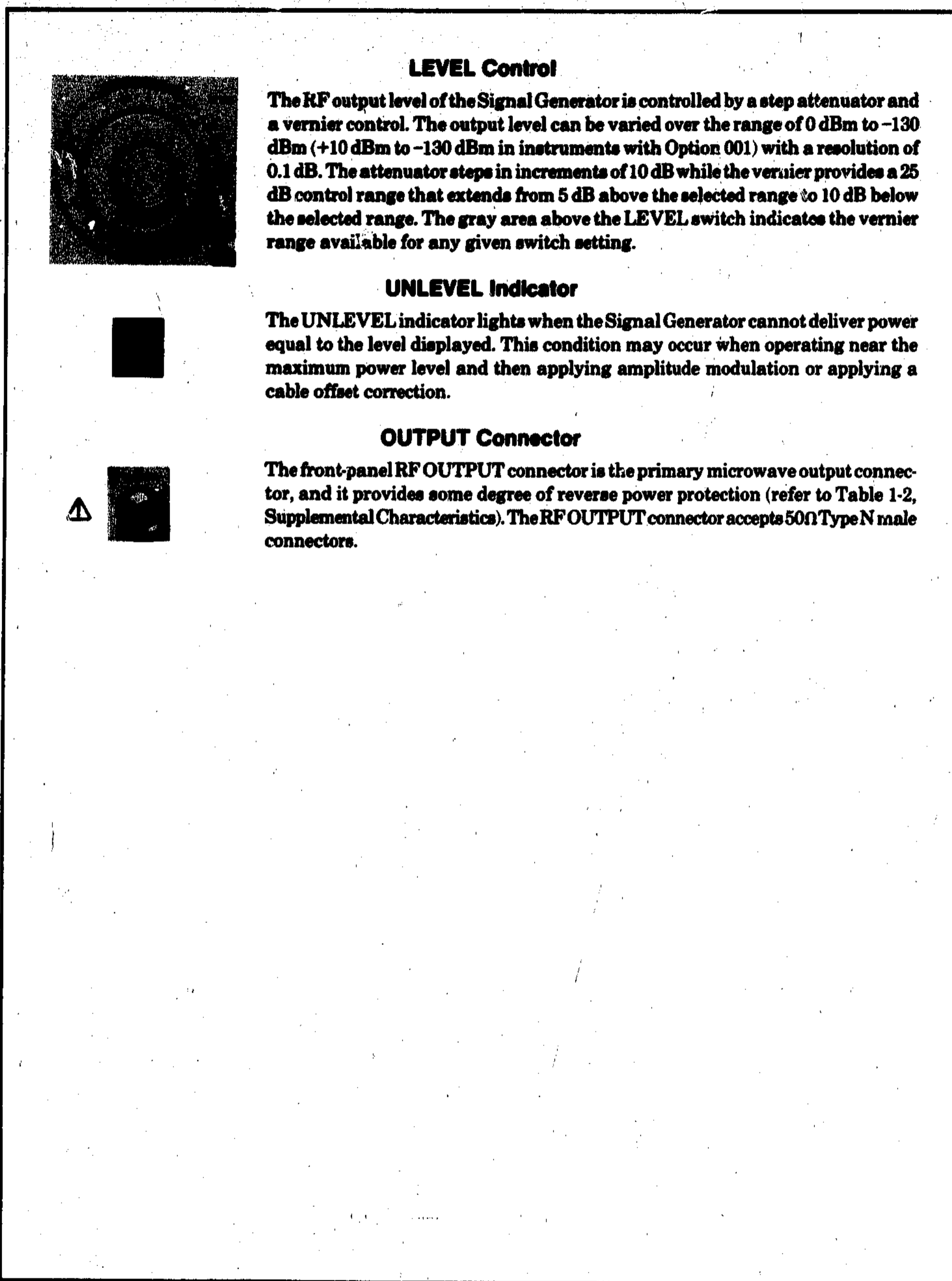
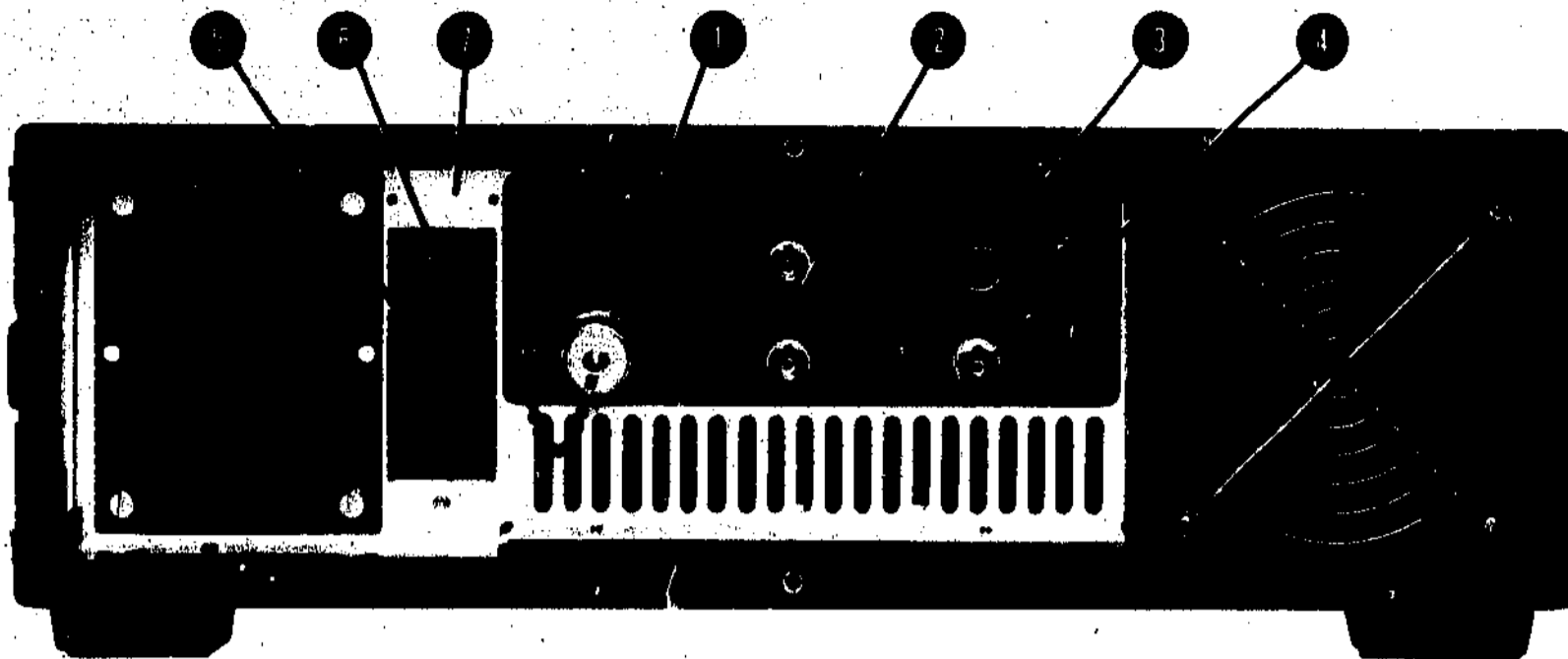


Figure 3-2. Display and Control Features (3 of 3)



### ● AUXILIARY OUTPUT Connector

The AUXILIARY OUTPUT connector provides an unlevelled sample of the oscillator output signal that is typically  $>-15$  dBm into  $50\Omega$ . This signal is derived from the oscillator output prior to the amplitude modulation and pulse modulation circuits, so AM and pulse modulation are not available on the signal. It will contain any FM component in the oscillator output. The rear-panel AUXILIARY OUTPUT connector accepts a male Type-N connector. The protective cap must be installed when the AUXILIARY OUTPUT is not in use; without the cap, RF leakage might produce erroneous results when testing at low signal levels.

#### CAUTION

*Never apply reverse power to the AUXILIARY OUTPUT connector. There is no reverse power protection at this point, and reverse power may destroy the microwave amplifier and the oscillator.*

### ● OUTPUT TO RECORDER Connectors

The recorder outputs include the RELATIVE VERNIER LEVEL output and the FREQUENCY output. The RELATIVE VERNIER LEVEL output provides an analog signal of 0V to 10V scaled at 2.5 dB/V to represent the 0 dB to 25 dB attenuation range of the front-panel LEVEL vernier control. The FREQUENCY output provides an analog signal of 0V to 10V that represents the specified frequency range. The loads connected to the recorder outputs should have an impedance greater than  $1\text{ M}\Omega$ .

### ● CABLE OFFSET Control

The CABLE OFFSET control provides a cable loss correction for up to 4.5 metres (14.7 feet) of RG-214 coaxial cable. When the CABLE OFFSET mode is

selected by the front-panel control, the microprocessor applies a correction to the leveled output power and the display shows the power level at the end of the cable (input to device under test). The correction factor is based upon the predicted cable losses at the selected output frequency.

### ● PHASE LOCK INPUT Connector

The PHASE LOCK INPUT connector provides a control feature that may basically be considered an inverted FM control input. It has a sensitivity of  $-5$  MHz/V, and the input level should not exceed  $\pm 2$  volts. When phase locking the Signal Generator output to an external signal, there are two input bandwidths available. Selecting either external FM mode provides a wide input bandwidth. Turning off all FM provides a narrow input bandwidth.

### ⚠ 5 Fuse

3A, 250V, Normal-Blow for 100/120V ac operation, or 1.5A, 250V Normal-Blow for 220/240V operation. Ordering information is presented in Section II Installation.

### ● Line Power Module

Permits operation from 100, 120, 220, or 240 Vac. The number visible in the window indicates the nominal line voltage to which the instrument must be connected (see Figure 2-1). The center conductor is the safety earth ground.

### ● Serial Number Plate

The first four digits and a letter constitute the prefix which defines the instrument configuration. The last five digits form a sequential suffix that is unique for each instrument. The plate also identifies any options supplied with the instrument.

Figure 3-3. Rear Panel Features

**3-3. OPERATOR'S CHECKS**

**NOTE**

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

Upon receipt of the instrument, or to check the Signal Generator for an indication of normal operation, perform the following the operational procedure. These procedures are designed to familiarize the operator with the Signal Generator and to provide an understanding of the operating capabilities.

1. Press LINE switch and verify that FREQUENCY, MODULATION, and LEVEL displays are filled with minus signs, go blank, and then are filled with eights. Refer to Table 3-2 if any error codes appear on the displays.

2. Rotate FREQUENCY control and verify that the FREQUENCY display responds to the changes in frequency.

3. Rotate the LEVEL step switch through steps and verify that the LEVEL display moves in 10 dB steps.

4. Rotate the LEVEL vernier and verify that the LEVEL display responds to the changes.

**Table 3-2. Power-up Error Codes**

Frequency Display	Modulation Display Test Numbers	Test	Power-up Error Code Numbers
5.25V	00	+5 Volt Power Supply	E50
6.20V	01	+6.2 Volt ALC Reference	E54
6.50V	02	+6.5 Volt microcircuit power supply	E55
15.00V	03	+15 Volt power supply	E51
-15.00V	04	-15 Volt power supply	E52
-30.00V	05	-30 Volt power supply	E53
-30.00 to 11.00V	06	Oscillator Power Supply-High Band	E57
-30.00 to 11.00V	07	Oscillator Power Supply-Low Band	E56
0.00V	10	Detector Differential on A6	E59
0.00V	11	Detector Amplifier on A6	E58
-9.00 to -0.5V	12	PIN Modulator Voltage A5TP4	E61
-0.1 to 5.00V	13	Multiplying DAC, ALC A7U5 Pin 8	E60
5.12V	16	#1 Freq. potentiometer, lower 1/3	E62
5.12V	17	#2 Freq. potentiometer, middle 1/3	E63
5.12V	18	#3 Freq. potentiometer, upper 1/3	E64
1. --	36	1. "--" means DAC is ok on bits 3-11 bits 0-2 not checked.	E10
2. e#		2. e# means this DAC bit is in error. If this error code is displayed all other error codes may be inaccurate.	
----	----	ROM checksum error	E01-E04
----	----	Front Panel checks	E05-E08
Table No.	----	Software can't find this software table	E09

**OPERATOR'S CHECKS (cont'd)**

5. Press FM INT  $\sim$  key and verify that its annunciator lights, the MODULATION display lights, and the MHz FM annunciator lights.

6. Rotate the FM vernier and verify that the MODULATION display responds to the changes in FM deviation. Rotate the FM vernier to the full clockwise position and verify that the OVERMOD annunciator lights.

7. Press AM EXT key and verify that its annunciator lights and that the MODULATION display changes from MHz FM to % AM.

8. Press AM EXT key and verify that its annunciator goes off.

9. Press FM INT  $\sim$  key and verify that its annunciator goes off.

10. Press dB REL key; verify that its annunciator is lighted and that the LEVEL display shows 0.0.

11. Press dBm key; verify that its annunciator is lighted and that the dB REL key annunciator goes off.

12. Press and hold the CABLE OFFSET key; verify that its annunciator lights and that the LEVEL display shows a number in the range of 0.0 to 4.5 (this number is determined by the setting of the rear-panel CABLE OFFSET control).

13. Release CABLE OFFSET key and verify that the LEVEL display returns to the settings established by the LEVEL switch and LEVEL vernier.

**3-4. OPERATING INSTRUCTIONS**

Paragraphs 3-5 through 3-8 explain how to set the Signal Generator for the CW mode, AM mode, FM mode, and pulse mode. Two or three types of modulation may be combined when desired. The front panel controls used to set the various modes of operation are shown in Figure 3-1.

**NOTE**

*The presence of a power-up error code when the instrument is turned on may not be critical. For instance, an error code indicating a faulty FM peak detector would not be critical if the Generator is to be used in the CW, AM, or pulse*

*mode. In situations of this type, the maintenance activities required to restore the instrument can be handled on a routine basis when time permits.*

**3-5. CW MODE OPERATION**

a. Press LINE switch (23) and verify that power-up diagnostics are completed without a critical error code display.

b. Using the FREQUENCY control (24), set desired frequency on the FREQUENCY display (1).

**NOTE**

*If a higher frequency resolution is required, a frequency counter may be connected to the rear-panel AUXILIARY OUTPUT connector.*

c. Using the LEVEL switch (11) and LEVEL vernier (12), set desired power level on the LEVEL display (9).

d. If the CABLE OFFSET feature is to be used, press and hold the CABLE OFFSET key (8) to display the CABLE OFFSET setting on the LEVEL display (9). If necessary, use rear-panel CABLE OFFSET control to establish correct setting.

**3-6. AM MODE OPERATION**

a. Press LINE switch (23) and verify that power-up diagnostics are completed without a critical error code display.

b. Using the FREQUENCY control (24), set desired frequency in the FREQUENCY display (1).

**NOTE**

*If a higher frequency resolution is required, a frequency counter may be connected to the rear-panel AUXILIARY OUTPUT connector.*

c. Using the LEVEL switch (11) and LEVEL vernier (12), set desired power level in the LEVEL display (9).

d. The EXT AM (external amplitude modulation) and CABLE OFFSET functions are mutually exclusive. The activation of either will deactivate the other.†

†Indicates manual change. See Section VII.



**AM MODE OPERATION (cont'd)**

e. For internal AM operation, press PULSE 1 kHz key (26) and verify that its annunciator lights. This will provide a 1 kHz square wave with a nominal 50% duty cycle.

**CAUTION**

*In the next step, the maximum allowable input level is 5V peak.*

f. For external AM operation, press AM EXT key (19) and verify that its annunciator lights. Then connect external modulation source to AM INPUT connector (21), and adjust external source level and/or AM vernier (20) to display desired modulation level (% AM) on the MODULATION display (3). The OVERMOD indicator (2) lights when an AM level above 99.8% is selected.

**NOTES**

*At RF output levels near the maximum specified power, the application of high levels of amplitude modulation may cause the UNLEVEL indicator (6) to light. This occurs when the RF amplifier cannot deliver the power required for the indicated level of modulation. Lowering the RF output level or the modulation level will cause the UNLEVEL indicator to go out.*

*External AM may be combined with FM and/or pulse modulation. The INT 1 kHz square wave may be combined with FM.*

**3-7. FM MODE OPERATION**

a. Press LINE switch (23) and verify that power-up diagnostics are completed without a critical error code display.

b. Using the FREQUENCY control (24), set desired frequency on the FREQUENCY display (1).

**NOTE**

*If a higher frequency resolution is required, a frequency counter may be connected to the rear-panel AUXILIARY OUTPUT connector.*

c. Using the LEVEL switch (11) and LEVEL vernier (12), set desired power level on the LEVEL display (9).

d. If the CABLE OFFSET feature is to be used, press and hold the CABLE OFFSET key (8) to display the CABLE OFFSET setting on the LEVEL display (9). If necessary, use rear-panel CABLE OFFSET control to establish correct setting.

e. For internal FM operation, press FM INT key (14) and verify that its annunciator lights. This will provide a 1 kHz sawtooth output.

f. Set FM deviation by using FM vernier (17) to obtain the desired modulation level (MHz FM) on the MODULATION display (3).

**CAUTION**

*In the next step, the maximum allowable input level is 5V peak.*

g. For external FM operation, press FM EXT 1 MHz/V key (15) or FM EXT 10 MHz/V key (16) and verify that its annunciator lights. Then connect external FM source to the FM INPUT/OUTPUT connector (18), and adjust external source level and/or FM vernier (17) to display the desired modulation level (MHz FM) on the MODULATION display (3). The OVERMOD indicator (2) lights when a peak deviation of 6.1 MHz or higher is selected.

**NOTE**

*FM may be combined with AM and/or pulse modulation.*

**3-8. PULSE MODE OPERATION**

a. Press LINE switch (23) and verify that power-up diagnostics are completed without a critical error code display.

b. Using the FREQUENCY control (24), set desired frequency on the FREQUENCY display (1).

**NOTE**

*If a higher frequency resolution is required, a frequency counter may be connected to the rear-panel AUXILIARY OUTPUT connector.*

c. Using the LEVEL switch (11) and LEVEL vernier (12), set desired power level on the LEVEL display (9).

**PULSE MODE OPERATION (cont'd)**

d. If the CABLE OFFSET feature is to be used, press and hold the CABLE OFFSET key (8) to display the CABLE OFFSET setting on the LEVEL display (9). If necessary, use rear-panel CABLE OFFSET control to establish correct setting.

**External Pulse Mode Operation**

e. Press EXTPULSE key (25) and verify that its annunciator lights.

**CAUTION**

*In the next step, the maximum allowable input level is 5V peak.*

f. Set external pulse source for a compatible output level, and connect the source to the PULSE INPUT (22) connector.

g. Set pulse rate and pulse width as required on the external pulse source.

**NOTE**

*The external pulse mode may be combined with AM and/or FM. It cannot be combined with the INT 1 kHz square wave.*

# PERFORMANCE CHECK

## SECTION IV PERFORMANCE TESTS

### 4-1. INTRODUCTION

The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

#### NOTE

*If the performance tests are to be considered valid, the following conditions must be met:*

*a. The Signal Generator must have a 20-minute warm-up for all specifications.*

*b. The line voltage for all instruments except those with Option 003 must be 100, 120, 220, or 240 Vac +5%, -10%; the line frequency must be 48 to 66 Hz. Instruments with Option 003 have the additional capability of operating on line frequencies of 48 to 440 Hz, but the line voltage is limited to a nominal 100 or 120 Vac if the line frequency is >66 Hz.*

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

### 4-2. EQUIPMENT REQUIRED

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

### 4-3. PERFORMANCE TEST RECORD

Results of the performance test may be tabulated on Table 4-1, Performance Test Record. The Performance Test Record lists all of the performance test specifications and the acceptable limits for each specification. If performance test results are recorded during an incoming inspection of the instrument, they can be used for comparison during periodic maintenance or troubleshooting procedures. The test results may also prove useful in verifying proper adjustments after repairs are made.

### 4-4. CALIBRATION CYCLE

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

### 4-5. ABBREVIATED PERFORMANCE TEST

The following abbreviated performance test procedure requires a frequency counter, power meter, power sensor, spectrum analyzer, and a test oscillator. Refer to Table 1-3, Recommended Test Equipment, for the suggested model numbers.

1. Connect a frequency counter to the OUTPUT connector of the Signal Generator, and tune the Generator to 2.300 GHz.
2. Set Signal Generator LEVEL control for an output power level of approximately -15 dBm and adjust counter triggering level if necessary. The counter should indicate a frequency between 2.271 GHz and 2.329 GHz.
3. Tune Generator to 4.000 GHz and verify that the counter indicates between 3.950 GHz and 4.050 GHz.
4. Tune Generator to 6.500 GHz and verify that the counter indicates between 6.451 GHz and 6.549 GHz.
5. Disconnect frequency counter and connect power sensor of the power meter to the OUTPUT connector of the Generator.
6. On the power meter, set the CAL FACTOR % control to the percentage indicated by the calibration chart on the power sensor. Then verify that the level indicated by the power meter is within  $\pm 2.5$  dB of that indicated by the LEVEL display on the Generator. If the measurement is out of tolerance, check CAL ADJ setting of the power meter and repeat measurement.
7. Set Signal Generator LEVEL to -5.0 dBm and verify that the power meter indicates within  $\pm 2.5$  dB of that level.

### ABBREVIATED PERFORMANCE TEST (cont'd)

8. Momentarily press the dB (REF) switch on the power meter, and verify that the power meter indication goes to zero. Then tune the Generator from 6.500 GHz down to 2.300 GHz while observing output level flatness on the power meter. The total variation (highest to lowest power level) should be less than 2 dB. Be sure to change the CAL FACTOR % control on the power meter when necessary.

9. Disconnect power sensor and connect the spectrum analyzer to the OUTPUT connector of the Generator. Tune both the Generator and the analyzer to approximately 4.0 GHz. The exact frequency is not important.

10. Adjust spectrum analyzer controls to place the peak of the signal at the top graticule line. Use a frequency span of 0.5 MHz/div., a bandwidth of 10 kHz, and a scan time of 20 ms/div.

11. On the Signal Generator, press the INT 1 kHz key and verify that its annunciator lights. Then verify that the spectrum analyzer shows a pulse spectrum with spectral components spaced 1 kHz apart.

12. Press the INT 1 kHz key again and verify that its annunciator goes off. Then press the FM INT  $\sim\sim\sim$  key and verify that its annunciator lights. The spectrum analyzer display should appear similar to the one shown in Figure 4-1.

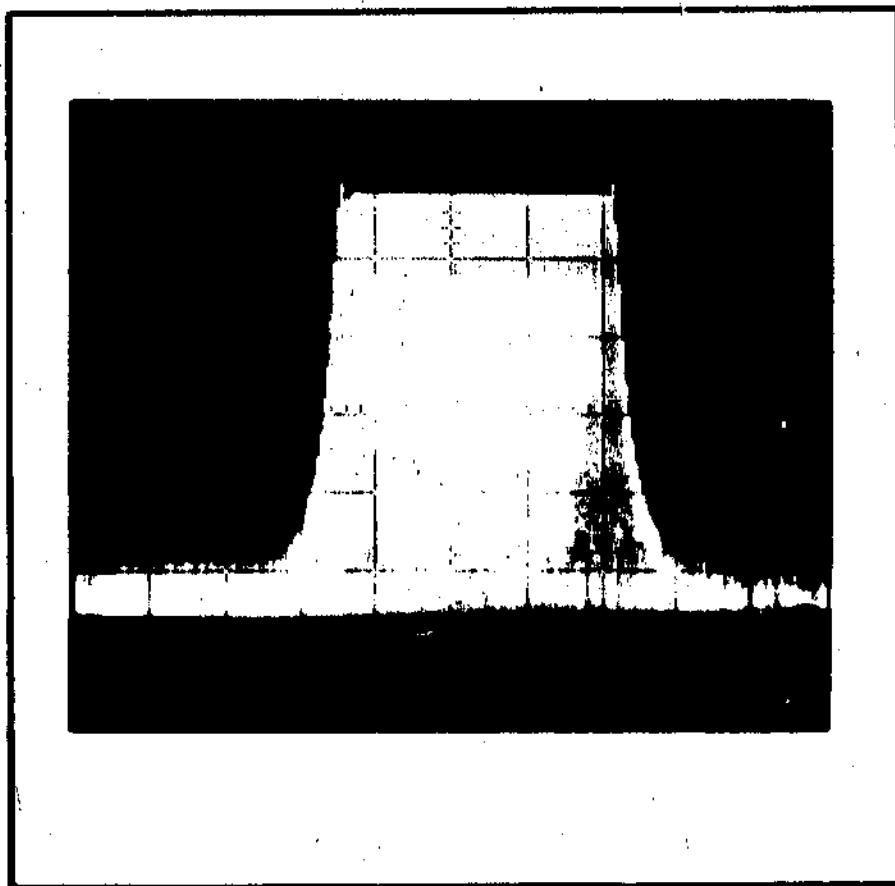


Figure 4-1. Sawtooth Spectrum

13. Press the FM INT  $\sim\sim\sim$  key again and verify that its annunciator goes off. Then step the LEVEL switch down in 10-dB increments to -120 dBm while watching the display on the spectrum analyzer. Verify that the steps are in fact 10 dB each. If the carrier signal cannot be seen all the way down to -120 dBm, then check the steps down to the lowest level that is visible.

14. Return the LEVEL switch to 0 dBm and verify that the peak of the carrier signal is on the top line of the spectrum analyzer graticule. Then tune the spectrum analyzer to approximately 8 GHz and check the level of the second harmonic. It must be at least 25 dB below the carrier level.

15. Return spectrum analyzer to 4.000 GHz. Press the Signal Generator's INT PULSE key, and verify that the key annunciator is lighted. The spectrum analyzer display should have a pulse spectrum with the lines spaced by 1 kHz and with minima every 5 kHz. Press INT PULSE key and verify that its annunciator is off.

16. Press AM EXT key and verify that its annunciator is lighted. Then connect the 600 $\Omega$  output of the test oscillator to the AM INPUT connector and turn the AM vernier fully clockwise. Set test oscillator output frequency to 10 kHz and output level to 0.354 Vrms. Verify that the MODULATION display on the Signal Generator shows about 50  $\pm$  5% AM. The 10 kHz sidebands on the spectrum analyzer should be 9 dB below the carrier. Press AM EXT key and verify that its annunciator is off.

#### 4-6. TEST PROCEDURES

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

**PERFORMANCE TESTS**

**4-7. FREQUENCY RANGE AND ACCURACY TESTS**

**Specification**

Electrical Characteristics	Performance Limits	Conditions
<b>FREQUENCY Range</b>	2.3 GHz to 6.5 GHz	See Table 1-2, Supplemental Characteristics
<b>Display Resolution</b>	5 MHz	Using 4-digit 7-segment display
<b>Calibration Accuracy</b>	≤4 GHz ±1.25% >4 GHz ±0.75%	

**Description**

A frequency counter is connected to the Signal Generator microwave OUTPUT, and the tuning limits are checked at the lower and upper ends of the tuning range. Calibration accuracy is verified by comparing the frequency counter indication with the front-panel indication of the signal generator.

**Equipment**

Frequency Counter ..... HP 5342A

**Procedure**

**Frequency Range and Calibration Accuracy**

1. Set Signal Generator output level to approximately -15 dBm. The actual level is not critical as long as the counter triggers properly.
2. Connect frequency counter to microwave OUTPUT connector of Signal Generator and check for proper triggering of counter. If necessary, adjust trigger level of counter or output level of Signal Generator.
3. Turn the Signal Generator FREQUENCY control counterclockwise until it reaches the mechanical stop, and record the minimum frequency attainable.  
\_\_\_\_\_GHz
4. Set Signal Generator for an indication of 2.300 GHz on its front-panel indicator, and verify that the frequency counter indicates between 2.271 GHz and 2.329 GHz.  
\_\_\_\_\_GHz
5. Set Signal Generator for an indication of 3.400 GHz on its front-panel indicator, and verify that the frequency counter indicates between 3.357 GHz and 3.443 GHz.  
\_\_\_\_\_GHz
6. Set Signal Generator for an indication of 4.500 GHz on its front-panel indicator, and verify that the frequency counter indicates between 4.466 GHz and 4.534 GHz.  
\_\_\_\_\_GHz

**PERFORMANCE TESTS**

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**FREQUENCY RANGE AND ACCURACY TESTS (cont'd)**

**Procedure  
(cont'd)**

- 7. Set Signal Generator for an indication of 5.600 GHz on its front-panel indicator, and verify that the frequency counter indicates between 5.558 GHz and 5.642 GHz.

\_\_\_\_\_GHz

- 8. Set Signal Generator for an indication of 6.500 GHz on its front-panel indicator, and verify that the frequency counter indicates between 6.451 GHz and 6.549 GHz.

\_\_\_\_\_GHz

- 9. Turn Signal Generator FREQUENCY control clockwise until it reaches the mechanical stop, and record the maximum frequency attainable.

\_\_\_\_\_GHz

- 10. If accuracy at other frequencies is critical for your applications, the Signal Generator may be checked at those frequencies. The specified accuracy at  $\leq 4$  GHz is  $\pm 1.25\%$ ; at  $> 4$  GHz the accuracy is  $\pm 0.75\%$ .

Indicated Freq. \_\_\_\_\_ GHz      Measured Freq. \_\_\_\_\_ GHz

Indicated Freq. \_\_\_\_\_ GHz      Measured Freq. \_\_\_\_\_ GHz

Indicated Freq. \_\_\_\_\_ GHz      Measured Freq. \_\_\_\_\_ GHz

Indicated Freq. \_\_\_\_\_ GHz      Measured Freq. \_\_\_\_\_ GHz

Indicated Freq. \_\_\_\_\_ GHz      Measured Freq. \_\_\_\_\_ GHz

**PERFORMANCE TESTS**

**4-8. SPECTRAL PURITY TESTS**

**Specification**

Electrical Characteristics	Performance Limits	Conditions
<b>SPECTRAL PURITY</b> Harmonics	<-25 dBc	Up to 18 GHz at maximum specified power
Spurious Output	<-80 dBc	
Residual FM	<5 kHz peak	50 Hz to 15 kHz post-detection bandwidth

**Description**

A spectrum analyzer with a tracking filter is connected to the output of the Signal Generator, and the analyzer is tuned to the fundamental frequency and adjusted to establish a convenient reference level on the display. The analyzer is then tuned to the second harmonic to check its levels in relation to the fundamental. If a particular harmonic is slightly out of specification, the Signal Generator is tuned to that frequency to establish a new reference at that frequency and thus improve the accuracy of the measurement.

To search for non-harmonic spurious output signals, the spectrum analyzer is tuned to the frequencies of possible spurious signals. If spurious output signals are found, they will be caused by the 30 MHz reference source used in the automatic level control circuits or the 1 MHz clock used for the microprocessor. They will be found 30 MHz or 1 MHz away from the fundamental.

Residual FM is measured by mixing the output of the Signal Generator with the output of another generator with equal or better residual FM; the result is measured on the modulation analyzer.

**Equipment**

- Spectrum Analyzer ..... HP 8565A
- Spectrum Analyzer (Low Frequency) ..... HP 3580A
- Signal Generator ..... HP 8683A or 8683B
- Modulation Analyzer ..... HP 8901A
- Frequency Counter ..... HP 5342A
- Audio Analyzer ..... HP 8903A
- Test Oscillator ..... HP 3335A
- Mixer ..... RHG DM 1-18

**Procedure**

**Harmonics Test**

1. Set Signal Generator to 2.4 GHz with an output level of 0 dBm. (+10 dBm on Option 001 instruments.)
2. Select 10 dB log scale and adjust spectrum analyzer to place peak of fundamental signal on top graticule line.
3. Without disturbing level calibration, tune spectrum analyzer to 4.8 GHz and observe the second harmonic. It must be more than 25 dB below the top graticule line.

(4.8 GHz second harmonic) \_\_\_\_\_ dBc



## PERFORMANCE TESTS

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### SPECTRAL PURITY TESTS (cont'd)

#### Procedure (cont'd)

#### NOTE

*If a harmonic is found to be slightly out of specification, the Signal Generator should be tuned to that frequency (if possible) to establish a new reference level at that frequency. Then return to the fundamental frequency and repeat the measurement.*

4. Set Signal Generator to 3.6 GHz.
5. Without disturbing level calibration, observe the second harmonic. It must be more than 25 dB below the top graticule line.  
(7.2 GHz second) \_\_\_\_\_ dBc
6. Set Signal Generator to 5.4 GHz.
7. Without disturbing level calibration, observe the second harmonic. It must be more than 25 dB below top graticule line.  
(10.8 GHz second) \_\_\_\_\_ dBc
8. Set Signal Generator to 6.4 GHz and tune spectrum analyzer to observe the fundamental frequency.
9. Adjust spectrum analyzer to place peak of fundamental signal on top graticule line.
10. Without disturbing level calibration, tune spectrum analyzer to 12.8 GHz and observe the second harmonic. It must be more than 25 dB below the top graticule line.  
(12.8 GHz second) \_\_\_\_\_ dB

#### Non-Harmonic Spurious Signal Test

11. Tune Signal Generator to 3.0 GHz and set output level to 0 dBm. Using the 10 dB log scale, adjust spectrum analyzer to place peak of fundamental signal on top graticule line of display.
12. Using test oscillator, connect a 1 MHz sine wave to the FM input of the Signal Generator and adjust sine wave level (at test oscillator or by using the front-panel FM CAL control of the Signal Generator) to produce easily visible 1 MHz sidebands on the display. Then tune analyzer to center either of the sidebands on the display. The 1 MHz signal is used only as a tuning aid; after the selected sideband is properly centered on the display, the FM must be turned off and the 1 MHz input signal disconnected.
13. Increase spectrum analyzer IF gain by 30 dB and begin narrowing bandwidth to lower the noise floor to  $<-86$  dBm. You will be looking for a signal (which may never be visible) that must be at least 80 dB below the carrier; it will have an offset of approximately 1 MHz. Record the level of the spurious signal (if visible).  
(1 MHz offset) \_\_\_\_\_ dBc

## PERFORMANCE TESTS

### SPECTRAL PURITY TESTS (cont'd)

#### Procedure (cont'd)

14. Retune the spectrum analyzer to a 30 MHz offset and repeat the search for a possible signal that must be at least 80 dB below the carrier; it will have an offset of approximately 30 MHz. Record the level of the spurious signal (if visible).

(30 MHz offset) \_\_\_\_\_ dBc

#### Residual FM Test

15. Connect equipment as shown in Figure 4-2. Set the output of the Signal Generator under test and the generator used as a local oscillator to maximum power. Verify that nothing is connected to the modulation inputs, and that all modulation selectors are off.

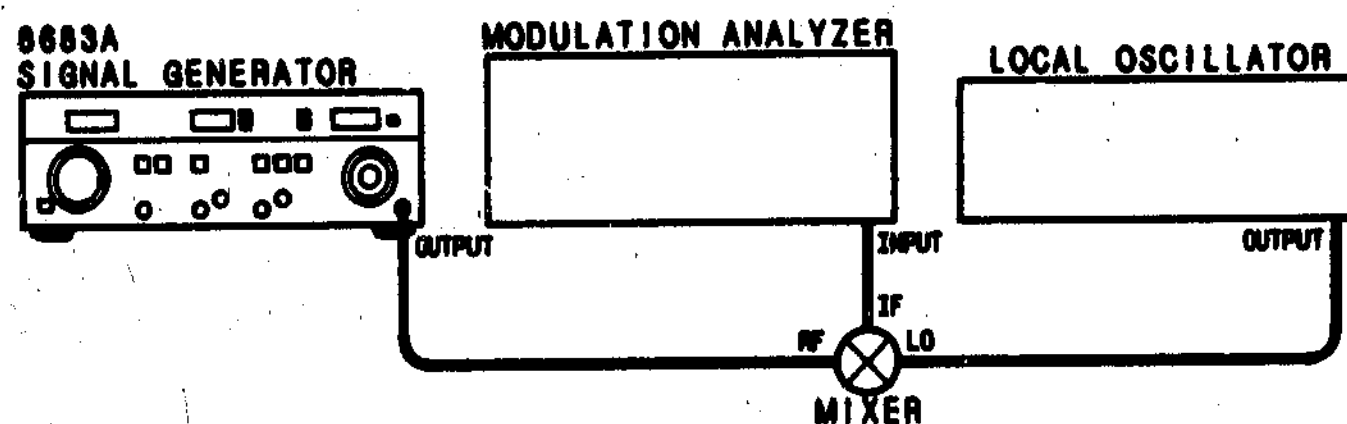


Figure 4-2. Residual FM Test Setup

16. Set the Signal Generator under test to 4.0 GHz and set local oscillator to approximately 4.2 GHz so the resulting IF is within the frequency range of the modulation analyzer.
17. On the modulation analyzer, select AUTOMATIC OPERATION, FM, 50 Hz HP FILTER, 15 kHz LP FILTER, and AVG.
18. Read residual FM directly from the modulation analyzer display. The result must be <5 kHz peak deviation.

(Residual FM) \_\_\_\_\_ kHz

## PERFORMANCE TESTS

### 4-9. RF OUTPUT TEST

#### Specification

Electrical Characteristics	Performance Limits	Conditions
<b>RF OUTPUT</b>		
<b>Level Range</b> with Option 001 with Option 002	0 dBm to -130 dBm +10 dBm to -130 dBm -1 dBm to -130 dBm	Leveled into 50Ω Leveled into 50Ω Leveled into 50Ω
<b>Level Accuracy<sup>1</sup></b>	±2.5 dB  ±3.5 dB	From maximum output to -110 dBm From -110 dBm to -120 dBm
<b>Display Resolution</b>	0.1 dB	Using a 3-1/2 digit 7-segment display
<b>Level Flatness</b>	±1.0 dB	With indicated power level >-10 dBm
<sup>1</sup> Accuracy error includes allowances for metering accuracy, detector linearity, temperature, flatness, harmonics, attenuator accuracy, and measurement error. Option 002 Reverse Power Protection affects level accuracy ±3 dB to -110 dBm and ±4 dB to -120 dBm.		

#### Description

A power meter is used to verify that the maximum specified power is available over the entire frequency range. For low-level signals, the signal is mixed down to the input range of a low-frequency spectrum analyzer; a calibration is performed at the lowest level read by the power meter to minimize errors introduced by the mixing process. A preamplifier is added for the extremely low-level readings. Flatness is verified by tuning across the entire frequency range of 2.3 GHz to 6.5 GHz and determining the difference between the highest and the lowest level indicated by the power meter.

#### Equipment

Power Meter .....	HP 436A
Power Sensor (Standard) .....	HP 8481A
Power Sensor (High Sensitivity) .....	HP 8484A
50 MHz Reference Attenuator .....	HP 11708A
Spectrum Analyzer .....	HP 3580A
Signal Generator .....	HP 8683A or 8683B
Amplifier .....	HP 6827A
Mixer .....	RHG DM 1-18

#### Procedure

##### Maximum Power

1. Connect standard power sensor to the power meter, and zero and calibrate the power meter.
2. Connect power sensor to microwave OUTPUT of the Signal Generator and set Signal Generator to +15 dBm at 4.0 GHz with all modulation off. Set calibration factor of the power meter to correspond to the 4.0 GHz value of the power sensor calibration data.
3. Verify that the Signal Generator CABLE OFFSET control is off.

**PERFORMANCE TESTS**

**RF OUTPUT TEST (cont'd)**

**Procedure (cont'd)**

4. Tune Signal Generator over the range of 2.3 to 6.5 GHz while verifying that output power is at least 0 dBm at all points in the frequency range. (In instruments with Option 001, output power must be at least +10 dBm at all points in the frequency range.) Adjust the calibration control as necessary while tuning over the frequency range. Record the maximum and minimum levels and the frequencies at which they occur.

Maximum Level \_\_\_\_\_ dBm

Frequency \_\_\_\_\_ GHz

Minimum Level \_\_\_\_\_ dBm

Frequency \_\_\_\_\_ GHz

**Level Accuracy**

5. Set Signal Generator under test to 4.0 GHz at 0 dBm (at +10 dBm if Signal Generator has Option 001) with all modulation off.
6. Connect standard power sensor to the power reference output of the power meter. Set calibration factor as required, and zero and calibrate the power meter.
7. Connect power sensor to RF OUTPUT of Signal Generator under test and measure the power. It should be 10 dBm  $\pm$ 2.5 dB (+10 dBm  $\pm$ 2.5 dB for Option 001).  
 \_\_\_\_\_ dBm
8. If testing an instrument with Option 001, change Signal Generator output level to 0 dBm and verify that power meter indicates 0 dBm  $\pm$ 2.5 dB. If testing an instrument without Option 001, skip this step.  
 \_\_\_\_\_ dBm
9. Change Signal Generator output level to -7 dBm and verify that power meter indicates -7 dBm  $\pm$ 2.5 dB.  
 \_\_\_\_\_ dBm
10. Change Signal Generator output level to -17 dBm and verify that power meter indicates -17 dBm  $\pm$ 2.5 dB.  
 \_\_\_\_\_ dBm
11. Change Signal Generator output level to -27 dBm and verify that power meter indicates -27 dBm  $\pm$ 2.5 dB.  
 \_\_\_\_\_ dBm
12. Replace standard power sensor with the high sensitivity power sensor, and connect sensor (through the reference attenuator) to the power reference output of the power meter. Set calibration factor as required, and zero and calibrate the power meter.

## PERFORMANCE TESTS

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### RF OUTPUT TEST (cont'd)

#### Procedure (cont'd)

13. Connect power sensor to RF OUTPUT of Signal Generator under test and measure the power. It should still be  $-27 \text{ dBm} \pm 2.5 \text{ dB}$ . \_\_\_\_\_ dBm
14. Change Signal Generator output level to  $-40 \text{ dBm}$  and verify that power meter indicates  $-40 \text{ dBm} \pm 2.5 \text{ dB}$ . \_\_\_\_\_ dBm
15. Change Signal Generator output level to  $-50 \text{ dBm}$  and verify that power meter indicates  $-50 \text{ dBm} \pm 2.5 \text{ dB}$ . \_\_\_\_\_ dBm
16. Change Signal Generator output level to  $-60 \text{ dBm}$  and verify that power meter indicates  $-60 \text{ dBm} \pm 2.5 \text{ dB}$ . \_\_\_\_\_ dBm
17. Change Signal Generator output level to  $-57 \text{ dBm}$ .

#### NOTE

*During the next two steps, do not disturb the LEVEL controls of the Signal Generator under test. If the control is disturbed, the  $-57 \text{ dBm}$  reference established on the spectrum analyzer will not be valid.*

18. Disconnect power sensor from the Signal Generator and connect RF port of mixer to the RF OUTPUT of the Signal Generator under test. Connect another signal generator (to serve as a local oscillator) to the LO port of the mixer. Connect the IF output of the mixer to the input of the low-frequency spectrum analyzer, and set local oscillator output level to  $+10 \text{ dBm}$ . If maximum power available is less than  $+10 \text{ dBm}$ , use maximum power. Then tune local oscillator to establish a  $20 \text{ kHz}$  difference frequency between the Signal Generator under test and the local oscillator.
19. On the spectrum analyzer, tune in the IF signal from the mixer and set its peak on the top graticule line. This establishes a  $-57 \text{ dBm}$  reference on the analyzer. Set the spectrum analyzer IF bandwidth as narrow as possible.

#### NOTE

*Do not disturb the controls of either Signal Generator until specifically instructed to do so.*

20. Starting at  $-57 \text{ dBm}$ , reduce the output level of the Signal Generator under test in  $10 \text{ dB}$  steps down to  $-107 \text{ dBm}$ . At each step, verify that the output level as measured on the spectrum analyzer display is within  $\pm 2.5 \text{ dB}$  of the level displayed by the Signal Generator under test.

$-57 \text{ dBm}$  \_\_\_\_\_ dBm  
 $-67 \text{ dBm}$  \_\_\_\_\_ dBm  
 $-77 \text{ dBm}$  \_\_\_\_\_ dBm  
 $-87 \text{ dBm}$  \_\_\_\_\_ dBm  
 $-97 \text{ dBm}$  \_\_\_\_\_ dBm  
 $-107 \text{ dBm}$  \_\_\_\_\_ dBm

**PERFORMANCE TESTS**

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**RF OUTPUT TEST (cont'd)****Procedure  
(cont'd)**

21. Without changing Signal Generator settings, install the preamplifier between the output of the mixer and the input of the spectrum analyzer. Set preamplifier gain to 20 dB.
22. Adjust spectrum analyzer as required to place peak of the -107 dBm signal on the top graticule line if possible; this establishes a new reference level at -107 dBm.
23. Change Signal Generator output level to -117 dBm and verify that the analyzer indicates -117 dBm  $\pm 3.5$  dB.

-117 dBm \_\_\_\_\_ dBm

**Level Flatness**

24. Connect the standard power sensor to the power meter, and zero and calibrate the power meter.
25. Connect standard power sensor to RF OUTPUT of Signal Generator under test, and set Signal Generator output level to -9 dBm. Verify that all modulation is off.
26. Press the dB (REF) switch on the power meter.
27. Tune the Signal Generator over the entire range of 2.3 to 6.5 GHz while observing the power meter display. Record the highest and lowest power levels. The difference between the highest and lowest power level must be  $\leq 2$  dB. Be sure to change the power meter calibration factor as required.

Highest Level \_\_\_\_\_ dB

Lowest Level \_\_\_\_\_ dB

Difference \_\_\_\_\_ dB

**PERFORMANCE TESTS**

**4-10. AMPLITUDE MODULATION TEST**

Specification	Electrical Characteristics	Performance Limits	Conditions
<b>AMPLITUDE MODULATION<sup>1</sup></b>			
Am Depth		0 to 70%	At 1 kHz rate
Am Distortion (Total Harmonic Distortion)		<10% at 40% depth and 1 kHz rate	
AM Rates		dc to 10 kHz	dc coupled 40% AM depth (3 dB BW)
		50 Hz to 10 kHz	ac coupled 40% AM depth (3 dB BW)
Incidental FM		<10 kHz peak-to-peak	30% AM depth
Internal AM		Fixed 1 kHz square wave with a duty cycle of 50 ±5%. On-Off ratio >30 dB at maximum power.	
<sup>1</sup> Amplitude modulation specifications are valid for the LEVEL vernier range of 10 to 20 dB below the maximum vernier setting with output levels at least 5 dB below the specified maximum output power.			

**Description** The output of the Signal Generator under test is mixed with the output of another signal generator to produce a frequency within the input range of a modulation analyzer. All modulation parameters are measured directly by the modulation analyzer or distortion analyzer.

**Equipment**

Signal Generator ..... HP 8683A or HP 8683B  
 Spectrum Analyzer ..... HP 8565A  
 Modulation Analyzer ..... HP 8901A  
 Audio Analyzer ..... HP 8903A  
 Mixer ..... RHG DM 1-18

**Procedure**

**AM Depth**

1. Connect microwave OUTPUT of Signal Generator under test to RF input of the mixer, and connect output of the signal generator used as a local oscillator to the LO input of the mixer. Connect output of the mixer to the input of the modulation analyzer.
2. Connect 600Ω output of the audio analyzer to the AM INPUT of the Signal Generator under test, and set the Signal Generator to 3.5 GHz at -9 dBm. Verify that all FM is turned off, select EXT AM, and set AM vernier fully clockwise.
3. On the signal generator used as a local oscillator, set output frequency to approximately 4.0 GHz and set output level to maximum available power. Verify that all modulation is turned off.

## PERFORMANCE TESTS

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### AMPLITUDE MODULATION TEST (cont'd)

#### Procedure (cont'd)

4. Set audio analyzer frequency to 1 kHz and adjust output level to obtain an indicated 70% MODULATION LEVEL on the signal generator under test.
5. Press the AM key on the modulation analyzer and verify that the analyzer indicates a modulation level between 65% and 75%.

(70%) \_\_\_\_\_ %

#### AM Distortion and AM Rates

6. Connect MODULATION OUTPUT of modulation analyzer to the input of the audio analyzer. Select AM mode on the modulation analyzer, and set audio analyzer output level to obtain an indicated 40% MODULATION on the Signal Generator under test. Verify that audio analyzer indicates a distortion level of <10%.

Distortion Level (40% Depth and 1 kHz rate) \_\_\_\_\_ %

7. Set audio analyzer output frequency to 2 kHz, verify AM percentage on modulation analyzer, and press the dB switch on modulation analyzer to establish a reference. Vary the modulation frequency (audio analyzer output frequency) over the range of 50 Hz to 10 kHz while observing the modulation analyzer display. The reading should vary by <3 dB (3 dB bandwidth must include AM rates of 50 Hz to 10 kHz).

#### Incidental FM

8. With the audio analyzer output level set to obtain an indicated 30% MODULATION on the Signal Generator under test, press the FM PEAK+ switch on the modulation analyzer. Record the reading from the analyzer in kHz, and press the PEAK- switch on the analyzer. Add the PEAK+ reading to the PEAK- reading and verify that the sum is <10 kHz.

Peak+ \_\_\_\_\_ kHz

Peak- \_\_\_\_\_ kHz

Sum \_\_\_\_\_ kHz

#### Internal AM

9. Connect microwave OUTPUT of Signal Generator to the spectrum analyzer, and set Signal Generator to any frequency in its specified range. Set output LEVEL to 0 dBm with all modulation off.
10. Set spectrum analyzer for 100 kHz resolution, select any convenient bandwidth, and tune signal to the center of the display. Set vertical sensitivity to 10 dB/division.
11. Select INT 1 kHz square wave on the Signal Generator.
12. Set the spectrum analyzer to zero span, 0.2 ms/division scan time, and VIDEO trigger. Adjust the trigger control to obtain a stable trace.
13. Fine tune the spectrum analyzer to obtain maximum amplitude of the square wave, and read the on-off ratio directly from the analyzer display. The ratio from the top of the square wave to the bottom of the square wave must be more than 30 dB.

On-Off Ratio \_\_\_\_\_ dB

14. Measure the duty cycle (on and off times). It must be 50 ±5%.

Duty Cycle \_\_\_\_\_ %



## PERFORMANCE TESTS

## 4-11. FREQUENCY MODULATION TEST

## Specification

Electrical Characteristics	Performance Limits	Conditions
<b>FREQUENCY MODULATION</b> Peak Deviation FM Rates	5 MHz dc to 10 MHz  100 Hz to 10 MHz	dc coupled (3 dB BW)  ac coupled (3 dB BW)
Incidental AM	<6%	With rate <100 kHz and peak deviation <1 MHz
Internal FM	Fixed 1 kHz sawtooth with variable deviation up to the maximum specified deviation	
Distortion	<5%	100 kHz rate and <1 MHz peak deviation

## Description

Peak-to-peak deviation is measured by modulating the Signal Generator under test with an external signal source and measuring low modulation frequencies (10 Hz to 100 Hz) on a spectrum analyzer. Deviation at higher modulation frequencies is measured on the spectrum analyzer using the carrier null (Bessel null) technique.

For FM rate measurement, the RF OUTPUT of the Signal Generator under test is mixed with the output of another generator (local oscillator) to produce a 70 MHz signal which is demodulated by a wideband discriminator. The demodulated output is measured on an oscilloscope and translated to dB to determine the 3 dB bandwidth.

Incidental AM is measured by mixing the output of the Signal Generator under test with the output of another generator (local oscillator) to produce a suitable input frequency for the modulation analyzer. The output is frequency modulated, and the amount of incidental AM is displayed by the modulation analyzer.

To measure FM distortion, the output of the instrument under test is mixed with the output of the local oscillator to produce a 70 MHz signal. This signal is demodulated by a wideband discriminator, and the distortion of the demodulated output is measured directly by the audio analyzer.

## Equipment

Signal Generator .....	HP 8683A or HP 8683B
Spectrum Analyzer .....	HP 8565A
Frequency Counter .....	HP 5342A
Test Oscillator .....	HP 3335A
Modulation Analyzer .....	HP 8901A
Oscilloscope .....	HP 1725A
Audio Analyzer .....	HP 8903A
70 MHz Modulator/Demodulator .....	HP 3717A
Mixer .....	RHG DM 1-18
Diode Detector .....	HP 8470B Opt. 012

## PERFORMANCE TESTS

## FREQUENCY MODULATION TEST (cont'd)

## Procedure

## FM Rates

1. Connect equipment as shown in Figure 4-3, and set Signal Generator under test to 4 GHz with an output level of 0 dBm or higher. Set generator used as a local oscillator to 4.070 GHz with the highest power available.

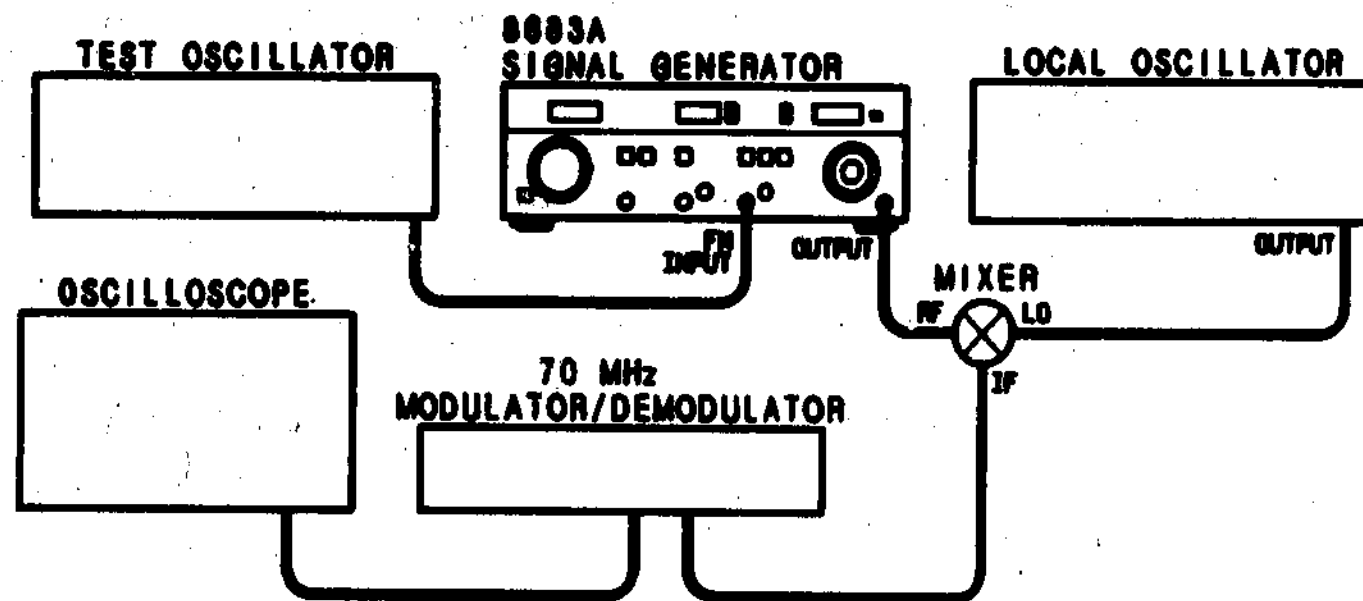


Figure 4-3. FM Rate Test Setup

2. On the Signal Generator, pull FM vernier out to provide AC coupling. Set test oscillator to 10 kHz with an output level of approximately 0.7 Vrms, and set a reference on the oscilloscope display at 6 divisions peak-to-peak.
3. Set the test oscillator to 100 Hz and record the total deflection on the oscilloscope. It should be >4.2 divisions.  
(100 Hz) \_\_\_\_\_ Divisions
4. Set the test oscillator to 10 MHz and record the total deflection on the oscilloscope. It should be >4.2 divisions.  
(10 MHz) \_\_\_\_\_ Divisions

## Incidental AM

5. Connect Signal Generator, local oscillator, mixer, and modulation analyzer as shown in Figure 4-4.
6. Set test oscillator output frequency to 50 kHz.
7. Connect 50Ω output of test oscillator to FM INPUT of Signal Generator. Select EXT 1 MHz/V FM and adjust test oscillator output level to obtain an indicated 0.4 MHz peak deviation.
8. Verify that the AM measured by the modulation analyzer is <6%.

Measured Level \_\_\_\_\_ %

## PERFORMANCE TESTS

## FREQUENCY MODULATION TEST (cont'd)

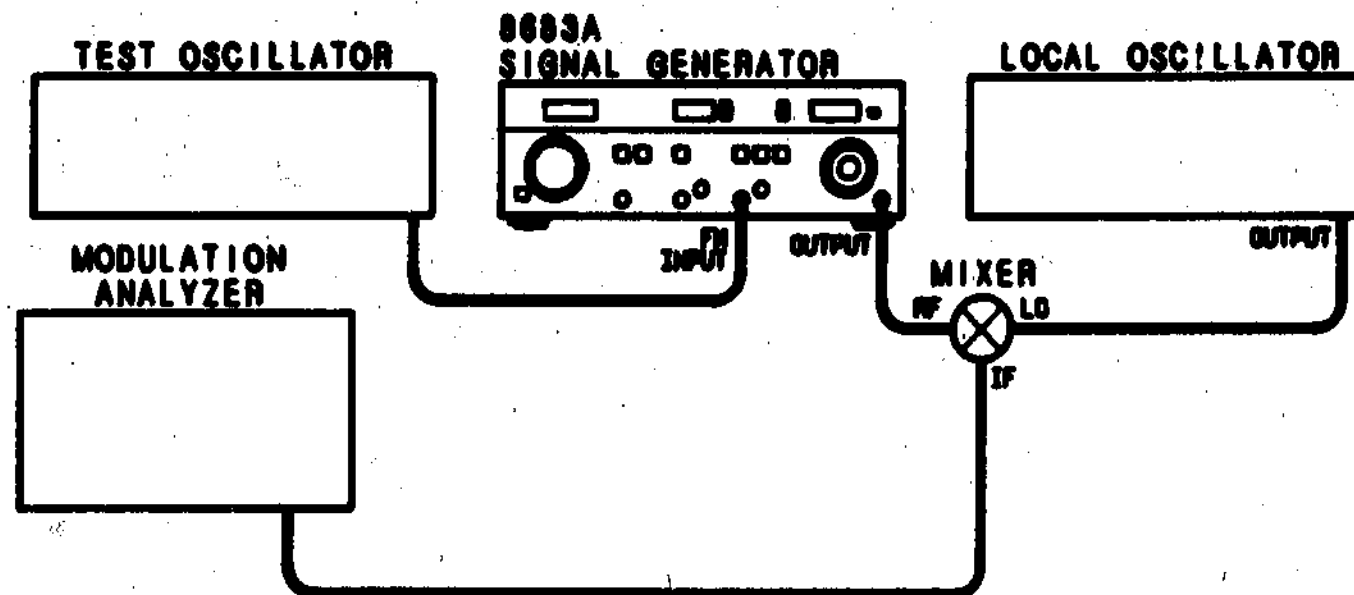
Procedure  
(cont'd)

Figure 4-4. Incidental AM Test Setup

**Internal FM**

9. Set Signal Generator to any frequency in its specified range, and to an output level of -10 dBm. Connect RF OUTPUT of Signal Generator to spectrum analyzer, and set analyzer for 100 kHz resolution with a scan width of 5 MHz/division.
10. On the Signal Generator, select FM INT and turn the FM vernier clockwise. Until the setting is below the point where the OVERMOD light turns on, the peaks of the signal on the spectrum analyzer display should be at least 10 MHz apart (5 MHz peak deviation). Record spacing.

\_\_\_\_\_ MHz

11. Rotate the FM vernier counterclockwise, and verify that the peaks of the displayed signal are less than 1 MHz apart when the control is fully counterclockwise. Record spacing.

Minimum Deviation \_\_\_\_\_ MHz

12. Connect FM OUTPUT of Signal Generator to a frequency counter, and adjust counter triggering as required. Verify that the internal sawtooth rate is approximately 1 kHz.

Internal FM Rate \_\_\_\_\_ Hz

**FM Distortion**

13. Connect equipment as shown in Figure 4-5, and set Signal Generator under test to 4 GHz with an output level of 0 dBm or higher.

## PERFORMANCE TESTS

## FREQUENCY MODULATION TEST (cont'd)

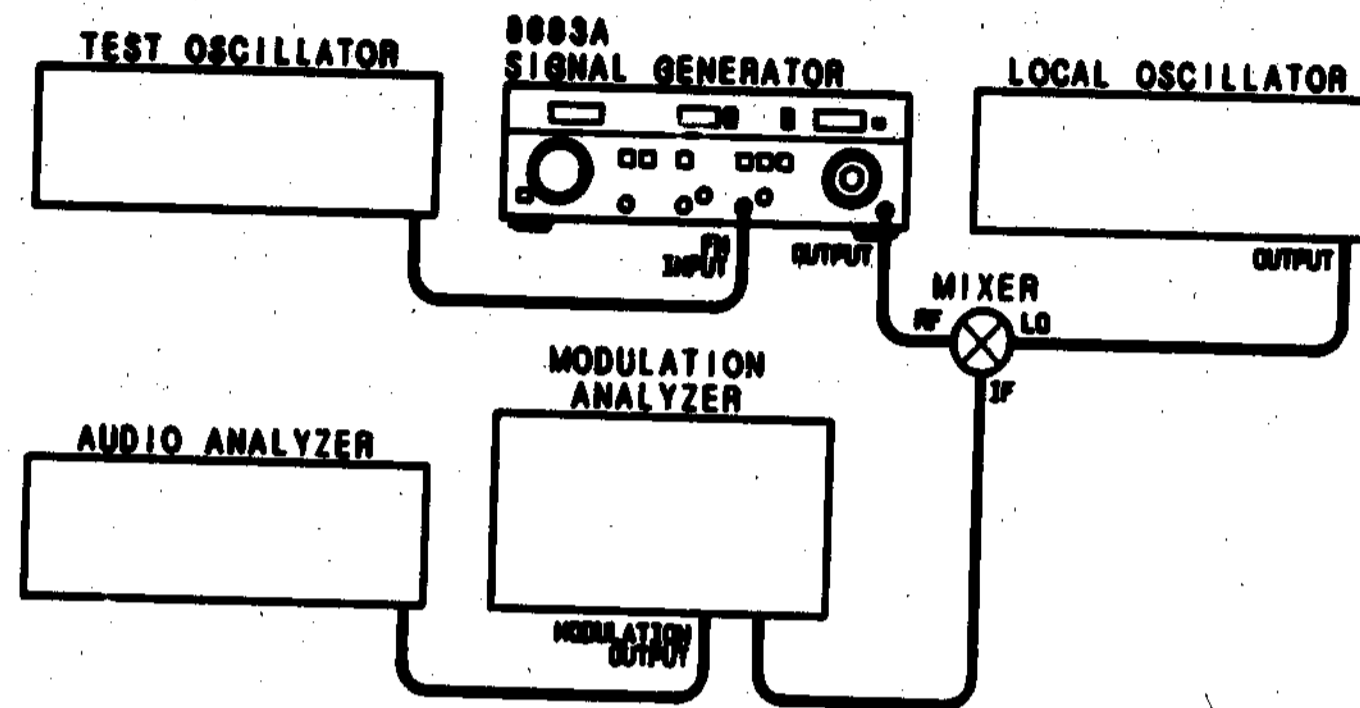


Figure 4-5. FM Distortion Test Setup

Procedure  
(cont'd)

14. Set signal generator used as a local oscillator to 4.07 GHz at the highest available power level. Verify that all modulation is off.
15. Verify that the 80 kHz low-pass filter in the audio analyzer is *not* selected. This filter is automatically selected when the instrument is powered up.
16. Select EXT 1 MHz/V FM on the Signal Generator, set audio analyzer to 100 kHz, and adjust output amplitude to obtain a 0.9 MHz peak deviation on the Signal Generator under test. Press the **DISTN** key on the audio analyzer and read distortion level on the right-hand display. It must be <5%.

Distortion Level \_\_\_\_\_ %

17. Lower the output amplitude of the audio analyzer and observe the distortion as the deviation is decreased. The distortion should remain under 5% for any deviation <1 MHz. Record maximum distortion level and peak deviation at which it occurs.

Maximum Distortion \_\_\_\_\_ %

Peak Deviation \_\_\_\_\_ MHz

**PERFORMANCE TESTS**

**4-12. EXTERNAL PULSE REQUIREMENTS TEST**

Specification	Electrical Characteristics	Performance Limits	Conditions
<b>EXTERNAL PULSE INPUT REQUIREMENTS</b>			
Rate		0 to 10 kHz	
Width		>10 $\mu$ s	
Input Levels		TTL compatible	

**Description** An external pulse generator is used to verify that the Signal Generator will produce a pulsed RF output when triggered by the minimum specified pulse width and pulse amplitude. Pulse rates up to 10 kHz may be used.

**Equipment**  
 Oscilloscope .....HP 1725A  
 Pulse Generator .....HP 8013B  
 Diode Detector .....HP 8470B Opt. 012

**CAUTION**

*External pulses applied to the EXT PULSE INPUT must not exceed 5V peak. Higher input voltages may damage the A6 Detector Amplifier Assembly.*

- Procedure**
1. Connect positive-going output of the pulse generator to the EXT PULSE input of the Signal Generator, and connect diode detector to the RF OUTPUT of the Signal Generator. A detector load may be needed to minimize overshoot and ringing. Connect detector output to the oscilloscope input.
  2. Set pulse generator pulse width to >10  $\mu$ s and set pulse amplitude to +2.0V. Set pulse period to 100  $\mu$ s or longer (to provide pulse rates up to 10 kHz).
  3. Verify that external pulse is triggering the Signal Generator. This test may be repeated at any pulse rate, pulse width, and pulse amplitude combination within the specified ranges. Check if external pulse sensitivity is satisfactory.

External Pulse Sensitivity \_\_\_\_\_

**PERFORMANCE TESTS**

**4-13. RF PULSE OUTPUT TEST**

**Specification**

Electrical Characteristics	Performance Limits	Conditions
RF PULSE OUTPUT Rise and Fall Time	<5 $\mu$ s	At maximum leveled power.
On-Off Ratio	>30 dB	

**Description**

The pulsed RF output of the Signal Generator is detected and observed on an oscilloscope. Rise and fall times and the ON-OFF ratio are measured.

**Equipment**

Spectrum Analyzer ..... HP 8565A  
 Oscilloscope ..... HP 1725A  
 Diode Detector ..... HP 8470B Opt. 012  
 Pulse Generator ..... HP 8013B

**Procedure**

1. Connect equipment as shown in Figure 4-6.

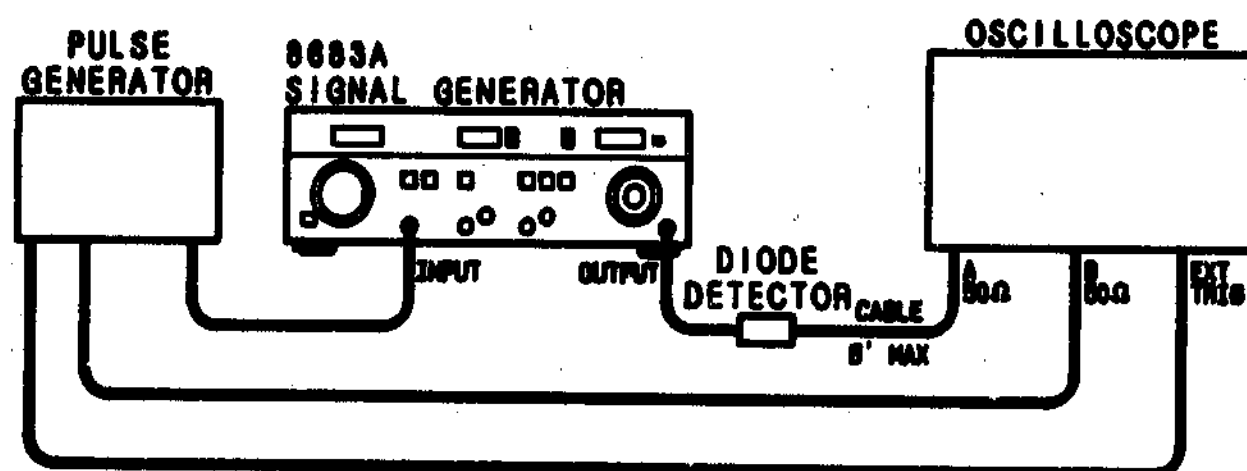


Figure 4-6. RF Pulse Characteristics Test Setup

2. Set Signal Generator to a midrange frequency with an output level of 0 dBm. Select EXT PULSE mode and set the external pulse generator controls as follows:  
 RATE ..... 10 kHz  
 DELAY ..... Minimum  
 WIDTH ..... 20  $\mu$ s
3. Set the oscilloscope for external triggering with the following settings:  
 TIME/DIV ..... 10  $\mu$ s  
 CHANNEL A ..... 0.05 VOLTS/DIV  
 CHANNEL B ..... 1 VOLTS/DIV  
 VERT DISPLAY ..... ALT  
 HORIZ DISPLAY ..... NORMAL

**PERFORMANCE TESTS**

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**RF PULSE OUTPUT TEST (conf'd)**

**Procedure**

4. Measure rise and fall times. The transition time (10% to 90%) in both cases must be  $< 5 \mu s$ .

Rise Time \_\_\_\_\_  $\mu s$

Fall Time \_\_\_\_\_  $\mu s$

5. Measure ON-OFF ratio by connecting OUTPUT to spectrum analyzer and observe ratio of pulse-on to pulse-off.

30 dB \_\_\_\_\_

Table 4-1. Performance Test Record (1 of 3)

Hewlett-Packard Company Model 8683A Signal Generator Serial Number _____		Tested By _____  Date _____		
Para. No.	Tests	Results		
		Minimum	Actual	Maximum
4-7.	<b>FREQUENCY RANGE AND ACCURACY</b>			
	Minimum Frequency		_____	2.300 GHz
	Calibration Accuracy			
	2.300 GHz	2.271 GHz	_____	2.329 GHz
	3.400 GHz	3.357 GHz	_____	3.443 GHz
	4.500 GHz	4.466 GHz	_____	4.534 GHz
	5.600 GHz	5.558 GHz	_____	5.642 GHz
	6.500 GHz	6.451 GHz	_____	6.549 GHz
	Maximum Frequency	6.500 GHz	_____	
	Other Frequency Settings (Optional)			
	_____ GHz ( $\leq 4$ GHz)	-1.25%	_____	+1.25%
_____ GHz ( $\leq 4$ GHz)	-1.25%	_____	+1.25%	
_____ GHz ( $> 4$ GHz)	-0.75%	_____	+0.75%	
_____ GHz ( $> 4$ GHz)	-0.75%	_____	+0.75%	
_____ GHz ( $> 4$ GHz)	-0.75%	_____	+0.75%	
4-8.	<b>SPECTRAL PURITY</b>			
	Spurious Signals			
	Harmonics			
	4.8 GHz (second)		_____	-25 dBc
	7.2 GHz (second)		_____	-25 dBc
	10.8 GHz (second)		_____	-25 dBc
	12.8 GHz (second)		_____	-25 dBc
	Non-harmonics			
	3.0 GHz			
	(1 MHz Offset)		_____	-80 dBc
(30 MHz Offset)		_____	-80 dBc	
Residual FM				
(50 Hz to 14 kHz Post Detection Noise Bandwidth)	_____	<5 kHz peak		



Table 4-1. Performance Test Record (2 of 3)

Para. No.	Tests	Results		
		Minimum	Actual	Maximum
4-8. RF OUTPUT TEST	Maximum Power			
	Maximum Level	0 dBm	_____	
	Maximum Level (Opt. 001)	+10 dBm	_____	
	Frequency of Highest Point _____ GHz			
	Minimum Level	0 dBm	_____	
	Minimum Level (Opt. 001)	+10 dBm	_____	
	Frequency of Lowest Point _____ GHz			
	Level Accuracy			
	+10 dBm (Option 001)	+7.5 dBm	_____	+12.5 dBm
	0 dBm	-2.5 dBm	_____	+2.5 dBm
	-7 dBm	-9.5 dBm	_____	-4.5 dBm
	-17 dBm	-19.5 dBm	_____	-14.5 dBm
	-27 dBm (Standard Power Sensor)	-29.5 dBm	_____	-24.5 dBm
	-27 dBm (High Sensitivity Power Sensor)	-29.5 dBm	_____	-24.5 dBm
	-40 dBm	-42.5 dBm	_____	-37.5 dBm
	-50 dBm	-52.5 dBm	_____	-47.5 dBm
	-60 dBm (into power meter)	-62.5 dBm	_____	-57.5 dBm
	-57 dBm (into spectrum analyzer)	-59.5 dBm	_____	-54.5 dBm
	-67 dBm	-69.5 dBm	_____	-64.5 dBm
	-77 dBm	-79.5 dBm	_____	-74.5 dBm
	-87 dBm	-89.5 dBm	_____	-84.5 dBm
	-97 dBm	-99.5 dBm	_____	-94.5 dBm
	-107 dBm (into spectrum analyzer)	-109.5 dBm	_____	-104.5 dBm
	-107 dBm (reference level via amplifier into spectrum analyzer)	-109.5 dBm	_____	-104.5 dBm
	-117 dBm	-119.5 dBm	_____	-114.5 dBm
	Level Flatness			
	Highest Level _____			
Lowest Level _____				
Difference			2 dB	
4-10. AMPLITUDE MODULATION	AM Depth	70%		
	AM Distortion (at 40% depth and 1 kHz rate)		_____	10%
	AM Rates (3 dB BW)			
	(dc coupled 50 Hz)	dc	_____	10 kHz
	(ac coupled 10 kHz)		_____	10 kHz
	Incidental FM (30% AM depth)			
	Peak + _____			
	Peak - _____			
	Sum _____			15 kHz
	Internal AM (1 kHz square wave)			
On/Off Ratio	30 dB	_____		
Duty Cycle	45%	_____	55%	

Table 4-1. Performance Test Record (3 of 3)

Para. No.	Tests	Results		
		Minimum	Actual	Maximum
4-11.	<b>FREQUENCY MODULATION</b>			
	FM Rates (3 dB BW)			
	(100 Hz rate)	>4.2 div.	_____	
	(10 MHz rate)	>4.2 div.	_____	
	Incidental AM Measured Level		_____	<6%
	Internal FM Deviation (fixed internal sawtooth)	5 MHz peak	_____	
Internal FM Period	~1 ms	_____	~1 ms	
Distortion (at 100 kHz rate and <1 MHz peak deviation)		_____	<5%	
4-12.	<b>EXTERNAL PULSE INPUT REQUIREMENTS</b>			
	Sensitivity at 10 kHz or less with >10 μs pulses	satisfactory	_____	
4-13.	<b>RF PULSE OUTPUT</b>			
	Rise Time		_____	<5 μs
	Fall Time		_____	<5 μs
	On/Off Ratio	30 dB	_____	

# ADJUSTMENTS

## SECTION V ADJUSTMENTS

### 5-1. INTRODUCTION

This section contains adjustments and checks that ensure proper performance of the Signal Generator. Adjustments are not required on any fixed periodic basis, and normally are performed only after a performance test has indicated that some parameters are out of specification. Performance tests should be completed after any repairs that may have altered the characteristics of the instrument, and the test results will make it possible to determine whether or not adjustments are required. Allow 60 minutes for the Signal Generator to warm up, and then remove the top cover for access to the test and adjustment points.

To determine which performance tests and adjustments to perform after a repair, refer to paragraph 5-6, Post Repair Tests, Adjustments, and Checks.

### 5-2. SAFETY CONSIDERATIONS

This section contains information, cautions, and warnings that must be followed for your protection and to avoid damage to the equipment being used.

#### WARNING

*Adjustments described in this section are performed with power applied to the instrument and with protective covers removed. Maintenance should be performed only by trained personnel who are aware of the hazards involved. When the maintenance procedure can be performed without power, the power should be removed.*

### 5-3. EQUIPMENT REQUIRED

Most of the adjustment procedures include a list of required test equipment, and the test equipment is also identified on the test setup diagrams. If substitutions must be made for the equipment listed in Table 1-3, Recommended Test Equipment, the equipment used must meet the critical specification listed in the table if the Signal Generator is to meet its performance requirements.

### 5-4. FACTORY SELECTED COMPONENTS

Factory selected components are identified on the schematics and parts lists by an asterisk (\*) which follows the reference designator. The nominal value of the selected component is shown. Manual change sheets will provide updated information pertaining to selected components. Table 5-1 lists the reference designator, the service sheet where the component is shown, the nominal value range, and the basis for selecting a particular value.

### 5-5. INTERRELATED ADJUSTMENTS

The -15V adjustment on the A11 Power Supply assembly should be the first item checked during any adjustment procedure. The -15 source provides a reference voltage for the +15V and -30V sources, and proper operation of these three power supplies should be verified before the more complex adjustment procedures are started.

### 5-6. POST-REPAIR ADJUSTMENTS

Table 5-2 lists the adjustments related to repairs or replacement of any of the assemblies.

Table 5-1. Factory Selected Components

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A5R43	7	3.83 k $\Omega$ to 7.5 k $\Omega$	<ol style="list-style-type: none"> <li>1. Selected to set the level at which the UNLEVEL light comes on.</li> <li>2. Set LEVEL control for maximum RF OUTPUT.</li> <li>3. Set LEVEL vernier fully clockwise.</li> <li>4. Connect a +1.0 Vdc signal to the AM INPUT.</li> <li>5. Measure the voltage (Vdc) on A5U1 pin 8.</li> <li>6. Measure reference uncal level (Vdc) at XA5 pin 35.</li> <li>7. Select a value for A5R43 so that the voltages measured in steps 5 and 6 are close, but such that the voltage at XA5 pin 35 is slightly greater than the voltage at A5U1 pin 8.</li> <li>8. The voltage (Vdc) at A5U1 pin 8 changes approximately 0.3 Vdc for an approximate change of 500<math>\Omega</math>.</li> </ol>

Table 5-2. Post-Repair Adjustments, Tests, and Checks

Assembly Repaired	Related Adjustment or Performance Test	Reference Service Sheet
A1 Front Panel	None	1, 2, 3
A5 ALC Control	5-9	7
A6 ALC Detector Amplifier	4-10, 4-11, 4-12, 4-13, 5-9	8
A7 ALC Reference	4-8, 4-9, 5-8	9
A8 I/O Board	5-11	10
A9 Processor	None	11
A10 FM Shaper	4-11, 5-10	12
A11 Power Supply	5-7	13, 14
A12 Motherboard	None	1-14
A13 Microcircuit Interface	None	BD2
A14 Oscillator	None	BD2
A15 Microwave Amplifier	None	BD2
A17 Line Power Module	None	13
A18 Oscillator Drive	4-7, 5-12, 5-13	Section VI, pages 6-24, 6-25

**ADJUSTMENTS**

**5-7. A11 POWER SUPPLY ADJUSTMENTS**

**Reference** Service Sheets 13 and 14.

**Description** The -15 Vdc is used as a reference for the -30 Vdc and +15 Vdc. Adjust the -15 Vdc first, using the digital voltmeter. The other adjustable supply on the power supply board is the +5 Vdc. The supplies and reference voltages can be read using the diagnostic mode and the front panel frequency display.

