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Errata

Title & Document Type:

Manual Part Number:

Revision Date:

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, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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.

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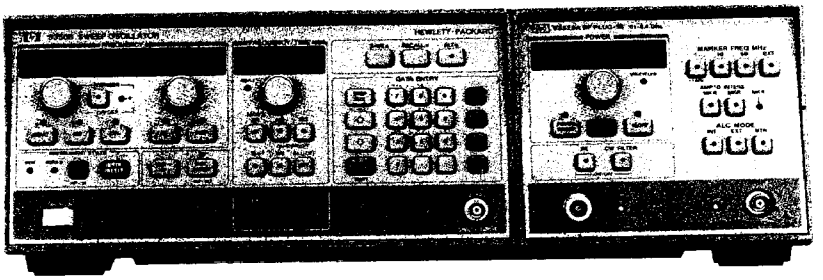
Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

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OPERATING AND SERVICE MANUAL

HP 8350B SWEEP OSCILLATOR



HEWLETT PACKARD

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HP 8350B
SWEEP OSCILLATOR
(Including Option 400)

SERIAL NUMBERS

This manual applies directly to HP Model 8350B SWEEP OSCILLATOR having serial number prefix 3241A.

With changes described in Section VII, this manual also applies to instruments with serial number prefixes 3239A, 3116A, 3115A, 3103A, 2933A, 2851A, 2749A, 2722A, 2712A, and 2638A.

For additional information about serial numbers, refer to INSTRUMENTS COVERED BY MANUAL in Section 1.

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SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

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 (refer to Table of Contents).



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.

SAFETY EARTH GROUND

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

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an autotransformer make sure the common terminal is connected to the neutral (grounded side of the mains supply).

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

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

Capacitors inside this product may still be charged even when disconnected from their power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

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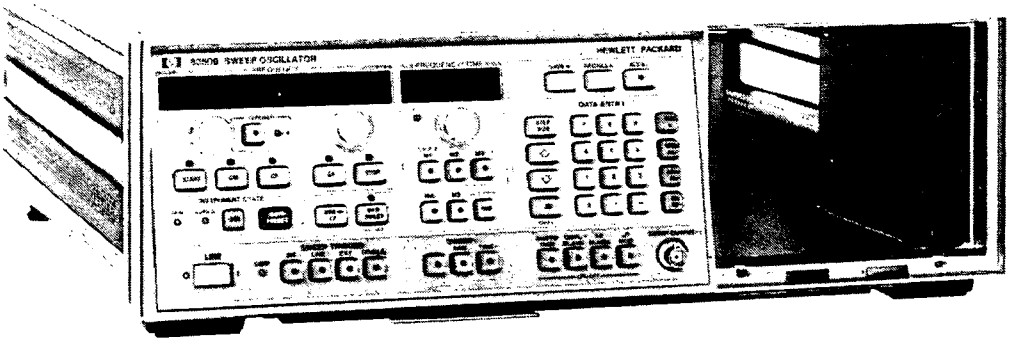
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SECTION VIII. SERVICE

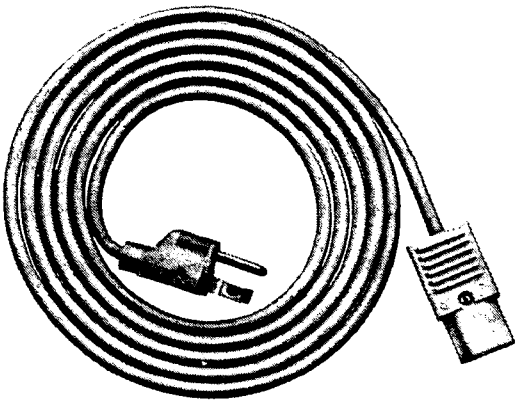
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HP 8350B SWEEP OSCILLATOR



POWER CABLE*

*POWER CABLE/PLUG SUPPLIED DEPENDS ON COUNTRY OF DESTINATION. REFER TO SECTION II FOR PART NUMBER INFORMATION.

Figure 1-1. Model 8350B Sweep Oscillator

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Section I. General Information

INTRODUCTION

This operating and service manual contains information required to install, operate, test, adjust, and service the HP Model 8350B Sweep Oscillator. Figure 1-1 shows the HP 8350B and power cable.

This manual is divided into eight major sections which provide the following information:

a. SECTION I, GENERAL INFORMATION, includes a brief description of the instrument, safety considerations, operating characteristics, instrument identification, options available, accessories available, and list of recommended test equipment.

b. SECTION II, INSTALLATION, provides information for initial inspection, preparation for use, battery information, rack mounting, storage, and shipment.

c. SECTION III, OPERATION, contains general operating information, local operating information (front panel operation), and remote operating information (Programming Notes which provide information on HP-IB use of the HP 8350B).

d. SECTION IV, PERFORMANCE TESTS, presents procedures required to verify that the performance of the instrument is in accordance with published operating characteristics. Performance test limits and other special tests related to specific RF plug-ins are supplied in each RF plug-in Operating and Service Manual. Included is an HP-IB remote operation verification procedure.

e. SECTION V, ADJUSTMENTS, presents procedures required to properly adjust and align the HP 8350B Sweep Oscillator mainframe after repair. Refer to the Operating and Service Manual of the specific RF plug-in used for adjustments related to the RF plug-in.

f. SECTION VI, REPLACEABLE PARTS, provides information required to order all parts and assemblies.

g. SECTION VII, MANUAL BACKDATING CHANGES, provides backdating information required to obtain documentation compatible with earlier shipment configurations.

h. SECTION VIII, SERVICE, provides an overall instrument block diagram with troubleshooting and repair procedures. Each assembly within the instrument is covered in separate paragraphs which are followed by a circuit description, schematic diagram, component location diagram, and troubleshooting information to aid in the proper maintenance of the instrument.

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SPECIFICATIONS

The HP 8530B Sweep Oscillator, together with an RF plug-in, forms a complete system unit. Therefore, Table 1-1 contains no specifications for the stand alone HP 8350B. Refer to the operating and service manual for the specific RF plug-in used for complete specifications. These specifications are the performance standards, or limits, against which the instruments may be tested. Table 1-2 lists the sweep oscillator operating characteristics. Operating characteristics are not specifications but are typical characteristics included as additional information for the user.

Table 1-1. HP 8350B Specifications

NOTE: Only the operating characteristics for the HP 8350B Sweep Oscillator mainframe are given in this manual. Refer to the operating and service manual for the specific RF plug-in used for complete specifications relating to the RF plug-in/mainframe combination.

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Table 1-2. HP 8350B Operating Characteristics (1 of 3)

OPERATING CHARACTERISTICS
HP 8350B SWEEP OSCILLATOR
(with RF Plug-in installed)

FREQUENCY CONTROL FUNCTIONS

Range: Refer to RF plug-in unit specifications.

Linearity: Refer to RF plug-in unit specifications.

START/STOP Sweeps: Sweeps up from the selected START frequency to the selected STOP frequency.

Range: START and STOP parameters are independent, fully calibrated, and continuously adjustable over the entire frequency range. STOP frequency must be greater than or equal to START frequency.

CF/ΔF Sweep: Sweeps symmetrically upward in frequency, centered on the Center Frequency (CF) setting.

ΔF: Frequency width of sweep. Continuously adjustable from zero to 100% of frequency range. START/STOP and CF/ΔF modes can be interchanged without affecting RF output.

ΔF Accuracy: Refer to RF plug-in unit specifications.

CF Accuracy: Refer to RF plug-in unit specifications.

CF Resolution: 0.00038% of band (262,144 points across band).

ΔF Resolution: 0.1% of frequency band (1024 points across band); 0.012% of frequency band for 1/8 band or less (8192 points across band); 0.0015% of frequency band for 1/64 band or less (16,384 points across band).

Display Resolution: 5 digits maximum.

CW Operation: Single frequency RF output. When changing between CF/ΔF and CW mode, the CW frequency and the Center Frequency (CF) are equivalent.

CW Accuracy: Refer to RF plug-in unit specifications.

CW Resolution: 0.00038% of frequency band (262,144 points across band).

Vernier: Adjusts CW frequency of swept range up to ± 0.05% for continuous adjustment. The ≠0 LED is on whenever a vernier adjustment value is present.

Vernier Resolution: Same as CW resolution.

Offset: Allows the CW frequency or the center frequency of the swept range to be offset by any amount up to the full range of the RF plug-in. After entering an offset and returning the displays to the previous mode, the ≠ 0 LED will be on indicating that an offset is present; however, the display will remain unchanged.

Resolution: Same as CF.

Accuracy: Refer to RF plug-in unit specifications.

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Table 1-2. HP 8350B Operating Characteristics (2 of 3)

Frequency Markers: Five frequency markers are independently adjustable and fully calibrated over the entire sweep range. A front panel key provides for the selection of either amplitude or intensity markers. The last marker engaged is the active marker and is the one modifiable by the control knob, step keys, keyboard or remote control. Intensity markers are available from the POS Z BLANK connector on the rear panel. The markers are −4 volt rectangular pulses with the exception of the active marker, which is a −8 volt pulse. Source impedance is approximately 1000 ohms.

Resolution: 0.4% of selected sweep width (256 points/sweep).

Accuracy: Refer to RF plug-in unit specifications.

Marker Output: Negative rectangular pulse available from the POS Z BLANK connector on the rear panel.

Marker Sweep: RF output is swept between Marker 1 and Marker 2 frequency values. The Marker 1 and Marker 2 frequency values can be entered as permanent sweep values with the **[SHIFT]** key. Pressing **[MKR SWEEP]** again returns the instrument to the last START/STOP values.

Marker→CF: Marker-to-Center Frequency function causes the CW or Center Frequency (CF) of the sweep output to equal the frequency of the active marker.

SWEEP AND TRIGGER MODES

Internal: Sweep recurs automatically.

Line: Sweep triggered by AC power line frequency.

External Trigger: Sweep is actuated by an external trigger signal applied to pin 9 of the rear panel programming connector on the rear panel. Trigger signal must be $>+2$ VDC, wider than 0.5 μs, and not greater than 1 MHz in frequency.

Single: Selects mode and triggers/aborts a single sweep.

Sweep Time: Continuously adjustable from 10 ms to 100 seconds. Minimum sweep time may be more than 10 ms depending upon the specific RF plug-in used and the bandwidth swept.

Manual Sweep: Front panel controls (knobs, keyboard, and step keys) provide continuous manual adjustment of frequency between end frequencies set in any of the sweep functions. Resolution is 0.1% of selected sweep width (980 points across sweep).

External Sweep: Sweep is controlled by a zero to +10 volt sweep ramp external signal applied to the front or rear panel SWEEP OUTPUT/SWEEP INPUT connectors. Resulting RF output frequency accuracy will be a function of input sweep ramp accuracy and linearity. The external sweep input must be zero volts at start of sweep, increasing linearly to +10 volts at the end of sweep.

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Table 1-2. HP 8350B Operating Characteristics (3 of 3)

Sweep Output: At the SWEEP OUTPUT/SWEEP INPUT connectors a positive-going, direct-coupled sawtooth waveform is present that is concurrent with swept RF output. Regardless of the sweep width, the start of the sweep is at zero volts and approximately +10 volts at end of the sweep. In CW mode, DC output is proportional to the RF plug-in unit full-band frequency.

MODULATION CHARACTERISTICS

External AM: Refer to RF plug-in unit specifications. Rear panel BNC connector.

Internal AM: Square wave modulation is available at all sweep speeds through front panel control. The modulation is factory preset to 27.775 kHz although selectable (via internal jumper) to 1.0 kHz or 27.775 kHz. Refer to the RF plug-in manual for On/Off ratio specifications.

External FM: Refer to RF plug-in unit specifications. Rear panel BNC connector.

GENERAL CHARACTERISTICS

Blanking

RF Blanking: when enabled, RF automatically is turned off during retrace and remains off until the start of next sweep.

Display Blanking: POS Z BLANK; Output with direct-coupled, positive rectangular pulse during retrace and bandswitch points of sweep. Negative intensity marker signals are also routed through this connector. NEG Z BLANK; direct-coupled, negative rectangular pulse during retrace and bandswitch points of sweep. Both are rear panel BNC outputs.

Pen Lift: Output to control the pen lift function of an X-Y recorder. Maximum sink current is approximately 600 mA."

Counter Trigger (CNTR TRIG): Output for controlling the external trigger input of the HP 5343A Microwave Frequency Counter. Rear panel BNC connector.

Stop Sweep: Input for stopping the progress of a forward sweep. Rear panel BNC connector.

Power Cable: A 2.29m (7.5 foot) power cable with NEMA plug is furnished.

Operating Temperature Range: 0°C to +55°C.

Power: 100, 120, 220, or 240 volts, ±10%, 50 to 60 Hz (Option 400: 100 or 115/120 VAC ±10% and 400 Hz ±10%). Approximately 270 volt-amps including RF plug-in unit used). Refer to Section II Installation for information.

Weight: (not including RF plug-in unit), Net 16.5 kg (36.4 lb) Shipping 22.7 kg (50 lb).

Dimensions: 425 mm Wide, 133.3 mm High, 422 mm Deep (16.75 x 16.6 in).

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SAFETY CONSIDERATIONS

General

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been manufactured and tested in accordance with international safety standards.

Safety Symbols

A complete listing of the safety symbols used in this manual is given on the page preceding Figure 1-1. Included are descriptions of symbols which refer the operator to the manual from the instrument, Protective Earth Ground, Frame or Chassis Terminals, Warning, and Caution symbols.

INSTRUMENTS COVERED BY MANUAL

Attached to the rear panel of the instrument is a serial number plate. A typical serial number plate is shown in Figure 1-2. The serial number is in two parts. The first four digits followed by a letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The content of this manual applies directly to instruments having the same serial number prefix as those listed on the title page of this manual under SERIAL NUMBER.

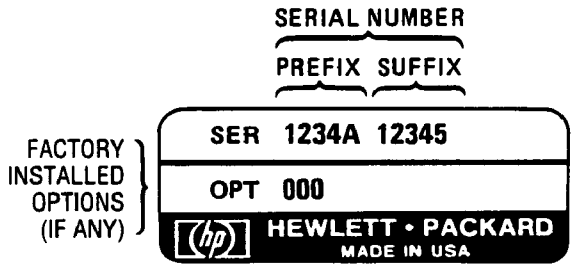


Figure 1-2. Typical Serial Number Plate

Instruments manufactured after the printing of this manual

A serial prefix that is not listed on the title page indicates that the instrument is different from those documented in this manual. When the instrument is a later version than what the manual directly applies to, the manual for that instrument is then supplied with a Manual Changes supplement that documents the differences.

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

Instruments manufactured before the printing of this manual

An instrument manufactured before the printing of this manual is different from those documented in this manual; therefore, a separate manual which applies to these instruments is available (HP part number 08350-90034).

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Refer any questions regarding this manual, the Manual Changes supplement, or the instrument to the nearest HP sales/service office. Always identify the instrument by model number, complete name, and complete serial number in all correspondence. Refer to the rear cover of this manual for a worldwide listing of Hewlett-Packard sales/service offices.

On the title page of this manual is a "Microfiche" part number. This number may be used to order 10x15 centimeter (4x6 inch) microfilm transparencies of the Manual. Each microfiche contains up to 60 photo duplicates of the manual pages. The microfiche package also includes the latest Manual Changes sheet as well as all pertinent Service Notes.

DESCRIPTION

To have a complete operating unit, the HP 8350B Sweep Oscillator must be used in conjunction with an RF plug-in unit which operates in the desired frequency range. The HP 83500 Series RF Plug-in units have been specifically designed for use with the HP 8350B. With the addition of the HP 11869A RF Plug-in Adapter, the HP 86200 Series RF Plug-ins may also be used with the HP 8350B.

The HP 8350B Sweep Oscillator, together with an RF plug-in unit, forms a complete, solid-state, swept signal source. The HP 8350B can be used with network analyzer systems such as the HP 8410/8510 Network Analyzers, the HP 8756/8757 Scalar Analyzers, and the HP Microwave Link Analyzers to provide a complete measurement system.

The HP 8350B is locally operated by the front panel which has been conveniently laid out to optimize the use of instrument operation function blocks. Frequency modes, sweep modes, marker operation, storage register control, and data entry controls are individually grouped for ease of operation and full control versatility on the HP 8350B Sweep Oscillator.

The HP 8350B is factory equipped with a remote programming interface using the Hewlett-Packard Interface Bus (HP-IB). This provides a remote operator with the same control of the instrument available to a manual local operator. Remote control is maintained by a system controller (desktop controller, computer, etc.) that sends commands or instructions to and receives data from the HP 8350B using the HP-IB. The HP-IB is Hewlett-Packard's implementation of the IEEE Standard 488-1978. A complete general description of the HP-IB is provided in the manual entitled "Condensed Description of the Hewlett-Packard Interface Bus" (HP Part Number 59701-90030).

OPTIONS

Option 400, 400 Hz AC Power Operation

The standard HP 8350B requires that the AC power line frequency be 50 to 60 Hz. Option 400 allows the instrument to operate with a 400 Hz AC power line frequency. In Option 400 instruments the ventilation fan is reversed so that the air exhausts out the rear. Refer to Figure 2-8a.

Option 803, HP 5343A Interface Cables

Option 803 contains two interface cables (HP Part Numbers 08350-60039, 08350-60040) used to interface the HP 8350B with the HP 5343A Frequency Counter for making frequency measurements while in the swept mode. Refer to Section III Local Operation for a detailed explanation of this feature.

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Option 850, HP 8410B Interface Cable

Option 850 contains the Source Control Cable (HP Part Number 08410-60146) used to synchronize the HP 8350B and HP 8410B Network Analyzer when making multi-octave magnitude and phase measurements. Refer to Section III Local Operation for a detailed explanation of this feature.

Option 908, Rack Mount Kit

Option 908, HP Part Number 5061-9677, contains a pair of flanges and the necessary hardware to mount the HP 8350B in an equipment rack with 482.6 mm (19 inches) horizontal spacing. Refer to Section II of this Operating and Service Manual for a detailed description of this kit and instructions for installation.

Option 910, Extra Operating and Service Manual

The standard instrument is supplied with one operating and service manual. Each Option 910 provides one additional operating and service manual. To obtain additional operating and service manuals after initial shipment, order by manual part number, listed on the title page and rear cover of this manual.

Option 913, Rack Mount Kit

Option 913, HP Part Number 5061-9771 contains a pair of flanges and the necessary hardware to mount the HP 8350B with handles in an equipment rack with 482.6mm (19 inch) horizontal spacing. Refer to Section II of this Operating and Service Manual for a detailed description of this kit and instructions for installation.

ACCESSORIES SUPPLIED

Figure 1-1 shows the HP 8350B and power cable. The power cable supplied depends upon the country of destination. Refer to Section II of this manual for HP Part Number information.

EQUIPMENT REQUIRED BUT NOT SUPPLIED

To have a complete operating sweep oscillator, the HP 8350B Sweep Oscillator must have an RF plug-in unit installed. The HP 83500 Series RF Plug-ins have been specifically designed for use with the HP 8350B. They provide calibrated output power levels, calibrated power sweeps, internal leveling and slope control, and full HP-IB programmability. The HP 86200 Series RF Plug-ins may be utilized with the HP 8350B with the addition of the HP 11869A RF Plug-in Adapter. The HP 11869A mounts at the rear of the HP 86200 Series RF Plug-in and provides the interface for signals and voltages from the HP 8350B to the RF plug-in. All of the HP 8350B standard operating features including HP-IB remote programming are available, however specific RF plug-in function (output power level, RF on/off, etc.) cannot be controlled or remotely programmed by the HP 8350B mainframe.

To use the HP-IB capabilities of the HP 8350B, a computing controller such as the HP 200 series Computers or the HP 85 Personal Computer is needed.