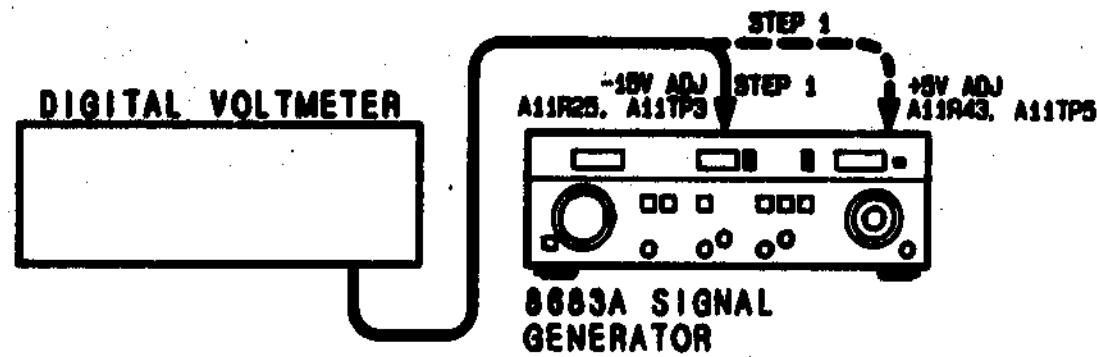


Figure 5-1. A11 Power Supply Adjustments

**Equipment** Digital Voltmeter.....HP 3456A

- Procedure**
1. Use equipment as shown in the adjustment setup. Measure at A11TP3 and adjust A11R25, labeled -15 ADJ, to  $-15.00 \pm 0.05$  Vdc. Measure at A11TP5 and adjust A11R43, labeled 5V ADJ, to  $+5.00 \pm 0.05$  Vdc.
  2. Remove instrument top cover and set the service switch A9S1 to the DIAG (diagnostic) position.
  3. Select the diagnostic test number 00 shown in the modulation display using the %AM/MHz FM and dB REL/CABLE OFFSET keys. The frequency display should indicate 5.00 volts  $\pm 0.05$  volts. This voltage is adjusted by A11R43, labeled 5V ADJ. Readjust if necessary to be in the center of the specified tolerance range.
  4. Select test number 04. The display should read  $-15.00 \pm 0.05$  volts. Adjust if necessary using A11R25, labeled -15 ADJ.
  5. Check the voltages shown by tests 00 to 05. They should be as shown in the following table.
  6. Set the instrument service switch A9S1 to NORM (normal) position.

Table 5-3. Voltage Levels

Diagnostic Test No.	Description	Typical
00	+5.0 Vdc supply	+5.00 Vdc
01	+6.5 Vdc $\mu$ circuit power	+6.45 Vdc
03	+15 Vdc supply	+15.09 Vdc
04	-15 Vdc supply	-15.00 Vdc
05	-30 Vdc supply	-30.04 Vdc

## ADJUSTMENTS

## 5-8. A7 ALC REFERENCE ADJUSTMENTS

**Reference** Service Sheet 9.

**Description** ALC Reference Adjustments consist of setting the RF level to agree with the front panel display, reference offset so that the LEVEL vernier agrees with the front panel display. AM sensitivity, 10 dB reference pad, and the 30 MHz reference oscillator harmonic level are also set.

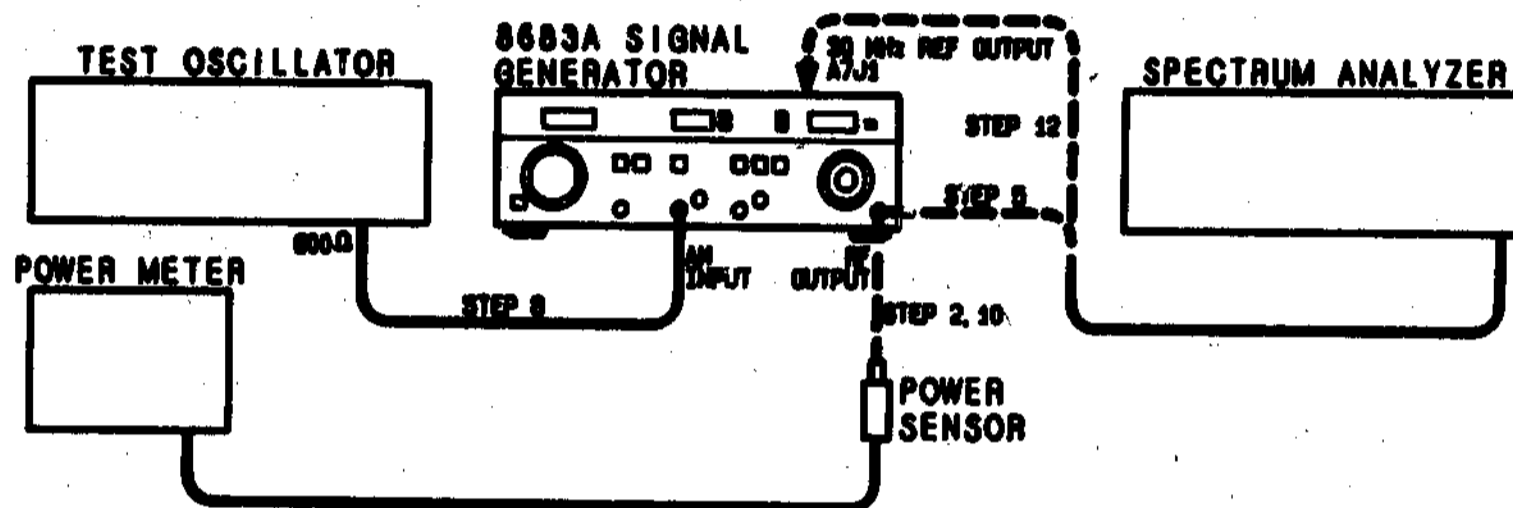


Figure 5-2. A7 ALC Reference Adjustments Setup

<b>Equipment</b>	Spectrum Analyzer .....	HP 8565A
	Test Oscillator .....	HP 3335A
	Power Meter .....	HP 436A
	Power Sensor .....	HP 8481A
	Adapter (SMC male to Type-N female) .....	HP 1250-1153
	Adapter (SMC male to BNC female) .....	HP 1250-0832

- Procedure**
1. Set the Signal Generator's frequency anywhere in its specified range.
  2. Connect the power meter and sensor to the microwave OUTPUT and set the Signal Generator to read 0.0 dBm in the 0 to -10 dBm range. Adjust RF LVL, A7R26, so the power meter agrees with the front panel display as closely as possible.
  3. Set the LEVEL vernier fully counterclockwise (Signal Generator should read about -20 dBm). Adjust REF OFFSET, A7R37, for agreement between the front panel display and the power meter.
  4. Repeat steps 1 through 3 until both -20 dBm and 0 dBm settings agree with the power meter within  $\pm 0.3$  dB.
  5. Connect a spectrum analyzer to the microwave OUTPUT connector and set the power to 0 dBm using the LEVEL switch one position down from the maximum power position.

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**ADJUSTMENTS**

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**A7 ALC REFERENCE ADJUSTMENTS (cont'd)****Procedure  
(cont'd)**

6. Select EXT AM on the Signal Generator.
7. Set the AM vernier fully clockwise to the CAL position.
8. Connect the test oscillator 600 $\Omega$  output to the AM INPUT connector. Set the oscillator to 10 kHz at about 0.35 Vrms (0.5 Vpeak). Adjust the output voltage of the test oscillator to obtain a modulation display of 50.0% on the Signal Generator display.
9. Adjust AM SENS, A7R10, to place the first modulation sidebands 12 dB below the carrier as viewed on the spectrum analyzer. Use 2 dB per vertical division on the spectrum analyzer for improved resolution.
10. Disconnect the modulation input and turn the AM off. Connect a power meter to the RF OUTPUT connector in place of the spectrum analyzer.
11. Switch the LEVEL switch from 0 dBm to -10 dBm. Adjust the -10 dB PAD ADJ, A7R67, if necessary, to obtain a 10.0 dB level change between these two steps.
12. Connect the 30 MHz REF output, A7J1, to the spectrum analyzer using an adapter SMC male to Type-N female, HP Part Number 1250-1153 or an adapter SMC male to BNC female, HP Part Number 1250-0832. Set the spectrum analyzer to 20 MHz per division, 300 kHz bandwidth, and tune to see the 30 MHz signal and harmonics.
13. Set the LEVEL vernier fully clockwise and adjust DIST ADJ, A7C39, to place the second harmonic 35 dB below the carrier.
14. Set the LEVEL vernier counter clockwise and look at the second harmonic level. If it is not -22 dBc or better, readjust DIST ADJ to get -22 dBc. Go to the previous step to recheck the level with the vernier clockwise. Repeat these steps as necessary to obtain -35 dBc or better with the vernier clockwise and -22 dBc or better with the vernier counterclockwise. Disconnect the spectrum analyzer and reconnect the orange 30 MHz reference cable.



## ADJUSTMENTS

## 5-9. A5 ALC CONTROL AND A6 ALC DETECTOR AMPLIFIER ADJUSTMENTS

**Reference** Service Sheets 7 and 8.

**Description** The adjustments performed here set up the ALC Control Assembly and the ALC Detector Amplifier Assembly.

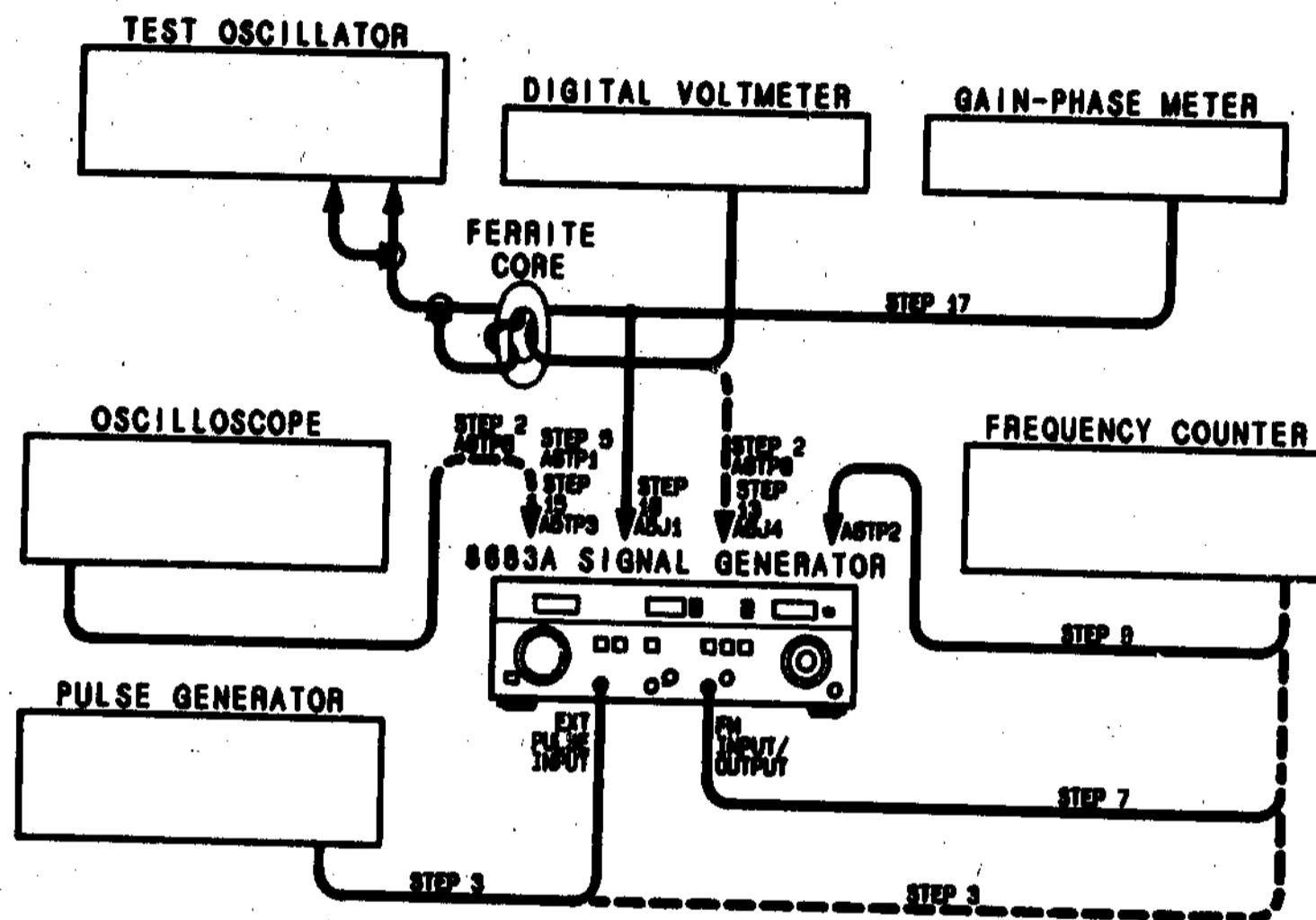


Figure 5-3. A5 ALC Control and A6 ALC Detector Amplifier Adjustments Setup

<b>Equipment</b>	Digital Voltmeter .....	HP 3455A
	Oscilloscope .....	HP 1725A
	Frequency Counter .....	HP 5342A
	Pulse Generator .....	HP 8013B
	Test Oscillator .....	HP 3335A
	50Ω load SMA .....	HP 0960-0053
	50Ω load SMC (two) .....	HP 1250-0839
	Ferrite Core .....	HP 9170-0441
	Gain-Phase Meter .....	HP 3575A Opt. 001
	SMC jack (straight) .....	HP 1250-1220
	SMC plug (right angle) .....	HP 1250-1167

- Procedure**
1. Install the A6 ALC Detector Amplifier board on an extender. Set the Signal Generator for an output power of  $-3$  dBm on the 0 to  $-10$  dBm range.
  2. Connect the voltmeter to A6TP8 and the oscilloscope to A6TP6. Adjust OFFSET COARSE, A6R31 (see Figure 5-4) to obtain  $5.9 \pm 0.1$  Vdc on the voltmeter.

## ADJUSTMENTS

## A5 ALC CONTROL AND A6 ALC DETECTOR AMPLIFIER ADJUSTMENTS (cont'd)

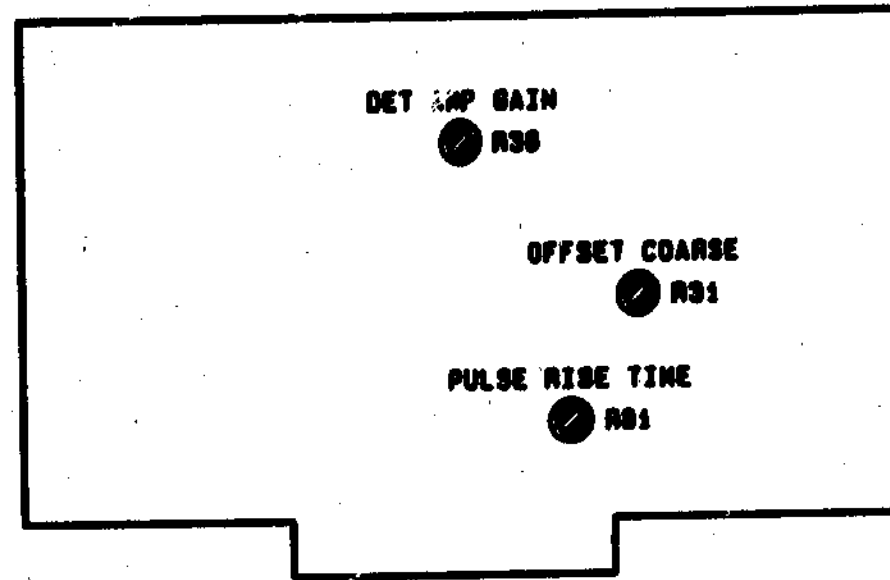
Procedure  
(cont'd)

Figure 5-4. A6 Assembly Adjustment Locations

3. Apply a 5 volt peak 100 Hz square wave to the Signal Generator PULSE INPUT. Select external (EXT) PULSE on the Signal Generator.
4. Select 20 MHz bandwidth limit on the oscilloscope and adjust DET AMP GAIN A6R36 to obtain spikes less than  $\pm 10$  mV. Repeat the two previous steps until both conditions are satisfied simultaneously. Disconnect the oscilloscope and voltmeter.
5. Connect the oscilloscope to A6TP1. Set the Signal Generator frequency to less than 3.0 GHz and slowly increase it to 3.25 GHz. Adjust  $\mu$ W FILTER, A6R43, until the voltage at A6TP1 just switches at 3.25 GHz.
6. Again decrease the frequency until the voltage switches low. Increase the frequency until the voltage switches high. If the frequency is not 3.25 GHz, readjust  $\mu$ W FILTER, A6R43, until the correct switching frequency is obtained. There is normally about 100 MHz hysteresis between the switch point going up compared to the switch point going down.
7. Connect a frequency counter to the FM INPUT/OUTPUT connector. Select FM INT (internal sawtooth) and adjust INT FM RATE, A6R42, to obtain 1 kHz on the counter.
8. Turn off FM INT.
9. Select INT 1 kHz PULSE. Connect the counter to A6TP2 and adjust INT 1 kHz, A6R6, for 1 kHz on the counter.
10. Disconnect the directional coupler (DC1) from the microwave detector (CR1), and replace it with a 50 $\Omega$  load.
11. Disconnect the orange 30 MHz REF (reference) input cable from A6J3 and the green EXT PULSE input cable from A6J2. Terminate the jacks with 50 $\Omega$  loads.
12. Reinstall the A6 board in the extrusion and secure it using all the cover screws. This is important for the next step.

## ADJUSTMENTS

## A5 ALC CONTROL AND A6 ALC DETECTOR AMPLIFIER ADJUSTMENTS (cont'd)

Procedure  
(cont'd)

13. Connect the dc voltmeter to A6J4 and adjust DETAMP OFFSET, A6R48, to obtain  $0 \pm 10 \mu\text{Vdc}$  at the jack.
14. Disconnect the red ALC ERROR input cable and connect a  $50\Omega$  load to A5J1. Make sure all modulation is off.
15. Connect an oscilloscope to A5TP3 and adjust OFFSET, A5R22, to obtain 0 Vdc on the oscilloscope with a drift of less than 10 mV in 10 seconds.
16. Set the test oscillator to a 100 kHz sine wave and connect it to A5J1 via the ferrite transformer shown in Figure 5-5.

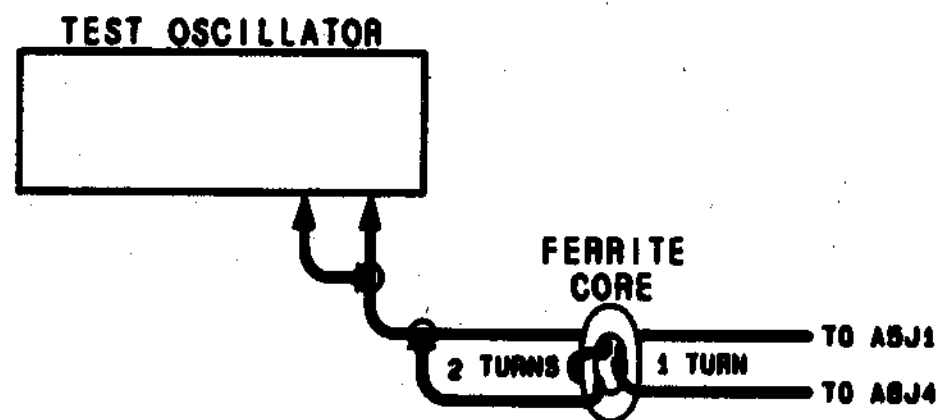


Figure 5-5. Ferrite Coupling Transformer Circuit

17. Connect the gain phase meter to A5J1 via the transformer. Set both channels A and B to the 2 mV—2V range and the 100 kHz to 1 MHz range. Set both the amplitude and phase reference to channel A.
18. Set the RF OUTPUT of the Signal Generator to 0 dBm. Adjust the test oscillator to obtain a reading of about -40 dBV on the gain phase meter.
19. Switch the gain phase meter amplitude switch to B/A. Increase the test oscillator frequency until the gain phase meter reads 0 degrees.
20. Tune the Signal Generator frequency. While tuning, keep the phase display near zero by changing the test oscillator frequency. Find the frequency where the B/A amplitude is the highest.
21. Center ALC GAIN II, A5R40, and adjust the test oscillator and ALC GAIN I, A5R4, simultaneously to obtain  $0 \pm 0.5$  degrees and  $-10 \pm 0.25$  dB readings on the gain phase meter. This should occur at a frequency above 600 kHz.

**ADJUSTMENTS**

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**A5 ALC CONTROL AND A6 ALC DETECTOR AMPLIFIER ADJUSTMENTS (cont'd)****Procedure  
(cont'd)**

22. Set the Signal Generator to the 0 to -10 dBm position and adjust the LEVEL vernier to obtain 0.0 dBm on the LEVEL display.
23. Simultaneously adjust the test oscillator frequency and ALC GAIN I, A5R4, to obtain  $0 \pm 0.5$  degrees and  $-10 \pm 0.25$  dB readings on the gain phase meter. This should occur at a frequency above 600 kHz.
24. Repeat the previous four steps until all conditions are met.

## ADJUSTMENTS

## 5-10. A10 FM SHAPER ADJUSTMENTS

**Reference** Service Sheet 12.

**Description** The FM Adjustments consist of setting the operating current for the shaping circuit, setting the gain after shaping, and setting the FM level to agree with the front panel display.

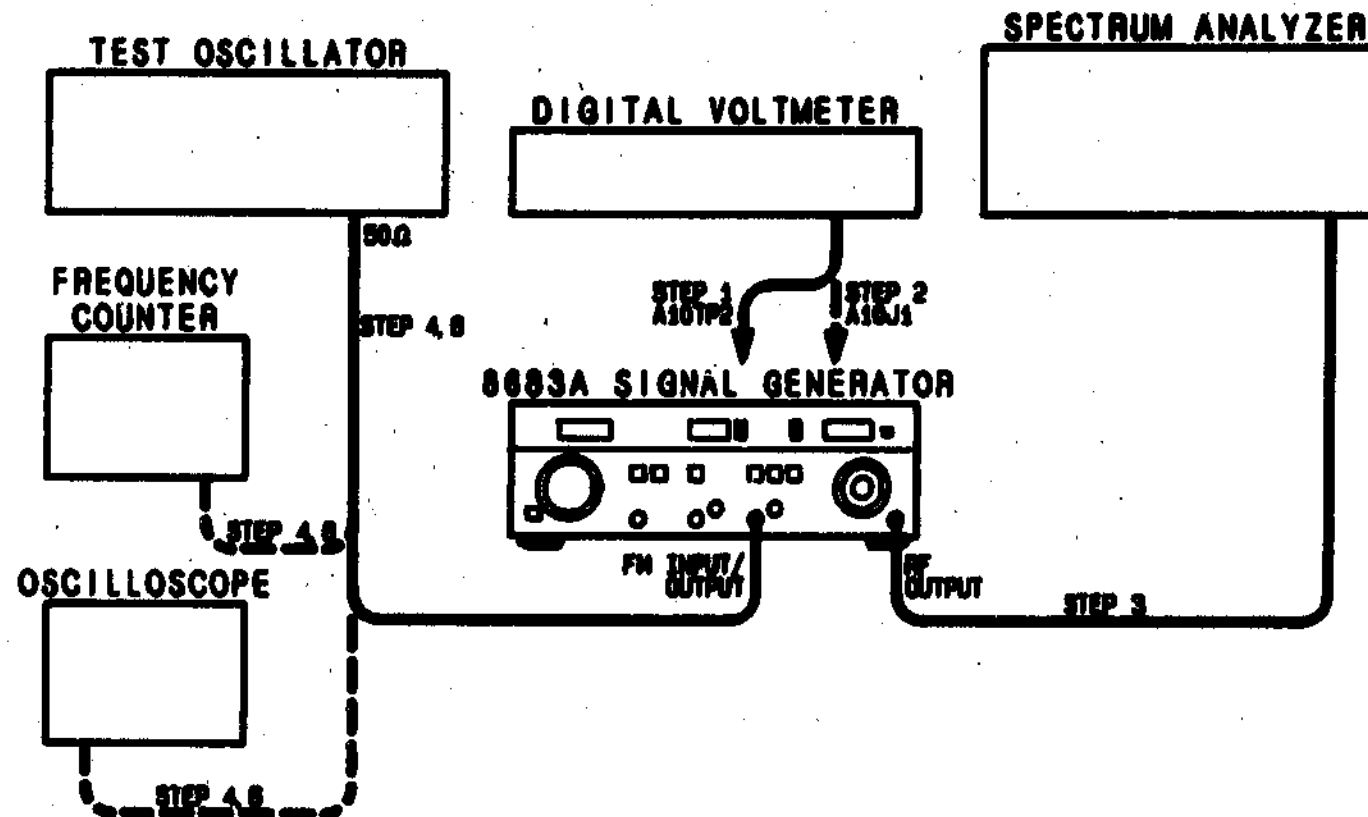


Figure 5-6. A10 FM Shaper Adjustments Setup

## Equipment

Test Oscillator .....	HP 8903A
Digital Voltmeter .....	HP 3456A
Oscilloscope .....	HP 1725A
Spectrum Analyzer .....	HP 8565A
Frequency Counter .....	HP 5342A

## Procedure

1. Connect the dc voltmeter to A10TP2 and adjust PRE DC, A10R19, for -0.8 Vdc.
2. Disconnect the cable from FM OUT connector, A10J1. Attach the voltmeter to A10J1. Adjust POST GAIN, A10R63, for -7.8 Vdc as measured at A10J1. Reconnect the cable to A10J1.
3. Set the instrument under test to 3.0 GHz at -20 dBm. Neither power level nor frequency are critical for this test. Connect a spectrum analyzer to the RF OUTPUT connector and tune the analyzer to center the carrier on the display using 1 MHz per division and 10 dB log display. Adjust the spectrum analyzer to place the carrier at the top graticule line.
4. Connect the test oscillator 50Ω output to the FM INPUT/OUTPUT connector of the Signal Generator under test. Set the test oscillator to 2.0791 MHz at about 0.35 Vrms (0.5 Vpeak). Adjust the output voltage so the modulation display on the Signal Generator reads 5.00 MHz.

**ADJUSTMENTS**

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**A10 FM SHAPER ADJUSTMENTS (cont'd)****Procedure  
(cont'd)**

5. Adjust FM ATTEN, A10R12, to null the carrier on the spectrum analyzer display. The carrier should be at least 40 dB below the top graticule line.
6. Reset the output of the test oscillator to again read 5.00 MHz on the MODULATION display. Readjust FM ATTEN, A10R12, to again null the carrier on the spectrum analyzer. Repeat this step as necessary to obtain both a carrier null and an indication of 5.00 MHz deviation (making sure that the modulation frequency has not drifted).

## ADJUSTMENTS

## 5-11. A8 I/O (INPUT/OUTPUT) ADJUSTMENTS

**Reference** Service Sheet 10.

**Description** The adjustments performed here set up the I/O Assembly.

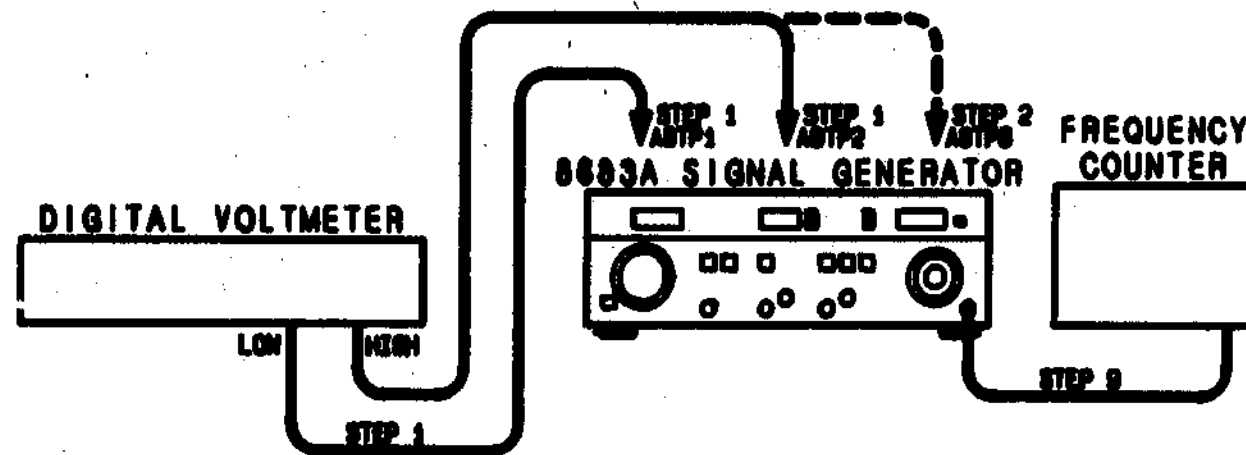


Figure 5-7. A8 I/O (Input/Output) Adjustments Setup

**Equipment**

Digital Voltmeter ..... HP 3456A  
 Frequency Counter ..... HP 5342A

**Procedure**

1. Connect the voltmeter return lead to analog ground A8TP1. Connect the voltmeter high lead to A8TP2. Adjust D/A REF (V REF), A8R31, to obtain  $10.240 \pm 0.001$  Vdc.
2. Connect the voltmeter to A8TP6. Set the service switch A9S1 to the DIAG (diagnostic) position and select diagnostic test #34. Measure the voltage. It should be approximately -10 Vdc. Note the voltage here: (subtract the absolute value of this voltage from 20.000 Vdc).

$$\begin{array}{r} 20.000 \text{ Vdc} \\ - \quad \text{Vdc} \\ = \quad \text{Vdc} \end{array}$$

3. Select diagnostic test #35. The measured voltage should match the voltage calculated in the previous step (about +10 Vdc). If the voltage is not correct adjust D/A GAIN (DAC GAIN), A8R34, to obtain the calculated voltage. The voltage difference between diagnostics #34 and #35 should be  $20.000 \pm 0.001$  Vdc. This should not be an iterative adjustment but it would be wise to double check the difference after making the adjustment.

4. Set the frequency control fully counterclockwise. Select diagnostic test #15 and set FREQ OFS (OFFSET), A8R20, for a display of -10.00V in the FREQUENCY display (negative numbers indicated by flashing the decimal point that is second from the left).

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**ADJUSTMENTS**

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**AS I/O (INPUT/OUTPUT) ADJUSTMENTS (cont'd)****Procedure  
(cont'd)**

5. Set the frequency control fully clockwise. Adjust **FREQ GAIN, A8R22**, for a display of 10.00 volts in the **FREQUENCY** display.
6. Select diagnostic test #16 and adjust **F1 (FREQ 1), A8R12**, for a display of 5.12 Vdc.
7. Select diagnostic test #17 and adjust **F2 (FREQ 2), A8R15**, for a display of 5.12 Vdc.
8. Select diagnostic test #18 and adjust **F3 (FREQ 3), A8R18**, for a display of 5.12 Vdc.
9. Select **NORM (normal)** mode using the service switch **A9S1** located at the top of the CPU board, and connect a frequency counter to the **RF OUTPUT** connector of the Signal Generator. Set the power level to -10 dBm or other level as required to trigger the counter.
10. Set the Signal Generator frequency to obtain 2.300 GHz as displayed on the frequency counter. Readjust **FREQ OFS (OFFSET), A8R20**, to obtain a display of 2.300 GHz on the Signal Generator's **FREQUENCY** display.
11. Set the Signal Generator to obtain 6.500 GHz on the frequency counter. Readjust **FREQ GAIN, A8R22**, to obtain a **FREQUENCY** display of 6.500 GHz.
12. Set the Signal Generator frequency so the counter reads 3.000 GHz. Readjust **F1 (FREQ 1), A8R12**, to obtain a **FREQUENCY** display of 3.000 GHz.
13. Set the Signal Generator frequency so the counter reads 4.500 GHz. Readjust **F2 (FREQ 2), A8R15**, to obtain a frequency display of 4.500 GHz.
14. Set the Signal Generator frequency so the counter reads 6.000 GHz. Redjust **F3 (FREQ 3), A8R18**, to obtain a **FREQUENCY** display of 6.000 GHz.



**ADJUSTMENTS**

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**5-12. SETTING PHYSICAL STOPS OF THE FREQUENCY TUNING MECHANISM****NOTE**

*This adjustment is necessary only after disassembly of the tuning drive mechanism.*

1. Push the tuning knob in and rotate clockwise until the stop is reached.
2. Rotate the tuning knob counterclockwise to the other stop while counting the number of turns. There should be about 21 turns from stop to stop.

**Number of Turns too High**

3. If the number of turns is too high, reset to the clockwise stop and count 21 turns counterclockwise. Loosen the set screw visible at the front of the bellows. Note the position of the tuning knob and rotate the knob to gain access to the other set screw.
4. Loosen the second set screw and carefully return the knob to the noted position.
5. Rotate the bellows clockwise with the fingers until the rear stop is reached.
6. Tighten one of the set screws and rotate the tuning knob as required to gain access to the other set screw.
7. Set the tuning mechanism to the counterclockwise stop and rotate clockwise to confirm there are approximately 21 turns stop to stop.

**Number of Turns too Low**

8. If the number of turns is too low, set the tuning knob to the clockwise stop, loosen the front bellows set screws and rotate the bellows counterclockwise one-half turn for each turn the tuning knob is short of 21 turns.
9. Retighten the set screws and check the number of turns. Make sure the tuning knob is at the clockwise stop before tightening the first set screw.

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**ADJUSTMENTS**

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**5-13. LUBRICATION OF THE DRIVE ASSEMBLY****NOTE**

*The main lubrication material used in this instrument is Molykote G-N Paste, HP Part Number 6040-0521. Molykote is a trademark of the Dow Corning Corporation. WD-40 lubricant HP Part Number 6040-0469 is also used. WD-40 is a trademark of the WD-40 Company.*

**Disassembly**

1. Rotate the tuning shaft counterclockwise until the stop is reached. Note that an Allen set screw is accessible at the front of the bellows, this screw will be loosened second. Rotate the tuning shaft clockwise to gain access to the other set screw. Loosen the set screw two or three turns and rotate the tuning shaft counterclockwise to hit the stop again.
2. Loosen the other set screw. Remove the four Pozidriv screws from the plate on the front of the casting. The gear assembly is mounted to this plate.
3. Pull the plate out. It may be necessary to move the plate slightly to free the shaft from the bellows and to get the shaft through the bushing. This work should be done on a flat level surface. A few spacing washers may fall off when the shaft is pulled out. Merely save them to put back on the shaft when the unit is reassembled.

**Lubrication****NOTE**

*The drive train will not require lubrication very often; it will depend on the severity of the environment.*

The following points are lubricated.

4. The normal and rapid tuning clutch assemblies are lubricated on their clutch surfaces with Molykote.
5. The inside diameter of the idler gear HP Part Number 08684-20054 is lubricated with Molykote. To do this, disassemble the drive assembly.
6. All gear teeth should be lightly lubricated with Molykote.
7. The ends of all gears where they touch flat washers used as shims should be lubricated with Molykote.
8. The ball bearings that ride against the normal speed clutch assembly should be lubricated with Molykote.
9. The entire length of the lead screw should be lubricated with WD-40. The lead screw is visible behind the tuning bellows. Spray the screw with WD-40 and tune rapidly over the entire tuning range a few times to uniformly distribute the lubricant.

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**ADJUSTMENTS**

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**LUBRICATION OF THE DRIVE ASSEMBLY (cont'd)****Procedure**

10. The ball at the end of the lead screw should be lubricated. Remove the oscillator from the casting and apply Molykote to the end of the lead screw and/or to the wear plate on the bellows attached to the oscillator.

**Reassembly**

11. Push the gear assembly straight into the casting. Make sure the index notch and index stud line up. As you are pushing the assembly in, keep a finger over the bushing through which the shaft that attaches to the bellows must pass. The bushing is easier to keep in place than to push back into place over the shaft.
12. Secure the plate to the casting with four Pozidriv screws.
13. Position the casting with the front end down. Place the spacing washers over the tuning shaft. Push the bellows over the tuning shaft as far as it will go and tighten the set screw.
14. Rotate the tuning shaft to gain access to the other set screw and tighten it.
15. Rotate the tuning shaft counterclockwise until the stop is reached. Rotate the tuning shaft clockwise and count the number of turns until the other stop is reached. There should be approximately 21 turns from stop to stop.

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# PARTS LIST

## SECTION VI REPLACEABLE PARTS

### 6-1. INTRODUCTION

This section contains information for ordering parts. Table 6-1 lists part numbers for restored assemblies. Table 6-2 lists abbreviations used in the parts list and throughout the manual. Table 6-3 lists all replaceable parts in reference designator order. Table 6-4 contains the names and addresses that correspond to the manufacturer's code numbers.

### 6-2. ABBREVIATIONS

Table 6-2 lists abbreviations used in the parts list, schematics, and throughout the manual. In some cases, two forms of the abbreviation are used, one all in capitals letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

### 6-3. REPLACEABLE PARTS LIST

Table 6-3 is the list of replaceable parts and is organized as follows:

- a. Electrical assemblies and their components in alphanumeric order by reference designation.
- b. Chassis-mounted parts in alphanumeric order by reference designation.
- c. Mechanical parts.

The information given for each part consists of the following:

- a. The Hewlett-Packard part number.
- b. Part number check digit (CD).
- c. Total quantity (Qty) used in the instrument.
- d. Part description.
- e. Five-digit code that represents a typical manufacturer.
- f. Manufacturer's part number.

### NOTE

*The total quantity for each part is given only once, that is, at the first occurrence of the part number in the list. The total quantities for optional assemblies are totalled by assembly and not integrated into the standard list.*

### 6-4. FACTORY SELECTED PARTS (\*)

Parts marked with an asterisk (\*) are factory selected parts. The value listed in the parts list is the nominal value. Refer to Sections V and VIII of this manual for information on determining what value to use for replacement.

### 6-5. PARTS LIST BACKDATING (†)

Parts marked with a dagger (†) are different in Signal Generators with serial number prefixes lower than the one that this manual applies to directly.

### 6-6. PARTS LIST UPDATING (Change Sheet)

Production changes to Signal Generators made after the publication date of this manual are accompanied by a change in the serial number prefix. Changes to the parts list are recorded by serial number prefix on a MANUAL CHANGES supplement. Also, parts list errors are noted in the ERRATA portion of the MANUAL CHANGES supplement.

### 6-7. ILLUSTRATED PARTS BREAKDOWN

Most mechanical parts are identified in Figures 6-1 through 6-4. These figures are located at the end of the replaceable parts table.

### 6-8. ORDERING INFORMATION

To order a part listed in the replaceable parts table, include the Hewlett-Packard part number (with the check digit), and the quantity required. Address the order to the nearest Hewlett-Packard office. The check digit will ensure accurate and timely processing of your order.

To order a part that is not listed in the replaceable parts table, include the instrument model number,

**ORDERING INFORMATION (cont'd)**

instrument serial number, description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

**NOTE**

*Within the USA, it is better to order directly from the HP Parts Center in Mountain View, California. Ask your nearest HP office for information and forms for the "Direct Mail Order System".*

**6-9. RECOMMENDED SPARES LIST**

Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard prepares a "Recommended Spares" list for this instrument. The contents of the list are based on failure reports and repair data. Quantities given are for one year of parts support. A complimentary copy of the "Rec-

ommended Spares" list may be requested from your nearest Hewlett-Packard office.

When stocking parts to support more than one Signal Generator or to support a variety of Hewlett-Packard instruments, it may be more economical to work from one consolidated list rather than simply adding together stocking quantities from the individual instrument lists. Hewlett-Packard will prepare consolidated "Recommended Spares" lists for any number or combination of instruments. Contact your nearest Hewlett-Packard office for details.

**6-10. RESTORED ASSEMBLIES**

Table 6-1 lists assemblies within the instrument that may be replaced on an exchange basis, thus affording a considerable cost saving. Exchange, factory-repaired and tested assemblies are available only on a trade-in basis; therefore, the defective assemblies must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the new assembly part number.

**Table 6-1. Part Numbers for Restored Assemblies**

Reference Designation	Description	Part Number <sup>1</sup>	
		Restored Assembly	New Assembly
A14	Microwave Oscillator (with EPROM)	08683-67201	08683-67001
	Microwave Output Assembly (includes DC1, AT1, CR1, and EPROM)	08683-60004	08683-60002

<sup>1</sup> When ordering extra assemblies for spare parts stock, use new assembly part number only. Restored orders require return of the defective part.

Table 6-2. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A . . . . . assembly	E . . . . . miscellaneous electrical part	P . . . . . electrical connector (movable portion); plug	U . . . . . integrated circuit; microcircuit
AT . . . . . attenuator; isolator; termination	F . . . . . fuse	Q . . . . . transistor; SCR; triode thyristor	V . . . . . electron tube
B . . . . . fan; motor	FL . . . . . filter	R . . . . . resistor	VR . . . . . voltage regulator; breakdown diode
BT . . . . . battery	H . . . . . hardware	RT . . . . . thermistor	W . . . . . cable; transmission path; wire
C . . . . . capacitor	HY . . . . . circulator	S . . . . . switch	X . . . . . socket
CP . . . . . coupler	J . . . . . electrical connector (stationary portion); jack	T . . . . . transformer	Y . . . . . crystal unit (piezo-electric or quartz)
CR . . . . . diode; diode thyristor; varactor	K . . . . . relay	TB . . . . . terminal board	Z . . . . . tuned cavity; tuned circuit
DC . . . . . directional coupler	L . . . . . coil; inductor	TC . . . . . thermocouple	
DL . . . . . delay line	M . . . . . meter	TF . . . . . test point	
DS . . . . . annunciator; signaling device (audible or visual); lamp; LED	MP . . . . . miscellaneous mechanical part		

ABBREVIATIONS

A . . . . . ampere	COEF . . . . . coefficient	EDF . . . . . electronic data processing	INT . . . . . internal
ac . . . . . alternating current	COM . . . . . common	ELECT . . . . . electrolytic	kg . . . . . kilogram
ACCESS . . . . . accessory	COMP . . . . . composition	ENCAP . . . . . encapsulated	kHz . . . . . kilohertz
ADJ . . . . . adjustment	COMPL . . . . . complete	EXT . . . . . external	kΩ . . . . . kilohm
A/D . . . . . analog-to-digital	CONN . . . . . connector	F . . . . . farad	kV . . . . . kilovolt
AF . . . . . audio frequency	CP . . . . . cadmium plate	FET . . . . . field-effect transistor	lb . . . . . pound
AFC . . . . . automatic frequency control	CRT . . . . . cathode-ray tube	F/F . . . . . flip-flop	LC . . . . . inductance-capacitance
AGC . . . . . automatic gain control	CTL . . . . . complementary transistor logic	FH . . . . . flat head	LED . . . . . light-emitting diode
AL . . . . . aluminum	CW . . . . . continuous wave	FIL H . . . . . fillister head	LF . . . . . low frequency
ALC . . . . . automatic level control	cw . . . . . clockwise	FM . . . . . frequency modulation	LG . . . . . long
AM . . . . . amplitude modulation	cm . . . . . centimeter	FP . . . . . front panel	LH . . . . . left hand
AMPL . . . . . amplifier	D/A . . . . . digital-to-analog	FREQ . . . . . frequency	LIM . . . . . limit
AFC . . . . . automatic phase control	dB . . . . . decibel	FXD . . . . . fixed	LIN . . . . . linear taper (used in parts list)
ASSY . . . . . assembly	dBm . . . . . decibel referred to 1 mW	G . . . . . gram	lin . . . . . linear
AUX . . . . . auxiliary	dc . . . . . direct current	GE . . . . . germanium	LK WASH . . . . . lock washer
avg . . . . . average	deg . . . . . degree (temperature interval or difference)	GHz . . . . . gigahertz	LO . . . . . low local oscillator
AWG . . . . . American wire gauge	° . . . . . degree (plane angle)	GL . . . . . glass	LOG . . . . . logarithmic taper (used in parts list)
BAL . . . . . balance	°C . . . . . degree Celsius (centigrade)	GRD . . . . . ground(ed)	log . . . . . logarithm(ic)
BCD . . . . . binary coded decimal	°F . . . . . degree Fahrenheit	H . . . . . henry	LPF . . . . . low pass filter
BD . . . . . board	K . . . . . degree Kelvin	h . . . . . hour	LV . . . . . low voltage
BE CU . . . . . beryllium copper	DEPC . . . . . deposited carbon	HET . . . . . heterodyne	m . . . . . meter (distance)
BFO . . . . . beat frequency oscillator	DET . . . . . detector	HEX . . . . . hexagonal	mA . . . . . milliamperes
BH . . . . . binder head	diam . . . . . diameter	HD . . . . . head	MAX . . . . . maximum
BKDN . . . . . breakdown	DIA . . . . . diameter (used in parts list)	HDW . . . . . hardware	MΩ . . . . . megohm
BP . . . . . bandpass	DIFF AMPL . . . . . differential amplifier	HF . . . . . high frequency	MEG . . . . . meg (10 <sup>6</sup> ) (used in parts list)
BPF . . . . . bandpass filter	div . . . . . division	HG . . . . . mercury	MET FLM . . . . . metal film
BRS . . . . . brass	DPDT . . . . . double-pole, double-throw	HI . . . . . high	MET OX . . . . . metallic oxide
BWO . . . . . backward-wave oscillator	DR . . . . . drive	HP . . . . . Hewlett-Packard	MF . . . . . medium frequency; microfarad (used in parts list)
CAL . . . . . calibrate	DSB . . . . . double sideband	HPF . . . . . high pass filter	MFR . . . . . manufacturer
ccw . . . . . counter-clockwise	DTL . . . . . diode transistor logic	HR . . . . . hour (used in parts list)	mg . . . . . milligram
CER . . . . . ceramic	DVM . . . . . digital voltmeter	HV . . . . . high voltage	MHz . . . . . megahertz
CHAN . . . . . channel	ECL . . . . . emitter coupled logic	Hz . . . . . Hertz	mH . . . . . millihenry
cm . . . . . centimeter	EMF . . . . . electromotive force	IC . . . . . integrated circuit	mho . . . . . mho
CMO . . . . . cabinet mount only		ID . . . . . inside diameter	MIN . . . . . minimum
COAX . . . . . coaxial		IF . . . . . intermediate frequency	min . . . . . minute (time)
		IMPG . . . . . impregnated	... . . . . minute (plane angle)
		in . . . . . inch	MINAT . . . . . miniature
		INCD . . . . . incandescent	mm . . . . . millimeter
		INCL . . . . . include(s)	
		INP . . . . . input	
		INS . . . . . insulation	

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-2. Reference Designations and Abbreviations (2 of 2)

MOD . . . . . modulator	OD . . . . . outside diameter	PWV . . . . . peak working voltage	TD . . . . . time delay
MOM . . . . . momentary	OH . . . . . oval head	RC . . . . . resistance-capacitance	TERM . . . . . terminal
MOS . . . . . metal-oxide semiconductor	OP AMPL . . . . . operational amplifier	RECT . . . . . rectifier	TFT . . . . . thin-film transistor
ms . . . . . millisecond	OPT . . . . . option	REF . . . . . reference	TGL . . . . . toggle
MTG . . . . . mounting	OSC . . . . . oscillator	REG . . . . . regulated	THD . . . . . thread
MTR . . . . . meter (indicating device)	OX . . . . . ounce	REPL . . . . . replaceable	THRU . . . . . through
mV . . . . . millivolt	oz . . . . . ounce	RF . . . . . radio frequency	TI . . . . . titanium
mVac . . . . . millivolt, ac	Ω . . . . . ohm	RFI . . . . . radio frequency interference	TOL . . . . . tolerance
mVdc . . . . . millivolt, dc	P . . . . . peak (used in parts list)	RH . . . . . round head; right hand	TRIM . . . . . trimmer
mVpk . . . . . millivolt, peak	PAM . . . . . pulse-amplitude modulation	RLC . . . . . resistance-inductance-capacitance	TSTR . . . . . transistor
mVp-p . . . . . millivolt, peak-to-peak	PC . . . . . printed circuit	RMO . . . . . rack mount only	TTL . . . . . transistor-transistor logic
mVrms . . . . . millivolt, rms	PCM . . . . . pulse-code modulation; pulse-count modulation	rms . . . . . root-mean-square	TV . . . . . television
mW . . . . . milliwatt	PDM . . . . . pulse-duration modulation	RND . . . . . round	TVI . . . . . television interference
MUX . . . . . multiplex	pF . . . . . picofarad	ROM . . . . . read-only memory	TWT . . . . . traveling wave tube
MY . . . . . mylar	PH BRZ . . . . . phosphor bronze	R&P . . . . . rack and panel	U . . . . . micro (10 <sup>-6</sup> ) (used in parts list)
μA . . . . . microampere	PHL . . . . . Phillips	RWV . . . . . reverse working voltage	UF . . . . . microfarad (used in parts list)
μF . . . . . microfarad	PIN . . . . . positive-intrinsic-negative	S . . . . . scattering parameter	UHF . . . . . ultrahigh frequency
μH . . . . . microhenry	PIV . . . . . peak inverse voltage	s . . . . . second (time)	UNREG . . . . . unregulated
μmho . . . . . micromho	pk . . . . . peak	" . . . . . second (plane angle)	V . . . . . volt
μs . . . . . microsecond	PL . . . . . phase lock	S-B . . . . . slow-blow (fuse) (used in parts list)	VA . . . . . voltampere
μV . . . . . microvolt	PLO . . . . . phase lock oscillator	SCR . . . . . silicon controlled rectifier; screw	Vac . . . . . volts, ac
μVac . . . . . microvolt, ac	PM . . . . . phase modulation	SE . . . . . selenium	VAR . . . . . variable
μVdc . . . . . microvolt, dc	PNP . . . . . positive-negative-positive	SECT . . . . . sections	VCO . . . . . voltage-controlled oscillator
μVpk . . . . . microvolt, peak	P/O . . . . . part of	SEMICON . . . . . semiconductor	Vdc . . . . . volts, dc
μVp-p . . . . . microvolt, peak-to-peak	POLY . . . . . polystyrene	SHF . . . . . superhigh frequency	VDCW . . . . . volts, dc, working (used in parts list)
μVrms . . . . . microvolt, rms	PORC . . . . . porcelain	SI . . . . . silicon	V(F) . . . . . volts, filtered
μW . . . . . microwatt	POS . . . . . positive; position(s) (used in parts list)	SIL . . . . . silver	VFO . . . . . variable-frequency oscillator
nA . . . . . nanoampere	POSN . . . . . position	SL . . . . . slide	VHF . . . . . very-high frequency
NC . . . . . no connection	POT . . . . . potentiometer	SNR . . . . . signal-to-noise ratio	Vpk . . . . . volts, peak
N/C . . . . . normally closed	p-p . . . . . peak-to-peak	SPDT . . . . . single-pole, double-throw	Vp-p . . . . . volts, peak-to-peak
NE . . . . . neon	PP . . . . . peak-to-peak (used in parts list)	SPG . . . . . spring	Vrms . . . . . volts, rms
NEG . . . . . negative	PPM . . . . . pulse-position modulation	SR . . . . . split ring	VSWR . . . . . voltage standing wave ratio
nF . . . . . nanofarad	PREAMPL . . . . . preamplifier	SPST . . . . . single-pole, single-throw	VTO . . . . . voltage-tuned oscillator
NI PL . . . . . nickel plate	PRF . . . . . pulse-repetition frequency	SSB . . . . . single sideband	VTVM . . . . . vacuum-tube voltmeter
N/O . . . . . normally open	PRR . . . . . pulse repetition rate	SST . . . . . stainless steel	V(X) . . . . . volts, switched
NOM . . . . . nominal	ps . . . . . picosecond	STL . . . . . steel	W . . . . . watt
NORM . . . . . normal	PT . . . . . point	SQ . . . . . square	W/ . . . . . with
NPN . . . . . negative-positive-negative	PTM . . . . . pulse-time modulation	SWR . . . . . standing-wave ratio	WIV . . . . . working inverse voltage
NPO . . . . . negative-positive zero (zero temperature coefficient)	PWM . . . . . pulse-width modulation	SYNC . . . . . synchronize	WW . . . . . wirewound
NRFR . . . . . not recommended for field replacement		T . . . . . timed (slow-blow fuse)	W/O . . . . . without
NSR . . . . . not separately replaceable		TA . . . . . tantalum	YIG . . . . . yttrium-iron-garnet
ns . . . . . nanosecond		TC . . . . . temperature compensating	Z <sub>0</sub> . . . . . characteristic impedance
nW . . . . . nanowatt			
OBD . . . . . order by description			

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10 <sup>12</sup>
G	giga	10 <sup>9</sup>
M	mega	10 <sup>6</sup>
k	kilo	10 <sup>3</sup>
da	deka	10
d	deci	10 <sup>-1</sup>
c	centi	10 <sup>-2</sup>
m	milli	10 <sup>-3</sup>
μ	micro	10 <sup>-6</sup>
n	nano	10 <sup>-9</sup>
p	pico	10 <sup>-12</sup>
f	femto	10 <sup>-15</sup>
a	atto	10 <sup>-18</sup>



Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	08684-60001	5	1	FRONT PANEL BOARD	28480	08684-60001
A1C1	0180-2820	6	25	CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A1C2	0180-2820	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A1C3	0180-2820	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A1C4	0180-2820	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A1C5	0180-2820	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A1C6	0180-2820	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A1C7	0180-2820	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A1DS1	1990-0511	8	10	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS2	1990-0511	8		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS3	1990-0511	8		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS4	1990-0511	8		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS5- A1DS7			4	NOT ASSIGNED		
A1DS8	1990-0511	8		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS9	1990-0511	8		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS10	1990-0511	8		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS11	1990-0752	8	1	DISPLAY-AN-SEG 1-CHAR .408-H RED	28480	5082-7756
A1DS12	1990-0511	8		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS13	1990-0511	8		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS14	1990-0511	8		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7750
A1DS15				NOT ASSIGNED		
A1DS16	1990-0665	3	11	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS17	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS18	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS19	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS20	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS21	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS22	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS23	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS24	1990-048J	6	2	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A1DS25	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS26	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1DS27				NOT ASSIGNED		
A1DS28	1990-0486	6		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4684
A1DS29	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	1990-0665
A1J1	1251-5720	5		CONNECTOR-RIBBON CABLE	28480	1251-5720
A1L1	9140-0096	1	2	INDUCTOR RF-CH-MLD 1UH 10% .166DX.385LG	28480	9140-0096
A1MP1	5041-0385	7	5	KEY CAP-HALF 'XAM'	28480	5041-0385
A1MP2	5041-0385	7		KEY CAP-HALF 'MHZ FM'	28480	5041-0385
A1MP3	5041-0385	7		KEY CAP-HALF 'CB REL'	28480	5041-0385
A1MP4	5041-0385	7		KEY CAP-HALF 'CABLE OFFSET'	28480	5041-0385
A1MP5	5041-0385	7		KEY CAP-HALF 'dBm'	28480	5041-0385
A1MP6	5041-0353	9	6	KEY CAP-FULL 'EXT'	28480	5041-0353
A1MP7	5041-0353	9		KEY CAP-FULL 'INT 1 KHz'	28480	5041-0353
A1MP8	5041-0353	9		KEY CAP-FULL 'EXT'	28480	5041-0353
A1MP9	5041-0353	9		KEY CAP-FULL 'INT'	28480	5041-0353
A1MP10	5041-0353	9		KEY CAP-FULL 'EXT 1 MHz/V'	28480	5041-0353
A1MP11	5041-0353	9		KEY CAP-FULL 'EXT 10 MHz/V'	28480	5041-0353
A1MP12	0380-1275	9	1	SPACER-RND .34-IN-LG .12-IN-ID	00000	ORDER BY DESCRIPTION
A1MP13	8159-0005	0	15	RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A1Q1	1853-0007	7	1	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	04713	2N3251
A1R1	0757-0401	0	21	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R2	0898-3155	1		RESISTOR 4.84K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A1R3	1810-0279	5	2	NETWORK-RES 10-SIP4.7K OHM X 9	01121	210A472
A1R4	1810-0279	5		NETWORK-RES 10-SIP4.7K OHM X 9	01121	210A472
A1R5	1810-0282	0	5	NETWORK-RES 10-SIP220.0K OHM X 9	01121	210A224
A1R6	0898-3453	2	5	RESISTOR 198K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1983-F
A1R7	0898-3453	2		RESISTOR 198K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1983-F
A1R8	0898-3453	2		RESISTOR 198K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1983-F
A1R9	1810-0273	9	1	NETWORK-RES 10-SIP470.0 OHM X 9	01121	210A471
A1R10	1810-0330	9	1	NETWORK-RES 16-DIP470.0 OHM X 8	01121	316B471

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
A1R11				NOT ASSIGNED		
A1R12	0757-0403	2	5	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A1R13	0698-3132	4	2	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1R14	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1R15	0698-0082	7	7	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R16	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R17	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R18	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R19	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A1R20	0698-3441	8	2	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A1S1	5060-9436	7	11	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S9	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S10	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1S11	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A1U1				NOT ASSIGNED		
A1U2	1820-1361	9	10	IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U3	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U4	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U5	1820-1300	6	3	IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
A1U6	1820-1730	6	7	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A1U7	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U8				NOT ASSIGNED		
A1U9	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U10	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U11	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U12	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U13				NOT ASSIGNED		
A1U14				NOT ASSIGNED		
A1U15	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A1U16	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U17	1820-1361	9		IC DCDR TTL BCD-TO-7-SEG 4-TO-7-LINE	07263	9374PC
A1U18	1820-1416	5	1	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A1U19	1820-1216	3	4	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A1U20	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A1U21	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
A1U22	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A1U23	1820-1300	6		IC SHF-RGTR TTL LS R-S PRL-IN PRL-OUT	01295	SN74LS195AN
A1U24	1820-1975	1	1	IC SHF-RGTR TTL LS NEG-EDGE-TRIG PRL-IN	01295	SN74LS165N
A1XA1DS1	1200-0803	8	14	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS2	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS3	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS4	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS5	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS6	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS7	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS8	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS9	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS10	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS11	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS12	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS13	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A1XA1DS14	1200-0803	8		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0803
A2				NOT ASSIGNED		

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
AJ				NOT ASSIGNED		
AK				NOT ASSIGNED		
AS	03684-80004	8	1	ALC CONTROL BOARD	28480	03684-80004
ASC1	0180-2055	9	25	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
ASC2	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
ASC3	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
ASC4	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
ASC5	0180-3307	4	1	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0180-2307
ASC6	0180-0116	1	8	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
ASC7	0180-0576	5	50	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
ASC8	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
ASC9	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
ASC10	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
ASC11	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
ASC12	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
ASC13	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
ASC14				NOT ASSIGNED		
ASC15	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
ASC16	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
ASC17	0180-3830	0	1	CAPACITOR-FXD 5UF +-10% 50VDC MET-POLYC	28480	0180-3830
ASC18	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
ASC19	0180-5030	6	1	CAPACITOR-FXD 2200PF +-5% 300VAC(RMS)	28480	0180-5030
ASC20	0180-0553	0	3	CAPACITOR-FXD 22UF+-20% 25VDC TA	28480	0180-0553
ASC21	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
ASC22	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
ASC23	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
ASC24	0180-0127	2	10	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0180-0127
ASC25	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X903582
ASC26	0180-3879	7	26	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
ASC27	0180-2815	1	2	CAPACITOR-FXD 100UF+-20% 10VDC TA	28480	0180-2815
ASC28	0180-3466	8	1	CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0180-3466
ASC29	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
ASC30	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
ASC31*	0180-2262	0	1	CAPACITOR-FXD 18PF +-5% 500VDC CER 0+-30	28480	0180-2262
ASC32	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
ASC33	0180-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0180-0127
ASC34				NOT ASSIGNED		
ASC35	0180-2883	1	1	CAPACITOR-FXD 4.7UF+-20% 35VDC TA	28480	0180-2883
ASCR1	1901-0518	8	4	DIODE-SM SIG SCHOTTKY	28480	1901-0518
ASCR2	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
ASCR3				NOT ASSIGNED		
ASCR4	1901-0050	3	56	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASCR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASCR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASCR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASCR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASCR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASCR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASCR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASCR12	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
ASCR13	1901-0033	2	8	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
ASJ1	1250-1220	0	8	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
	2190-0124	4	1	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9	1	NUT-HEX-DBL-CHAN 10-32-THD .067-IN-THK	28480	2950-0078
ASK1	0490-0916	6	5	RELAY-REED 1A 500MA 100VDC 5VDC-GOIL	28480	0490-0916
ASL1	9140-0210	1	9	INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
ASL2	9100-3922	4	7	INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
ASL3	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
ASL4	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
ASL5	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210

See introduction to this section for ordering information  
 \*Indicates factory selected value  
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Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
ASMP1	08684-0001	7	1	COVER-ALC CONTROL	28480	08684-00017
ASMP2	502*-0866	7	10	KNOB-P.C. BOARD PULLER	28480	5021-0866
	0515-0211	8	12	SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00600	ORDER BY DESCRIPTION
ASMP3	0510-0034	3	11	RETAINER-RING BWD EXT. .25-TN-DIA STL	28480	0510-0034
ASQ1	1855-0414	4	1	TRANSISTOR J-FET 2N4393 N-CHAN D-MODE	04713	2N4393
ASQ2	1854-0477	7	5	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
ASQ3	1853-0316	1	1	TRANSISTOR-DUAL PNP PD=500MW	28480	1C53-0316
ASQ4	1854-0477	7	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
ASQ5	1855-0081	1	3	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081
ASQ6	1853-0034	0	4	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
ASQ7	1854-0071	7	4	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
ASQ8	1858-0032	8	2	TRANSISTOR ARRAY 14-PIN PLSTC DIP	3L585	CA3148E
ASQ9				NOT ASSIGNED		
ASQ10	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
ASQ11				NOT ASSIGNED		
ASQ12	1853-0314	9	4	TRANSISTOR PNP 2N2905A SI TO-39 PD=800MW	04713	2N2905A
ASQ13	1853-0459	3	11	TRANSISTOR PNP SI PD=825MW FT=200MHZ	28480	1853-0459
ASQ14	1853-0459	3		TRANSISTOR PNP SI PD=825MW FT=200MHZ	28480	1853-0459
ASQ15	1853-0459	3		TRANSISTOR PNP SI PD=825MW FT=200MHZ	28480	1853-0459
ASQ18				NOT ASSIGNED		
ASQ19				NOT ASSIGNED		
ASQ20	1854-0810	2	7	TRANSISTOR NPN SI PD=825MW FT=200MHZ	28480	1854-0810
ASQ21	1853-0459	3		TRANSISTOR PNP SI PD=825MW FT=200MHZ	28480	1853-0459
ASQ22	1855-0420	2	1	TRANSISTOR J-FET 2N4391 N-CHAN D-MODE	01295	2N4391
ASR1	0757-0485	6	18	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
ASR2	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
ASR3	0757-0485	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
ASR4	2100-2489	9	3	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	30983	ET50X502
ASR5	0757-0428	1	5	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
ASR6	0757-0123	3	1	RESISTOR 34.9K 1% .125W F TC=0+-100	28480	0757-0123
ASR7	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
ASR8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
ASR9				NOT ASSIGNED		
ASR10	0757-0289	2	2	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
ASR11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
ASR12	0757-0199	3	8	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
ASR13	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
ASR14	0757-0416	7	13	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
ASR15	0757-0442	9	28	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
ASR16	0698-3442	9	4	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
ASR17	0757-0440	7	15	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
ASR18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
ASR19	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
ASR20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
ASR21	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
ASR22	2100-3161	6	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	02111	43P203
ASR23	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
ASR24	0757-0439	4	1	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
ASR25	0757-0441	8	2	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
ASR26	0757-0458	7	2	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
ASR27	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
ASR28	0757-0419	0	3	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
ASR29	0698-3438	3	3	RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
ASR30	0757-0438	3	8	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
ASR31	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
ASR32	0698-3404	3	1	RESISTOR 383 1% .5W F TC=0+-100	28480	0698-3404
ASR33	0757-0405	4	4	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
ASR34	0698-3433	8	1	RESISTOR 28.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-28R7-F
ASR35	0698-3438	3		RESISTOR 147 1% .125W F TC=0+-100	24546	C4-1/8-T0-147R-F
ASR36	0757-0290	5	3	RESISTOR 8.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-8191-F
ASR37	0757-0200	7	2	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
ASR38	0757-0485	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
ASR39	0757-0278	9	2	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
ASR40	2100-2489	9		RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	30983	ET50X502

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
ASR41	0757-0440	7			RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
ASR42	0757-0280	3			RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
ASR43*	0698-3155	1		10	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
ASR44	0757-0440	7			RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
ASR45	0757-0440	7			RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
ASR46	0757-0401	0			RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
ASR47	0698-3443	0		6	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
ASR48	2100-3274	2		1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
ASR49	0757-0440	7			RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
ASR50	0757-0420	3		2	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
ASR51	0757-0401	0			RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
ASR52	0757-0442	9			RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
ASR53	0757-0440	7			RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
ASR54	0698-3400	9		1	RESISTOR 147 1% .5W F TC=0+-100	28480	0698-3400
ASR55	0757-0465	6			RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
ASR56	0698-3155	1			RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
ASR57					NOT ASSIGNED		
ASR58					NOT ASSIGNED		
ASR59	0757-0180	2		5	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
ASR60	1810-0206	8		3	NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103
ASR61	1810-0206	8			NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103
ASR62	0757-0180	2			RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
ASR63	0698-3437	2		5	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
ASR64	0757-0464	5		1	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
ASR65	0757-0394	0		3	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
ASR66	0757-0465	6			RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
ASR67	0698-3160	8		5	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
ASTP1	1251-0800	0		40	CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0800
ASTP2	1251-0800	0			CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0800
ASTP3	1251-0800	0			CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0800
ASTP4	1251-0800	0			CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0800
ASTP5	1251-0800	0			CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0800
ASTP6	1251-0800	0			CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0800
ASTP7	1251-0800	0			CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0800
ASTP8	1251-0800	0			CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0800
ASTP9	1251-0800	0			CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0800
ASU1	1826-0138	8		3	IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
ASU2†	1826-0801	0		1	IC OP AMP PRCN TO-99 PKG	06665	OP-16FJ
ASU3	1826-0138	8			IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
ASU4					NOT ASSIGNED		
ASU5	1826-0783	9			IC OP AMP LOW-NOISE 8-DIP-C PKG	52083	XR5534ACN
ASU1	8159-0005	0			RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6	08884-80015	1		1	ALC DETECTOR AMPLIFIER BOARD	28480	08884-80015
ABC1	0160-3879	7			CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
ABC2	0160-3879	7			CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
ABC3	0160-3879	7			CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
ABC4	0160-3879	7			CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
ABC5	0160-3879	7			CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
ABC6	0160-2617	1		20	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
ABC7	0160-3879	7			CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
ABC8	0160-0576	5			CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
ABC9	0160-2617	1			CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
ABC10	0160-0576	5			CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
ABC11	0160-3879	7			CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
ABC12	0160-3879	7			CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
ABC13	0160-0118	1			CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D885X9035B2
ABC14	0160-2617	1			CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
ABC15	0160-4764	1		2	CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4764
ABC16	0160-0576	5			CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
ABC17	0160-0576	5			CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
ABC18	0160-4768	5		1	CAPACITOR-FXD 470PF +-5% 100VDC CER	28480	0160-4768
ABC19	0160-2617	1			CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
ABC20	0160-2617	1			CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K

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
A6C21	0180-0491	5	11	CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A6C22	0180-0553	0		CAPACITOR-FXD 22UF+-20% 25VDC TA	28480	0180-0553
A6C23	0180-3877	5	9	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0180-3877
A6C24	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A6C25	0180-0573	2	2	CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0180-0573
A6C26	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
A6C27	0180-0578	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0578
A6C28	0180-0578	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0578
A6C29	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A6C30	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A6C31	0180-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0180-3877
A6C32	0180-0578	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0578
A6C33	0180-0578	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0578
A6C34	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A6C35	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A6C36	0180-3454	4	1	CAPACITOR-FXD 220PF +-10% 1KVDC CER	28480	0180-3454
A6C37	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A6C38	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
A6C39	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
A6C40	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
A6C41	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A6C42	0180-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0180-3877
A6C43	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
A6C44	0180-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0180-3877
A6C45	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A6C46	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A6C47	0140-0199	6	1	CAPACITOR-FXD 240PF +-5% 300VDC MICA	72136	DM15F241J0300MV1CR
A6C48	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
A6C49	0180-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0180-3877
A6C50*	0140-0195	2	2	CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300MV1CR
A6CR1	08884-67006	4	1	DETECTOR ASSY-REFERENCE	28480	08884-67006
A6CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR8†				NOT ASSIGNED		
A6CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6E1	9170-0016	8	2	CORE-SHIELDING BEAD	28480	9170-0016
A6E2	9170-0016	8		CORE-SHIELDING BEAD	28480	9170-0016
A6J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
A6J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
A6J3	1250-1425	7	1	CONNECTOR-RF SMC M SGL-HOLE-RR 50-OHM	28480	1250-1425
A6J4	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
A6L1	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .168DX.385LG	28480	9140-0210
A6L2	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .168DX.385LG	28480	9140-0210
A6L3	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .168DX.385LG	28480	9140-0210
A6L4	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A6L5	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .168DX.385LG	28480	9140-0210
A6L6	9100-1646	5	1	INDUCTOR RF-CH-MLD 430UH 5% .2DX.45LG	28480	9100-1646
A6L7	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A6L8	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .168DX.385LG	28480	9140-0210
A6L9	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A6L10	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A6L11	9100-3922	4		INDUCTOR-FIXED 120-1300 HZ	28480	9100-3922
A6L12	9140-0142	8	1	INDUCTOR RF-CH-MLD 2.2UH 10% .105DX.26LG	28480	9140-0142
A6MP1	08884-00019	9	1	COVER-ALC DETECTOR AMPLIFIER	28480	08884-00019
A6MP2	5021-0866	7		KNOB-P.C. BOARD PULLER	28480	5021-0866
	0515-0211	8		SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
A6MP3	0510-0034	3		RETAINER-RING BWD EXT .25-IN-DIA STL	28480	0510-0034
A6Q1	1853-0281	9	4	TRANSISTOR PNP 2N2907A SI T0-18 PD=400MW	04713	2N2907A
A6Q2	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A6Q3	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A6Q4	1854-0477	7		TRANSISTOR NPN 2N2222A SI T0-18 PD=500MW	04713	2N2222A
A6Q5	1853-0034	0		TRANSISTOR PNP SI T0-18 PD=360MW	28480	1853-0034

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
A6Q6	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A6Q7	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A6Q8	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A6Q9	1854-0345	8	5	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q10	1854-0247	9	2	TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A6Q11	1854-0247	9		TRANSISTOR NPN SI TO-39 PD=1W FT=800MHZ	28480	1854-0247
A6Q12	1853-0034	0		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A6Q13	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q14	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q15	1855-0262	0	1	TRANSISTOR JFET DUAL N-CHAN D-MODE SI	28480	1855-0262
A6Q16	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q17	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A6R1	0757-0290	5		RESISTOR 8.19K 1% .125W F TC=0+-100	19701	MF4C-1/8-T0-8191-F
A6R2	0698-3153	9	2	RESISTOR 3.07K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A6R3	0698-7205	0	2	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51F1-F
A6R4	0757-0401	9		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R5	0698-7204	9		RESISTOR 46.4 1% .05W F TC=0+-100	24546	C3-1/8-T0-46R4-F
A6R6	2100-2522	1		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	30983	ET50X103
A6R7	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A6R8	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R9	0698-3157	3	9	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A6R10	0698-3161	9	1	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A6R11	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A6R12	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A6R13	0757-0290	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R14	0757-0290	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R15	0698-3447	4	8	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A6R16	0757-1094	9	9	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A6R17	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R18	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R19	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R20	0698-7247	0	2	RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-F
A6R21	0698-3151	7	1	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A6R22	0698-3155	1		RESISTOR 4.84K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4841-F
A6R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R24	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A6R25	0698-3450	9	1	RESISTOR 42.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4222-F
A6R26	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A6R27	0757-0421	4	1	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A6R28	0757-0419	0		RESISTOR 891 1% .125W F TC=0+-100	24546	C4-1/8-T0-891R-F
A6R29	0698-3150	6	2	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A6R30	0698-7195	7	2	RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-T0-1966-F
A6R31	2100-2497	9	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	82PR2K
A6R32	0698-3444	1	5	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R33	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A6R34	0698-7195	7		RESISTOR 19.6 1% .05W F TC=0+-100	24546	C3-1/8-T0-1966-F
A6R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R36	2100-1986	6	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A6R37	2100-2499	9		RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	30983	ET50X502
A6R38	0698-3452	1	3	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A6R39	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A6R40	0757-7317	7	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A6R41	0698-7247	0		RESISTOR 2.87K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2871-F
A6R42	2100-2313	5	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	30983	ET50X102
A6R43	2100-3750	9		RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	28480	2100-3750
A6R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R45	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A6R46	0757-0402	1	2	RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-F
A6R47	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A6R48	2100-3611	1	1	RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	32997	3292X-1-503
A6R49	0698-7260	7	1	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-F
A6R50	0757-0290	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R51	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A6R52	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R53	0698-3159	5	3	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A6R54	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A6R55				NOT ASSIGNED		

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
A6R56	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R57	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R58	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R59	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R60	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R61	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A6R62	0757-0274	5	4	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A6R63	0698-3152	8	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A6R64	0698-0084	9	2	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A6R65	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T0-51R1-F
A6R66	0757-0815	0	2	RESISTOR 562 1% .5W F TC=0+-100	29480	0757-0815
A6R67	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A6R68	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A6R69	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R70	0698-3440	7	4	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R71	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R72				NOT ASSIGNED		
A6R73	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A6R74	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R75	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R76	0757-0417	8	3	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A6R77	0698-3445	2	4	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A6R78	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R79	0698-3402	1	5	RESISTOR 316 1% .5W F TC=0+-100	26480	0698-3402
A6R80	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R81	2100-2030	6	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	73138	82PR20K
A6R82	0757-0802	5	1	RESISTOR 162 1% .5W F TC=0+-100	26480	0757-0802
A6R83	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A6U1	1826-0522	4	3	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	01295	TL074CN
A6U2	1820-0684	7	1	IC INV TTL S HEX 1-INP	01295	SN74S05N
A6U3	1820-1425	6	1	IC SCHMITT-TRIG TTL LS NAND QUAD 2-INP	01295	SN74LS132N
A6U4	1826-0471	2	1	IC OP AMP LOW-DRIFT TO-99 PKG	26480	1826-0471
A6U5	1826-0026	3	2	IC COMPARATOR PRCN TO-99 PKG	01295	LM311L
A6U6	1826-0412	1	1	IC COMPARATOR PRCN DUAL 8-DIP-P PKG	27014	LM333N
A6U7	1826-0059	2	1	IC OP AMP GP TO-99 PKG	01295	LM201AL
A6VR1	1902-0579	3	1	DIODE-ZNR 5.1V 5% PD=1W IR=10UA	28480	1902-0579
A6W1				NOT ASSIGNED		
A6W2	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6W3				NOT ASSIGNED		
A6W4	8159-0005	0		RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
A6W5	08684-20136	3	1	CABLE SHIELDED DET AMPL. 30MHZ REF IN	28480	08684-20136
A7	08684-60010	6	1	ALC REFERENCE BOARD	28480	08684-60010
A7C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A7C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A7C3	0160-4084	8	24	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A7C4	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A7C5	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A7C6	0160-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A7C7	0160-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A7C8	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A7C9	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A7C10	0160-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084

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
A7C11	0180-2619	3	1	CAPACITOR-FXD 22UF+-10% 15VDC TA	25088	D22GS1B15K
A7C12	0180-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0180-0127
A7C13	0180-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-4084
A7C14	0180-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-4084
A7C15	0180-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-4084
A7C16	0180-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-4084
A7C17	0180-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-4084
A7C18	0180-4084	8		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-4084
A7C19	0180-3878	6	2	CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0180-3878
A7C20	0180-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0180-3878
A7C21	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C22	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C23	0180-4084	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-4084
A7C24	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C25	0180-2599	6	1	CAPACITOR-FXD 800PF +-10% 200VDC CER	28480	0180-2599
A7C26	0180-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0180-0575
A7C27	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C28	0180-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0180-3877
A7C29	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C30	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C31	0180-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0180-0127
A7C32	0180-2201	7	1	CAPACITOR-FXD 51PF +-5% 300VDC MICA	28480	0180-2201
A7C33	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C34	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C35	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C36	0180-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0180-0127
A7C37	0180-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0180-3877
A7C38	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C39	0121-0105	4	1	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A7C40	0180-2199	2	1	CAPACITOR-FXD 30PF +-5% 300VDC MICA	28480	0180-2199
A7C41	0180-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0180-3877
A7C42	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C43	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C44	0180-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0180-2055
A7C45*	0180-0575	4	3	CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0180-0575
A7CR1	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR6	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR8	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A7CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS D0-35	28480	1901-0050
A7CR12	1901-0518	8		DIODE-SM SIG SCHOTTKY	28480	1901-0518
A7CR13	1901-0839	4	1	DIODE-PIN	28480	5082-3080
A7J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-0MM	28480	1250-1220
A7L1	9140-0112	2	2	INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0112
A7L2	9140-0112	2		INDUCTOR RF-CH-MLD 4.7UH 10%	28480	9140-0112
A7L3	9100-2261	2	4	INDUCTOR RF-CH-MLD 2.7UH 10% .105DX.26LG	28480	9100-2261
A7L4	9100-2261	2		INDUCTOR RF-CH-MLD 2.7UH 10% .105DX.26LG	28480	9100-2261
A7L5	9100-2261	2		INDUCTOR RF-CH-MLD 2.7UH 10% .105DX.26LG	28480	9100-2261
A7L6	9100-2261	2		INDUCTOR RF-CH-MLD 2.7UH 10% .105DX.26LG	28480	9100-2261
A7L7	9100-3548	0	2	INDUCTOR RF-CH-MLD 470NH 5% .186DX.385LG	28480	9100-3548
A7L8	9100-3548	0		INDUCTOR RF-CH-MLD 470NH 5% .186DX.385LG	28480	9100-3548
A7L9	08684-80008	4	1	COIL-ALC	28480	08684-80008
A7L10	08684-80009	5	1	COIL-ALC	28480	08684-80009
A7MP1	08684-00018	6	1	COVER-ALC REFERENCE	28480	08684-00018
A7MP2	5021-0886	7		KNOB-P.C. BOARD PULLER	28480	5021-0886
	0515-0211	8		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
A7MP3	0510-0034	3		RETAINER-RING BMD EXT .25-IN-DIA STL	28480	0510-0034