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EQUIPMENT AVAILABLE

Service Accessories

Service Accessory Kit (HP Part Number 08350-60020) is available for servicing the HP 8350B and HP 83500 Series RF plug-ins. The accessory kit includes:

- Two 44-pin printed circuit board extenders. The HP Part Number for each extender is 08350-60031. These boards have keyed slots which allow them to be used in troubleshooting the HP 83500 Series RF plug-ins as well.
- An RF plug-in extender cable set that provides all electrical connections when the RF plug-in is removed from the sweep oscillator. The RF Plug-in Interface Connector is extended by one cable (HP Part Number 08350-60034) and the Power Supply Interface Connector is extended by the other cable (HP Part Number 08350-60035).
- One hex Balldriver (HP Part Number 8710-0523). Used to remove the hold down plate hex screws from the front panel when repair is necessary.
- One 16-pin I.C. Test Clip (HP Part Number 1400-0734), one 20-pin I.C. Test Clip (HP Part Number 1400-0979), and one 40-pin IC Test Clip (HP Part Number1400-1097) are provided as an aid for probing integrated circuits when troubleshooting.

RECOMMENDED TEST EQUIPMENT

Most of the equipment required for testing and adjustment of the instrument is listed in Table 1-4. Other equipment may be substituted if it meets or exceeds the critical specifications indicated in the table.

Refer to the Recommended Test Equipment list in the operating and service manual of the RF plug-in used for a listing of equipment specifically relating to the RF plug-in used. Not all equipment included in this list is necessary for all RF plug-ins.

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

Instrument Model	Critical Specifications	Recommended
Spectrum Analyzer	Frequency Range: 0.01 to 22 GHz Residual FM: ≤100 Hz Must have auxiliary IF output when used with the HP 8902A Modulation Analyzer.	HP 8566B
Oscilloscope	Dual channel X vs. Y display mode Sensitivity: ≤0.1μS/DIV Horizontal Sweep Rate: ≤.1μS/DIV	HP 1740A
Oscilloscope Probe	1 : 1 General Purpose Probe	HP 10021A
Scalar Network Analyzer	Capable of both modulated and unmodulated (AC/DC detection) transmission measurements Power Resolution: ≤0.25 dB/DIV	HP 8757A
Detector	Compatible with Scalar Network Analyzer Frequency Range: 0.01 to 18 GHz Maximum Input Power: +20 dBm	HP 85025A
Power Splitter	Frequency Range: DC to 18 GHz Output Port Tracking: ≤0.4 dB Maximum Input Power: +27 dBm	HP 11667A
Digital Voltmeter	Range: −50V to +50V Accuracy: ± 0.01% Input Impedance: ≥10 M Ohm Computing Math	HP 3456A
Universal Counter	Frequency Mode Frequency Range: ≥30 kHz Frequency Resolution: ≤10 Hz Time Period Mode Frequency Range: ≥20 kHz Resolution: ≤50 μS	HP 5328B
Measuring Receiver	(May be used in addition to Spectrum Analyzer) Frequency Range: Must cover auxiliary IF Output frequency of Spectrum Analyzer used Residual FM: ≤10 Hz	HP 8902A
Directional Coupler	Frequency Range: .1 to 2.0 GHz Nominal Coupling: ≥20 dB Maximum Coupling Variation: ±1 dB Minimum Directivity: ≥32 dB	HP 778D
Directional Coupler	Frequency Range: 1.7 to 12.4 GHz Mean Output Coupling: ≥20 dB Output Coupling Variation: ±.75 dB Minimum Directivity: 1.7 to 4 GHz − 30 dB 4 to 12.4 GHz − 26 dB	HP 779D
RMS Voltmeter	dB Range: −20 to −70 dBm (0 dBm=1 mW into 600 Ohms) Frequency Range: 10 Hz to 10 MHz Accuracy: ±5% of full scale	HP 3400A

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

Instrument Model	Critical Specifications	Recommended
Function Generator	Frequency Range: 0.1 Hz to 10 MHz Output Level: 10V p-p into 50 Ohms Output Level Flatness: ≤+3% from 10 Hz to 100 kHz ≤+10% from 100 kHz to 10 MHz	HP 3312A
Air Line Extension (2 required)	Impedance: 50 Ohms Frequency Range: DC to 12.4 GHz Reflection Coefficient: .018+.001 (times the frequency in GHz)	HP 11567A
Step Attenuator	Frequency Range: DC to 26.5 GHz Incremental Attenuation: 0 to 70 dB in 10 dB steps Calibration Accuracy: ≤+.1 dB at all steps	HP 8495D
Attenuator	Attenuation: 3 dB ± .5 dB Frequency Range: .01 to 12.4 GHz Maximum Input Power: ≥+20 dBm	HP 8491B Opt. 003
Attenuator	Attenuation: 6 dB ± 0.5 dB Frequency Range: .01 to 12.4 GHz Maximum Input Power: ≥+20 dBm	HP 8491B Opt. 006
Attenuator	Attenuation: 10 ± 0.5 dB Frequency Range: .01 to 12.4 Maximum Input Power: ≥+20 dBm	HP 8491B Opt. 010
Attenuator	Attenuation: 20 ± 0.5 dB Frequency Range: .01 to 12.4 GHz Maximum Input Power: ≥+20 dBm	HP 8491B Opt. 020
Adjustable Short	Frequency Range: 1.8 to 18.0 GHz Impedance: 50 ± 1.5 Ohms	HP 905A
Adjustable AC Line Transformer	Select to cover line voltage used 100-120 volt 220-240 volt	General Radio W5MTB General Radio W10HM73
Line Voltage Monitor	To be used with above Adjustable AC Line Transformers 120 volt Monitor 240 volt Monitor	 RCA 120B RCA WV 503A
Adapter	Precision 7mm to Type N(m)	HP 11525A
Adapter	3.5mm(f) to Type N(m)	HP 1250-1744

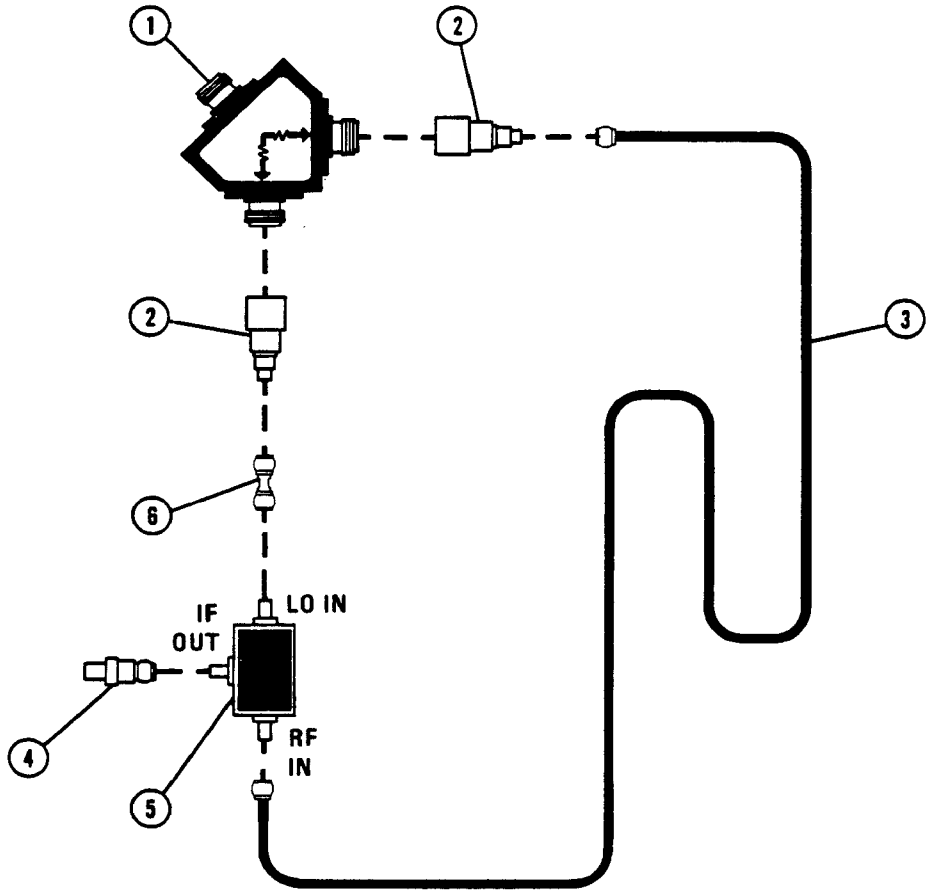
Maury Microwave Corp., 8610 Helms Ave., Cucamonga, CA 91730

General Radio, 300 Baker Avenue., Concord, MA 01742

RCA Distribution & Special Products Div., DEPT. EM, New Holland Ave., Lancaster, PA 17604

Amphenol North America, Bunker-Ramo Corp., RF Operations, 33 E. Franklin St., Danbury, CT 06810

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Item	Description	HP Part Number
1	Power Splitter	HP 11667A
2	Adapter: Type-N Male to 3.5mm Female (2 required)	1250-1250
3	Delay Line: >1 meter (3 feet in length, 3.5mm male connectors)	08503-20038
4	Adapter: BNC Female to Male 3.5mm	11250-1200
5	Mixer: Double Balanced 1 to 12 GHz: 1 to 26.0 GHz	 0960-0451 0955-0307
6	Adapter: 3.5mm Male to 3.5mm Male	1250-1159

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Section II. Installation

INTRODUCTION

This section provides installation instructions for the HP 8350B Sweep Oscillator and its accessories. This section also includes information about initial inspection and damage claims, preparation for use, and packaging, storage, and shipment.

INITIAL INSPECTION

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV, Performance Tests, of this manual. If, after the adjustments have been made, the instrument combination still fails to meet specifications, refer to Section V, Adjustments, of the Operating and Service Manual for the RF plug-in being used. If a circuit malfunction is suspected, refer to troubleshooting procedures in Section VIII, Service, of this or the RF plug-in manual. If the instrument does not pass the above electrical tests, if the shipment contents are incomplete, or if there is mechanical damage or defect, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or if the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. If the shipping container is damaged, or if the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. Hewlett-Packard will arrange for repair or replacement without waiting for claim settlement.

PREPARATION FOR USE

Power Requirements

The HP 8350B Sweep Oscillator requires a power source of 100, 115/120, 220, or 230/240 VAC, ±10%, 50 to 60 Hz, single-phase (100, 115/120 VAC ±10% and 400 Hz ±10%, single phase for Option 400 instruments). Power consumption is approximately 270 volt-amps, depending upon the specific RF plug-in unit used.

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Line Voltage and Fuse Selection

Figure 2-1 illustrates the line voltage selection card and fuse location in the Power Line Module on the rear panel of the HP 8350B. Select the line voltage and fuse as follows:

a. Measure the AC line voltage.

b. Refer to Figure 2-1. At the instrument rear panel power line module, select the line voltage (100, 120, 200, or 220 volts) closest to the voltage you measured in step A. Note the available line voltage must be within +10% to −10% of the line voltage selection as shown in Table 2-1. If it is not, you must use an autotransformer between the power source and the HP 8350B.

Table 2-1. Line Voltage/Fuse Selection

Measured ac Line Voltage	PC Selector Board Position	Fuse/ HP Part Number
90 to 110 Volts	100	4.0 A 2110-0055
108 to 132	120	4.0 A 2110-0055
198 to 242 volts	220	2.0 A 2110-0002
216 to 264	240	2.0 A 2110-0002

c. Make sure the correct fuse is installed in the fuse holder. The required fuse rating for each line voltage is indicated in Table 2-1 and below the power line module on the rear panel of the HP 8350B.

CAUTION

To prevent damage to the instrument, make the correct line voltage and fuse selection before connecting line power to the instrument.

Power Cable

In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate power line outlet, this cable grounds the instrument cabinet. Table 2-2 shows the styles of plugs available on power cables supplied with HP instruments. The HP Part Numbers for the plugs are part numbers for the complete power cables. The type of power cable/ plug shipped with the instrument depends upon the country of destination.

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WARNING

Before switching on this instrument, be sure that only the specified power cable is used. The instrument is provided with a three-wire power cord which grounds the instrument cabinet. This power cord should only be inserted in a socket outlet provided with a protective earth contact. This protective action should not be negated by the use of an extension cord (power cable) without a protective conductor (ground). Grounding one conductor of a two-conductor outlet is not sufficient protection.

The offset pin of the three-prong connector is the grounding pin. When operating the HP 8350B from a two-contact outlet, the protective grounding feature may be preserved by using a three-prong to two-prong adapter (USA connectors only, HP Part Number 1251-0048) and connecting the green wire of the adapter to ground.

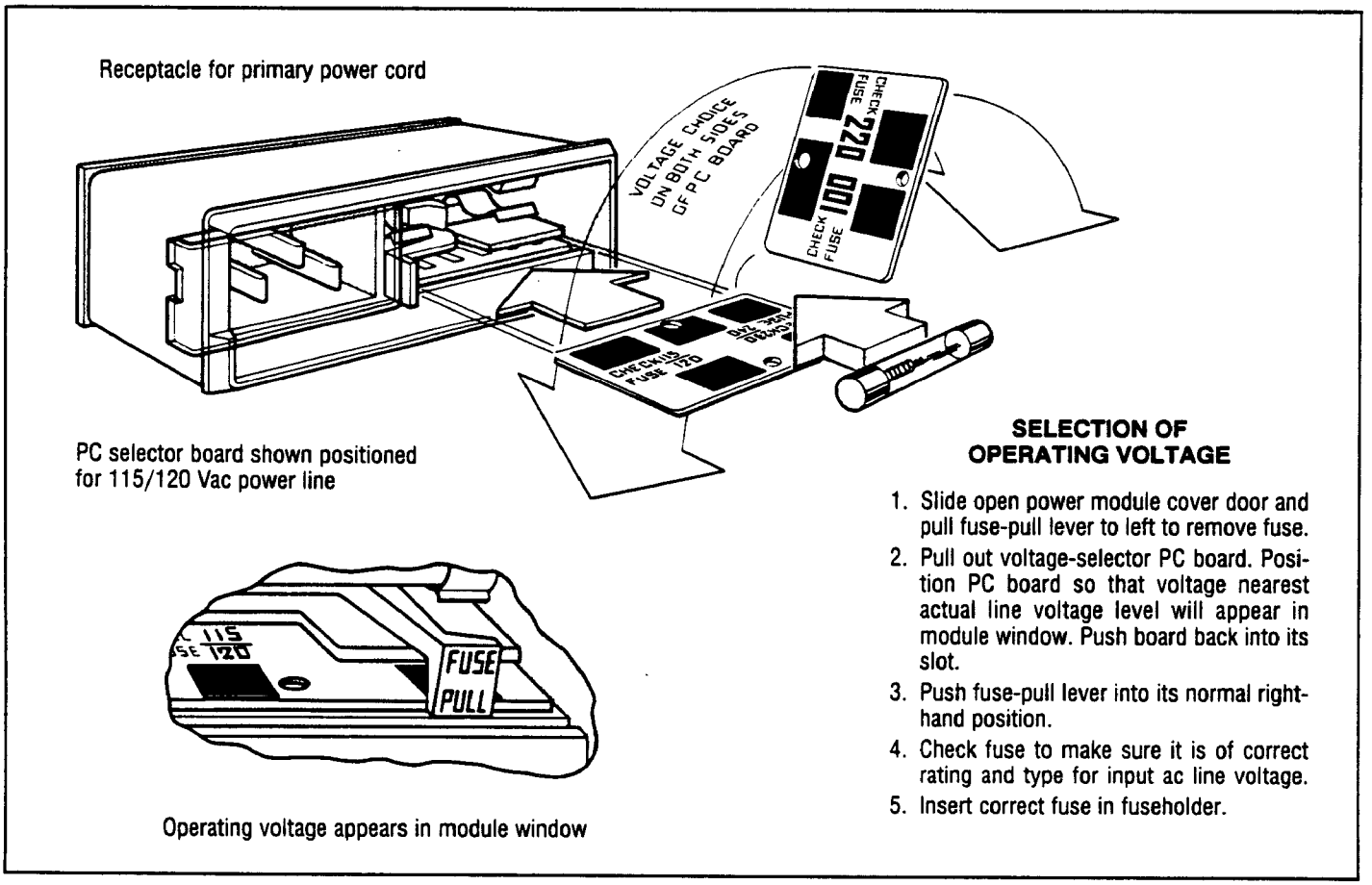
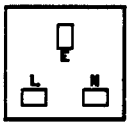
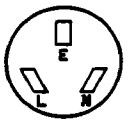
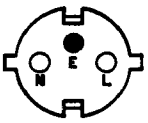
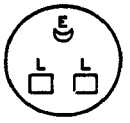
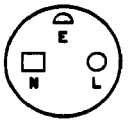
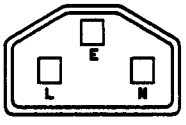


Figure 2-1. Power Line Module

NOTE: Option 400 operates with a power line voltage of 100, or 115/120 VAC only.

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Table 3. AC Power Cables Available

Plug Type[1]	Cable HP Part Number[2]	CD[3]	Plug Description[2]	Cable Length (inches)	Cable Color	For Use in Country
250V 	8120-1351 8120-1703	0 6	Straight BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
250V 	8120-1369 8120-0696	0 4	Straight ZNSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	7 2	Straight CEE7-VII 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt, Republic of So. Africa, India (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight NEMA5-15P 90° Straight NEMA5-15P Straight NEMA5-15P 90° Straight NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
250V 	8120-2104	3	Straight SEV1011.1959 24507,Type 12	79	Gray	Switzerland
250V 	8120-0698	6	Straight NEMA6-15P			United States, Canada
220V 	8120-1957 8120-2956	2 3	Straight DHCK 107 90°	79 79	Gray Gray	Denmark
250V 	8120-1860	6	Straight CEE22-VI (System Cabinet Use)			

1. E = Earth Ground; L = Line; N = Neutral
2. Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.
3. The Check Digit (CD) is a coded digit that represents the specific combination of numbers used in the HP Part Number. It should be supplied with the HP Part Number when ordering any of the power assemblies listed above, to expedite speedy delivery.

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HP-IB Address Selection

WARNING

The HP-IB address switch is set with the top cover removed from the HP 8350B and should be set only by a skilled person who is aware of the hazard involved. Prior to setting the HP-IB address switch, the LINE switch should be set to OFF and the power cord should be disconnected from the AC power source for maximum safety. Capacitors inside the instrument may still be charged even when the instrument is disconnected from its AC power source. Use caution when setting the HP-IB address switch to avoid touching assemblies or components within the instrument other than the HP-IB address switch.

When the HP 8350B is used under remote control with the HP-IB "address", the HP 8350B is differentiated from any other instrument on the bus by its own unique address. This HP-IB address is initially preset in the HP 8350B by a 5-segment address switch A8S1, located on the A8 HP-IB Interface assembly, as shown in Figure 2-2 . A diagram of A8S1 is given in Figure 2-3. Each of the 5 switches corresponds to one of the digits of the 5-digit binary equivalent of the address, as shown in Table 2-3. A8S1 switch A1 corresponds to the Least Significant Bit (LSB) of the binary address and switch A5 corresponds to the Most Significant Bit. The HP-IB address can be modified by a front panel SHIFT function.

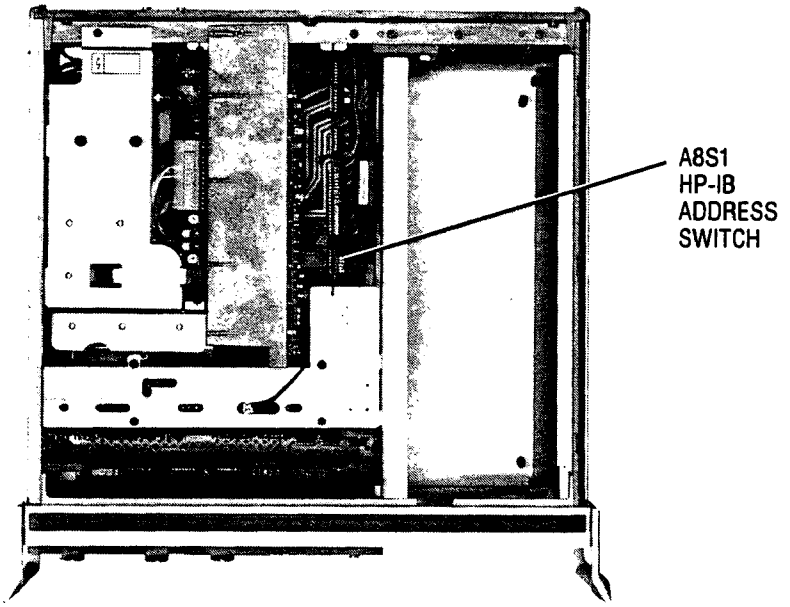


Figure 2-2. Location of A8S1 HP-IB Address Switch

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The 8350B stores HP-IB address information in battery supported non-volatile memory. This allows the instrument to retain the assigned HP-IB address when the instrument is turned off, regardless of A8S1 address switch setting. The address will be retained as long as the battery is charged to a sufficient level. If battery power to the A3 Microprocessor ever fails or is interrupted, the HP-IB address will revert back to the A8S1 address switch setting. An INSTRUMENT PRESET command will not modify the current HP-IB address.