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
A7Q1	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A7Q2	1855-0020	8	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0020
A7Q3	1854-0637	1	3	TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A7Q4	1855-0082	2	1	TRANSISTOR J-FET P-CHAN D-MODE SI	28480	1855-0082
A7Q5	1853-0284	8	2	TRANSISTOR PNP SI PD=310MW FT=100MHZ	04713	2N5401
A7Q6	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081
A7Q7	1855-0081	1		TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081
A7Q8	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A7Q9	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A7Q10	1854-0474	4	1	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A7Q11	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A7Q12	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A7Q13	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q14	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7R1	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A7R2	0757-0189	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A7R3	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R4	0757-0289	2		RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A7R5	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A7R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R7	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A7R8	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A7R9	0698-0083	8	10	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A7R10	2100-2574	3	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	30983	ET50X501
A7R11	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R13	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A7R14	0757-0200	7		RESISTOR 5.82K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A7R15	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A7R16	0698-3154	0	2	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A7R17	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A7R18	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A7R19	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R20	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A7R21	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A7R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R24	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R25	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A7R26	2100-3058	8	3	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A7R27	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R28	0698-0418	5	1	RESISTOR 7.5K .5% .125W F TC=0+-50	28480	0698-0418
A7R29	0698-0417	4	1	RESISTOR 1.884K .5% .125W F TC=0+-50	28480	0698-0417
A7R30	0698-0416	3	1	RESISTOR 473.2 .5% .125W F TC=0+-50	28480	0698-0416
A7R31	0698-0419	6	1	RESISTOR 158.7 .5% .125W F TC=0+-50	28480	0698-0419
A7R32	0698-3180	8		RESISTOR 31.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3182-F
A7R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R35	0698-8826	3	2	RESISTOR 825K 1% .125W F TC=0+-100	28480	0698-8826
A7R36	0698-8826	3		RESISTOR 825K 1% .125W F TC=0+-100	28480	0698-8826
A7R37	2100-2514	1	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	30983	ET50W203
A7R38	0698-3463	2		RESISTOR 196K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1963-F
A7R39	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A7R40	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A7R41	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A7R42	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R43	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A7R44	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R45	0698-3180	8		RESISTOR 31.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3182-F
A7R46	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R47	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R48	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A7R49	0757-0443	0	2	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A7R50	0757-0402	1		RESISTOR 110 1% .125W F TC=0+-100	24546	C4-1/8-T0-111-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
A7R51	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R52	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A7R53	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A7R54	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A7R55	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A7R56	0698-3443	0		RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A7R57	0698-0983	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A7R58	0757-0346	2	13	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A7R59	0757-0198	2	1	RESISTOR 100 1% .5W F TC=0+-100	28480	0757-0198
A7R60	0757-0798	8	1	RESISTOR 110 1% .5W F TC=0+-100	28480	0757-0798
A7R61	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A7R62	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A7R63	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R64	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A7R65	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R66	0698-3159	5		RESISTOR 28.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2812-F
A7R67	2100-2521	0	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	30983	ET50X202
A7R68	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R69	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A7R70	0698-3180	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A7R71	0757-0815	0		RESISTOR 582 1% .5W F TC=0+-100	28480	0757-0815
A7TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A7U1	1826-0800	9	2	IC OP AMP LOW-BIAS-H-IMPQ QUAD 14-DIP-P	01295	TL074ACN
A7U2	1826-0413	2	1	IC OP AMP LOW-BIAS-H-IMPQ TO-99 PKG	34371	HA2-2605-5
A7U3	1826-0138	8		IC COMPARATOR GP QUAD 14-DIP-P PKG	01295	LM339N
A7U4	1826-0600	9		IC OP AMP LOW-BIAS-H-IMPQ QUAD 14-DIP-P	01295	TL074ACN
A7U5	1826-0581	5	5	IC SWITCH ANLG 18-DIP-C PKG	27014	LF135080
A7U6	1826-0462	1	1	IC CONV 10-B-D/A 16-DIP-C PKG	04713	MC3410CL
A7VR1	1902-0943	5	2	DIODE-ZNR 2.4V 5% D0-35 PD=.4W TC=-.037%	28480	1902-0943
A7VR2	1902-0943	5		DIODE-ZNR 2.4V 5% D0-35 PD=.4W TC=-.037%	28480	1902-0943
A7VR3	1902-0041	4	1	DIODE-ZNR 5.11V 5% D0-35 PD=.4W	28480	1902-0041
A7VR4	1902-0680	7	3	DIODE-ZNR 1N827 6.2V 5% D0-7 PD=.4W	24046	1N827
A7VR5	1902-0958	2	5	DIODE-ZNR 10V 5% D0-35 PD=.4W TC=+.075%	28480	1902-0958
A8	08884-80009	3	1	I/O BOARD	28480	08884-80009
A8C1	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C2	0180-2817	3	3	CAPACITOR-FXD 47UF+-20% 10VDC TA	28480	0180-2817
A8C3	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C4	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C5	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C6	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C7	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C8	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C9	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C10	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C11	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C12	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C13	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C14	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C15	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
A8C16	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
A8C17	0180-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0180-0127
A8C18	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C19	0180-4786	3	1	CAPACITOR-FXD 30PF +-5% 200VDC CER 0+-30	28480	0180-4786
A8C20	0180-0572	1	5	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0180-0572
A8C21	0180-0572	1		CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0180-0572
A8C22	0180-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0180-0127
A8C23	0180-0573	2		CAPACITOR-FXD 4700PF +-20% 100VDC CER	28480	0180-0573
A8C24	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A8C25	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576

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
A8C26	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C27	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1850K
A8C28	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C29	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C30	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A8L1	9100-1620	5	4	INDUCTOR RF-CH-MLD 15UH 10% .166DX.385LG	28480	9100-1620
A8L2	9100-1620	5		INDUCTOR RF-CH-MLD 15UH 10% .166DX.385LG	28480	9100-1620
A8L3	9100-1620	5		INDUCTOR RF-CH-MLD 15UH 10% .166DX.385LG	28480	9100-1620
A8MP1	08684-00015	5	1	COVER-I/O	28480	08684-00015
A8MP2	5021-0866	7		KNOB-P.C. BOARD PULLER	28480	5021-0866
	0515-0211	8		SCREW-MACH M3 X 0.5 8MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
A8MP3	0510-0034	3		RETAINER-RING BUD EXT .25-IN-DIA STL	28480	0510-0034
A8MP4	0403-0026	6	2	PLUG-HOLE BDR-HD FOR .187-D-HOLE NYL	02768	207-120241-03-0101
A8Q1	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=900MW	01295	2N2219A
A8R1	1810-0282	0		NETWORK-RES 10-SIP220.0K OHM X 9	01121	210A224
A8R2	1810-0282	0		NETWORK-RES 10-SIP220.0K OHM X 9	01121	210A224
A8R3	0698-8358	2	4	RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-8358
A8R4	0698-7529	1	4	RESISTOR 150K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-1503-B
A8R5				NOT ASSIGNED		
A8R6	0698-8358	2		RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-8358
A8R7	0698-8358	2		RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-8358
A8R8	0698-8353	7	4	RESISTOR 50K .1% .125W F TC=0+-25	28480	0698-8353
A8R9	0698-8353	7		RESISTOR 50K .1% .125W F TC=0+-25	28480	0698-8353
A8R10	0698-8353	7		RESISTOR 50K .1% .125W F TC=0+-25	28480	0698-8353
A8R11	0698-8358	2		RESISTOR 100K .1% .125W F TC=0+-25	28480	0698-8358
A8R12	2100-3054	6	3	RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A8R13				NOT ASSIGNED		
A8R14	0698-8353	7		RESISTOR 50K .1% .125W F TC=0+-25	28480	0698-8353
A8R15	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A8R16	0698-0485	2	1	RESISTOR 46.33K .1% .1W F TC=0+-10	28480	0698-0485
A8R17	0698-8251	8		RESISTOR 28.7K 1% .1W F TC=0+-10	19701	5023Z1/8-T13-2872-F
A8R18	2100-3054	6		RESISTOR-TRMR 50K 10% C SIDE-ADJ 17-TRN	02111	43P503
A8R19	0698-8319	9	2	RESISTOR 10K 1% .1W F TC=0+-10	19701	5023Z1/8-T13-1002-F
A8R20	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8R21*	0698-8251	8	3	RESISTOR 28.7K 1% .1W F TC=0+-10	19701	5023Z1/8-T13-2872-F
A8R22	2100-3056	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8R23	0698-8251	8		RESISTOR 28.7K 1% .1W F TC=0+-10	19701	5023Z1/8-T13-2872-F
A8R24	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A8R25	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A8R26	0698-8319	9		RESISTOR 10K 1% .1W F TC=0+-10	19701	5023Z1/8-T13-1002-F
A8R27	0698-5355	7	1	RESISTOR 5.62K 1% .1W F TC=0+-10	28480	0698-5355
A8R28				NOT ASSIGNED		
A8R29	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A8R30	0698-0090	7	1	RESISTOR 484 1% .5W F TC=0+-100	28480	0698-0090
A8R31	2100-3109	2	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
A8R32	0698-0642	7	2	RESISTOR 10K .1% .125W F TC=0+-5	28480	0698-0642
A8R33	0698-3460	1	1	RESISTOR 422K 1% .125W F TC=0+-100	28480	0698-3460
A8R34	2100-3123	0	2	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A8R35	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A8R36	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A8R37	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A8R38	0698-0642	7		RESISTOR 10K .1% .125W F TC=0+-5	28480	0698-0642
A8R39	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A8R40	0698-0144	4	1	RESISTOR 10K .01% .1W F TC=0+-5	28480	0698-0144
A8R41	0698-8630	3	1	RESISTOR 20K .1% .125W F TC=0+-25	28480	0698-8630
A8R42	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R43	0698-8885	4	1	RESISTOR 20K .01% .125W F TC=0+-10	28480	0698-8885
A8R44	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R45	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A8R46	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A8R47	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R48				NOT ASSIGNED		
A8R49				NOT ASSIGNED		
A8R50	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

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

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A8TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A8TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A8TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A8TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A8TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A8TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A8TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A8U1	1826-0574	6	1	IC OP AMP LOW-DRIFT T0-99 PKG	07263	UA714LHC
A8U2	1826-0522	4		IC OP AMP LOW-BIAS-H-IMPQ QUAD 14-DIP-P	01295	TL074CN
A8U3	1826-0865	6	1	IC CONV 12-B-D/A 18-DIP-P PKG	24355	AD7541KN
A8U4	1820-1794	2	2	IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A8U5	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A8U6	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A8U7	1826-0581	5		IC SWITCH ANLG 16-DIP-C PKG	27014	LF135080
A8U8	1826-0581	5		IC SWITCH ANLG 16-DIP-C PKG	27014	LF135080
A8U9	1826-0581	5		IC SWITCH ANLG 16-DIP-C PKG	27014	LF135080
A8U10	1826-0581	5		IC SWITCH ANLG 16-DIP-C PKG	27014	LF135080
A8U11	1826-0522	4		IC OP AMP LOW-BIAS-H-IMPQ QUAD 14-DIP-P	01295	TL074CN
A8U12	1826-0675	8	1	IC SWITCH ANLG DUAL 14-DIP-P PKG	01295	TL182CN
A8U13	1826-0026	3		IC COMPARATOR PRCN T0-99 PKG	01295	LM311L
A8U14	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A8U15	1820-1730	6		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS273N
A8VR1	1902-0680	7		DIODE-ZNR 1N827 6.2V 5% D0-7 PD=.4W	24046	1N827
A9	08684-60008	2	1	CENTRAL PROCESSING UNIT BOARD	28480	08684-60008
A9C1	0180-2618	2	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	25088	D33GS1B10K
A9C2	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A9C3	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A9C4	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A9C5	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A9C6	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A9C7	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A9C8	0180-2617	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A9C9	0180-0575	4		CAPACITOR-FXD .047UF +-20% 50VDC CER	28480	0180-0575
A9C10	0180-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0180-3879
A9C11	0180-2620	6		CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A9C12	0180-2306	3	3	CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0180-2306
A9C13	0180-2306	3		CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0180-2306
A9C14	0140-0205	5	1	CAPACITOR-FXD 62PF +-5% 300VDC MICA	72136	DM15E620J0300WV1CR
A9CR1	1901-0033	2		DIODE-GEN PRP 180V 200MA D0-7	28480	1901-0033
A9L1	9140-0096	1		INDUCTOR RF-CH-MLD 1UH 10% .168DX.385LG	28480	9140-0096
A9L2	9140-0129	1	1	INDUCTOR RF-CH-MLD 220UH 5% .168DX.385LG	28480	9140-0129
A9MP1	08684-00014	4	1	COVER-CPU	28480	08684-00014
A9MP2	5021-0866	7		KNOB-PC PBOARD PULLER	28480	5021-0866
A9MP3	0515-0211	8		SCREW-MACH #3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
A9MP4	0510-0034	3		RETAINER-RING 8WD EXT .25-IN-DIA STL	28480	0510-0034
A9MP5	0403-0026	6		PLUG-HOLE BDR-HD FOR .187-D-HOLE NYL	02768	207-120241-03-0101
A9R1	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A9R2	1810-0204	6	1	NETWORK-RES 8-SIP1.0K OHM X 7	01121	208A102
A9R3	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R4	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A9R5	0757-0260	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R6	0698-0083	8		RESISTOR 1.98K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1981-F
A9R7	0698-0083	8		RESISTOR 1.98K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1981-F
A9R8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R9	1810-0280	8	1	NETWORK-RES 10-SIP10.0K OHM X 9	01121	210A103
A9R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R11	1810-0206	8		NETWORK-RES 8-SIP10.0K OHM X 7	01121	208A103
A9R12	0698-3453	2		RESISTOR 198K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1983-F
A9R13	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A9R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R15	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
A9R18	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A9R17	1810-0282	0		NETWORK-RES 10-SIP220.0K OHM X 9	01121	210A224
A9R18	1810-0282	0		NETWORK-RES 10-SIP220.0K OHM X 9	01121	210A224
A9R19	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9S1	3101-1524	4	1	SWITCH-SLIDE, DP3T-NS	28480	3101-1524
A9TP1	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9TP2	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9TP3	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9TP4	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9TP5	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9TP6	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9TP7	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9TP8	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9TP9	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9TP10	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A9U1	1820-2099	2	1	IC MICPROC NMOS 8-BIT	04713	MC6802P
A9U2	1820-1216	3		IC OADR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A9U3	1820-1216	3		IC OADR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A9U4	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A9U5	1826-0205	0	1	IC TIMER TTL	18324	NE5556A
A9U6	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A9U7	1820-2075	4	1	IC MISC TTL LS	01295	SN74LS246N
A9U8*	08684-80007	3	1	ROM 8K	28480	08684-80007
A9U9				EPROM 2K NSR UNIQUE TO EACH INSTRUMENT		
A9U10				NSR P/O RESTORED ASSY REF. TO TABLE 6-1.		
A9U11				NSR P/O RESTORES ASSY REF. TO TABLE 6-1.		
A9U12	1820-1794	2		IC BFR TTL LS NON-INV OCTL	27014	DM81LS95N
A9U13	1820-1858	9	2	IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A9U14	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A9W1	8151-0013	4		WIRE-22AWGF	28480	8151-0013
A9Y1	0410-0465	2	1	CRYSTAL-QUARTZ 4 MHZ	28480	0410-0465
	0403-0253	1	1	BUMPER FOOT-ADH MTG .25-IN-WD	28480	0403-0253
A9X9U1	1200-0654	7	1	SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A9X9U2-				NOT ASSIGNED		
A9X9U7						
A9X9U8	1200-0567	1	1	SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A9X9U9	1200-0541	1	3	SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A9X9U10	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A9X9U11	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A10	08684-60012	8	1	FM SHAPER BOARD	28480	08684-60012
A10C1	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C2	0180-2817	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A10C3	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C4	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C5	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C6	0180-2817	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A10C7	0180-2815	1		CAPACITOR-FXD 100UF+-20% 10VDC TA	28480	0180-2815
A10C8	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C9	0180-2817	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A10C10	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C11	0180-2817	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A10C12	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C13	0180-2817	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A10C14	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C15	0180-2817	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A10C16	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C17	0180-0049	9	1	CAPACITOR-FXD 20UF+75-10% 50VDC AL	58289	30D208G050CC2
A10C18	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C19	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576
A10C20	0180-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0180-0576

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
A10C21	0160-0576	5	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C23	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C24	0140-0198	3		CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A10C25	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A10C26	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C27	0160-3879	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879	
A10C28			NOT ASSIGNED			
A10C29	0160-0127	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127	
A10C30	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C31	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C32	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C33	0160-0491	5	CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0160-0491	
A10C34	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C35	0160-0491	5	CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0160-0491	
A10C36	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C37	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C38	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C39	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C40	0140-0195	2	CAPACITOR-FXD 130PF +-5% 300VDC MICA	72136	DM15F131J0300WV1CR	
A10C41	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C42	0160-0127	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127	
A10C43	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C44	0160-2306	3	CAPACITOR-FXD 27PF +-5% 300VDC MICA	28480	0160-2306	
A10C45	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C46	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C47	0160-0127	2	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127	
A10C48	0160-0576	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576	
A10C49	0160-0553	0	CAPACITOR-FXD 22UF+-20% 25VDC TA	28480	0160-0553	
A10CR1	1901-0033	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033	
A10CR2	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR3	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR4	1901-0033	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033	
A10CR5	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR6	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR7	1901-0033	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033	
A10CR8	1901-0033	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033	
A10CR9	1901-0033	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033	
A10CR10	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR11	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR12	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR13	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR14	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR15	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR16	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR17	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR18	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR19	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR20	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR21	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR22	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR23	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR24	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR25	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR26	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR27	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR28	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR29	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR30	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR31	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR32	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR33	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR34	1901-0050	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050	
A10CR35	1901-0033	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033	

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
A10E1	9170-0847	3	3	CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A10E2	9170-0847	3		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A10E3	9170-0029	3	5	CORE-SHIELDING BEAD	28480	9170-0029
A10E4	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A10E5	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A10E6	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
	8151-0013	4	1	WIRE 22AWG 1X22 BARE WIRE USED IN E4,5,6.	28480	8151-0013
A10E7	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A10E8	9170-0847	3		CORE-SHIELDING BEAD	02114	56-590-65/3B PARYLENE COATED
A10J1	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
A10J2	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
A10J3	1250-1220	0		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-1220
A10K1	0490-0916	6		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-0916
A10K2	0490-0916	6		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-0916
A10K3	0490-0916	6		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-0916
A10K4	0490-0916	6		RELAY-REED 1A 500MA 100VDC 5VDC-COIL	28480	0490-0916
A10L1	9140-0210	1		INDUCTOR RF-CH-MLD 100UH 5% .186DX.385LG	28480	9140-0210
A10L2	9100-2259	8	1	INDUCTOR RF-CH-MLD 1.5UH 10% .105DX.26LG	28480	9100-2259
A10L3	9100-2260	1	2	INDUCTOR RF-CH-MLD 1.8UH 10% .105DX.26LG	28480	9100-2260
A10L4	9100-2260	1		INDUCTOR RF-CH-MLD 1.8UH 10% .105DX.26LG	28480	9100-2260
A10MP1	08684-00018	8	1	COVER-FM SHAPER	28480	08684-00018
A10MP2	5021-0866	7		KNOB-P.C. BOARD PULLER	28480	5021-0866
	0515-0211	8		SCREW-MACH M3 X 0.5 6MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
A10MP3	0510-0034	3		RETAINER-RING BWD EXT .25-IN-DIA STL NOT ASSIGNED	28480	0510-0034
A10Q1	1853-0293	3	2	TRANSISTOR PNP 2N5583 SI TO-39 PD=1W	04713	2N5583
	1205-0011	0	7	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A10Q2	1854-0597	2	2	TRANSISTOR NPN 2N5943 SI TO-39 PD=1W	04713	2N5943
	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A10Q3	1854-0475	5	1	TRANSISTOR-DUAL NPN PD=750MW	28480	1854-0475
A10Q4	1858-0032	8		TRANSISTOR ARRAY 14-PIN PLSTC DIP	3L585	CA3146E
A10Q5	1853-0405	9	2	TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
	1205-0202	1	2	THERMAL LINK DUAL TO-18-CS CONNECTS Q5 AND Q6.	28480	1205-0202
A10Q6	1853-0405	9		TRANSISTOR PNP SI PD=300MW FT=850MHZ	04713	2N4209
	1205-0202	1		THERMAL LINK DUAL TO-18-CS	28480	1205-0202
A10Q7	1854-0210	6	1	TRANSISTOR NPN 2N2222 SI TO-18 PD=500MW	04713	2N2222
A10Q8	1853-0293	3		TRANSISTOR PNP 2N5583 SI TO-39 PD=1W	04713	2N5583
	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A10Q9	1853-0430	0	3	TRANSISTOR PNP 2N4959 SI TO-72 PD=200MW	04713	2N4959
	1205-0202	1		THERMAL LINK DUAL TO-18-CS CONNECTS Q9 AND Q10.	28480	1205-0202
A10Q10	1853-0430	0		TRANSISTOR PNP 2N4959 SI TO-72 PD=200MW	04713	2N4959
	1205-0202	1		THERMAL LINK DUAL TO-18-CS	28480	1205-0202
A10Q11	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A10Q12	1854-0597	2		TRANSISTOR NPN 2N5943 SI TO-39 PD=1W	04713	2N5943
	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A10Q13	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A10Q14	1853-0430	0		TRANSISTOR PNP 2N4959 SI TO-72 PD=200MW	04713	2N4959
A10Q15	1854-0295	7	1	TRANSISTOR-DUAL NPN PD=400MW	28480	1854-0295
A10Q16	1854-0477	7		TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	04713	2N2222A
A10Q17	1853-0284	8		TRANSISTOR PNP SI PD=310MW FT=100MHZ	04713	2N5401
A10Q18	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A10Q19	1854-0689	3	1	TRANSISTOR-DUAL NPN TO-71	28480	1854-0689
A10Q20	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A10R1	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R2	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A10R3	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R4	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R5	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R6	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R7	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R8	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R9	0898-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A10R10	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180

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
A10R11	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A10R12	2100-3123	0		RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A10R13	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A10R14	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A10R15	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A10R16	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A10R17*	0757-0280	3	35	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R18*	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R19*	2100-3750	9	2	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	28480	2100-3750
A10R20	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A10R21	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R22	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R23	0698-3455	4	2	RESISTOR 261K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2613-F
A10R24	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R25	0698-3455	4		RESISTOR 261K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2613-F
A10R26	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R27	0698-3440	7		RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A10R28	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R29	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A10R30	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A10R31	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A10R32	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R33	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A10R34	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A10R35	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A10R36-				NOT ASSIGNED		
A10R36						
A10R39	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A10R40	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A10R41	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A10R42	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A10R43	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A10R44	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A10R45	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A10R46	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A10R47	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R48	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R49	0698-0085	0	3	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A10R50	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A10R51	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A10R52	0757-0180	2		RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A10R53	0757-0289	1	3	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A10R54	0757-0399	5	2	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A10R55	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A10R56	0757-0439	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R57	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A10R58	0698-3449	6	2	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A10R59	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A10R60	0698-4037	0	1	RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A10R61	0757-0159	5	2	RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159
A10R62	0757-0159	5		RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159
A10R63	2100-3732	7	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	28480	2100-3732
A10R64	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R65	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A10R66	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A10R67	0698-3449	6		RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A10R68	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1211-F
A10R69	0757-0403	2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A10R70	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R71	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A10R72	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R73	0698-3402	1		RESISTOR 316 1% .5W F TC=0+-100	28480	0698-3402
A10R74	0698-3402	1		RESISTOR 316 1% .5W F TC=0+-100	28480	0698-3402
A10R75	0698-3402	1		RESISTOR 316 1% .5W F TC=0+-100	28480	0698-3402
A10R76	0698-3402	1		RESISTOR 316 1% .5W F TC=0+-100	28480	0698-3402

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
A10R77	0757-0440		7	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A10R78	0757-0346		2	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R79	0757-0346		2	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A10R80	0757-0401		0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A10R81	0688-7529		1	RESISTOR 150K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-1503-B
A10R82	0757-0405		6	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R83	0757-0428		1	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A10R84	0688-0083		8	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-Y0-1961-F
A10RT1	0837-0015		2	THERMISTOR DISC 500-OHM TC=-4.4%/C-DEG	28480	0837-0015
A10TP1	0360-0535		0	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A10TP2	0360-0535		0	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A10TP3	0360-0535		0	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A10TP4	0360-0535		0	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A10TP5	0360-0535		0	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A10TP6	0360-0535		0	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A10U1	1826-0051		4	IC COMPARATOR GP DUAL 14-DIP-P PKG	01295	TL514CN
A10U2	1820-1367		5	IC GATE TTL 5 AND QUAD 2-INP	01295	SN74S08N
A10U3	1826-0323		3	IC OP AMP GP QUAD 14-DIP-C PKG	28480	1826-0323
A10VR1	1902-3036		3	DIODE-ZNR 3.18V 5% DO-7 PD=.4W TC=-.064%	28480	1902-3036
A10VR2	1902-0954		8	DIODE-ZNR 6.8V 5% DO-35 PD=.4W TC=+.057%	28480	1902-0954
A10VR3	1902-0958		2	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.075%	28480	1902-0958
A10VR4	1902-0958		2	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.075%	28480	1902-0958
A10VR5	1902-3005		6	DIODE-ZNR 2.43V 5% DO-7 PD=.4W TC=-.076%	28480	1902-3005
A10VR6	1902-3104		6	DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A10VR7	1902-0958		2	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.075%	28480	1902-0958
A10VR8	1902-0949		1	DIODE-ZNR 4.3V 5% DO-35 PD=.4W TC=+.017%	28480	1902-0949
A11	08683-60048		9	POWER SUPPLY BOARD	28480	08683-60048
A11C1	0160-3457		7	CAPACITOR-FXD 2000PF +-10% 250VDC CER	28480	0160-3457
A11C2	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C3	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C4	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C5	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C6	0160-0572		1	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A11C7	0160-0572		1	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A11C8	0160-4084		9	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C9	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C10	0140-0196		3	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A11C11	0160-4387		4	CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A11C12	0160-4387		4	CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A11C13				NOT ASSIGNED		
A11C14	0180-2617		1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A11C15	0180-2617		1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A11C16	0180-2617		1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A11C17	0180-2620		6	CAPACITOR-FXD 2.2UF+-10% 50VDC TA	25088	D2R2GS1B50K
A11C18				NOT ASSIGNED		
A11C19				NOT ASSIGNED		
A11C20				NOT ASSIGNED		
A11C21	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C22	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C23	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C24	0160-0572		1	CAPACITOR-FXD 2200PF +-20% 100VDC CER	28480	0160-0572
A11C25	0180-0491		5	CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A11C26	0180-0491		5	CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A11C27	0180-2617		1	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	25088	D6R8GS1B35K
A11C28	0180-2617		3	CAPACITOR-FXD 47UF+-20% 10VDC TA	28480	0180-2617
A11C29	0180-2617		3	CAPACITOR-FXD 47UF+-20% 10VDC TA	28480	0180-2617
A11C30	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C31	0140-0196		3	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A11C32	0160-4084		8	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A11C33	0160-4387		4	CAPACITOR-FXD 47PF +-5% 200VDC CER 0+-30	28480	0160-4387
A11C34	0160-4764		1	CAPACITOR-FXD 150PF +-5% 100VDC CER	28480	0160-4764

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
A11CR1	1901-0328	8	16	DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR2	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR3	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR4	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR5	1901-0418	7		DIODE-PWR RECT 400V 1.5A	28480	1901-0418
A11CR6	1901-0418	7	3	DIODE-PWR RECT 400V 1.5A	28480	1901-0418
A11CR7	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR8	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A11CR9	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A11CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A11CR11	1901-0328	8	7	DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR12	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR13	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR14	1901-0418	7		DIODE-PWR RECT 400V 1.5A	28480	1901-0418
A11CR15	1901-0418	7		DIODE-PWR RECT 400V 1.5A	28480	1901-0418
A11CR16	1901-0328	8	1	DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR17	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR18	1906-0231	2		RECTIFIER-INTEGRATED	28480	1906-0231
A11CR19	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR20	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR21	1901-0028	5	4	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A11CR22	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A11CR23	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A11CR24	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A11CR25	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A11CR26	1901-0328	8	8	DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR27	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR28	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11CR29	1901-0328	8		DIODE-PWR RECT 400V 1A 6US	03508	A140
A11DS1	1990-0778	9		1	LED-LAMP ARRAY LUM-INT=800UCD	28480
A11DS2	1990-0597	0	1	LED-LAMP LUM-INT=1MCD IF=80MA-MAX BVR=5V	28480	5082-4150
A11F1	2110-0002	9	2	FUSE 2A 250V NTD 1.25X.25 UL	75915	312002
A11F2	2110-0012	1		FUSE .5A 250V NTD 1.25X.25 UL	28480	2110-0012
A11F3	2110-0002	9		FUSE 2A 250V NTD 1.25X.25 UL	75915	312002
A11F4	2110-0043	8		FUSE 1.5A 250V NTD 1.25X.25 UL	28480	2110-0043
A11F5	2110-0058	3		FUSE 8A 250V NTD 1.25X.25 UL IEC	75915	312006
A11F6	2110-0520	6	1	FUSE-BIPIN 5 AMP	75915	273005
A11J1	1251-7033	7	1	PC BOARD EDGE CONN TO TRANS SECONDARY. CONNECTOR-RT ANGLE 5-PIN	28480	1251-7033
A11J2						
A11MP1	1205-0011	0	1	HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A11MP2	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A11MP3	1205-0011	0		HEAT SINK TO-5/TO-39-CS	28480	1205-0011
A11MP4	1205-0312	4		HEAT SINK SGL TO-3-CS	28480	1205-0312
A11MP5	2360-0119	8		SCREW-MACH 6-32 .438-IN-LG PAN-HL-POZI	00000	ORDER BY DESCRIPTION
A11MP6	2420-0001	5	5	NUT-HEX-W/LKUR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
A11Q1†	1884-0244	9	6	THYRISTOR-SCR VRRM=400	3L585	S28000
A11Q2†	1884-0244	9		THYRISTOR-SCR VRRM=400	3L585	S28000
A11Q3†	1884-0244	9		THYRISTOR-SCR VRRM=400	3L585	S28000
A11Q4	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A11Q5	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A11Q6	1853-0459	3	2	TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A11Q7†	1853-0001	1		TRANSISTOR PNP SI TO-39 PD=800MW	28480	1853-0001
A11Q8†	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A11Q9†	1884-0244	9		THYRISTOR-SCR VRRM=400	3L585	S28000
A11Q9†	1884-0244	9		THYRISTOR-SCR VRRM=400	3L585	S28000
A11Q10	1854-0813	5	1	TRANSISTOR NPN 2N3501S SI TO-39 PD=1W	28480	1854-0813
A11Q11	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A11Q12	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A11Q13†	1853-0001	1		TRANSISTOR PNP SI TO-39 PD=800MW	28480	1853-0001
A11Q14	1853-0459	3		TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A11Q15	1853-0459	3	1	TRANSISTOR PNP SI PD=625MW FT=200MHZ	28480	1853-0459
A11Q16†	1854-0232	2		TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0232
A11Q17	1854-0810	2		TRANSISTOR NPN SI PD=625MW FT=200MHZ	28480	1854-0810
A11Q18	1200-0173	5		INSULATOR-XSTR DAP-GL	28480	1200-0173
A11Q18					NOT ASSIGNED	

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
A11Q19†	1984-0244		9	THYRISTOR-SCR VRRM=400	3L585	S26000
A11R1	0757-0401		0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A11R2	0698-3447		4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A11R3	0757-0401		0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A11R4	0757-0199		3	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A11R5	0698-3160		8	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A11R6	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R7	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R8	0698-3437		2	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A11R9	0757-0405		4	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A11R10	0698-3445		2	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A11R11	0757-0442		9	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R12	0698-3443		0	RESISTOR 297 1% .125W F TC=0+-100	24546	C4-1/8-T0-297R-F
A11R13	0698-3157		3	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A11R14				NOT ASSIGNED		
A11R15	0698-0085		0	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A11R16	0757-0290		5	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A11R17				NOT ASSIGNED		
A11R18	0698-3155		1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A11R19	0698-3155		1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A11R20	0757-0440		7	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A11R21				NOT ASSIGNED		
A11R22	0757-0440		7	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A11R23	0757-1094		9	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A11R24	0757-0443		0	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A11R25	2100-0545		4	RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	32997	3292X-1-102
A11R26	0757-0440		7	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A11R27				NOT ASSIGNED		
A11R28				NOT ASSIGNED		
A11R29	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R30	0757-0401		0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A11R31	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R32	0757-0401		0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A11R33	0698-3447		4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A11R34	0757-0417		8	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A11R35	0698-3150		6	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A11R36	0698-7529		1	RESISTOR 150K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-1503-B
A11R37	0698-7529		1	RESISTOR 150K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-1503-B
A11R38	0757-0199		3	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A11R39	0698-3437		2	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A11R40	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R41	0757-0442		9	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A11R42	0757-0416		7	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A11R43	2100-3755		4	RESISTOR-TRMR 50 10% C SIDE-ADJ 17-TRN	29480	2100-3755
A11R44	0698-3445		2	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A11R45	0757-0403		2	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A11R46	0757-0403		2	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A11R47	0698-3445		2	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A11R48	0698-0085		0	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A11R49	0757-0288		1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A11R50	0757-0401		0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A11R51	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R52	0757-0401		0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A11R53	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R54	0757-0288		1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A11R55	0757-0401		0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A11R56	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R57	0757-0417		8	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A11R58	0698-3447		4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A11R59	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R60	0757-0280		3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A11R61	0698-3447		4	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-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
A11TP1	0380-0535	0			TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A11TP2	0380-0535	0			TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A11TP3	0380-0535	0			TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A11TP4	0380-0535	0			TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A11TP5	0380-0535	0			TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A11TP6	0380-0535	0			TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A11TP7	0380-0535	0			TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A11TP8	0380-0535	0			TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A11U1†	1828-0783	9		4	IC OP AMP LOW-NOISE 8-DIP-C PKG	52063	XR5534ACN
A11U2†	1828-0783	9			IC OP AMP LOW-NOISE 8-DIP-C PKG	52063	XR5534ACN
A11U3†	1828-0783	9			IC OP AMP LOW-NOISE 8-DIP-C PKG	52063	XR5534ACN
A11VR1	1902-3369	5		1	DIODE-ZNR 61.9V 5% DO-7 PD=.4W TC=+.085% NOT ASSIGNED	28480	1902-3369
A11VR2							
A11VR3	1902-0880	7			DIODE-ZNR 1N827 6.2V 5% DO-7 PD=.4W	24046	1N827
A11VR4	1902-0963	9		3	DIODE-ZNR 16V 5% DO-35 PD=.4W TC=+.088%	28480	1902-0963
A11VR5	1902-3301	5		1	DIODE-ZNR 34.8V 5% DO-35 PD=.4W	28480	1902-3301
A11VR6	1902-0958	2			DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.075%	28480	1902-0958
A11VR7	1902-0955	9		2	DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.062%	28480	1902-0955
A11VR8	1902-0967	3		1	DIODE-ZNR 24V 5% DO-35 PD=.4W TC=+.094%	28480	1902-0967
A11VR9	1902-0955	9			DIODE-ZNR 7.5V 5% DO-35 PD=.4W TC=+.062%	28480	1902-0955
A11VR10	1902-0952	6		1	DIODE-ZNR 5.6V 5% DO-35 PD=.4W TC=+.046%	28480	1902-0952
A11VR11	1902-0963	9			DIODE-ZNR 16V 5% DO-35 PD=.4W TC=+.088%	28480	1902-0963
A11VR12	1902-0963	9			DIODE-ZNR 16V 5% DO-35 PD=.4W TC=+.088%	28480	1902-0963
A11W1	8159-0005	0			RESISTOR-ZERO OHMS 22 AWG LEAD DIA	28480	8159-0005
MISCELLANEOUS PARTS							
	2380-0119	8		4	SCREW-MACH 6-32 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2420-0001	5		4	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	00000	ORDER BY DESCRIPTION
A11XA11F1-							
A11XA11F5	2110-0269	0		10	FUSEHOLDER-CLIP TYPE .25D-FUSE	28480	2110-0269
A11XA11F6	1251-2194	1			CONNECTOR-SGL CONT SKT .021-IN-BSC-SZ	28480	1251-2194
A12	08884-80003	7		1	MOTHERBOARD	28480	08884-80003
A12C1	0180-2987	8		1	CAPACITOR-FXD .034F+75-10% 20VDC AL	28480	0180-2987
	2880-0128	7		10	SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0011	8		10	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
A12C2	0180-3041	7		2	CAPACITOR-FXD 8700UF+75-10% 40VDC AL	28480	0180-3041
	2880-0128	7			SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0011	8			WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
A12C3	0180-3041	7			CAPACITOR-FXD 8700UF+75-10% 40VDC AL	28480	0180-3041
	2880-0128	7			SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0011	8			WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
A12C4	0180-0877	9		1	CAPACITOR-FXD 5800UF+75-10% 40VDC AL	28480	0180-0877
	2880-0128	7			SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0011	8			WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
A12C5	0180-3102	1		1	CAPACITOR-FXD 3000UF+75-10% 75VDC AL	28480	0180-3102
	2880-0128	7			SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0011	8			WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0011
A12C6	0180-0197	8		1	CAPACITOR-FXD 2.2UF+10% 20VDC TA	56289	150D225K9020A2
A12CR1	1901-0418	7			DIODE-PWR RECT 400V 1.5A	28480	1901-0418
	0340-0669	9		1	INSULATOR-XSTR SLBL-ORG-POLYM	28480	0340-0669
A12J1	1251-5393	8		1	CONNECTOR 3-PIN M POST TYPE	28480	1251-5393
A12J2	1251-6173	4		1	CONNECTOR 2-PIN M POST TYPE	28480	1251-6173
A12J3	1251-4348	1		1	CONNECTOR 6-PIN M POST TYPE	28480	1251-4348
A12J4	1251-4353	8		1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4353
A12J5	1251-5170	9		1	CONNECTOR 2-PIN M POST TYPE	28480	1251-5170
A12J6	1251-6010	8		10	CONNECTOR 3-PIN M POST TYPE	28480	1251-6010
A12MP1	0590-1076	3		10	THREADED INSERT-NUT M3 X 0.5 1.5-MM-LG	28480	0590-1076
A12MP2	08884-00029	1		1	PLATE-HEAT SINK	28480	08884-00029
A12MP3	08884-00038	2		1	LABEL-MOTHERBOARD A	28480	08884-00038

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
A12Q1	1853-0344	5	1	TRANSISTOR PNP 2N5878 SI TO-3 PD=150W	04713	2N5878
	0515-0352	8	4	SCREW-MACHINE ASSEMBLY M3 X 0.5 12MM-LG	00000	ORDER BY DESCRIPTION
	1251-2313	6	4	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A12Q2	1854-0743	0	1	TRANSISTOR NPN 2N5878 SI TO-3 PD=150W	01295	2N5878
	0515-0352	8	8	SCREW-MACHINE ASSEMBLY M3 X 0.5 12MM-LG	00000	ORDER BY DESCRIPTION
	1251-2313	6	6	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A12Q3	1854-0311	8	1	TRANSISTOR NPN 2N4240 SI TO-66 PD=35W	3L585	2N4240
	0515-0353	9	6	SCREW-MACHINE ASSEMBLY M3 X 0.5 10MM-LG	00000	ORDER BY DESCRIPTION
	1251-3172	7	3	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
A12R1	0757-0280	3	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F	
A12R2	0698-3155	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F	
A12R3	0698-3155	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F	
A12R4	0757-0278	9	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F	
A12R5	0757-0447	4	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F	
A12R6	0811-1686	7	RESISTOR 1 5% 2W PW TC=0+-800	75042	BWH2-1R0-J	
A12R7	0811-1686	7	RESISTOR 1 5% 2W PW TC=0+-800	75042	BWH2-1R0-J	
A12R8	0811-1672	5	RESISTOR 3.3 5% 2W PW TC=0+-400	75042	BWH2-3R3-J	
A12R9	0698-3158	4	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F	
A12R10	0698-8827	4	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-8827	
A12U1	1826-0837	4	1	IC-LM 239K, VOLTAGE REGULATOR	28480	1826-0837
	0515-0353	9	8	SCREW-MACHINE ASSEMBLY M3 X 0.5 10MM-LG	00000	ORDER BY DESCRIPTION
	1251-2313	6	6	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A12U2	1826-0423	4	1	IC V RGLTR TO-3	27014	LM317K
	0515-0353	9	8	SCREW-MACHINE ASSEMBLY M3 X 0.5 10MM-LG	00000	ORDER BY DESCRIPTION
	1251-2313	6	6	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2313
A12XA1A	1251-5720	5	2	CONNECTOR 34-PIN M POST TYPE	28480	1251-5720
A12XA2-				NOT ASSIGNED		
A12XA4	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA5	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA6	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA7	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA8A	1251-2026	8	10	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA8B	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA9A	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA9B	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA10	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA11A	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A12XA11B	1251-2026	8	8	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A13	08684-60018	2	1	MICROCIRCUIT INTERCONNECT BOARD	28480	08684-60018
A13C1	0160-3879	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A13C2	0160-3879	7	7	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A13C3	0160-3877	5	5	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A13F1	2110-0513	7	2	FUSE .125A 125V NTO .348X.25	75915	273.125
A13F2	1251-2194	1	5	CONNECTOR-SGL CONT SKT .021-IN-BSC-SZ	28480	1251-2194
	2110-0513	7	7	FUSE .125A 125V NTO .348X.25	75915	273.125
	1251-2194	1	1	CONNECTOR-SGL CONT SKT .021-IN-BSC-SZ	28480	1251-2194
A13L1	9100-1811	4	1	INDUCTOR RF-CH-MLD 220MH 20%	28480	9100-1811
A13L2	9100-1620	5	5	INDUCTOR RF-CH-MLD 15UH 10% .1E8DX.385LG	28480	9100-1620
A13VR1	1902-3139	7	1	DIODE-ZNR 8.25V 5% DO-35 PD=.4W	28480	1902-3139
	1251-3172	7	7	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172

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	08683-67001	8		1	MICROWAVE OSCILLATOR	28480	08683-67001
A15	08683-67002	9		1	MICROWAVE AMPLIFIER (EXCEPT OPT.001)	28480	08683-67002
A16	08683-67003	0		1	MICROWAVE POWER AMPLIFIER(OPT. 001)	28480	08683-67003
A17	0960-0443	1		1	MODULE-LINE POWER	28480	0960-0443

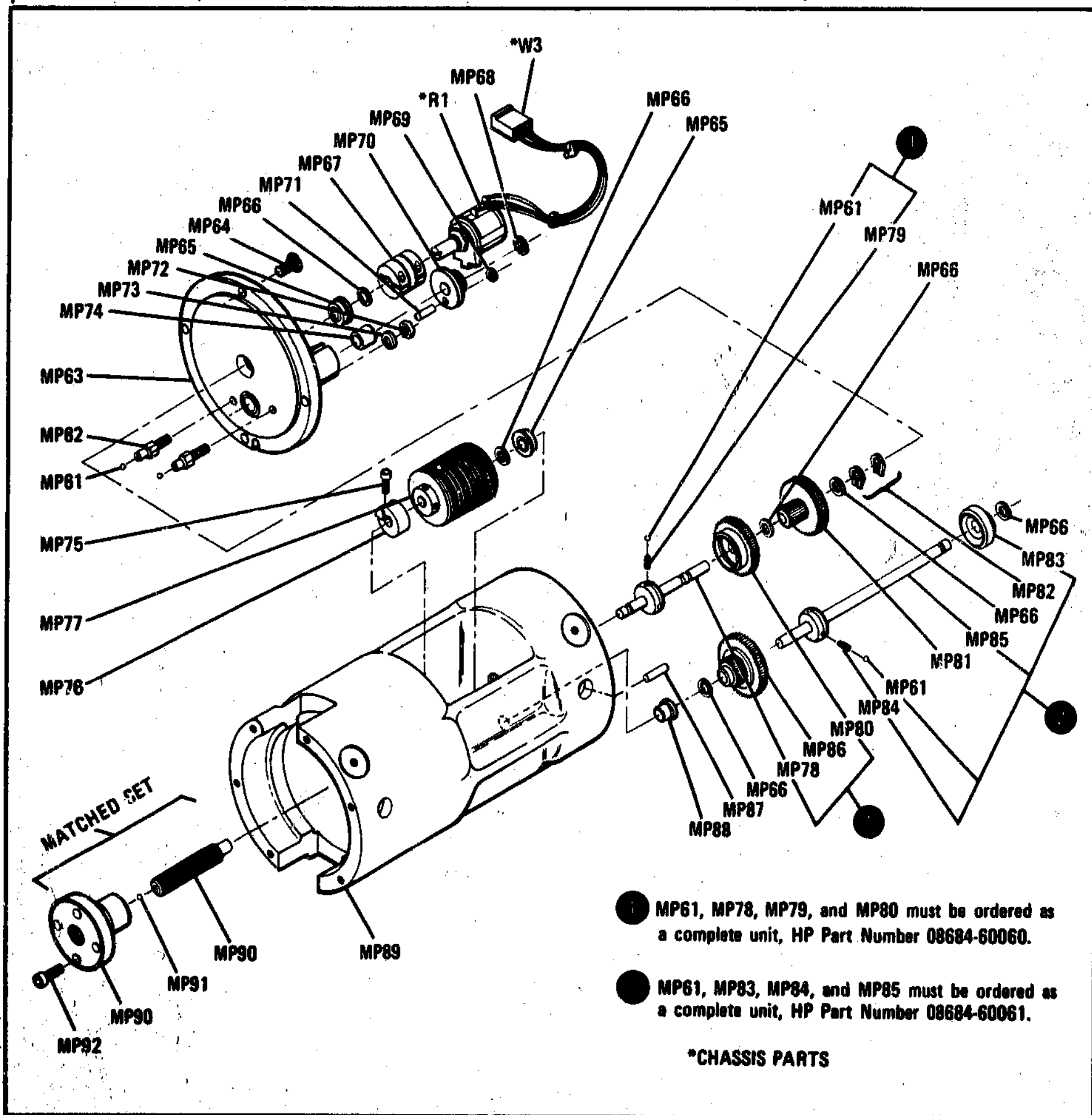


Figure 6-1. A18 Oscillator Drive Assembly Illustrated Parts Breakdown

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A18	08683-60003	6	1	OSCILLATOR DRIVE ASSEMBLY	28480	08683-60003
A18MP1- A18MP60				NOT ASSIGNED		
A18MP61	1410-0226	4	10	BALL BEARING-0.09375 DIA	28480	1401-0226
A18MP62	08684-20048	6	2	RETAINER-BALL BEARING	28480	08684-20048
A18MP63	08634-20068	0	1	CAP-DRIVE	28480	08684-20068
A18MP64	0515-0356	2		SCREW-METRIC 3.5 X 10	00000	ORDER BY DESCRIPTION
A18MP65	1410-0557	4	2	BEARING-RING	28480	1410-0557
A18MP66	3050-0017	9	6	WASHER-FL MTLCL 1/4 IN .26-IN-ID	28480	3050-0017
A18MP67	1500-0587	1	1	COUPLER-RIGID	13201	3497X1-8-8
A18MP68	0510-1140	4	1	RETAINER-RING	28480	0510-1140
A18MP69	0510-0958	0	1	RETAINER-RING PUSH	28480	0510-0958
A18MP70	08684-20130	7	1	BUSHING-FINGER	28480	08684-20130
A18MP71	1480-0518	4	1	PIN-DOWEL	28480	1480-0518
A18MP72	0535-0007	2		NUT-HEX DOUBLE CHAMBER	00000	ORDER BY DESCRIPTION
A18MP73	2190-0585	1		WASHER-LK MLCCL 3.5 MM 3.6-MM-ID	28480	2190-0585
A18MP74	1410-0046	6	1	BUSHING-BEARING SLEEVE	28480	1410-0046
A18MP75	3030-0221	5	1	SCREW-SKT HD CAP 4-40 .375-IN-LG SST-302	00000	ORDER BY DESCRIPTION
A18MP76	08684-20129	4	1	STOP-TRAVEL ADJUST	28480	08684-20129
A18MP77	1500-0606	5	1	BELLOWS-COUPLING	28480	1500-0606
A18MP78	08684-20066	8	1	SHAFT-OSCILLATOR	28480	08684-20066
A18MP79	1480-1845	0	4	SPRING-COMPRESSION	28480	1480-1845
A18MP80	08684-20041	9	1	CLUTCH-GEAR POT	28480	08684-20041
A18MP81	08684-20054	4	1	GEAR-IDLER	28480	08684-20054
A18MP82	0510-0005	8	2	RETAINER-RING BSC EXT .25-IN-DIA STL	28480	0510-0005
A18MP83	08684-20056	6	1	CLUTCH-NORMAL	28480	08684-20056
A18MP84	1480-1844	9	4	SPRING-COMPRESSION	28480	1480-1844
A18MP85	08684-20067	9	1	KNOB-SHAFT FREQ. TUNE	28480	08684-20067
A18MP86	08684-20051	1	1	CLUTCH-RAPID	28480	08684-20051
A18MP87	1480-0021	4	1	PIN DOWEL 0.50 LG	28480	1480-0021
A18MP88	1410-0047	7	1	BUSHING-SHOULDER	71041	FB-46-2
A18MP89	08683-20022	5	1	HOUSING DRIVE	28480	08683-20022
A18MP90	08683-20020	3	1	SCREW-LEAD (P/O MATCHED SET)	28480	08683-20020
A18MP91	1410-0005	7	1	BALL-BRG TYPE .125-DIA GRADE-50 STL	28480	1410-0005
A18MP92	0515-0349	3	4	SCREW-METRIC ALLEN CAP	00000	ORDER BY DESCRIPTION

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
CHASSIS PARTS						
AT1	08684-60030	0	1	OUTPUT ATTENUATOR	28480	08684-60030
AT2	0960-0633	1	2	PERIPHERAL MODE ISOLATOR	28480	0960-0633
AT3	0960-0633	1		PERIPHERAL MODE ISOLATOR (OPT 002)	28480	0960-0633
B1	3160-0381	3	1	FAN 30CFM(EXCEPT OPT.003)	28480	3160-0381
B1B	3160-0317	5	1	FAN TUBAXIAL (OPT. 003)	28480	3160-0317
B1C1	0160-3968	5	1	CAPACITOR-FXD 0.47UF(OPT. 003)	28480	0160-3968
B1MP1	0340-0037	5	1	TERMINAL-TURRET (OPT. 003 ONLY)	28480	0340-0037
B1MP2	0340-0039	7	3	INSULATOR-BUSHING (OPT. 003 ONLY)	28480	0340-0039
B1MP3	1400-0493	6	1	STRAP-CABLE .14W (OPT. 003 ONLY)	06383	PLT1.5-MP8
B1W22	8150-2839	2	2	WIRE-BLACK	28480	8150-2839
B1W22B	8150-3125	3	1	WIRE-BLACK/YELLOW	28480	8150-3125
C1	0160-4065	5	1	CAPACITOR-FXD .1UF +-20% 250VAC(RMS)	28480	0160-4065
CR1	08684-67005	3	1	MICROWAVE DETECTOR ASSEMBLY	28480	08684-67005
DC1	0955-0133	5	1	MICROWAVE DIRECTIONAL COUPLER	28480	0955-0133
F1	2110-0043	8		FUSE 1.5A 250V FOR 220V TO 240V AC IN	28480	2110-0043
F1	2110-0003	0	1	FUSE 3A 250V NTD 1.25X.25 UL FOR 100V TO 120V AC IN	75915	312003
FL1	08683-60007	0	1	FILTER, LOW PASS	28480	08683-60007
J1	1250-0102	5	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0102
	2190-0068	5	2	WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
	2950-0054	1	3	NUT-HEX-DBL-CHAM 1/2-28-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
J2				NOT ASSIGNED		
J3				NOT ASSIGNED		
J4	1250-0083	1	4	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	2190-0016	3	8	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8	6	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J5	1250-0083	1	1	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	2190-0016	3	3	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8	8	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J6	08684-60058	2	1	OUTPUT CONNECTOR	28480	08684-60058
J7				NOT SEPARATELY REPLACEABLE (P/O W31)		
J8	1250-0083	1	1	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	2190-0016	3	3	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8	8	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J9	1250-0083	1	1	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
	2190-0016	3	3	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
	2950-0001	8	8	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
J10	1250-0102	5	5	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0102
	2190-0068	5	5	WASHER-LK INTL T 1/2 IN .505-IN-ID	28480	2190-0068
	2950-0054	1	1	NUT-HEX-DBL-CHAM 1/2-28-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
MP1				MP1-40 SHOWN & LISTED ON FP IPB		
MP41				MP41-60 SHOWN & LISTED ON RP IPB		
MP61				MP61-100 SHOWN & LISTED ON A18 IPB		
MP101				MP101-120 SHOWN & LISTED ON CAB PTS IPB		
MP121	08683-00001	8	1	BRACKET DRIVE (BOTTOM)	28480	08683-00001
	0515-0389	1	20	SCREW-MACH M3.5 X .06 X 8MM-LG	00000	ORDER BY DESCRIPTION
	1520-0222	3	16	GROMMET	28480	1520-0222
	0515-0443	8	8	SCREW-MACH. 144 X 0.7	28480	0515-0443
	2190-0586	2	8	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
MP122	08683-00002	9	1	BRACKET-DRIVE (TOP)	28480	08683-00002
	0515-0356	2	8	SCREW-MACHINE ASSEMBLY M3.5 X 0.6	00000	ORDER BY DESCRIPTION
	1520-0222	3	3	GROMMET	28480	1520-0222
	2190-0586	2	2	WASHER-LK HLCL 4.0 MM 4.1-MM-ID	28480	2190-0586
	0515-0443	8	8	SCREW-MACH. 144 X 0.7	28480	0515-0443
	0515-0389	1	1	SCREW-MACH M3.5 X .06 X 8MM-LG	00000	ORDER BY DESCRIPTION

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		
MP123	08683-00003	0	1	BRACKET-DRIVE	28480	08683-00003		
	2360-0115	4	2	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION		
	08682-20028	8	2	PLUG-HOLE	28480	08682-20028		
MP124	08684-00005	3	1	DECK-MAIN	28480	08684-00005		
	1520-0222	3		GROMMET	28480	1520-0222		
	2190-0401	0	1	WASHER-FIBER	28480	2190-0401		
MP125	08684-00009	7	1	BRACKET SUPPLY	28480	08684-00009		
MP126	08684-00021	3	1	BRACKET-SIDE	28480	08684-00021		
				SCREW				
MP127	08684-00034	8	1	BRACKET-ATTENUATOR	28480	08684-00034		
	2200-0105	4	2	SCREW-ATTENUATOR TO BRACKET	00000	ORDER BY DESCRIPTION		
	0515-0389	1		SCREW MACH M3.5 X .06 X 8MM-LG	00000	ORDER BY DESCRIPTION		
	3050-0892	8		WASHER-FL MTL C 3.5 MM 3.8-MM-ID	28480	3050-0892		
MP128	08684-00049	5	1	BRACKET-DECK	28480	08684-00049		
	0515-0389	1		SCREW-MACH M3.5 X .06 X 8MM-LG	00000	ORDER BY DESCRIPTION		
MP129	08684-20060	2	1	EXTRUSION-6 BOARD	28480	08684-20060		
	0624-0269	7	44	SCREW-TPG 4-24 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION		
MP130	7121-2527	5	1	LABEL-CAUTION	28480	7121-2527		
MP131	7120-4163	7	2	NOT ASSIGNED	28480	7120-4163		
MP132				LABEL-WARNING				
MP133	08684-00042	8	1	NOT ASSIGNED	28480	08684-00042		
MP134				CONTACT-AMPLIFIER				
MP135				CONTACT-MODULATOR				
MP136	7121-2504	8	1	LABEL-DIAGNOSTIC INFO.	28480	7121-2504		
	08683-00007	4	1	BRACKET PHI (OPTION 002)	28480	08683-00007		
Q1	1854-0669	9	1	TRANSISTOR NPN 2N6057 SI T0-3 PD-150W	04713	2N6057		
	1200-0043	8	1	INSULATOR-XSTR ALUMINUM	28480	1200-0043		
	08684-00046	2	1	INSULATOR (Q1)	28480	08684-00046		
	0626-0002	0	2	SCREW-TPG 6-20 .5-IN-LG PAN-HD-SLT	00000	ORDER BY DESCRIPTION		
R1	2100-0398	5	1	RESISTOR-VAR PREC W/W 10-TRN 50K 3% (FREQUENCY)	28480	2100-0398		
R2	2100-3912	5	1	RESISTOR-VAR W/SW 20K 10% LIN DPDT-NC-NO (AM INPUT)	28480	2100-3912		
				NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK				
				WASHER-LK INTL T 1/4 IN .256-IN-ID				
				WASHER-LK INTL T 3/8 IN .377-IN-ID				
R3	0757-0418	9	1	RESISTOR 619 1% .125W F TC-0+-100 (P/O AM INPUT)	24546	C4-1/8-T0-619R-F		
R4	2100-3913	6	1	RESISTOR-VAR W/SW 50 10% LIN DPDT-NC-NO (FM INPUT/OUTPUT)	28480	2100-3913		
				NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK				
				WASHER-LK INTL T 1/4 IN .256-IN-ID				
				WASHER-LK INTL T 3/8 IN .377-IN-ID				
R5	2100-3946	5	1	NOT ASSIGNED	28480	2100-3946		
R6				RESISTOR-VAR 10K(RF LEVEL 10DB STEP) (RF LEVEL 10 DB STEP)				
2950-0006				3			2	NUT-HEX-DBL-CHAM 1/4-32-THD .094-IN-THK
	WASHER-LK INTL T 3/8 IN .377-IN-ID							
R7	2100-3945	4	1	RESISTOR-VAR 10K(RF LEVEL VERNIER) (RF LEVEL VERNIER)	28480	2100-3945		
				2950-0054			1	NUT-HEX-DBL-CHAM 1/2-28-THD .125-IN-THK
				2190-0016			3	WASHER-LK INTL T 3/8 IN .377-IN-ID
R8	2100-3933	0	1	RESISTOR-VAR CONTROL CP 25K 10% LIN (CABLE OFFSET)	28480	2100-3933		
				2190-0067			4	WASHER-LK INTL T 1/4 IN .256-IN-ID
				2950-0006			3	NUT-HEX-DBL-CHAM 1/4-32-THD .094-IN-THK
				00000				ORDER BY DESCRIPTION
S1	3101-2216	3	1	SWITCH (LINE POWER ON/OFF)	28480	3101-2216		
T1	9100-4209	2	1	TRANSFORMER-POWER 100/120/220/240V	28480	9100-4209		
W1	8120-3282	0	1	CABLE-GRAY RIBBON FROM A1J1 TO A12XA1B	28480	8120-3282		
W2	08684-60046	8	1	NOT ASSIGNED	28480	08684-60046		
W3				CABLE-FREQ. POT TO A12J1				
W4				CABLE-J4 AM INPUT TO A12J2				
W5	08684-60047	9	1	CABLE-FROM RB,7 LEVEL TO A12J3	28480	08684-60047		
	08684-60048	0	1		28480	08684-60048		

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
W6	8120-3281	9	1	CABLE-GRAY RIBBON FROM A12XA13 TO A13J1	28480	8120-3281
W7	08684-60029	7	1	CABLE- FROM A12J4 TO Q1 REGULATOR	28480	08684-60029
W8	08684-60045	7	1	CABLE- FROM A12J5 TO J8, J9 REAR PANEL	28480	08684-60045
W9	08684-60044	6	1	CABLE-FROM A12J6 TO R8 REAR PNL CBL-OFFS	28480	08684-60044
W10	08684-60057	1	1	CABLE-FROM J1 INPUT PULSE TO A3J1 DELAY	28480	08684-60057
W11				NOT ASSIGNED		
W12				NOT ASSIGNED		
W13	08684-60055	9	1	CABLE FROM A6J1 TO J5 FM I/O (BROWN) CABLE FROM J5 FM I/O TO A10J3 FM IN(YEL) NOT ASSIGNED	28480	08684-60055
W14				NOT ASSIGNED		
W15				NOT ASSIGNED		
W16	08684-60026	4	1	CABLE-FROM A7J1 30MHZ REF. TO A6J3	28480	08684-60026
W17	08684-60027	5	1	CABLE-FROM A6J4 DET AMP TO A5J1 ALC CONT	28480	08684-60027
W18	08684-60038	8	1	CABLE-FROM A10 FM OUT TO OSC. VARACTOR	28480	08684-60038
W19	08684-60028	6	1	CABLE-FROM J10 PHASE LOCK IN TO A10J2	28480	08684-60028
W20	8120-1376	1	1	CABLE-LINE POWER	28480	8120-1376
W21	08684-60041	3	1	CABLE-LINE POWER MODULE SWITCH	28480	08684-60041
W22	8150-2639	2	1	CABLE-POWER MODULE FAN(EXCEPT OPT. 003)	28480	8150-2639
W22	8150-3125	3	1	CABLE-POWER MODULE FAN (OPT. 003)	28480	8150-3125
W23	08684-60043	5	1	CABLE-A11 POWER SUPPLY TO OSCILLATOR	28480	08684-60043
W24-				NOT ASSIGNED		
W29				NOT ASSIGNED		
W30	08683-20015	6	1	CABLE-A14 OSC. OUT TO A15 UW AMP IN	28480	08683-20015
W31	08684-20069	1	1	CABLE-REAR PANEL RF AUX OUT	28480	08684-20069
W32	08683-20016	7	1	UW AMP OUT TO AT2 PMI IN	28480	08683-20016
W33	08683-20018	8	1	CABLE-FROM AT2 PMI OUT TO DC1 UW DIRC IN	28480	08683-20018
W34	08683-20047	4	1	CABLE-FROM DC1 UW DIRC OUT TO AT1 ATT IN	28480	08683-20047
W35	08684-20074	8	1	CABLE-FROM AT1 OUT TO RF OUTPUT (EXCEPT OPTION 002)	28480	08684-20074
W36	08683-20051	0	1	AT1 ATTEN OUT TO AT3 PMI IN (OPT 002)	28480	08683-20051
W37	08683-20052	1	1	AT3 PMI OUT TO RF OUTPUT (OPT 002)	28480	08683-20052

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
FRONT PANEL IPB						
MP1	0370-3106	0	1	KNOB-LEVEL VERNIER	28480	0370-3106
MP2	0370-3108	0	1	KNOB-LEVEL 100B STEP	28480	0370-3108
MP3	0370-3104	6	2	KNOB-BLUE POINTER	28480	0370-3104
MP4	08884-20109	0	1	NUT-FRONT PANEL POTS	28480	08884-20109
MP5	0370-3107	9	1	KNOB-FREQ. CRANK	28480	0370-3107
MP6	5040-6928	4	1	DIVIDER STRIP	28480	5040-6928
MP7	7120-1254	1	1	NAMEPLATE .312-IN-WD .54-IN-LG AL	28480	7120-1254
MP8	08883-20041	8	1	WINDOW (OPTION 002)	28480	08883-20041
MP9	08883-20029	2	1	WINDOW (EXCEPT OPTION 002)	28480	08883-20029
MP10	1800-0692	1	3	CLIP-RETAINER	28480	1800-0692
MP11	08884-00030	4	1	LINE SWITCH BRACKET	28480	08884-00030
	0520-0128	7	1	SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2190-0045	8	1	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0045
	3050-0098	6	2	WASHER-FL MTLCL NO. 2 .094-IN-ID	28480	3050-0098
MP12	5041-1682	9	1	KEY CAP-LINE SWITCH	28480	5041-1682
MP13	08884-00031	5	1	BRACKET-RF CONNECTOR	28480	08884-00031
MP14	08884-20135	2	1	SLEEVE-RF CONNECTOR MOUNTING	28480	08884-20135
MP15	1400-0082	9	2	CLAMP-CABLE .125-DIA .375-WD NYL	28480	1400-0082
	0515-0068	3	1	SCREW-MACH M3.5 X 0.6 16MM-LG PAN-HD	28480	0515-0068
	2190-0585	1	10	WASHER-LK HLCL 3.5 MM 3.6-MM-ID	28480	2190-0585
	3050-0892	8	14	WASHER-FL MTLCL 3.5 MM 3.8-MM-ID	28480	3050-0892
MP16*	08884-20140	9	1	COLLAR LOCK	28480	08884-20140
MP17	1500-0004	7	1	COUPLER-INSERT	28480	1500-0004
MP18	1500-0006	9	2	HUB-COUPLER .188 LG	28480	1500-0006
MP19	08884-00028	0	1	BRACKET-100B STEP RF LEVEL POT	28480	08884-00028
MP20	08884-20132	9	1	GEAR-DRIVEN	28480	08884-20132
	3030-0007	5	2	SCREW-SET 4-40 .125-IN-LG SMALL CUP-PT	00000	ORDER BY DESCRIPTION
MP21	08884-20089	5	1	PLATE-ATTENUATOR DRIVE (REAR)	28480	08884-20089
MP22	08884-20124	9	1	GEAR-OUTPUT	28480	08884-20124
MP23	3050-0032	8	2	WASHER-FL MTLCL NO. 8 .189-IN-ID	28480	3050-0032
MP24	08884-20123	8	1	GEAR-IDLER	28480	08884-20123
MP25	08884-40003	5	1	GEAR-DETENTED	28480	08884-40003
MP26	08884-20097	5	1	SHAFT-RF LEVEL POT	28480	08884-20097
MP27*	08884-20141	0	1	BLOCK-SPRING CARRIER	28480	08884-20141
MP28	1460-1885	8	1	SPRING-COMPRESSION	28480	1460-1885
MP29	1410-0075	1	1	BALL-BRG TYPE .1562-DIA GRADE-100 SST	00000	ORDER BY DESCRIPTION
MP30	08884-20088	4	1	PLATE-ATTENUATOR DRIVE (FRONT)	28480	08884-20088
MP31	0390-0002	8	3	SPACER-RND .25-IN-LG .156-IN-ID	00000	ORDER BY DESCRIPTION
MP32	08884-20134	1	1	INSULATOR-FRONT PANEL P.C. BOARD	28480	08884-20134
MP33	08884-20131	8	1	GEAR-DRIVING	28480	08884-20131
	3030-0007	5	1	SCREW-SET 4-40 .125-IN-LG SMALL CUP-PT	00000	ORDER BY DESCRIPTION
MP34	08884-00008	6	1	BRACKET-RF LEVEL VERNIER POT	28480	08884-00008
MP35	5040-6888	5	1	LIGHT PIPE (12MM)	28480	5040-6888
MP36	0890-0041	6	1	TUBING-SHRINK	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information

\*Indicates factory selected value

†Backdating information in Section VII

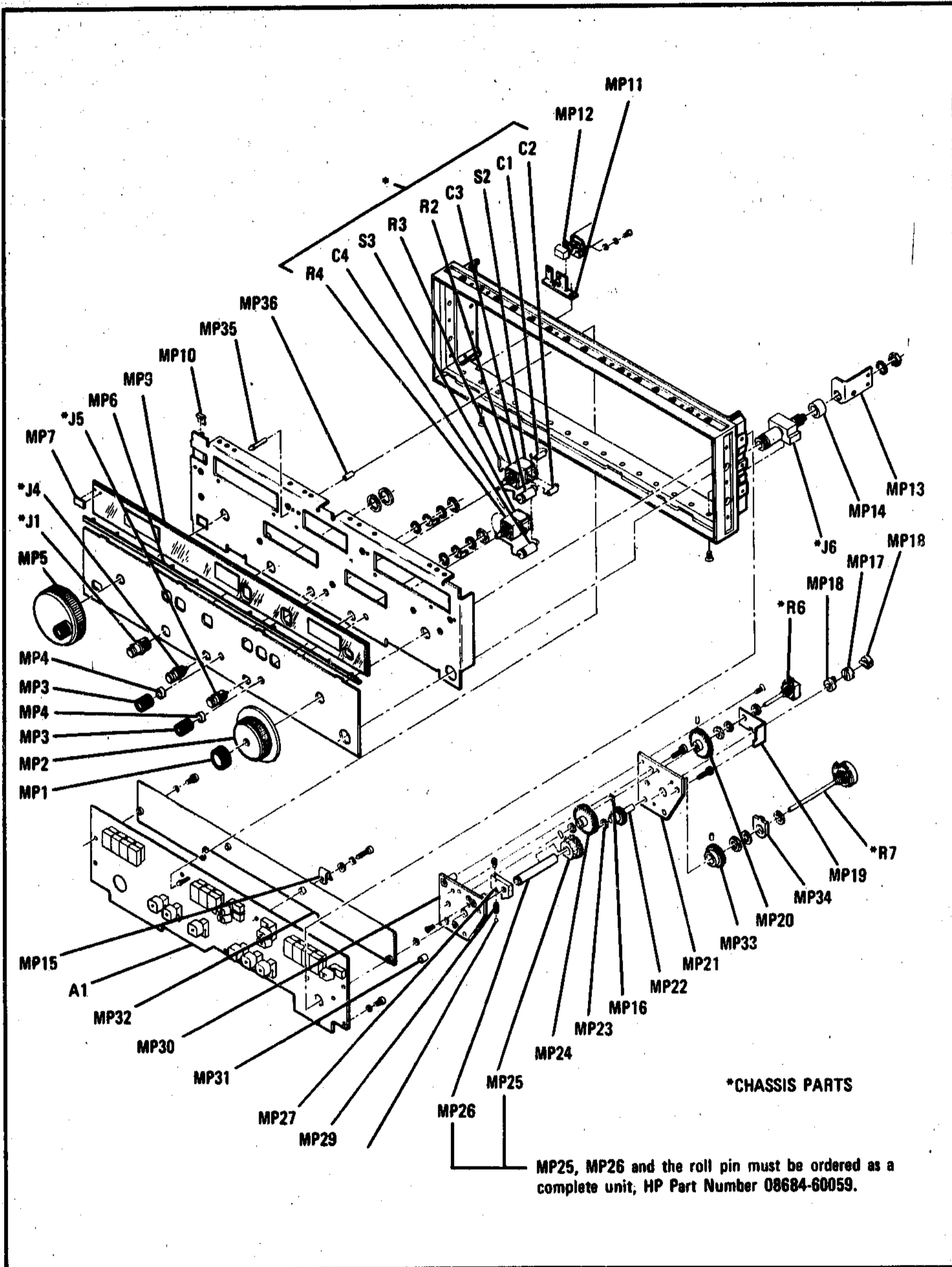


Figure 6-2. Front Panel Illustrated Parts Breakdown

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				REAR PANEL IPB		
MP41	1400-0015	8	2	CLAMP-CABLE .25-DIA .375-WD STL	28480	1400-0015
	0515-0355	1	1	SCREW-METRIC 3.5 X 18	00000	ORDER BY DESCRIPTION
	3050-0098	6		WASHER-FL MTL C NO. 2 .094-IN-ID	28480	3050-0098
MP42	08684-00032	6	1	BRACKET-REAR PANEL (EXCEPT OPT. 003)	28480	08684-00032
	0515-0354	0		SCREW-MACH. M3.5 X 8	00000	ORDER BY DESCRIPTION
MP43	08684-00039	3	1	BRACKET-REAR PANEL (OPTION 003)	28480	08684-00039
	0515-0354	0	2	SCREW-MACH. M3.5 X 8	00000	ORDER BY DESCRIPTION
MP44	4040-1891	9	1	COVER-FAN 60 HZ (EXCEPT OPT. 003)	28480	4040-1891
	0515-0350	6	2	SCREW-MACH M3.5 X 0.6 35MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	2190-0585	1		WASHER-LOCK	28480	2190-0585
	3050-0892	8		WASHER-FL MTL C 3.5 MM 3.8-MM-ID	28480	3050-0892
MP45	4040-1892	0	1	COVER-FAN 400 HZ (OPTION 003)	28480	4040-1892
	0515-0351	7	4	SCREW-MACH M3.5 X 0.6 48MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
	2190-0585	1		WASHER-LOCK	28480	2190-0585
MP46	3160-0300	6	1	GUARD-FAN	28480	3160-0300
MP47	0370-3105	7	1	KNOB-BLACK POINTER	28480	0370-3105
MP48	1250-0522	3	1	CAP-COAXIAL (INCLUDES CHAIN)	28480	1250-0522
MP49	08684-00033	7	1	PANEL-AUXILIARY (EXCEPT OPT. 003)	28480	08684-00033
MP50	08684-00041	7	1	PANEL-AUXILIARY (OPTION 003)	28480	08684-00041
MP51	08684-80005	1	1	COVER-TRANSFORMER	28480	08684-80005
	0515-0275	4	4	SCREW-MACH M5 X 0.8 70MM-LG PAN-HD	28480	0515-0275
	0535-0005	0	4	NUT-HEX DBL-CHAIN M5 X 0.8 5.3MM-THK	00000	ORDER BY DESCRIPTION
	2190-0567	3	8	WASHER-LK HLCL 5.0 MM 5.1-MM-ID	28480	2190-0567
	3050-0894	0	4	WASHER-FLAT MTL C	28480	3050-0894
MP52	1400-0053	4	1	CLAMP-CABLE .172-DIA .375-WD NYL	28480	1400-0053
	0515-0067	2	1	SCREW-MACH M3.5 X 0.8 10MM-LG PAN-HD	28480	0515-0067
	0535-0007	2	3	NUT-HEX	00000	ORDER BY DESCRIPTION
	3050-0892	8		WASHER-FLAT	28480	3050-0892
	2190-0018	5	1	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
MP53	5040-7221	2	4	STANDOFF-REAR PANEL (OPTION 003)	28480	5040-7221
	2380-0195	0	4	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	28480	2380-0195

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

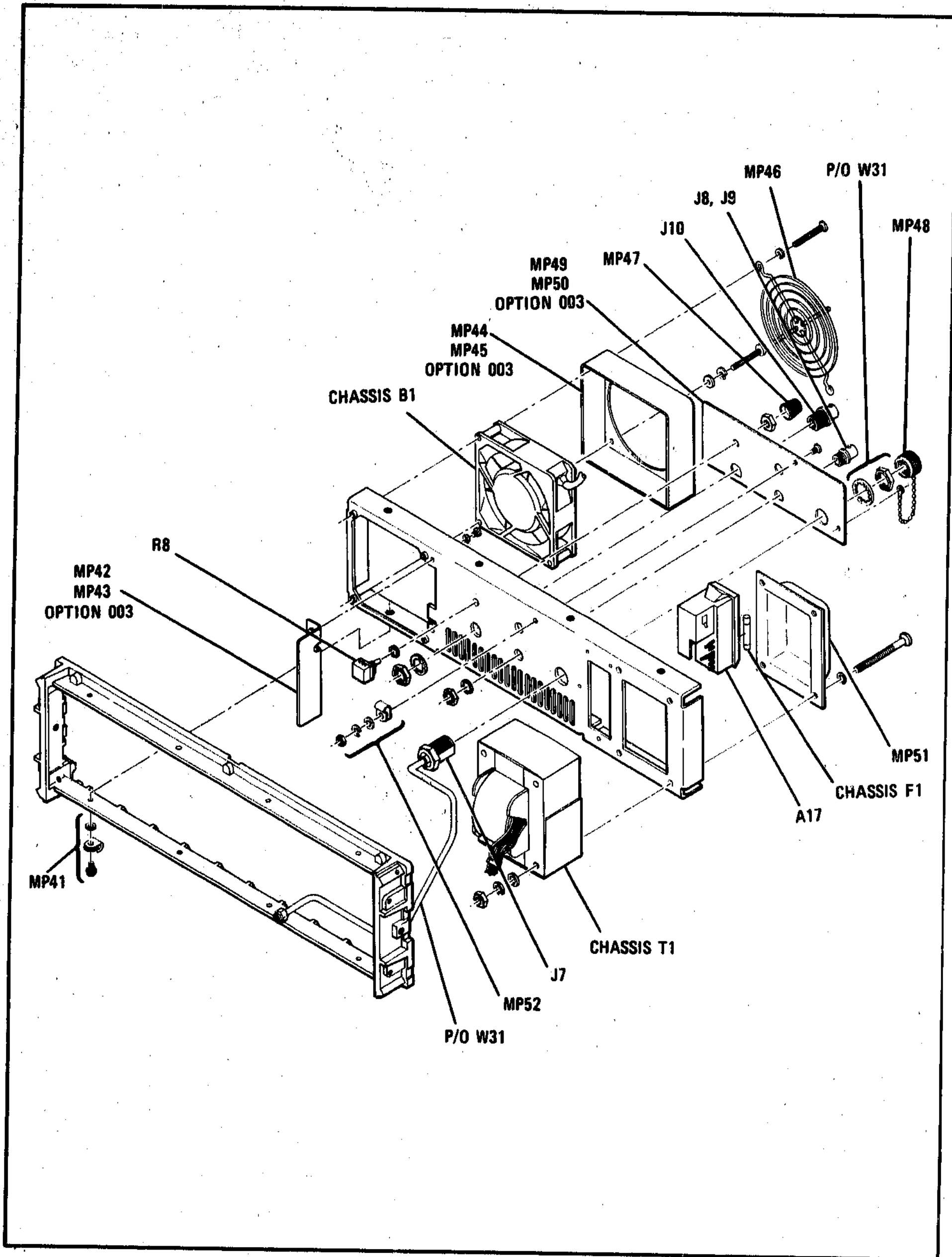


Figure 6-3. Rear Panel Illustrated Parts Breakdown

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
CABINET PARTS						
MP101	5040-7220	1	2	HANDLE CAP-REAR	28480	5040-7220
MP102	5060-9936	2	2	COVER-SIDE (PERFORATED)	28480	5060-9936
MP103	08684-00010	0	1	PANEL-REAR (SUB)	28480	08684-00010
	0515-0506	4	1	SCREW-MACH SEMS	00000	ORDER BY DESCRIPTION
MP104	5060-9834	9	1	COVER-TOP	28480	5060-9834
MP105	5020-8804	7	1	FRAME-REAR	28480	5020-8804
MP106	5040-7202	9	1	TRIM STRIP (TOP)	28480	5040-7202
MP107	5020-8836	5	3	STRUTS-CORNER	28480	5020-8836
	2510-0192	6	4	SCREW-MACH 8-32 .25-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
MP108	5020-8803	6	1	FRAME-FRONT	28480	5020-8803
MP109	08684-00002	0	1	PANEL-FRONT (SUB)	28480	08684-00002
MP110	08684-00001	9	1	PANEL-FRONT DRESS	28480	08684-00001
MP111	5060-9846	3	1	COVER-BOTTOM	28480	5060-9846
MP112	5040-7201	8	2	FOOT-FULL 1/2 MODULE	28480	5040-7201
MP113	1460-1345	5	2	TILT STAND SST	28480	1460-1345
MP114	5060-9899	6	2	HANDLE-FRONT	28480	5060-9899
MP115	5020-8896	7	2	TRIM-FRONT HANDLE	28480	5020-8896
MP116	5040-7222	3	2	FOOT-REAR (NON-SKID)	28480	5040-7222
MP117	5040-7219	8	2	HANDLE CAP (FRONT)	28480	5040-7219
MP118	5060-9803	2	2	HANDLE-STRAP	28480	5060-9803
MP119	5061-2071	4	1	RACK FLANGE KIT (OPTION 913)	28480	5061-2071

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



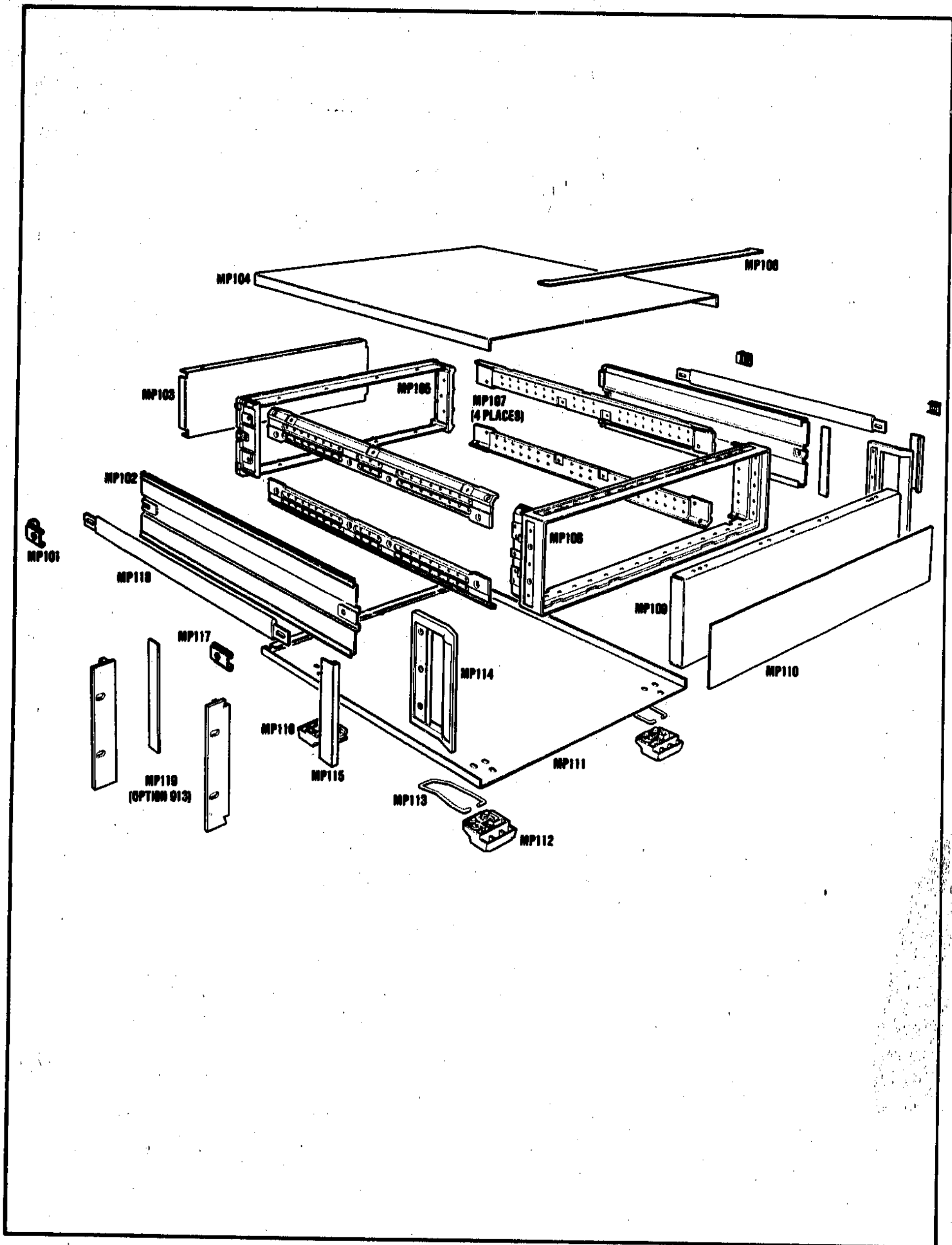


Figure 6-4. Cabinet Parts Illustrated Parts Breakdown

Table 6-4. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
00000	ANY SATISFACTORY SUPPLIER		
01121	ALLEN-BRADLEY CO	MILWAUKEE WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75222
02111	SPECTROL ELECTRONICS CORP	CITY OF IND CA	91745
02114	FERRONCUBE CORP	SAUGERTIES NY	12477
02768	ILLINOIS TOOL WORKS INC FASTEX DIV	DES PLAINES IL	60016
03508	GE CO SEMICONDUCTOR PROD DEPT	AUBURN NY	13201
03888	K D I PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
06383	PANDUIT CORP	TINLEY PARK IL	60477
06865	PRECISION MONOLITHICS INC	SANTA CLARA CA	95050
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94042
13201	MELICAL PRODUCTS CO	SANTA MARIA CA	90254
18324	SIGNETICS CORP	SUNNYVALE CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD MA	01980
24355	ANALOG DEVICES INC	NORWOOD MA	02062
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	18701
25088	SIEMENS CORP	ISELIN NJ	08830
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
31585	RCA CORP SOLID STATE DIV	SOMERVILLE NJ	
30983	MEPCO/ELECTRA CORP	SAN DIEGO CA	92121
32987	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
34371	HARRIS SEMICON DIV HARRIS-INTERTYPE	MELBOURNE FL	32901
52083	EXAR INTEGRATED SYSTEMS INC	SUNNYVALE CA	94086
52763	STETTNER ELECTRONICS INC	CHATTANOOGA TN	13035
58289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71041	BOSTON GEAR WKS DIV OF NA ROCKWELL	QUINCY MA	02171
72136	ELECTRO MOTIVE CORP	FLORENCE SC	08226
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92834
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA PA	19108
75915	LITTELFUSE INC	DES PLAINES IL	60016

**BACK DATING  
MANUAL  
CHANGES**

## SECTION VII MANUAL CHANGES

### 7-1. INTRODUCTION

This section contains information for adapting this manual to instruments for which the content does not apply directly. In addition, information about recommended modifications for improvements to the instrument is provided.

in a yellow MANUAL CHANGES supplement. For additional information about serial number coverage refer to INSTRUMENTS COVERED BY THIS MANUAL in Section I.

### 7-2. MANUAL CHANGES

To adapt this manual to your instrument refer to Table 7-1 and make all of the manual changes listed opposite your instrument serial number. Perform these changes in the sequence listed.

If your instrument is not listed on the title page of this manual or in Table 7-1, it may be documented

Table 7-1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes
2138A	F, E, D, C, B, A
2149A	F, E, D, C, B
2208A	F, E, D, C
2244A	F, E, D
2319A	F, E
2333A	F

## MANUAL CHANGES

### 7-3. MANUAL CHANGE INSTRUCTIONS

#### CHANGE A

Table 6-3:

Change A5C31 to 0150-0059 CD8, CAPACITOR-FXD 3.3 PF  $\pm$  .25 PF 500 VDC CER.  
Add A5C36 0140-0197 CD4 CAPACITOR-FXD 180 PF  $\pm$  5% 300 VDC MICA Mfr. Code 72136 Mfr. Part Number DM15F181J0300WV1CR.

Change A11VR1 to 1902-3345, CD7, DIODE-ZNR 51.1V 5% DO-35 PD=0.4W.

Service Sheet 7 (schematic):

Change A5C31 to 3.3 pF.

Add a 180 pF capacitor, C36, from the collector of Q8D to ground.

Service Sheet 13 (schematic):

Change the schematic as shown below:

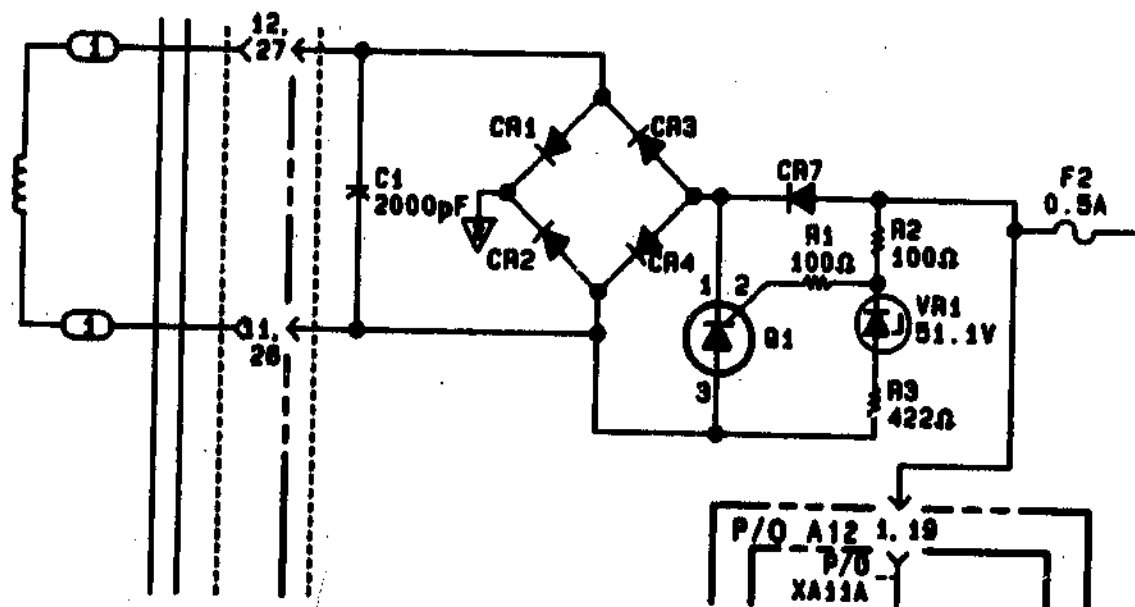


Figure 7-1. P/O Power Supply (Negative Regulator) Schematic Diagram. (Change A)

## MANUAL CHANGES

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### CHANGE B

#### Paragraph 3-6, AM MODE OPERATION:

Change step d. to "If the CABLE OFFSET feature is to be used, press and hold the CABLE OFFSET key (8) to display the CABLE OFFSET setting on the LEVEL display (9). If necessary, use rear-panel CABLE OFFSET control to establish correct setting."

#### Table 6-3:

A9U8, originally 08684-80001, CD7, EPROM 8K, was changed to 08684-80006, CD2, ROM 8K. However, the part currently listed in Table 6-3 is the recommended replacement. Therefore, no manual change is suggested.

Change A10R19 to 2100-0670, CD6, RESISTOR-TRMR 10K 10% C SIDE-ADJ 17-TURN.

#### Section VIII, POWER-UP DIAGNOSTICS:

Change the third, fourth, and fifth sentences in the second paragraph to "To stop the action at each error, just press the EXT AM key. If the displays don't power-up correctly and the "LEVEL" decimal point blinks quickly, press the EXT AM key,... quickly release...quickly press... etc. to slow down the blinks to count them."

#### Service Sheet 12 (schematic):

Change A10 R19 to 10K.

### CHANGE C

#### Figure 3-3:

Change photo item 7 (serial number plate) to a position above item 6 (line power module).

#### Table 6-3:

A5U2 was originally 1826-0371, CD1 IC OP AMP LOW BIAS-H-IMPED TO-99 PKG. However, the part currently listed in Table 6-3 is the recommended replacement. Therefore, no manual change is suggested.

Delete A6C50.

Add A6CR8 1901-0539 CD3 DIODE-SM SIG SCHOTTKY 28480 1901-0539.

A9U8 originally 08684-80001, CD7, EPROM 8K, was changed to 08684-80006, CD2, ROM 8K. However, the part currently listed in Table 6-3 is the recommended replacement. Therefore, no manual change is suggested.

A11Q7 was originally 1853-0314, CD9, TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW. However, the part currently listed in Table 6-3 is the recommended replacement. Therefore, no manual change is suggested.

A11Q13 was originally 1853-0314, CD9, TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW. However, the part currently listed in Table 6-3 is the recommended replacement. Therefore, no manual change is suggested.

A11Q16 was originally 1854-0039, CD7, TRANSISTOR NPN 2N3053S SI TO-39 PD=1W. However, the part currently listed in Table 6-3 is the recommended replacement. Therefore, no manual change is suggested.

A11U1, U2, and U3 were originally 1826-0569, CD9, IC OP AMP LOW-NOISE TO-99 PKG. However, the part currently listed in Table 6-3 is the recommended replacement. Therefore, no manual change is suggested.

Change MP16 to 0510-0052, CD5, RETAINER RING GRPR EXT 0.125-IN-DIA STL.

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**MANUAL CHANGES**

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**CHANGE C (cont'd)****Service Sheet 7 (Schematic):**

A5U2 was originally 1826-0371. However, the part currently listed in the table of transistor and integrated circuit parts is the recommended replacement. Therefore, no manual change is suggested.

**Service Sheet 8 (schematic):**

Delete C50 and in its place add CR8 (  ) with anode attached to base of Q10.

**Service Sheet 13 (Schematic):**

A11Q7 and A11Q13 were originally 1853-0314. However, the part currently listed in the table of transistor and integrated circuit parts is the recommended replacement. Therefore, no manual change is suggested.

A11U1 and U2 were originally 1826-0569 as listed in the TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS. However, the parts currently listed in this table is the recommended replacement. Therefore, no manual change is suggested.

**Service Sheet 14 (Schematic):**

A11Q16 was originally 1854-0039. However, the part currently listed in the table of transistor and integrated circuit parts is the recommended replacement. Therefore, no manual change is suggested.

A11U3 was originally 1826-0569 as listed in the TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS. However, the part currently listed in this table is the recommended replacement. Therefore, no manual change is suggested.

**CHANGE D****Table 1-1:**

Change FREQUENCY MODULATION Incidental AM to <5%.

**Paragraph 4-11, Specification:**

Change Incidental AM to <5%.

**Paragraph 4-11, Procedure:**

Change Step 8 to "Verify the AM measured by the modulation analyzer is <5%."

**Table 4-1:**

Change, under paragraph 4-11, Incidental AM measured level to <5% in the column labeled Maximum.

**Table 6-3:**

A8R21 was originally 31.6K. However, a 28.7K resistor is the recommended replacement. Therefore, no manual change is suggested.

**Service Sheet 10 (Schematic):**

A8R21 was originally 31.6K. However, a 28.7K resistor is the recommended replacement. Therefore, no manual change is suggested.

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**MANUAL CHANGES**

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**CHANGE E**

## Table 6-3:

Change A10R17 and R18 to 0757-0401, CD0, RESISTOR 100 1% 0.125W FTC=0±100, Mfr Code 24546, Mfr Part Number C4-1/8-TO-101-F.

Change MP27 to 08684-20079, CD3, BLOCK-SPRING CARRIER, Mfr Code 28480, Mfr Part Number 08684-20079.

## Service Sheet 12 (Schematic):

Change A10R17 and R18 to 100Ω.

**CHANGE F**

## Table 1-1:

Add, under GENERAL MODULATION SPECIFICATIONS, Simultaneous AM/Pulse and AM/FM/Pulse.

Change footnote 2 to "Amplitude modulation specifications are valid for the LEVEL vernier range of 5 to 15 dB below the maximum vernier setting with output levels at least 5 dB below the specified maximum output power."

## Table 1-2:

Delete the SIMULTANEOUS MODULATION heading and the text that refers to it.

## Table 6-3:

Delete A7C45.

Change A11Q1, Q2, Q3, Q8, Q9 and Q19 to 1884-0012 CD9 THYRISTOR-SCR 2N3528 TO-8 VRRM=200.

## Service Sheet 9 (Schematic):

Delete 0.047 μF capacitor C45.

## Service Sheet 13 (Schematic):

Change, in the table of transistor and integrated circuit part numbers, A11Q1, Q2 and Q8 to 1884-0012.

## Service Sheet 14 (Schematic):

Change, in the table of transistor and integrated circuit part numbers, A11Q3, Q9 and Q19 to 1884-0012.

# SERVICE INFORMATION



## SECTION VIII SERVICE

### 8-1. INTRODUCTION

This section contains information required for troubleshooting and repairing the Signal Generator. It includes block diagrams, schematic diagrams, principles of operation, troubleshooting procedures, and repair procedures.

### 8-2. SERVICE SHEETS

The foldout pages in the last part of this section are the service sheets (SS). They contain block diagrams, schematic diagrams, supplemental diagrams, and associated information.

### 8-3. Block Diagrams

The block diagrams and related service information are found on Service Sheets BD1 and BD2. BD1 is an overall block diagram that shows the major functional sections of the Signal Generator. It serves as an index to the more detailed information on the succeeding Service Sheets, and is the starting point for most troubleshooting procedures. BD2 shows the microwave chain with the cabling and connections to the microcircuit interface.

### 8-4. Schematic Diagrams

The schematic diagrams and their associated information are presented in Service Sheets 1 through 3 and 7 through 14. These diagrams, in functional groupings, are designed to aid in understanding the principles of operation and to aid in troubleshooting the Signal Generator.

### 8-5. SAFETY CONSIDERATIONS

#### 8-6. Before Applying Power

Verify that the instrument is properly set to operate from the available line voltage and that the correct fuse is installed. An uninterrupted safety earth ground must be provided from the main power source to the instrument input wiring terminals, power cord, or supplied power cord set.

#### 8-7. Warnings and Cautions

Pay attention to the **WARNINGS** and **CAUTIONS**. They must be followed for your protection and to avoid damage to the equipment.

### WARNINGS

*Maintenance described herein must be performed with power supplied to the instrument and with protective covers removed. Such maintenance should be performed only by service trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.*

*Any interruption of the protective (grounding) conductor (inside or outside of the instrument) or disconnection of the protective earth terminal will create a potential shock hazard and could result in personal injury. Grounding one conductor of a two-conductor outlet is not sufficient. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative (i.e., secured against unintended operation).*

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

*Capacitors inside the instrument may still be charged even if the instrument is disconnected from the power source.*

*Make sure that only 250 volt normal-blow fuses with the specified current rating are used for replacement. Do not use repaired fuses or short-circuited fuseholders. To do so could create a shock or fire hazard.*

### CAUTIONS

*Some printed circuit boards contain devices that may be damaged if the board is removed or installed while the power is on. Verify that the **LINE** switch is **OFF** or that the power cord is unplugged before you remove or install a printed circuit board.*

*After removing MOS devices from sockets, store the devices with the pins in conductive foam. This will prevent accidental damage from a static discharge. Refer to the notes on each schematic diagram to identify the MOS devices.*

### 8-8. RECOMMENDED TEST EQUIPMENT AND ACCESSORIES

Test equipment and test accessories required to maintain the Signal Generator are listed in Table 1-3, Recommended Test Equipment. Equipment other than that listed may be used if it meets the critical specifications listed.

### 8-9. SERVICE TOOLS, AIDS AND INFORMATION

#### 8-10. Service Tools

Equipment recommended for use when changing components on printed circuit boards is listed in Table 8-1. The following unique service tools will make servicing of this instrument much easier.

**Pozidriv Screwdrivers.** Many screws in the Signal Generator appear to be Phillips type, but they

are not. To avoid damage to the screw heads, Pozidriv screwdrivers should be used. The Pozidriv No. 1 size can be ordered as Hewlett-Packard part number 5710-0899, and the Pozidriv No. 2 size can be ordered as HP part number 8710-0900.

**Tuning Tools.** For adjustments requiring non-metallic tuning tools, use the blade tuning tool HP part number 8710-0033 or hex tuning tool (JFD Model No. 5284) HP part number 8710-1010. For other adjustments, an ordinary small screwdriver is sufficient. No matter which tool is used, never force any adjustment control against its stops. This is especially critical when adjusting variable inductors or capacitors.

**Heat Staking Tool.** The front-panel pushbutton switches have small plastic pins that protrude

Table 8-1. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended	HP Part No.
Soldering Tool	Soldering, Heat Staking	Wattage: 35W Tip Temp.: 390—440°C (735—825°F)	Ungar No. 135 Ungar Division Eldon Ind. Corp. Compton, CA 90220	8690-0167
Soldering Tip	Soldering, Unsoldering	*Shape: Chisel	*Ungar PL113	8690-0007
Soldering Tip	Heat Staking	Shape: Cupped	HP 5020-8160 or modified Ungar PL11	5020-8160
De-Solder Aid	To remove molten solder from connection	Suction Device	Soldapullt by Edsyn Co., Van Nuys, CA 91406	8690-0060
Rosin (flux) Solvent	To remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board.	Freon	8500-0232
Solder	Component replacement; Circuit Board repair wiring	Rosin (flux core, high tin content (63/37 tin/lead), 18 gauge (SWG) 0.048 in. diameter preferred.		8090-0607

\*For working on circuit boards; for general purpose work, use No. 555 Handle (8690-0281) and No. 4037 Heating Unit 47½ — 56½ W (HP 8690-0006); tip temperature of 850 — 900°F; and Ungar No. PL113 ⅛" chisel tip.

**Service Tools (cont'd)**

through the printed circuit board, and the pins are then flattened with a heated tool that softens the plastic. The heat staking tool is a standard soldering iron with a special tip attached.

**8-11. Hardware**

The Signal Generator has a mixture of Unified National (inch) and metric screws. The metric screws are defined by Industrial Fasteners publication (IFI 500) and are identified in the replaceable parts list as metric. Unified National screws have a dull gray appearance and the metric screws have a shiny silver appearance. Do not use a metric screw in a Unified National nut, thread damage will result.

**8-12. Assembly Components and Cable Locations**

Printed circuit board assemblies are numbered sequentially from front to back. For example, A1 is part of the front panel assembly. The locations of individual components on the printed circuit boards and other assemblies are shown on the appropriate Service Sheet. The complete reference designator consists of the assembly designator plus the part designator. For example, A6R9 is resistor R9 on the A6 assembly. For specific component descriptions and ordering information, refer to Table 6-3, Replaceable Parts. Chassis, frame, and other mechanical parts are identified in Figures 6-1 through 6-4.

Major mechanical parts have reference designators that begin with the letters MP. Other mechanical parts such as screws, washers and nuts are listed in the replaceable parts list immediately below the part to which they fasten. To find the part number and description of a mechanical part, find the part in one of the figures in Section VI or Section VIII. The part in the figure will be labeled with its reference designator. Look up the reference designator in the Table of Replaceable Parts. If the part is fastening hardware such as a screw, washer or nut, determine the reference designator of the associated part. The fastening hardware items will be listed immediately below the associated part.

**8-13. Test Point and Adjustment Locations**

Most test points and adjustments are indicated on individual circuit board assemblies. Test points

and adjustments can also be found on the component locator diagrams shown on the appropriate Service Sheet.

**8-14. Service Aids on Printed Circuit Boards**

The service aids on the printed circuit boards include test points, indicator LEDs, reference designators, adjustment names, and assembly part numbers.

**8-15. Other Service Documents**

Service Notes, Manual Changes Supplements, Application Notes, and other service literature are available through Hewlett-Packard. For further information, contact your nearest Hewlett-Packard office.

**8-16. Post-Service Product Safety Checks**

Visually inspect interior of instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy cause of any such condition.

Using a suitable ohmmeter, check resistance from instrument enclosure to ground pin on power cable plug. The reading must be less than one ohm. Flex the power cable while making this measurement to determine whether intermittent discontinuities exist.

Check any indicated front or rear panel ground terminals, using the above procedure.

Check resistance from instrument enclosure to the line and neutral (tied together) with the power switch on and the power source disconnected. The minimum acceptable resistance is two megohms. Replace any component which results in a failure.

**8-17. Etched Circuits (Printed Circuit Boards)**

The etched circuit boards in the Generator have plated-through holes which make a solderable path through to both sides of the insulating material. Soldering can be done from either side of the board with equally good results. When soldering to any circuit board, keep in mind the following recommendations.

1. Avoid unnecessary component substitution. Substitution can result in damage to the circuit board and/or adjacent components.

**Etched Circuits (Printed Circuit Boards) (cont'd)**

2. Do not use a high-power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.
3. Use a suction device or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

**8-18. MOS and CMOS Integrated Circuit Replacement**

MOS and CMOS integrated circuits are used in this instrument. They are prone to damage from both static and transients and must be handled carefully. When working on the Generator, keep in mind the following recommendations to avoid damaging these sensitive components.

1. Do not remove any board unless the Generator has been turned off or unplugged.
2. When removing a socketed MOS or CMOS device from an assembly, be careful not to damage it. High-grip sockets are used throughout the instrument. Avoid removing devices from these sockets with pullers. Instead, use a small screwdriver to pry the device up from one end, slowly pulling it up one row of pins at a time.
3. Once a MOS or CMOS device has been removed from an assembly, immediately stick it into a pad of conductive foam or other suitable holding medium.
4. When replacing a MOS or CMOS device, ground the foam on which it resides to the instrument before removing it. If a device requires soldering, make sure that the assembly is lying on a sheet of conductive foam, and that the foam and soldering iron tip are grounded to the assembly. Apply as little heat as possible.
5. Before turning the instrument off, remove any large ac sources which may be driving MOS switches.

**8-19. LOGIC SYMBOLOGY**

The logic symbols used in this manual are based on the American National Standard Institute (ANSI) Y32.14-1973, "Graphic Symbols for Logic

Diagrams (Two State Devices)". A summary of this symbology is provided here and in Table 8-2, Schematic Diagram Notes, to aid in interpreting these symbols.

**8-20. Qualifiers**

Qualifiers are that portion of a device symbol that denotes the logic function. For example, "&" denotes the AND function. See Figure 8-1 for a summary of the basic logic symbols and their qualifiers.

Power supply and ground connections are not shown on the symbols. This information is tabulated on the right margins of the service sheets.

**8-21. Indicator Symbols**

Indicator symbols identify the active state of a device's input or output, as shown in Figure 8-2.

**8-22. Contiguous Blocks**

Two symbols may share a common boundary parallel or perpendicular to the direction of signal flow. Note that in the examples shown in Figure 8-3, there is generally no logic connection across a horizontal line, but there is always an implied logic connection across a vertical line. Notable exceptions to this rule are the horizontal lines beneath control blocks and between sections of shift registers and counters (dividers).

**8-23. Dependency Notation**

Dependency Notation simplifies symbols for complex integrated circuit elements by defining the interdependencies of inputs or outputs without actually showing all the elements and interconnections involved (see Figures 8-4 through 8-6). The following examples use the letter A for address, C for control, G for AND, V for OR, and F for free dependencies. The dependent input or output is labeled with a number that is either prefixed (e.g. 1X) or subscripted (e.g., X<sub>1</sub>). They both mean the same thing. Note that many times a controlled line may already be labeled with a number that indicates input or output weighting (for example, in a coder). In this case, the controlling or gating input will be labeled with a letter (see Figure 8-6).

**8-24. Common Control Block**

The control block is used in conjunction with an array of related symbols in order to group common logic lines. Figure 8-7 shows how the control block is usually represented. Figure 8-8 shows a quad

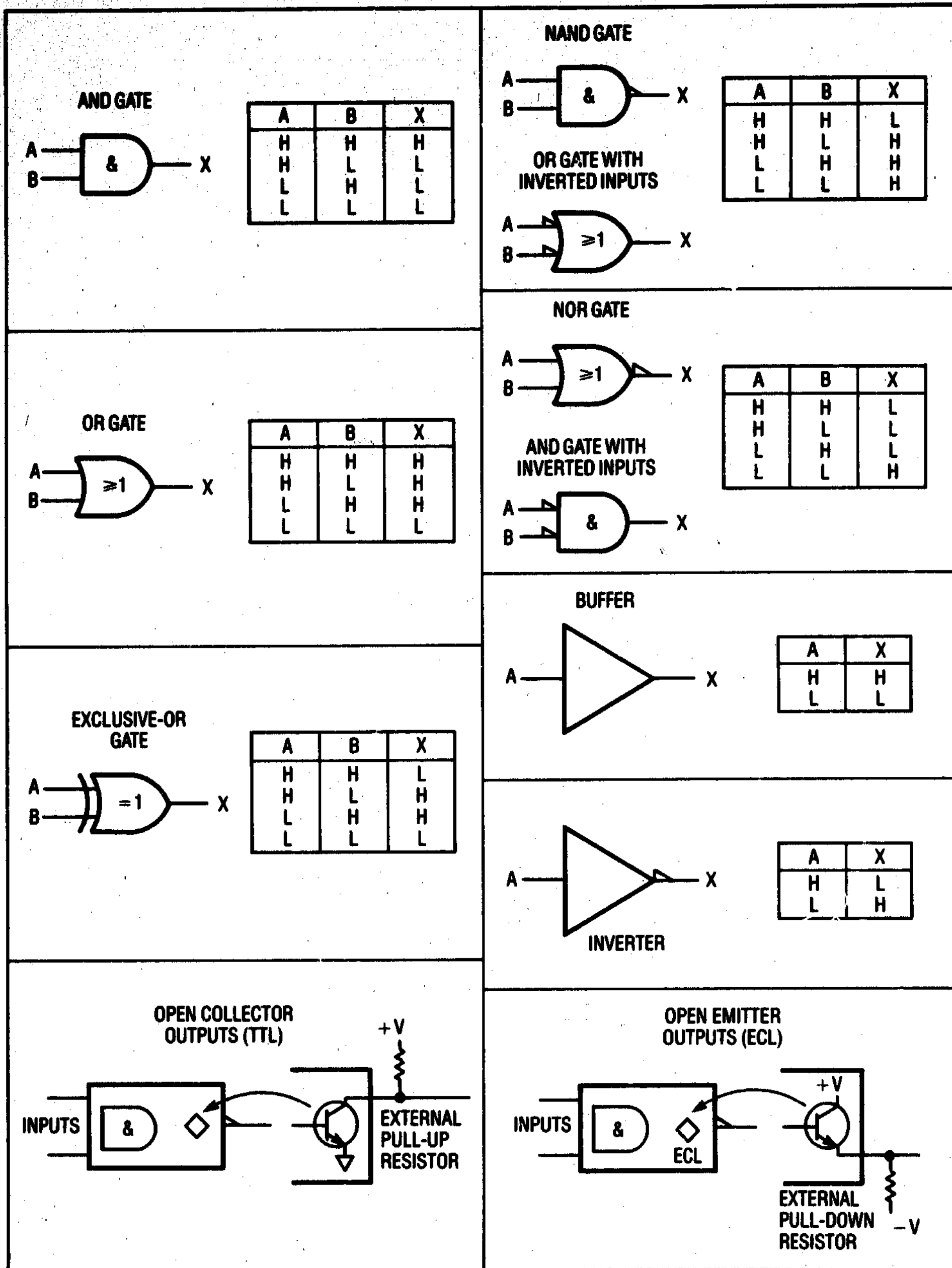


Figure 8-1. Basic Logic Symbols and Qualifiers

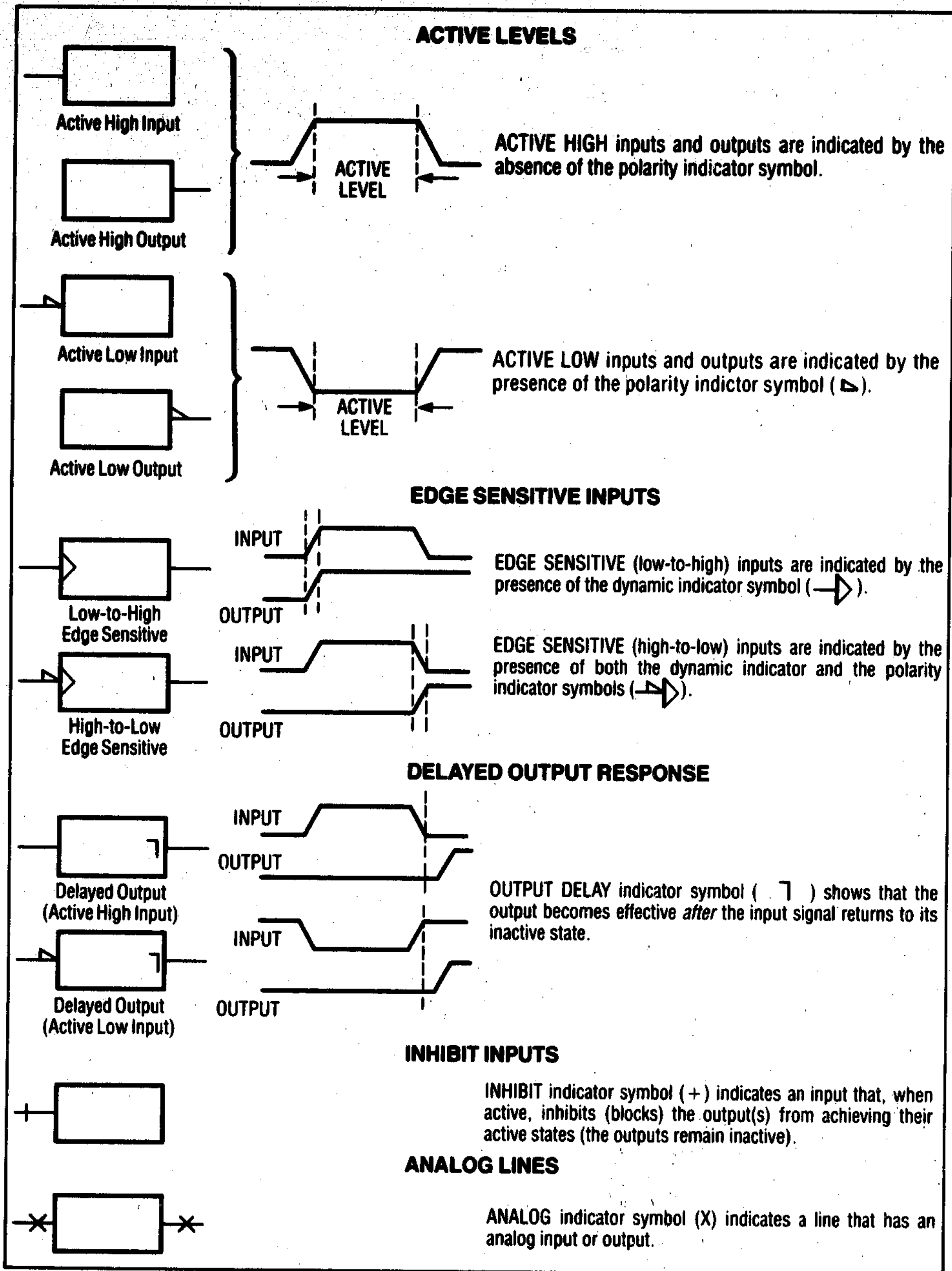


Figure 8-2. Indicator Symbols

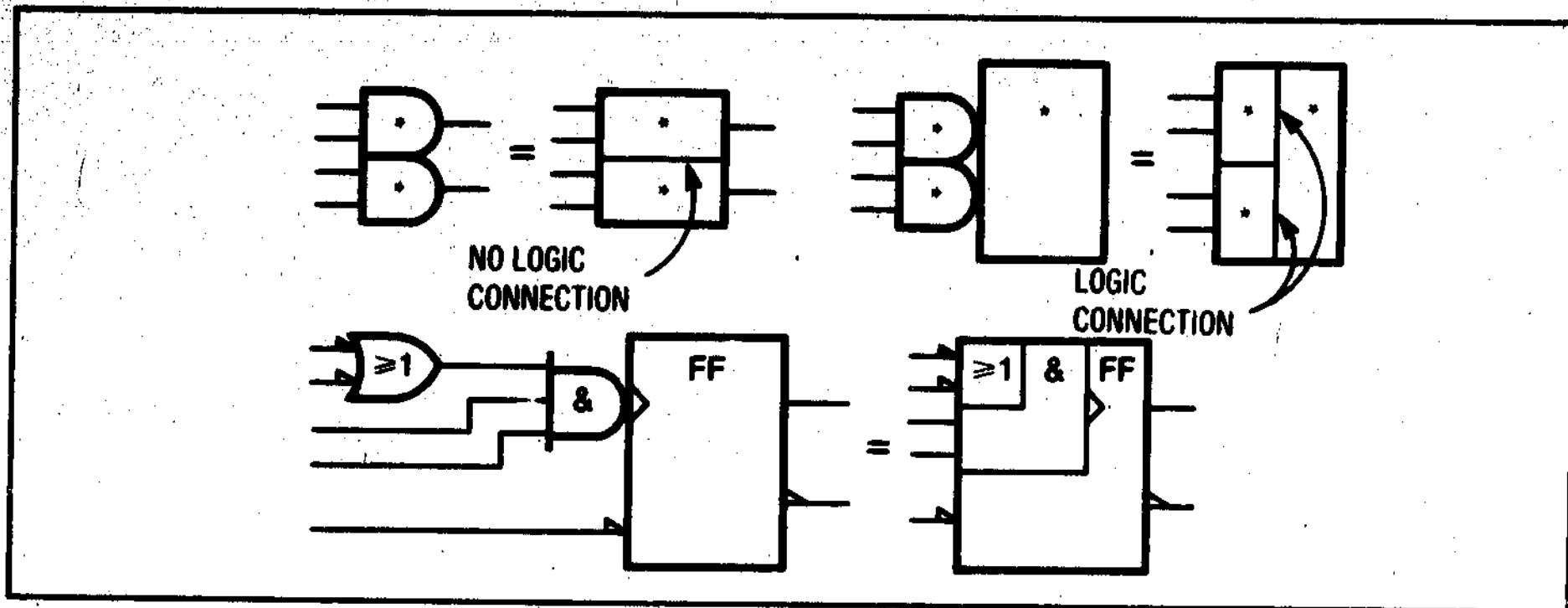


Figure 8-3. Contiguous Blocks

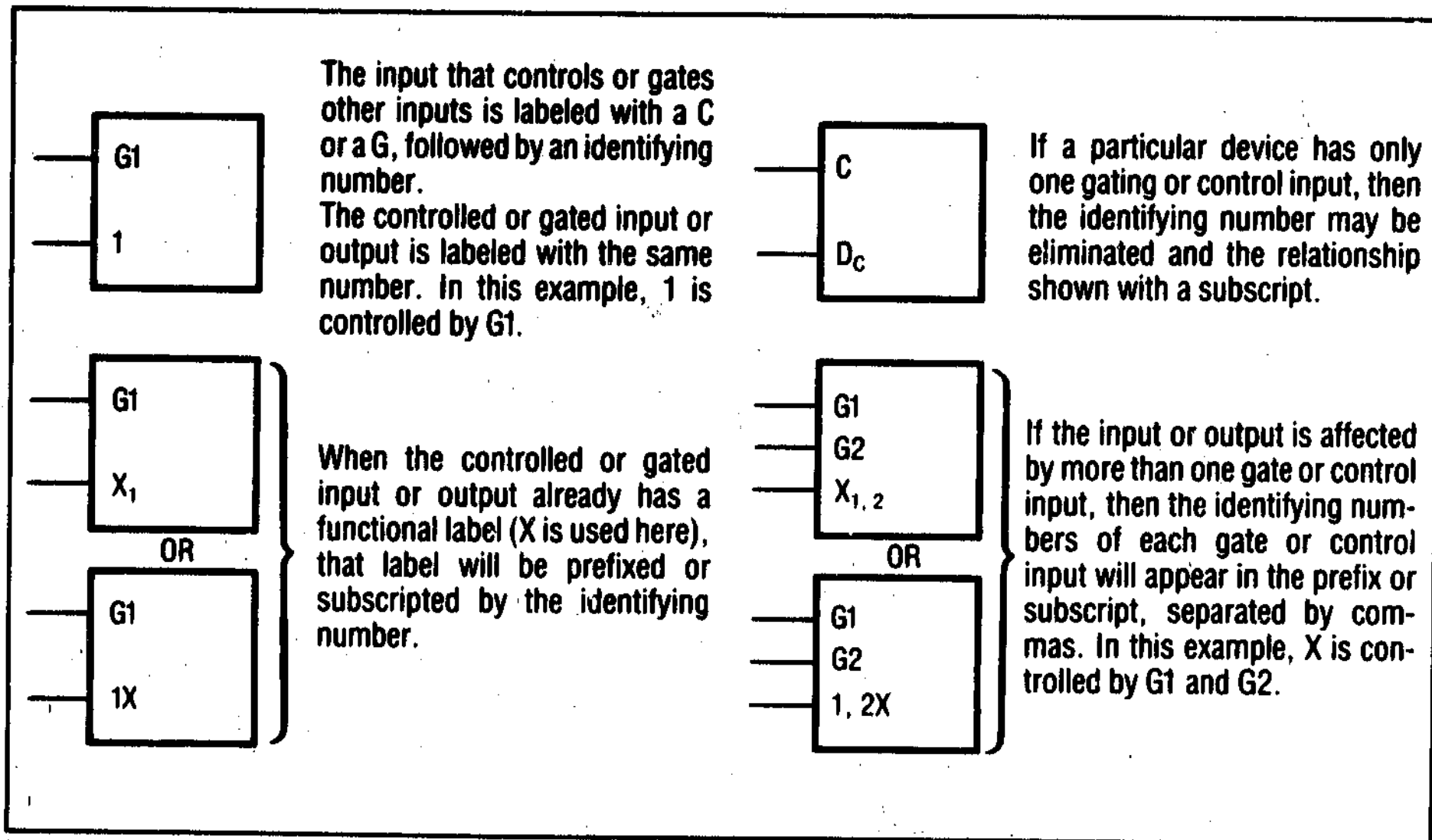


Figure 8-4. AND Dependency Notation

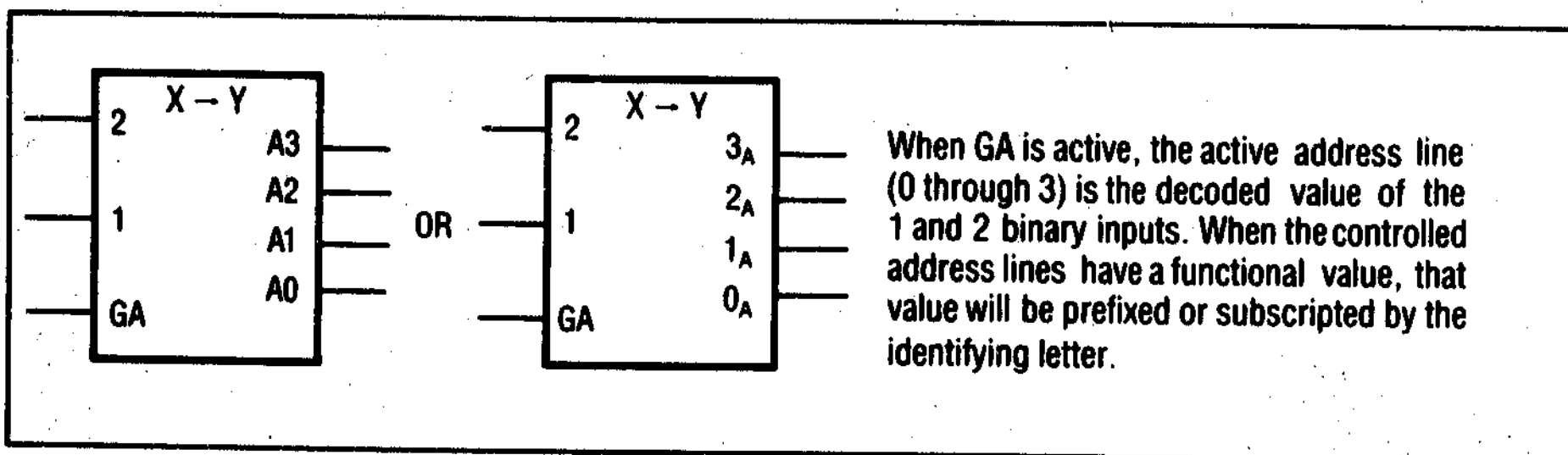


Figure 8-5. Address Dependency Notation: Coder Example Using Alpha Characters (Letters)

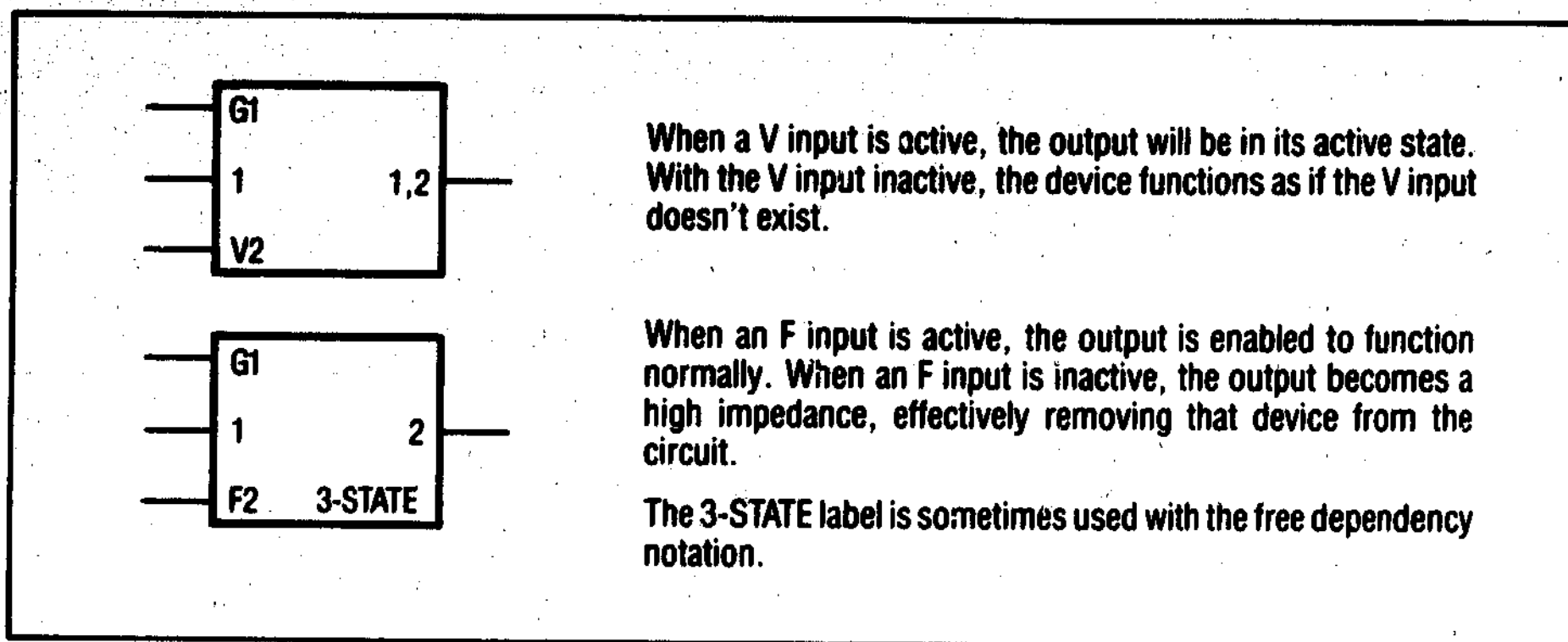


Figure 8-6. OR and Free Dependency Notation

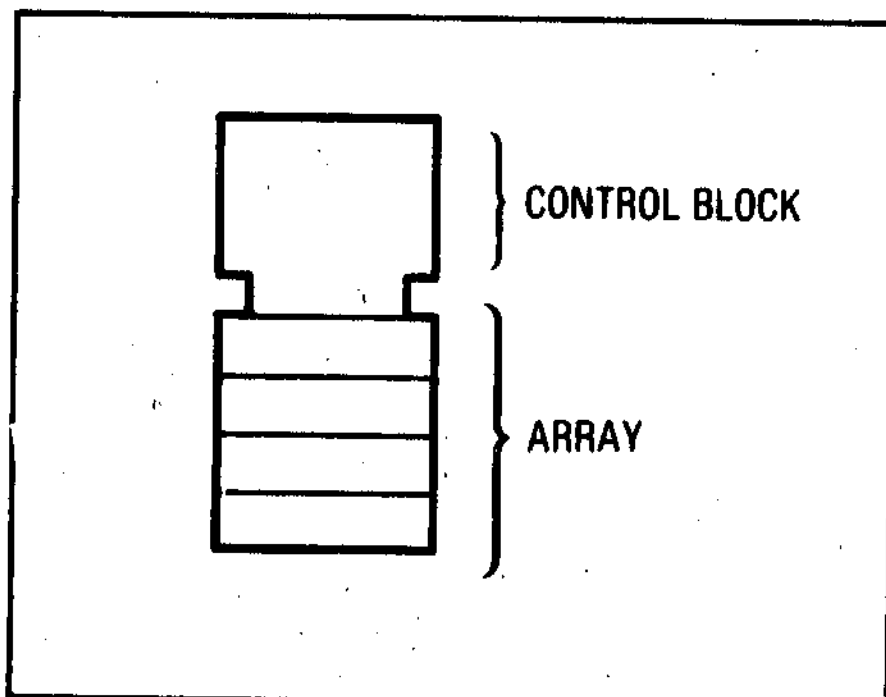


Figure 8-7. Common Control Block

**Common Control Block (cont'd)**

D-type flip flop with reset. This can be redrawn as shown in Figure 8-9. Note that the more complex representation shown in Figure 8-8 can be used when the flip flops are functionally scattered around the schematic (i.e., not used as a quad unit).

**8-25. LINEAR DEVICE THEORY**

**8-26. Operational Amplifiers**

The source of gain in an operational amplifier can be characterized as an ideal, differential voltage amplifier having low output impedance, high input impedance, and very high differential gain. The output of an operational amplifier is proportional to the difference in the voltages applied to

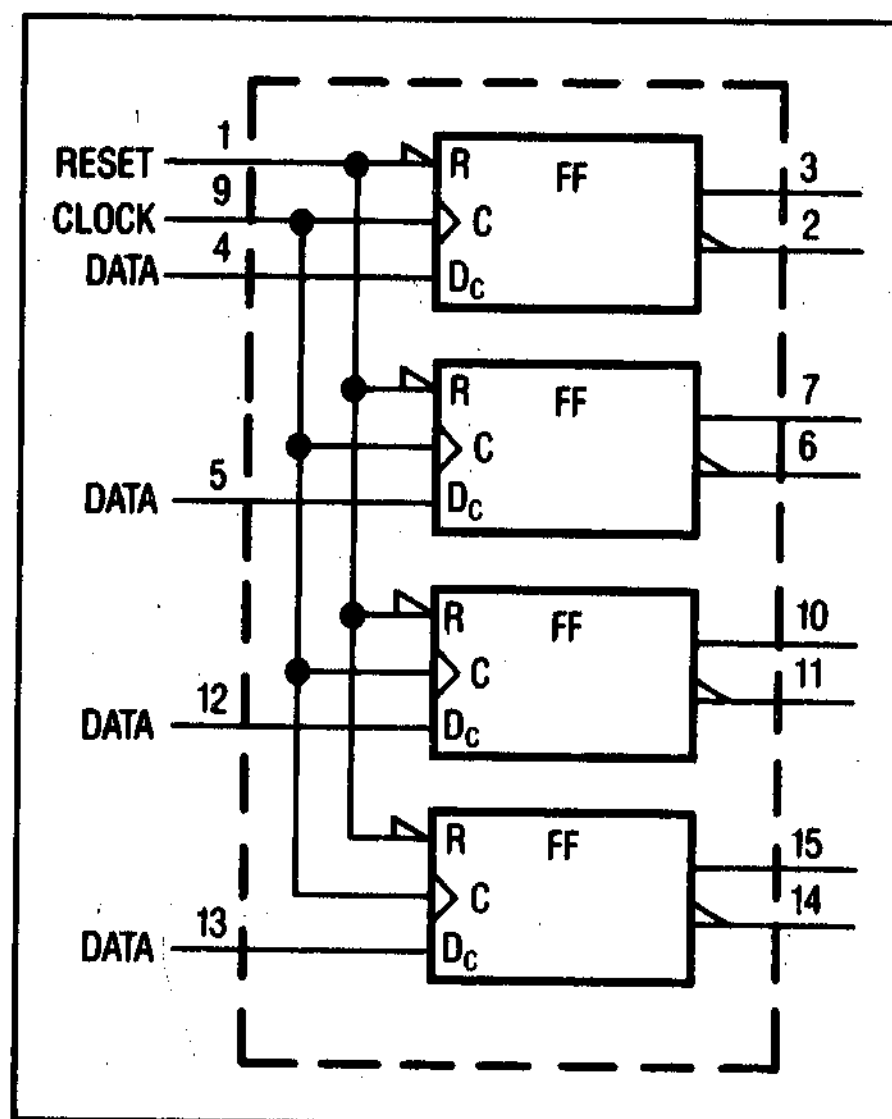


Figure 8-8. Quad D-Type Latch (Individual)

the two input terminals. In use, the amplifier output drives the input voltage difference close to zero through a feedback path.

When troubleshooting an operational amplifier circuit, measure the voltages at the two inputs; the difference between these voltages should be less than 10 mV. (Note: this troubleshooting procedure



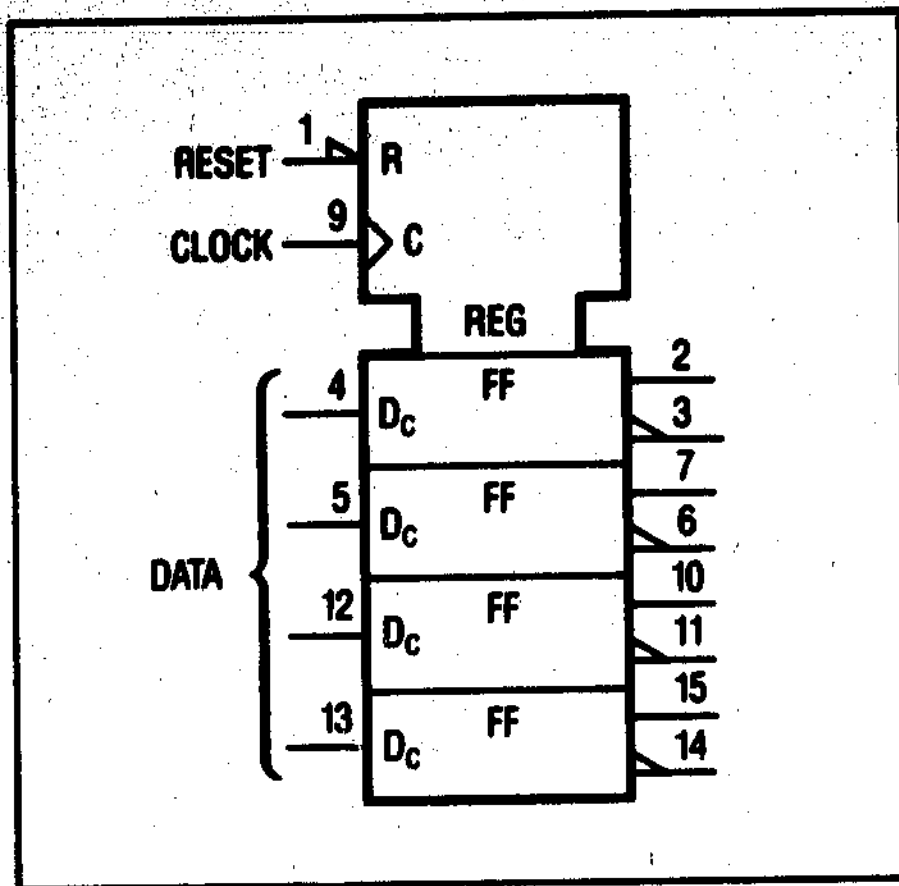


Figure 8-9. Quad D-Type Latch (Combined)

**Operational Amplifiers (cont'd)**

will not work for operational amplifiers which are configured as comparators.) A difference voltage much greater than 10 mV indicates trouble in the amplifier or its external circuitry. Usually, this difference will be several volts and one of the inputs will be very close to one of the supply voltages (e.g., +15V or -15V).

Next, check the amplifier's output voltage. It will probably also be close to one of the supply voltages (e.g. ground, +15V or -15V). Check to see that the output conforms to the inputs. For example, if the inverting input is more positive than the non-inverting input, the output should be negative; if the non-inverting input is more positive than the inverting input, the output should be positive. If the output conforms to the inputs, check the amplifier's external circuitry. If the amplifier's output does not conform to its inputs, it is probably defective.

Figures 8-10 through 8-14 show typical operational amplifier configurations. Figure 8-10 shows a non-inverting buffer amplifier with gain of 1. Figure 8-11 is a non-inverting amplifier with gain determined by R1 and R2. Figure 8-12 is an inverting amplifier with a gain determined by R1 and R2.

**8-27. Comparators**

Comparators are used as level sense amplifiers, switch drivers, pulse height discriminators, and

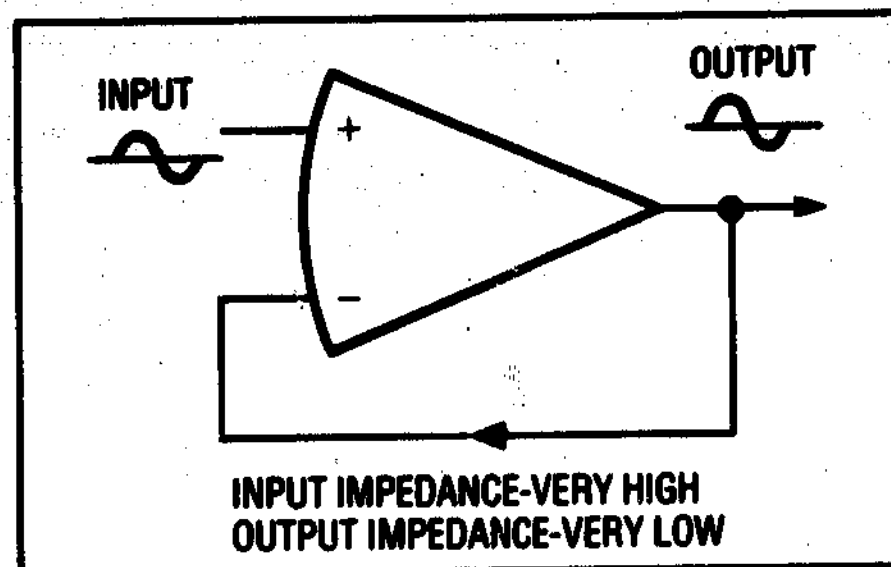


Figure 8-10. Non-Inverting Amplifier (Gain = 1)

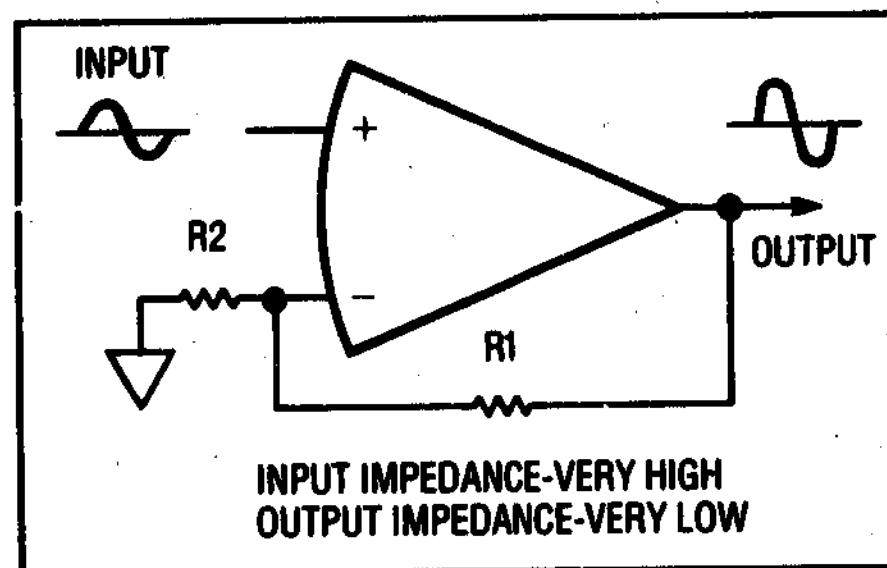


Figure 8-11. Non-Inverting Amplifier (Gain = 1 + R1/R2)

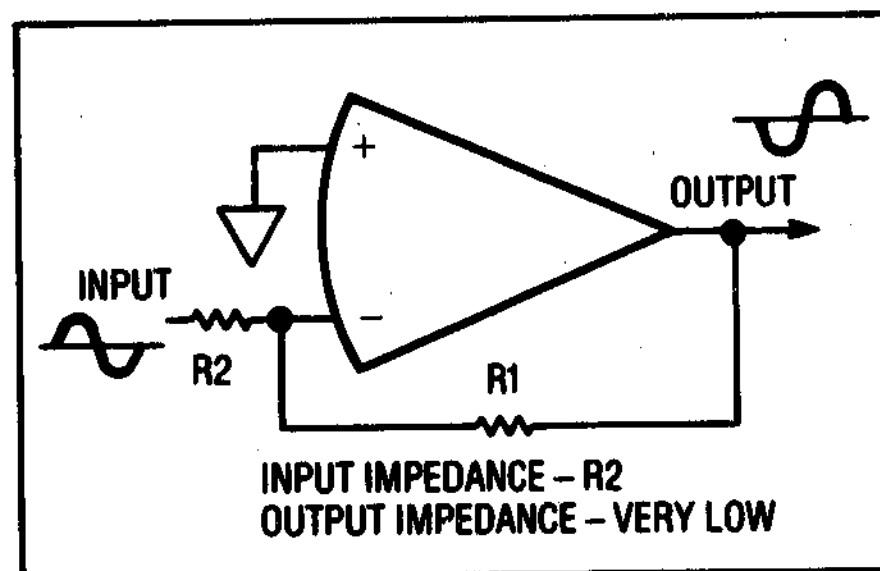


Figure 8-12. Inverting Amplifier (Gain = -R1/R2)

voltage comparators. A voltage reference is connected to one of the amplifier's outputs as shown in Figures 8-13 and 8-14. When the input signal voltage crosses the reference, the output goes positive; the output remains positive until the signal re-crosses the reference.

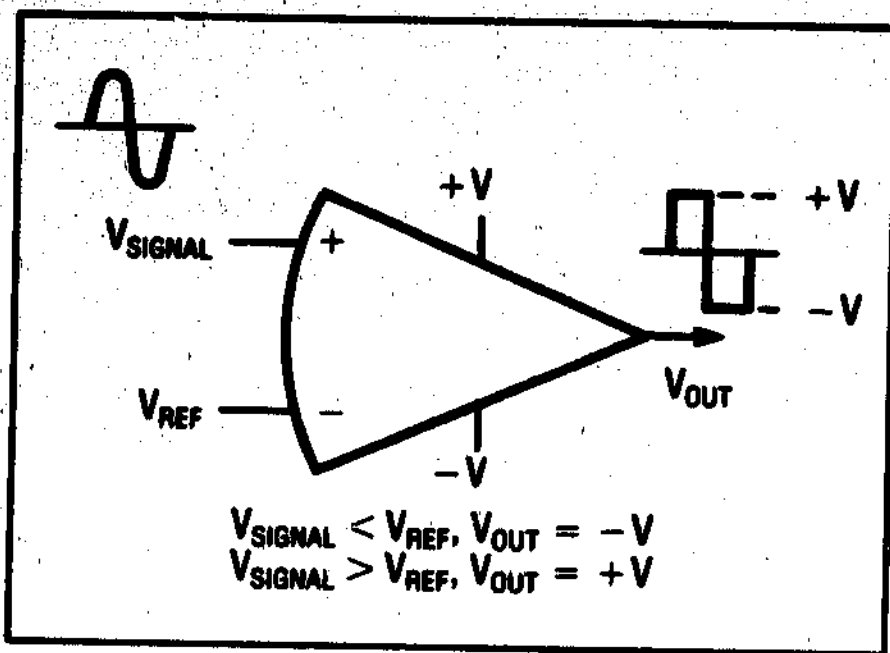


Figure 8-13. Non-Inverting Comparator

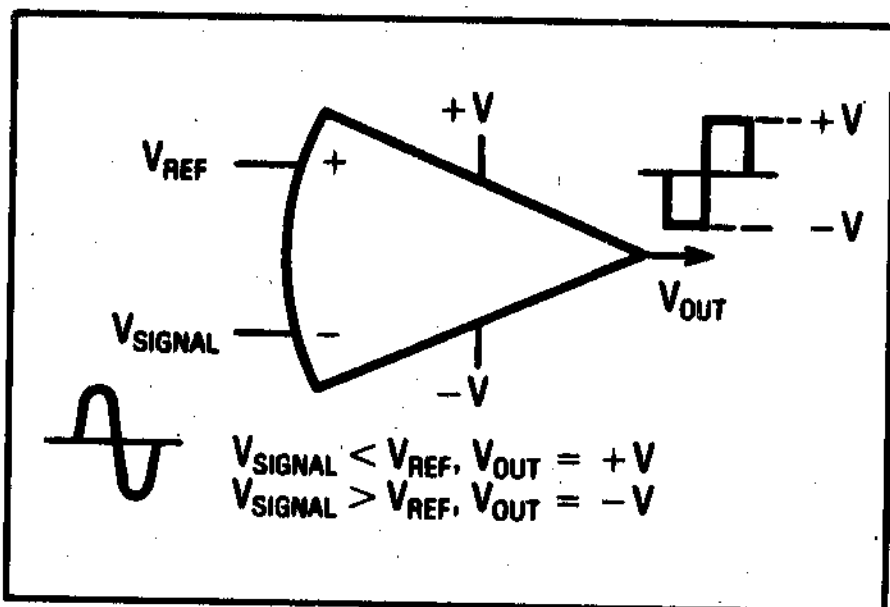


Figure 8-14. Inverting Comparator

**8-28. Limiter (Transistor Array)**

The limiter shown in Figure 8-15 is simply a transistor array in a differential amplifier configuration. Its limiting characteristic is a function of its external biasing. The figure shows two of the common biasing arrangements and the internal circuitry of the device. The minus sign at pin 8 indicates signal inversion relative to the input. The plus sign at pin 5 (or the omission of the minus sign) indicates non-inversion.

**8-29. SCHEMATIC DIAGRAM NOTES**

Table 8-2 summarizes the symbology used in presenting many of the devices on the schematics.

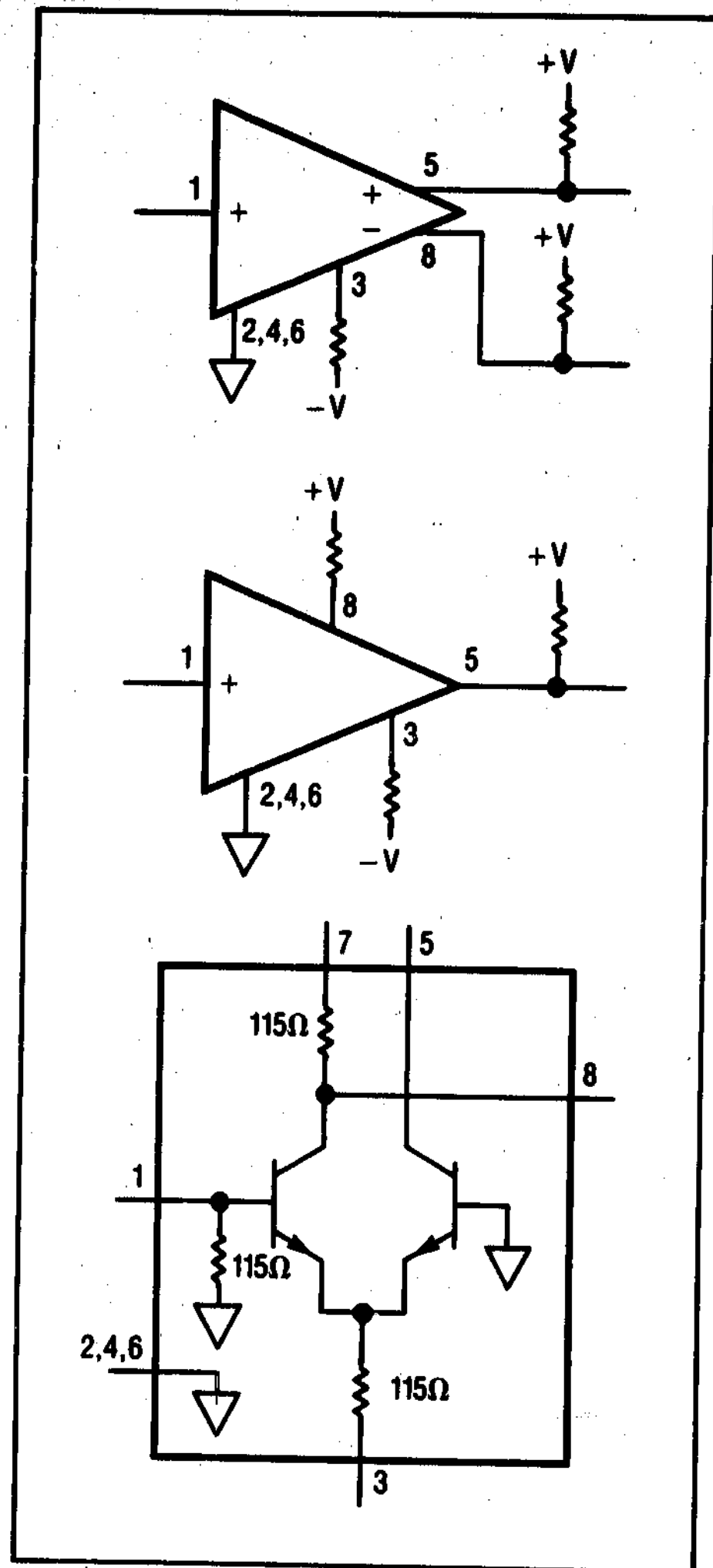


Figure 8-15. Limiter (Transistor Array)

Table 8-2. Schematic Diagram Notes (1 of 8)

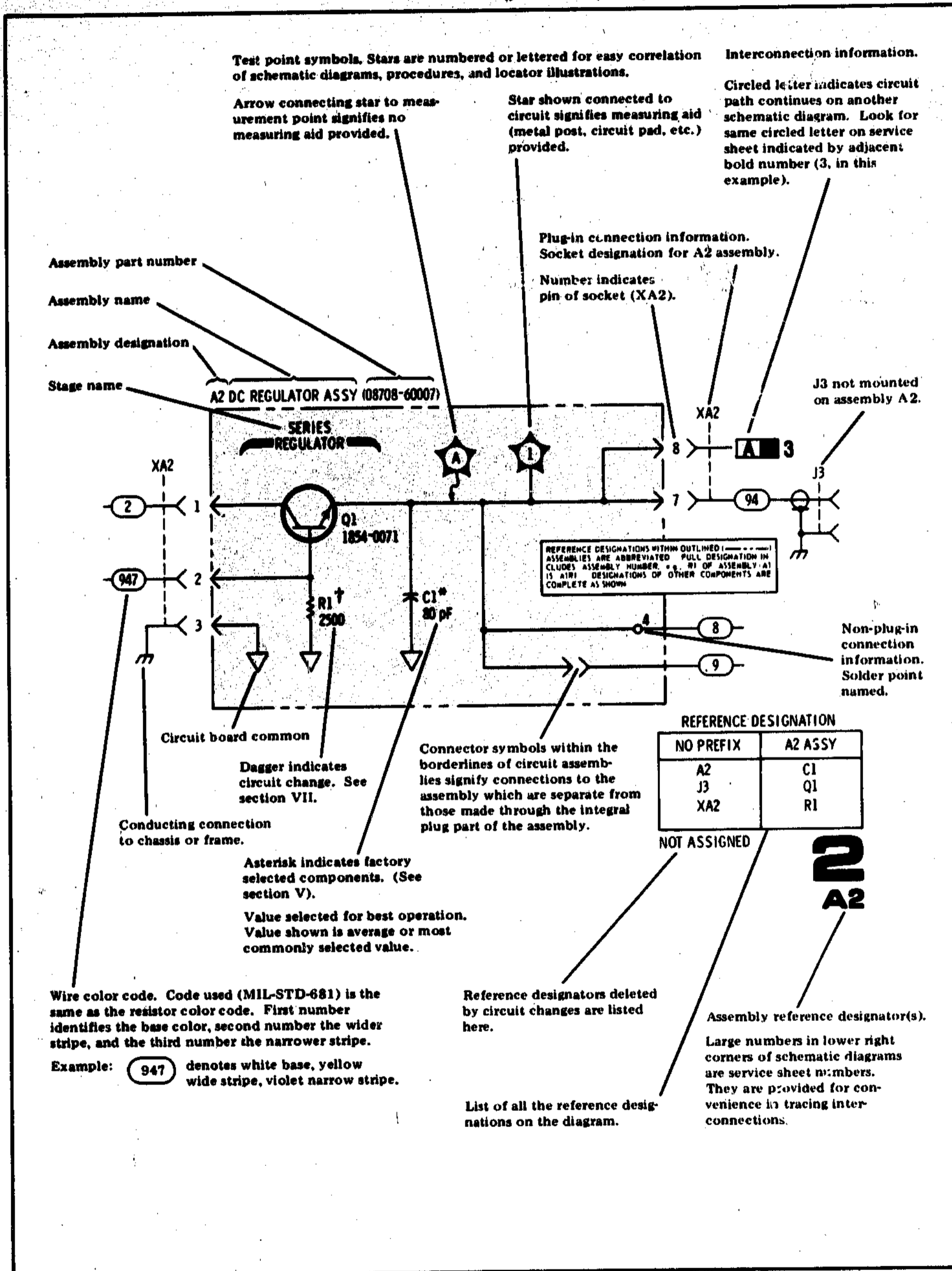


Table 8-2. Schematic Diagram Notes (2 of 8)

**SCHEMATIC DIAGRAM NOTES**

*	Asterisk denotes a factory-selected value. Value shown is typical.
†	Dagger indicates circuit change. See Section VII.
◐	Tool-aided adjustment.
○	Manual control.
▭	Encloses front-panel designation.
▭ (dashed)	Encloses rear-panel designation.
— — — — —	Circuit assembly borderline.
- - - - -	Other assembly borderline.
—→—	Heavy line with arrows indicates path and direction of main signal.
- - - - -→	Heavy dashed line with arrows indicates path and direction of main feedback.
—→	Indicates stripline (i.e., RF transmission line above ground).
↻ CW	Wiper moves toward cw with clockwise rotation of control (as viewed from shaft or knob).
①	Numbered Test Point measurement aid provided.
0	Encloses wire or cable color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider stripe, and the third number identifies the narrower stripe, e.g., denotes white base, yellow wide stripe, violet narrow stripe.
⊥	A direct conducting connection to earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea, or land vehicle).
↻	A conducting connection to a chassis or frame.
▽	Common connections. All like-designation points are connected.
[AK] 12	Letters = off-page connection, e.g., [AK] Number = Service Sheet number for off-page connection, e.g., 12
① THIS PAGE	Number (only) = on-page connection.

Table 8-2. Schematic Diagram Notes (3 of 8)

**SCHEMATIC DIAGRAM NOTES**



Indicates multiple paths represented by only one line. Letters or names identify individual paths. Numbers indicate number of paths represented by the line.



Coaxial or shielded cable.



Relay. Contact moves in direction of arrow when energized.



Indicates a pushbutton switch with a momentary (ON) position.



Indicates a PIN diode.



Indicates a current regulation diode.



Indicates a voltage regulation diode.



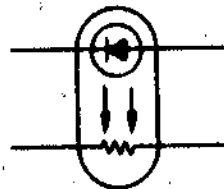
Indicates a Schottky (hot-carrier) diode.



Multiple transistors in a single package—physical location of the pins is shown in package outline on schematic.



Identification of logic families as shown (in this case, ECL).

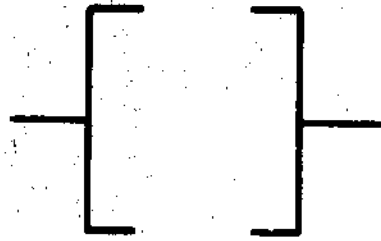


Indicates an opto-isolator of a LED and a photoresistor packaged together. The resistance of the photoresistor is a function of the current flowing through the LED.

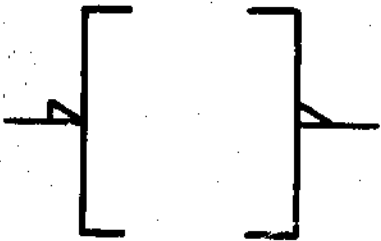
Table 8-2. Schematic Diagram Notes: (4 of 8)

**DIGITAL SYMBOLOGY REFERENCE INFORMATION**

**Input and Output Indicators**



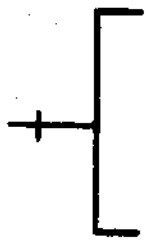
**Implied Indicator**—Absence of polarity indicator (see below) implies that the active state is a relative high voltage level. Absence of negation indicator (see below) implies that the active state is a relative high voltage level at the input or output.