Thirty-one different address codes are available (decimal 0 to 30). The HP 8350B is shipped from the factory preset to binary address "1011" (decimal 19), as shown in Figure 2-3. The HP-IB address can by read directly from the front panel by pressing **[SHIFT] [LCL]**. The current HP-IB address is then displayed in decimal form in the FREQUENCY/TIME display. If the HP-IB address must be changed enter the decimal equivalent of the desired HP-IB address and press **[GHz]** to terminate the entry. The FREQUENCY TIME display should now indicate the new HP-IB address.

HP-IB address labels are available by ordering HP Part Number 7120-6853 (each). (See Figure 2-4). These labels allow easy reference to the HP-IB address of each system component.

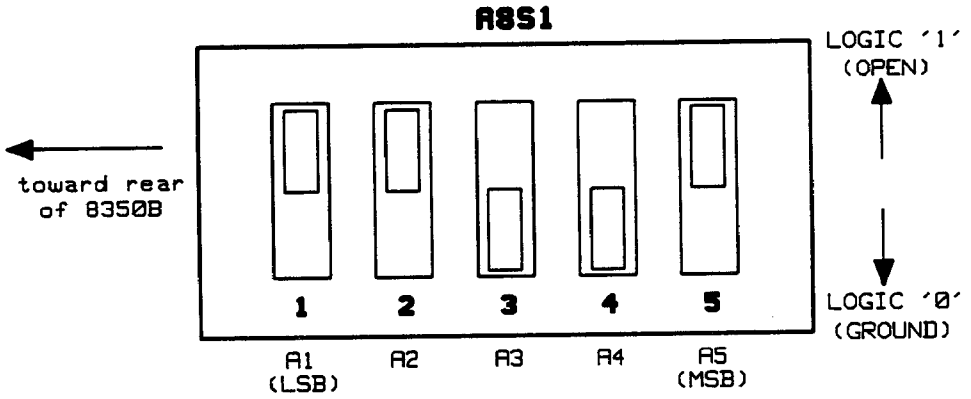


Figure 2-3. A8S1 HP-IB Address Switch

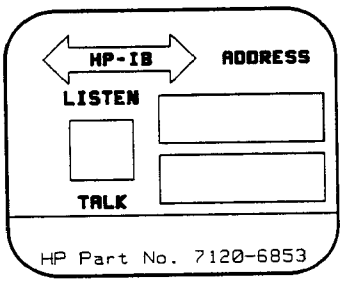


Figure 2-4. HP-IB Address Label

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Table 2-3. HP-IB Address Codes

Address Characters		A8S1 Address Switch Settings					Address
Listen	Talk	(MSB) A5	A4	A3	A2	(LSB) A1	Decimal Equivalent
SP	@	0	0	0	0	0	
!	A	0	0	0	0	1	1
"	B	0	0	0	1	0	1
#	C	0	0	0	1	1	3
$	4	0	0	1	0	0	4
%	E	0	0	1	0	1	5
&	F	0	0	1	1	0	6
'	G	0	0	1	1	1	7
(	H	0	1	0	0	0	8
)	I	0	1	0	0	1	9
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
-	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	/	1	1	1	0	0	28
=	]	1	1	1	1	0	29
>	^	1	1	1	1	1	30

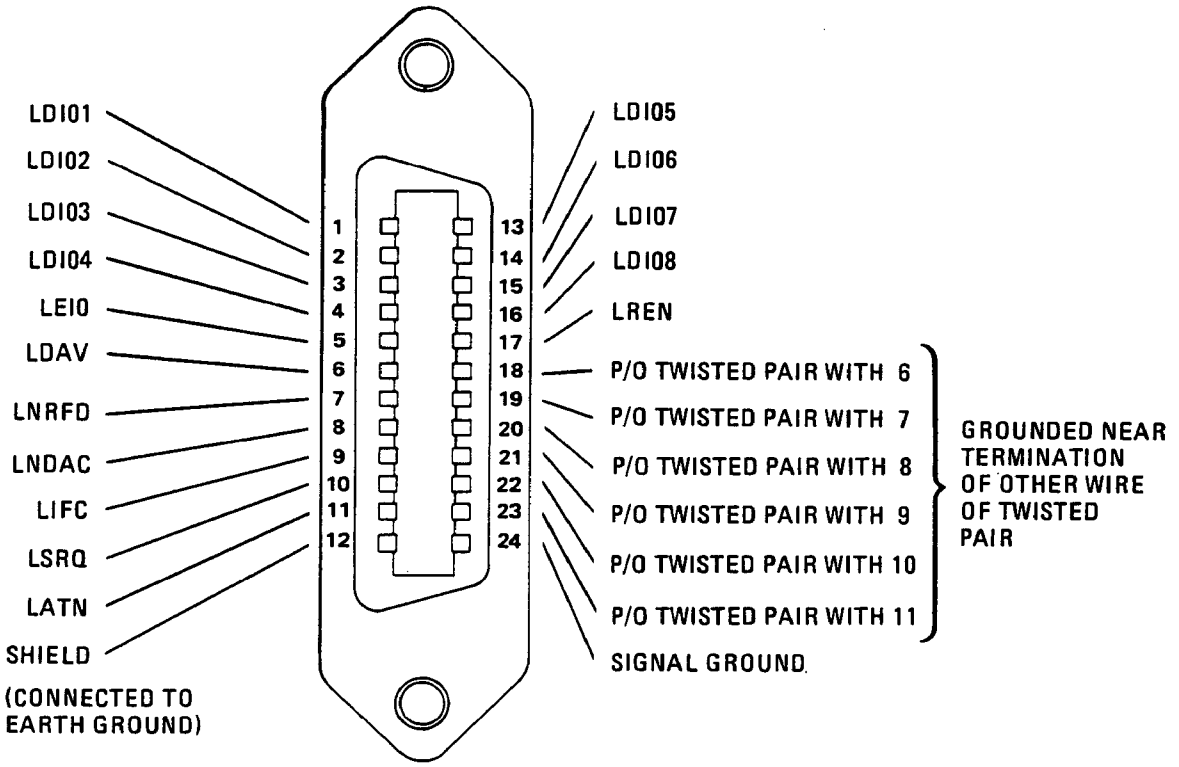
11869A Switch Settings for HP 86200 Series RF Plug-ins

The identification switch on the HP 11869 RF Plug-in Adapter must be preset when using the adapter with HP 86200 Series RF Plug-ins in the HP 8350B. The setting of the identification switch is interrogated at power on, when the 8350B INSTR PRESET button is pressed, or when an HP-IB Instrument Preset ("IP") command is received. If the identification switch is set incorrectly the START/STOP frequencies will be in error. Refer to Section II, Installation, of the HP 11869A Operating and Service Manual for instructions to set the identification switch properly.

Internal Square Wave Modulation Frequency Selection

Internal square wave modulation is available at all sweep speeds on the HP 8350B. Internal square wave modulation is selected by the front panel MOD pushbutton. Modulation frequency is selectable by an internal jumpers to be either 27.78 kHz (preset at the factory for use with HP 8756/8757 Scalar Network Analyzer systems) or 1 kHz.

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HP-IB Logic Levels:
True (low) State ≤0.8 Vdc; False (high) State ≥+2.4 Vdc.

MNEMONICS TABLE

Mnemonic	Description
L ATN	LOW=Attention control line
L DAV	LOW=Data Valid Control line
L DIOI thru 8	LOW=Data Input/Output lines
L EOI	LOW=End Or Identify control line
L IFC	LOW=Interface Clear control line
L NDAC	LOW=Data Not Accepted control line
L NRFD	LOW=Not Ready For Data control line
L REN	LOW=Remote Enable control line
L SRQ	LOW=Service Request control line

Figure 2-5. HP-IB Connector Signals and Pin Configuration

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RF Plug-in Configuration Switch

Each RF plug-in has a configuration switch which must be preset prior to operation in the HP 8350B. This is a multiple switch with individual switches that correspond to various RF plug-in functions such as, FM sensitivity selection, FM input coupling selection (direct coupled or cross-over), RF power level at instrument power on, and Option 002 Step Attenuator operation. Refer to the operating and service manual of the specific RF plug-in used for detailed information on the configuration switch.

Interconnections

There are two RF plug-in interconnections on the HP 8350B Sweep Oscillator mainframe. These are the RF Plug-in Interface Connector (J2) and the Power Supply Interface Connector (J3). J2 and J3 are visible at the rear of the RF plug-in channel. A complete listing of pins and the associated signals and voltages for these connectors are listed on the overall instrument Wiring List in Section VIII, Service, of this manual.

Mating Connectors

All of the externally mounted connectors on the HP 8350B are listed in Table 2-4. Opposite each mainframe connector is an industry identification, the HP part number of a mating connector, and the part number of an alternate source for the mating connector. For HP part numbers of the externally mounted connectors themselves, refer to Section VI, Replaceable Parts, of this manual.

HP-IB Interface Connector and Cables

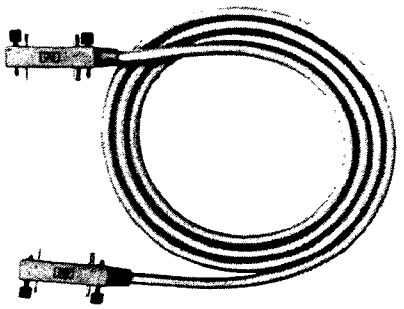
The HP-IB Interface Connector J4, located on the rear panel of the HP 8350B, allows the sweep oscillator to be connected to any other device on the HP-IB Interface Bus. A complete illustration of pin configuration and signals on the HP-IB Interface Connector is given in Figure 2-5.

All instruments on the HP-IB Interface Bus are interconnected by HP-IB Interface Cables. A list of the available HP-IB Interface Cables and their part numbers is given in Figure 2-6. As many as 15 instruments can be connected in parallel on the HP-IB Interface Bus. To achieve design performance on the bus, proper voltage levels and timing relationships must be maintained. If the system cable is too long or if the accumulated cable length between instruments is too long, the data and control lines cannot be driven properly and the system may fail to perform. Therefore, the following restrictions must be observed:

a. With two instruments in a system, the cable length must not exceed 4 meters (12 feet).

b. When more than two instruments are connected on the bus, the cable length to each instrument must not exceed 2 meters (6 feet) per unit.

c. The total cable length between all units cannot exceed 20 meters (65 feet).



HP-IB Cable Part Numbers	Lengths
HP 10833A	1 m (3.3 ft.)
HP 10833B	2 m (6.6 ft)
HP 10833C	4 m (13.2 ft.)
HP 10833D	0.5 m (1.6 ft.)

Figure 2-6. HP-IB Interface Cables Available

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Table 2-4. HP 8350B Mating Connectors

8350B Connector		Mating Connector	
Connector Name	**Industry Identification**	**HP Part Number**	**Alternate Source**
J1 SWEEP OUTPUT/ SWEEP INPUT (front panel)	BNC	1251-0256	Specialty Connector 25-P118-1
J4 HP-IB INTERFACE BUS*	24-Pin Micro Ribbon	1251-0293	Amphenol 57-30240
J5 POS Z BLANK	BNC	1250-0256	Specialty Connector 25-P118-1
J6 NEG Z BLANK	BNC	1250-0256	Specialty Connector 25-P118-1
J7 PEN LIFT	BNC	125-0256	Specialty Connector 25-P118-1
J8 SWEEP OUT/IN (rear panel)	BNC	1250-0256	Specialty Connector 25-P118-1
J9 CNTR TRIG	BNC	1250-0256	Specialty Connector 25-P118-1
J10 STOP SWEEP	BNC	1250-0256	Specialty Connector 25-P118-1
J11 FM INPUT	BNC	1250-0256	Specialty Connector 25-P118-1
J12 AM INPUT	BNC	1250-0256	Specialty Connector 25-P118-1
J13 PROGRAMMING CONNECTOR	25-Pin D Series	1251-7902	Berg Eleck. Div. 0671-0025
J14 ALT SWP INTERFACE**	Audio 3-Pin Connector TA-3F	no HP Part Number	Switchcraft

* Refer to Figure 2-6 for HP-IB Interface Cable information. HP-IB Interface connector J4 signals and pin configuration are given in Figure 2-5.

** A 1219 mm (48") cable assembly with a Switchcraft TA-3F Audio 3-Pin connector on each end is supplied with the Model 8755C Swept Amplitude Analyzer as the Alternate Sweep Cable. The complete cable may be ordered separately as HP Part Number 8120-3174.

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Programming Connector

The Programming Connector J13 on the rear panel of the HP 8350B provides digital control of display functions and sweep oscillator step up control. Figure 2-7 gives a description of all pins and signals available on the programming connector. When the HP 8410B/8411 Network Analyzer is used with the HP 8350B, the HP 8410B/C Source Control Cable (HP Part Number 08410-60146) connects the HP 8410B/C rear panel SOURCE CONTROL and the HP 8350B rear panel PROGRAMMING CONNECTOR. Additionally, the sweep oscillator RF plug-in 0.5/1.0 V/GHz output connects to the HP 8410B/C rear panel FREQ REF INPUT to insure that the HP 8410B phase locks with sweep oscillator properly when sweeping octave or multi-octave bands.

Operating Environment

Temperature. The instrument may be operated in temperatures from 0''C to +55''C.

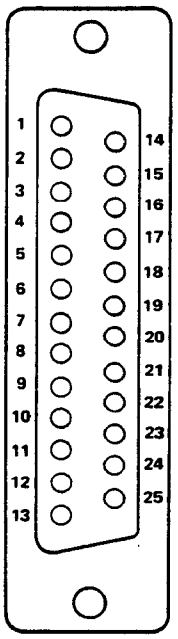
Humidity. The instrument may be operated in environments with humidity from 5% to 80% relative at +25''C to +40''C. However, the instrument should also be protected from temperature extremes which cause condensation within the instrument.

Altitude. The instrument may be operated at altitudes up to 4572 meters (approximately 15,000 feet).

Cooling. Clearances for ventilation should be at least 10 cm (4 inches) at the rear of the cabinet and 7.6 cm (3 inches) at the sides. The clearances provided by the plastic feet in bench stacking and the filler strips in rack mounting are adequate for the top and bottom cabinet surfaces. A diagram illustrating the path for cooling airflow generated by the rear panel fan is given in Figure 2-8. Insure that the air intake and exhaust venting holes are not obstructed within the limits shown in Figure 2-8.

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PROGRAMMING CONNECTOR J13
(as seen from rear panel)



Logic Levels:*

Low ≤0.8 Vdc
High ≥2.4 Vdc

Control of input lines can be accomplished by contact closure to ground for a logic low level and open circuit for a logic high level.

Pin	Mnemonic	Description	In/Out
1		NO CONNECTION	
2	L MP	LOW = MARKER PULSE	OUTPUT
3	L PLRQ	LOW = PENLIFT REQUEST	INPUT
4	ALT1	ALTERNATE SWEEP 1	OUTPUT
5	L SFSSRQ	LOW = STOP FORWARD SWEEP REQUEST	INPUT
6	+5VA	+5 VOLTS (100 ma MAX)	OUTPUT
7	L RFB	LOW = RF BLANK	OUTPUT
8	L RF BRQ	LOW = RF BLANK REQUEST	INPUT
9	EXT TRG	HIGH = EXTERNAL TRIGGER SWEEP	INPUT
10	PL	HIGH = PENLIFT	OUTPUT*
11	L MUTE	LOW = PEN MUTE FOR X-Y RECORDER	OUTPUT
12		NO CONNECTION	
13		NO CONNECTION	
14	L BP1	LOW = BLANKING PULSE 1	OUTPUT
15	L MRKQ	LOW = MARKER REQUEST	INPUT
16	L RTS	LOW = RETRACE STROBE	OUTPUT
17	L ALTE	LOW = ALTERNATE SWEEP ENABLE	OUTPUT
18	L SSRQ	LOW = STOP SWEEP REQUEST	INPUT
19	GND DIG	DIGITAL GROUND	
20	L BPRQ	LOW = BLANKING PULSE REQUEST	INPUT
21	L CNTR	LOW = COUNTER TRIGGER	OUTPUT
22	L STPADV	LOW = STEP ADVANCE	INPUT
23	L PL	LOW = PENLIFT	OUTPUT
24	SYNC TRG	HIGH = SYNCHRONIZING TRIGGER	OUTPUT
25		NO CONNECTION	

* OPEN COLLECTOR OUTPUT

Figure 2-7. Programming Connector Signals and Pin Configuration

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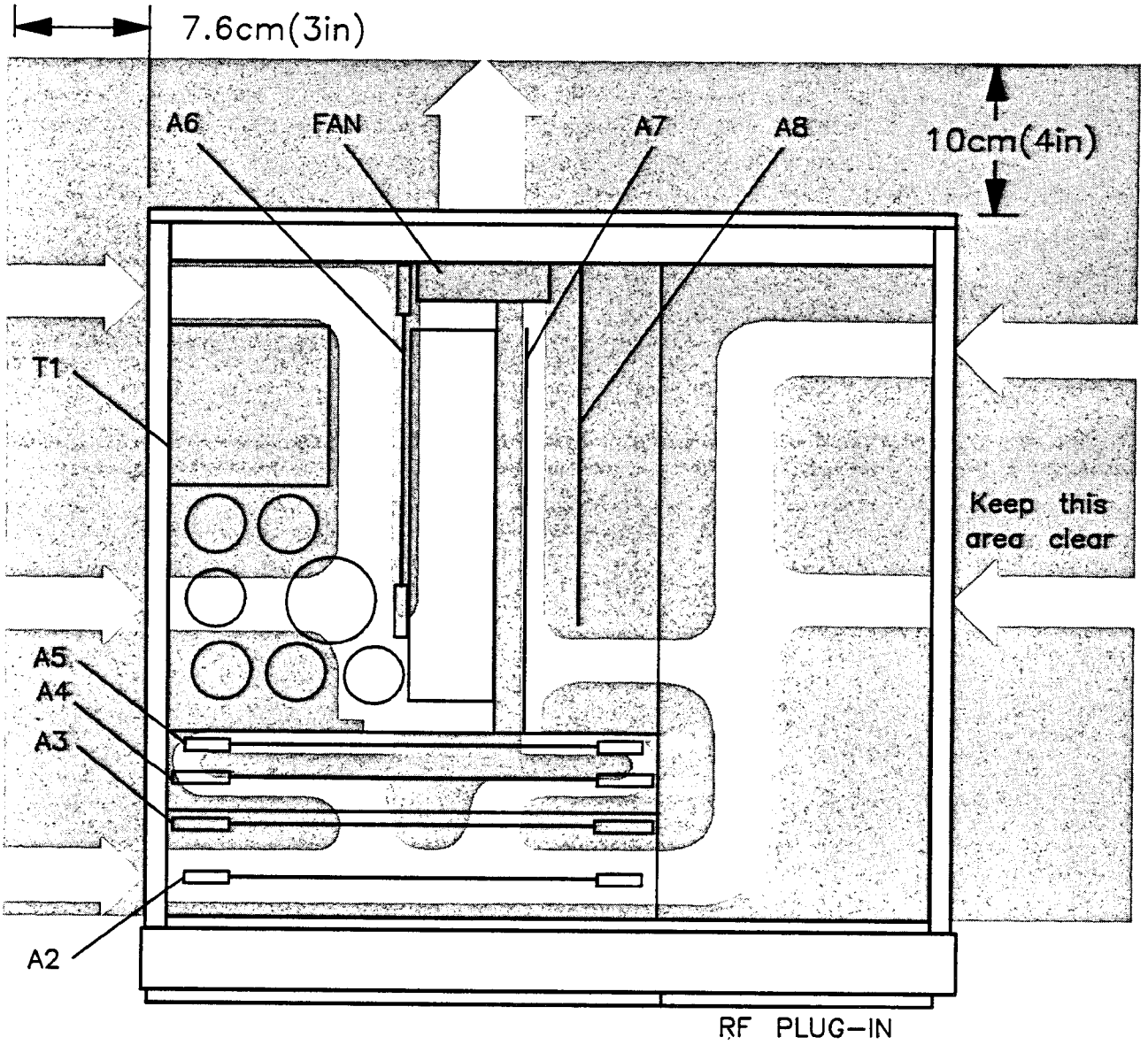