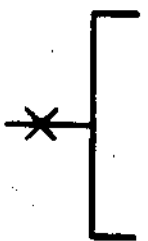
**Polarity Indicator**—The active state is a relatively low voltage level.



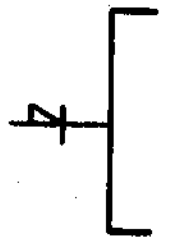
**Dynamic Indicator**—The active state is a transition from a relative low to a relative high voltage level.



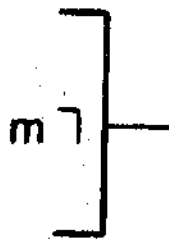
**Inhibit Input**—Input that, when active, inhibits (blocks) the active state outputs of a digital device.



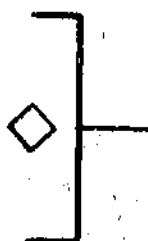
**Analog Input**—Input that is a continuous signal function (e.g., a sine wave).



**Polarity Indicator used with Inhibit Indicator**—Indicates that the relatively low level signal inhibits (blocks) the active state outputs of a digital device.



**Output Delay**—Binary output changes state only after the referenced input (m) returns to its inactive state (m should be replaced by appropriate dependency or function symbols).



**Open Collector Output**—Output that must form part of a distributed connection.

Table 8-2. Schematic Diagram Notes (5 of 8)

**DIGITAL SYMBOLOGY REFERENCE INFORMATION**

**Input and Output Indicators (Cont'd)**

3-STATE

Three-state Output—Indicates outputs that can have a high impedance (disconnect) state in addition to the normal binary logic states.

**Combinational Logic Symbols and Functions**



AND—All inputs must be active for the output to be active.



OR—One or more inputs being active will cause the output to be active.



Logic Threshold—m or more inputs being active will cause the output to be active (replace m with a number).



EXCLUSIVE OR—Output will be active when one (and only one) input is active.



m and only m—Output will be active when m (and only m) inputs are active (replace m with a number).



Logic Identity—Output will be active only when all or none of the inputs are active (i.e., when all inputs are identical, output will be active).



Amplifier—The output will be active only when the input is active (can be used with polarity or logic indicator at input or output to signify inversion).

X/Y

Signal Level Converter—Input level(s) are different than output level(s).



Bilateral Switch—Binary controlled switch which acts as an on/off switch to analog or binary signals flowing in both directions. Dependency notation should be used to indicate affecting/affected inputs and outputs. Note: amplifier symbol (with dependency notation) should be read to indicate unilateral switching.

X-Y

Coder—Input code (X) is converted to output code (Y) per weighted values or a table.

(Functional Labels)

The following labels are to be used as necessary to ensure rapid identification of device function.

MUX

Multiplexer—The output is dependent only on the selected input.

DEMUX

Demultiplexer—Only the selected output is a function of the input.

CPU

Central Processing Unit

PIO

Peripheral Input/Output

SMI

Static Memory Interface

Table 8-2. Schematic Diagram Notes (6 of 8)

## DIGITAL SYMBOLOGY REFERENCE INFORMATION

## Sequential Logic Functions

1 

**Monostable**—Single shot multivibrator. Output becomes active when the input becomes active. Output remains active (even if the input becomes inactive) for a period of time that is characteristic of the device and/or circuit.

G 

**Oscillator**—The output is a uniform repetitive signal which alternates between the high and low state values. If an input is shown, then the output will be active if and only if the input is in the active state.

FF

**Flip-Flop**—Binary element with two stable states, set and reset. When the flip-flop is set, its outputs will be in their active states. When the flip-flop is reset, its outputs will be in their inactive states.

T

**Toggle Input**—When active, causes the flip-flop to change states.

S

**Set Input**—When active, causes the flip-flop to set.

R

**Reset Input**—When active, causes the flip-flop to reset.

J

**J Input**—Analogous to set input.

K

**K Input**—Analogous to reset input.

D

**Data Input**—Always enabled by another input (generally a C input—see Dependency Notation). When the D input is dependency-enabled, a high level at D will set the flip-flop; a low level will reset the flip-flop. Note: strictly speaking, D inputs have no active or inactive states—they are just enabled or disabled.

m

**Count-Up Input**—When active, increments the contents (count) of a counter by "m" counts (m is replaced with a number).

-m

**Count-Down Input**—When active, decrements the contents (count) of a counter by "m" counts (m is replaced with a number).

→ m

**Shift Right (Down) Input**—When active, causes the contents of a shift register to shift to the right or down "m" places (m is replaced with a number).

← m

**Shift Left (Up) Input**—When active, causes the contents of a shift register to shift to the left or up "m" places (m is replaced with a number).

## NOTE

*For the four functions shown above, if m is one, it is omitted.*

(Functional Labels)

The following functional labels are to be used as necessary in symbol build-ups to ensure rapid identification of device function.



Table 8-2. Schematic Diagram Notes (7 of 8)

**DIGITAL SYMBOLOGY REFERENCE INFORMATION****Sequential Logic Functions (Cont'd)**

mCNTR	Counter—Array of flip-flops connected to form a counter with modulus m (m is replaced with a number that indicates the number of states: 5 CNTR, 10 CNTR, etc.).
REG	Register—Array of unconnected flip-flops that form a simple register or latch.
SREG	Shift Register—Array of flip-flops that form a register with internal connections that permit shifting the contents from flip-flop to flip-flop.
ROM	Read Only Memory—Addressable memory with read-out capability only.
RAM	Random Access Memory—Addressable memory with read-in and read-out capability.

**Dependency Notation**

mAm	Address Dependency—Binary affecting inputs of affected outputs. The m prefix is replaced with a number that differentiates between several address inputs, indicates dependency, or indicates demultiplexing and multiplexing of address inputs and outputs. The m suffix indicates the number of cells that can be addressed.
Gm	Gate (AND) Dependency—Binary affecting input with an AND relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or letter (the identifier).
Cm	Control Dependency—Binary affecting input used where more than a simple AND relationship exists between the C input and the affected inputs and outputs (used only with D-type flip-flops).
Vm	OR Dependency—Binary affecting input with an OR relationship to those inputs or outputs labeled with the same identifier. The m is replaced with a number or the letter (the identifier).
Fm	Free Dependency—Binary affecting input acting as a connect switch when active and a disconnect when inactive. Used to control the 3-state behavior of a 3-state device.

**NOTE**

*The identifier (m) is omitted if it is one—that is, when there is only one dependency relationship of that kind in a particular device. When this is done, the dependency indicator itself (G, C, F, or V) is used to prefix or suffix the affected (dependent) input or output.*

Table 8-2. Schematic Diagram Notes (8 of 8)

**DIGITAL SYMBOLOGY REFERENCE INFORMATION****Miscellaneous**

**Schmitt Trigger**—Input characterized by hysteresis; one threshold for positive going signals and a second threshold for negative going signals.

**Active**

**Active State**—A binary physical or logical state that corresponds to the true state of an input, an output, or a function. The opposite of the inactive state.

**Enable**

**Enabled Condition**—A logical state that occurs when dependency conditions are satisfied. Although not explicitly stated in the definitions listed above, functions are assumed to be enabled when their behavior is described. A convenient way to think of it is as follows:

A function becomes active when:

- it is enabled (dependency conditions—if any—are satisfied)
- and its external stimulus (e.g., voltage level) enters the active state.

**8-30. DIAGNOSTICS**

The diagnostic mode is enabled with the switch on top of the microprocessor board A9. In the "DIAG" position, 39 processes are performed. The test number (0-38) is shown in the modulation display. To index through the tests, four keys are used. Two keys index by 1's and two keys index by 10's. Holding down these keys will cause the test number to change until the key is released. The keys are summarized in Figure 8-16.

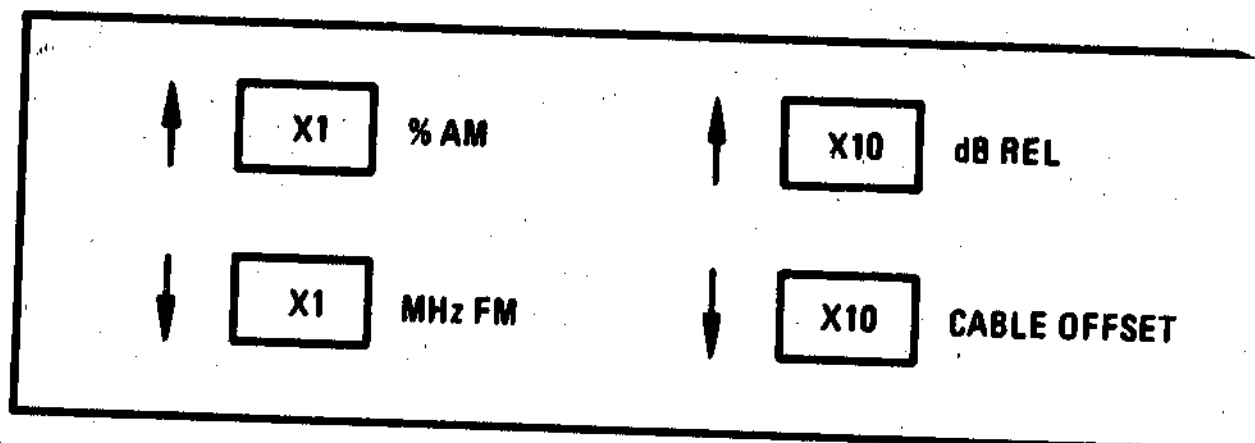


Figure 8-16. Diagnostic Indexing Keys

If a negative sign flashes to the left of the test number, then the voltage is out of specification for that test.

The test results are displayed in the frequency digits. Negative voltages are represented by a second decimal point flashing in the frequency digits. Displayed resolution is 10 mV.

Test results also can be displayed on a data terminal via the RS 232 type of interface. (See "Connecting an HP 8683A/B or HP 8684A/B to a data terminal for display of diagnostic data" in this section.) An example is:

$$+15V = 14.94$$

which means the 15 volt power supply measures 14.94 volts.

Tests 0 through 28 are the individual voltage measurement tests that are in the same order as Test 29. For example, Test 0 is "+5V.d", Test 1 is "+6.2V<sub>ref</sub>", etc. (see the summary in Table 8-4).

Test 29 sends the results of Tests 0 through 28 to the RS-232 port. It displays all the voltages listed under their related functional headings (modulation, power supplies, etc.) Voltages that are out of specification are underlined or shown in inverse video on the terminal screen.

Test 30 displays in the frequency digits: "-OP-" which stands for "Output Flip Flop Testing". If any of the flip flops A8, U6, U15; A9U13, U14 are out of spec, the "-OP-" will disappear and "8 15", for example, will appear if A8, U15 flip flop(s) are out of spec. On a terminal, the results of 32 flip flops are displayed and if any of them are out of spec, the voltage is underlined (or shown in inverse video). The voltage displayed is the change in voltage for each flip flop going from a "0" to a "1" as measured by I/O channel "Ladder 1". Table 8-3 shows an example of what is seen on the terminal.

Table 8-3. Typical Text Displayed on Terminal Screen for Diagnostic Test 30

A#	BIT	0	1	2	3	4	5	6	7
8	U6	04.16	04.32	04.32	04.32	04.32	04.16	04.16	04.32
8	U15	04.16	04.32	04.32	03.52	04.32	04.16	04.16	04.16
9	U13	04.16	04.16	04.16	04.48	03.84	03.68	04.16	04.16
9	U14	04.00	03.52	04.16	04.16	04.16	04.16	04.16	03.84

Table 8-4. Summary of Diagnostic Tests 0-28

Frequency Digits Measure <sup>1</sup> (10 mV resolution)	Test Number (modulation window)	Power-up Error Codes	XAS Pin Number <sup>2</sup>
+5 volt power supply	00	E50	A3, 21
+6.2 volt ALC reference A7 TP2	01	E54	B1
+6.5 volt microwave power supply	02	E55	A28
+15 volt power supply	03	E51	A7
-15 volt power supply	04	E52	A32
-30 volt power supply	05	E53	A36
Oscillator "high" power	06	E57	A6
Oscillator "low" power	07	E56	A16
Attenuator potentiometer on front panel	08		A27
Level potentiometer on front panel	09		B20
Detector, differential on A6	10	E59	A8
Detector, amplifier on A6	11	E58	A11
Pin modulator voltage, A5TP4	12	E61	A29
Multiplier DAC, ALC: A7U5, pin 8	13	E60	A30
Cable offset on rear panel	14		A12
Frequency (linearized): A8TP4	15		TP4
#1 frequency potentiometer, lower 1/3	16	E62	N/C
#2 frequency potentiometer, middle 1/3	17	E63	N/C
#3 frequency potentiometer, upper 1/3	18	E64	N/C
AM "+" peak detector: A7U4 pin 7	19		A31
AM "-" peak detector: A7U4 pin 14	20		A10
FM "+" peak detector: A10TP5	21		A26
FM "-" peak detector: A10TP6	22		A24
FM varactor diagnostic XA10 pin 24	19		B19
Sample & hold out A8U11, pin 1	24		N/C
Ground, analog	25	E65	B2
LADDER 1: Test A8 U6, 15; A9U13, 14	26		B22, 23
LADDER 2: Test A1 U5, U21, U22	27		A17
Push to lock: future use	28		A35

<sup>1</sup>Negative voltages flash the decimal point to the left of the fixed decimal point.  
<sup>2</sup>Out of spec voltages flash the "-" sign just to the left of the displayed test number.

**DIAGNOSTICS (cont'd)**

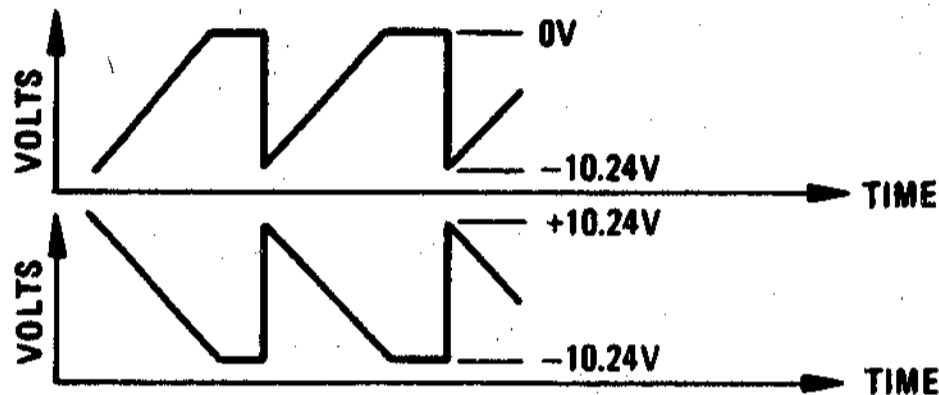
Test 31 displays in the frequency digits “—00—”, then “—11—”, which signifies that the flip flops A8(U5, U6, U14, U15) A9(U13 and U14) are exercised from zero's to one's. Relays are exercised during this test, so do not leave it in this test any longer than required. Note in this test, as in all other tests, the state can be momentarily frozen by pressing any “lower key” (not: %AM, MHz FM, dB REL, or CABLE OFFSET).

Test 32 flashes all key LEDs, decimal points (except the Level decimal point), and sequences all displays from 0's to 9's, —'s, E's, H's, L's, P's and (Blank)'s. Pressing a “lower key” will freeze the action for viewing. Note that the dBm key LED is inverted in relation to the other key LEDs.

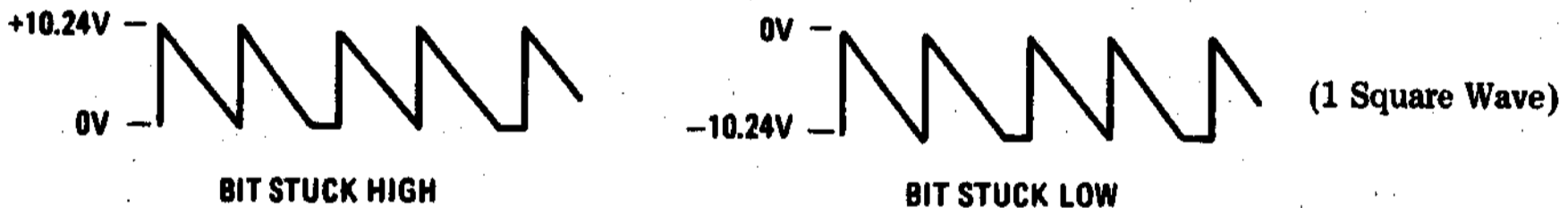
Test 33 sweeps the DAC on two test points:

A8, TP5 from -10.24V to 0V:

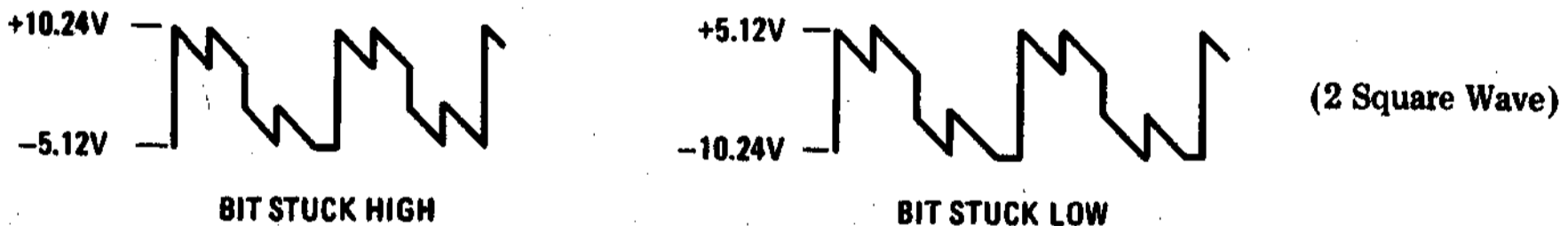
A8, TP6 from -10.24V to +10.24V:



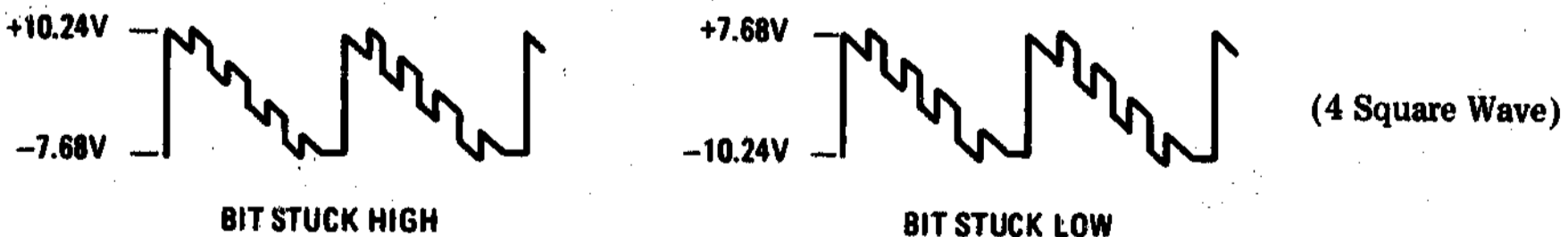
The above two tests check the functional operation of A8U1 and U2D which amplifies the DAC output and A8U2C, which has a gain of +2 with an offset of 10.24 volts. The DAC, A8U3, can be checked by looking at the fine-grainness of the scope trace. If the MSB (U8, pin 4) is bad, A8TP6 will look like:



If the next bit is bad, (U8, pin 5), the trace will look like:



If the next bit is bad, (U8, pin 6), the trace will look like:



Each successive bit doubles the number of square waves seen, so if the LSB (U8, pin 15) is bad, there are 2048 square waves superimposed on the ramp. More than one bit bad will superimpose square waves upon square waves. The DAC should step in approximately 5 mV steps. If this is not so, the error is in either the DAC or A8U5 or A8U14 which drive the DAC.

Test 34 sets the DAC to -10.000 volts.

Test 35 sets the DAC to +10.000 volts.

**DIAGNOSTICS (cont'd)**

**Test 36** checks the DAC (A8U3) by using: (1) the DAC itself, (2) the Sample & Hold (A8U11A, U12), and (3) multiplexer channel number 26 (A8U10, pin 11, and U11C). DAC bits 3 through 11 are tested. DAC bits 0, 1 and 2 are not tested. "—" is shown in the FREQUENCY display. If any or all bits test bad, the "—" changes to the bad bit(s) in sequence. The bits correspond to: pin 15 = bit 0, pin 14 = bit 1, ..., pin 4 = bit 11 on A8U3.

Bits 0, 1 and 2 cannot be checked because of the input voltage offset errors of op-amps U11A, U11C, U13 and the DAC output voltage uncertainty of  $\pm 1$  least significant bit which is 5 mV.

The terminal displays (bit 7 does not work):

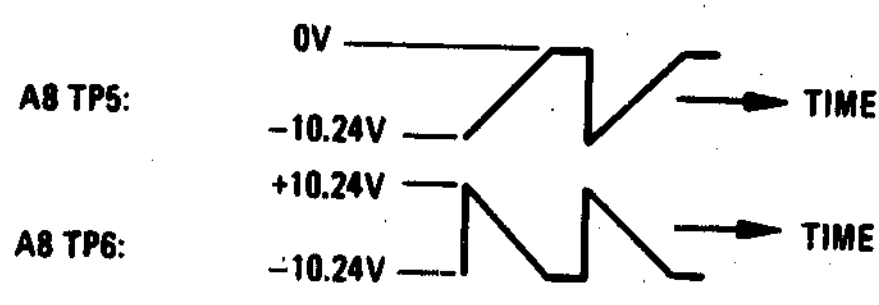
DAC BIT	03	04	05	06	07	08	09	10	11
	OK	OK	OK	OK	ERROR	OK	OK	OK	OK

If the DAC output changed correctly, A8 TP8 will read a "0". However, if the bit that was checked didn't produce a change as it should, the DAC voltage will change in the WRONG direction, causing a reading at TP8 or "1".

**Test 37** is reserved for possible future application.

**Test 38** is used to set the instrument baud rate so that it matches the baud rate of the remote data terminal used during Test 29. To set the baud rate, select Test 38, press and release the dBm key until the desired baud rate is shown in the frequency display of the instrument.

Table 8-5. Summary of Diagnostic Tests 29—38

Frequency Digits Display	Test Number (modulation window)	What It Does
Flashes many numbers	29 <sup>1</sup>	Displays on the terminal a summary of the first 29 tests.
1. —OP— 2. A U	30	1. Normal operation: flip flops ok. 2. Flip flop(s) out of spec on IC; A = board number; U = IC number on board. Terminal displays flip-flop voltage swings; if out of spec, it is underlined. The voltages represent the change in voltage for each flip flop going from the "0" to "1" state.
—00— alternating —11—	31 <sup>2</sup>	Changes state on 48 flip flops on: A8U5, U6, U14, U15 and A9U13 and U14 from "0"s to "1"s. The rate is approximately 0.5 Hz. Pressing any lower front panel key will freeze the state for detailed troubleshooting.
0000 1111 . PPPP	32	Front panel check: flashes all displays including decimal points (except LEVEL decimal point). Pushing any lower key will freeze the action.
—EEP	33	Sweeps the DAC over its range.  
1.0.00	34	Sets DAC to -10.000 volts on A8TP6.
10.00	35	Sets DAC to +10.000 volts on A8TP6
1. — — 2. e#	36	1. "— —" means DAC is ok on bits 3-11 (bits 0-2 not checked). 2. e# means this DAC bit is in error.
P111	37	Reserved for possible future applications.
Baud Rate	38	Power up at a 9600 baud rate. Select other baud rates, shown in the frequency display, with the front panel dBm key.

<sup>1</sup>Out of spec voltages are indicated by underlining or inverse video on the terminal.  
<sup>2</sup>Relays are exercised during this test. Do not leave this test enabled any longer than required.

### 8-31. Power-Up Diagnostics

When the HP 8683A is turned on, power-up diagnostics are performed. If the instrument is correctly operating, the center segments of all the displays will light for a brief period. The display will then blank for a short time and then all segments in the displays will light. The whole sequence takes approximately 5 seconds.

If the microcomputer detects errors upon power-up, additional sequences are displayed in the "FREQ" and "MOD" displays. Since there are over 20 power-up checks, the information goes by quickly. To stop the action at each error, just press the EXT AM key. If the displays don't power-up correctly and the "LEVEL" decimal point blinks quickly, press the EXT AM key . . . quickly release . . . quickly press . . . etc, to slow down the blinks to count them. The number of blinks tells what the error number is. Refer to Table 8-7 for a listing of front panel error codes.

### 8-32. RAM Checks

If the 6802 internal RAM does not work properly, the microprocessor can not assume it can use its stacks properly, therefore, it blinks a decimal point in the "LEVEL" display. The blinking occurs three times; the "ON" and "OFF" duration being equal in length. After blinking, the microcomputer does its normal instrument power-up which may or may not work properly. If power-up is successful, then only three blinks will be seen followed by normal operation. The 6802 should be replaced since some internal RAM is defective and errors could still occur. If power-up is not successful, the blinking will be continuous with intervening pauses. The heartbeat circuits on A9 keep resetting the 6802, causing the RAM to be rechecked and the decimal point will continue to blink. Replace the 6802.

### 8-33. ROM Checks

The microprocessor checks all four EPROM/ROM sockets for proper checksum. If an error occurs, the error codes displayed are shown in Table 8-6.

Table 8-6. ROM Error Codes

Modulation Display	Checksum Error in A9, U#
E01	U8 (8K)
E02	U9 (2K)
E03	U10 (2K)
E04	U11 (2K)

### 8-34. Front Panel Checks

Four critical IC's on the front panel board are checked. They are: A1U23, U5, U21, and U24. These IC's serially shift in the "address and data" from the microprocessor used to load all the output flip-flops and display drivers. They also parallel load the state of the keys to tell what key is pushed (parallel load feature not diagnosed). The loaded key information is serially shifted back out to the microprocessor ("serial shift out" is checked). Testing U23, U5, and U21 is done via the diagnostic output called LADDER 2.

U24 is only used to parallel load keys and has no outputs to test, so it is tested by shifting patterns through U23, U5, U21, and U24. The patterns should arrive intact to the microprocessor via pin 30 on A1J1. All four IC's must shift properly for U24 to test ok. The error message is E08.

The microcomputer assumes if these tests fail, the front panel is not functioning properly. Therefore, it displays to the front panel the error codes and flashes (long off, short on) the "LEVEL" decimal point. The microprocessor controls the decimal point directly via A9U24. The number of flashes is the same as the error message number. To slow down the sequence, push a key.



Table 8-7. Front Panel Error Codes

Modulation Display	Meaning <sup>1</sup>
E05 <sup>2</sup>	A1U23's 4 outputs did not go from "0"s to "1"s correctly. At fault? U16C, U23, or R5.
E06 <sup>2</sup>	A1U5's 4 outputs did not go from "0"s to "1"s correctly. At fault? U16C, U23, or R5.
E07 <sup>2</sup>	A1U21's 4 outputs did not go from "0"s to "1"s correctly. At fault? U16C, U23, U5, U21, or R5, R6, R7, R8.
E08	Patterns sent by the microcomputer did not shift in and out of A1U23, U5, U21, and U24 correctly. At fault? U16C, U23, U5, U21, or U24. Additionally, A9U12 may not work so that the microprocessor can't receive. A9U6, U2, or U3 may be at fault by not enabling U12 to receive.

<sup>1</sup>All four tests assume that IC's on the microcomputer board send bits to the front panel. These IC's are: A9U6, U2, U3, or U13. They are checked via diagnostic test 31 (or test 29 assuming the front panel does not work and a data terminal is connected to the R5232 port).

<sup>2</sup>Three tests check the flip flop outputs use diagnostic test signal "LADDER 2". It is assumed that the DAC, A8U3, and the input multiplexer, A8U9, pin 11 work.

### 8-35. Table Tests

There are eight individually tailored ROM tables in each instrument. Upon power-up, if any of these tables are missing, "E09" error message is issued along with the table type not found displayed in the frequency digits. These tests are shown in Table 8-8.

Table 8-8. Table Tests

Frequency Digits Display Table	Error Number Modulation Window	Meaning
01	E09	Signature table: Date, etc.
02	E09	Annunciator table: 1) pulse lights; 2) frequency decimal point.
03	E09	Frequency table: individual frequency calibration data.
04	E09	ALC table: absolute level for output power, LEVEL display offset. Capability to calibrate ALC separate from the attenuator is latent in this table.
05	E09	Attenuator table: relative power variations with frequency for each step of the attenuator plus ALC coupler, detector, cabling, and output connector combined. (The coupler and detector data could be pulled out and put in the ALC table.)
06	E09	Coaxial table: frequency variations for 4 meters of RG-214/U cable.
07	E09	FM table: individual correction for varactor tuning sensitivity of the microwave oscillator.
08	E09	Limits table: contains the high and low limits for each I/O channel that is checked upon power-up. Also contains the error code to be displayed if an error is found.

**8-36. DAC Self Test**

The DAC bits 3 through 11 are checked using the DAC itself. If any or all bits give incorrect results, error code E10 is displayed. See HP 8683A Diagnostics Test 36 for more details.

**DAC SELF TEST**

Modulation Display	Meaning
E10	Some or all of the DAC bits (A8U3) have errors. Bits 3-11 are checked. Bits 0-2 are not checked.

**8-37. Voltage Limit Tests**

Upon power-up, many voltages are checked to see if they are between specified bounds. If any of the voltages measured are outside of their high and low limits, error codes are displayed at power-up. Pressing any lower key on the front panel will freeze the action so they can be read. A summary of these specifications are listed in Table 8-9.

**Table 8-9. I/O Channel Voltage Limits**

Error Number (Modulation Window)	Lower Limit	Upper Limit	Measurement
E50	4.75	5.50	+5V, digital 5 volt supply
E51	14.50	15.50	+15 volt supply
E52	-15.50	-14.50	-15 volt supply
E53	-31.00	-29.00	-30 volt supply
E54	5.70	6.70	+6.2 volt ALC reference
E55	6.50	7.50	+6.5 volt microwave power supply
E56	*	*	Oscillator low end power supply
E57	*	*	Oscillator high end power supply
E58	1.00	5.00	ALC detector amplifier
E59	-0.30	+30	ALC detector, differential
E60	-0.10	5.00	ALC multiplying DAC
E61	-9.00	-0.50	ALC pin modulator
E62	-0.10	10.24	1st frequency potentiometer, A8R12
E63	-0.10	10.24	2nd frequency potentiometer, A8R15
E64	-0.10	10.24	3rd frequency potentiometer, A8R18

### CONNECTING AN HP 8683A/B OR HP 8684A/B TO A DATA TERMINAL FOR DISPLAY OF DIAGNOSTICS DATA

The HP 8680 series of Microwave Signal Generators contains provisions for transmitting the results of the internal diagnostic tests to a remote device (normally a Data Terminal) for display and evaluation. This is accomplished with an RS 232C type of interface accessed through a printed circuit board edge connector located under the top cover on Assembly A9 (CPU). An adaptor cable from the PC Edge connector to a 25 Pin USA Modem connector is available from Hewlett-Packard as part of the HP 11727A Support Kit or as a separate part and is the recommended method of connection discussed in this procedure. As indicated in Table 8-1, connection to only 6 pins of the adaptor cable 25 pin connector is required.

Table 8-10. USA Modem Connector Pin Assignments

25-Pin Modem Connector Pin Number	RS232C/CCITT V.24 Code Description
2	BA/103 Transmitted Data (Data Out)
3	BB/104 Received Data (Data In)
5	CB/106 Clear to Send
7	AB/102 Signal Ground (Common Return)
8	CF/107 Received Line Signal Detector
12	SCF/102 Secondary Received Line Signal Detector

For a Data Terminal or remote device to be compatible with the HP 8680 series remote interface, the following requirements must be met:

1. Any device connected must accept a transition from 0 to +4 volts as data received.
2. The remote device must transmit data within the following limits:  
Data Low: -12.0 to 1.0V  
Data High: +8.0 to +13.0V.
3. The remote device must recognize and respond to the following escape sequences:
  - a. "esc & a-XXR" Vertical Tab up XX rows.
  - b. "esc & dB" Turn on inverse video or underline.

- c. "esc & d@" Turn off inverse video or underline.
- d. "esc J" Clear screen from current position of cursor to end of screen.
- e. "esc & a0r0C" Cursor to position 0, 0.
- f. "esc H" Cursor home up.
- g. "esc K" Clear line from cursor position to end of line.

Once it has been established that the data terminal meets the compatibility requirements noted above and the proper connections to the HP 8680 series generator have been made, the only action required to initiate data transmission is to enable the REMOTE function on the terminal and establish a compatible data transfer baud rate.

To accomplish this, first set the data transfer Baud Rate of the terminal to one of the following values; 110, 150, 300, 600, 1200, 2400, 4800, or 9600. Then turn the 8680 series generator "ON" and set the service switch on A9 assembly to the "DIAG" position. Select diagnostics Test 38 — "Auto Baud" and set the generator baud rate by using the dBm key and observing the frequency display. Any other test number may now be selected and the test results will be transmitted to the terminal for display as well as appearing in the display of the HP 8680 series signal generator. Test 29 is particularly useful in conjunction with a data terminal. This test will display the results of Tests 0 through 28 on the terminal screen simultaneously, highlighting (underline or inverse video depending on the terminal) those test results that are not within the error limits stored in the signal generator. Tests 30 and 36 will also result in annotated tabular displays on a data terminal in contrast to the single display available on the front panel of the signal generator. Test 30 displays the change in voltage from a "0" to a "1" for 32 I/O flip-flops associated with the microprocessor and Test 36 displays the results of testing the DAC (A8U3) bits 3 through 11.

## SERVICE SHEET BD1

### PRINCIPLES OF OPERATION

#### General

The Signal Generator simplified block diagram, Figure 8-17, shows the eight major assemblies and the microwave chain. The assembly number is in the upper left corner of the assembly block and its related service sheet number is in the lower right corner of the assembly block. The diagram can be divided into four major groupings, (1) microwave generation, (2) central processing unit (front panel, input/output, and microprocessor), (3) automatic level control including amplitude modulation and (4) frequency modulation.

The explanation that follows describes briefly the function of each assembly. The items explained here are not necessarily shown on the block diagram but the information is given as an introduction to circuits shown on the service sheets. A detailed description of the function of each circuit can be found on the respective service sheet.

#### Four Functional Groupings

First, the microwave frequencies are generated with transistors positioned in a mechanically tuned cavity inside the A14 Microwave Oscillator module. Second, the central processing unit (CPU) has a microprocessor that on the power-up sequence accesses read only memory (ROM) to process stored diagnostic routines. During the diagnostic, power-up errors detected are briefly displayed. After power-up is completed, the CPU waits for a key down signal caused by a front panel key being pressed. Third, the automatic level control (ALC) circuitry compares the instrument microwave output level to a locally generated 30 MHz reference source and generates a level correction signal. Level correction is accomplished by a PIN diode circuit in the ALC modulator. Amplitude modulation of the microwave signal is effected by modulating the reference source. Fourth, frequency modulation of the microwave modulation is accomplished with a varactor diode modulating the capacitive loading of the microwave cavity. Pulse signals are generated either from an external source or internally generated via a 1 kHz oscillator. The signals are routed via the ALC detector amplifier and ALC control assemblies to the ALC modulator in the A15 Microwave Amplifier. Instrument capabilities include simultaneous AM, FM, and pulse modulation.

#### Microwave Generation

Microwave frequencies are generated in a high-Q coaxial cavity and are tuned by changing the length of the center conductor (plunger) in the cavity. The A14 Microwave Oscillator cavity is a mechanically tuned one-quarter wavelength transverse electromagnetic (TEM) type. The FM varactor diodes are positioned inside the cavity and, when driven by the A10 FM Shaper Assembly, gives FM capability to the oscillator. The microwave signal is transmitted through semi-rigid coaxial cable to the microwave amplifier module. This module also contains a PIN diode modulator (used for ALC and pulse modulation) and an automatically switched microwave low-pass filter which attenuates harmonics when they are in the instrument's frequency range.

#### Central Processing Unit

The assemblies that are part of the CPU group are the A1 Front Panel, the A9 Central Processing Unit, and the A8 Input/Output assemblies.

The A1 Front Panel has the controls and displays, and processes signals to and from the CPU. It also contains LADDER 2, a signal to the I/O used in checking proper operation of 12 flip-flops on the A1 assembly.

The A9 Central Processing Unit, using the front panel information as its input, generates strobes, data bus information, and has the components used with LADDER 1 (a signal line used in checking proper operation of 32 flip-flops on the A8 and A9 assemblies).

A8, Input/Output, uses diagnostic and analog signals from several other assemblies to generate 12 bits of information for the ALC reference. The front panel FREQUENCY, LEVEL range and vernier, and rear panel CABLE OFFSET controls are also inputs to the I/O assembly.

The A1 Front Panel Assembly provides five major functions, (1) keys to be pressed and then read by the CPU, (2) shifting of front panel data in and out, (3) decoding of a four bit address used in the address decoding of bits A0 through A10 that control latches and seven segment displays, (4) latching for data that is used as control for a few signals throughout the instrument, and (5) the displaying of frequency, modulation, and level; UNLEVEL and OVERMOD annunciators, and in-key annun-

### Central Processing Unit (cont'd)

ciators. Front panel data is used by the A9 Central Processing Unit (CPU) Assembly. When a front panel key is pressed, the key-down signal is detected by the A9 CPU Assembly, and the microprocessor reads which key is pressed and then takes appropriate action. The microprocessor checks the state of the key down line approximately every 20 ms. Inputs to this assembly go through buffer gates to the bidirectional data bus.

The data bus bits D0 through D7 of the microprocessor are latched, then gated as output control signals. The data bus bits go to the A8 Input/Output Assembly to set up processing of analog signals. The A8 I/O assembly's major functions are (1) receiving data from the A9 CPU assembly which is loaded into input flip-flops (the first two flip-flops feed a second set of flip-flops which control channel selection of analog signal multiplexing); (2) digital-to-analog converting that is done with a 12 bit DAC to generate a signal for the analog to digital comparator, (3) the sampling and holding which provides a voltage proportional to frequency called SWEEP OUT and (4) self testing of the DAC. A second set of flip-flops also provides output information to control the ALC circuitry.

### Automatic Level Control and Amplitude Modulation

The microwave signal level of the instrument is monitored by the ALC system via the coupled output from DC1. This signal is rectified and low-pass filtered by CR1 and the resulting dc voltage is compared to a dc voltage similarly derived from the 30 MHz reference source. The amplified difference between the two voltages makes the ALC error signal which is fed back to the PIN modulator in the microwave amplifier module. The non-linear transfer characteristic of CR1 is compensated for by using a similar diode for the reference source rectifier. Stability of the ALC loop is ensured by an integrator on the ALC control assembly.

The ALC circuitry has three related assemblies: the A7 ALC Reference, A6 ALC Detector Amplifier, and A5 ALC Control. The A7 ALC Reference Assembly has four major functions. They are (1) generating a 30 MHz reference signal, (2) AM input buffering and peak detecting, (3) digital power level control (using a DAC and multiplexer for the ALC linear bits A0 through A9 and ALC log bits A0 and A1), and (4) attenuating the 30

MHz reference by 10 dB. The 30 MHz reference produced by the A7 assembly is used by the A6 assembly. The A6 ALC Detector Amplifier Assembly has five major functions. They are (1) the amplification of the detector differential voltage to produce the ALC error signal from the 30 MHz and microwave detectors' outputs, (2) generating a 1 kHz squarewave for internal pulse (3) generating a 1 kHz sawtooth for internal FM, (4) determining the pulse mode and (5) providing the driving signal for the microwave filter. The A5 ALC Control Assembly uses the ALC error signal generated by the A6 assembly to complete the control loop. Completion of the loop uses these major functions: (1) driving the FET switch sampler, (2) integrating the ALC error signal, (3) driving signal for the ALC pin modulator in the A15 Microwave Amplifier module, (4) loop gain compensation and setting the ALC loop bandwidth, and (5) unlevel detecting for AM overmodulation. The A7 ALC Reference Assembly is made up of a 30 MHz oscillator feeding a precision voltage controlled attenuator followed by an output buffer. The voltage controlled attenuator allows the output level of the reference assembly to be controlled with a dc voltage. During amplitude modulation, this voltage is modulated by the AM input signal. Modulation of the ALC reference source is used to modulate the microwave signal. In the AM mode the time constant of the integrator in the loop is decreased, enabling the loop to follow the AM input signal.

The 30 MHz reference signal and the signal detected by CR1 Microwave Detector are differentially amplified on the A6 ALC Detector Amplifier to produce an ALC error signal. This error signal goes to the A5 ALC Control to drive the ALC modulator in the A15 Microwave Amplifier module. Other outputs of the ALC detector amplifier are the internal 1 kHz sawtooth FM signal and drive to the microwave filter in the A15 Microwave Amplifier module.

### Frequency Modulation

The A10 FM Shaper Assembly, using either an externally applied FM input/output signal or INT FM (internally generated 1 kHz sawtooth), produces a voltage output driving the varactor diodes in the A14 Microwave Oscillator. This voltage is a function of the frequency deviation desired. The rear panel PHASE LOCK input is also applied to the FM shaper for externally locking the generator to a stable source. The main functions of this

**Frequency Modulation (cont'd)**

assembly are (1) shaping the signals that are applied to the microwave varactor diodes in the A14 Microwave Oscillator, (2) processing the phase lock input used for locking to a stable source, and (3) peak detecting the applied FM signals. The peak detected signals are routed back to the A8 I/O assembly as two of the analog signals that get multiplexed.

**TROUBLESHOOTING**

1. Turn on the instrument. Ignore the erratic display that can occur momentarily when the instrument is first turned on. Watch for error codes in the modulation window. The codes will come by too fast to read. If error codes are seen, turn the instrument off for a few seconds and, before turning the instrument on, press and hold any of the lower keys on the front panel until an error code is seen. This causes the first error code to be frozen in the display until a key is pressed, at which time the next error code will be displayed until there are none left. If the instrument does not turn on properly (i.e. no displays) go to Service Sheet 13 to check the power supplies.
2. If any error codes are present, go to the service sheet indicated in Table 8-11. If there is more than one error code, go to the service sheet indicated by the first error code that occurs in the display.
3. If no turn-on error codes are displayed, continue with this procedure. The following steps will assume that there were no error messages displayed at turn-on. Remove the instrument top cover and locate the Service Switch on the A9 board. Set the switch to the DIAG(nostic) position.
4. Select Diagnostic Test 32. This test lights the various front panel displays. The sequence should be 0123456789EHL P and the individual LEDs in the keys should be on. Watch for any incorrect displays or LEDs that do not switch on and off. If all is OK, continue to the next step, otherwise go to the front panel test procedure on Service Sheet 1.
5. Select Diagnostic Test 30. If all is normal, the frequency window should display —OP—. If instead, two numbers are displayed, it means

**Table 8-11. Turn-on Errors**

Error Code	Service Sheet	Suspect Assembly	Problem Area
E50 to E53	SS13	A11 Power Supply	5.25V, 15V, -15V, -30V power supplies
E55 to E57	SS13	All Power Supply	+6.5V power supply, osc. hi and low band power supplies
E55	SS10	A8 I/O Board	Analog ground
E01 to E04	SS11	A9 CPU Board	ROM checksum error
E09	SS11	A9 CPU Board	Missing EPROM table
E05 to E08	SS1	A1 Front Panel	Front panel latches
E54	SS9	A7 ALC Reference	+6.2V ALC reference
E58 to E61	SS&	A5 ALC Loop	ALC loop
E62 to E64	SS11	A8 I/O Board	Frequency display adjustments F1, F2, F3

the voltage swing from logic-low to logic-high on a particular IC is incorrect. The first number in the display is the reference designator of the board and the second number is the IC number. For example, if the display shows 9 13, this means A9U13. Go to the Service Sheet for the particular board involved to finish troubleshooting.

6. Select Diagnostic Test 08. Rotate the LEVEL Range switch fully clockwise. Momentarily cycle the test switch to NORM and back to DIAG. The frequency display should indicate 10.24 volts  $\pm$  0.02 volts. Set the LEVEL switch fully counterclockwise. The voltage should drop to near 0.0 volts after the test switch is cycled. If these voltages are incorrect go to Service Sheet 10 to continue troubleshooting R6, the LEVEL potentiometer, and the circuit reads it.
7. Select Diagnostic Test 09. Rotate the LEVEL vernier fully clockwise. After cycling the test

**TROUBLESHOOTING (cont'd)**

- switch, the display should read  $10.24 \pm 0.02$  volts. Set the LEVEL vernier fully counterclockwise. The voltage should drop to near 0.0 volts after the test switch is cycled. If these voltages are incorrect, go to Service Sheet 7 to continue troubleshooting R7, the LEVEL vernier, and the circuit that reads it.
8. Select Diagnostic Test 14. Rotate the rear panel CABLE OFFSET control fully clockwise. After cycling the test switch, the display should read  $10.24 \pm 0.02$  volts. Set the CABLE OFFSET fully counterclockwise. The voltage should drop to near 0.0 volts after the switch is cycled. If these voltages are incorrect go to Service Sheet 10 to continue troubleshooting R8, the CABLE OFFSET potentiometer, and the circuit that reads it.
  9. Select Diagnostic Test 15. Rotate the FREQUENCY tuning control fully clockwise. The display should read approximately +10 volts after cycling the test switch. Rotate the FREQUENCY control fully counterclockwise. The display should read approximately -10 volts after cycling the test switch. The decimal point between the 1 and the 0 should be flashing, indicating a negative number. If either voltage is incorrect go to Service Sheet 10 to continue troubleshooting R1, the FREQUENCY potentiometer, and the circuits around U11 and U2.
  10. Set test switch to NORM and select EXTERNAL AM. Set test switch to DIAG and select Diagnostic Test 19. The voltage displayed should be close to 0.0 volts. Select Diagnostic Test 20. The voltage should also be close to 0.0 volts. This checks the AM peak detector outputs with no modulation applied. If these voltages are correct, continue to the next step, otherwise, go to Service Sheet 9 to troubleshoot the AM peak detectors.
  11. Connect the 600 ohm output of a Test Oscillator to the AM input. Set the signal level to 1 volt peak out of the Test Oscillator at about 5 kHz (frequency is not critical). Set the front panel AM vernier fully clockwise. Select Diagnostic Test 19. The display should read close to 1.00 volts. The reading depends on how accurately the Test Oscillator output level can be set. Select Diagnostic Test 20. The display should be equal to that during Test 19. A difference of 5% between the two readings is acceptable. If these voltages are correct, continue to the next step, otherwise go to Service Sheet 9 to troubleshoot the AM peak detectors.
  12. Disconnect signal from the AM input and connect the Test Oscillator 50 ohm output to the FM input. Make sure the output of the Test Oscillator is still 1 volt peak. Set Test switch to NORM, turn off EXTERNAL AM and select EXTERNAL FM 10 MHz/V.
  13. Select DIAG mode on the Test switch and select Diagnostic Test 21. Set FM control fully clockwise. The display should read close to 1.00 volts. Select Diagnostic Test 22. The reading should be equal to that observed during Test 21. A difference of 5% between the two readings is acceptable. If the voltages are correct, continue to the next step, otherwise go to Service Sheet 12 to troubleshoot the FM peak detectors.
  14. Set test switch to NORM and set frequency to 2.3 GHz. Set LEVEL range and vernier controls to get a display of -10 dBm on the LEVEL display. Zero and calibrate a power meter with an HP 8481A power sensor. Set power meter CAL FACTOR to match the power sensor. The meter should read  $-10 \pm 2.5$  dBm and the UNLEVEL light on the Signal Generator should be off. If all is correct, continue to the next step, otherwise go to Block Diagram 2 to troubleshoot RF level problem.
  15. Set LEVEL range switch to get 0 dBm output display. The unlevel light should remain out and the power meter display should match within  $\pm 2.5$  dB. If all is correct, continue to the next step, otherwise go to Service Sheet 7 to troubleshoot ALC or microwave chain problems.
  16. If the instrument has option 001, set LEVEL range switch to get a +10 dBm output display. The unlevel light should remain out and the power meter display should read  $10 \pm 2.5$  dBm. If all is correct, continue to the next step, otherwise go to Service Sheet 7 to troubleshoot ALC or microwave chain problems.
  17. Tune slowly from 2.3 to 6.5 GHz while watching the power meter and the UNLEVEL light.

**TROUBLESHOOTING (cont'd)**

- Change the CAL FACTOR as needed while tuning to maintain accuracy in the power meter reading. The UNLEVEL light should not come on over the entire range and the power output should remain flat within  $\pm 1$  dB. The absolute level should be  $0.0 \pm 2.5$  dBm ( $+10.0 \pm 2.5$  dBm with opt. 001), though it will usually be closer. If all is correct, continue to the next step, otherwise go to Service Sheet 7 to troubleshoot ALC or microwave chain problems.
18. Move the power sensor from the front panel to the AUXILIARY OUTPUT on the rear panel. The output should be greater than -15 dBm across the band. Typically the output will rise by several dB in the middle of the band. These are typical levels only, there are no warranted specifications associated with this output. If the level is several dB too low, go to Block Diagram 2 to troubleshoot the microwave chain.
  19. Attach a dc voltmeter to the rear panel BNC connector labeled FREQUENCY. At the bottom of the band the output should be 0 Vdc and at the top of the band it should be 10 Vdc (typical levels only). Also, the voltage should change linearly as the frequency is tuned. If the voltage is incorrect, go to Service Sheet 10 to troubleshoot A8U11, U12 and associated components.
  20. Move the voltmeter to the connector labeled RELATIVE VERNIER LEVEL. This output should vary from 0 to 10 Vdc as the LEVEL vernier is rotated over its range. The change should be 2.5 dB per volt. If the voltage is incorrect go to Service Sheet 7 to troubleshoot R7, the front panel LEVEL vernier control, and associated components.
  21. Connect a spectrum analyzer to the front panel microwave output connector and the 50 ohm output of a Test Oscillator to the FM input. Select 1 MHz/V External FM and set the Test Oscillator to 100 kHz at 1 volt peak (0.707 V<sub>rms</sub>). Set the front panel FM vernier fully clockwise. The modulation display should read approximately 1 MHz and the OVER-MOD light may be on. Rotate the FM vernier to get a display of 240 kHz. The spectrum analyzer should show a null of the carrier since this should correspond to the first Bessel null (modulation index of 2.404). Typical accuracy of the FM metering is  $\pm 10\%$  of full scale. If the results of this step are incorrect, go to Service Sheet 12 to troubleshoot FM problems.
  22. Select 10 MHz/V External FM and set modulation rate to 1 MHz. If necessary, adjust the FM vernier to get a display of 2.40 MHz deviation. The carrier displayed on the spectrum analyzer should be nulled at these settings as well. Typical accuracy of the FM metering is  $\pm 10\%$  of full scale. If the results of this step are incorrect, go to Service Sheet 12 to troubleshoot FM problems.
  23. Turn off FM and select External AM. Connect the Test Oscillator to the AM input. Set Test Oscillator frequency to 10 kHz at 0.5 volts peak. With the AM vernier fully clockwise, this should correspond to 50% AM and the modulation sidebands should be about 12 dB below the carrier. If the levels are correct continue to the next step, otherwise go to Service Sheet 9 to troubleshoot U3, U1D, U6 and associated components.
  24. Turn off AM and connect a microwave frequency counter to the microwave OUTPUT connector. Set the level controls to maximum power. Set the displayed frequency on the Signal Generator as close as possible to the settings shown in Table 8-12. It may not be possible to set the numbers exactly as shown. The frequency counter should read within the limits shown. If frequencies are not within the limits shown, go to Service Sheet BD2 to troubleshoot problems with the microwave oscillator and other components in the microwave chain.

Table 8-12. Frequency Accuracy

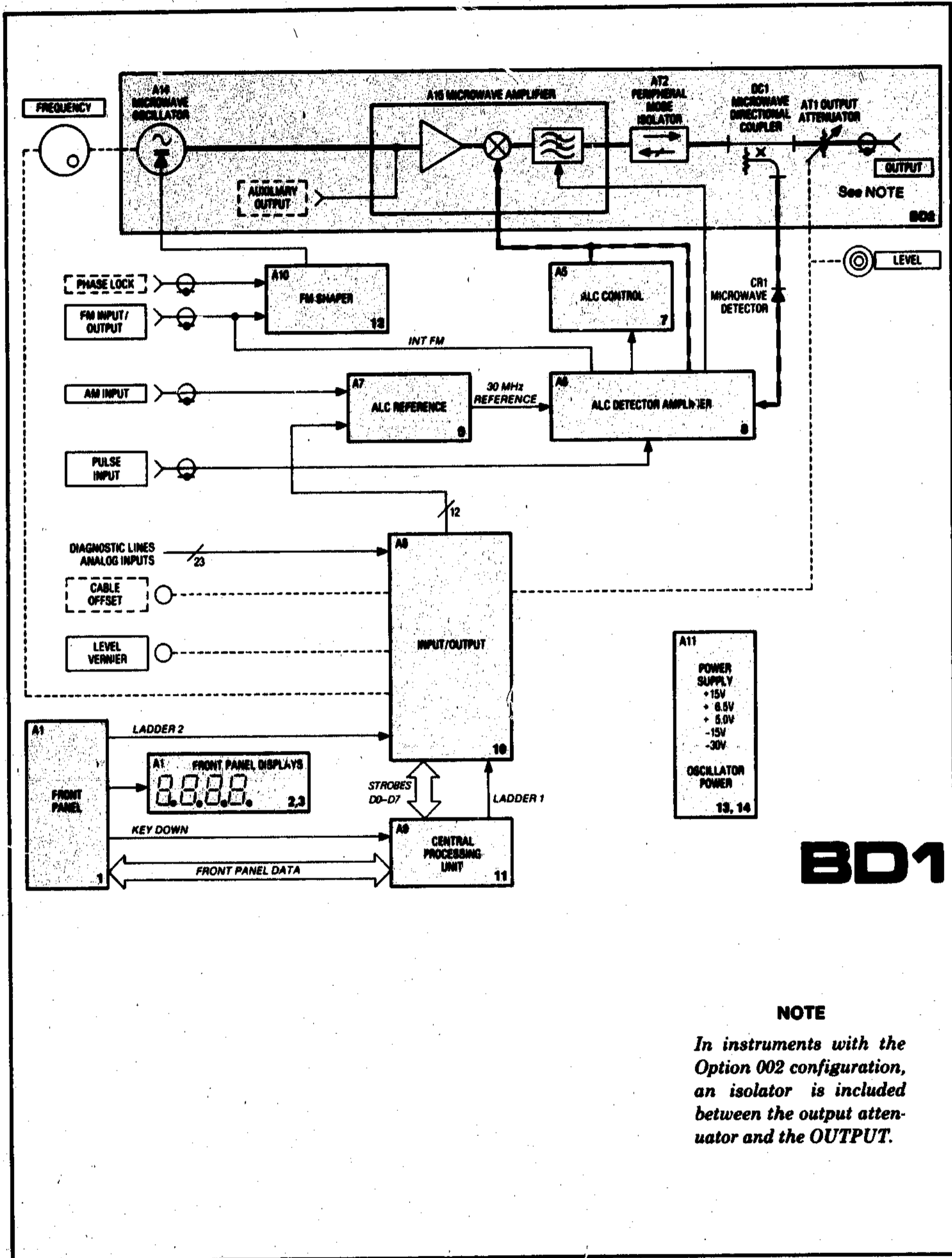
Signal Generator Setting	Frequency Counter	
	Minimum	Maximum
2.3 GHz	2.2712 GHz	2.3287 GHz
4.0 GHz	3.9500 GHz	4.0500 GHz
5.0 GHz	4.9625 GHz	5.0375 GHz
6.0 GHz	5.9550 GHz	6.0450 GHz
6.5 GHz	6.4512 GHz	6.5487 GHz

Other frequencies can be checked if problems are suspected. The specifications are shown in Table 1-1.



**TROUBLESHOOTING**

25. Connect spectrum analyzer to the microwave OUTPUT connector. Select PULSE INT 1 kHz mode. Set the spectrum analyzer to 1 kHz per division with appropriate bandwidth and scan time. The spectrum analyzer display should have spectrum lines every 1 kHz with zero amplitude points every 10 kHz. If the spectrum is not approximately as indicated, go to Service Sheet 8 to troubleshoot possible pulse problems.
26. Select PULSE EXT mode and attach a pulse generator to the PULSE INPUT connector. Set the pulse generator to provide a +5 volt pulse with a width  $>10 \mu\text{s}$ . Vary the rate delivered by the pulse generator while watching the spectrum analyzer display. The spacing between lines of the pulse spectrum should vary with the pulse generator frequency. If the variation does not occur or the pulse spectrum disappears, go to Service Sheet 8 to troubleshoot circuitry related to the Pulse functions.
27. Turn off INTERNAL PULSE mode and select external AM. Do the AM Distortion and AM Rates steps of the AM performance tests, paragraph 4-10, steps 6 and 7. If the instrument works properly, continue to the next step. Otherwise go to Service Sheet 9 to troubleshoot AM distortion problems or Service Sheet 7 to troubleshoot AM bandwidth problems.
28. Connect spectrum analyzer to RF output and connect 50 ohm output of test oscillator to FM INPUT connector. Set 1 MHz on test oscillator and select 10 MHz/V on the Signal Generator. Set FM vernier fully clockwise and adjust test oscillator output amplitude to get the first carrier null on the spectrum analyzer display. The modulation display on the Signal Generator should read  $2.40 \text{ MHz} \pm 0.50 \text{ MHz}$ .
29. Change the test oscillator frequency to 2 MHz. Adjust the test oscillator output to again obtain the carrier null. This should occur at a displayed deviation of  $4.80 \pm 0.50 \text{ MHz}$ . If FM performance is not correct, go to Service Sheet 12 to troubleshoot the FM shaper board. This completes the main troubleshooting procedure. If no problem has revealed itself, either the instrument is working properly, the problem is intermittent or is a subtle deviation from specifications not checked in this procedure.



**BD1**

**NOTE**

*In instruments with the Option 002 configuration, an isolator is included between the output attenuator and the OUTPUT.*

Figure 8-17. Simplified Block Diagram

## SERVICE SHEET BD2 — MICROWAVE CHAIN BLOCK DIAGRAM

### PRINCIPLES OF OPERATION

#### The Microwave Chain

The microwave chain consists of all parts from the microwave oscillator to the front panel connector.

The output of the oscillator is fed via a semirigid coaxial cable to the input of a combination power amplifier and ALC modulator, A15. There are two outputs from this module. One line feeds the auxiliary output on the rear panel. The auxiliary output is not amplified and has no reverse power protection; it is intended for monitoring purposes only. The second line is the amplified output.

Several other important components have been integrated into the power amplifier. The ALC modulator is part of the amplifier, as is a switched low pass filter, which is used to suppress harmonics. A signal derived from the frequency tuning voltage switches the low-pass filter in the amplifier. The filter switches from a mode in which its cutoff frequency is about mid-band to a mode in which the cutoff is slightly above the highest normal operating frequency of the Signal Generator. The filter allows harmonic performance to be good, even at the bottom of the band where the second harmonic is still within the specified frequency range of the instrument.

The signal that is amplified in the power amplifier then goes to the isolator whose function is to protect the power amplifier from reverse power and at the same time to minimize ripple effects caused by SWR interactions. The forward loss of the isolator is about 0.7 dB and its reverse isolation is about 20 dB.

The next item in the microwave chain is a directional coupler. The ALC Sample Signal that goes to the Microwave Detector shown on Service Sheet 8, is connected to the coupled output. This output is about 12 dB down from the directional coupler's input signal. The main output of the directional coupler goes to a 10 dB step attenuator that is switched by the front panel range knob. In a standard instrument, the output of the attenuator goes directly to the front panel output connector. If the instrument is an Option 002 with improved reverse power protection, an additional isolator is inserted between the output attenuator and the front panel connector.

#### The Microwave Oscillator

The microwave oscillator is a transistor oscillator resonated by a high-Q cavity in which the dimensions are changed to tune the resonant frequency. The cavity dimensions are effectively changed by altering the penetration depth of a tuning rod. The cavity is made of highly polished aluminum with a non-contacting probe made of polished, anodized aluminum.

There are two GaAs FET oscillator transistors coupled into the cavity. One is positioned so that its coupling antenna controls the oscillating frequency in the bottom half of the band. The other transistor is positioned to control oscillations in the top half of the band.

The tuning rod travels 15 mm in the cavity, tuning the cavity from 2.250 to 6.700 GHz. Note that the specified frequency range is smaller than the absolute tuning range of the oscillator. Outside the specified range the power tends to drop off rather quickly. Performance beyond the specified limits should not be relied on from unit to unit.

The cavity can be thought of as a distributed L-C resonant circuit. Changing tuning rod depth changes the L and C of the cavity, thus changing the frequency. When the cavity is being frequency modulated with varactor diodes, the diodes' capacitance is changed by the FM voltage. This changes the total cavity capacitance, thus changing the overall L-C circuit and tuning the frequency. Any movement or dimensional change in the cavity causes the frequency to tune in either a cyclical manner (in the case of vibration) or as a frequency drift (in the case of dimensional change).

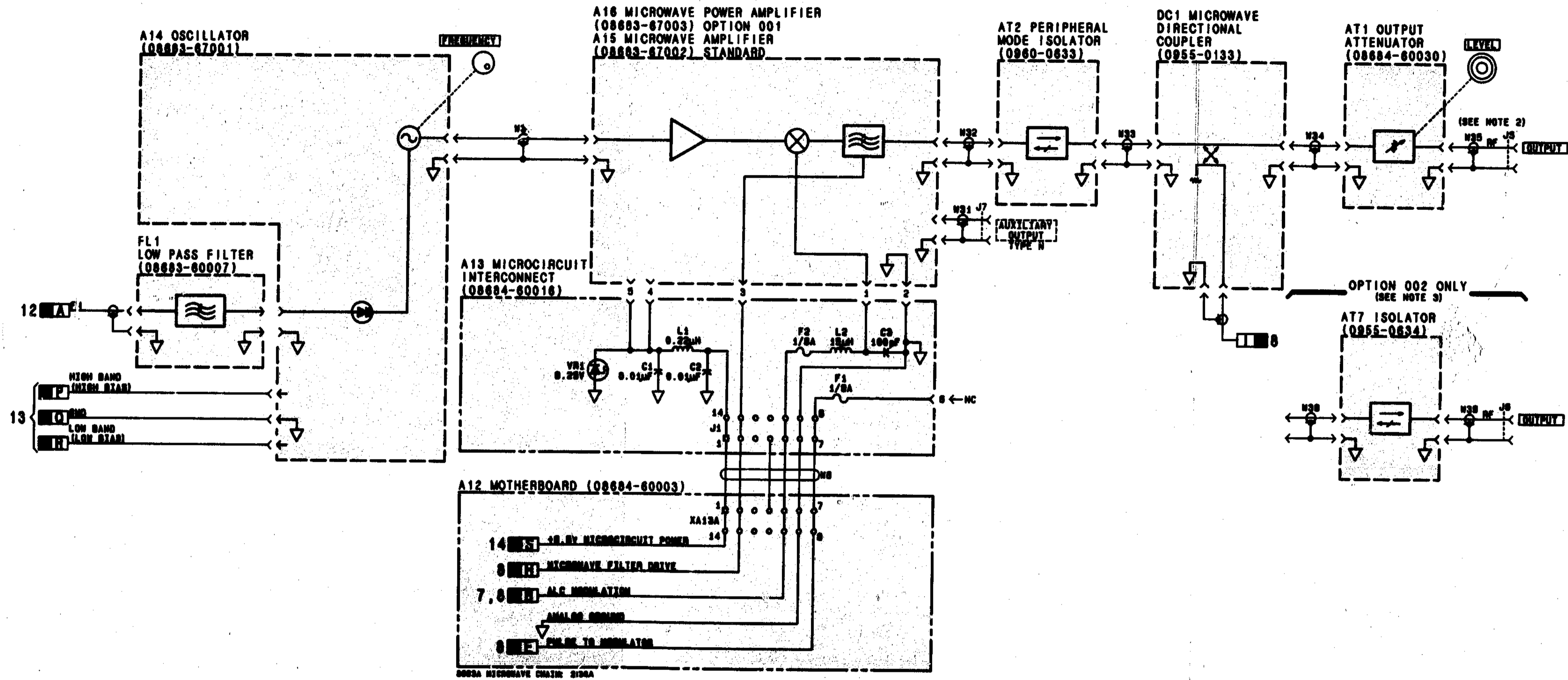
Careful selection of materials for the cavity parts helps to reduce frequency drift due to temperature. This selection includes the choice of various alloys that have complementary expansion coefficients with temperature.

Yet another way to look at the oscillator is as a coaxial transmission line with a short at one end. At the frequency of interest the line is less than  $1/4$  wavelength and appears as an inductive reactance. The other end is terminated with a capacitance. The circuit is parallel resonant at the frequency where the capacitive reactance equals the inductive reactance. Tuning is done mainly by changing the position of the tuning probe, which changes the capacitance.

**SERVICE SHEET — BD2 (cont'd)**

Oscillation is accomplished by coupling the FETs into the cavity in a positive feedback configuration. The signal is coupled into the output connector by a probe that protrudes in the cavity.

The oscillator can be frequency modulated. Two varactor diodes are coupled into the cavity via another probe. By changing bias voltage on the varactors, the net capacitance of the entire cavity is slightly changed. This changes the resonant frequency and thereby generates FM.



- NOTES**
1. REFER TO TABLE 8-2 FOR SCHEMATIC DIAGRAM NOTES.
  2. N33 (08684-20074) IS IN STANDARD CONFIGURATION INSTRUMENTS ONLY.
  3. CIRCUITRY APPLIES ONLY TO INSTRUMENTS WITH THE OPTION 002 CONFIGURATION. † INDICATES CIRCUIT CHANGE. SEE SECTION VII.

**REFERENCE DESIGNATIONS**

NO PREFIX	A12
A14, 15	XA13A
A16 (OPTION 001 ONLY)	A13
A7-8	C1-3
A7 (OPTION 002 ONLY)	F1, 2
J5	L1, 2
N30-37	L1, 2
N38, 39 (OPT. 002 ONLY)	VR1

**SEMI-RIGID COAX CABLE PART NUMBERS**

REFERENCE DESIGNATION	PART NUMBER
N30	08683-20015
N31	08684-20139
N32, 34	1290-1789
N33	08684-20088
N35	08684-20072
N36	08684-20120
N37	08684-20074
N38	08684-20077
N39	08684-20078

**BD2**

Figure 8-18. Microwave Chain Block Diagram

## SERVICE SHEET 1 P/O FRONT PANEL

### PRINCIPLES OF OPERATION

#### General

The circuits shown on the schematic for this service sheet perform two functions: 1) It provides the means for the CPU to determine which key in the keyboard has been pressed. 2) It receives data and front panel device address information for use by the front panel latches, decoders, and LEDs.

**Data Registers and Address Register.** The data registers and address register perform two functions. They receive display data and front panel device address information. They also form part of the keyboard output circuitry.

**Miscellaneous Register.** This register receives keyboard and diagnostic information and shifts the information out to the CPU via the Front Panel Data Output line.

**Address Decode.** U19 and U20 decode the four front panel device address lines into eleven device select lines that enable data latches, displays, and display drivers.

**J, L, and Miscellaneous Latches.** These latches store data bits that drive annunciators and the decimal points in the seven segment displays. They also send function select signals to other areas of the Signal Generator.

#### Sending Data From the Keyboard

When any key is depressed, the associated 4700Ω resistor is connected to ground. This causes the base voltage of Q1 to drop to about 2.5 volts. Q1 saturates causing the Key Down line to go to a TTL high. The CPU checks the Key Down line approximately every 20 milliseconds and when a depressed key is sensed, the CPU sets the Front Panel Serial Parallel line low. Data from all keys is loaded into the registers upon the rising edge of the next clock pulse. When a key has been pressed, a TTL low will be loaded into the associated register flip-flop, otherwise, a TTL high will be loaded. After the keyboard data has been stored, the Front Panel Serial Parallel line is set high. The CPU then begins a routine whereby it checks the Front Panel Data Output line for the presence of a TTL low and shifts in the next bit of key data if no TTL low is detected. This sequence will continue until a TTL low is detected. By keeping track of the number of read/shift operations performed, the CPU can identify which key has been pressed.

#### Receiving Data From the CPU

The CPU sends a bit string to the front panel consisting of four front panel device address bits and eight bits of data. When data is sent from the CPU to the front panel board, the Front Panel Serial Parallel line is set high. The data is shifted into the address and data registers via the Front Panel Input line on the rising edges of the next twelve Front Panel Clock pulses. After all data is shifted in, the Front Panel Strobe is pulsed low. This enables the Address Decode ICs and the four front panel device address lines are decoded to select one of the eleven device select lines. Data stored in the Data Registers is then loaded into the selected latch or binary to seven segment decoder.

## SERVICE SHEET 1 (cont'd)

### TROUBLESHOOTING

This troubleshooting procedure assumes that the CPU board is working properly.

1. Turn the instrument off and on to cause the turn-on diagnostic tests to be performed. Watch the modulation display for error numbers and watch the first decimal point in the output level display. If the microprocessor detects a front panel error, it will flash the decimal point a number of times equal to the error number. If there are no error messages continue with this procedure, otherwise investigate possible front panel problems according to Table 8-13.

Table 8-13. Front Panel Errors

Error Code	Problem	Check
E05	A1U23 outputs wrong	A1U23, A1U16 and A1R5
E06	A1U5 outputs wrong	A1U5, A1U16, A1U23 or A1R5
E07	A1U21 outputs wrong	A1U21, U16, U23, U5, U21, R5-R8
E08	A1U24 outputs wrong	A1U16, U23, U5, U21, U24. Could be caused by A9U12, A9U6, A9U2 or A9U3)

If the error code is one not shown here, return to Block Diagram 1 troubleshooting to look at the error code table there.

During the next three steps, other components will be checked. If an improper response is noted, go to the schematic to isolate the particular failure seen.

2. Press the FM INT key and then the AM EXT key. Press the MHz FM, dB REI, and CABLE OFFSET keys. Verify that the key LEDs light. If all are correct, then A1U5 parallel input is functioning correctly.
3. Press the EXT PULSE, INT 1 kHz and AM keys. Watch for proper response on the front panel lamps and displays. If all are correct, then A1U21 parallel input is functioning correctly.
4. Press the INT  $\sim$ , EXT 1 MHz/V, EXT 10 MHz/V and dBm display mode keys. Watch for proper response on the front panel lamps and displays. If all are correct, then A1U24 is probably functioning correctly.
5. Observe the decimal point in the frequency display: it should be after the second digit and should be lit continuously. The decimal point in the level display should be after the third digit. If a decimal point is not lit, replace the LED display, after first checking the input voltage on the decimal point drive input (pin 6 on the display). Since the decimal point of some displays is not needed, moving the display into another position is a valid alternative. Check the schematic to determine which display position does not use the decimal point before moving it.

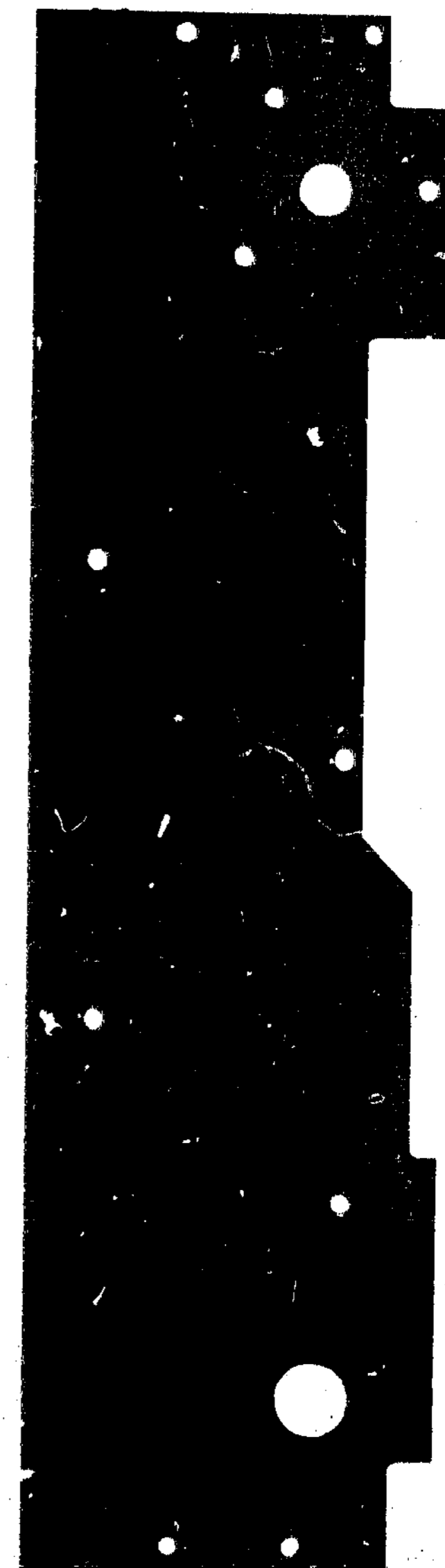
## SERVICE SHEET 1 (cont'd)

6. Slowly tune the frequency while observing the numbers shown in the frequency display. Make sure each digit can display odd and even numbers and that there are no segments or numbers that can not be obtained. Because of the limited resolution of the analog to digital converter, there are some frequencies that can not be displayed. For example, if you try to tune 6000 MHz you may only be able to display 5999 or 6001 MHz. The oscillator tunes continuously but the display has gaps. If all numbers from zero to nine can be displayed on all digits (except the most significant digit) then the LED displays and the data pathway from the microprocessor are functioning correctly. If there are problems, go to Service Sheet 10 to check the operation of the FREQUENCY potentiometer and the following frequency shaping circuits. If that circuitry is working properly, go to Service Sheet 2 to troubleshoot the LED frequency display and decoders.

### HOW TO REMOVE THE FRONT PANEL BOARD

1. Remove the top and bottom covers. Remove the knobs for FREQUENCY, LEVEL range and LEVEL vernier. Remove the collar from the front of the LEVEL vernier shaft. This requires a 0.050 inch Allen wrench.
2. Remove the C-washer retaining ring from the shaft that goes to the range potentiometer, R6. Pull straight back on the LEVEL potentiometers to remove them. Disconnect the cable attaching the potentiometers to the motherboard and set the assembly aside.
3. Remove the three screws, accessible through access holes, that hold the attenuator drive gear assembly in place. Set the screws and the three spacers aside. DO NOT remove the three flat head screws from the gear assembly.
4. Remove the four screws that hold the front frame to the four corner struts. Slide the front frame out far enough to clear the end of the frequency tuning shaft.
5. Remove the four screws holding the insulating sheet in place. Note that the longer screw is used to hold the cable clamp in place. Set the sheet aside.
6. Remove W1, the ribbon cable, from A1J1. Remove the remaining four screws that hold the board to the front panel.

### A1 FRONT PANEL ASSEMBLY



NOTE: J1 IS LOCATED ON CIRCUIT SIDE OF BOARD

← Microwave Chain Block Diagram SERVICE SHEET **BD2**

Figure 8-19. Front Panel Component Locations

**SERVICE  
INFORMATION  
CON'T**

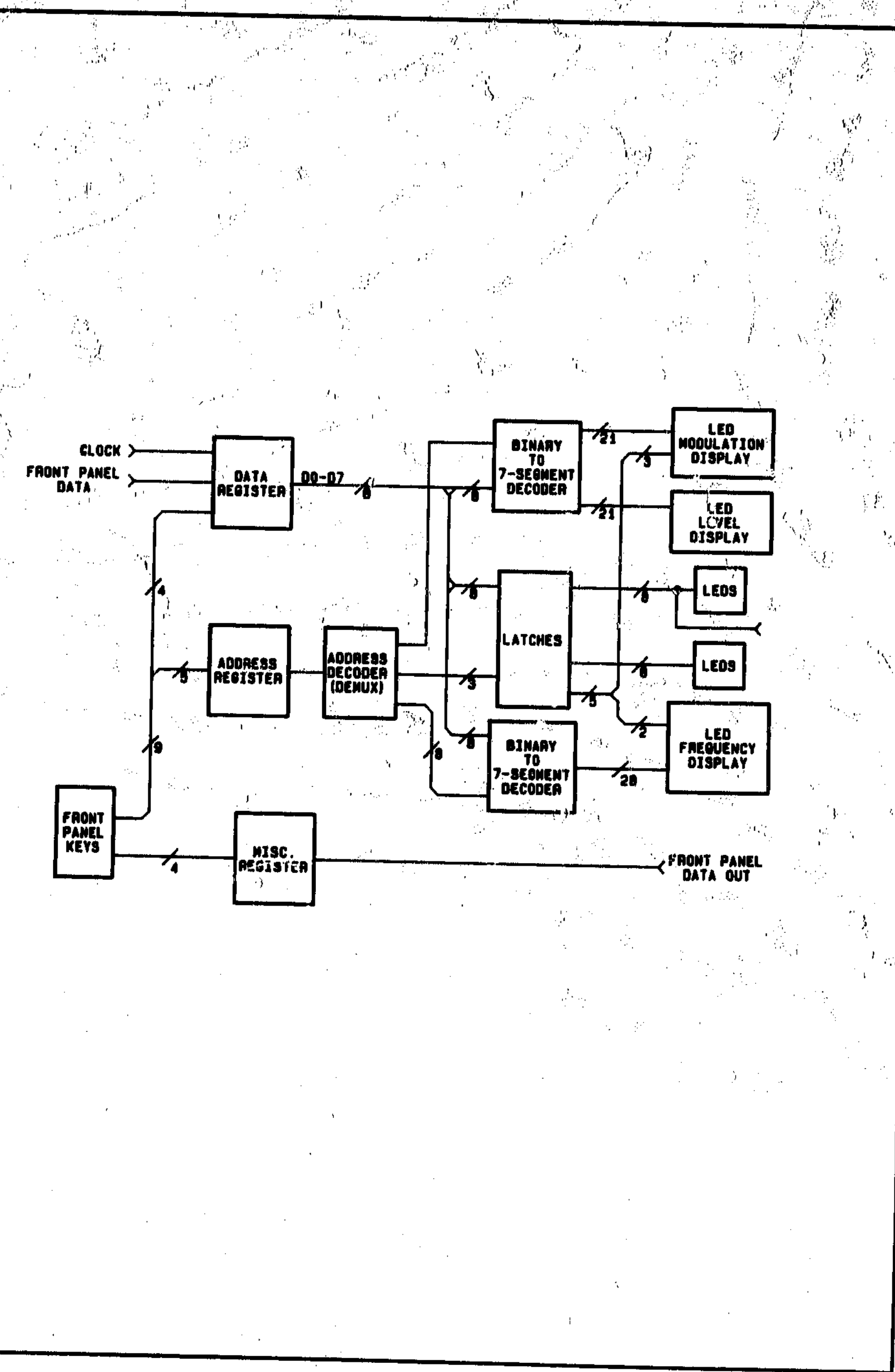
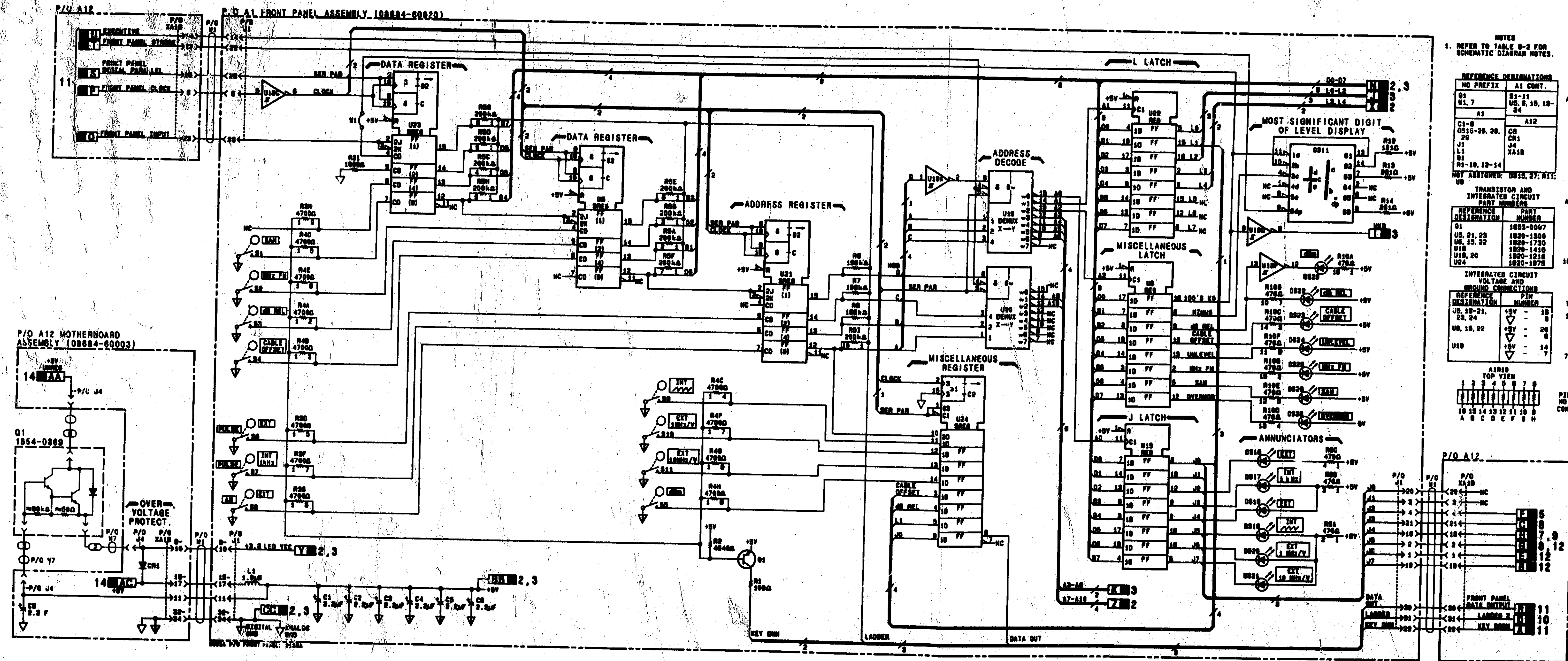


Figure 8-20. Front Panel Simplified Block Diagram



NOTES  
1. REFER TO TABLE 8-2 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS

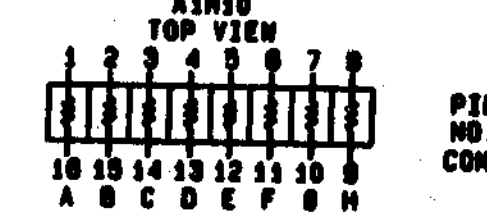
NO PREFIX	A1 COMY.	A1US, 18-21, 23, 24	CIRCUIT BOARD TOP VIEW
01	US, 8, 18, 18-24	A1US, 18-21, 23, 24	CIRCUIT BOARD TOP VIEW
01-8	US, 8, 18, 18-24	A1US, 18-21, 23, 24	CIRCUIT BOARD TOP VIEW
0516-20, 20, 29	US, 8, 18, 18-24	A1US, 18-21, 23, 24	CIRCUIT BOARD TOP VIEW
J1	US, 8, 18, 18-24	A1US, 18-21, 23, 24	CIRCUIT BOARD TOP VIEW
L1	US, 8, 18, 18-24	A1US, 18-21, 23, 24	CIRCUIT BOARD TOP VIEW
01	US, 8, 18, 18-24	A1US, 18-21, 23, 24	CIRCUIT BOARD TOP VIEW
R1-10, 12-14	US, 8, 18, 18-24	A1US, 18-21, 23, 24	CIRCUIT BOARD TOP VIEW
US	US, 8, 18, 18-24	A1US, 18-21, 23, 24	CIRCUIT BOARD TOP VIEW

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER	TOP VIEW
01	1854-0888	TOP VIEW
US, 24, 29	1854-1300	TOP VIEW
US, 18, 22	1854-1700	TOP VIEW
U18	1854-1410	TOP VIEW
U18, 20	1854-1210	TOP VIEW
U24	1854-1875	TOP VIEW

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	VOLTA	GROUND CONNECTION	TOP VIEW
J8, 18-21, 23, 24	+5V	18	TOP VIEW
US, 18, 22	+5V	20	TOP VIEW
U18	+5V	14	TOP VIEW



P/O A12

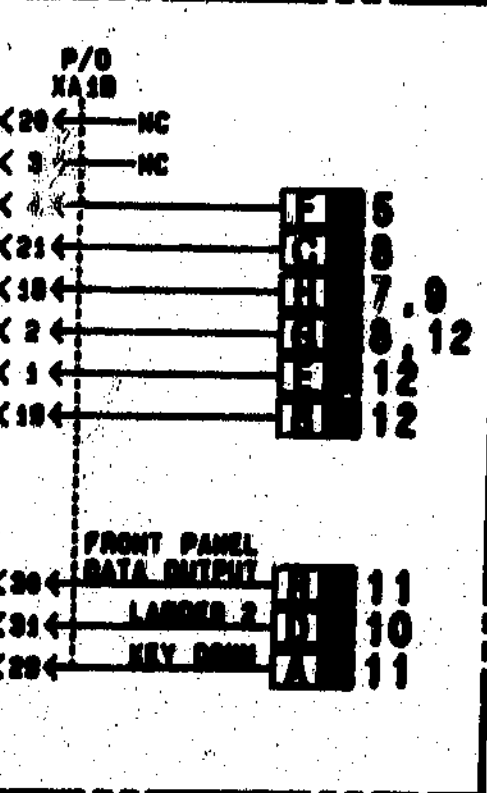


Figure 8-21. P/O Front Panel Schematic Diagram

## SERVICE SHEET 2 P/O FRONT PANEL

### PRINCIPLES OF OPERATION

#### General

The schematic diagram on this service sheet shows the frequency display and related circuitry. The seven segments of the displays are driven by binary-to-seven-segment decoders. The decimal points are driven by the L3 and L4 data lines.

#### Binary to Seven Segment Decoders

After the address and data information is shifted into U5, U21, and U23 (see Service Sheet 1), the decoders for the two most significant digits in the display are addressed. Data on the eight data lines at that instant is in the form of two four-bit binary groups representing the information to be displayed in the two most significant digits. The four bit code on data lines D0-D3 is decoded by U10 and the four bit code on data lines D4-D7 is decoded by U9. After the information is decoded and latched, the two least significant digits are addressed and display data is latched into them.

### TROUBLESHOOTING

1. Observe the frequency display while changing frequency. If non-adjacent numbers in the display seem to track one another, check for the possibility of a data line that does not change state or a data latch that is permanently enabled.
2. Tune the frequency control to the lowest frequency obtainable. The display should indicate <2.300 GHz and be stable. If the display is not stable, go to Service Sheet 10 to troubleshoot problems with R1, the frequency potentiometer, and associated components.
3. Slowly tune the frequency while watching the least significant digit. Numbers from 0 through 9 should be obtainable, although there may be gaps due to the limitation of the analog to digital converter. The intent here is to be sure all numbers can be stored and displayed.
4. Repeat number observation for the next digit. If some numbers cannot be displayed in all positions, go to Service Sheet 1 to troubleshoot possible problems with data registers A1U22 and A1U5. Otherwise continue to the next step.
5. Tune from 2.3 to 6.5 GHz while observing the most significant digit of the frequency display. Make sure all appropriate numbers can be displayed. If some numbers cannot be displayed, use the schematic to troubleshoot the latches and displays.

A1 FRONT PANEL ASSEMBLY

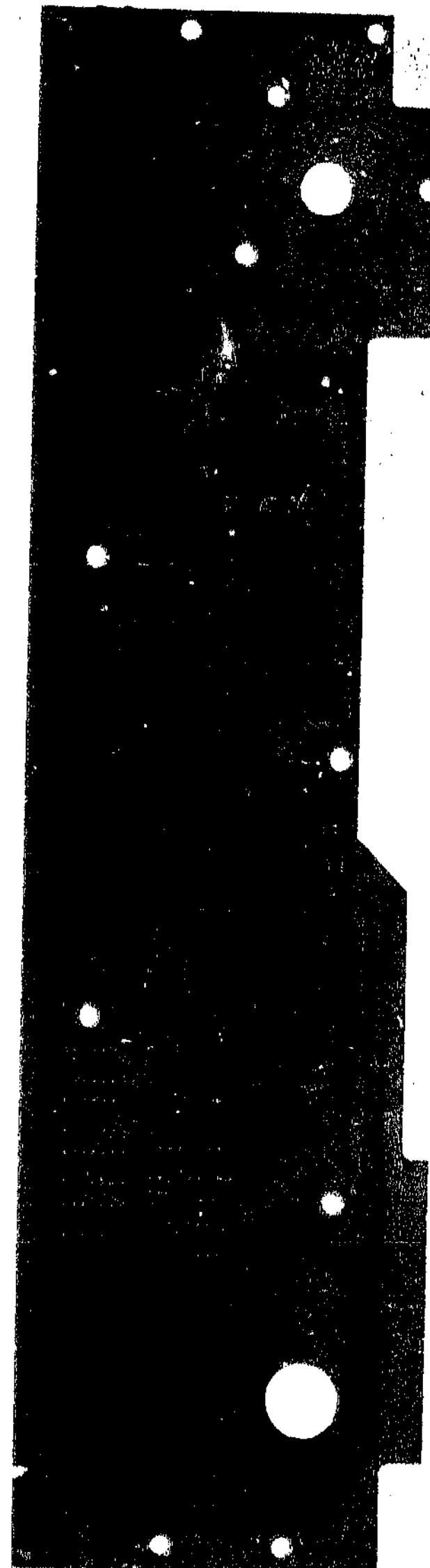


Figure 8-22. Front Panel Component Locations





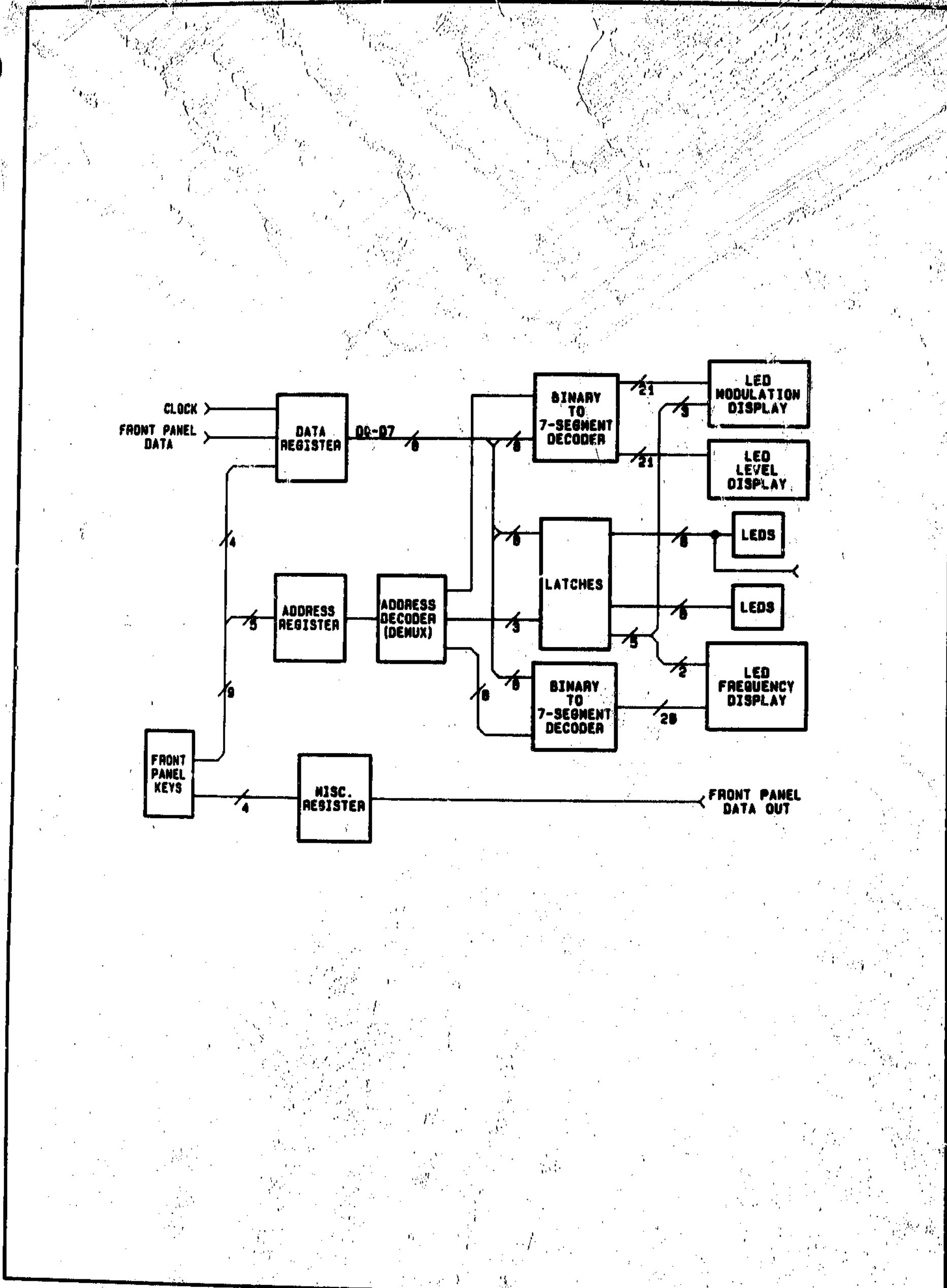
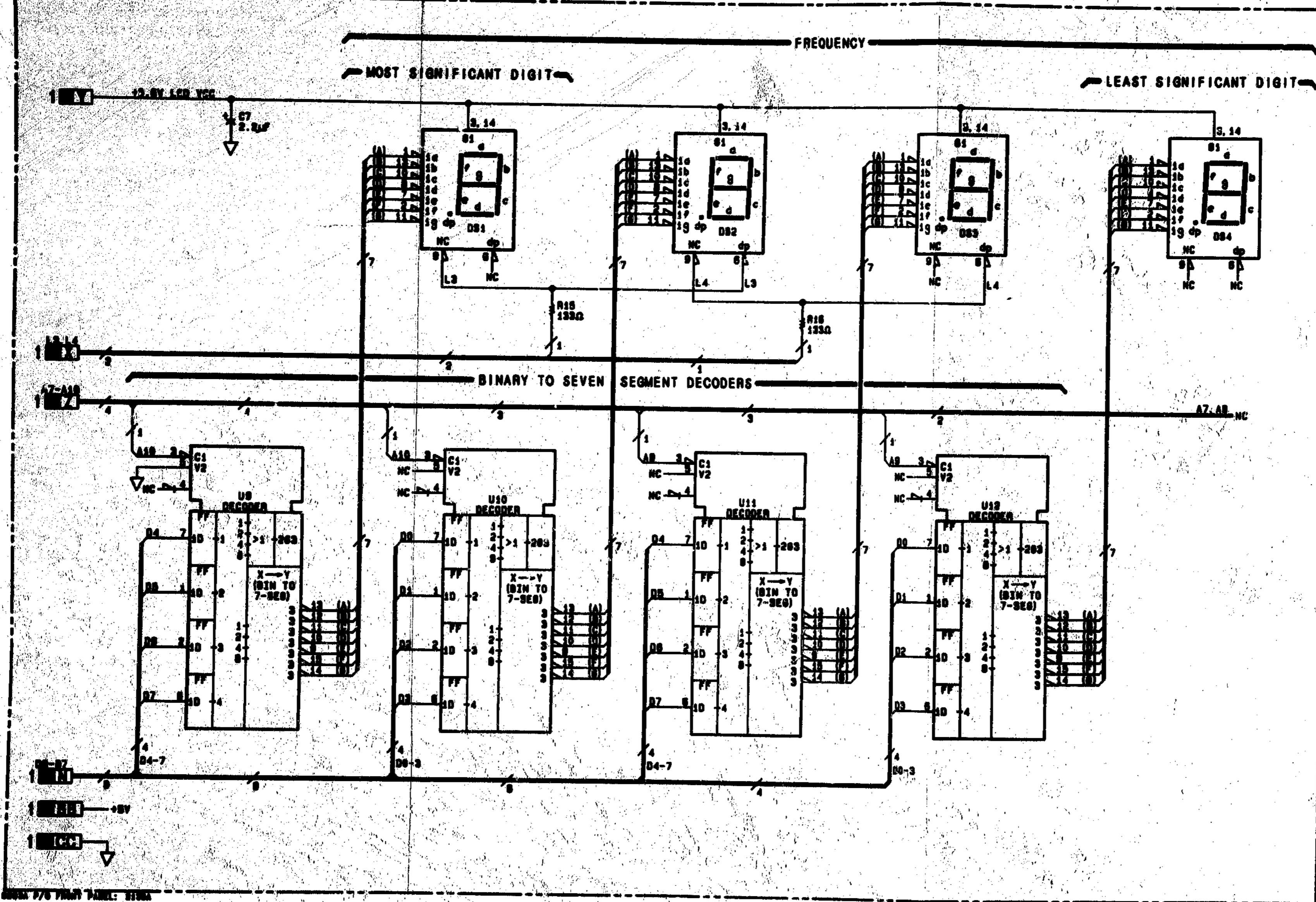


Figure 8-23. Front Panel Simplified Block Diagram

P/O A1 FRONT PANEL ASSEMBLY (08984-60020)



NOTES  
1. REFER TO TABLE 8-2 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS

A1	
C7	
DS1-4	
R15, 16	
U9-12	
NOT ASSIGNED: DS5-7; U1, 13, 14	

SEVEN SEGMENT DISPLAYS AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
DS1-4	1990-0511
U9-12	1920-1361

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U9-12	+5V - 16
	⏏ - 8

FORM 776 FRONT PANEL: 8188A

2  
P/O A1

Figure 8-24. P/O Front Panel Schematic Diagram

### SERVICE SHEET 3 P/O FRONT PANEL

#### PRINCIPLES OF OPERATION

##### General

The schematic diagram on this service sheet shows the modulation level displays related circuitry. Operation of the circuitry on this service sheet is similar to the operation of the circuitry on Service Sheet 2. The display segments are driven by binary-to-seven-segment decoders. The decimal points in the modulation display are driven by the L0, L1, L2, and L3 data lines. The decimal point in the level display is fixed to one decimal place via a 133Ω resistor to ground.

##### Binary to Seven Segment Decoders

U2 and U4, the decoders that drive the two least significant digits of the modulation display, are enabled via the same device select line. The same is true of U7 and U17, the decoders that drive the two least significant digits of the level display. Data to be decoded by these devices is in the form of two four-bit binary groups that exist on the eight data lines. The four lower order data bits go to one decoder in an addressed pair while the four higher order data bits go to the other decoder in the addressed pair. The decoders that drive the most significant digit in both displays have an extra control line. When this line is set high, the associated display will be blanked. The display will be blanked when it is a leading zero occurring before the decimal point.

#### TROUBLESHOOTING

This troubleshooting procedure should be used in conjunction with the information included on Service Sheets 1 and 2 since they all involve the same circuit board.

1. Set the LEVEL controls (both range and vernier) fully clockwise. The LEVEL display should read 15.0 and the lamp in the dBm key should be on. If the dB REL lamp is on, press the dBm key to change display modes. If the proper mode cannot be selected, go to Service Sheet 1 to continue troubleshooting.
2. Rotate the range and vernier controls fully counterclockwise. The LEVEL display should read -130.0 dBm. If the display is correct for steps 1 and 2, continue to the next step, otherwise go to step 7.
3. Rotate the range switch while watching the LEVEL display. The display should change in exactly 10 dB increments up to -10 dBm. There should be a 10 dB change for each click of the switch. If the display changes correctly, continue to the next step. Otherwise go to step 14.
4. Slowly rotate the vernier while watching the LEVEL display. The display should change in 0.1 dB increments up to +15 dBm. All power levels in this range should be obtainable. Watch the least significant digit to be sure there are no gaps. If all is correct, continue to the next step, otherwise go to step 17.

### SERVICE SHEET 3 (cont'd)

#### PRINCIPLES OF OPERATION

##### General

The schematic diagram on this service sheet shows the modulation level displays related circuitry. Operation of the circuitry on this service sheet is similar to the operation of the circuitry on Service Sheet 2. The display segments are driven by binary-to-seven-segment decoders. The decimal points in the modulation display are driven by the L0, L1, L2, and L3 data lines. The decimal point in the level display is fixed to one decimal place via a 133Ω resistor to ground.

##### Binary to Seven Segment Decoders

U2 and U4, the decoders that drive the two least significant digits of the modulation display, are enabled via the same device select line. The same is true of U7 and U17, the decoders that drive the two least significant digits of the level display. Data to be decoded by these devices is in the form of two four-bit binary groups that exist on the eight data lines. The four lower order data bits go to one decoder in an addressed pair while the four higher order data bits go to the other decoder in the addressed pair. The decoders that drive the most significant digit in both displays have an extra control line. When this line is set high, the associated display will be blanked. The display will be blanked when it is a leading zero occurring before the decimal point.

#### TROUBLESHOOTING

This troubleshooting procedure should be used in conjunction with the information included on Service Sheets 1 and 2 since they all involve the same circuit board.

5. Select EXTERNAL AM. The MODULATION display should indicate 0.0 and the lamp in the % AM key should be on. Set the RF power level to 0 dBm so there is no possibility of unleveling in the following step.
6. Connect a test oscillator to the AM INPUT connector. Set the AM vernier fully clockwise. Set the test oscillator to 1 kHz at 0.8 Vrms. The MODULATION display should read 99.9% and the OVERMOD lamp should be on. Reduce the test oscillator output slowly. At approximately 0.7 Vrms the number shown in the modulation display should begin decreasing. The display should decrease in 0.1 or 0.2 increments as the input voltage is dropped. The resolution will depend on the resolution of the DAC on the A8 I/O board. Observe the display to be sure all numbers can be displayed. It may not be possible to get all the way down to 0.0% with a modulation source attached. If all is correct up to this step, it appears that the board is working properly and that much of the instrument is working. If there is a problem with the instrument, go to troubleshooting for Block Diagram 1 to help isolate it.
7. Select Test 08 to test the attenuator potentiometer. Rotate the LEVEL range switch fully clockwise. The FREQUENCY display should read about 0.9 Vdc. Rotate the range switch counterclockwise. The voltage should rise about 0.6 to 0.7 volts per step up to about 8.8 Vdc at the lowest power setting. If these voltages are stable and of the proper level, go to the next step. Otherwise go to Service Sheet 10 to troubleshoot problems with R6 or the circuitry that reads it.
8. Select Test 09 to test the LEVEL vernier potentiometer. Rotate the LEVEL vernier fully counterclockwise. The FREQUENCY display should read 0.0 Vdc and be stable. Rotate the vernier fully clockwise. The display should rise smoothly up to about 10.23 Vdc. If the voltages are incorrect, go to Service Sheet 7 to troubleshoot R7, the LEVEL vernier, and the circuitry that reads it.
9. Carefully observe the level display. If only the most significant digit of the level display is incorrect, go to Service Sheet 1. If the least significant and the tens digits are both incorrect, but not the units digit, the problem is probably due to a malfunction on the input data bus. Select Test 30 to test A1U5, U21 and U23. These are the latches involved with the storage of data on the front panel board. Other flip-flops and latches are also tested by this procedure. If all the flip-flops being tested are working properly, the frequency display should read -OP-. Otherwise the display should give two numbers, the first being the reference designator of the board and the second being the reference designator of a specific integrated circuit. If the failure is in one of the front panel data latches, the frequency display may be incorrect. If this is the case, use an external terminal attached to the edge connector labeled RS232 on the CPU board to get information without using the front panel board. See the intro-

### SERVICE SHEET 3 (cont'd)

ductory material at the beginning of Section VIII for information on the use of this connector.

10. Remove the front panel to allow access to the back of the front panel board. This removal is accomplished by removing all screws under the top trim strip and three screws on the bottom of the frame. Also remove the frequency tuning knob and disconnect the white and yellow coax cables. Carefully slide the front panel forward and support it at a 45 degree angle so the back can be reached. Remove the insulating board mounted on the back of the front panel board.

11. Set the LEVEL range and vernier fully clockwise, which should be 15.0 dBm, although the display may not show it. If the display is correct go to step 13. Otherwise continue with this step. Use a voltmeter to look at the signals driving the displays. The following lines should read 2 Vdc: A1DS12 pins 10 and 13; DS13 pins 1, 2, 8, 10, and 11; DS14 pins 1, 2, 7, 8, 10, and 13. Drive inputs not listed should be at about 2.5 Vdc. If these are correct, measure pins 3 and 14 to be sure 3.6 Vdc is present. If all is correct, replace the defective LED display. Otherwise replace the defective decoder, A1U16, U17 or U7 depending on which digit is incorrect, or troubleshoot the power supply problem if there is a problem with the 3.6 Vdc supply.

12. Change the range and vernier controls to find an incorrect level display. Probe the input data lines into the LED displays to isolate the malfunction to the display or the decoder. Note the lettering adjacent to each segment of the LED display on the schematic. The input line with the same letter should be high to turn that segment on. If you cannot find an incorrect display, you have taken an incorrect branch to get to this step. Return to step 1 and retest the MODULATION and LEVEL displays.

13. If the level display doesn't change each time the switch is clicked, go to step 16.

14. Observe the display while changing power levels to determine if the fault is due to a problem with a display segment or with a data input line. In other words, is a display segment stuck on/off or is there an offset from the expected digit that could be attributed to a stuck line on the data bus? If the problem is a stuck segment go to step 12. If the problem appears to be a stuck data line go to step 9.

15. Note where the display does not change. If the problem is at one end or the other of the power range, there is likely a problem with R6, the range potentiometer or with the circuitry that reads it. Check the voltage range of the potentiometer using Test 08. The range should be as shown in step 7.

16. Select Test 32 to check the ability of the front panel displays to show all possible numbers. All digits of the display should cycle

### SERVICE SHEET 3 (cont'd)

continuously through the following sequence:

0 . 1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9 . E . H . L . P

If the entire sequence can be displayed in the LEVEL display, go to Service Sheet 7 to troubleshoot LEVEL vernier problems.

17. Select NORMAL mode on the service switch. Observe the display while changing vernier levels to determine if the fault is due to a problem with a display segment or with a data input line. In other words, is a display segment stuck on/off or is there an offset from the expected digit that could be attributed to a stuck line on the data bus? If the problem is a stuck segment go to step 12. If the problem appears to be a stuck data line go to step 9.

#### A1 FRONT PANEL ASSEMBLY



Figure 8-25. Front Panel Component Locations

P/O Front Panel  
P/O A1  
SERVICE SHEET 2

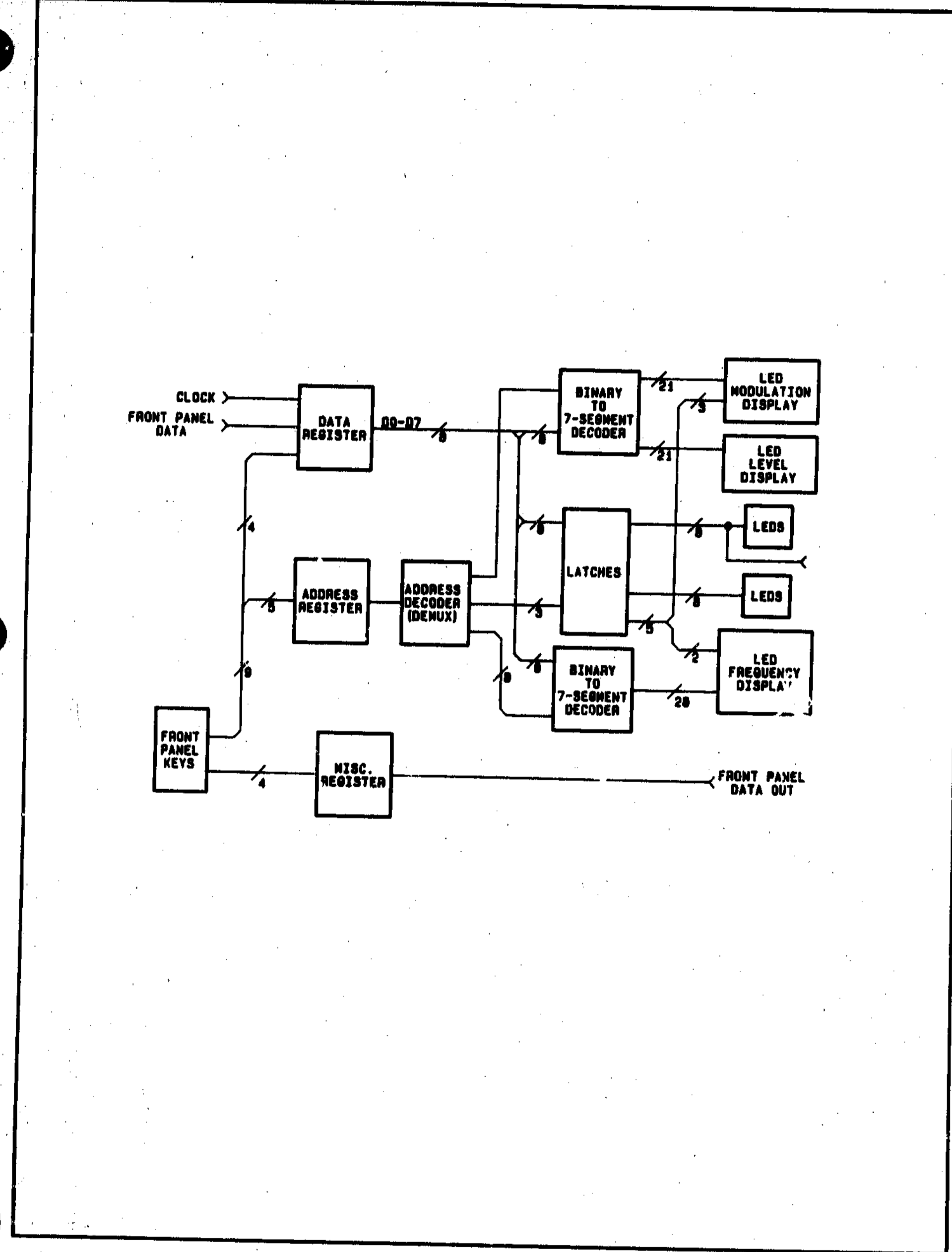
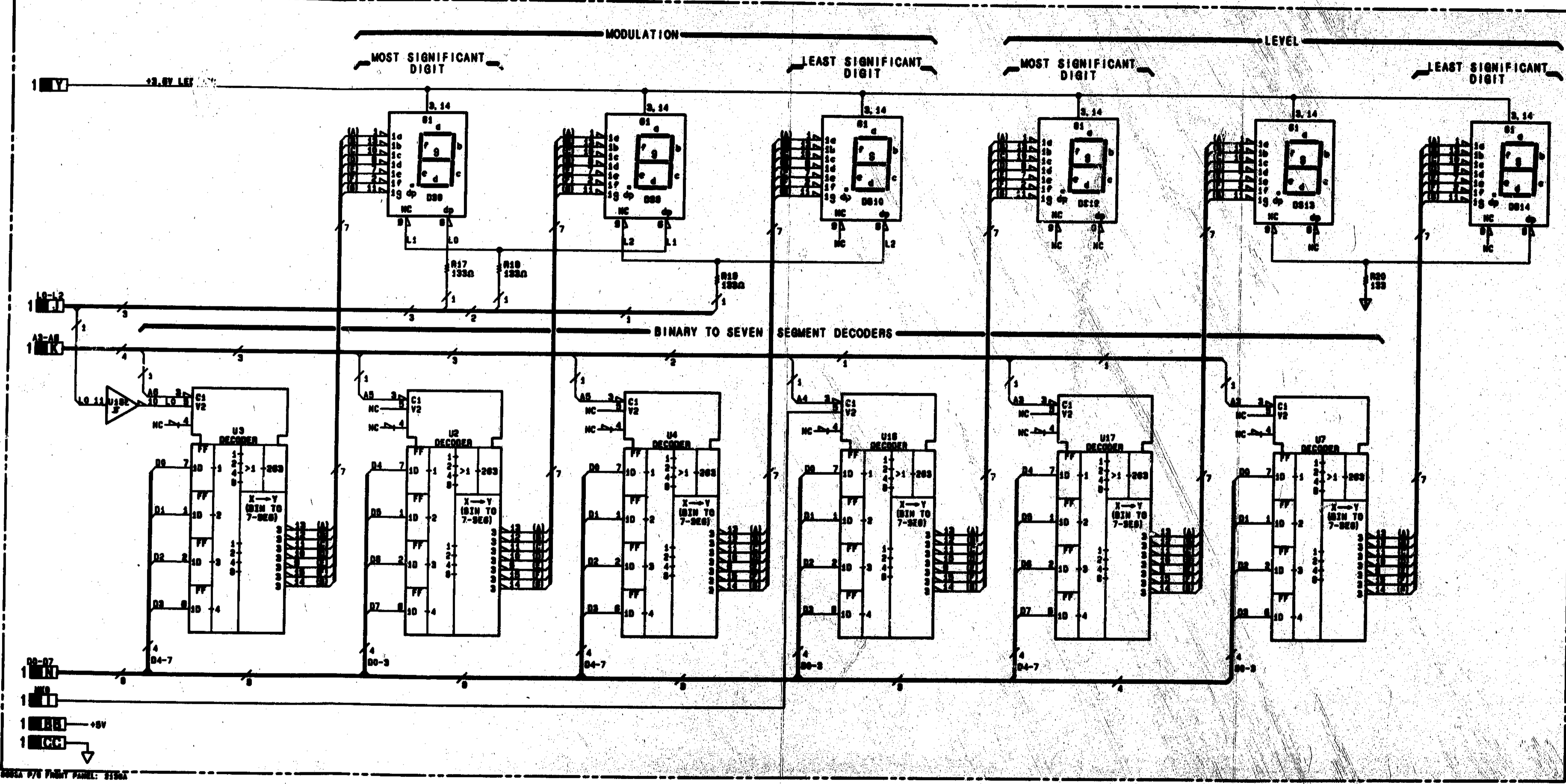


Figure 8-26. Front Panel Simplified Block Diagram

P/O A1 FRONT PANEL ASSEMBLY (08684-60020)



08684 P/O FRONT PANEL: 8236A

Figure 8-27. P/O Front Panel Schematic Diagram

NOTES  
1. REFER TO TABLE 8-2 FOR SCHEMATIC DIAGRAM NOTES.

REFERENCE DESIGNATIONS	
A1	
086-10, 12-14	
R17-20	
U2-4, 7, 16-18	

SEVEN SEGMENT DISPLAYS AND INTEGRATED CIRCUIT PART NUMBERS	
REFERENCE DESIGNATION	PART NUMBER
086-10, 12-14	1800-0011
U2-4, 7, 16, 17	1820-1361
U18	1820-1418

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS		
REFERENCE DESIGNATION	VOLTS	PIG NUMBER
U2-4, 7, 16, 17	+5V	18
	∇	8
U18	+5V	14
	∇	7

**SERVICE SHEET 7  
ALC CONTROL**

**PRINCIPLES OF OPERATION**

**General**

The ALC Control Assembly accepts the ALC ERROR voltage from the ALC Detector Amplifier Assembly and a voltage generated by the front panel LEVEL vernier control. These two inputs control the circuit which generates the current needed to drive the ALC PIN Modulator in the power amplifier (in the microwave chain). This changes the actual power output monitored by the ALC Detector Amplifier Assembly and thus completes the loop. The loop acts to drive the ALC ERROR voltage generated by the ALC Detector Amplifier Assembly as close to zero as possible.

**Sampling FET Switch Driver, and Integrator**

The ALC Error voltage enters the board on the red coaxial cable from the ALC Detector Amplifier Assembly. It immediately passes through the ALC GAIN 1 adjustment, or through an FET, Q22, which bypasses the adjustment if the user has selected Pulse mode. The adjustment sets the gain of an integrator made up of U2 and capacitors C17 and C19. (C17 is much larger than C19, however, and is thus dominant when it is in the circuit.) Between the adjustment and the integrator is an FET, Q5, that acts as a switch during Pulse mode. By switching the input to the integrator on only during the time that there is actually a pulse present, the integrator is charged to the peak of the pulse. This allows the pulses to be leveled even though the signal in the loop is being switched on and off by the ALC Modulator in the Microwave Chain. Both capacitors, C17 and C19, are selected during Pulse Modulation, and the gain of U2 is increased by shunting the ALC GAIN 1 adjustment.

**Gain Compensation**

From U2 the signal is fed to one side of differential pair Q8C and Q8D. This circuit does three things:

1. The voltage swing at the output of U2 is transformed into a current swing at the collector of Q8D.
2. The base of Q8D is ac-coupled to the input ground line of the integrator. This serves to cancel out high frequency noise that appears on the ground side of the input connector, X1.
3. The maximum allowable ALC Modulation drive signal level is set at this point due to the limited current availability from Q2. This limits the PIN modulator drive signal during unlevelled conditions to a safe level.

**ALC Modulator Driver**

The output current from Q8D drives the emitters of Q8A and Q8B. Current flow through Q8A is controlled by the setting of the front panel LEVEL vernier control. The current ultimately delivered by Q3A is thereby controlled by the LEVEL vernier. The collector of Q3A drives the negative input of amplifier U5, which in turn drives the final output transistor, Q12. The signal from Q12 goes through a shaper circuit which compensates for the logarithmic characteristics of the PIN Modulator.

**SERVICE SHEET 7 (cont'd)**

The feedback paths around U5 perform several important functions. C31 locally stabilizes the combination of U5 and Q12. It also provides high frequency rolloff to help maintain loop stability. In the highest microwave power range, Q1 is turned on to put the series combination of C30, R40, and R50 in parallel with R53. This decreases the net gain of U5. R40 is set so the current reduction from Q12 corresponds to an ultimate increase in output power of 10 dB at the front panel, while the net gain of U5 is decreased by 10 dB.

**Unlevel Detector**

A group of comparators on the board monitors the ALC Modulation signal and the REF UNCAL signal to generate an AM Overmod flag if either signal is outside its normal operating range. This flag is used to indicate that the power output is not what it should be. It is also used to indicate that the AM percentage currently being used is too much. This is done under the rationale that if the power being requested cannot be delivered, the instrument certainly cannot deliver enough for the peak of any AM waveform. Also the emitter voltage of Q8B is monitored to detect conditions where the microwave amplifier is being driven to deliver maximum power.

**100 ms One Shot**

When an overmodulation or unlevel situation is detected, one or more of the outputs of U1 will be pulled low. This causes transistor Q13, which had previously been off, to turn on. With the transistor off, the current that flows through R64 from the +5 volt power supply will begin charging C35. The voltage on C35 is compared to a one volt reference at the inverting input of U3B. When the voltage of C35 drops below Vref, the output of the comparator goes low, where it stays until the cause of unleveling or overmodulation is remedied.

**TROUBLESHOOTING**

This procedure is used to determine which circuit board may be at fault in a failure of the ALC loop. The technician will be directed to specific troubleshooting procedures for an individual board after initial checks give reasonable assurance that the problem lies on that board.

Set initial conditions by making sure all modulation is off (including pulse) and CABLE OFFSET is off. Set the operating frequency to about 5 GHz (mid-band).

1. Set the front panel LEVEL range and vernier controls to obtain a display of -10 dBm on the Signal Generator front panel. The UNLEVEL light should be out. If the unlevel light is on, go to step 8 to continue. Otherwise continue to the next step.
2. Change the range switch to get a 0 dBm display. The UNLEVEL light should be off. If the light comes on go to step 15. Otherwise continue to the next step.

**SERVICE SHEET 7 (cont'd)**

3. Connect power meter to the microwave OUTPUT connector. The meter should read  $0.0 \pm 2.5$  dBm. Slowly tune from 2.3 to 6.5 GHz while observing the actual power output. It should remain within  $\pm 1$  dB across the band, and the UNLEVEL light should remain off.

4. Turn off pulse and select EXTERNAL AM. Attach the 600 ohm output of a Test Oscillator to the AM INPUT. Set the Test Oscillator to 10 kHz at 0.5 volts rms. The display on the Signal Generator should indicate about 70% modulation (since modulation in this instrument is calibrated to correspond to the peak voltage). The display on the spectrum analyzer should show the fundamental modulation sidebands about 9 dB below the carrier. If everything is correct in this step, the ALC loop appears to be working properly. If AM performance is not as indicated, troubleshoot A7 board on Service Sheet 9.

5. Connect power meter to the microwave OUTPUT connector. If no (or very little) power is being delivered continue to next step. If higher than desired power is being delivered go to step 13.

6. Connect power meter to rear panel AUX. OUTPUT connector. The signal there should be  $> -15$  dBm. If the signal is correct, continue to the next step. Otherwise go to Block Diagram 2 troubleshooting since the cause of failure is not ALC.

7. Remove the top cover and locate the A7 ALC Reference board. With the high impedance input of an oscilloscope measure the 30 MHz Reference output from that board. With the range and vernier fully clockwise the 30 MHz signal should be about 4 Volts peak to peak. If the signal is present go to the next step, otherwise go to Service Sheet 9 to continue troubleshooting.

8. Remove the bi-pin fuse in front of the power amplifier. Power output should go to the maximum available out of the microwave OUTPUT connector - greater than 0 dBm across the band. If there is still no power output, go to Block Diagram 2 to troubleshoot microwave chain problems.

9. Reinstall the fuse and disconnect the red cable that brings the ALC ERROR voltage to A5. With the error voltage missing, power output should rise to the maximum available. Next, connect a 50 $\Omega$  load or a short to the ALC ERROR input (A5J1); the output power should drop to the minimum obtainable from the ALC modulator, probably -40 dBm or less. If the power varies as stated, troubleshoot the A6 board, otherwise troubleshoot the A5 board.

10. Connect power meter to the microwave OUTPUT. Vary the LEVEL vernier. If power can be varied over the range of the vernier, adjustment of the ALC loop boards may be needed.

**SERVICE SHEET 7 (cont'd)**

11. Connect an oscilloscope to the 30 MHz Reference output. With the LEVEL vernier clockwise the signal should be about 4 Vp-p and with the vernier counterclockwise the signal should be about 0.25 Vp-p. Reduce the power output RANGE one step. The front panel display should read -20 dBm and the oscilloscope should read about 0.04 Vp-p. The negative peak of the sine wave may be flattened at the lower voltage levels. If the signal is present at the proper level, go to Service Sheet 8 to troubleshoot the Detector Amplifier Board. Otherwise go to Service Sheet 9 to troubleshoot the ALC Reference Board.

12. Connect a power meter to the microwave OUTPUT connector. If the UNLEVEL light goes out, return to step 3 to continue troubleshooting.

13. Observe the power actually being delivered as shown on the power meter. Unplug the small bi-pin fuse at the front of the power amplifier. This removes all drive from the ALC modulator. The power should go to the maximum obtainable. If that level is still less than 0 dBm, go to Block Diagram 2 to troubleshoot a microwave chain problem. Otherwise continue.

14. Reinstall the bi-pin fuse. Disconnect the ALC ERROR cable from the A5 board. The microwave power output should again rise to the maximum obtainable. If the power does not rise, troubleshoot A5, the ALC Control board. Otherwise go to step 10 to continue troubleshooting.

**Board Level Troubleshooting For A5, the ALC Control Board**

1. Set indicated power output to -10 dBm in the top power range. If this can not be done, go to step 7.

2. Connect a spectrum analyzer or power meter to the RF OUTPUT connector.

3. Disconnect the red coax cable from the ALC ERROR input. This opens the ALC loop and should cause the power output to rise to the maximum available ( $> 0$  dBm). Also, the UNLEVEL light should turn on. If this works properly continue to the next step, otherwise go to step 9.

4. Install the ALC Control board on a 2 x 18 extender board. Measure the voltage at the emitter of Q14 with a dc voltmeter. With the LEVEL vernier clockwise, the emitter should read about 10.8 Vdc. With the vernier counterclockwise, it should read about 0.7 Vdc. If the levels are incorrect, go to step 6.

5. Attach a low voltage power supply to the ALC ERROR input. A very small positive voltage (greater than about 25 millivolts) should cause the modulator to turn off and the power output to drop by  $> 60$  dB (typically). Measure the voltage at TP4. It should be about 0.3 Vdc with the ALC ERROR input disconnected and about -7.5 Vdc with the small positive voltage applied. If the

**SERVICE SHEET 7 (cont'd)**

voltages are proper but the microwave signal is not responding properly, go to Block Diagram 2 to continue troubleshooting. If the voltages are incorrect go to step 10.

6. Measure the voltage at the base of Q21 with the LEVEL vernier fully clockwise. The voltage should read about 10.2 Vdc. With the vernier counterclockwise it should read near 0 Vdc. If the voltages are correct, troubleshoot Q14, Q20 and Q21. If the voltages are incorrect, troubleshoot Q20, Q21 and R7.

7. Install the A5 board on a 2x18 extender. Measure the voltage at the emitter of Q20. With the LEVEL vernier fully clockwise, the voltage should read about 10.2 Vdc. With the vernier fully counterclockwise it should read about 0.05 Vdc. If the voltages are correct, go to Service Sheet 10 to continue troubleshooting problems with the reading of the vernier voltage.

8. Connect voltmeter to the rear panel RELATIVE VERNIER LEVEL connector. This output should read about 10.2 Vdc with the vernier clockwise and 0.0 Vdc with the vernier counterclockwise. If the voltage doesn't vary properly, check Q20 and Q21 for leakage and R7 for proper connection and operation.

9. Measure the voltage at A5TP4 with the red coax disconnected. It should read near 0 volts. If the voltage is correct but the microwave power output is low, go to Service Sheet 2 to continue troubleshooting. If the voltage is incorrect, use the voltages on the schematic to find the failure. If both the power and voltage are correct but the UNLEVEL light does not turn on, troubleshoot U1, U3 and associated components.

10. Measure the voltage at TP3 with the ALC ERROR input terminated in a 50 $\Omega$  load. The voltage should read about -11 Vdc. Remove the load. The voltage should change to about +0.6 Vdc. If the voltages are incorrect troubleshoot U2, Q5, Q22 and associated components.

11. Measure the voltage at the collector of Q8D. With the load disconnected it should read about 0.6 Vdc. With the load installed the voltage should change to about -0.8 Vdc. If the voltages are incorrect, use the voltages on the schematic to troubleshoot the gain compensation circuit. Otherwise troubleshoot Q8A, Q8B, Q3A, and Q3B.

Service

HP 8683A

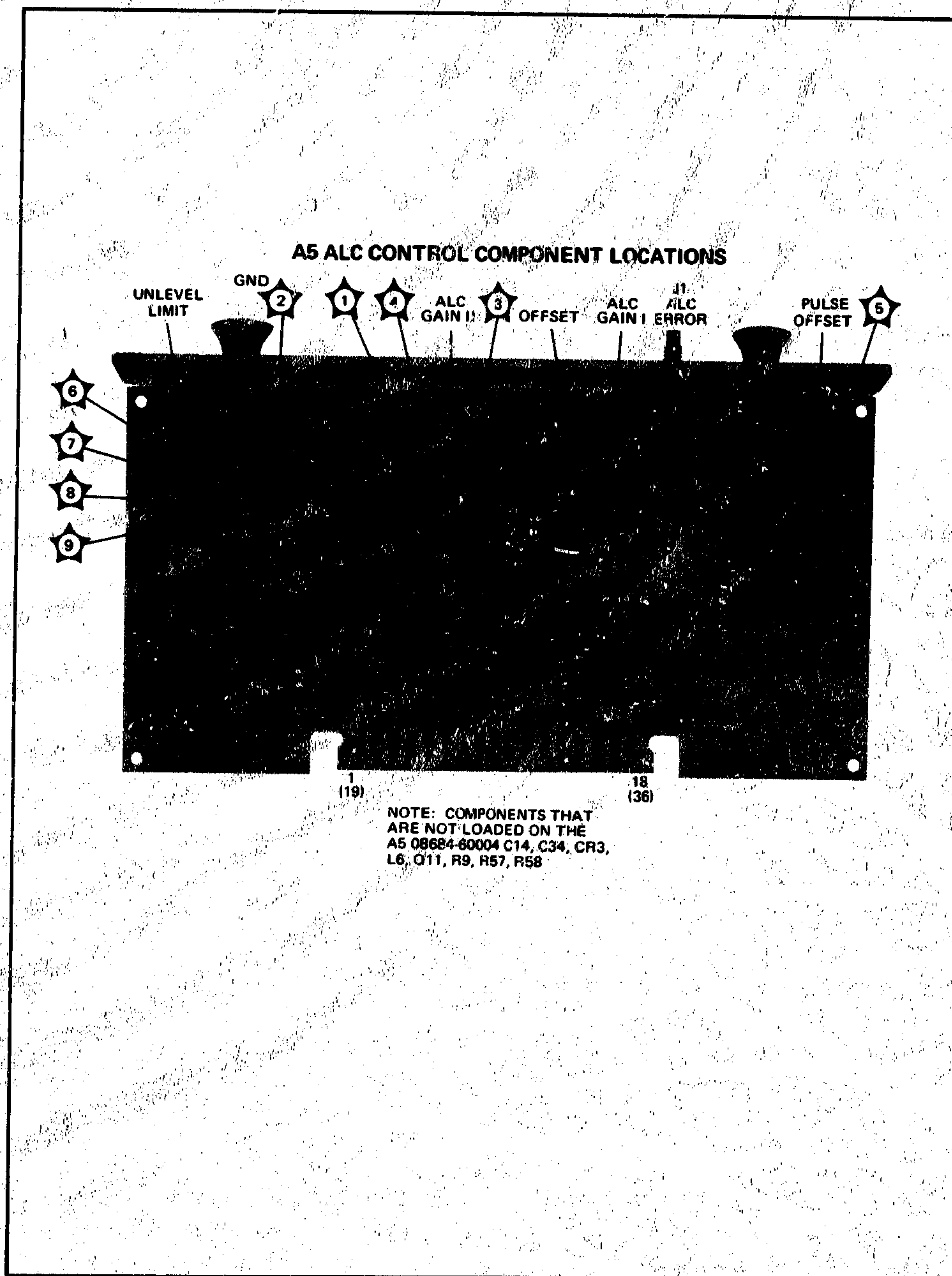


Figure 8-28. ALC Control Component Locations

← P/O Front Panel  
P/O A1  
SERVICE SHEET **3**

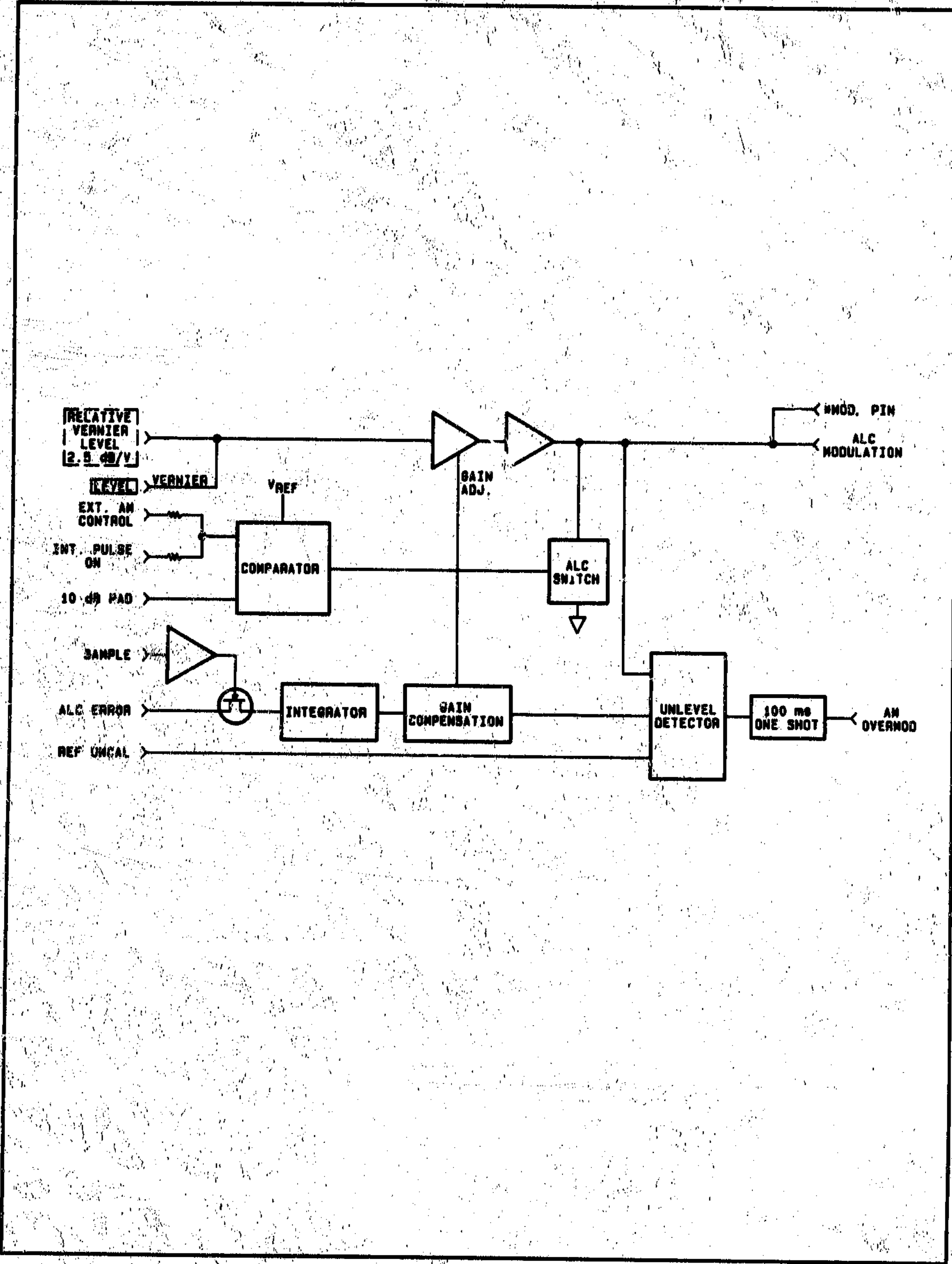
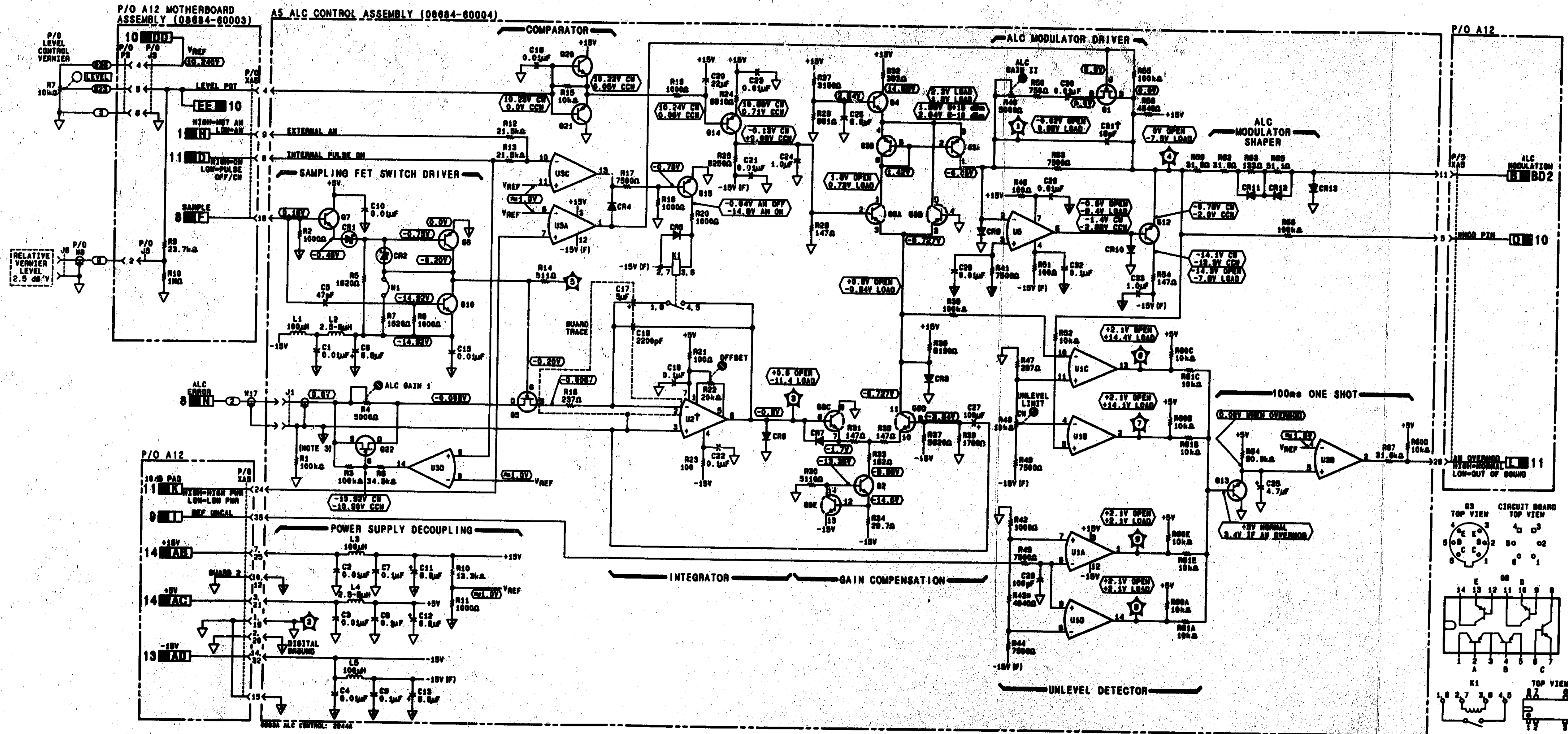


Figure 8-29. ALC Control Simplified Block Diagram



- NOTES
- REFER TO TABLE 8-2 FOR SCHEMATIC DIAGRAM NOTES.
  - PHONETICS PRECEDED BY AN ASTERISK (\*) ARE SIGNAL LINES USED BY THE MICROPROCESSOR.
- REFERENCE DESIGNATIONS FOLLOWED BY AN ASTERISK (\*) ARE FACTORY SELECTED COMPONENTS. THE TYPICAL VALUE IS SHOWN. REFER TO SECTION V FOR SELECTION PROCEDURE.
- † INDICATES CIRCUIT CHANGE. SEE SECTION VII.

NO PREFIX	AS (CONT)	LOGIC LEVEL
JB	01-8, 10, 12-20	HIGH
PA	18, 20-22	LOW
WB, B	R1-8, 10-25, 27-38, 58-67	< 15 MORE POS. THAN NEG.
AD	U1-3, 5	OPEN
CR1, 2, 4-13	A12	WICKED, LOW
J1	J3, 5	
N1	R8, 10	
L1-5	RAS	

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
Q1	1825-0414
Q2, 4	1824-0477
Q3	1824-0426
Q4	1825-0425
Q5	1825-0434
Q7, 10	1824-0472
Q8	1825-0426
Q12	1825-0414
Q13-15, 21	1823-0426
Q20	1824-0410
Q22	1020-0420
U1, 3	1822-0138
U2	1822-0801
U5	1822-0785

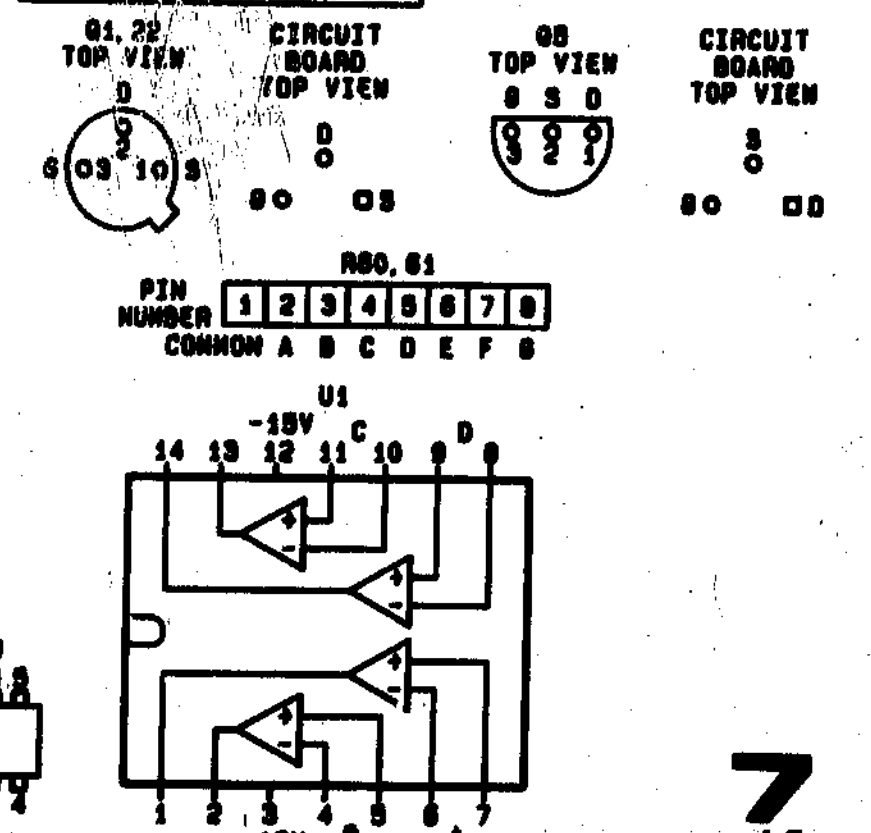


Figure 8-30. ALC Control Schematic Diagram

**SERVICE SHEET 8  
ALC DETECTOR AMPLIFIER**

**PRINCIPLES OF OPERATION**

**General**

The ALC Detector Amplifier Assembly, A6, contains four circuits. However, only one circuit, the one that produces the ALC Error signal is used by the ALC loop. The other three circuits produce signals that are used elsewhere in the Signal Generator.

The first major circuit compares the voltage levels from the ALC Microwave Detector and the ALC Reference Detector. From this comparison comes a voltage called ALC Error whose amplitude is the difference between the two voltages being compared. This ALC Error voltage is processed by circuitry shown on Service Sheet 7 and ultimately used to change the attenuation of the ALC Attenuator in the Power Amplifier (Service Sheet BD2). Thus, the ALC Error signal causes the leveling of the power output of the signal generator.

The second and third circuits are two 1 kHz oscillators (one called the 1 kHz Oscillator and the other called the FM Sawtooth Generator). The 1 kHz Oscillator generates a square wave used in pulse modulation. The FM Sawtooth Generator produces a sawtooth used in frequency modulation. The Internal FM Sawtooth signal is sent to the FM INPUT/OUTPUT connector and through the FM CAL potentiometer to the FM Shaper Assembly (Service Sheet 12). It is not used by the ALC loop.

**Pulse Modulator Driver**

The Pulse Modulator Driver, the fourth major circuit, is fed by the 1 kHz square wave, produced by the 1 kHz Oscillator. The Pulse Modulator Driver is also fed by the front panel EXT PULSE input. The signal produced by the Pulse Modulator Driver is fed to the ALC Modulator.

**Detector Amplifier**

The microwave and 30 MHz signals received from the ALC Reference Board are immediately detected and fed to gates of two FETs in a differential amplifier. The output of the amplifier is taken from the collector of Q14 and fed to a quasi-complementary amplifier made up of Q8, Q9 and Q7. The base of Q8 receives an input from integrated circuit amplifier U4.

U4 acts to minimize any dc offset in the overall detector amplifier. Notice that its positive input has a feedback path from the emitter of Q7. The integrated circuit and the transistors that follow it end up with a voltage gain of 10, set by the ratio of the values of R52 and R44. Detector amplifier offset is adjusted as close to zero volts as possible when both inputs to the ALC Detector Amplifier Assembly are at zero. This arrangement of an FET amplifier with an integrated amplifier in parallel provides both high speed with the FETs and good dc accuracy with the integrated circuit.

**SERVICE SHEET 8 (cont'd)**

Yet another differential amplifier, U7, monitors the detector voltages to generate a diagnostic voltage called \*Det Diff, used by the microprocessor to check the ALC loop. When the loop is leveled, this voltage is very near zero (about 0.01V). If the signal from the Microwave Detector is missing, the \*Det Diff voltage goes to nearly +15 volts; if the output signal from the Reference Detector circuit is missing, the situation is not nearly so clear. On a transient basis the voltage approaches -15 volts but the loop would interpret the lack of a reference signal as a command to reduce the output power of the ALC loop as low as possible. With the microwave signal turned off as much as possible, the detector differential will be slightly positive, very close to the voltage when leveled. The front panel UNLEVEL indicator would turn on under these circumstances because the residual power level is greater than zero.

**TROUBLESHOOTING**

There are three independent circuits on this board. Choose the starting place that deals with the type of malfunction being investigated.

- ALC Problems, start with step 1.
- Pulse Problems, start with step 8.
- FM Problems, start with step 13.

**ALC Problems**

1. Set the front panel LEVEL range and vernier controls to get a display of -10 dBm with all modulation off and CABLE OFFSET off. Select Test 10. The display in the frequency window should be very close to 0 volts. Since you are troubleshooting ALC problems, it probably will be some other value.
2. Disconnect the 30 MHz REF input and the microwave input to the board (located on the side of the board). Terminate both inputs with 50Ω loads. Connect a dc voltmeter to A6J4. The meter should read  $0 \pm 10 \mu\text{Vdc}$ . The board must be installed in its housing and screwed into place to make this measurement valid. If this voltage is correct, continue to step 6 for a few final checks of this board. If the voltage is not within limits, continue to the next step.
3. Put the A6 board on a 2x18 extender. Move the voltmeter to TP8. With the inputs still terminated it should read about +5.9 Vdc. If the voltage is incorrect, use the voltages on the schematic to troubleshoot the differential amplifier made up of Q14, Q15, and Q16. Otherwise continue to the next step.
4. Select Test 10. The indicated voltage should be near zero. If the voltage is correct, continue to the next step. If the voltage is incorrect, troubleshoot the differential amplifier made up of Q14, Q15 and Q16.
5. Measure the voltage at A6TP7. It should be  $0 \pm 0.7 \text{ Vdc}$ . If the voltage is correct, troubleshoot Q7, Q8 and Q9. Otherwise troubleshoot U4 and associated components.

**SERVICE SHEET 8 (cont'd)**

6. Disconnect the microwave input and 30 MHz REF input. Measure the voltage at A6TP5. The voltage should read about -25 mVdc. Disconnect the ALC ERROR output. The voltage at TP5 should not change significantly.
7. Reconnect the microwave input. This will require a longer coaxial cable with SMC connectors. The signal at TP5 should read about 2.6 Vdc. Reconnect the ALC ERROR output. TP5 should drop to about 2 mVdc. If the voltage swings both positive and negative at the correct levels, the ALC part of this board is working properly. Otherwise, troubleshoot the differential amplifier and U4.

**Pulse Problems**

8. Install the board on an extender for these measurements.
9. Return service switch to NORM. Select INTERNAL PULSE mode. Measure signal at edge connector pin 18 on an oscilloscope. It should be a 1 kHz square wave with an amplitude of 13 Vp-p with the low level at -9 volts. If this signal is correct, go to step 11.
10. Measure the signal at A6TP2 on the oscilloscope. It should be a 1 kHz square wave of 3 Vp-p. If the signal is correct, troubleshoot the pulse modulator driver, otherwise troubleshoot the 1 kHz oscillator made of U6 and associated components.
11. Select EXTERNAL PULSE mode and connect a pulse modulator to the PULSE INPUT. Set a pulse width of 1 ms with a rate of 2 kHz and amplitude of > 1V peak. The oscilloscope should show this pulse at edge connector pin 18 with an amplitude of 13 Vp-p. If the signal is missing, continue to the next step. Otherwise go to Block Diagram 2 to troubleshoot the Pulse Modulator.
12. Check the external pulse INPUT that enters this board at A6J2 on the green coax. If the signal is present at this point, with an amplitude > 2 Vp-p, troubleshoot A6U3B, A6U3C, A6U2D and associated components. Otherwise, suspect green coax W10.

**FM Problems**

13. Connect oscilloscope to the front panel FM INPUT/OUTPUT connector. Press the FM INT key. Rotate FM vernier fully clockwise. The sawtooth amplitude should be 2.3 Vp-p at 1 kHz rate. If the signal is correct continue to the next step, otherwise go to step 17.
14. Press the FM INT key again to turn off the sawtooth. If the signal disappears, this portion of the FM circuit is working properly. If there are FM problems, go to Service Sheet 12 to continue troubleshooting.
15. Press FM INT. Observe the signal at A6U1 pin 14. This should be a sawtooth of about 2.3 Vp-p. If the signal is present, troubleshoot Q1, Q3 and Q4, otherwise continue to the next step.

**SERVICE SHEET 8 (cont'd)**

16. Measure the voltage at the base of Q2. It should be about 4.3 Vdc when INTERNAL FM is selected and about 3.7 Vdc otherwise. If the levels are correct, troubleshoot Q2 and the U1 sawtooth generator. Otherwise measure the switching signal at edge connector pin 9. It should be < 0.7Vdc with INTERNAL FM selected and a logic high at other times. If it is correct, replace U2. Otherwise go to Service Sheet 1 to continue troubleshooting.

Service Sheets 4, 5, and 6  
Not Used

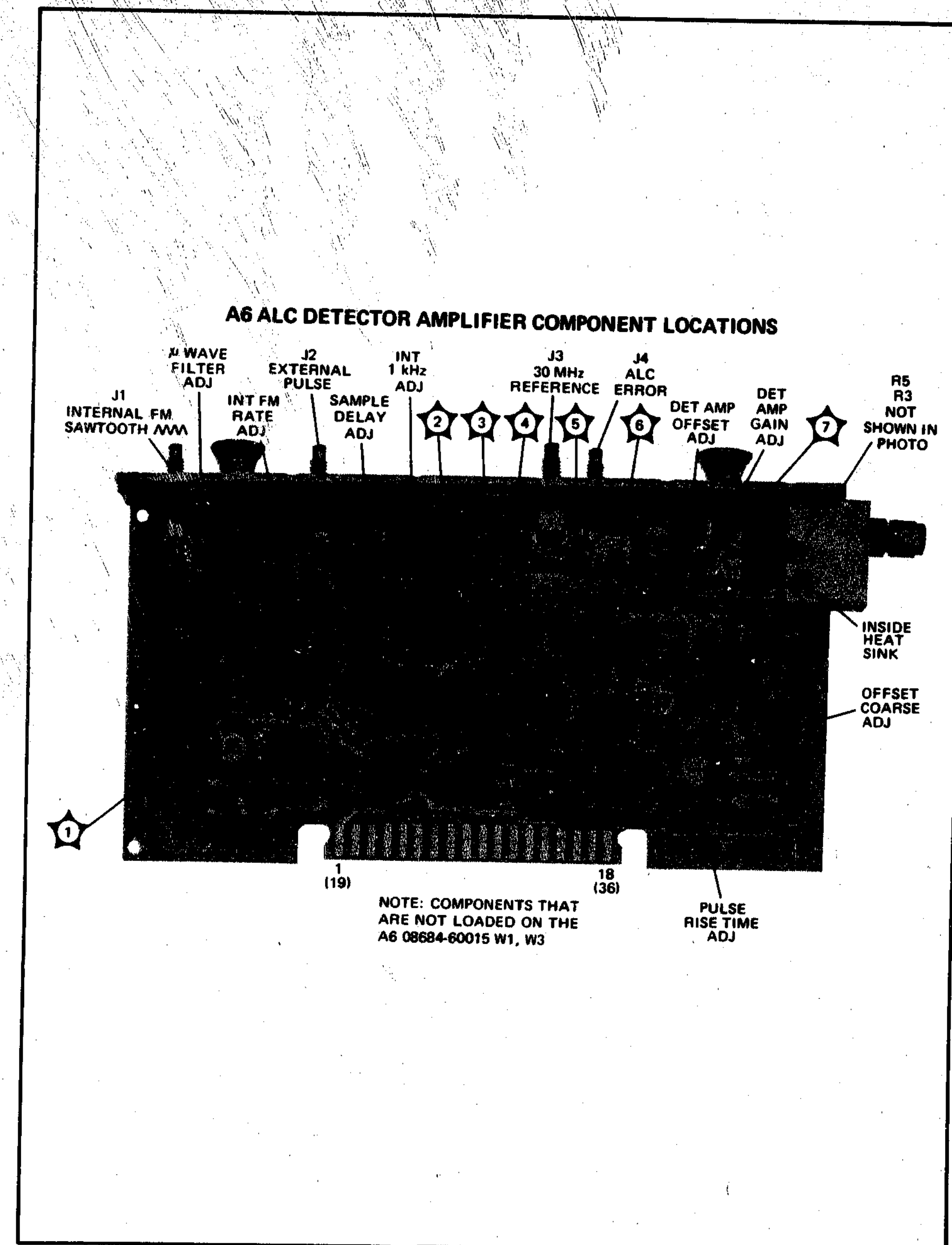


Figure 8-31. ALC Detector Amplifier Component Locations



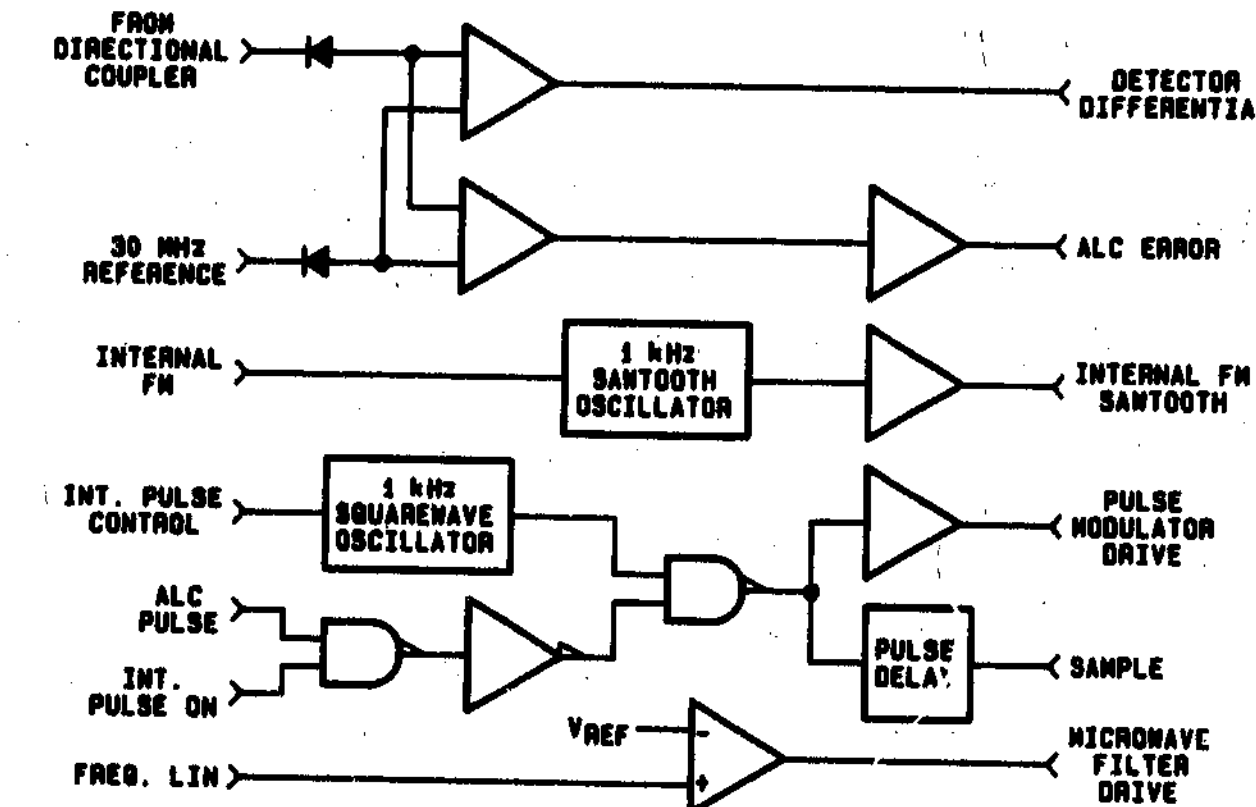
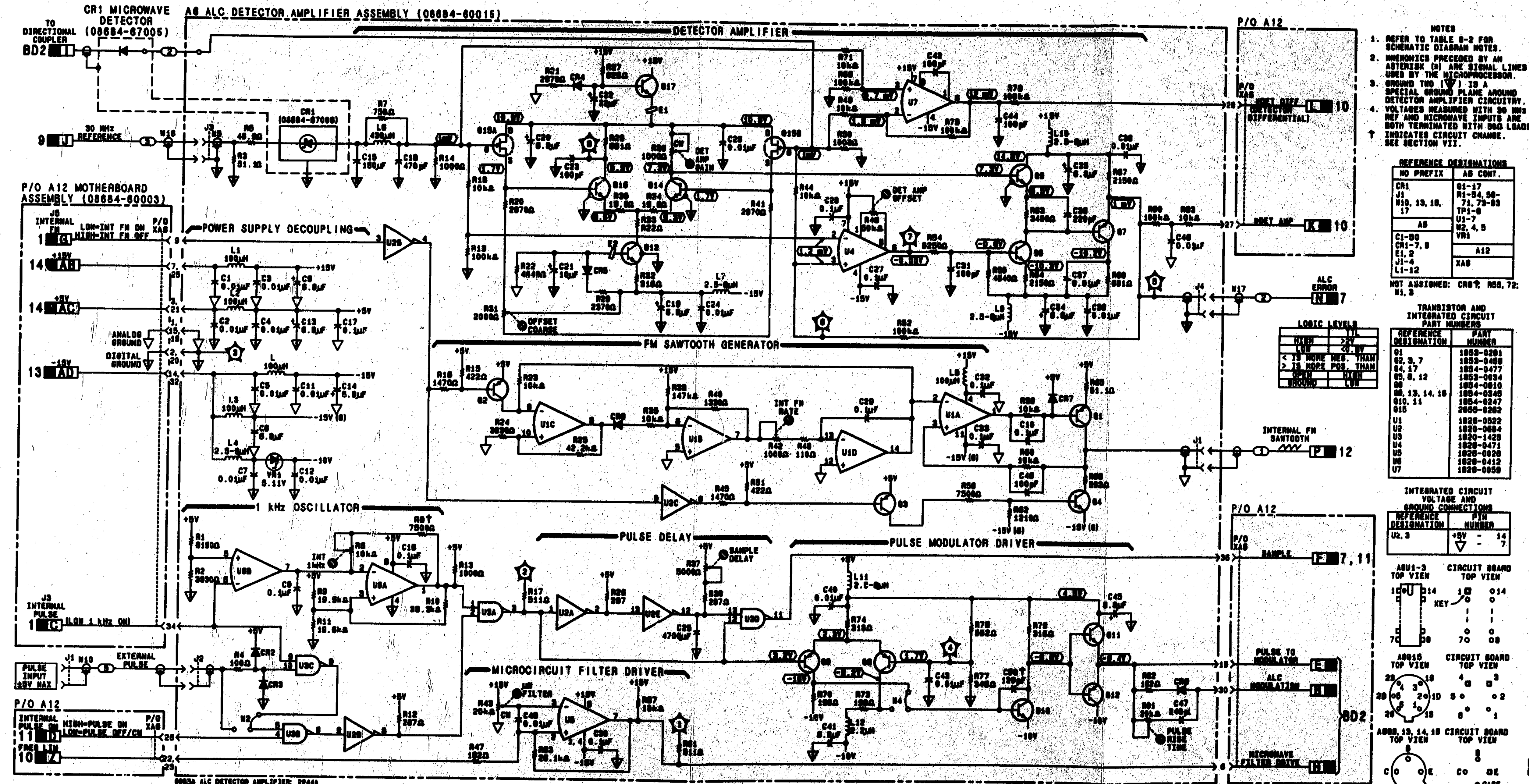


Figure 8-32. ALC Detector Amplifier Simplified Block Diagram



- NOTES
- REFER TO TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
  - WHENHONIC PRECEDED BY AN ASTERISK (\*) ARE SIGNAL LINES USED BY THE MICROPROCESSOR.
  - GROUND TIE (VT) IS A SPECIAL GROUND PLANE AROUND DETECTOR AMPLIFIER CIRCUITRY.
  - VOLTAGE MEASURED WITH 30 MHz REF AND MICROWAVE INPUTS ARE BOTH TERMINATED WITH 50Ω LOADS. SEE SECTION VII.