Figure 2-8a. HP 8350B Ventilation Clearances Airflow (Option 400)

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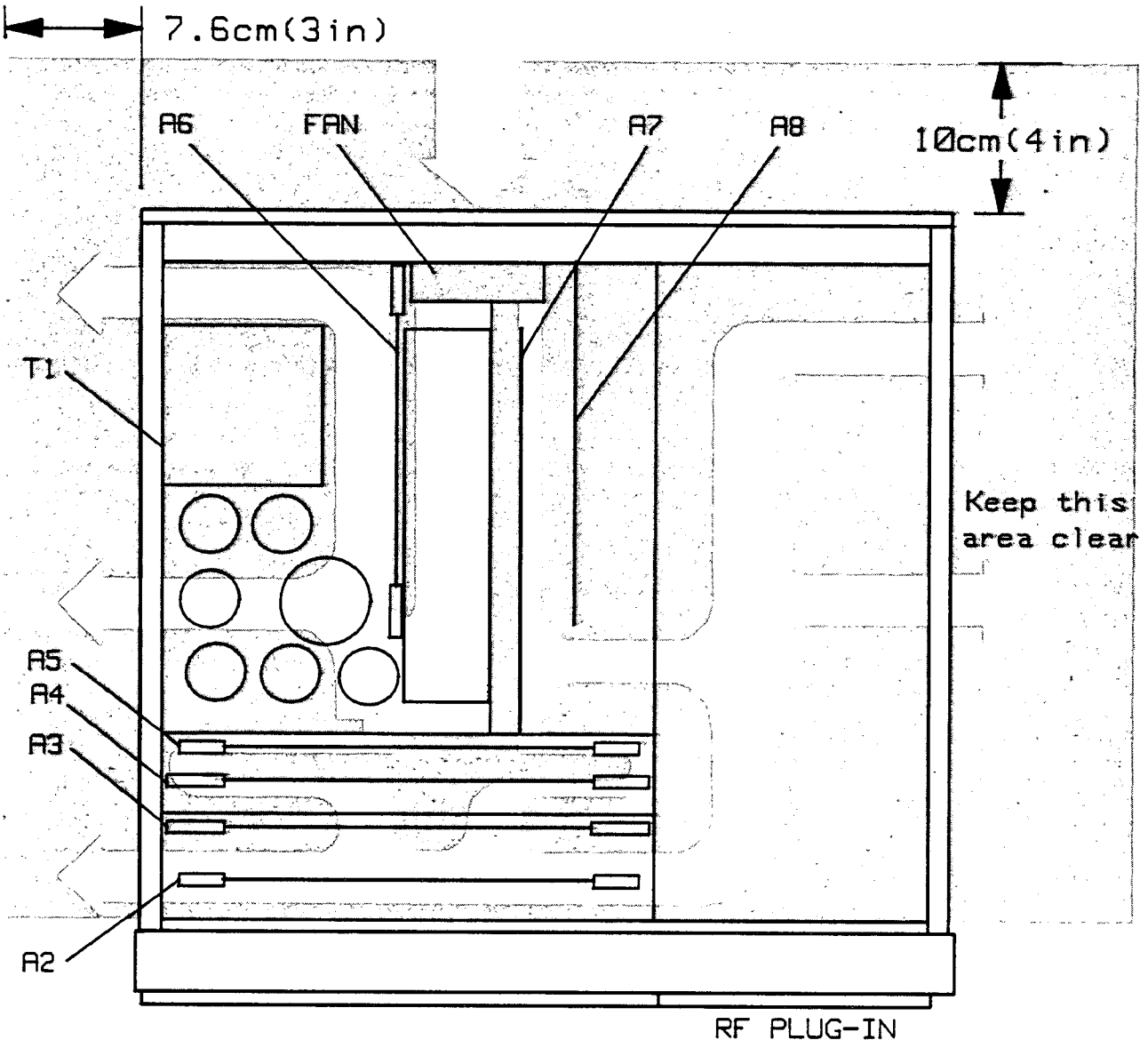


Figure 2-8. HP 8350B Ventilation Clearances Airflow

RF Plug-in Installation

To operate as a completely functional sweep oscillator the HP 8350B Sweep Oscillator must have an RF plug-in unit installed. To install an HP 86200 Series RF plug-in (coupled to an HP 11869A RF Plug-in Adapter) in the HP 8350B, refer to Section II, Installation, of the HP 11869A Operating and Service Manual. To install an HP 83500 Series RF plug-in unit into the HP 8350B mainframe:

a. Set the HP 8350B mainframe LINE switch to OFF.

b. Remove all connectors and accessories from the front and rear panel connectors to prevent them from being damaged.

c. Position the RF plug-in latching handle in the fully raised position. The latching handle should spring easily into the raised position and be held by spring tension.

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d. Insure that the mainframe RF plug-in channel is clear, align the RF unit in the channel and slide it carefully into place towards the rear of the channel. It should slide easily without binding.

e. The drawer latch handle slot will engage with the locking pin just before the RF plug-in is fully seated.

f. Press the latch handle downward, while still pushing in on the RF plug-in, until the drawer latch is fully closed and the front panel of the RF plug-in is aligned with the mainframe front panel.

Bench Operation

The instrument cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation. The tilt stand inclines the instrument for ease of operating the front panel controls and to allow the RF plug-in to be removed more easily. The plastic feet provide clearance for air circulation and make the instrument self-aligning when stacked on other Hewlett-Packard full rack-width modular instruments. The instrument is packaged at the factory with two shipping pads attached to the front sides (refer to Figure 2-12). If the instrument does not include front handle or rack mount options, replace the shipping pads with the self-adhesive trim strips supplied with the instrument.

Extended Service (Option W30)

Option W30 adds two additional years of return-to-HP hardware support, to follow the first year of warranty. Option W30 can be ordered at the time of sale only. Instruments ordered with Option W30 are identified on the serial number label.

Front Handles

CAUTION

When installing front handles and rack mount kits, insure that the correct screws, specified in the installation figures in this section of the manual, are used. Use of a screw which is longer than the specified length may result in damage to internal components located behind the screw mounting holes in the instrument.

Instruments contain a Front Handle Kit. This kit supplies the necessary hardware and installation instructions for mounting two front handles on the instrument. Installation instructions are also given in Figure 2-9. Additional kits may be ordered as HP Part Number 5061-9689.

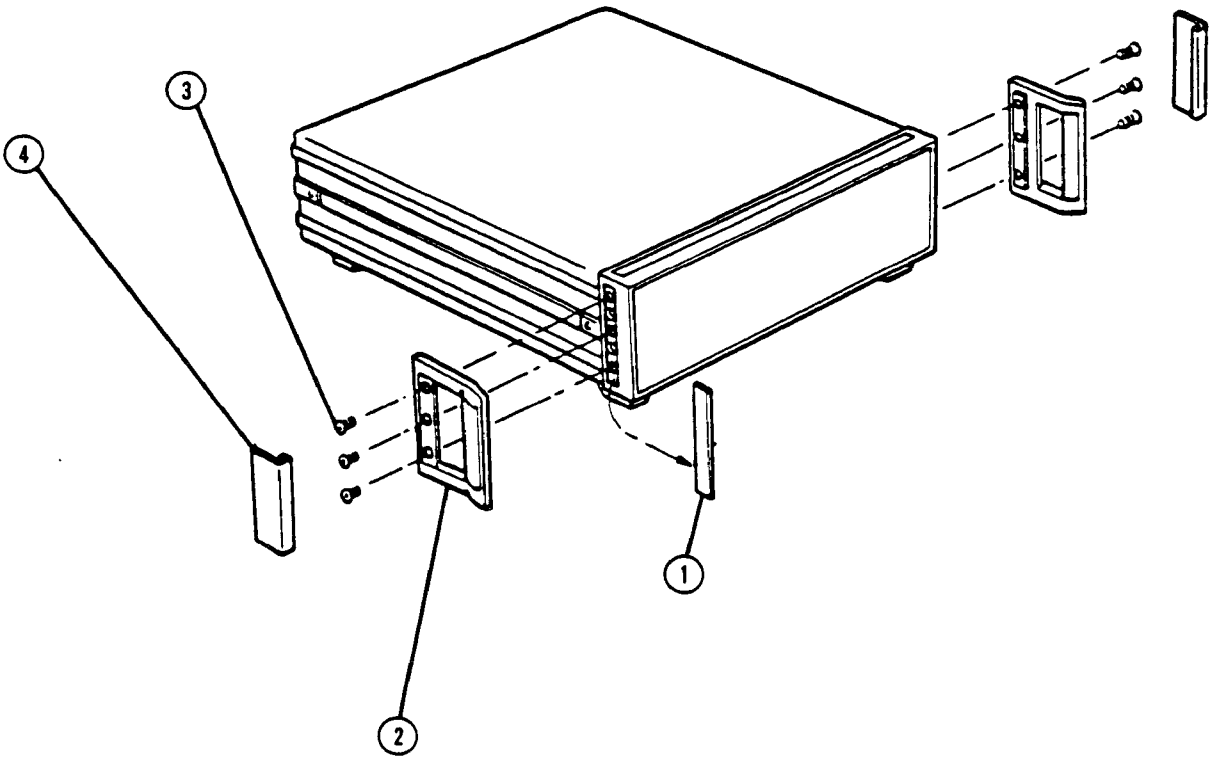
Rack Mounting (Option 908)

Instruments with Option 908 contain a Rack Mount Kit. This kit supplies the necessary hardware and installation instructions for preparing the instrument to mount on an equipment rack with 482.6 mm (19 in.) support spacing. Installation instructions are also given in Figure 2-10. Additional Option 908 kits may be ordered as HP Part Number 5061-9677.

Rack Mounting with Front Handles (Option 913)

Instruments with Option 913 contain a Rack Mount Kit. This kit contains a pair of flanges and the hardware necessary to mount an HP 8350B with handles, in an equipment rack with 482.6mm (19 inch) horizontal spacing. Refer to Figure 2-11 for a detailed description of this kit and instructions for installation. Additional Option 913 kits may be ordered as HP Part Number 5061-9771.

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INSTALLATION INSTRUCTIONS:

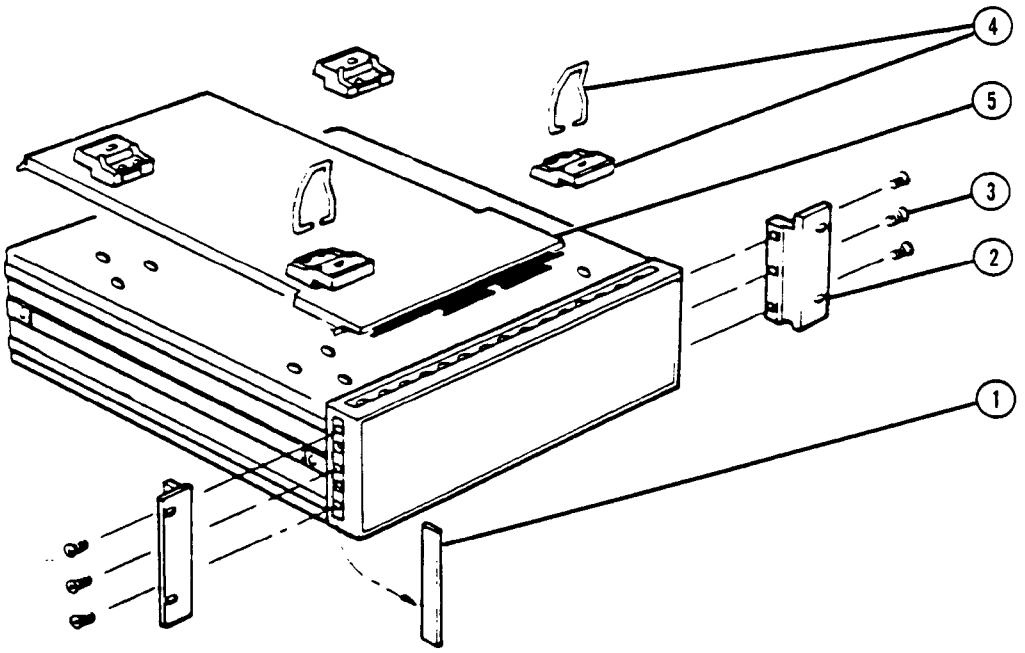
1. REMOVE SIDE TRIM STRIPS (1).
2. ATTACH FRONT HANDLE ASSEMBLY (2) WITH THREE SCREWS (3) PER SIDE.
3. PRESS FRONT HANDLE TRIM (4) IN PLACE.

FRONT HANDLE KIT (HP Part Number 5061-9689) CONTENTS

Item	Qty.	HP Part No.	CD	Description
2	2	5061-9499	4	Front Handle Assembly
3	6	0515-0896	5	M4 × 0.7 × 10 Screw
4	2	5020-0896	7	Front Handle Trim

Figure 2-9. Front Handles Kit

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INSTALLATION INSTRUCTIONS:

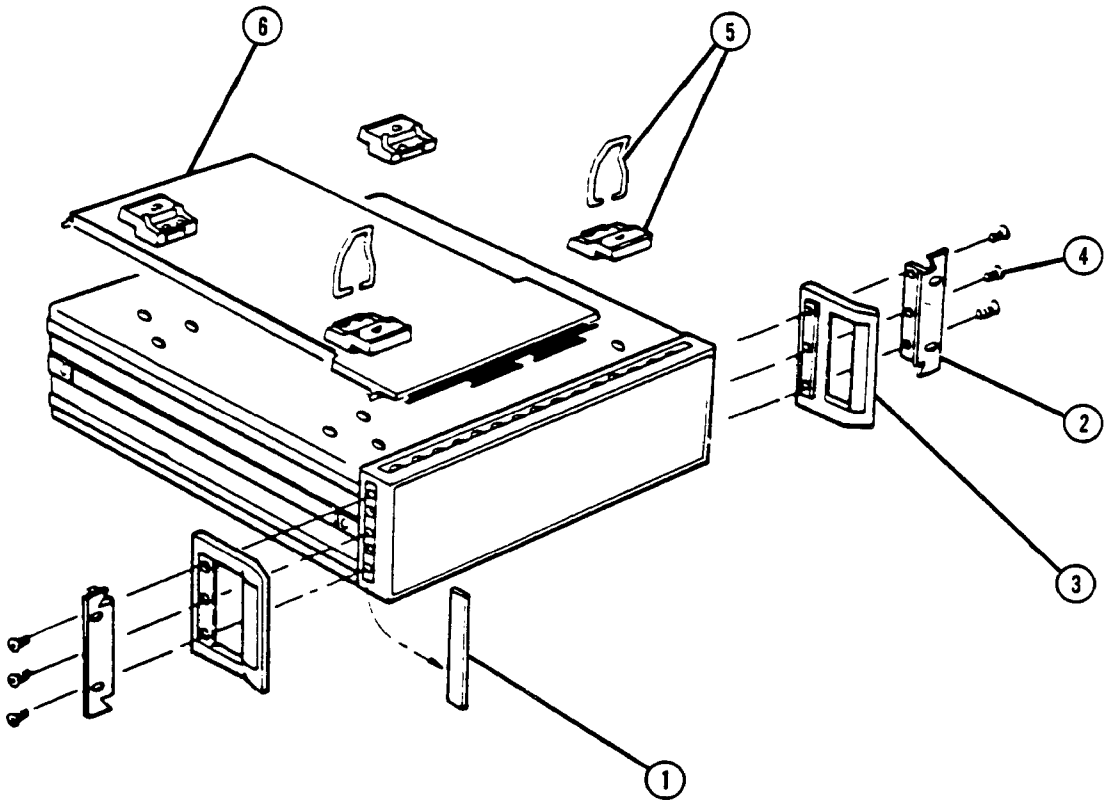
1. REMOVE SIDE TRIM STRIPS (1).
2. ATTACH RACK MOUNT FLANGE (2) WITH SCREWS (3).
3. REMOVE FEET AND TILT STANDS (4) BEFORE RACK MOUNTING. THIS ALSO REMOVES INFORMATION CARD TRAY (5). TO RETAIN USE OF INFORMATION CARDS, DO NOT REMOVE FEET, AND WHEN RACK MOUNTING, ALLOW APPROXIMATELY 2CM (3/4 INCH) BELOW INSTRUMENT TO ACCOMMODATE THE TRAY. (NO FILLER STRIP IS PROVIDED.)

OPTION 908 (HP Part Number 5061-9677) CONTENTS

Item	Qty.	HP Part No.	CD	Description
2	2	5020-8862	7	Rack Mount Flange
3	6	0515-1114	2	M4 × 0.7 × 10 Screw

Figure 2-10. Option 908 Rack Mount Kit

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INSTALLATION INSTRUCTIONS:

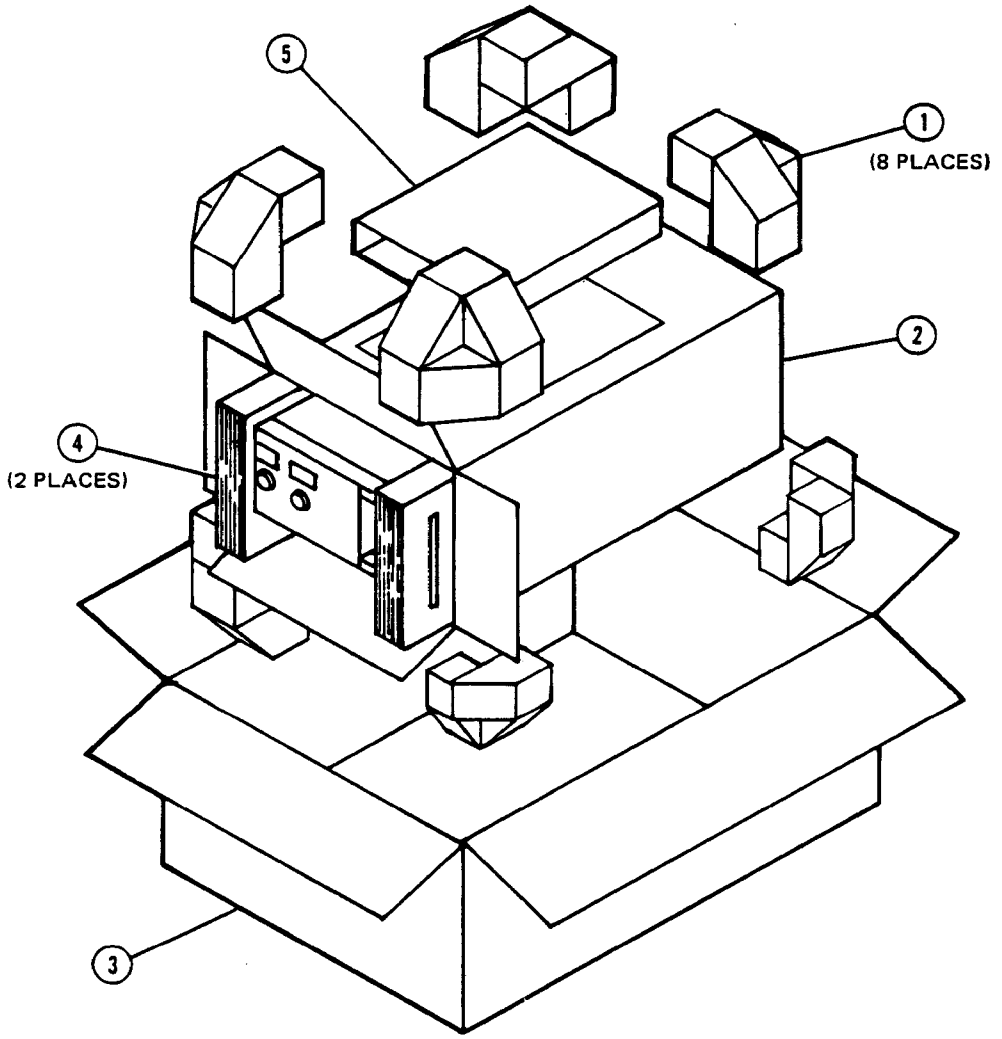
1. REMOVE SIDE TRIM STRIPS (1).
2. ATTACH RACK, MOUNT FLANGE (2) AND FRONT HANDLE ASSEMBLY (3) WITH THREE SCREWS (4) PER SIDE.
3. REMOVE FEET AND TILT STANDS (5) BEFORE RACK MOUNTING. THIS ALSO REMOVES INFORMATION CARD TRAY (6). TO RETAIN USE OF INFORMATION CARDS, DO NOT REMOVE FEET, AND WHEN RACK MOUNTING, ALLOW APPROXIMATELY 2CM (3/4 INCH) BELOW INSTRUMENT TO ACCOMMODATE THE TRAY. (NO FILLER STRIP IS PROVIDED.)