REFERENCE DESIGNATIONS

NO PREFIX	AS CONT.
CR1	01-17
CR1-7, 9	R1-84, 86-71, 73-83
E1, 2	TP1-8
J1-4	U1-7
L1-12	W2, 4, 5
	VR1
	A12
	XAB

NOT ASSIGNED: CR0, R5, 7, 2; N1, 2

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
01	1829-0201
02, 3, 7	1829-0488
04, 17	1824-0477
05, 8, 12	1824-0294
06	1824-0810
08, 13, 14, 16	1824-0245
09, 11	1824-0277
10	2850-0202
U1	1820-0522
U2	1820-0884
U3	1820-1429
U4	1820-0471
U5	1820-0026
U6	1820-0412
U7	1820-0059

INTERCONNECTED VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN NUMBER
U2, 3	+2V - 14
U2, 3	XAB

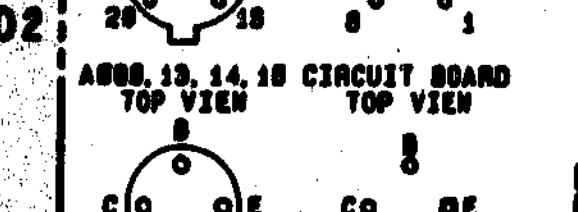
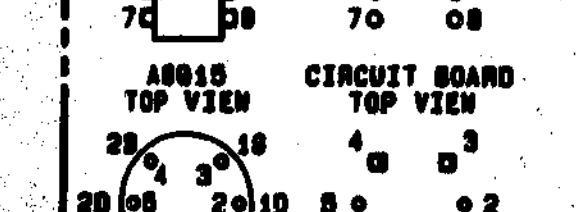
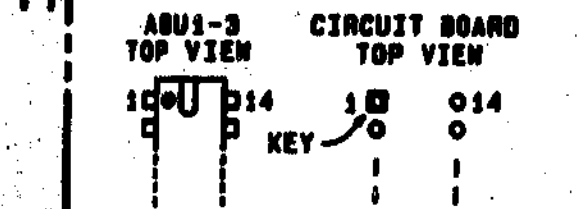


Figure 8-33. ALC Detector Amplifier Schematic Diagram



## SERVICE SHEET 9 ALC REFERENCE

### PRINCIPLES OF OPERATION

#### 30 MHz Oscillator

The heart of the ALC Reference assembly is a free-running oscillator made up of two FETs, Q6 and Q7. The 30 MHz output frequency is determined by tank circuit L7 and C32. Precise frequency is not critical for proper ALC operation. The drain of Q6 is RF grounded via two 0.01  $\mu$ F capacitors, C22 and C24. The circuitry going to the +15V supply is power supply decoupling and is not involved with the oscillator itself. It is important however that decoupling capacitors C22 and C24 are intact.

The oscillator amplitude is about 20 volts peak-to-peak at the drain of Q7. This signal is coupled to the Reference Modulator circuit via a few turns of wire wrapped around L7. This combination of L7 and the few turns of wire forms a 7 to 1 step down transformer called T1. (The primary winding can be replaced separately by unsoldering the leads and carefully pulling the molded inductor out from inside the secondary winding.)

#### Reference Modulator and 30 MHz Peak Detector

The Reference Modulator and the 30 MHz Peak Detector are part of a small leveling loop. The output from the detector is fed back to amplifier U2, which generates an error signal to drive the Reference Modulator and level the output of the 30 MHz Oscillator. Because it has to work at only one frequency, the results are very accurate, typically within 0.01 dB for a given output power at a particular microwave frequency. The accuracy of this level is not guaranteed but if it varies by a significant amount there is reason for further checking. When the microwave frequency is tuned, the reference amplitude will change because it tracks level correction data stored in an EPROM on the Central Processing Unit (CPU) Assembly.

#### Digital Power Control

The amount of voltage delivered by the reference leveling loop (30 MHz Oscillator, Reference Modulator, 30 MHz Peak Detector) is determined by the negative input to operational amplifier U2. Ultimately that input is set by the microprocessor in response to the microwave frequency, the front panel LEVEL range and vernier controls, and the rear panel Cable Offset control. The level is also determined by the amplitude modulation INPUT from the front panel connector when EXT AM is selected by the operator.

The microprocessor reads the settings of the Range, Vernier, Cable Offset and Frequency controls. From all of these settings it determines what power the ALC loop should be delivering. The Microprocessor translates that information into 12 lines (or bits) of digital information. Ten of the lines are linearly encoded and two are logarithmically encoded. With this combination of log and linear there is a total dynamic range of 60 dB, not all of which is used. (Usually only about 48 dB of the total dynamic range is needed.) When

## SERVICE SHEET 9 (cont'd)

external AM is selected, the AM Input signal is fed through several circuits to the Vref(-) input of U6 (a digital to analog converter) along with the -6.2 V reference (from U11), thereby modulating the output current from the converter.

The 30 MHz signal at the Reference Output connector has an amplitude of about 2 volts peak-to-peak when the LEVEL vernier is fully clockwise in the 0 dBm power range and about 2.5 volts peak-to-peak in the +10 dBm range. With the vernier fully counterclockwise in the 0 dBm range, there is barely enough signal to measure on an oscilloscope although it can be easily seen on a spectrum analyzer.

### TROUBLESHOOTING

1. Disconnect the orange coax cable connected to A7J1. Attach an oscilloscope to J1. Set the Signal Generator controls for a reading of -10 dBm on the 0 dBm range. The 30 MHz signal should be about 0.56 Vp-p  $\pm$  0.05 Vp-p. The voltage will rise slightly at the top of the band since the reference level changes with the microwave frequency to compensate for increasing loss in the microwave chain. If the voltage is correct you are probably looking in the wrong place for a problem. The exact frequency of the ALC Reference signal is not critical.
2. Increase the front panel setting to +5 dBm. The voltage should rise in small steps as the vernier is rotated up to 3.4 Vp-p.
3. Lower front panel setting to -20 dBm. The voltage should drop to 0.17 Vp-p.
4. Select the next lower power range (called the -10 dBm range). The front panel display should drop to -30 dBm and the reference voltage should drop to about 0.03 Vp-p. Rotate the vernier clockwise. The voltage should rise to about 0.56 Vp-p at a setting of -5 dBm.
5. If everything is correct so far, the ALC reference is working well. If any of the voltages are incorrect, go to step 9.
6. The next steps check the AM positive and negative peak detectors. Select EXTERNAL AM and attach a test oscillator to the AM INPUT. Set the test oscillator to 5 kHz at 1 volt peak (0.7 Vrms). Set the SERVICE switch on the A9 board to DIAG. Select Test 19. The FREQUENCY display shows the positive peak voltage. Vary the AM vernier; the displayed voltage should change linearly with changes in AM vernier and AM input voltage. With 1 volt peak applied to the AM INPUT connector and the AM vernier fully clockwise, the display should read close to 1 volt.
7. Select Test 20. This shows the negative peak voltage. Again vary the AM vernier and watch for linear changes. With 1 volt applied to the AM INPUT connector and the AM vernier fully clockwise, the display should read close to 1 volt. A difference of 1-2% between the positive and negative peak readings should be no cause for concern.

## SERVICE SHEET 9 (cont'd)

8. If both positive and negative peak detectors are operating properly, this board is working properly (with the possible exception of a problem with the least significant ALC bit). If only one of the peak detectors gives normal response, troubleshoot the other one. If neither works properly, check the external AM buffer and the external AM switching circuit made up of Q2 and Q4.
9. Switch LEVEL Range to 0 dBm and FREQUENCY to 10 GHz. Attach a dc voltmeter to A7TP4. Rotate the ALC vernier fully clockwise. The voltage should read 3.79 Vdc. Rotate the vernier fully counterclockwise. The voltage should read 0.14 Vdc. If the voltages are correct, the problem is in the 30 MHz reference oscillator or reference modulator. Use the voltages on the schematic to isolate the problem. You may also wish to carefully feel the cases of Q3, Q8, and Q9. If the oscillator has failed, these transistors will get very warm, since they will be turned on all the way in an attempt to get the proper voltage level from the oscillator.
10. If the voltage range at A7TP4 is incorrect, attach the voltmeter to A7TP3. This voltage varies as shown in Figure 8-34. If this voltage is correct, measure U1B pins 5 and 6. They should be equal. If they are equal, the multiplexer, U5, is probably defective. If the inputs to U1B are not equal, then the problem is probably in U1B or associated components.

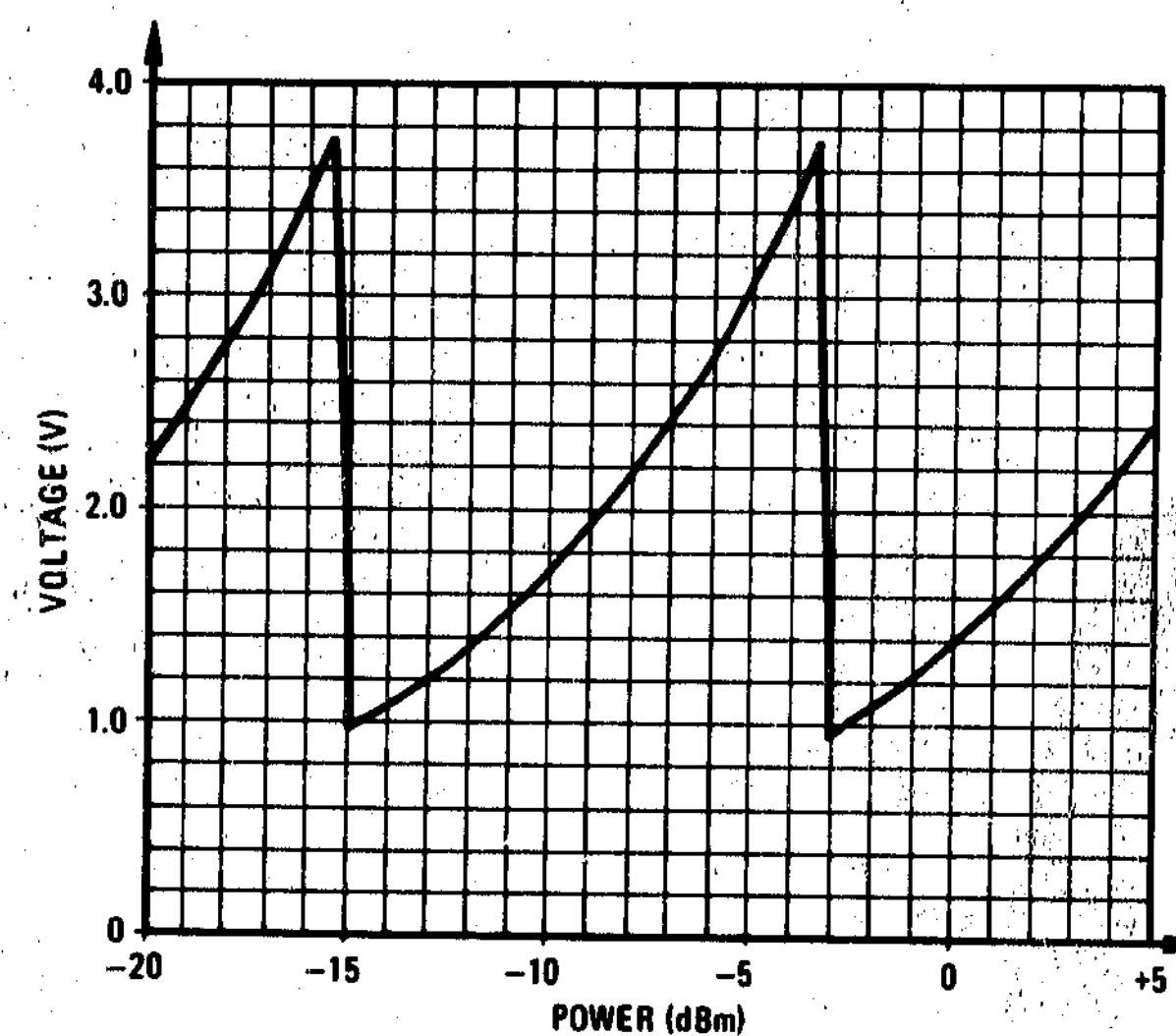


Figure 8-34. Voltage at A7TP3 vs. Power Output

11. Select Test 01. The FREQUENCY display should show 6.3 volts, very closely. If this voltage is correct, suspect a problem with U6. If the voltage is incorrect, troubleshoot U1D and associated components.

← ALC Detector Amplifier  
A6  
SERVICE SHEET **8**

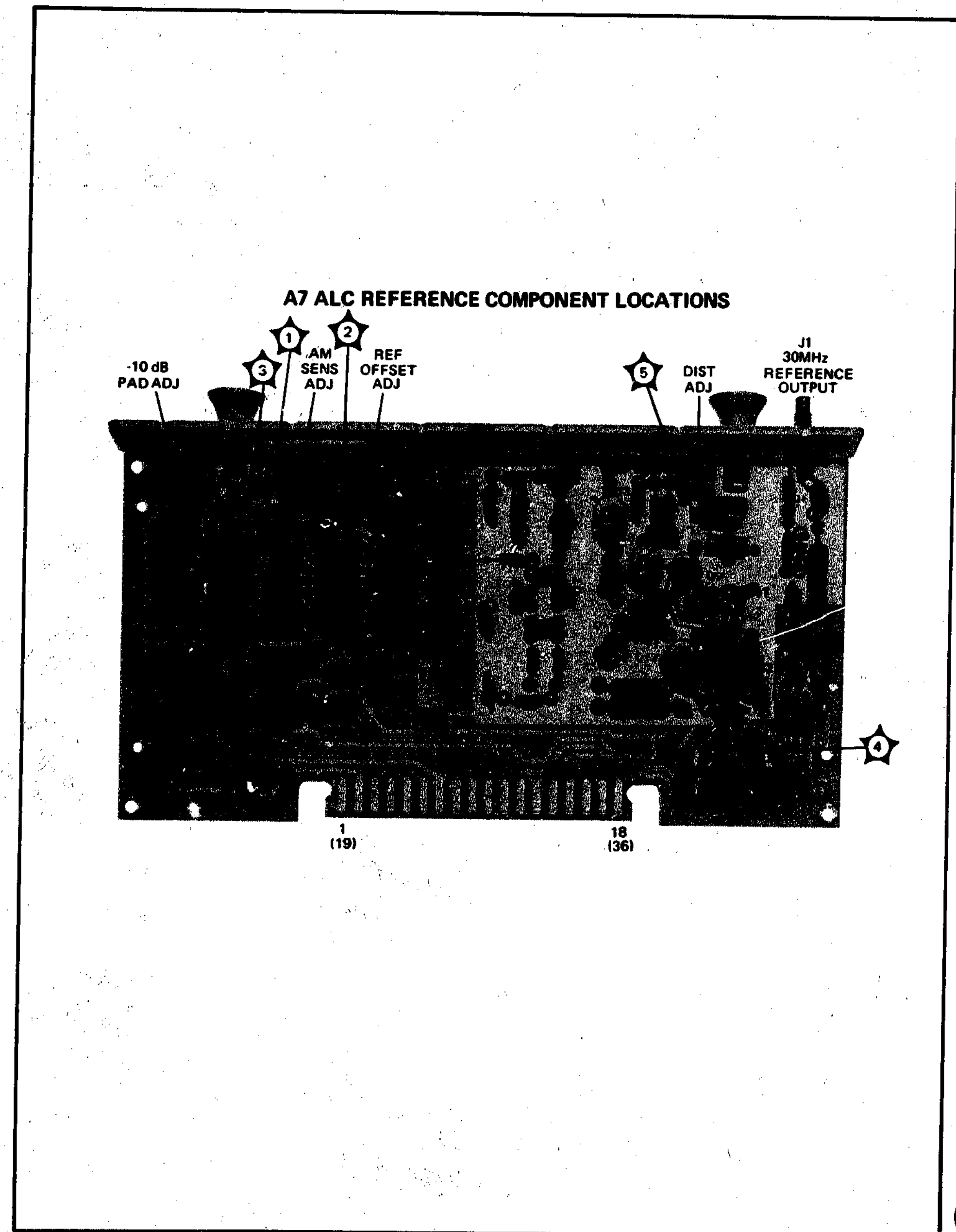


Figure 8-35. ALC Reference Component Locations

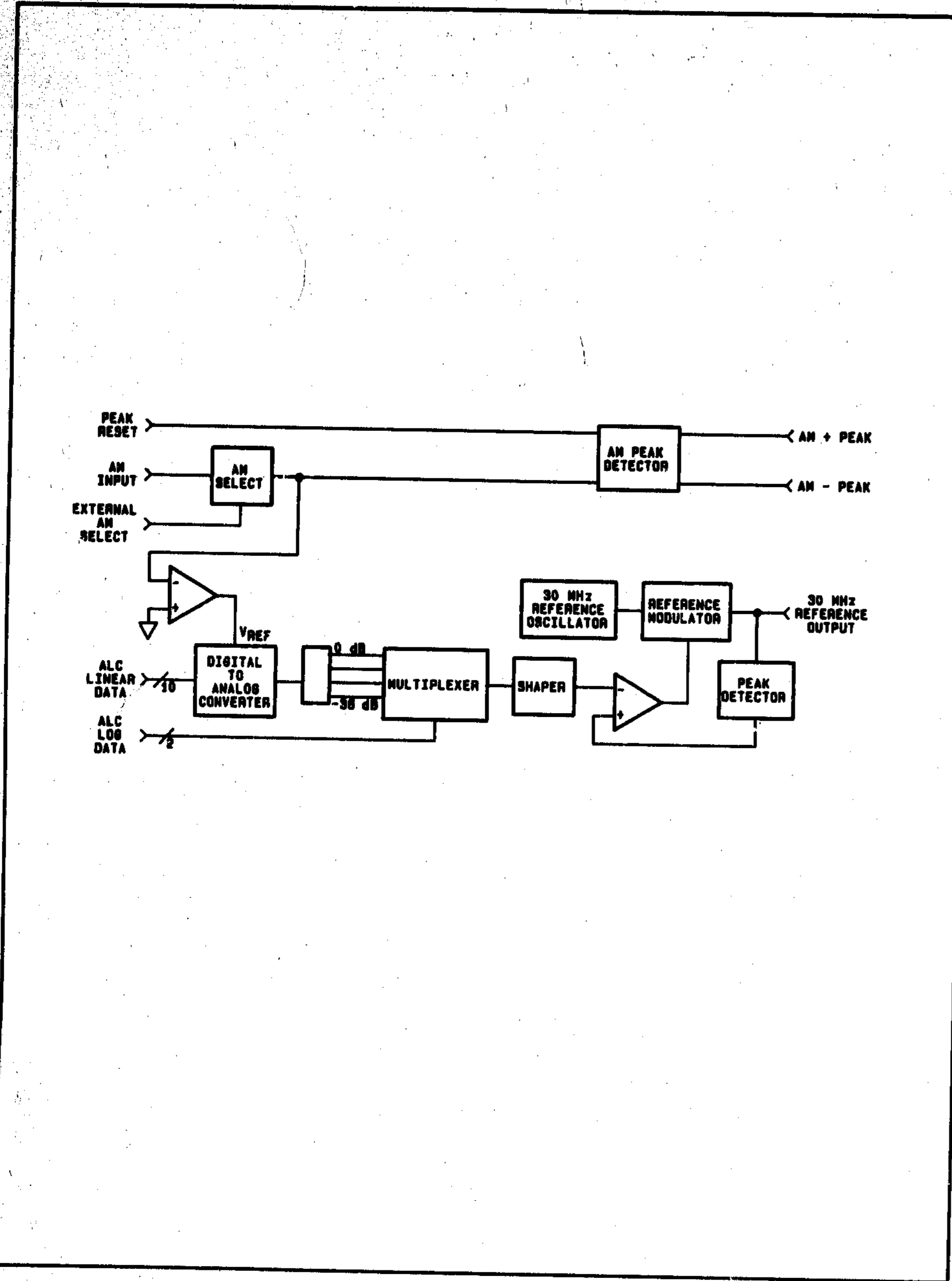


Figure 8-36. ALC Reference Simplified Block Diagram

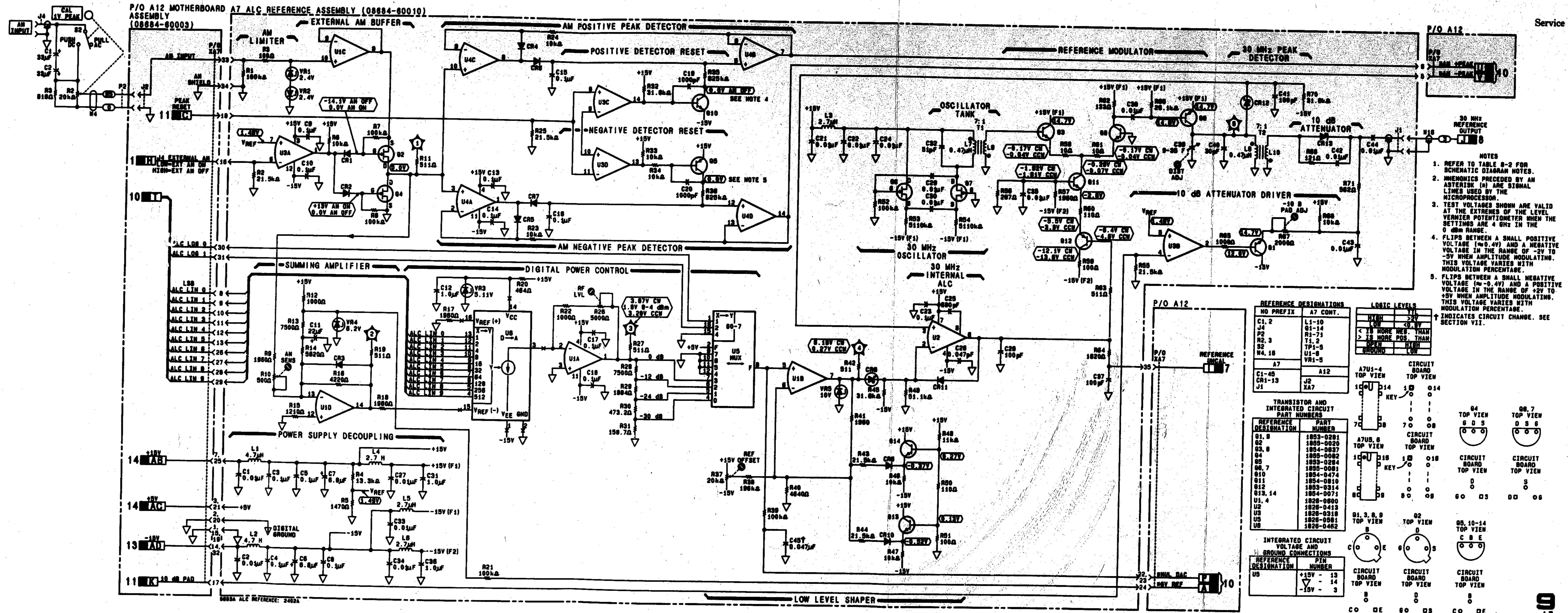


Figure 8-37. ALC Reference Schematic Diagram

**SERVICE SHEET 10  
INPUT/OUTPUT**

**PRINCIPLES OF OPERATION**

**General**

The Input/Output (I/O) Assembly translates analog inputs from various places in the Signal Generator into digital signals for use by the microprocessor on the Central Processing Unit (CPU) Assembly. The I/O Assembly also generates an analog output voltage that tracks the microwave output frequency and a set of ten linear and two logarithmic digital outputs to control ALC power.

**Digital-to-Analog Converter (DAC) and Analog-to-Digital Comparator (ADC)**

A variety of analog signals come to the I/O Assembly from the Signal Generator. Twenty-nine signals are scanned by the microprocessor. The microprocessor cannot tolerate analog signals directly; they must first be converted into a digital format. A technique called successive approximation is employed in the conversion. The DAC on the I/O Assembly is given a digital input from the microprocessor that sets its most significant bit true and all other input bits false. This sets the output voltage halfway between the lowest and the highest voltages the DAC can deliver. The output voltage of the DAC is compared to one of the analog signals that enters the board. The result of the comparison, which is done by A8U13, is either a high or a low signal. This signal is sent to the microprocessor via a 3-state buffer (A8U4) that drives the data bus back to the microprocessor. The microprocessor will decide whether the actual voltage level it is trying to determine is less than or greater than the halfway voltage that it used for its first guess. If the signal is high, the voltage is somewhere between 50% and 100% of the DAC output range. If the signal is low, the actual voltage is something less than the half voltage first guess. At this point, the first "bit" produced as a result of the comparison is in fact the most significant bit of the byte that will correspond to the exact voltage level.

In the next step of the successive approximation technique the microprocessor sets the second bit of the DAC input high. The highest order bit is either high or low depending on the result of the first comparison. The new voltage used for comparison is either 75% or 25% of the range of the DAC. This new voltage is again either higher or lower than the voltage being measured. This bit is sent to the microprocessor that will then know the first two most significant bits of the byte. This process repeats a total of twelve times until all twelve bits have been determined. This is basically a computer controlled digital voltmeter.

**SERVICE SHEET 10 (cont'd)**

**TROUBLESHOOTING**

1. Connect a dc voltmeter to the rear panel FREQUENCY 0 to 10 V FULL BAND connector. Tune to the lowest obtainable frequency. The voltmeter should read  $0.0 \pm 0.1$  volts, and be stable to two decimal places.
2. Tune to the highest obtainable frequency. The voltmeter should read  $10.0 \text{ volts} \pm 0.1$  volts, and be stable to three decimal places. If these voltages are correct, many of the major components on the I/O board are working properly. This also checks significant portions of the CPU board, A9. Continue to the following steps if the voltages are incorrect.
3. Remove the top cover and connect the dc voltmeter to A8TP4. Tune from the bottom of the band to the top of the band. The voltage should go from  $-10.00 \pm 0.15$  Vdc at the bottom of the band to  $+10.00 \pm 0.15$  Vdc at the top. If these voltages are correct, continue to the next step. Otherwise go to step 10.
4. Set service switch to DIAG position and select Test 35. The front panel display should show 10.00 volts. Select Test 34 and the display should show -10.00 volts. A negative voltage is indicated by a flashing decimal point.
5. If the display does not indicate the proper voltages, connect dc voltmeter to A8TP6 and redo Tests 34 and 35. The voltages should be  $-10.000$  and  $+10.000 \pm .01$  Vdc. If the measured voltages are correct, the D to A converter is working. If the displayed voltages are incorrect, there is a problem related to the measurement portion of this board or a problem with the A9 CPU board. The following steps isolate such problems.
6. Measure the DAC reference voltage at A8TP2. It should read  $10.240 \pm 0.003$  Vdc. If it is not within tolerance, but close, re-adjust it after you find the cause of the malfunction. The DAC will function with an incorrect reference, but with degraded accuracy. If the DAC reference is correct, continue to the next step, otherwise troubleshoot the Vref generator.
7. Connect dc voltmeter to A8TP5. Select Test 34. The voltmeter should read  $0.0 \pm 0.2$  Vdc. Select Test 35. The voltmeter should read  $-10.0 \pm 0.2$  Vdc. If the voltages are correct, troubleshoot A8U2C circuitry.  
  
Turn instrument off and place the A8 I/O assembly on extender boards before continuing.
8. Attach Signature Analyzer ground lead to A9 GND and connect other Signature Analyzer leads as follows:  
  
Start (A8U3 pin 4), rising edge  
Stop (A8U3 pin 4), falling edge  
Clock (A9 CLK), rising edge
9. Turn instrument on and select Test 33. Measure the signatures as shown in Table 8-14 on the data input lines to the DAC.

**SERVICE SHEET 10 (cont'd)**

**Table 8-14. DAC Signatures**

A8U3 Pin #	Signature	Line Name
4	1013	J3
5	H839	J2
6	19H3	J1
7	46U2	J0
8	C7F0	K7
9	32C5	K6
10	HH47	K5
11	9H65	K4
12	8H00	K3
13	C857	K2
14	5587	K1
15	9338	K0

If the signatures are correct, troubleshoot U3, U1 and U2D.

10. Set the service switch on A9 to SA. Connect signature analyzer leads as follows:

Start A9TP9 (labeled A15), rising edge  
Stop A9TP9 (labeled A15), falling edge  
Clock A9TP8 (labeled CLK), falling edge  
GND A9TP1

Measure signatures on A8U5 and A8U14 as shown in Table 8-15.

**Table 8-15. Program Data Latch Signatures**

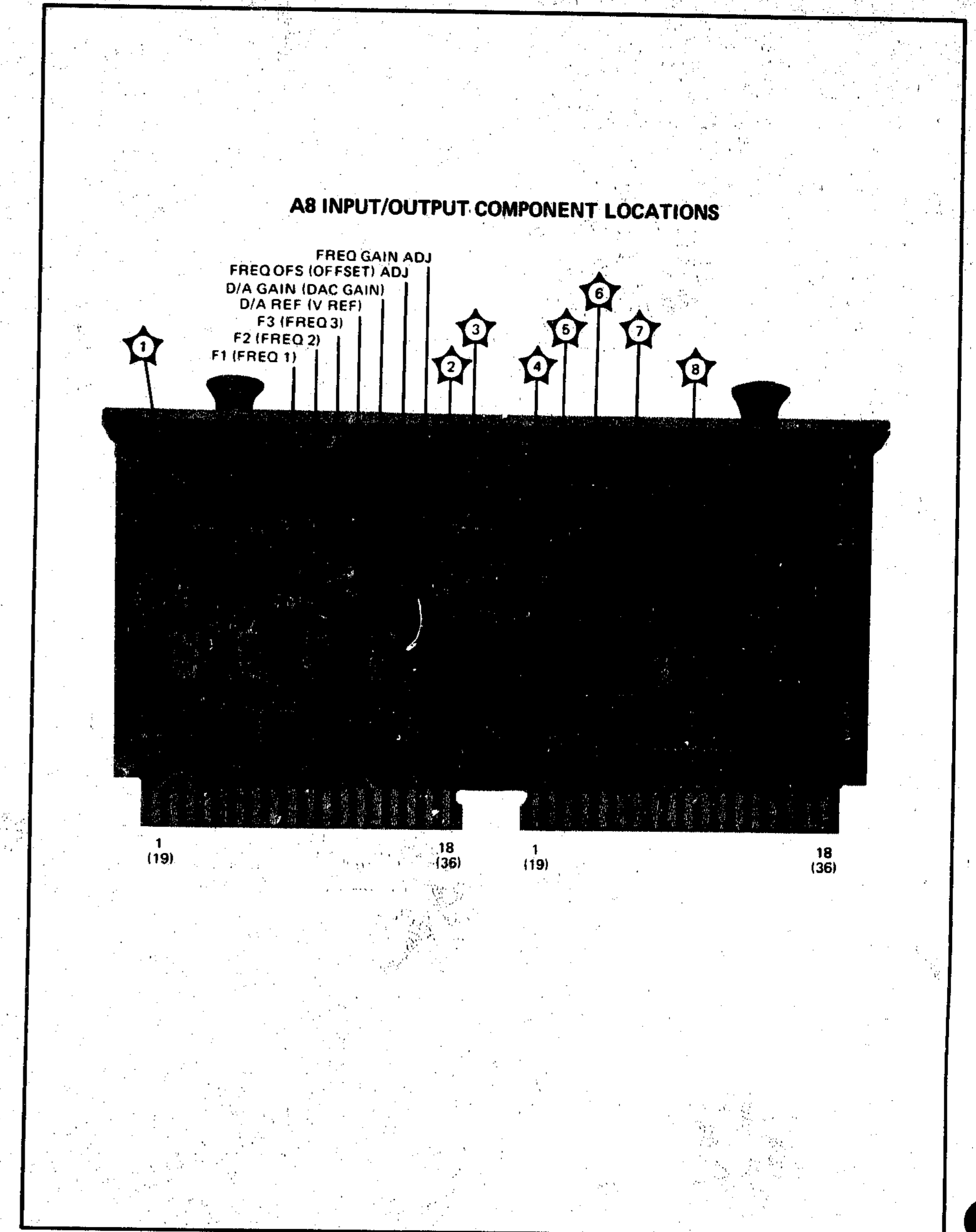
Pin #	A8U5	A8U14
1	0001	0001
2	0001	0001
3	79F4	1P99
4	1P99	79F4
5	0001	0001
6	0001	0001
7	2F21	P700
8	P700	2F21
9	0001	0001
10	0000	0000
11	60CA	CP4H
12	0001	0001
13	F162	66PU
14	8P87	F038
15	0001	0001
16	0001	0001
17	F038	8P87
18	66PU	F162
19	0001	0001
20	0001	0001

<sup>1</sup> For the Pin 11 signature, set start to falling edge.

**SERVICE SHEET 10 (cont'd)**

If these signatures are correct, troubleshoot A8U6, U15, U3 and U10 to find what is causing incorrect input into the DAC (U3). If there is an incorrect signature on an input pin, backtrace to the CPU board, A9. If the incorrect signature is on an output pin, replace the IC after checking the output line to be sure it is not shorted or open.

11. Set the service switch to NORM. Connect the voltmeter to A8TP3. The voltage should go from 0 to 10 volts as the frequency is tuned across the band, and should be stable. If the voltage is correct, troubleshoot A8U2A and associated components. Otherwise continue to the next step.
12. Connect voltmeter to A8U11D pin 14. The voltage should go from -3.15 V to -6.32 V as the frequency is tuned across the band. Do not be satisfied by a range that is less than this by more than 0.2 volts or so. If the voltage is correct, troubleshoot A8U11B circuitry, otherwise troubleshoot A8U11D circuitry. Pay special attention to leakage in A8C17 as this can cause the output voltage to be unstable.



**Figure 8-38. Input/Output Component Locations**

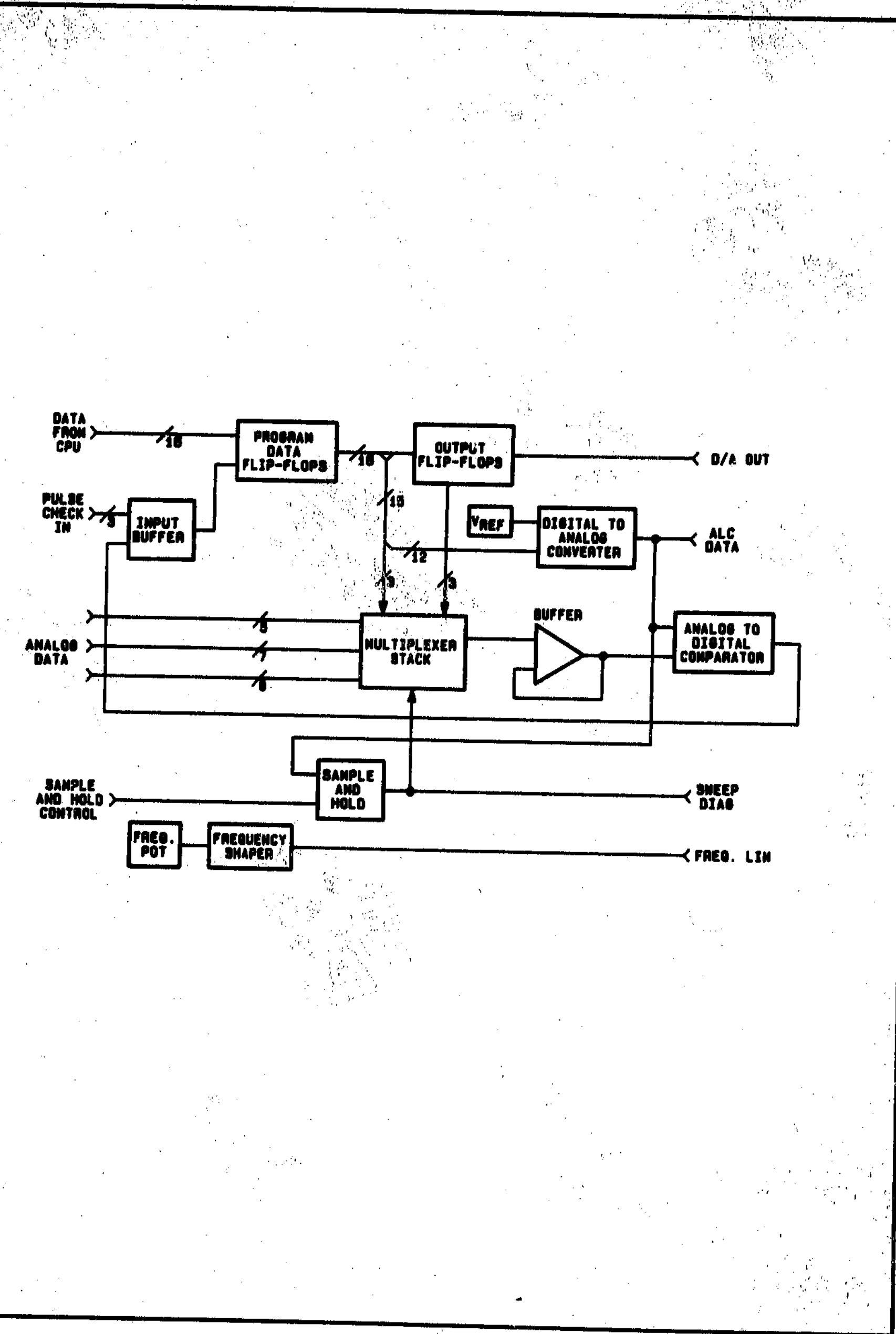
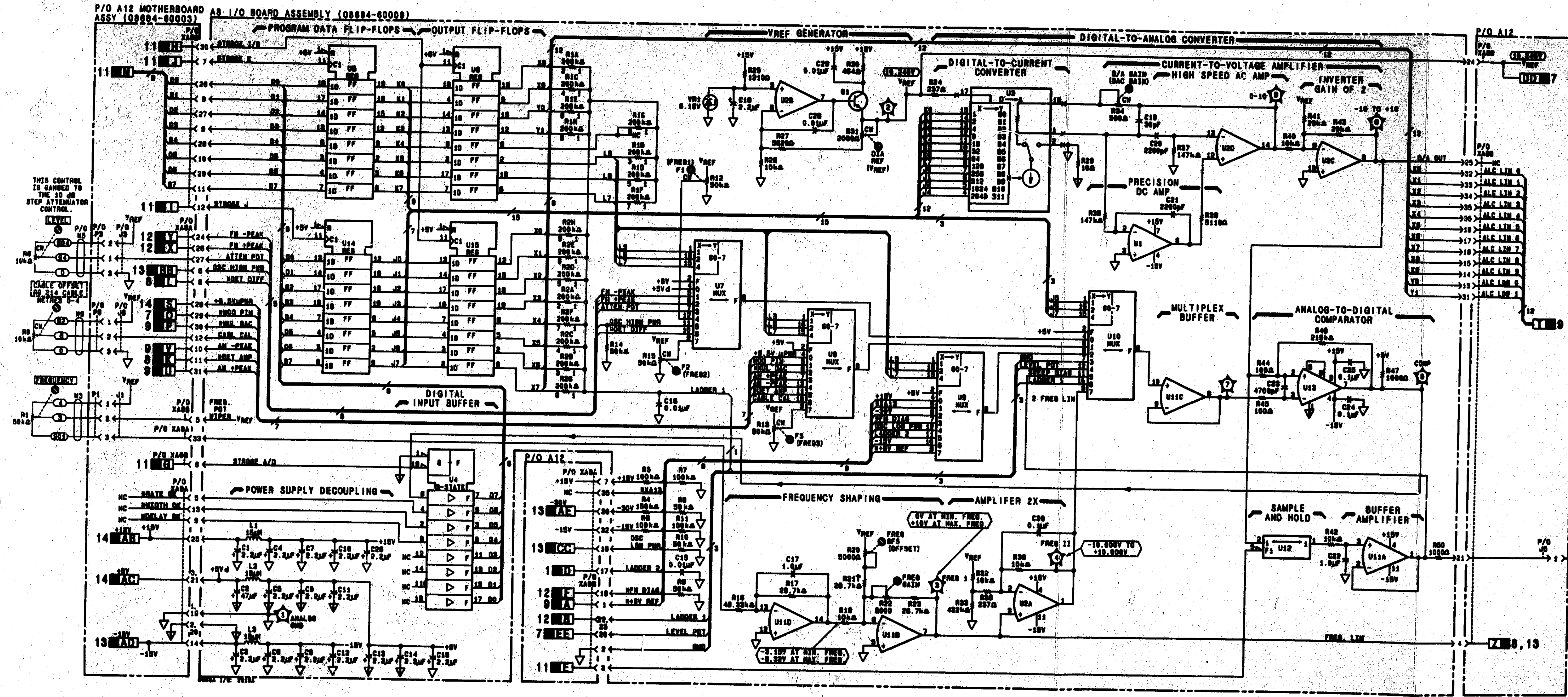


Figure 8-30. Input/Output Simplified Block Diagram



NOTES

- REFER TO TABLE 8-3 FOR SCHEMATIC DIAGRAM NOTES.
- MEMORICONS PRECEDED BY AN ASTERISK (\*) ARE SIGNAL LINES USED BY THE MICROPROCESSOR.
- ↑ INDICATES CIRCUIT CHANGE. SEE SECTION VII.

REFERENCE DESIGNATIONS

NO PREFIX	AB	CONT
J0	R1-4, 9-12	
P1, 3, 8	14-27, 28	
R1, 5, 8	27, 30	
W3, 5, 9, 9	27-9	
	U1-13	
C1-30	A12	
U1-3	J1, 3, 5, 6	
	XABA, 8	
ROY ASSEMBLY:	ABR, 13, 28,	
	48, 49	

LOGIC LEVELS

NO PREFIX	AB	CONT
U1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100	

TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
U1	1084-0637
U2, 11	1028-0574
U3	1028-0222
U4	1028-0885
U5	1028-1725
U6, 8, 14, 15	1028-1730
U7-10	1028-0881
U12	1028-0775
U13	1028-0228

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	VOLTAGE	PIN
U5	+5V	18
	+5V	9
U4-8, 14, 15	+5V	20
	+5V	10
U7-10	+5V	13
	+5V	14
	+5V	3
U12	+15V	7
	+5V	8
	-15V	7
	-15V	8

GROUND CONNECTIONS

REFERENCE DESIGNATION	PIN
U5	18
	9
U4-8, 14, 15	20
	10
U7-10	13
	14
	3
U12	7
	8
	7
	8

U1, 13

PIN	COMMON
1	A
2	B
3	C
4	D
5	E
6	F
7	G
8	H

Figure 8-40. Input/Output Schematic Diagram

**SERVICE SHEET 11  
CENTRAL PROCESSING UNIT**

**PRINCIPLES OF OPERATION**

**General**

The Central Processing Unit (CPU) Assembly is a control board that contains a microprocessor (U1) and read only memory (ROM), U8. The CPU also contains some latches and data selectors which mediate the transfer of data into and out of the microprocessor.

The CPU automatically makes corrections and monitors many test points in the Signal Generator to assure the operator confidence that the instrument is working properly.

Furthermore, the CPU reads the keys pressed on the front panel and responds by lighting appropriate LEDs on the front panel and running a segment of program stored in the ROM to set circuitry into desired states. The CPU Assembly reads the settings of several potentiometers via an Analog-to-Digital Comparator (ADC) on the Input/Output (I/O) Assembly. Using the data derived from the potentiometer settings it sends information to the front panel displays for output power level, frequency, and FM. It also sends data to the ALC loop.

The ROM holds an equation used to calculate the loss due to the frequency response of a length of RG-214 coaxial cable. Because the CPU knows the frequency, it can calculate how much additional power is needed to compensate for the cable loss. If Cable Offset is selected on the rear panel, the correction is automatically made for every frequency.

For long cables, the amount of additional power required to compensate for the cable may be more than the digital bits controlling the ALC loop can handle. This can be thought of as "digital saturation". If this happens, the UNLEVEL light will blink and the ALC loop will be set to maximum available power.

When the Signal Generator is turned on, the microprocessor performs a set of measurements to check critical circuits in the instrument; this takes about 3 seconds. If all is well, the instrument begins to operate normally. If a problem is detected, the CPU displays one or more error codes successively in the MODULATION display window. (See Tables 8-4 and 8-5 for a listing of the error codes with their diagnostic test number.) These error messages flash by quickly, but can be stopped for viewing by pressing and holding any front panel key, the EXT AM key for example, while turning on the LINE switch. After the first error number is displayed, the key can be released. The error number will remain in the modulation display. Pressing the key again will step the display through all error messages, one for each press of a key. When there are no more error messages, the instrument will finish the power-up sequence. With this warning the operator can determine if the fault is such that the instrument needs immediate repair or if the problem is in a part of the instrument not needed for the particular use. In either event, after running the turn-on tests the CPU runs its normal operating program. This allows a user to continue to use an instrument if the error is non-essential for the desired function.

A three-position switch, S1, at the top of the CPU Assembly allows a technician to select one of three operating modes. The switch should be left in NORM position during normal operation. For troubleshooting, either of the other two positions can be selected. The center position, DIAG, selects a routine in the ROM that allows a large number of analog voltages in the instrument to be displayed on the front panel. The third position, SA, selects the free-running signature analysis mode.

**SERVICE SHEET 11 (cont'd)**

In this position the basic core of the CPU can be checked. Signature analysis is limited to the central CPU core because most of the instrument is manually operated and therefore not synchronous.

**Processor**

The heart of the CPU is the 6802 microprocessor, U1. This is an 8-bit device with 16-bit addressing (meaning it can address 64k of memory). When the instrument is turned on, the microprocessor is designed to go to a particular memory location in the ROM and execute whatever instruction it finds there. The 6802 microprocessor looks at the highest two memory locations. In this instrument, it finds an instruction telling it to jump to another address. There it finds the start of a routine that the instrument executes every time it is turned on. During power-up testing, the microprocessor looks at a number of analog signals to determine if they are within normal operating range. If any of them are incorrect, an error code is displayed in the MODULATION window on the front panel.

At the end of power-up testing, the CPU begins its normal operating program in which it polls the keyboard regularly to determine if any key was pressed. It also regularly reads several front panel voltages from potentiometers attached to front panel controls to see if the FREQUENCY, LEVEL range or LEVEL vernier have been changed. It responds to such changes by interpreting tables in the ROM to determine new display data from the raw voltage coming from the wipers of the potentiometers.

**Bidirectional Data Bus Buffer**

The data inputs and outputs are routed through U7, a 3-state bidirectional buffer. Input data comes in primarily through U12, the input buffer. This data includes, among other things, front panel data, the key-down signal and the RS-232-like terminal interface. Data also enters on the data bus from the A8 I/O Assembly. The most important data from A8 is the voltage divider comparator bit (the output of the ADC), which is used by the CPU to measure analog voltages. The data flow through the bus is primarily outward from the CPU Assembly to the I/O Assembly.

**8K ROM**

The main operating program is stored in U8, an 8K ROM. This includes programming to maintain the display, set the output power, run the diagnostic checks, and interface to an external terminal. Calibration data is stored in from one to three 2K EPROMs (U9, U10 and U11). The Signal Generator is shipped from the factory with one EPROM installed in the U9 socket. If EPROMs are installed in the U10 or U11 sockets, it means that either an oscillator or output assembly has been changed. The sockets should be filled from left to right. Any empty sockets should be to the right of any installed EPROMs. The memory chips are addressed through U2, which receives 3 bits of address information from the microprocessor and decodes it to enable one of the EPROMs.

**SERVICE SHEET 11 (cont'd)**

**TROUBLESHOOTING**

1. Turn the instrument off for several seconds and back on. Watch the front panel displays. There may be some odd characters displayed briefly. All decimal points and single LED annunciators should light for about 1 second. The displays should next show dashes for about 1 second followed by 8's for about 1 second. Finally, the instrument should show frequency and power level in dBm mode with all modulation off. Optionally, if the microprocessor detects a malfunction in the instrument, it will quickly display the error number or numbers in the modulation window before displaying the dashes. If the instrument turns on properly, it is very likely that the CPU board is functioning correctly. If it does not turn on properly, continue with this procedure.

2. Remove the instrument top cover. Use a logic probe to look at the four ROM test points, Clock, R/W (read/write), and A15 test points on the top of the CPU board. All these test points should show activity. If any of them do not show activity, go to step 6 to continue.

3. Put the CPU board on an extender, set service switch to SA, and do signature analysis of the address lines as shown in Table 8-16.

Start: A9TP9, falling edge  
Stop: A9TP9, falling edge  
Clock: A9TP8, falling edge

**Table 8-16. Address Line Signatures**

Measurement Point A9U1	Signature	Signal Name Address
Pin 9	UUUU	Line A0
10	FFFF	A1
11	8484	A2
12	P763	A3
13	1U5P	A4
14	0356	A5
15	U759	A6
16	6F9A	A7
17	7791	A8
18	6321	A9
19	37C5	A10
20	6U28	A11
22	4FCA	A12
23	4868	A13
24	9UP1	A14
25	0001	A15

If any of the signatures are incorrect, go to step 5.

4. Only if the address signatures are all correct, check the data signatures as shown in Table 8-17. Note that changes in A9U8 are reflected in the signatures. Be sure to use the proper column of signatures. Connect the Signature Analyzer leads as follows:

**SERVICE SHEET 11 (cont'd)**

Start: A9TP4, falling edge  
Stop: A9TP4, rising edge  
Clock: A9TP8, falling edge  
GND: A9TP1

**Table 8-17. ROM Data Line Signatures**

A9U8 Pin Number	Signature for ROM Part Numbers			Data Line Number
	08684 -80001	08684 -80006	08684 -80007	
11	7PF9	AH03	6AA6	D0
12	P7A8	1PF8	446C	D1
13	CFP9	2F38	PP91	D2
15	8340	05UU	UP91	D3
16	P4U8	2441	U09A	D4
17	94P9	P254	1C2P	D5
18	067U	31UC	59A7	D6
19	2P75	FC7C	UF77	D7

**Address Signature Incorrect**

5. If signatures on adjacent pins are the same, carefully inspect the board for shorts between pins or traces. If all signatures are incorrect, change the microprocessor, U1. If some signatures are correct, use a logic pulser and current probe to determine if the cause is due to a defective microprocessor or due to a defect in one of the several ICs attached to the address bus.

**One or More Test Points Show No Activity**

6. Put the CPU board on two 2x18 pin extender boards. The best place to start will depend on which test points show no activity.

No Clock Step 8  
No R/W Step 9  
No ROM1...4 signals Step 11

**No Clock**

7. Use the logic probe to look at U1 pins 38 and 39 to see if the clock oscillator is running. If the oscillator is running and there is no activity on the CLK test point, check for a short on the PHASE 2 line (U1 pin 37). If the line is not shorted to ground, replace the microprocessor. Otherwise use a logic pulser and current probe to find the short or the IC input that is loading down the line.

**No R/W**

8. Put the service switch into the SA position. The R/W test point should go high. If it does not, change the microprocessor. If that doesn't fix the problem, check the line for a short to ground or to an adjacent trace or pin. Return the switch to NORM position.

9. Check the bidirectional data buffer, U7, using a logic probe to be sure it passes data. If it does not pass data, the microprocessor

**SERVICE SHEET 11 (cont'd)**

could cause the Read/Write line to be stuck high or low depending on whether the microprocessor is trying to send or receive data. When the Read/Write line is low, the data should pass from left to right (into the microprocessor), and go the other direction when the Read/Write line is high.

**ROM1, ROM2, ROM3 or ROM4 Signals Missing**

10. Set the service switch to SA. Do signature analysis on U2 and U3. The signatures are shown in Table 8-18 and Table 8-19.

**A9U2 Signatures:**

Start: TP9, falling edge  
Stop: TP9, falling edge  
Clock: TP8, falling edge  
GND: TP1

**Table 8-18. A9U2 Address Decoder Signatures**

A9U2 Pin	Signature
7	1183
9	64HF
10	29A4
11	5FUA
12	2302
13	F9CF
14	534H
15	C9U1

**A9U3 Signatures:**

Start: TP9, falling edge  
Stop: TP9, falling edge  
Clock: TP8, falling edge  
GND: TP1

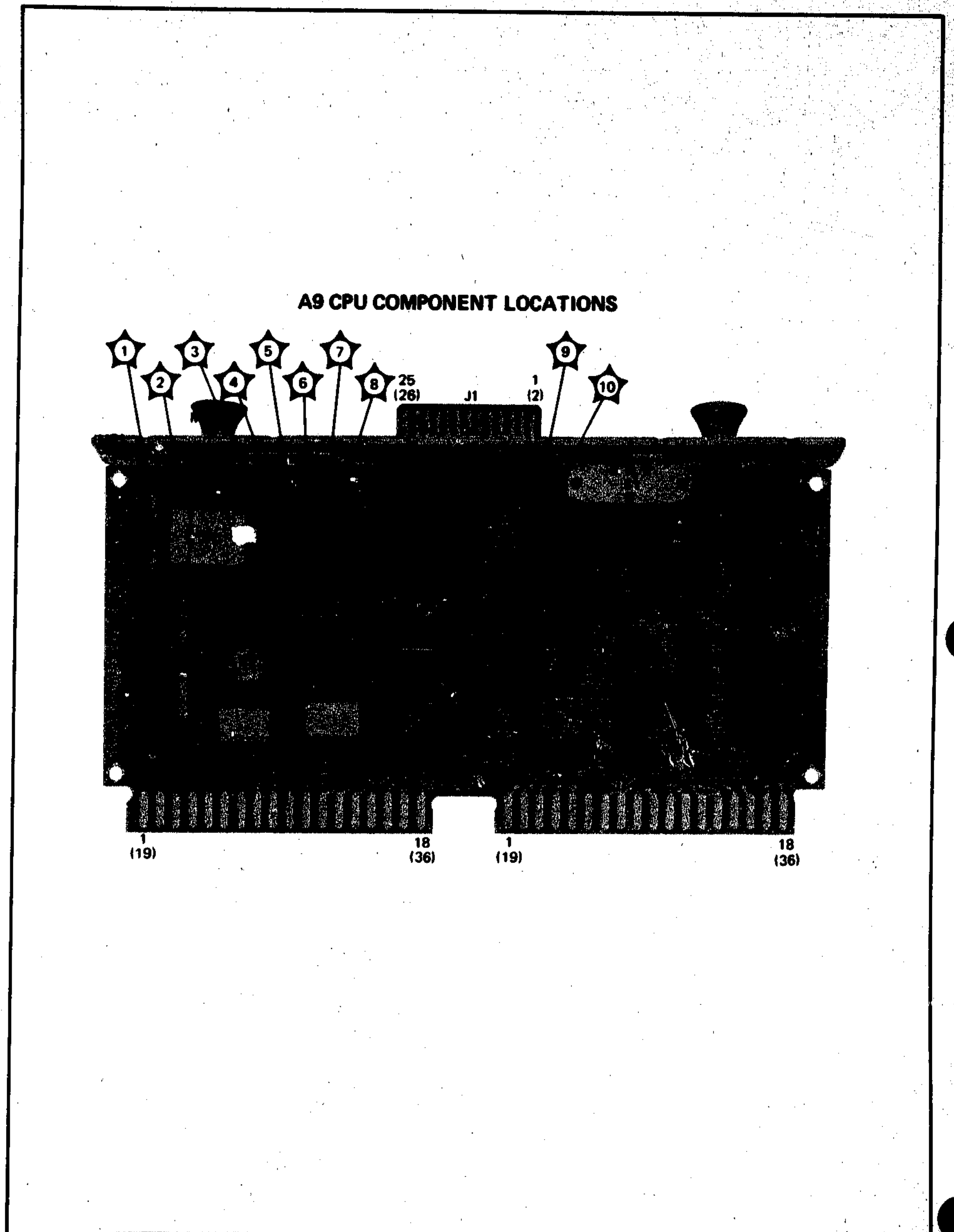
**Table 8-19. A9U3 Address Decoder Signatures**

A9U3 Pin	Signature
7	CA8U
9	6U84
10	U66P
11	7952
12	FC58
13	91H7
14	60CA
15	CP4H

If one or more signatures are incorrect, backtrace to the signatures for the address lines. If the address signatures are correct, replace the IC that generates the incorrect signature after checking the line for shorts, opens, or bent IC leads. If all U2 and U3 signatures are correct, the malfunction is probably in ROM U8 but could also be in the microprocessor, U1. Perform signature analysis on the data lines to try to isolate the malfunction.

**No A15 Signal**

11. This signal goes only one place, from U1 to U2. (The signal is also connected to an edge connector pin, but goes nowhere.) Change the microprocessor as the first step in troubleshooting this failure (since it is in a socket). If that does not fix the problem then replace U2, the demultiplexer and put the original microprocessor back in.



**Figure 8-41. Central Processing Unit Component Location**

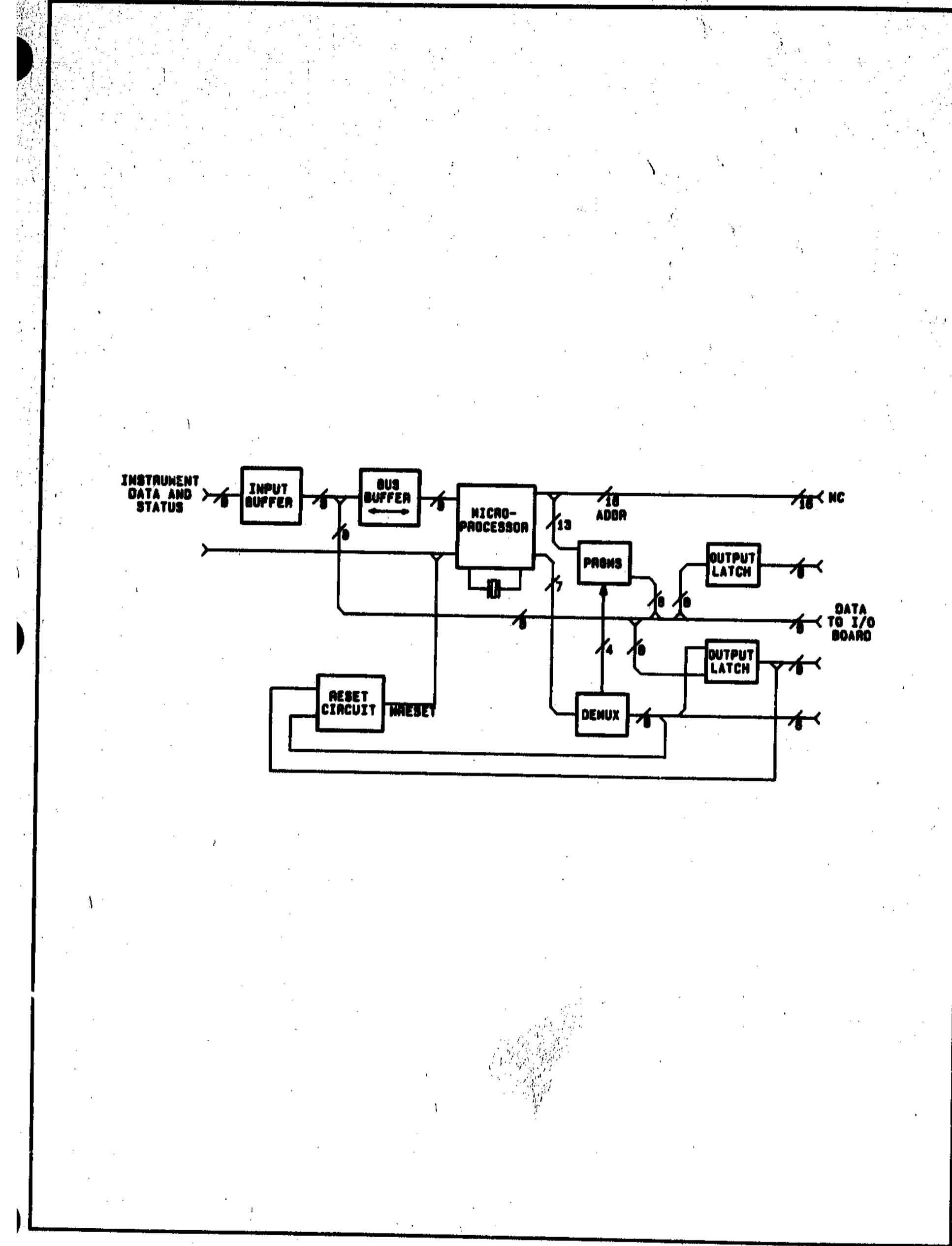
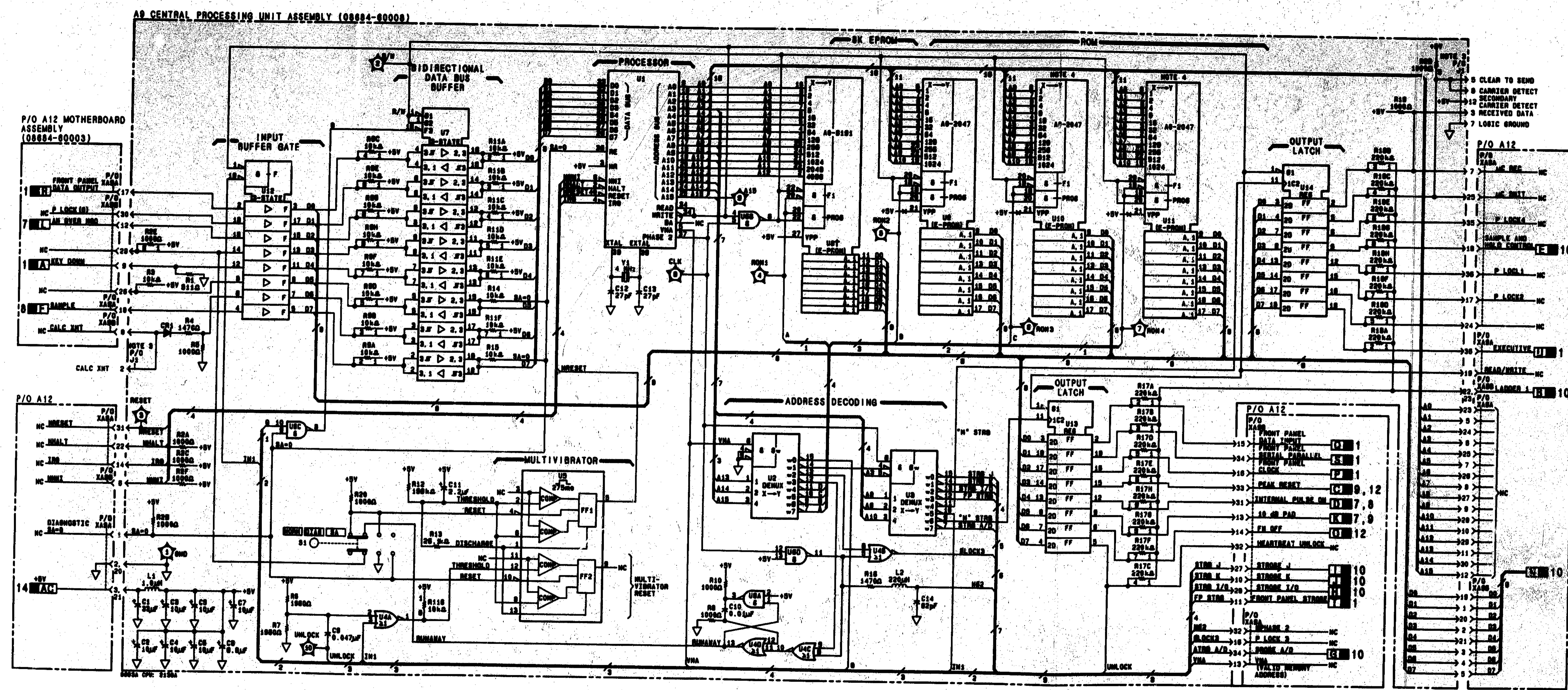


Figure 8-42. Central Processing Unit Simplified Block Diagram



**NOTES**

- REFER TO TABLE 8-2 FOR SCHEMATIC DIAGRAM NOTES.
- SYMBOLS PRECEDED BY AN ASTERISK (\*) ARE SIGNAL LINES USED BY THE MICROPROCESSOR.
- EDGE CONNECTOR J1 IS AN RS-232C PORT USED FOR INTERFACING WITH A DATA TERMINAL.
- E-PROMS U10 AND U11 ARE NOT NORMALLY LOADED, HOWEVER SOCKETS ARE PROVIDED SO THAT IF THE OSCILLATOR ASSEMBLY OR THE OUTPUT ASSEMBLY IS CHANGED NEW CALIBRATION DATA WILL BE PROVIDED IN A NEW E-PROM WHICH WILL BE INSTALLED IN THE EMPTY SOCKET.

**REFERENCE DESIGNATIONS**

AS	AS COM.	LOGIC LEVEL
C1-14	TP-10	HIGH >V <V
CR1	U5-10	<V <V
L1, 2	V1	<V <V
R1-20	A12	DEF. HIGH
S1	XA8A, 8	GROUND LOW

**TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS**

REFERENCE DESIGNATION	PART NUMBER	REFERENCE DESIGNATION	PIN
U1	1820-2000	U1	+5V - 8, 20
U2, 3	1820-1218	U2, 3	+5V - 1, 2
U4	1820-1144	U4, 8	+5V - 14
U5	1820-0205	U5	+5V - 7
U6	1820-1187	U6, 12-14	+5V - 18
U7	1820-2075	U7	+5V - 20
U8-11	08884-80001	U8-11	+5V - 1, 26, 28
U12	AUT. PARTS	U12	+5V - 14
U13, 14	1820-1784	U13, 14	+5V - 24
	1820-1828		

**AB2, 8, 11, 17, 18 TOP VIEW**

AB	1	2	3	4	5	6	7	8	9	10
AB1	0	0	0	0	0	0	0	0	0	0
AB2	0	0	0	0	0	0	0	0	0	0
AB3	0	0	0	0	0	0	0	0	0	0
AB4-8	0	0	0	0	0	0	0	0	0	0
AB9	0	0	0	0	0	0	0	0	0	0
AB10	0	0	0	0	0	0	0	0	0	0
AB11	0	0	0	0	0	0	0	0	0	0
AB12	0	0	0	0	0	0	0	0	0	0
AB13	0	0	0	0	0	0	0	0	0	0
AB14	0	0	0	0	0	0	0	0	0	0
AB15	0	0	0	0	0	0	0	0	0	0
AB16	0	0	0	0	0	0	0	0	0	0
AB17	0	0	0	0	0	0	0	0	0	0
AB18	0	0	0	0	0	0	0	0	0	0
AB19	0	0	0	0	0	0	0	0	0	0
AB20	0	0	0	0	0	0	0	0	0	0
AB21	0	0	0	0	0	0	0	0	0	0
AB22	0	0	0	0	0	0	0	0	0	0
AB23	0	0	0	0	0	0	0	0	0	0
AB24	0	0	0	0	0	0	0	0	0	0
AB25	0	0	0	0	0	0	0	0	0	0
AB26	0	0	0	0	0	0	0	0	0	0
AB27	0	0	0	0	0	0	0	0	0	0
AB28	0	0	0	0	0	0	0	0	0	0
AB29	0	0	0	0	0	0	0	0	0	0
AB30	0	0	0	0	0	0	0	0	0	0

**ABUS TOP VIEW**

ABUS	1	2	3	4	5	6	7	8	9	10
ABUS1	0	0	0	0	0	0	0	0	0	0
ABUS2	0	0	0	0	0	0	0	0	0	0
ABUS3	0	0	0	0	0	0	0	0	0	0
ABUS4-8	0	0	0	0	0	0	0	0	0	0
ABUS9	0	0	0	0	0	0	0	0	0	0
ABUS10	0	0	0	0	0	0	0	0	0	0
ABUS11	0	0	0	0	0	0	0	0	0	0
ABUS12	0	0	0	0	0	0	0	0	0	0
ABUS13	0	0	0	0	0	0	0	0	0	0
ABUS14	0	0	0	0	0	0	0	0	0	0
ABUS15	0	0	0	0	0	0	0	0	0	0
ABUS16	0	0	0	0	0	0	0	0	0	0
ABUS17	0	0	0	0	0	0	0	0	0	0
ABUS18	0	0	0	0	0	0	0	0	0	0
ABUS19	0	0	0	0	0	0	0	0	0	0
ABUS20	0	0	0	0	0	0	0	0	0	0
ABUS21	0	0	0	0	0	0	0	0	0	0
ABUS22	0	0	0	0	0	0	0	0	0	0
ABUS23	0	0	0	0	0	0	0	0	0	0
ABUS24	0	0	0	0	0	0	0	0	0	0
ABUS25	0	0	0	0	0	0	0	0	0	0
ABUS26	0	0	0	0	0	0	0	0	0	0
ABUS27	0	0	0	0	0	0	0	0	0	0
ABUS28	0	0	0	0	0	0	0	0	0	0
ABUS29	0	0	0	0	0	0	0	0	0	0
ABUS30	0	0	0	0	0	0	0	0	0	0

Figure 8-43. Central Processing Unit Schematic Diagram

SERVICE SHEET 12  
FM SHAPER

PRINCIPLES OF OPERATION

General

The purpose of the FM Shaper assembly is to produce a signal (FM OUT) that controls the varactor diodes in the microwave oscillator. The frequency of the oscillator changes logarithmically relative to the FM OUT signal. The FM OUT signal is an exponential function (that is the antilog) of the modulation signal into the FM Shaper. The oscillator, therefore, changes frequency linearly relative to the modulation signal into the FM Shaper.

The FM Shaper Board

**Inputs.** The input signal is routed in through J5 onto the AC/DC coupling network. The external sawtooth signal is connected from the ALC Detector assembly to the top of the FM vernier, R4. This signal supplies a sawtooth current for ramping in 10 MHz per Volt sensitivity.

The FM vernier is used to adjust total peak-to-peak FM deviation of the signal that has been selected for use. It also provides 50 ohm termination for the modulation source.

R2, CR2, CR3, CR5, and CR6 provide circuit protection from the entering FM signal by forming a diode clamp. Voltages greater than 1.4 volts at J3 cause one branch of diodes to turn on, thereby limiting the voltage to a safe level.

**Mode Section.** FM sensitivity of 10 MHz per volt or 1 MHz per volt is selected by reed relays which select the desired point along a series resistive divider, composed of R9 and R10. The microprocessor selects which tap in the resistive divider is to be used via AND gates in U2, namely U2A and U2B. The selected voltage (above R9 for 10 MHz per Volt sensitivity, and above R10 for 1 MHz per Volt sensitivity) is then applied to the base of Q19A, the start of the shaper block. U2B and U2C control the circuit that turns off FM when the signal generator is in CW mode. U2B directs the output of the attenuator circuit through R15 to ground, and U2C activates both the relay for capacitor that shuts the output of the video amplifier and the bandwidth reduction circuits inside the video amplifier.

**AC Temperature Compensation.** The loss of the input attenuator changes over temperature to compensate for changing resistance of the shaping diodes. The loss is varied by changes of the resistance of thermistor RT1.

**R12 is the pre-gain control.** The greater the resistance of R12, the greater the voltage at the resistive divider.

**FM Shaping.** A DC current flows through Q19B and the string of diodes made up of CR17 through CR23. This current is adjusted by changing potentiometer R19. A voltage of -8.5 V at TP4 produces a 21.5 volt drop across R20, and a 1 mA current through both strings of diodes.

The FM signal is applied to the base of Q19. Because signal voltage variations are low due to the low impedance path of the reference diodes, a voltage is impressed across the signal string of diodes and a current flows which varies exponentially with the input voltage.

SERVICE SHEET 12 (cont'd)

**Current Mirror Gain of Three.** The current leaves the collector of Q6 and flows into the collector of Q4A, which acts as a diode. R28 protects diode-connected Q4A from having its collector and base connected to ground if TP3 is accidentally shorted to ground. A very small amount of current flows through the bases of Q4B, Q4C, and Q4E. This avoids significantly disturbing the balanced current flow through the two diode strings. Because the bases and emitters of transistors Q4A, B, C, and E are tied together, and because these transistors are matched, the base-emitter voltage of Q4A is duplicated by the other three transistors, therefore, their collector currents are replicas of the shaper current that flows through Q4A. The sum of the collector currents is three times the shaper current.

**Common Base Amplifier.** Q4D improves the bandwidth after shaping by reducing the capacitance at the high impedance node, TP2.

After leaving the common base amplifier, the signal enters the buffer amplifier which is used as a hi-performance operational amplifier. It has a swing range between -2 and -23 volts.

Feedback resistors R59, R63, R64, and R66 determine the gain of the amplifier by the following equation:

$$G = 1 + (R63 + R64 + R66) / (R59 + R63 + R64 + R66)$$

R63 is the "post-gain" control.

**Input Buffer.** The input buffer is composed of Q3A, Q3B, Q9, Q10, Q15A, Q15B, and their associated passive elements. Q3A and Q3B are common emitter amplifiers that buffer the Q10-Q9 differential pair. Resistors R43 and R57 provide current returns for the 2 mA collector currents in Q3A and Q3B.

Bias current of 1 mA comes from +15 volts through R46 and is split by inductors L3 and L4, the proportion of the split determined by the base voltages of Q9 and Q10. At low frequencies, L3 and L4 short-circuit R48, leading to maximum gain at DC for good bias stability. Zener diodes VR4 and VR7 allow Q10 and Q9 to operate at safe collector-emitter voltages. Without the zener diodes, Q15A would pull the collector of Q9 to -29.3 volts, leaving the Q9 collector-emitter voltage at about 30 V.

**Current Mirror.** Q15A and Q15B form a current mirror. Its operation is similar to the Current Mirror Gain of Three circuit on this board. The current flow through Q15B will be identical to the current flow through Q15A. As the current through Q10 increases to drive Q14, the current through Q9, Q15A and consequently, Q15B decreases proportionately. The increase of current through Q10 and proportionate decrease of current through Q15B causes a net current gain of two into the base of Q14. Q14, is an emitter-follower. Its low impedance output drives Q12. Q13 pulls a constant 5 mA through R65 as part of an active biasing network. Q13 also places a capacitive load across the base of Q12. The base of Q13 is biased at -28.7V by R67, R68, and CR32. Q12 determines the base voltage of emitter-follower Q8 by pulling its collector through resistors R73 and R74. This stage provides much of the gain required for the video amplifier. C44 causes an increase in gain and feedback phase compensation at high frequencies by lowering the impedance at the junction of R70 and R71 as frequency rises.

SERVICE SHEET 12 (cont'd)

Output transistors Q1 and Q2 are biased by currents flowing through diodes CR33 and CR34, and through R72. The transistors' collector currents are between 8 and 13 mA.

The FM Shaper board has a low-pass filter connected between the output of the FM shaper and the varactors in the oscillator cavity. (The filter is at J1 and is not seen on the schematic.) The purpose of the filter is to keep any microwave signal present at the varactor port on the oscillator from getting onto the FM board.

**Positive and Negative Peak Detectors.** The operation of the positive and negative peak detectors is similar, therefore, only the positive peak detector will be explained here. U1A, Q11, Q17, CR30, C33, and U3A compose the sample/hold feedback loop of the positive peak detector. The input signal is connected from J3 to pin 6 of U1A, the comparator. The output of U1A goes to 3.2 volts when the plus input exceeds the minus input, and to -0.5 volts when the minus input exceeds the plus input.

**Buffer and High Frequency Charging.** Q11 and Q17 buffer the output. They also level shift the DC, and provide a current source to drive the sample/hold capacitor, C33. The voltage on C33 represents the peak positive voltage of the modulation signal. The voltage is monitored by U3A and routed to pin 5 of U1A. When this voltage falls below the input modulation's signal voltage, U1A's output goes high, turning off the sample/hold circuitry.

When the voltage at pin 6 rises above that of pin 5, the comparator output goes low, turning on Q11 and Q17. C33 starts charging until its voltage, which is read at pin 5 of U1A, becomes greater than that of pin 6. Now, U1A's output, at pin 8, returns to 3.2 volts, turning off Q17 and consequently stopping the charge current.

The voltage on C33 remains updated to the positive peak voltage of the input signal, and is coupled to the microprocessor via a low-pass filter consisting of R54 and C38.

**Positive and Negative Peak Reset.** Operation of the positive and negative peak reset circuits is similar, therefore, only the positive peak reset circuit will be explained. Theoretically, the peak detector circuit would keep updating to the most positive peak it receives; the peak voltage would never come down, however, the microprocessor discharges C33 just after it finishes reading the peak voltage. When the microprocessor pulls pin 5 on U3B below 1.5 volts, which is the constant bias voltage at pin 6, the output of the operational amplifier U3B goes to -6 volts. CR24 turns on and allows C33 to discharge into the output of U3B, pin 7.

TROUBLESHOOTING

1. Connect 50 ohm test oscillator output to FM input. Select EXT 10 MHz/V FM and set the test oscillator to 10 kHz at 0.35 Vrms (0.5 Vpeak). The MODULATION display should indicate about 5 MHz deviation. If the indicated deviation is correct, continue to the next step. Otherwise go to step 9.

SERVICE SHEET 12 (cont'd)

2. Select EXT 1 MHz/V FM. The indicated display should drop by a factor of 10. If it does not, go to step 12.

3. Connect a spectrum analyzer to the RF OUTPUT connector. Set the test oscillator to 415 kHz. Adjust the test oscillator output amplitude to obtain an indicated deviation of 1 MHz on the Signal Generator MODULATION display. The carrier should be close to being nulled with these settings. Vary the test oscillator frequency to null the carrier. The null should occur between 370 kHz and 460 kHz. This range is typical, not a hard specification.

4. Select EXT 10 MHz/V FM. Set the test oscillator to 2.08 MHz and adjust the amplitude to get 5 MHz indicated deviation. The carrier should be close to being nulled. Vary the test oscillator frequency to null the carrier. The null should occur between 1.87 MHz and 2.3 MHz. If the performance in steps 3 or 4 is not correct, go to step 13.

5. Disconnect the test oscillator and replace with a low voltage power supply; set the supply to zero before connecting. Push the FM vernier in to be sure dc FM is selected. Set spectrum analyzer to 5 MHz/division and center the signal. Slowly increase the power supply voltage. The frequency should rise as the voltage is increased until the frequency is about 10 MHz higher with 1 Vdc applied. Above about 1 volt, the input protection diodes start to conduct and keep the frequency from rising further. Note that FM metering does not work for dc FM. As the power supply voltage is being changed, the display will show some meaningless numbers and then drop to a low value determined by the ripple of the power supply and any ground loops between the Signal Generator and the power supply.

6. Reverse the polarity of the power supply voltage. The frequency should drop to about 10 MHz below the nominal center frequency. If you try to reverse polarity by changing the center conductor and ground leads, you will very likely create a ground loop and not be able to obtain the expected negative frequency shift. To properly apply a negative voltage from a power supply with both positive and negative outputs floating, ground the negative output while applying positive voltage to the FM input. Ground the positive output while applying negative voltage. If all is correct to this point, the FM Shaper board is working normally. If there are problems with dc FM, continue to the next step. Otherwise no problem has been discovered with the FM portion of the instrument.

DC FM Problems

7. If there is no frequency change when applying a dc voltage, check for proper functioning of S3, the front panel AC/DC selector switch by measuring the resistance from the front panel FM connector to the end of the yellow coax cable where it enters the FM shaper board. The resistance should be very near zero. If the resistance is near zero, continue to the next step. Otherwise troubleshoot S3 and the associated components on the input.

SERVICE SHEET 12 (cont'd)

8. Select EXT 10 MHz/V FM. Apply 0.5 Vdc to the FM input. Measure the voltage at the base of Q19A. There should be about 0.17 Vdc on the base. Select EXT 1 MHz/V FM. The voltage should drop by a factor of 10. If the voltages are correct, remove the input voltage and use the voltages on the schematic to find the malfunction between that point and the output. Otherwise troubleshoot the input voltage divider and deviation range selection relays.

Incorrect Deviation Display in the EXT 10 MHz/V Range

9. Set the service switch on the A9 CPU board to the DIAGNOSTIC position and select Test 21. The FREQUENCY display window should indicate about 0.35 volts. Select Test 22. The voltage should stay nearly the same as Test 21 but the decimal point to the left of the units digit should flash to indicate a negative voltage. If the voltages differ by more than a few hundredths of a volt, troubleshoot the peak detectors and buffers. A significant difference can also indicate a problem on the I/O Board, A10.

10. Disconnect the FM input signal while observing the indicated voltages in Tests 21 and 22. Both voltages should drop to zero (or very near) when the input is removed. If they don't both go to zero, troubleshoot the peak reset circuits.

11. Measure the voltages at A10TP5 and TP6 with a dc voltmeter. The voltages should match those displayed with Tests 21 and 22 in step 9 and should correspond to the peak of the input voltage. If a 0.5 Vpeak (0.35 Vrms) sine wave is applied to the FM input with the FM vernier fully clockwise, TP5 should read 0.5 Vdc and TP6 should read -0.5 Vdc. If the test points read correctly but the diagnostic tests show the wrong voltages go to Service Sheet 10 to continue troubleshooting. If the test point voltages are incorrect, troubleshoot the peak detectors and the input circuit after first checking the output of the test oscillator to be sure it is correct. If all four measurements are correct, go to Service Sheet 11 to check CPU operation and ROM signatures.

12. Set service switch to NORM and press EXT 1 MHz/V key. If the LED in the EXT 1 MHz/V key fails to light, go to Service Sheet 1 to continue troubleshooting. If the LED lights, go to Service Sheet 11 to troubleshoot problems with front panel data handling.

SERVICE SHEET 12 (cont'd)

13. Install the FM Shaper board on a 2x18 pin extender board. Connect an oscilloscope to the center conductor of J1. Apply a 1 kHz sine wave to the FM connector at about 0.4 Vrms. Select EXT 10 MHz/V FM range. Set the FM vernier to obtain an indicated deviation of 5 MHz. A 10 Vp-p sine wave should be present. The top half of the sine wave is a little broader than the bottom half due to the FM Shaper circuit, however, there should be no evidence of clipping on the signal. The positive peak of the sine wave should be at about -7 volts and the negative peak should be at about -17 volts. Rotate the FM vernier fully counterclockwise. The sine wave amplitude should drop to near

zero with a remaining bias of about -11 Vdc. If the voltages are all correct, continue to the next step. Otherwise, troubleshoot the input buffer and output amplifier.

14. Reset the FM vernier for 5 MHz indicated deviation. Select EXT 1 MHz/V FM range. Use ac coupling on the oscilloscope to allow convenient viewing of the sine wave. The sine wave should drop to about 1 Vp-p around the -7.5 Vdc bias. If the signal does not drop properly, troubleshoot relays K1, K2 and K3 as well as the resistive divider and the relay drive signals. If the voltages are correct, troubleshoot the microwave oscillator varactor input. See Block Diagram 2.

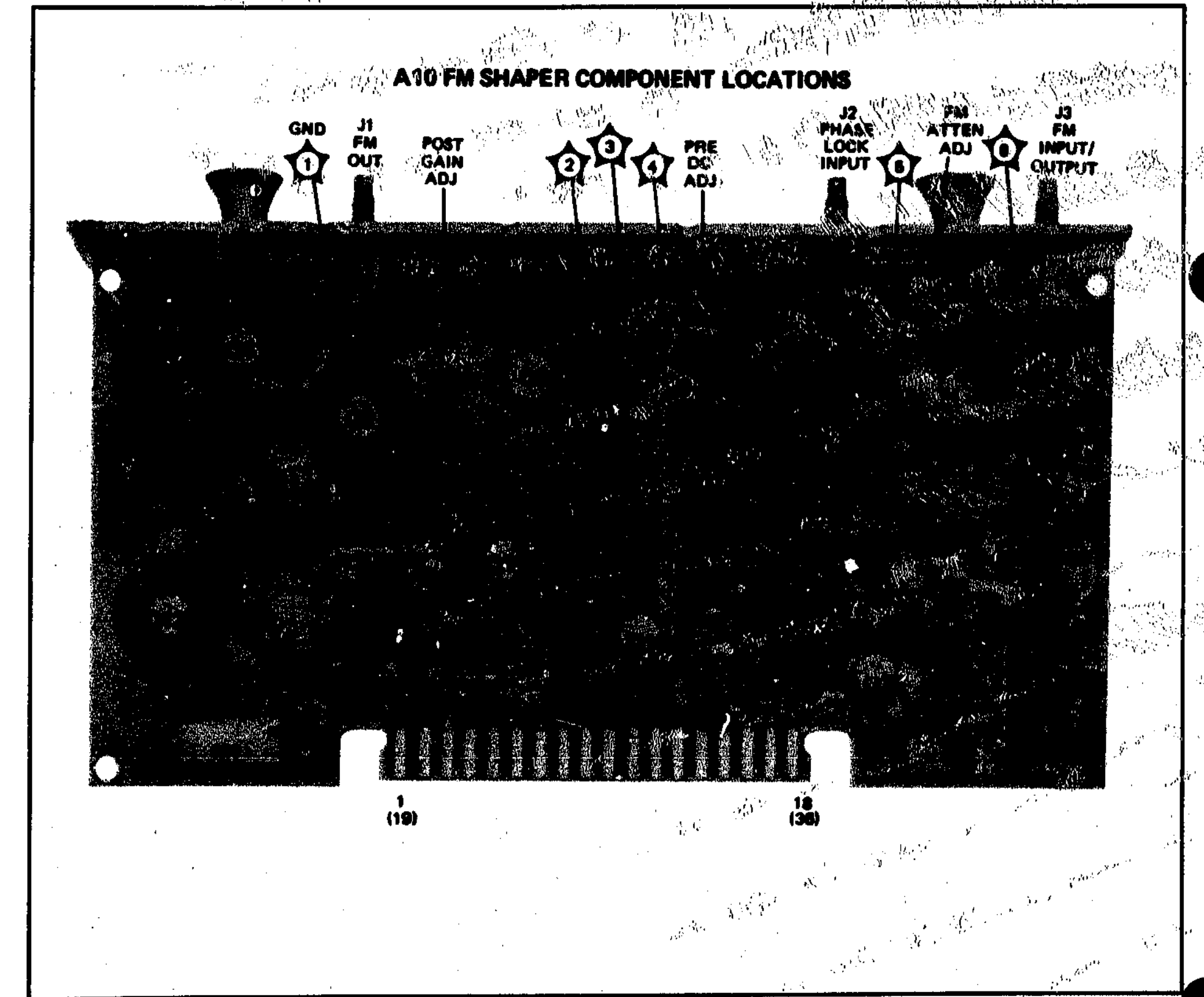


Figure 8-44. FM Shaper Component Locations

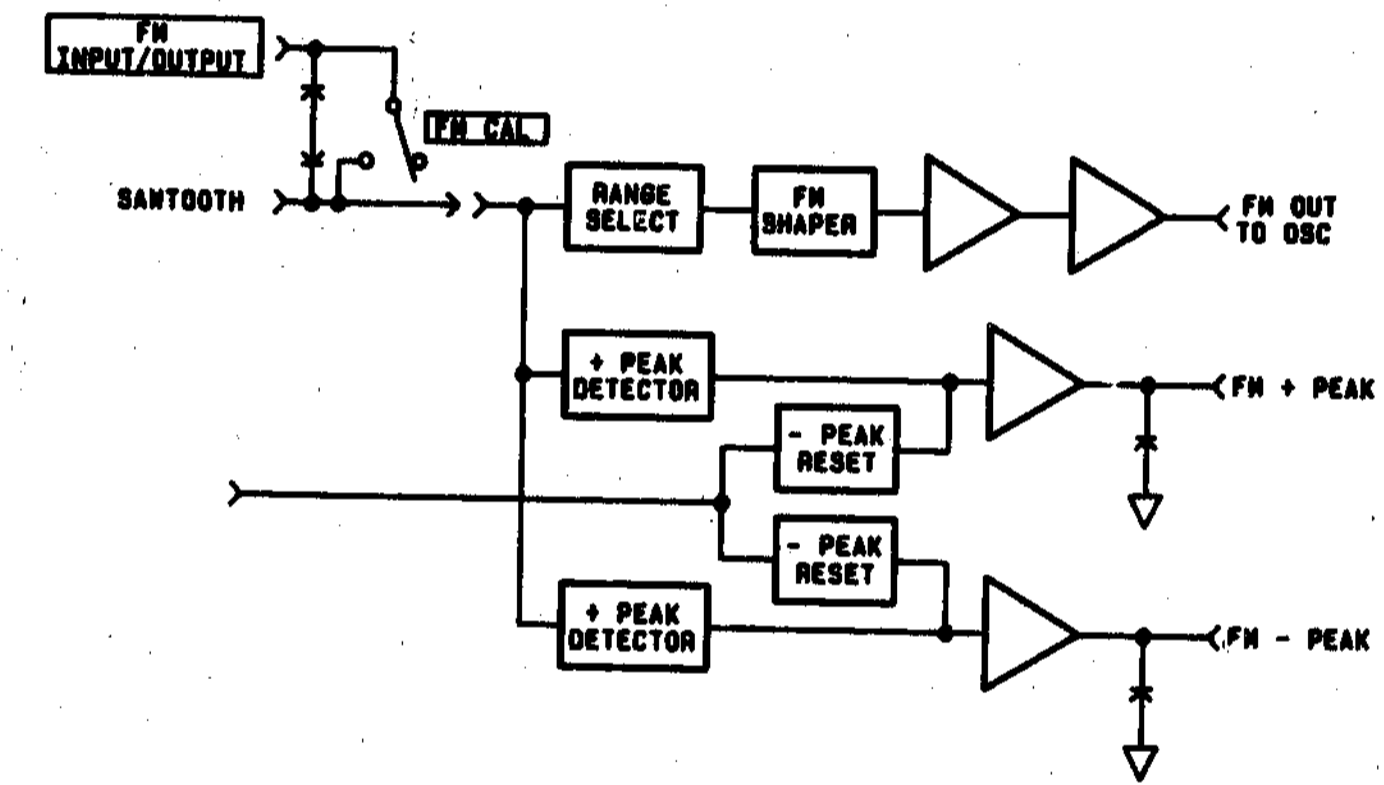
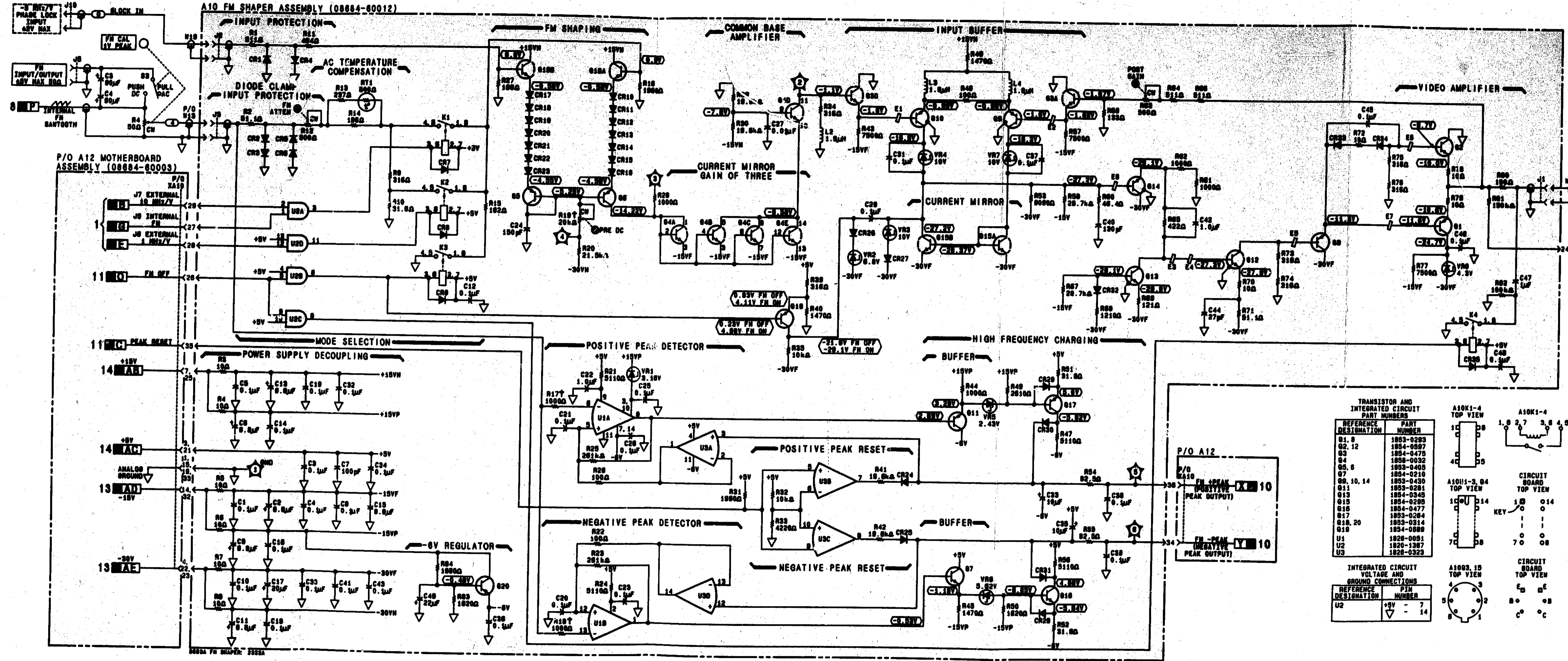


Figure 8-45. FM Shaper Simplified Block Diagram



TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS

REFERENCE DESIGNATION	PART NUMBER
Q1, 9	1883-0293
Q2, 12	1884-0997
Q3	1884-0478
Q4	1888-0032
Q5, 6	1883-0405
Q7	1884-0210
Q8, 10, 14	1883-0420
Q11	1883-0281
Q13	1884-0340
Q15	1884-0290
Q16	1884-0477
Q17	1883-0264
Q18, 20	1883-0314
Q19	1884-0088
Q1	1826-0088
U2	1820-1387
U3	1828-0329

INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS

REFERENCE DESIGNATION	VOLTAGE	PN NUMBER
U2	+5V	7
U2	-15V	14

- NOTES
- REFER TO TABLE 8-2 FOR SCHEMATIC DIAGRAM NOTES.
  - WIRENAMES PRECEDED BY AN ASTERISK (\*) ARE SIGNAL LINES USED BY THE MICROPROCESSOR.
  - ↑ INDICATES CIRCUIT CHANGE. SEE SECTION VII.

LOGIC LEVELS

WIRE	LEVEL
VH	2.0V
LV	2.0V
< 18	MORE POS. THAN 18
> 18	MORE POS. THAN 18
00	0V
01	0V

REFERENCE DESIGNATIONS

NO PREFIX	A10 CONT.
C3, 4	L2-4
J5, 10	R1-20
R4	R1-35, 38-84
R5	R1, 3-7
R13, 18, 19	U1-3
U10	VH1-8
C1-27, 28-48	A12
CR1-38	XA10
E1-7	
J1-3	
K1-4	

NOT ASSIGNED: CR9; L1; R36-38

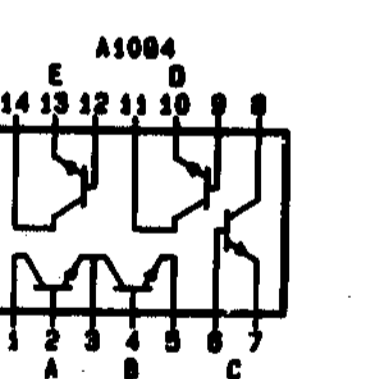


Figure 8-46. FM Shaper Schematic Diagram



## SERVICE SHEET 13 POWER SUPPLY [NEGATIVE REGULATOR]

### PRINCIPLES OF OPERATION

#### General.

There are fixed supplies at -15 Vdc and -30 Vdc. All the supplies have foldback current limiting and overvoltage crowbar protection.

#### Foldback Current Limiting.

Foldback current limiting works in the following way. The -15V supply will be used as an example. At the output of A12Q2 there is a 1 ohm resistor; the resistor value determines the maximum current that can flow before current limiting begins. The voltage developed across this resistor is sensed by A11Q6 whose emitter is connected to the output side of this "sense" resistor and whose base is connected through a 348 ohm resistor to the input side of the resistor. During normal power supply operation the voltage dropped across the resistor will be less than the transistor's base-emitter junction turn-on voltage. If the current increases so the voltage drop is about 0.7 volts, transistor Q6 will turn on and start to sink current into the output of A11U2, the regulator reference amplifier. This current would normally go to the base of A11Q7 to be amplified as base drive for the series regulator transistor. With this current removed, the base drive to the series pass transistor decreases and causes the current delivered by the power supply to drop. Once the power supply has started to limit current output in this way, the best way to recover is to completely remove the input voltage from the power supply by unplugging the instrument from the mains.

#### Crowbar Circuit.

A crowbar circuit is present on all the power supply regulators as protection against overvoltage conditions. Depending on the nature of the problem, the crowbar circuit may or may not blow the associated fuse. The crowbars can be reset by turning off the instrument for a few seconds and turning it back on again.

The fan is powered by the mains through the line switch. Its operation is independent of any of the dc supplies. If an instrument appears to be completely dead, you can quickly decide if mains voltage is reaching the instrument by checking for fan operation. This also allows you a quick check on the condition of the mains fuse in the line power module.

## SERVICE SHEET 13 (cont'd)

The -30 volt power supply has an additional circuit at the output of the bridge rectifier. A crowbar circuit there is included to protect the instrument from large line voltage surges or from accidentally connecting the instrument to a 230 volt main when the line power module is set for 120 volts. The transformer secondary being monitored by the crowbar is typically 36 volts rms. A zener diode, A11VR1, is set to turn on the SCR when the transformer secondary exceeds about 62 volts peak. As with any precision instrument, care should be taken to avoid exposing the instrument to line surges. Even if the crowbar doesn't fire, proper operation can be disrupted by sudden changes of the mains voltage.

### TROUBLESHOOTING

Observe the green LED array at the top of the power supply board. The negative power supply

LEDs should be on at about the same brightness. If they are on, use a digital voltmeter to confirm that they are within specifications. Refer to Table 8-20 for voltage specifications. If one or both of these LEDs are off, troubleshoot to find the cause of the LED being off. Note that the -30 volt supply is referenced to the -15 volt supply. If it is wrong, they will both be wrong. Use the voltages on the schematic to troubleshoot to the defective component.

Table 8-20. Negative Power Supply Test Data

Power Supply Voltage	Typical Accuracy	Diagnostic Test Number	A11 Test Point
-15 V	± 0.05 V	04	TP4
-30 V	± 0.1 V	05	TP2

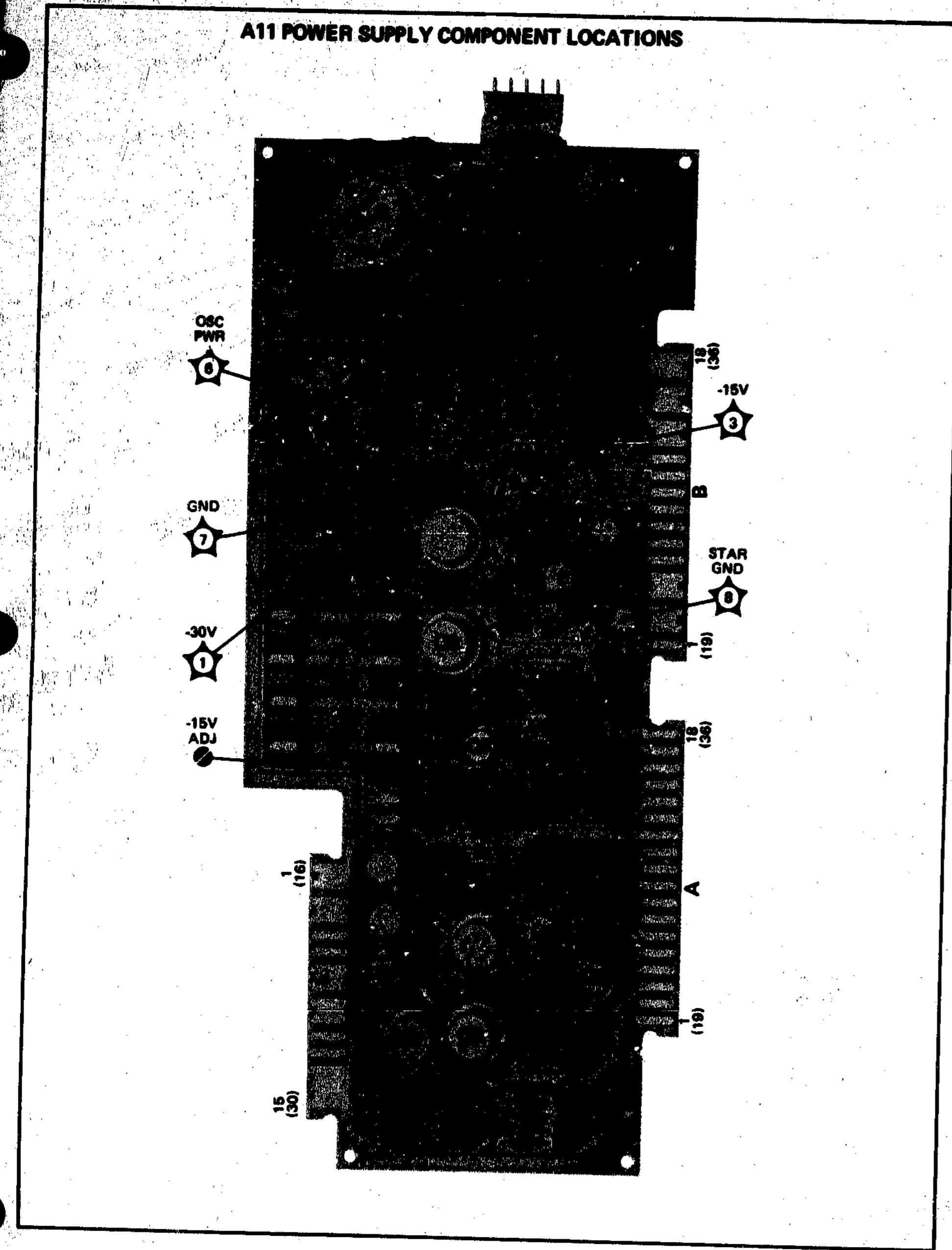


Figure 8-47. Power Supply Component Locations

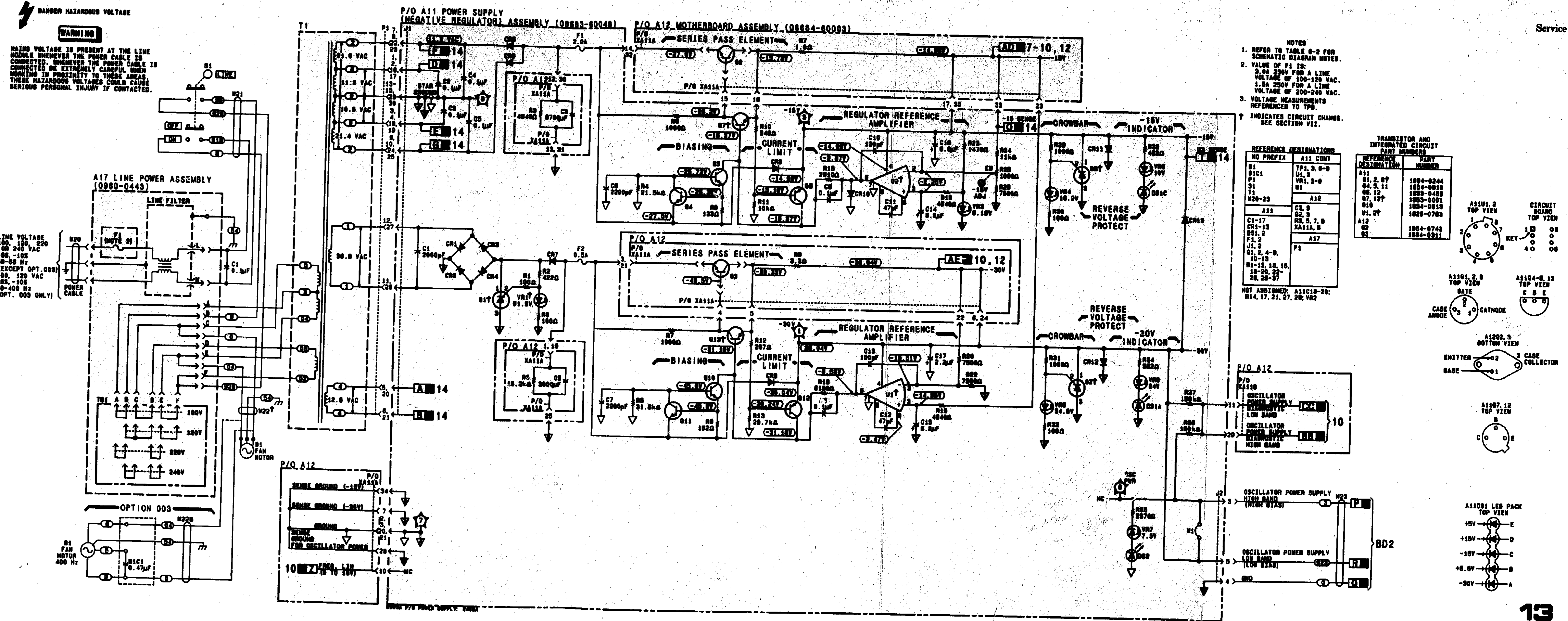


Figure 8-48. Power Supply (Neg. Regulators) Schematic Diagram

## SERVICE SHEET 14 POWER SUPPLY [POSITIVE REGULATOR]

### PRINCIPLES OF OPERATION

#### Fixed Supplies

There are fixed supplies at +5 Vdc, +6.5 Vdc, and +30 Vdc. The fixed regulated supplies are of two types. The higher current supply, the +15V uses a series pass transistor while the two lower current supplies, the +6.5V and +5V supplies use three port regulators. All the supplies have foldback current limiting and overvoltage crowbar protection.

#### Foldback Current Limiting

Foldback current limiting works in the following way. The +15V supply will be used as an example. At the output of A12Q1 there is a 1 ohm resistor; the resistor value determines the maximum current that can flow before current limiting begins. The voltage developed across this resistor is sensed by A11Q17 whose emitter is connected to the output side of this "sense" resistor and whose base is connected through a 348 ohm resistor to the input side of the resistor. During normal power supply operation the voltage dropped across the resistor will be less than the transistor's base-emitter junction turn-on voltage. If the current increases so the voltage drop is about 0.7 volts, transistor Q17 will turn on and start to conduct current from the output of A11U3, the reference regulator amplifier. This current would normally go to the base of A11Q16 to be amplified as base drive for the series regulator transistor. With this current removed, the base drive to the series pass transistor decreases and causes the current deli-

vered by the power supply to drop. Once the power supply has started to limit current output in this way, the best way to recover is to completely remove the input voltage from the power supply by unplugging the instrument from the mains.

**Crowbar Circuit.** A crowbar circuit is present on all the power supply regulators as protection against overvoltage conditions. Depending on the nature of the problem, the crowbar circuit may or may not blow the associated fuse. The crowbars can be reset by turning off the instrument for a few seconds and turning it back on again.

### TROUBLESHOOTING

Observe the green LED array at the top of the power supply board. The positive power supply LEDs should be on at about the same brightness. If they are not, use a digital voltmeter to confirm that they are within specifications. Refer to Table 8-21 for voltage specifications. If one or more LEDs are off, troubleshoot to find the cause of the LED being off. Note that the +15 volt supply is referenced to the -15 volt supply. If it is wrong, they will both be wrong. Use the voltages on the schematic to troubleshoot to the defective component.

Table 8-21. Positive Power Supply Test Data

Power Supply Voltage	Typical Accuracy	Diagnostic Test Number	A11 Test Point
+5 V	± 0.05 V	00	TP6
+6.5 V	± 0.1 V	02	TP3
+15 V	± 0.1 V	03	TP5

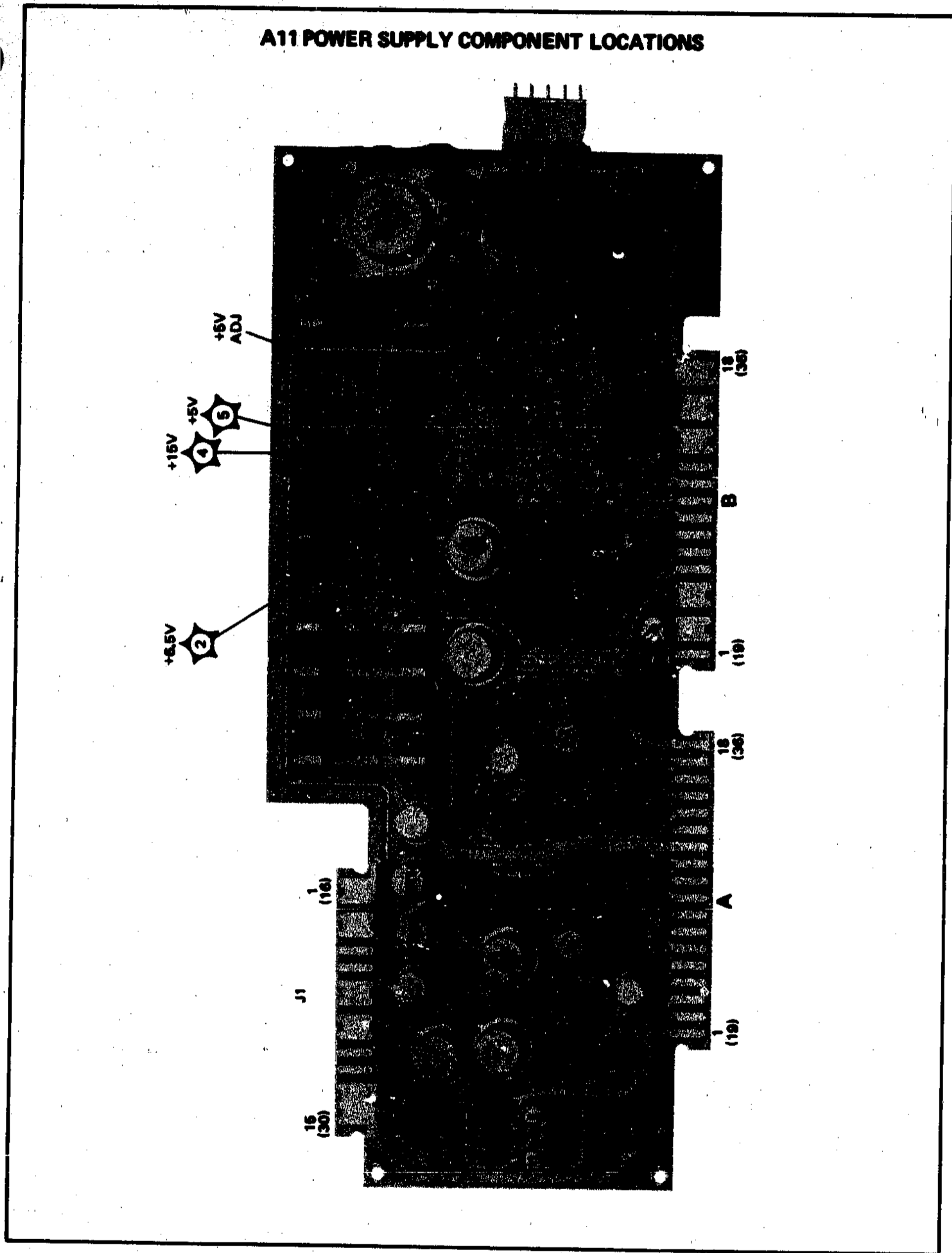


Figure 8-49. Power Supply Component Locations

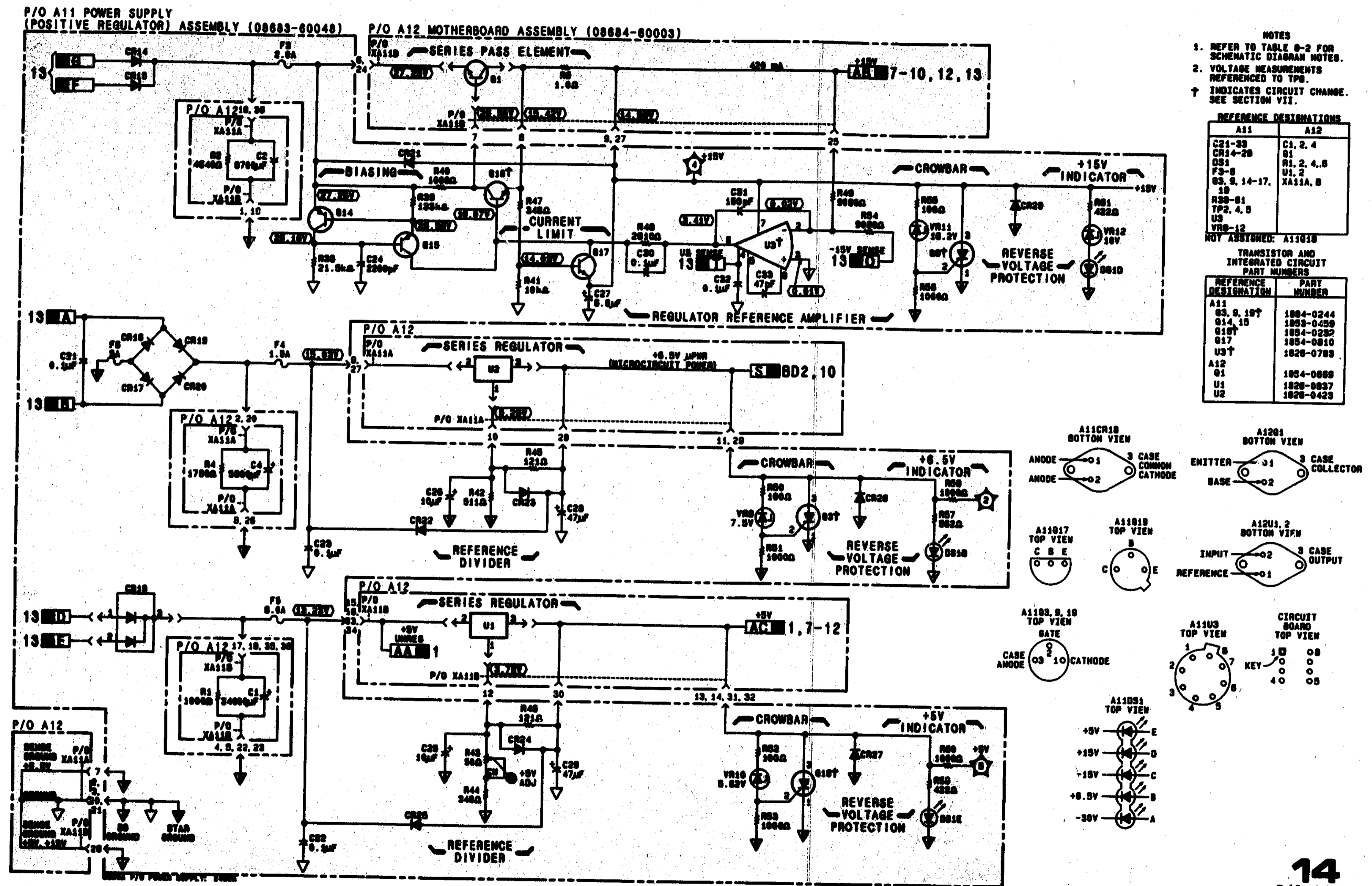


Figure 8-50. Power Supply (Pos. Regulator) Schematic Diagram

**A12 MOTHERBOARD COMPONENT LOCATIONS**



NOTE: COMPONENTS  
XA2, XA3, AND XA4,  
ARE NOT LOADED ON  
THE 08684-60003

**Figure 8-51. Motherboard Component Locations**

# **MANUAL CHANGES**

# MANUAL CHANGES

## SIGNAL GENERATOR

### MANUAL IDENTIFICATION

Model Number: HP 8683A  
Date Printed: May 1984  
Part Number: 08683-90023

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
8424A	1	2452A	1-4
2424A00188 to 2424A00193	1, 2	2511A	1-5
2431A	1, 2	2542A	1-6
2448A	1, 2, 3	▶2648A	1-7

▶ NEW ITEM

### ERRATA

Page 1-4, Table 1-1:

Add to SPECTRAL PURITY Spurious Output Conditions, "CW mode".

Add to RF OUTPUT Level Range Performance Limits -1 dBm to -130 dBm, Option 002 leveled into 50Ω.

Page 1-5, Table 1-1:

Change FREQUENCY MODULATION Incidental AM Performance Limits to <6%.

Page 1-9, Table 1-2:

Under PULSE MODULATION delete, "Nominal input impedance is 50Ω" and add, "The maximum allowable input level is ±5V peak."

Page 1-10, Table 1-3:

Change Digital Voltmeter to HP 3456A.

Page 1-11, Table 1-3:

Change Test Oscillator to HP 654A.

Page 3-1, paragraph 3-1:

In the second sentence delete, "and an abbreviated performance test."

Page 3-3, Figure 3-2:

Add the following sentence to FM Controls. "When operating in the FM INT mode, disconnect any external FM sources."

Page 4-5, paragraph 4-8:

Under EQUIPMENT change Test Oscillator to HP 654A.

### 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.

18 September 1986

12 Pages

Printed in U.S.A.



**ERRATA (cont'd)**

Page 4-13, paragraph 4-10:

Change Step 5 to read as follows:

5. Set audio analyzer frequency to 1 kHz, and adjust output level to assure that at least 70% modulation level can be achieved, as read on the modulation analyzer. Record the maximum modulation level obtained.

Modulation Level \_\_\_\_\_ %

Change the last sentence of Step 7 to read as follows:

Record the frequencies at which the 3 dB points are attained.

Upper 3 dB Point (>10 kHz) \_\_\_\_\_ kHz

Lower 3 dB Point (<50 Hz) \_\_\_\_\_ Hz

Change the first sentence of Step 8 to read as follows:

With the audio analyzer output frequency set to 10 kHz and the output level set to obtain an indicated 30% MODULATION on the Signal Generator under test, press the FM PEAK+ switch on the modulation analyzer.

Page 4-14, paragraph 4-11:

Under EQUIPMENT change Test Oscillator to HP 654A.

Page 4-17, Step 6:

Change the first sentence of Step 16 to read as follows:

Select EXT 1 MHz/V FM on the Signal Generator, set the audio analyzer to 100 kHz, and adjust output amplitude to a 0.4 MHz peak deviation on the Signal Generator under test.

Page 4-22, Table 4-1 Performance Test Record:

Replace pertinent information in Table 4-1 with Table 4-1A.

**Table 4-1A. Performance Test Record**

Para. No.	Test	Results		
		Min.	Actual	Max.
4-10.	AM Rates (3 dB BW) Upper 3 dB Point Lower 3 dB Point	10 kHz	_____ _____	50 Hz

Page 5-4, paragraph 5-8:

Under EQUIPMENT change Test Oscillator to HP 654A.

Page 5-6, paragraph 5-9:

Under EQUIPMENT change Digital Voltmeter to HP 3456A and Test Oscillator to HP 654A.

Page 5-7, Figure 5-4:

Remove PULSE RISE TIME, R81.

Page 5-10, paragraph 5-10:

Under EQUIPMENT change Test Oscillator to HP 654A.

Page 6-6, Table 6-3:

Change R12 to 0698-3132 CD4 RESISTOR 261 1% .125W F TC = 0 ±100, Mfr. Code 24546, Mfr. Part Number C4-1/8-T0-2610-F.

Change R14 to 0757-0403 CD2 RESISTOR 121 1% .125W F TC = 0 ±100, Mfr. Code 24546, Mfr. Part Number C4-1/8-T0-121R-F.

Change A1R15 through A1R20 to 0698-3437 CD2 RESISTOR 133 1% 0.125W F TC = 0±100.

Page 6-9, Table 6-3:

Change A5R43 to 0698-5355 CD7 RESISTOR 5.62K 1% 0.1W F TC = 0±100.

Page 6-11, Table 6-3:

A6R24 If A6R24 needs replacement, replace it with the recommended part described in CHANGE 6.



**ERRATA (cont'd)****Page 6-15, Table 6-3:**

**A8.** If A8 needs replacement, replace it with the recommended assembly described in **CHANGE 6**.

**Page 6-20, Table 6-3:**

**Change A10Q3** to 1854-0712 CD3 TRANSISTOR DUAL NPN PD=1.8W.

**Page 6-24, Table 6-3:**

**A11R25.** If A11R25 needs replacement, replace it with the recommended part described in **CHANGE 6**.

**Page 6-26, Table 6-3:**

**A13.** Add the following below A13:

**A13MP1** 0515-0615 CD6 SCREW-MACH M2 x 0.4 10MM-LG PAN HD

**A13MP2** 0535-0018 CD5 NUT-HEX DBL-CHAM M2 x 0.4 1.6MM-THK

**A13MP3** 2190-0591 CD9 WASHER-LK HLCL 2.0MM 2.2MM-ID

**A13MP4** 3050-0982 CD7 WASHER-FL MTLC 2.0MM 2.2-MM-ID 5-MM-OD

**A13MP5** 3050-0982 CD7 WASHER-FL MTLC 2.0MM 2.2-MM-ID 5-MM-OD

**Page 6-27, Table 6-3:**

**A16.** Add four each of the following below A16:

**A16MP1** 0515-0507 CD5 SCREW-MACH M2 x 0.4 18MM-LG PAN HD

**A16MP2** 0535-0018 CD5 NUT-HEX DBL-CHAM M2 x 0.4 1.6MM-THK

**A16MP3** 2190-0591 CD9 WASHER-LK HLCL 2.0MM 2.2MM-ID

**A16MP4** 3050-0982 CD7 WASHER-FL MTLC 2.0MM 2.2-MM-ID 5-MM-OD

**Page 6-29, Table 6-3:**

Add to AT1, CR1, and DC1 Description, "NSR REFER TO TABLE 6-1."

**Page 6-31, Table 6-3:**

**W31.** If W31 needs replacement, replace it with the recommended part described in **CHANGE 6**.

**Page 6-34, Table 6-3:**

**MP51.** If MP51 needs replacement, replace it with the recommended part described in **CHANGE 6**.

**Page 6-36, Table 6-3:**

**Change MP114** to 5061-0089 CD0 FRONT HANDLE KIT.

**Change MP115** to 5001-0439 CD8 TRIM, FRONT SIDE.

**Page 8-24, paragraph 8-31:**

Change the third and fourth sentences in the second paragraph to, "To stop the action, if error codes are detected in the diagnostics and are being displayed in the FREQUENCY or MODULATION displays, press any key and hold it while pressing the LINE switch to the ON position. This will allow the reading of the error code, then press any key to continue the diagnostic. To slow down the action, when the displays don't power-up correctly and the decimal point in the LEVEL display blinks, press any key and hold it while pressing the LINE switch to the ON position."

**Page 8-30, Step 6:**

In the fourth sentence change 10.24 volts to 0.8 volts.

In the sixth sentence change "drop" to "rise" and 0.0 volts. to 8.7 volts.

**Page 8-39, Figure 8-21 (Service Sheet 1):**

Change part number for P/O A1 FRONT PANEL ASSEMBLY to 08684-60001.

**Page 8-41, Figure 8-24 (Service Sheet 2):**

Change part number for P/O A1 FRONT PANEL ASSEMBLY to 08684-60001.

**ERRATA (cont'd)**

Page 8-43, Figure 8-27 (Service Sheet 3):

Change part number for P/O A1 Front Panel Assembly to 08684-60001.

Page 8-55, Figure 8-46 (Service Sheet 12):

Change, in the table of transistor and integrated circuit part numbers, A10Q3 to 1854-0712.

**CHANGE 1**

Page 1-6, Table 1-1:

Change electrical characteristics operating and non-operating environment performance limits to, "Exceeds MIL-T-28800C Class V requirements for temperature, humidity, shock and vibration."

Page 2-2, paragraph 2-8:

Change Humidity to, "40°C at <95% relative".

Page 2-3, paragraph 2-12:

Change Humidity to, "40°C at <95% relative".

Page 6-26, Table 6-3:

Change A12Q3 to 1854-0814 CD6 TRANSISTOR NPN SI.

Page 8-57, Figure 8-48 (Service Sheet 13):

In the table of TRANSISTOR AND INTEGRATED CIRCUIT PART NUMBERS change A12Q3 to 1854-0813.

**CHANGE 2**

Page 6-26, Table 6-3:

Delete A13C3.

Page 8-37, Figure 8-18 (Service Sheet BD2):

Delete Capacitor A13C3.

**CHANGE 3**

Page 6-18, Table 6-3:

Change A9U8 to 08684-80012 CD0 ROM 8K.

Page 8-52, Table 8-17:

Add signatures for ROM part number 08684-80012 as shown:

A9U8 PIN #	08684-80012
11	0H93
12	P19H
13	P030
15	7P12
16	6U2A
17	33CU
18	3U67
19	576A

Page 8-53, Figure 8-43 (Service Sheet 11):

Change, in the table of transistor and integrated circuit part numbers, A9U8 to 08684-80012.

**CHANGE 4**

Page 6-5, Table 6-3:

Change A1 to 08684-60153 CD8 FRONT PANEL BOARD.

Change A1C1 through A1C7 to 0180-0197 CD8 CAPACITOR-FXD 2.2 μF ±10% 20 VDC.

**CHANGE 4 (cont'd)**

Page 6-5, Table 6-3 (cont'd):

Change A1DS1 through A1DS4, A1DS8 through A1DS10, and A1DS12 through A1DS14 to 1990-0540 CD3 DISPLAY NUMERIC SEG.

Change A1DS11 to 1990-0681 CD3 DISPLAY AN SEG.

Page 6-6, Table 6-3:

Add A1R22 through A1R31 0757-0438 CD3 RESISTOR 5.11K 1% 0.125W FTC=0±100.

Change A1U2, U3, U4, U7, U9, U10, U11, U12, U16, and U17 to 1820-3395 CD3 IC DCDR TTL BCD to 7 SEG 4 to 7 LINE.

Change A1XA1DS1 through A1XA1DS14 to 1200-1170 CD4 SOCKET IC.

Page 8-38, Figure 8-19:

Change to Figure 8-19 Front Panel Component Locations (Part of **CHANGE 4**) found in this supplement.

Page 8-39, Figure 8-21 (Service Sheet 1):

Change A1 Front Panel Assembly to 08684-60153.

Change serial prefix to 2452A in lower left corner.

Page 8-40, Figure 8-22:

Change to Figure 8-22 Front Panel Component Locations (Part of **CHANGE 4**) found in this supplement.

Page 8-41, Figure 8-24 (Service Sheet 2):

Change the schematic symbol for U9, U10, U11, and U12 to the symbol shown on page 5 of this supplement.

Change, in the table of integrated circuit part numbers, U9 through U12 to 1820-3395.

Change A1 Front Panel Assembly to 08684-60153.

Change serial prefix to 2452A in lower left corner.

Page 8-42, Figure 8-25:

Change to Figure 8-25 Front Panel Component Locations (Part of **CHANGE 4**) found in this supplement.

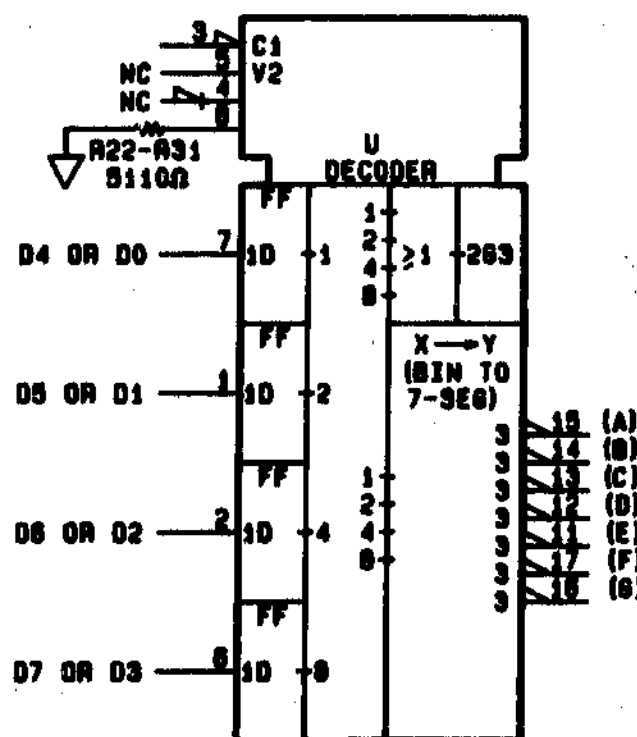
Page 8-43, Figure 8-27 (Service Sheet 3):

Change the schematic symbol for U2, U3, U4, U7, U16, and U17 to the symbol shown in this supplement.

Change A1 Front Panel Assembly to 08684-60153.

Change serial prefix to 2452A in lower left corner.

Change, in the table of integrated circuit part numbers, U2—U4, U7, U16, and U17 to 1820-3395.



P/O Figure 8-24 (Service Sheet 2) and P/O Figure 8-27 (Service Sheet 3)

**CHANGE 5**

Page 6-34, Table 6-3:

Change the screws listed below MP53 to 0515-1232 CD5 SCREW-MACH M 3.5 x 0.6 8MM-LG PAN-HD.

Page 6-36, Table 6-3:

Change MP101 to 5041-6820 CD7 HANDLE CAP-REAR.

Below MP101, add 0515-1132 CD4 QTY2 SCREW-MACH M5 x 0.8 10MM-LG.

Change MP104 to 5061-9434 CD7 COVER-TOP.

Change MP105 to 5021-5904 CD3 FRAME-REAR.

Change MP107 to 5021-5836 CD1 STRUTS-CORNER and change the quantity (QTY) to 4.

Change the screws listed below MP107 to 0515-1331 CD5 SCREW-METRIC SPECIALTY M4 x 0.7

THD; 6 and change the quantity (QTY) to 16.

Change MP108 to 5021-5803 CD2 FRAME-FRONT.

Below MP109, add 2360-0190 CD5 QTY10 SCREW-MACH 6-32 .188-IN-LG 100 DEG.

Change MP111 to 5061-9446 CD1 COVER-BOTTOM.

Change MP114 to 5061-9689 CD4 HANDLE KIT-FRONT.

Change MP117 to 5041-6819 CD4 HANDLE CAP (FRONT).

Below MP117, add 0515-1132 CD4 QTY2 SCREW-MACH M5 x 0.8 100MM-LG.

Change MP119 to 5061-9771 CD5 RACK FLANGE KIT (OPTION 913).

**CHANGE 6**

Page 6-11, Table 6-3:

Change A6R24 to 0698-3152 CD8 RESISTOR 3.48K 1% .125W F TC=0±100.

Page 6-15, Table 6-3:

Change the HP Part Number and Mfr. Part Number for the I/O BOARD (A8) to 08684-60159.

Page 6-24, Table 6-3:

Change A11R25 to 2100-4090 CD2 RES-TRMR 1K 10%.

Page 6-31, Table 6-3:

W31. Add the following below W31: 08731-210 CD2 LOCK-NUT.

Page 6-34, Table 6-3:

Change MP51 to 7100-1283 CD4 COVER-TRANS.

Page 6-35, Table 6-3:

W31 RF Aux Output Cable. Replace lockwasher and hex nut, used to attach W31 to the rear panel, with locknut 08731-210.

Page 8-47, Figure 8-33 (Service Sheet 8):

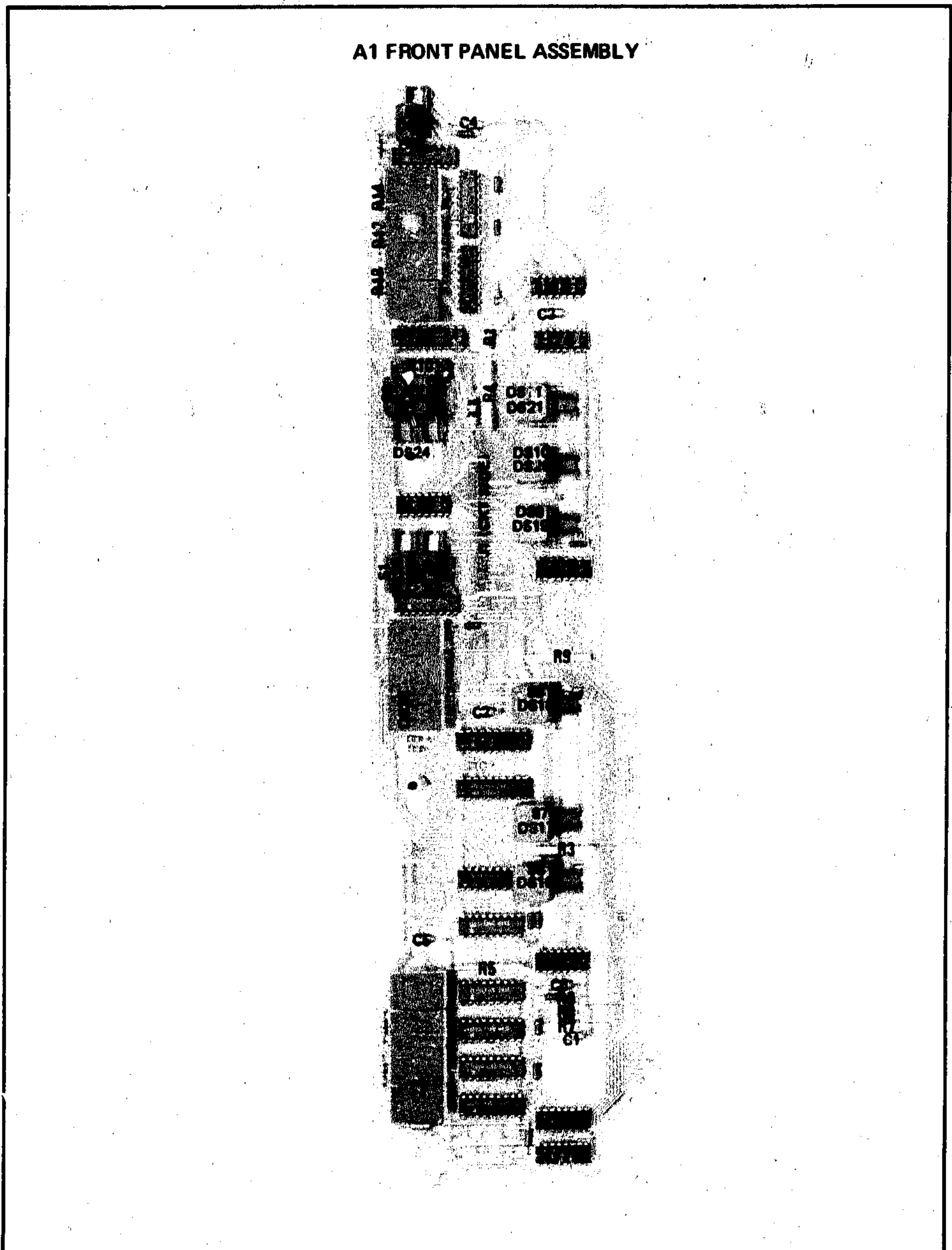
Change the value of R24 to 3.48 kΩ.

Page 8-51, Figure 8-40 (Input/Output Schematic Diagram):

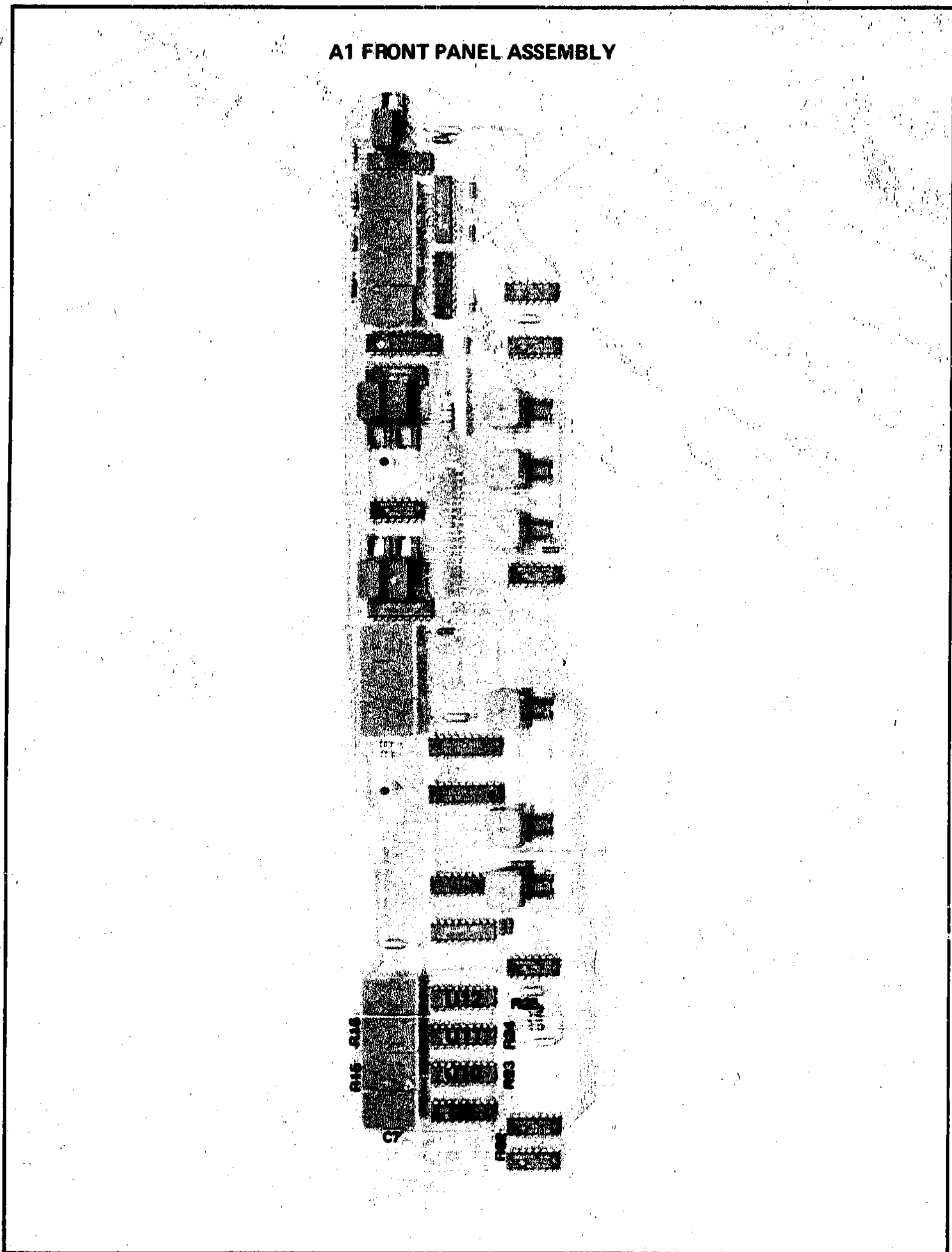
Change the part number on the upper left side of the schematic to 08684-60159.

Replace the "Integrated Circuit Voltage and Ground Connections" table with the following table:

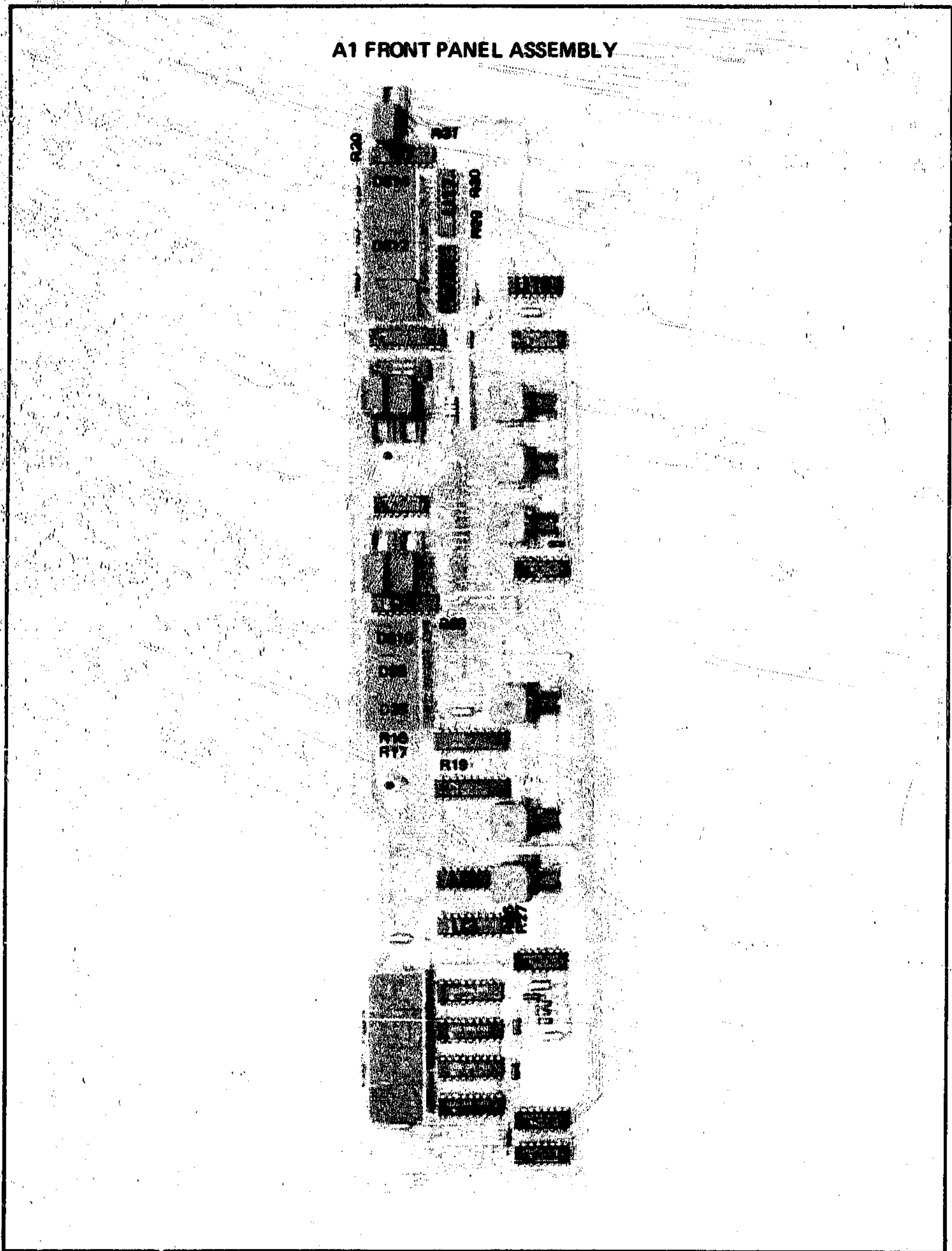
INTEGRATED CIRCUIT VOLTAGE AND GROUND CONNECTIONS		
REFERENCE DESIGNATION	PIN NUMBER	
U3	+15V	16
	▽	3
U4-6, 14, 15	+5V	20
	▽	10
U7-10	+15V	13
	▽	14
	-15V	3
U12	+15V	6
	+5V	7
	▽	8
	-15V	9



**Figure 8-19. Front Panel Component Locations (Part of Change 4)**



**Figure 8-22. Front Panel Component Locations (Part of Change 4)**



**Figure 8-25. Front Panel Component Locations (Part of Change 4)**

**►CHANGE 7****Page 6-18, Table 6-3:**

Change the HP Part Number and Mfr. Part Number for the FM SHAPER BOARD (A10) to 08684-60158 CD3.  
Change A10C16 and A10C20 to 0160-4835 CD7 CAPACITOR-FXD .1  $\mu$ F  $\pm$ 10% 50 VDC CER.

**Page 6-19, Table 6-3:**

Change A10C23 to 0160-4835 CD7 CAPACITOR-FXD .1  $\mu$ F  $\pm$ 10% 50 VDC CER.  
Change A10C38 and A10C48 to 0160-4835 CD7 CAPACITOR-FXD .1  $\mu$ F  $\pm$ 10% 50 VDC CER.  
Add A10C50 0160-3761 CD6 CAPACITOR-FXD 820 PF  $\pm$ 10% 50 VDC CER.

**Page 6-20, Table 6-3:**

Delete A10Q19 and show as NOT ASSIGNED.  
Add A10Q21 and A10Q22, 1854-0977 CD2 TRANSISTOR NPN SI DARL TO-92 PD=625 MW.

**Page 6-21, Table 6-3:**

Change A10R29 and A10R30 to 0698-3150 CD6 RESISTOR 2.37K 1% .125W F TC=0 $\pm$ 100.

**Page 6-22, Table 6-3:**

Add A10R85 0698-3453 CD2 RESISTOR 196K 1% .125W F TC=0 $\pm$ 100.  
Add A10R86 and A10R87, 0757-0443 CD0 RESISTOR 11K 1% .125W F TC=0 $\pm$ 100.  
Add A10R88 0698-7205 CD0 RESISTOR 51.1 1% .05W F TC=0 $\pm$ 100.  
Add A10R89 0698-3164 CD2 RESISTOR 712 1% .125W F TC=0 $\pm$ 100.  
Add A10R90 0698-7235 CD6 RESISTOR 909 1% .05W F TC=0 $\pm$ 100.

**Page 8-54, Figure 8-44:**

Change to Figure 8-44 A10 FM Shaper Component Locations (Part of Change 7) found in this supplement.

**Page 8-55, Figure 8-46 (Service Sheet 12):**

Change A10 FM Shaper Assembly to 08684-60159.  
Add a resistor, R85, 196 k $\Omega$ , from the connection of A10J3 and A10R2 to +5V.  
Replace the appropriate portion of Figure 8-46 with Figure 8-46A.



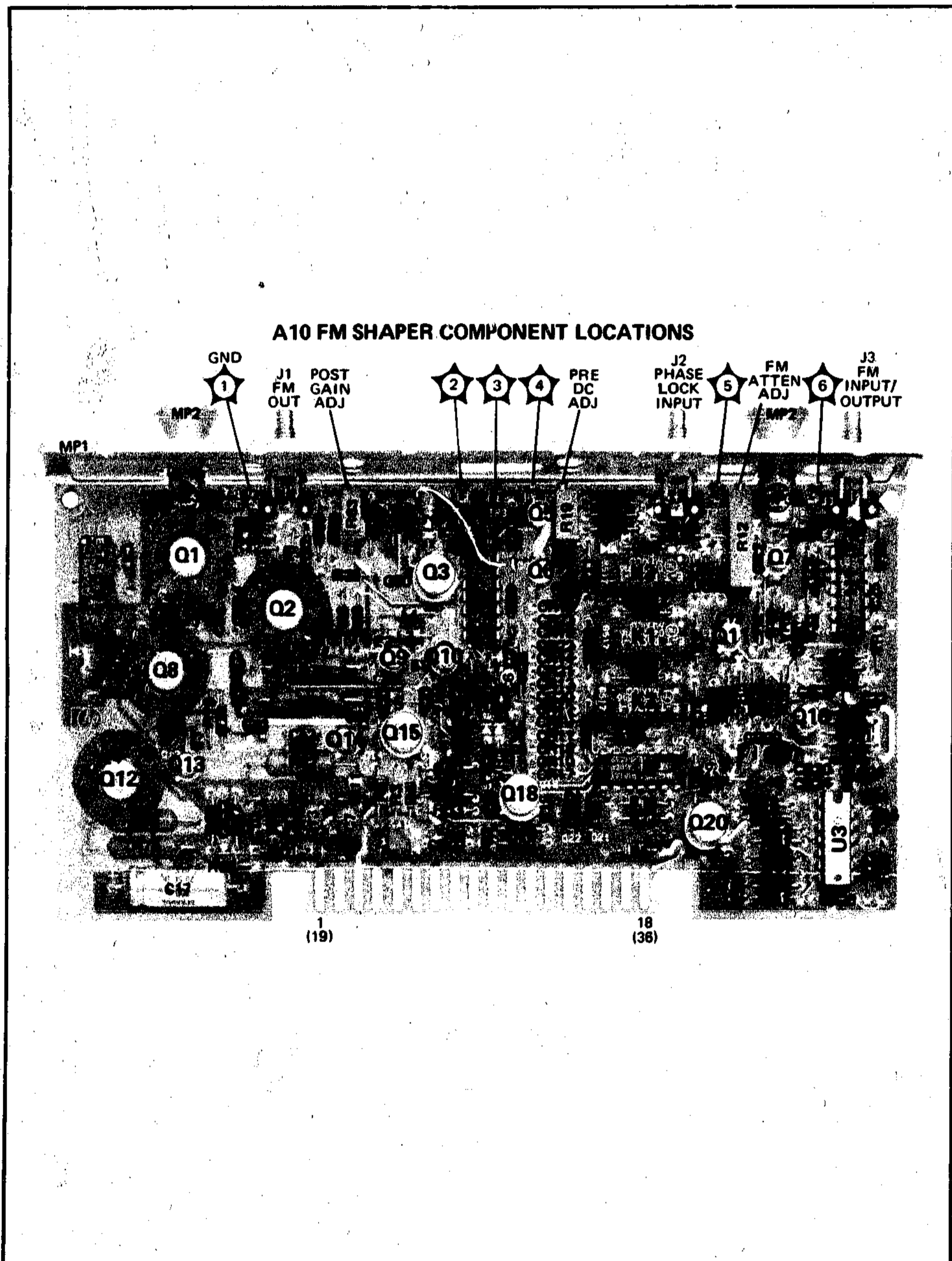


Figure 8-44. A10 FM Shaper Component Locations (Part of Change 7)

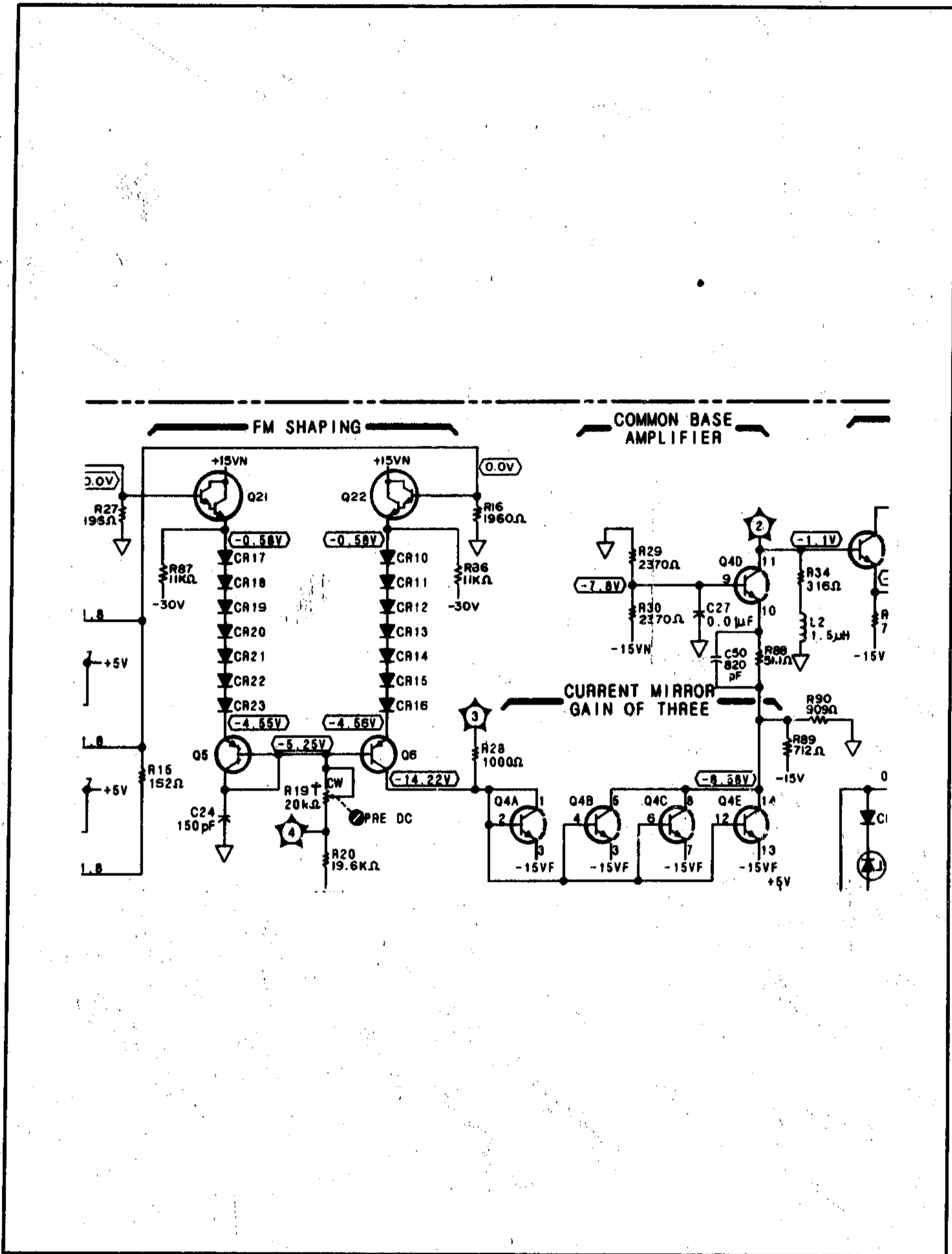


Figure 8-46A. P/O FM Shaper Schematic Diagram (Part of Change 7)