OPTION 913 (HP Part Number 5061-9771) CONTENTS

Item	Qty.	HP Part No.	CD	Description
2	2	5020-8874	1	Rack Mount Flange
3	2	5061-9499	4	Front Handle Assembly (supplied with Standard HP 8350B)
4	6	0515-1106	2	M4 × 0.7 × 10 Screw

Figure 2-11. Option 913 Rack Mount Kit with Handles

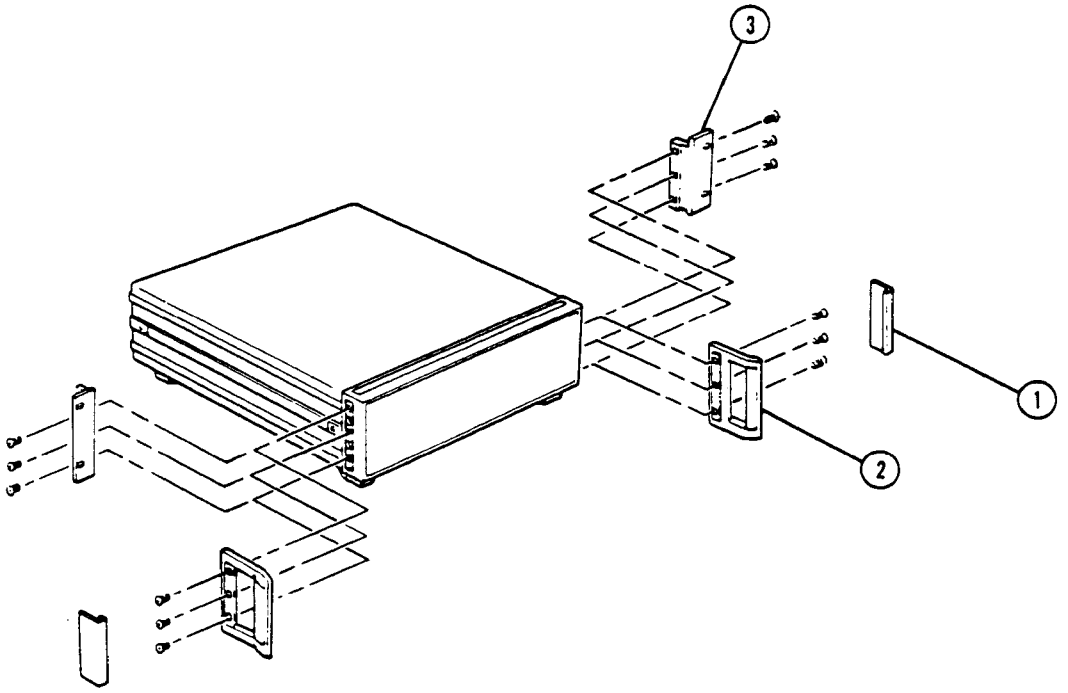
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Item	Qty.	HP Part No.	CD	Description
1	8	9220-2733	7	Foam Pads – Top Corners; Bottom Corners
2	1	08350-80049	0	Carton – Inner
3	1	9211-4499	7	Carton – Outer
4	2	08756-80010	5	Side Pads – Corrugated Cardboard
5	2	9220-2950	0	Sleeve – For Manual Protection
6	1	4114-1051	0	Poly Bag – To Cover Instrument (not shown)

Figure 2-12. Packaging for Shipment using Factory Packaging Materials

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1. REMOVE RACK MOUNT FLANGE (3) AND/OR FRONT HANDLE ASSEMBLY. (1)(2).

Figure 2-13. Preparation of Instrument for Shipment

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Battery Operation

The HP 8350B contains a battery pack (inserted in the battery holder with a battery hold down clamp) and has nonvolatile memory which retains the contents of all instrument state storage registers, the current instrument state, and the HP-IB address. When shipped from the factory, the batteries are fully charged. The batteries will retain a sufficient charge to hold the memory contents for approximately 20 days from the date at which they were fully charged. The batteries are charged within the instrument, and a full charge is maintained at all times when the instrument LINE switch remains ON. The batteries do not charge when the instrument LINE switch is OFF. When fully discharged, the batteries will typically take approximately 30 hours to obtain a full charge. Allow the instrument to be on for at least 24 hours when new or when the instrument has been turned off for a long enough period of time that the batteries might have become discharged to a level where memory contents may have been lost. Refer to Section VI, Replaceable Parts, in this manual for information and part number required to order individual battery packs.

STORAGE AND SHIPMENT

Environment

The instrument may be stored or shipped in environments within the following limits.

Temperature	−40''C to +75''C
Humidity	5% to 95% relative at 0'' to +40''C
Altitude	Up to 15240 meters (approximately 50,000 feet)

The instrument should also be protected from temperature extremes which may cause condensation in the instrument.

Packaging

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. A complete diagram and listing of packaging materials used for the HP 8350B is shown in Figure 2-12. Prior to shipping in the factory packaging materials, the shipping pads should replace the front handles or rack mount flanges, as shown in Figure 2-13, to hold the instrument securely in the packaging material. If the instrument is being returned to Hewlett-Packard for servicing, complete and attach one of the blue service tags located at the end of section III, Operation, of this manual. Mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

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

a. Wrap the instrument in heavy paper or plastic. If shipping to a Hewlett-Packard Office or Service Center, attach a tab indicating the type of service required, return address, model number, and full serial number.

b. Use a strong shipping container.

c. Use enough shock-absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

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

f. In any correspondence, refer to the instrument by model number and full serial number.

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Section III. Operation

INTRODUCTION

This section is divided into the following major sections:

FRONT AND REAR PANEL FEATURES.

OPERATOR's MAINTENANCE includes information on:

- Fuses
- Air Filter
- Plug-in Interconnect
- Service Tag Information

OPERATING INSTRUCTIONS provides information on:

- Instrument State
- Data Entry-Step Keys/Keyboard
- Frequency Sweep Mode
- Sweep/Sweep Trigger
- Frequency Markers/Sweep Time/Marker Transfer
- Storage Registers
- Modulation/Blanking
- Local Operator's Checks
- Remote Only Functions
- Remote Operator's Check

Programming Notes are individual publications documenting the use of different controllers to control the HP 8350B under remote operation (Hewlett-Packard Interface Bus, HP-IB).

SAFETY

Before applying power, refer to SAFETY CONSIDERATIONS in Section I of this manual.

The information, cautions, and warnings in this manual must be followed to ensure safe operation and to keep the instrument safe.

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WARNING

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

Only fuses with the required rated current and specified type should be used. Do not use repaired fuses or short circuited fuseholder. To do so could cause a shock or fire hazard.

CAUTION

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

OPERATING CHARACTERISTICS

Table 3-1 briefly summarizes the major operating characteristics of the sweep oscillator. The table is not intended to be an in-depth listing of all operations and ranges. For more information on sweep oscillator capabilities, refer to Specifications Table 1-1, and Operating Characteristics Table 1-2.

Panel Features

Figure 3-1 Front Panel features provides a reference to a functional block figure number which provides a complete description of each control within the function block. Rear Panel features are described in Figure 3-2.

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FRONT PANEL FEATURES

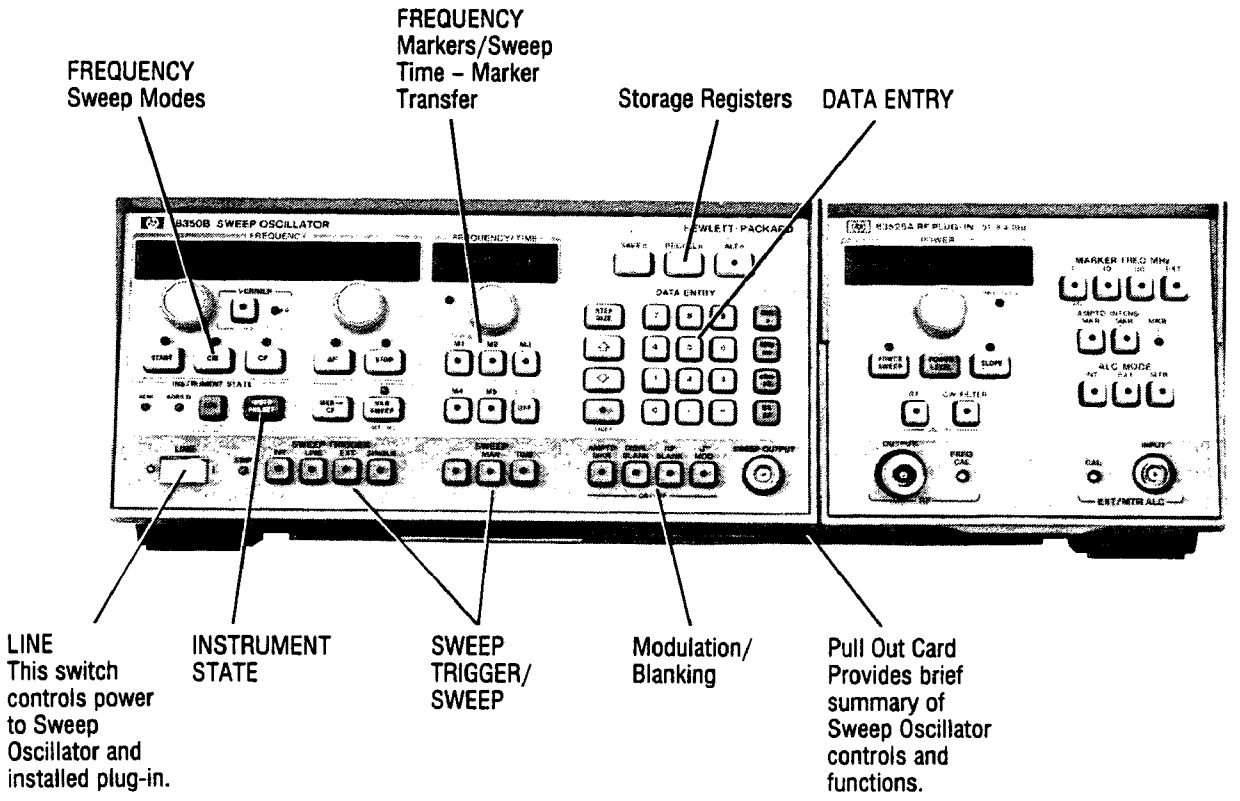
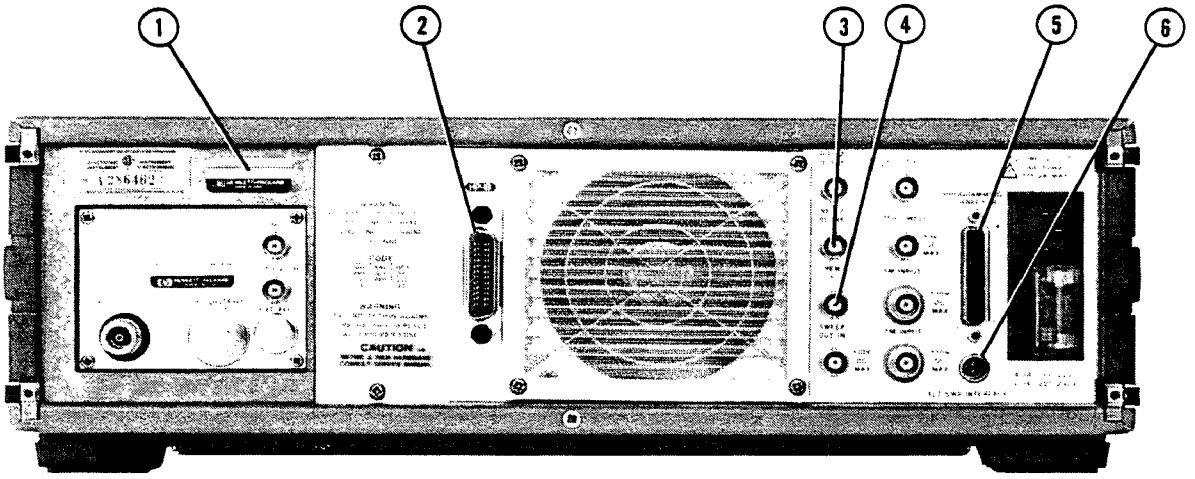


Figure 3-1. Front Panel Features

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REAR PANEL FEATURES



1 SERIAL PLATE and Option label.

2 HP INTERFACE BUS input/output connector allows interface with other HP-IB instrument or controllers.

3 POS Z BLANK output connector provides positive (+5V) retrace and bandswitch blanking and negative intensity marker Z-axis modulation signals for external display.

CNTR TRIG. Counter trigger output connector when used with STOP SWEEP with appropriate frequency counter (SWP INTFC B) to stop the forward sweep long enough to take a frequency count.

NEG Z BLANK output connector provides retrace (−5V) and bandswitch blanking Z-axis modulation signals for external displays.

4 PEN LIFT output connector provides TTL output to the remote penlift coil of an X-Y recorder.

SWEEP OUT/IN connector parallels front panel SWEEP OUT/IN connector. Provides and accepts sweep signal.

FM INPUT connector passes signal thru to plug-in for frequency modulation or phase-lock error signal inputs.

5 PROGRAMMING CONNECTOR provides digital control of external display functions and sweeper ◆ control.

Pin	Description	in/out	Logic
1	—		
2	Marker Pulses	output	TTL −
3	Pen Lift Request	input	TTL −
4	Sweep Alternate	output	TTL −
5	Stp Fwd Swp Req.	input	TTL −
6	+5 volts (100 ma Max)	output	TTL −
7	RF Blanking	output	TTL −
8	RF Blank Request	input	TTL −
9	Ext Trig Input	input	TTL +
10	Pen Lift	output	TTL
11	Recorder Mute	output	TTL −
12	—		
13	—		
14	Blanking Pulse	output	TTL −
15	Marker Request	input	TTL −
16	Retrace	output	TTL −
17	Alternate Swp En	output	TTL −
18	Stop Swp Request	input	TTL −
19	Digital Ground	in/out	
20	Blk Pulse Request	input	TTL −
21	Counter trigger	output	TTL −
22	Step Up Advance	input	TTL −
23	Inverse Penlift	output	TTL −
24	8410 Ext Trigger	output	TTL +
25	—		

6 ALT SWP INTERFACE connector may be connected to the HP 8755C ALT SWP INTERFACE connector via cable HP Part No. 8120-3174 to provide Alternate Sweep Function.

Figure 3-2. Rear Panel Features

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OPERATOR'S CHECKS

The local operator's check allows the operator to make a quick check of the main instrument functions prior to use. This check assumes that an RF plug-in is installed in the sweep oscillator and that a 10 dB attenuator, oscilloscope, and appropriate crystal detector are available. If these items are not available the preliminary self test may still be performed.

The remote operator's check (Figure 3-4) allows the operator to make a quick check to the main remote functions prior to use. This test is shown in program statements for HPL and BASIC and a general flow chart.

OPERATING INSTRUCTIONS

Located underneath the sweep oscillator is a pullout information card which contains information on general operating instructions, some remote programming information, and some plug-in usage information.

SOFTWARE REVISION NUMBER

The current mainframe software revision may be displayed by pressing **[SHIFT 49]**. The revision number will appear in the FREQUENCY/TIME display. The current software revision for any installed HP 83500 series plug-in may be displayed by pressing **[SHIFT 99]**. The revision number will appear in the plug-in POWER display.

For a complete reference of each function refer to the function group index (Table 3-1).

OPERATOR'S MAINTENANCE

Operator's maintenance consists of replacing defective fuses, cleaning the air filter, and cleaning the plug-in interface connectors. These items are discused in the following paragraphs.

Fuses

There are twelve fuses in the HP 8350B. Only the AC line fuse located at the back of the instrument may be replaced by the Operator. The value for the AC fuse is printed on the rear panel of the instrument below the power module. The value and HP part number for the AC fuse may be found in Sections II (Installation) and IV (Replaceable Parts).

WARNING

For continued protection against fire hazard, replace only with 250V fuses of the same current rating and type (normal blow).

To replace the AC fuse the line switch should be switched off then the AC line cord removed from the power source and instrument. With the line cord removed, access may be gained to the fuse compartment. The fuse may be removed by pulling the lever inside the fuse compartment. The internal fuses should only be replaced by a qualified service technician.

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WARNING

It is important that the following maintenance procedures be executed to retain the safety features which have been designed into the instrument.

Air Filter

The cooling fan located on the rear panel has a metal filter attached which will require periodic cleaning. Due to the variety of environmental conditions the interval between cleanings cannot be estimated. Error signal E016 indicates reduced air flow through an increase in temperature in the cooling system. When this error is noted on display a clogged filter may be the reason. To clean the filter refer to Section VIII of the manual.

Plug-in Interconnect

If plug-ins are changed frequently and/or the connectors are dirty the HP 8350B plug-in connect connectors may require cleaning to avoid voltage losses (tune voltage).

Service Tag Information

If the sweep oscillator requires service and the operators maintenance is not sufficient the instrument may be sent as per Section II to your local HP service organization. Before sending the instrument back, fill out and attach one of the blue service tags. If a sweep oscillator error code is noticed when a failure occurs, note that error code in the failure symptoms/special control settings section of the tag.

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Table 3-2. Functional Block Index

Function	Function Block Index	Page
ALL OFF	Frequency Markers	3-24
Alternate Sweep	Storage Registers	3-28
Amplitude Markers 8350B	Modulation/Blanking	3-31
Back Space	Data Entry	3-11
Blanking Display	Modulation/Blanking	3-31
Modulation/Blanking RF	Modulation/Blanking	3-31
Center Frequency	Frequency Sweep Mode	3-16
CW Mode	Frequency Sweep Mode	3-16
Data Entry	Data Entry	3-11
dB – dBm	Data Entry	3-11
Delta Δ Frequency	Frequency Sweep Mode	3-16
Display Blanking	Modulation/Blanking	3-31
Display Multiplier	Frequency Sweep Mode	3-16
Display Offset	Frequency Sweep Mode	3-16
Down◂▸step	Data Entry	3-11
Frequency Sweep Modes	Frequency Sweep Mode	3-16
Frequency Markers 8350B	Frequency Markers	3-24
GHz	Data Entry	3-11
HP-IB Only Functions	HP-IB Special Functions	3-37
Instrument Preset	Instrument State	3-9
Intensity Markers 8350B	Frequency Markers	3-24
Internal Sweep Trigger	Sweep/Sweep Trigger	3-21
Line Sweep Trigger	Sweep/Sweep Trigger	3-21
Local Key	Instrument State	3-9
Manual Sweep	Sweep/Sweep Trigger	3-21
M1 to M5	Frequency Markers	3-24
Marker Delta	Frequency Markers	3-24
Marker Sweep	Frequency Markers	3-24
Marker → Center Frequency	Frequency Markers	3-24
Memory Lock	Storage Registers	3-28
Memory Unlock	Storage Registers	3-28
Millisecond	Data Entry	3-11
MHz	Data Entry	3-11
Offset	Frequency Sweep Mode	3-16
Recall n	Storage Registers	3-28
Save n	Storage Registers	3-28
Shift	Data Entry	3-11
Single Sweep Trigger	Sweep/Sweep Trigger	3-21
Square Wave Modulation	Blanking/Modulation	3-31
Start Sweep	Frequency Sweep Mode	3-16
Step Size	Data Entry	3-11
Stop Sweep	Frequency Sweep Mode	3-16
Time Sweep	Frequency Markers	3-24
Up ▴ Step Key	Data Entry	3-11
Vernier	Frequency Sweep Mode	3-16

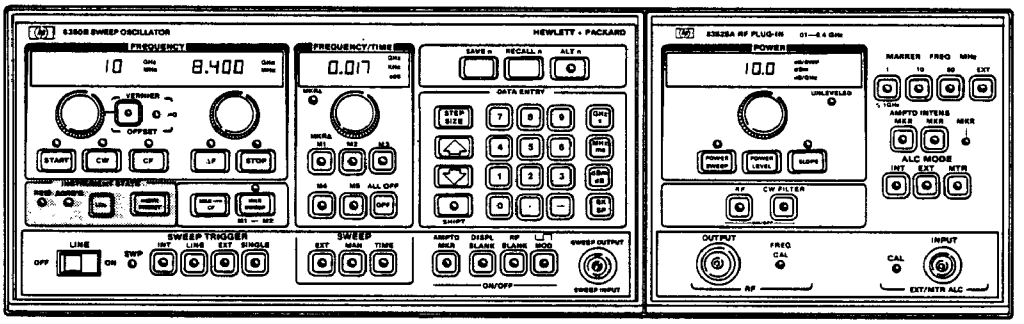
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Instrument State

DESCRIPTION

This function block contains two LEDs one that indicate whether the sweep oscillator is in the remote mode, and another indicates when it is addressed to talk or listen. The local key when not in local lockout will switch the sweep oscillator from remote to local (front panel) control. The Instrument Preset key when engaged will first run the sweep oscillator self test then set the controls to the preset condition.

PANEL LAYOUT



LOCAL [LCL]

Returns sweep oscillator control to front panel from remote operation unless a local lockout has been executed. The HP 8350B retains the same control settings when switched from remote to local.

INSTRUMENT PRESET [INSTR PRESET]

Turning the HP 8350B on or performing an INSTR PRESET causes an internal self test to occur. Only after the INSTR PRESET command will the instrument be set to the preset condition. If certain internal errors or failures are detected during the self test or during normal operation they will be indicated via error codes in the form Ennn'' (where n=0, . . . ,9) read from the left FREQUENCY display. For a complete description of the error code listing see Section VIII of this manual.

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If, after INSTR PRESET, the self test completes without errors the instrument presets to:

SWEEP MODE: START/STOP, over full frequency range of plug-in

SWEEP TIME: fastest allowable for plug-in

MARKERS: reset/off

MODULATION: off

SWEEP TRIGGER/SWEEP/SWEEP: INT-TIME

VERNIER/OFFSET: 0 MHz

DISPLAY BLANKING: on

SAVE/RECALL: All SAVE registers remain unchanged.

All Other Functions: off

When using 83500 series plug-ins:

POWER LEVEL: is device dependent

RF: on (Selectable by RF plug-in configuration switch.)

ALC MODE: INT

All Other Functions: off DATA ENTRY

LIMITATIONS/CONCERNS

1. Local key will not function if a Local Lockout has been implemented.
2. Allowable HP-IB addresses are from 00 through 30. However, the value 21 is typically reserved for the controller and should be avoided.
3. The HP-IB address will remain unchanged even if power is turned off.
4. If an instrument problem occurs, Section VIII of this manual contains some operator initiated self-tests. The results of these tests should be recorded on one of the blue tags located after Operator's Maintenance paragraphs in this section. This may help to isolate the problem and enable service to reduce turn around time.

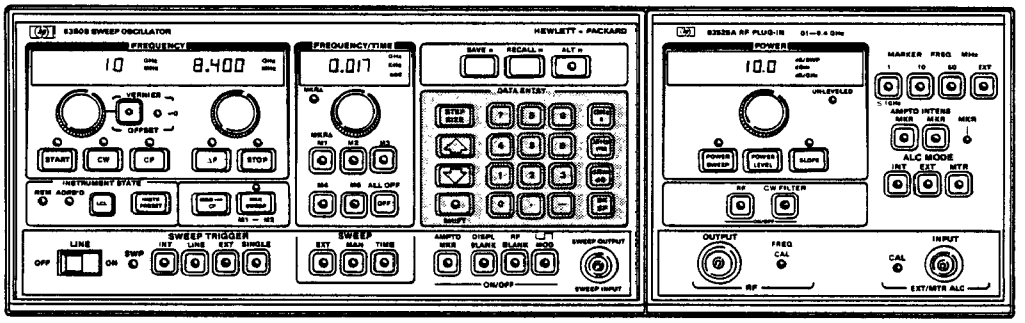
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Data Entry-Step Keys/Keyboard

DESCRIPTION

The DATA ENTRY section shown below, contains the numeric keyboard, terminators (i.e., GHz, seconds, dBm), step size/up/down, backspace and shift keys. This section allows a specific value to be entered for any frequency, time, or power parameter. The entry will modify the active function (last function selected) and must be terminated with the appropriate GHz/seconds, MHz/milliseconds, or dBm/dB key. The step up [▲] and step DOWN [▼] keys allow the active function to be incremented or decremented. Step size for frequency and power may be changed to any desired value.

PANEL LAYOUT



NUMBER/UNIT KEYS

These keys are used to enter values of frequency, time or power. Holding a number key down causes it to repeat.

Example:

To enter a START frequency of 1.870 GHz:

Press **[START] [1] [.] [8] [7] [GHz/s]**

or

[START] [1] [8] [7] [0] [MHz/ms]

to enter the equivalent frequency in MHz.

BACKSPACE KEY [BK SP].

Prior to pressing a units key the value entered from the keyboard may be changed via the BK SP key without effecting the current instrument state. The backspace key allows the user to alter digits already entered. Holding down the Backspace key causes it to repeat.

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STEP UP AND STEP DOWN KEYS [▲] [▼]

These keys increment or decrement the active function (including memory registers) by the STEP SIZE or preset amount. By holding either key down the HP 8350B will continue to step; therefore eliminating the need for the user to repeatedly press the step keys. The STEP UP function may be engaged via the remote STEP UP ADVANCE on the rear panel AUX PROGRAMMING connector. The STEP UP ADVANCE is incremented by supplying contact closure to ground or logical 0 to pin 22.

[STEP SIZE]

Entering a frequency or power increment to be used with the UP or DOWN key. The STEP SIZE key is pressed before the quantity is entered. A frequency step that is entered is common for START, STOP, CF, CW, MARKER and MANUAL SWEEP functions. A power step is used for varying POWER LEVEL. Default values are assigned at instrument preset for step sizes until new values are entered. Note that a step size for SWEEP TIME cannot be entered and always increments in a 1, 2, 5 sequence. The step keys affect the last active function. The entered Step Size is not displayed.

Example:

To set a 250 MHz step size:

Press **[STEP SIZE] [2] [5] [0] [MHz/ms]**

After this, each time the UP or DOWN key is pressed the active frequency parameter will change by 250 MHz.

[SHIFT] KEY (BLUE)

This key is used to activate the functions coded in blue on the front panel and other special SHIFT functions are also explained on the pull out information card. The lamp in the center of this key is on when the key is active.

Example:

To activate all 5 frequency markers:
Press **[M1] [M2] [M3] [M4] [M5]**

To turn off all 5 frequency markers at once: Press **[SHIFT] [OFF]**; this activates the (markers) ALL OFF command.

The SHIFT key is also used to set the HP-IB address. Press **[SHIFT] [LCL]**; the FREQUENCY/TIME display will indicate the present HP-IB address number. The address may be changed to any value between 0 and 30 by using the keyboard to enter a number and the GHz, MHz or dBm key as a terminator (It does not make any difference which of the terminator keys is pressed). The HP 8350B is factory preset for an HP-IB address of 19.

NOTE: Address number 21 is normally reserved for the remote controller address and should not be used.

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SHIFT FUNCTIONS

* **[SHIFT] [START]** Frequency display multiplier mode.

[SHIFT] [CW] Swept CW mode.

* **[SHIFT] [CF]** In CW mode, frequency control knob has coarse frequency resolution.

* **[SHIFT] [ΔF]** In CW mode, frequency control knob has fine frequency resolution.

[SHIFT] [STOP] Frequency display offset mode.

[SHIFT] [VERNIER] (offset) Frequency offset control.

[SHIFT] [M1] (MKR Δ) Displays difference frequency between two markers.

[SHIFT] [M2] (ON-CNTR) Turns on control signal to frequency counter.

[SHIFT] [M3] (OFF-CNTR) Turns off control signal to frequency counter.

[SHIFT] [LCL] (HP-IB) Displays and allows changing of HP-IB address.

** **[SHIFT] [INSTR PRESET]** Returns to normal mode and resets multiplier to 1.

[SHIFT] [MKR SWEEP] Redefines start and stop frequency such that MKR 1 is start frequency and MKR 2 is stop frequency.

* **[SHIFT] [SAVE]** Locks the SAVE/RECALL registers to prevent changing entries.

* **[SHIFT] [RECALL]** Removes lock from Save/Recall register.

** **[SHIFT] [ALT]** Frequency multiplier is not reset to 1 when **[INSTR PRESET]** is pressed.

[SHIFT] [STEP SIZE] Resets step sizes to default values.

[SHIFT] [POWER SWEEP] Locks internal attenuator setting. Allows independent control of ALC amplifier level.

[SHIFT] [POWER LEVEL] Aligns YTM and YIG oscillator above first switch point (2.4 GHz) for maximizing output power.

[SHIFT] [SLOPE] Locks ALC loop. Allows independent control of internal step attenuators.

** **[SHIFT] [0] [1]** Blanks front panel display.

** **[SHIFT] [0] [2]** Regenerates front panel display.

** **[SHIFT] [0] [3]** Sets all SAVE/RECALL registers to a preset state.

** **[SHIFT] [4] [9]** Displays mainframe's firmware revision on the frequency-time LED display.

** **[SHIFT] [9] [9]** Displays plug-in's firmware revision on the power LED display.

* HP 8350B firmware revision 3 or greater
** HP 8350B firmware revision 6 or greater

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LIMITATIONS/CONCERNS

1. Step size not settable for sweep time. It is a 1, 2, 5, data progression like 10 msec, 20 msec, 50 msec, 100msec, etc.
2. There is no visable data display for step size values.
3. Step size entry is differentiated via units terminator (i.e., frequency or power step).
4. All numeric entries are not input/entered until the appropriate units terminator is entered (GHz/seconds, MHz/milliseconds, or dBm/dB).
5. Auto step via depressing and holding an up or down key.
6. Negative numeric data must be entered with negative sign first.
7. Blank and unnecessary negative signs are ignored by the sweep oscillator (i.e., 0.5 seconds, the zero is ignored, or −10 seconds, the negative sign is ignored).
8. Some shift functions are not labeled on the front panel. Refer to the list above for all shift functions.
9. Shift key indicator stays on until a correct shift function key stroke is entered.
10. Holding number key or backspace key down will cause it to be continuously selected.
11. On Instrument Preset step size parameters revert to default values.

LOCAL FUNCTION PROCEDURE

Function	Activate	Data Forms				Range
		On/Off	Knob	Step	Keyboard	
STEP SIZE Frequency	(Frequency Parameter) [STEP SIZE]		X	X	X	Range: See plug-in frequency limits
STEP SIZE Power	(Power Parameter) [STEP SIZE]		X	X	X	Range: See plug-in power limits
Reset to default STEP SIZE	[SHIFT][STEP SIZE]	X				

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REMOTE FUNCTION PROCEDURE

Mode	Function	Program Code				
		Prefix	Range	Resolution	Suffix	Scale
STEP SIZE	Frequency Step Size	SF	See plug-in frequency limits		GZ MZ KZ HZ	GHz MHz kHz Hz
	Power Step Size	SP	See plug-in	See plug-in	DM	
STEP INCREMENT	Step Up (▲)	UP				
STEP DECREMENT	Step Down (▼)	DN				
BACK SPACE	Back Space	BK				
Default STEP SIZE	Reset to default STEP SIZE	SH SS				

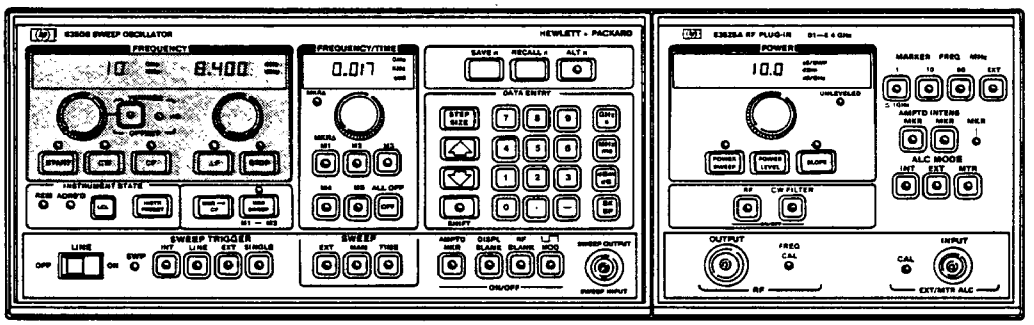
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Frequency Sweep Mode

DESCRIPTION

The gray area, shown below, is the function block that contains the keys to select one of the three desired modes (**START/STOP**, **CW**, **CF/ΔF**) or a modification of the mode (**VERNIER**, **OFFSET**, **COARSE** or **FINE CW** control knob resolution, **DISPLAY MULTIPLIER**, **DISPLAY OFFSET**). The two displays provide a visual display of the frequency/ies in the mode selected. The rotary control knobs provide a variable control to change the frequency of the function selected.

PANEL LAYOUT



[START]/[STOP]

When either the START or STOP key is pressed the sweep oscillator is put in the START/STOP mode swept RF output begins at the START frequency and ends at the STOP frequency. The START frequency must be less than or equal to the STOP frequency. The left FREQUENCY control knob and display correspond to the value of the start frequency. While the right FREQUENCY control knob and display corresponds to the value of the stop frequency. Frequencies may be changed in three ways.

- Frequency control knob – Provides continuous adjustment. Clockwise rotation increases frequency.
- Keyboard data entry – Specific frequency values may be entered for the active frequency mode by pressing the desired values and units.
- Step Control Key – THE ACTIVE FREQUENCY FUNCTION can be incremented or decremented by pressing the appropriate STEP key. The value of the STEP SIZE can be set to any desired value (see STEP SIZE for setting procedure).

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[CF]/[ΔF]

The CF/ΔF mode allows the swept output frequency range to be read as a center frequency and a frequency sweep width. The output frequency is swept from CF-ΔF/2 (start frequency) to CF+ΔF/2 (stop frequency). When changing between CF/ΔF and START/STOP modes only the method of display changes. The swept RF output remains the same.

When either CF or ΔF is activated the left display shows the center frequency (CF), the right display shows the delta frequency (ΔF). Both the CF and ΔDF can be changed via the appropriate control knob, number/units keyboard or step keys.

[CW]

When the CW function is activated the HP 8350B outputs a constant frequency. The value of the CW frequency is displayed on the left FREQUENCY display. The CW frequency is always the same as the center frequency (CF) of the CW/ΔF swept range. The CW frequency value can be changed using the control knob, data entry keyboard or step keys. In CW mode, the SWEEP OUT voltage is equal to a percentage of the full band. Pressing **[SHIFT] [CW]** enters a swept" CW mode with the SWEEP OUT being a 0 to 10 volt ramp that results in the display trace being a flat horizontal line. This is often useful when reading values (e.g., dB of attenuation) from a CRT screen when at a CW frequency.

CW Fine/Coarse Control Knob Resolution

CW control knob resolution is coarse when CW mode is activated after an INSTRUMENT PRESET. To change from coarse control knob resolution, 0.0015% of band/16,384 points, to fine resolution, 0.00038% of band/262,144 points, press **[SHIFT] [ΔF]**. To return to coarse control knob resolution press **[SHIFT] [CF]**.

FREQUENCY VERNIER

The effective center frequency of any mode (CW or swept) may be adjusted with high resolution up to ±0.05% of the frequency band being used with the vernier. Pressing the VERNIER key activates the function and sets the left FREQUENCY display to read the vernier value in MHz.

1. "≠0" light is on whenever a frequency vernier or frequency offset is present in any mode. After setting vernier, to return to the previous mode, press the appropriate key (e.g., START, CF, etc.) and the display will return to reading the appropriate frequencies and the "≠ 0" lamp will be lit.
2. Frequency vernier can be set by the control knob, data entry keyboard, or step keys.
3. The displayed vernier adjustment can be up to ±0.05% of the frequency band being swept. When in a sub-band of a multiband plug-in (for example, the 0.01-2 GHz band of the 83525A .01-8.4 GHz plug-in) the adjustment range will be ±0.05% of the sub-band. This feature allows for better frequency resolution than would otherwise be possible with the vernier when using a multiband plug-in.
4. The vernier adds its value to the appropriate frequency parameter and then resets the vernier to zero when the adjustment exceeds ±0.05% for continuous adjustment.
5. ZEROING VERNIER. To set the vernier to zero, press **[VERNIER] [0] [MHZ/ms]** and the "≠0" lamp will turn off.

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FREQUENCY OFFSET

The frequency offset feature allows the CW frequency and/or the effective center frequency of the swept range to be shifted by any amount up to the full range of the plug-in.

1. To enter an offset press **[SHIFT] [VERNIER]** and enter the offset by either the left FREQUENCY control or data keyboard. The amount of offset (in GHz or MHz) will be shown in the left FREQUENCY display and the "≠ 0" lamp will be lit.
2. To exit the displayed offset mode press the appropriate mode key (i.e., START, CW, etc.). The sweep limits displayed will appear to be unchanged, however the "≠ 0" lamp will be on, indicating the offset is present and the actual RF output frequency will be shifted.
3. To display or adjust the frequency offset press **[SHIFT] [VERNIER]**. To zero the offset press **[SHIFT] [VERNIER] [0] [MHz]**.

OVERRANGE

The HP 8350B will permit frequency sweeps beyond the specified range of the plug-in by ±2.0% of the plug-in bandwidth. However, plug-in performance in the overrange condition is unspecified.

As a warning of the frequency overrange condition the GHz or MHz annunicator will flicker in the appropriate function display.

LIMITATIONS/CONCERNS

1. The range of frequencies input to the mainframe is determined by the plug-in (values to ±2% out of range are accepted).
2. The order in which START/STOP or CF/ΔF are entered is not important.
3. START frequency must be lower than STOP frequency. Entering a Start frequency greater than the Stop frequency causes the Stop frequency to equal the Start frequency.
4. Lights except as noted indicate active values/function.
5. Frequency values entered do not change when mode is changed.
6. Sweep Out provides a 0 to 10 volt ramp for all sweeps with 0 volts corresponding to the effective start frequency and 10 volts to the stop frequency. In CW mode the voltage out multiplied by 10 is equal to the percentage of band (except Swept CW). Example: With a 1 volt sweep output, CW frequency is equal to 10% of band.
7. Vernier value can "roll over" if knob or step causes the vernier value to exceed its maximum range. When this happens the CW/CF value is changed and the vernier value is reset to 0 MHz (or appropriate value).
8. All LED display multiplier values and LED display offset values default to 1 and 0 after an Instrument Preset.

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LOCAL FUNCTION PROCEDURES

Mode	Modifier	Activate	Data Forms				Range and Resolution
			On/Off	Knob	Step	Keyboard	
START/STOP	Start Frequency	[START]		X	X	X	Same as ΔF - See Section I, Table 1-1
	Stop Frequency	[STOP]		X	X	X	
CONTINUOUS WAVE	Continuous Wave	[CW]		X	X	X	.00038% of band
	Coarse CW Control Knob Resolution	[SHIFT] [CF]	X				.0015% of band
	Fine CW Control Knob Resolution	[SHIFT] [ΔF]	X				.00038% of band
	CW Vernier	[VERNIER]		X	X	X	
SWEPT CW	Swept CW	[SHIFT] [CW]		X	X	X	
CF/ΔF	Center Frequency	[CF]		X	X	X	See Section I - Table 1-1
	Delta Frequency	[ΔF]		X	X	X	
ANY MODE	(RF) Offset	[SHIFT] [VERNIER]		X	X	X	.00038% of band
	Display Multiplier	[SHIFT] [START]				X[1]	
	Display Offset	[SHIFT] [STOP]				X[1]	

1. Entered only after pressing GHz, MHz, or dBm keys.

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REMOTE FUNCTION PROCEDURES

Mode	Function	Program Code				
		Suffix	Scale	Resolution	Suffix	Scale
START/STOP	Start	FA	Plug-in	Same as ΔF	GZ MZ KZ HZ	GHZ MHz kHz Hz
	Stop	FB				
CW	CW	CW	Plug-in	.00038% of Band		
	Swept CW	SH CW				
CF/ΔF	Center Frequency	CF	Plug-in	See Sec. I - Table 1-1		
	Delta Frequency					
OFFSET	Frequency Offset	SH VR				
VERNIER	Frequency Vernier	VR	±0.05% of Band	.00038% of Band		
FRONT PANEL DISPLAY	Display Multiplier	SH FA				
	Display Offset	SH FB				

1. Depends on plug-in used; 1 kHz if <2 GHz in HP 83525 or HP 83522.

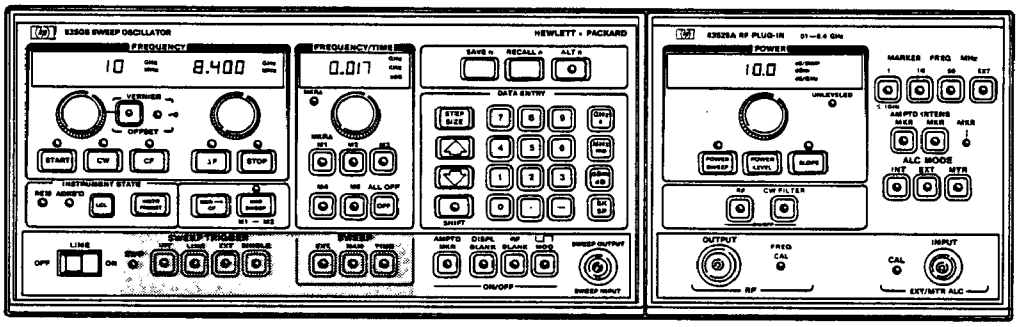
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Sweep/Sweep Trigger

DESCRIPTION

This function block contains seven keys for control of sweep source and time. This block also has a SWP LED to indicate sweep in progress. The SWEEP keys enable selection of EXTERNAL, MANUAL or TIME sweep controls. The SWEEP TRIGGER keys enable selection of INTernal, LINE, EXTernal and SINGLE sources of sweep triggering. Lights on keys indicate active function.

PANEL LAYOUT



EXTERNAL SWEEP [EXT]

This enables sweep input via front or rear panel SWP INPUT BNC (SWP INPUT 0 to 10 volts) to externally tune the RF plug-in oscillator. Where 0V input corresponds to the lower frequency limit of the sweep range and 10V corresponds to the upper limit. DC sweep input voltages will cause CW frequency outputs. Frequency/Time display is blanked and markers and blanking outputs are disabled when in external sweep mode.

MANUAL SWEEP [MAN]

This enables manual control of sweep voltage by using the FREQUENCY/TIME rotary control, step keys or number/units keyboard. When using the manual sweep mode the FREQUENCY/TIME display indicates the present output frequency.

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SWEEP [TIME]

This enables the output to be swept at the user-specified or default rate. If the time key is lit but the display reads GHz/MHz or is blank, press the TIME key again and the display will read seconds. The HP 8350B can allow sweep times from 0.01 seconds to 100 seconds although the minimum sweep time is dependent on the plug-in being used and the bandwidth being swept. The triggering for TIME may be one of the following trigger sources.

[INT]

This enables internal sweep triggering (free run, auto).

[LINE]

This enables triggering by power line frequency.

[EXT]

This enables external triggering of sweep via rear panel auxiliary connector pin 9. A two volt trigger (20.0 volts max) must be supplied to auxiliary connector. This signal must be wider than 0.5 microsecond at less than a 1 MHz repetition rate.

[SINGLE]

This selects and/or triggers single sweep mode. The initial engagement of SINGLE also aborts any sweep in process.

LIMITATIONS/CONCERNS

1. SWEEP TRIGGER controls work only in TIME sweep mode.
2. Using the step keys with sweep time forces specific values in a 1,2,5 sequence such as 10ms, 20ms, 50ms, 100ms, etc. No other step size values can be set for sweep time.
3. Single sweep, when initially engaged, switches to single sweep mode and terminates current sweep. If presently in single sweep, engaging single sweep triggers a new sweep. Holding the key down will result in continuous single sweeps.

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LOCAL FUNCTION PROCEDURES

Function	Activate	Data Forms				Range and Resolution
		On/Off[3]	Knob	Step	Keyboard[1]	
SWEEP TYPE	[EXT]	X				
Manual	[MAN]		X	X	X	Range: Present Sweep Width Resolution: 0.1% of present sweep
Time	[TIME]		X	X[2]	X	
SWEEP TRIGGER Internal	[INT]	X				
Line	[LINE]	X				
External Volts (2 to 5 Volts Input)	[EXT]	X				
Single Activates	[SINGLE]					

1. Values must end with terminator (GHz, MHz, S, or mS).
2. The step size may not be set for time.
3. Each mode (except TIME) disables other modes.

REMOTE FUNCTION PROCEDURES

Mode	Function	Program Code			
		Prefix	Range	Suffix	Scale
Sweep Type	External	SX			
	Manual	SM	Frequency	GZ MZ KZ HZ	GHz MHz kHz Hz
	Time	ST	0.01 – 100 second	SC MS	seconds msec
Sweep Trigger	Internal	T1			
	Line	T2			
	External	T3			
	Single	T4			

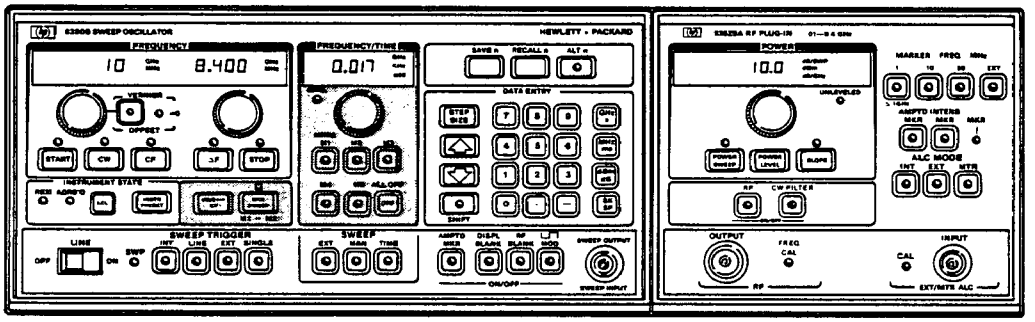
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Frequency Markers/Sweep Time/Marker Transfer

DESCRIPTION

The frequency marker functions consist of up to five independent and contiuously variable frequency markers. When a marker is activated it is set to its last active frequency unless INSTRUMENT PRESET has been activated in which case the marker will be set to center of the present sweep.

PANEL LAYOUT



MARKERS [M1] [M2] [M3] [M4] [M5]

A marker can be in one of three states:

- ACTIVE – Lamp in center of key flashing.
- ON – Lamp on.
- OFF – Lamp off.

The five mainframe markers are available in two forms, Intensity and Amplitude.

Intensity markers are active any time a marker is selected. These markers are available at the Positive Z-axis output (rear panel BNC) and appears as intensified dots on a display.

Amplitude markers are only on when the AMPTD MKR key has been pressed. Amplitude marker circuitry is internal to the HP 8350B mainframe and RF plug-ins and causes dips in the RF output power at the selected marker frequencies.

Only one marker at a time, the "active" marker, can have its value altered. Pressing any marker key makes that marker "active".

- When a marker is active, the keyboard, FREQUENCY/TIME control knob, step keys, or DATA ENTRY keyboard can be used to modify its value. The value of the active marker in GHz/MHz is displayed.
- By pressing OFF, the active marker only will be turned off. If multiple markers are on, the remaining lamps will remain lit although the display will go blank.

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- A marker may be initially activated or returned to active state by pressing the corresponding marker key.
- All markers may be turned off simultaneously by pressing **[SHIFT] [OFF]**.

MARKER DELTA [MKR Δ]

This function allows the frequency difference between the active frequency marker and the previously active frequency marker to be displayed and the trace between them intensified (if intensity markers are selected).The active marker is still active and modifiable via the FREQUENCY/TIME control knob, step keys, keyboard, or remotely via HP-IB.

MARKER TO CENTER FREQUENCY [MKR → CF]

When this key is pressed the frequency of the active marker becomes the center frequency swept output. The frequency span remains unchanged if it is within the frequency limits of the plug-in. If the original frequency span exceeds the plug-in limits, the frequency span will be reduced to retain symmetry.

MARKER SWEEP [MKR SWEEP]

This function temporarily uses the values of Markers 1 and 2 and reassigns them to the Start and Stop frequencies respectively. The previous values of the Start and Stop frequencies are saved and reassigned when exiting Marker Sweep mode. If Marker 1 is greater than Marker 2 (or M2 less than M1) the lower frequency is used for the Start frequency, and the higher value for the Stop frequency. Note that the values of Markers 1 and 2 and hence the temporary Start and Stop frequency values can be modified in marker sweep mode by using either the start or the stop controls or M1 or M2 controls. The new values of M1 and M2 are retained upon exiting Marker Sweep mode. To exit this mode, press **[MKR SWEEP]** and the lamp over the key will go out. Pressing **[SHIFT] [MKR SWEEP]** causes the values of M1 and M2 to become the START/STOP frequency values permanently.

LIMITATIONS/CONCERNS

1. All frequency markers are initialized to the value of the center frequency of the frequency range of the plug-in only after Instrument Preset.
2. When active marker values are out of the set frequency sweep range, the values will be reassigned to the center frequency of the set sweep when the FREQUENCY/TIME knob is first turned.
3. If no markers are presently active when entering MKR Δ, Markers 1 and 2 are assumed the active and previously active markers respectively.
4. If marker 1 frequency is higher than marker 2 frequency then these values are interchanged in marker sweep mode.

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5. START and STOP values are modified to correspond to the new center frequency and old sweep width in MKR → CF. Likewise the Δ frequency span and START/STOP may be modified so that the new frequency sweep is within the frequency range of the plug-in.

6. If no marker is presently active the previously active marker is assumed. After Instrument Preset Marker 1 is assumed to be the active marker.

7. If Marker 1 and/or Marker 2 are not on when MKR SWEEP is engaged, they are turned on and their previous values used.

8. If sweep width is out of range when MKR → CF is engaged, it will automatically scale down the frequency to be within plug-in frequency range.

9. The plug-in and markers have the overrange capability of + 2% of RF plug-in frequency range, if this occurs a flickering of the GHz or MHz annunciator will occur.

LOCAL FUNCTION PROCEDURE

Function	Activate	Data Forms				Range and Resolution
		On/Off	Knob	Step	Keyboard[1]	
Markers	[M1] to [M5]		X	X	X	Resolution: 0.4% of Selected Sweep Width
Marker Δ	[SHIFT] [M1]		X	X	X	
Marker to Center Frequency	[MKR→CF]		X	X	X	Range See plug-in
Marker Sweep	[MKR SWEEP]	X	X	X	X	
Permanent Marker Sweep	[SHIFT] [MKR SWEEP]		X	X	X	
Turn Off Active Marker	[OFF]	X				
Turn Off All Markers	[SHIFT] [OFF]	X				
Counter Interface Enable	[function] [SHIFT] [M2]	X				
Counter Interface Disable	[SHIFT] [M3]	X				

1. Values must end with terminator (GHz or MHz).

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REMOTE FUNCTION PROCEDURE

Function	Description	Program Code				
		Prefix	Range	Resolution	Suffix	Scale
Markers	Select and Position Markers	M1 to M5	Plug-in	0.4% of Selected Sweep Width	GZ MZ KZ HZ	GHz MHz kHz Hz
MARKER Δ	Displays Difference Frequency	SH M1				
MKR → CF	Active Marker to Center Frequency	MC				
MARKER SWEEP	Sweep ON M1 and M2 OFF	MP1 MP0				
MARKER SWEEP	Permanent Marker Sweep	SH MP				
OFF	Active Marker Off	M1 to M5			MO*	
ALL OFF	All Markers Off	SH			MO*	
Counter Interface Enable	Counting End Points or Marker On Swept Frequency	FA, FB, or M1 to M5 SH M2				
Counter Interface Disable	Disables Swept Counting	SH M3				

* The suffix M followed by either a letter O or number zero is allowable.

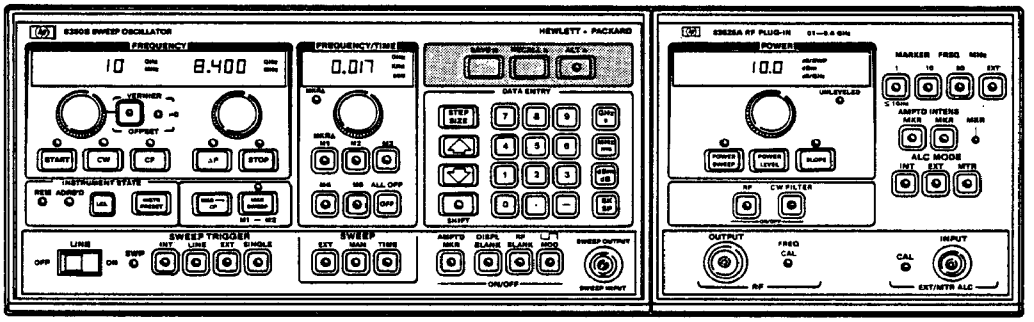
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Storage Registers

DESCRIPTION

The SAVEn function allows all the control settings to be stored in one of the nine internal registers. The RECALLn function will implement the previously stored settings. Alternate n function alternates between the current state and the register selected on successive sweeps.

PANEL LAYOUT



[SAVEn]

Enables up to five current settings (modes, frequencies etc.) to be stored in a register. Instrument settings are stored in memory locations 1 through 9 by pressing **[SAVEn]** and 1,..., or 9.

[RECALLn]

To recall the stored instrument settings, press **[RECALLn]** and the register number that the settings are stored in. When enabled the registers may be incremented with the [▲] button or decremented with the [▼] button. Registers not previously stored will contain the instrument preset settings.

SAVE REGISTER LOCK

All save registers may be write-protected (locked) by pressing **[SHIFT] [SAVEn]**. This command makes it impossible to change the contents of any register until it is unlocked by pressing **[SHIFT] [RECALLn]**. Since the HP 8350B memory is non-volatile the contents of the save registers and the locked/unlocked status are retained even with Line power off. If a SAVEn command is attempted after the SAVE LOCK is engaged an Error 30 (E030) will be displayed.

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[ALTn]

Alternates between current state and selected stored register on successive sweeps. When the HP 8350B is in this mode the lamp will be on and the SAVEn and RECALLn keys disabled. To exit from the ALTn mode press the key again, the lamp will turn off and the SAVEn/RECALLn keys will become operational. When using the HP 8350B with an HP scalar network analyzer, channel 1 displays the current instrument state and channel 2 displays the stored setting (provided the HP 8350B ALT SWP INTERFACE cable is connected to the HP 8755C or system interface is connected to the HP 8756/57).

LIMITATIONS/CONCERNS

1. Unused registers have instrument preset values stored until new values are stored.
2. The instrument retains stored settings even with AC power off.
3. Remote step up advance (Programming Connector) or auto step allows cycling of RECALL storage registers only.

LOCAL FUNCTION PROCEDURE

Function	Activate	Data Forms				Range
		On/Off	Knob	Step	Keyboard	
Store Settings	[SAVEn]				X	Integers 1 to 9
Recall Settings	[RECALLn]			X[1]	X	Integers 1 to 9
Memory Lock	[SHIFT] [SAVEn]				X	
Memory Unlock	[SHIFT] [RECALLn]				X	
Alternate Sweep Settings	[ALTn]			X[1]	X	Integers 1 to 9
Alternate Sweep Off	[ALTn]	X			X	

1. Step keys activated only after a number has been entered.

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REMOTE FUNCTION PROCEDURE

Function	Description	Program Code	
		Prefix	Range
SAVE	Store Current Settings	SV	Register 1 to 9
RECALL	Resets Stored Settings	RC	Register 1 to 9
LOCK	Memory Lock	SH SV	
UNLOCK	Memory Unlock	SH RC	
ALTERNATE	Successive Sweep Selected and Current	AL1	Register 1 to 9
	Alternate Off	AL0	

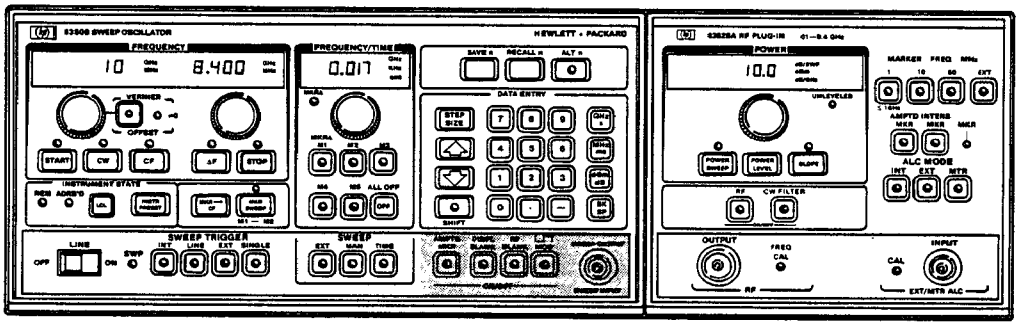
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Modulation/Blanking

DESCRIPTION

This function block controls the frequency marker display mode, RF power and external CRT control. Mainframe frequency markers can be RF amplitude dips or CRT intensity dots (via Z-axis control). The RF power can be turned off during the retrace sweep. The CRT display retrace sweep can be blanked. The internal square-wave amplitude modulation can be enabled. The square-wave frequency is 27.775 kHz standard for proper operation with the HP 8755/56A/57A Scalar Network Analyzers or internally selectable (see Section VIII, A5 Sweep Generator) to 1 kHz for proper operation with the HP 415 SWR Meter and other instruments. The sweep input/output connector is also in this block.

PANEL LAYOUT



AMPLITUDE MARKER [AMPTD MKR]

This function, when engaged (light on), sets the mainframe frequency markers into RF amplitude dips instead of Z-axis controlled CRT intensity dots.

DISPLAY BLANKING [DISPL BLANK]

This function, when engaged (light on), blanks the retrace sweep on CRT displays via Z-axis control.

RF BLANKING [RF BLANK]

This function, when engaged (light on), blanks (turns off) the RF power during the retrace sweep.

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SQUARE-WAVE MODULATION [⌐¬ MOD]

This function, when engaged (light on), enables the internal amplitude modulation square-wave. The standard square-wave frequency is 27.775 kHz, internally selectable to 1 kHz.

SWEEP OUTPUT/SWEEP INPUT

When sweep oscillator is in MANUAL or TIME sweep mode this connector provides a linear ramp voltage from 0 to 10 volts that is synchronous with RF sweep. In external sweep mode connector is input for a sweep ramp from 0 to 10 volts.

LIMITATIONS/CONCERNS

1. Changing frequency of modulation (1 or 27.775 kHz) requires moving of a jumper.
2. Plug-in frequency markers are controlled from plug-in for CRT intensity dots or RF amplitude dips.
3. Internal square-wave modulation and a External AM signal can be used simultaneously.
4. CRT Z-axis control is provided with both positive and negative polarity control for blanking (via rear panel POS Z-BLANK or NEG Z-BLANK). Mainframe frequency markers, when used in the CRT intensity dot mode are useable with positive polarity Z-axis control only.

LOCAL FUNCTION PROCEDURE

Function	Activate	Data Forms			
		On/Off	Knob	Step	Keyboard
Amplitude Markers	[AMPTD MKR]	X			
Display Blanking	[DSPL BLANK]	X			
RF Blanking	[RF BLANK]	X			
Squarewave Modulation	[⌐¬ MOD]	X			

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REMOTE FUNCTION PROCEDURE

Mode	Function	Program Code
		Prefix
Amplitude Markers	Amplitude Marker On Amplitude Marker Off	AK1 AK0
Blanking	Display Blanking On Display Blanking Off	DP1 DP0
	RF Blanking On RF Blanking Off	RP1 RP0
Modulation	⊔⊓ Modulation On ⊔⊓ Modulation Off	MD1 MD0

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Local Operator's Checks

DESCRIPTION

The preliminary check provides assurance that most of the internal functions of the sweep oscillator are working. The main check provides a general check of the overall functions of the sweep oscillator.

PRELIMINARY CHECK

(Self test) Each time the sweep oscillator is turned on or INSTR PRESET button is engaged the instrument performs a series of self tests taking about one second to complete. When the self test is complete the instrument will perform one of the following functions: If the self test was initiated by turning the power on the instrument will be in the same functional configuration that it was in before it was turned off. If the self test was initiated by an INSTRUMENT PRESET the instrument will be in the preset mode if a plug-in is installed or the left-most frequency display will have an E001 error code indicating no plug-in is installed. If error code E016 is observed refer to Operator's Maintenance paragraphs at the beginning of this section. If another error code is noted, the sweep oscillator requires service. Refer to the paragraph titled Service Tag Information located in the Operator's Maintenance paragraphs. Plug-in related error information (E050 to E099) is in the plug-in manual.

1. Set LINE switch to ON. Press **[INSTR PRESET]**. Observe display in START/STOP mode with display frequency equaling plug-in range or E001 if no plug-in is installed.

MAIN CHECK

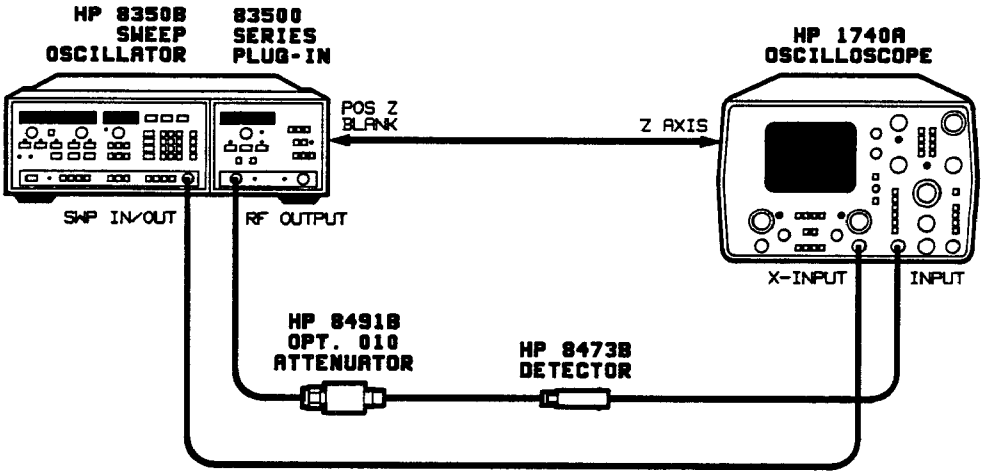
Equipment

RF plug-in	HP 83500 series or HP 86200 series with adapter HP 11869A (18 GHz or less)
Oscilloscope	HP 1220A or HP 1740A
Crystal Detector	HP 8473C (or a crystal detector that will cover frequency range of interest)
Attenuator 10 dB	8491B Option 010
Cables BNC to BNC (3)	10503A (123 cm)

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Setup

Connect the equipment listed above as shown in the diagram below. Select External Sweep on oscilloscope.



CAUTION

BEFORE CONNECTING LINE POWER and turning on the instrument, verify that all devices connected to this instrument are connected to the protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

NOTE: BEFORE SWITCHING ON THIS INSTRUMENT, ensure that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and the safety precautions are taken. See Power Requirements, Line Voltage Selection, Power Cables, and associated warnings and cautions in Section II.

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Procedure

1. Set LINE switch to ON position. Press **[INSTR PRESET]**. Observe that the LEDs above START and STOP buttons are on and the frequency range of the installed plug-in is displayed. The oscilloscope trace should show detected RF signal output below zero-volt reference with no discontinuities in swept trace across band.

2. Press **[CW]** button and observe that the LED above the button is on. Notice the oscilloscope trace is reduced to a dot at the center of the CRT. Also notice the mainframe frequency display is at the center of the plug-in frequency range.

3. Press **[CF]** button and observe the LED above CF and ΔF buttons is on. Notice the center frequency display reads the center of the plug-in frequency range and ΔF display is equal to frequency span.

4. Press **[M1]** button. Observe button LED blinking and check for an intensity dot at approximately the center of the trace.

5. Press SWEEP **[TIME]** button; then press DATA ENTRY **[▼]** button a few times and observe sweep getting slower. Press DATA ENTRY **[▲]** button a few times and observe sweep getting faster.

6. Press DATA ENTRY **[.] [1] [GHz/s]** and observe FREQUENCY/TIME display is 0.100 sec.

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HP-IB Only Functions

DESCRIPTION

This section describes functions which are only accessible via the HP-IB. These functions allow the HP-IB user to learn about the present instrument state, setup the instrument state, and enable some special functions to improve HP-IB operation.



FUNCTIONS

Input/Output Learn String

A string of 90 bytes of binary data that completely describes the present instrument state (does not include the storage registers) of the HP 8350B and 83500 Series Plug-in. This information is packed and encoded for minimal storage requirements thereby making data analysis difficult. If data analysis is necessary, use the output mode string and output interrogated parameter functions instead. When output from the HP 8350B is stored in an ASCII character data string, the learn string can later be input to the HP 8350B to restore that instrument state. The length of the learn string is fixed, independent of the functions selected and the plug-in used.

The output learn string function learns the present sweeper settings only. To learn the storage register settings, sequentially recall each storage register and then learn the present sweeper settings. Likewise, to restore the storage registers, input the learn string for the appropriate storage register then save the present sweeper settings in the proper register.

Input/Output Micro Learn String

A string of 8 bytes of binary data that completely describes the present CW frequency, vernier, sweep output voltage, and power level of the HP 8350B and 83500 Series Plug-in. This information is packed and encoded for minimal storage requirements thereby making data analysis difficult. When output from the HP 8350B and stored in an ASCII character data string, the micro learn string can later be input to the HP 8350B to restore the instrument state for rapid CW frequency programming. The length of the micro learn string is fixed, independent of the functions selected and the plug-in used.

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In this mode the HP 8350B numeric displays are blanked and the micro learn string bytes are used to pre-load the appropriate internal DAC's. For proper operation the HP 8350B must be in the CW mode and the plug-in CW Filter capacitor should be off. Since the micro learn string overrides the present values of the HP 8350B when it is input, do not program any functions while in this mode. If a function is programmed one of two things may occur: 1) the HP 8350B may exit the input micro learn string mode with the previous sweeper settings restored, or 2) the HP 8350B may interpret the program codes as another micro learn string and cause the instrument to enter a non-predicatable state. The only function that is valid for execution while the micro learn string is in effect is the network analyzer trigger function.

To output the micro learn string: 1) program the desired CW frequency, 2) program the "OX" code, then 3) read the 8 byte string

To input the micro learn string: program the "IX" code and the 8 byte string. When the user desires to exit the input micro learn string mode and return to the normal mode of operation, the user must exit properly. When in the input micro learn string mode the HP 8350B accepts the input program code/ bytes in a special binary entry mode. The mode is exited by programming the HP 8350B with a function code that does not start with a number (0-9) or the letters A through F since these are interpreted as possible micro learn string data characters. It is suggested that the user exit this mode by using the "M0" (the 'o' can be the letter 'o' or the number zero, either will work) code as the mode terminator and then restore the numeric displays via the "CW", "ST", and "PL" function codes.

Output Mode String

A string of 8 bytes of binary data that describes all of the presently active functions of the HP 8350B and 83500 Series Plug-in. This information is not packed thus allowing simple data analysis. The information passed indicates only which functions are presently active functions with no numeric values included. By determining the decimal value of each byte the user can determine which function is active. To determine the actual numeric value of some functions use the output interrogated parameter function. The length of the mode string is fixed, independent of the functions selected and the plug-in used.

Output Interrogated Parameter

The HP 8350B outputs the present numeric value of the instructed parameter that is to be interrogated. Any parameter that has a numeric value associated with it such as Start Frequency, Sweep Time, etc., can be interrrogated. The units of the output data are Hz, dBm, dB, or sec., implied with the function selected.

Output Active Parameter

The HP 8350B outputs the numeric value of the parameter that is presently active, ie. enabled for value modification from the step keys or data entry. The units of the output data are Hz, dBm, dB, or sec., implied with the function selected.

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Output Status

The HP 8350B outputs 3 sequential bytes, 8 bits wide, that indicate the present instrument status. The first status byte is equivalent to the status byte of the serial poll (the status byte Message). The second and third status bytes are the extended status bytes which provide additional information. See the Status Byte Information table for a description of each status byte. Status byte values are cleared upon execution of a serial poll (the status byte Message), device clear (the Clear Message), CS (Clear status), and/or Instrument Preset function command. The CS (Clear status) command also clears the extended status bytes.

Service Request Mask

This determines which bits within the HP 8350B status byte (byte #1) can cause the HP 8350B to send a Request Service (SRQ) Message to the HP-IB controller. The status byte mask is a one 8-bit byte value where with each bit position corresponds to the same bit position as in the HP 8350B status byte. If a bit in the status mask byte is set (logical '1') then this condition is enabled for SRQ generation. If the bit value is cleared (logical '0') then the bit is ignored. The status byte mask value ranges from decimal 0 to 255 where the decimal value can be determined by summing the decimal values of each status byte bit to be enabled (the user must always select the SRQ bit); the first and second extended status bytes can be masked the same way as the status byte. The default at power on is a status mask byte of '00000000' or decimal 0 and extended status byte mask value of '11111111' or decimal 255. The request masks are reset to the default value at power on only and are not affected by an instrument preset.

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Status Byte Information

STATUS BYTE (#1)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	N/A	REQUEST SERVICE (RQS)	SRQ on Syntax Error	SRQ on End of Sweep	N/A	SRQ on Change in Extended Status Byte	N/A	SRQ on Front Panel Key Pressed
EXTENDED STATUS BYTE (#2)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	Airflow Failure	*RF Unleveled	Power Failure/on	N/A	N/A	N/A	N/A	Self Test Failed
SECOND EXTENDED STATUS BYTE (#3)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	N/A	N/A	N/A	N/A	N/A	N/A	N/A	SRQ on Numeric Parameter Altered to Default Value
*** Bit/Functions not usable with 86200 Series Plug-ins and 11869A Adapter.**								

Output Harmonic Number

The HP 8350B outputs the ratio of the RF OUTPUT frequency to the AUX. OUTPUT frequency. The output in the heterodyne band condition is zero.

Output Software Revision Number

The HP 8350B outputs the revision level of the mainframe and plug-in software in the following manner: 08350B REV X, Y where X is the mainframe software revision level and Y is the plug-in software revision level. Example "08350B REV 1, 5".

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Network Analyzer Trigger (8410B/C)

This causes an external trigger pulse to be generated for the HP 8410B/C Microwave Network Analyzer to re-phase lock on the present RF signal. This is used to insure proper HP-IB operation in stepped CW frequency sweeps to guarantee that the HP 8410B/C is phase-locked at the proper RF frequency after CW settling.

Reset Sweep

This aborts the present single sweep that is in progress and resets the sweep so that it can be triggered again. This function is enabled only if the HP 8350B is in the single sweep trigger mode and has the same effect as programming a single sweep trigger (T4).

Take Sweep

This triggers a single sweep. This function is enabled only if the HP 8350B is in the single sweep trigger mode and has the same effect as programming a single sweep trigger (T4").

Display Update ON/OFF

This selects whether or not the HP 8350B updates its numeric displays upon further programming of any parameter with a numeric value. The function reduces the amount of time involved in programming the HP 8350B numerically related parameters (ie. CW Frequency) and aids in producing faster stepped CW frequency sweeps. The default at power on and instrument preset is the display update on state. When in the display update off state, the HP 8350B numeric displays will be blanked.

FM Sensitivity (83500 Series plug-ins Only)

This selects the External FM Input sensitivity of −20 MHz per volt or −6 MHz per volt. This function is normally selected with an internal plug-in switch but can be overridden via the HP-IB. Note that the FM sensitivity is reset to the switch position after turning power on or if an Instrument Preset is executed. Thus the user should select the desired sensitivity after performing either of these actions.

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LIMITATIONS/CONCERNS

1. When using the micro learn string (both input and output), the HP 8350B must be in the CW mode and the plug-in CW Filter capacitor should be off.
2. You must exit the input micro learn string mode with the "M0" code only. The numeric displays will still be blanked until the appropriate functions are re-activated.
3. All learn string and micro learn string characters must be retained and re-input to the HP 8350B. If the HP 8350B does not receive the expected number of characters it will undergo an Instrument Preset.
4. The valid functions for the output interrogated parameter are: FA, CW, CF, DF, FB, VR, SHVR, M1, M2, M3, M4, M5, SHM1, SF, SM, ST, PL, PS, SL, and SP.
5. The request mask byte value is reset only when another value is programmed is unaffected by Instrument Preset.
6. The plug-in FM Sensitivity range is reset after an Instrument Preset to the value selected by the internal switch.
7. The output learn string, output micro learn string, output mode string, and output status functions send a data message consisting of a string of 8-bit binary bytes terminated using the bus END command (EOI and ATN true) with the last byte. The output interrogated parameter and output active functions send a data message consisting of a 14 character ASCII string representing the numeric value in exponential form terminated with a Carriage Return/Line Feed (CR/LF).

   Binary Syntax: [b***b] [EOI]

   Numeric Syntax: [+d.dddddE+dd] [CR] [LF]

   Where the character 'b' indicates an 8-bit binary byte and 'd' indicates a decimal digit (0 through 9). Note that the binary output format could have bytes that may be misinterpreted as Carriage Returns and/or Line Feeds so the user should defeat the ASCII CR/LF as valid character string terminators and rely on the byte count.

REMOTE FUNCTION PROCEDURE

Mode	Function	Input		8350B Output Response To Input	Notes
		Prefix	Data		
Display Update On/Off	DISPLAY UPDATE ON	DU1			
	DISPLAY UPDATE OFF	DU0			
FM Sensitivity	−20 MHz/V	F1			
	−6 MHz/V	F2			
Learn String	OUTPUT LEARN STRING	OL		90 bytes [EOI]	
	INPUT LEARN STRING	IL	90 bytes		

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REMOTE FUNCTION PROCEDURE (CONT'D)

Mode	Function	Input		8350B Output Response To Input	Notes
		Prefix	Data		
Micro Learn String	OUTPUT MICRO LEARN STRING	OX		8 bytes [EOI]	
	INPUT MICRO LEARN STRING	IX	8 bytes		
Mode String	OUTPUT MODE STRING	OM		8 bytes [EOI]	
Output Interrogated Parameter	OUTPUT PARAMETER	OP	(Function Prefix)	±d.dddddE±dd [CR/LF]	Valid Functions: FA,CW,CF,DF,FB, M1, M2, M3, M4, M5, VR, SHV4,SHM1, SS, ST, SM, PL, PS, SL, SP, SHFA, SHFB
	OUTPUT HARMONIC NUMBER	OH		dd [CR/LF]	
	OUTPUT SOFTWARE REVISION NUMBER (OUTPUT IDENTITY)	OI		08350B REV d, d [CR/LF]	
Output Active Parameter	OUTPUT ACTIVE	OA		±d.dddddE±dd [CR/LF]	
Status Bytes	OUTPUT STATUS	OS		3 bytes [EOI]	
	CLEAR STATUS	CS		Clears all 3 Status Bytes	
Request Status Bytes	REQUEST STATUS BYTE MASK	RM	1 byte		
	REQUEST EXTENDED STATUS BYTE MASK	RE	1 byte		
	REQUEST SECOND EXTENDED STATUS BYTE MASK	R2	1 byte		
Reset Sweep	RESET SWEEP	RS			
Take Sweep	TAKE SWEEP	TS			
Trigger	NETWORK ANALYZER TRIGGER (8410B)	NT			

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8350B MODE STRING DEFINITION

NOTE: In all bit number references mentioned below, bit 0 is the least significant bit and bit 7 is the most significant bit.

In bytes 1 and 2 the numeric value of the entie byte indicates function.

BYTE 1

Numeric Byte Value	Front Panel Key Codes
0-9	0-9
10	•
11	-
12	Backspace
13	Step Up
14	Step Down
15	Marker to CF
16	Permanent Marker Sweep
17	Instrument Preset
18	Single Sweep
19-64	(Reserved for future use)
65-254	Not Assigned
255	Any other key

BYTE 2

Numeric Byte Value	Active Function Code
1	Save
2	Recall
3	Alt
7	Power Level
8	Sweep Time
10	CW
11	CF
12	DF
13	Start
14	Stop
15	Marker 1
16	Marker 2
17	Marker 3
18	Marker 4
19	Marker 5
23	HP-IB Address
26	Manual frequency
27	Frequency Offset
28	Frequency Multiplier
29	RF Slope
32	Number of steps
35	ALC
36	Attenuator
43	Sweep Time Limit
60	Vernier
61	RF Offset
62	Step Size (frequency or power)
63	Hex Entry Address
64	Hex Entry Data
65	Key Test
66-255	Not assigned

Figure 3-3. HP-IB Only Functions (1 of 3)

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BYTE 3

Byte 3 is separated into 3 functional parts. Bits 0, 1, and 2 contain a number that represents the Active Marker. Bits 3, 4, and 5 contain a binary number that represents the last Active Marker. Bits 6 and 7 are not used.

Bits	Definition
0-2	Active Marker Binary number corresponds to marker number)
3-5	Last Active Marker (Binary number corresponds to marker number)
6, 7	Not used

BYTE 4

Each of the 8 bits that make up byte 4 independently represents the status of the frequency Markers and Marker Modes. A logic one in any bit indicates active function.

Bit	Definition
0	Marker Sweep
1	Marker 1
2	2
3	3
4	4
5	5
6	Counted Markers
7	Marker Delta Mode

BYTE 5

Byte 5 is separated into 3 functional parts. Bits 0 and 1 contain a binary number that indicates the Sweep Trigger mode. Bits 2, 3, and 4 contain a binary number that indicates the Sweep Source. Bits 5, 6, and 7 contain a binary number that indicates Sweep Mode.

Bits	Definition
0-1	Sweep Trigger 0 Internal Free Run 1 Line 2 External
2-4	Sweep Source 0 Continuous Analog Sweep ("Time") 1 Single Analog Sweep 2 Manual 3 External Sweep Input 4 Continuous Step Sweep 5 Single Step Sweep
5-7	Sweep Mode 0 Start/Stop 1 CF/DF 2 Swept CW 3 CW

Figure 3-3. HP-IB Only Functions (2 of 3)

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BYTE 6	
Each of the bits that make up byte 6 independently represents the status of the function listed. A logic one in any bit represents active function.	
Bits	**Definition**
0	Amplitude Markers
1	Display Blanking
2	RF Blanking
3	Sqr. Wave Mod.
4	Entry and RPG
5	Save Lock
6	Alt. Sweep Mode
7	Keyboard Shifted
BYTE 7	
Bits 0 and 1 of byte 7 contain a binary number that indicates ALC Leveling Mode. Bits 2, 3, 4, and 5 independently represent the status of the functions listed (a logic one in any one of these bits indicates active function). Bits 6 and 7 are not used.	
Bit(s)	**Definition/Function**
0-1	ALC Leveling Mode 0 Internal 1 External 2 Power Meter
2	CW Filter
3	RF Power Sweep
4	RF Power Slope
5	RF Power Output
6, 7	Not used
BYTE 8	
Each of the bits in byte 8 independently represents the status of the functions listed. A logic one in any bit indicates active function.	
Bit	**Definition**
0	Xtal Amplitude Markers
1	Xtal Intensity Markers
2	Phase Lock
3	Pulse Modulation
4	Frequency Modulation
5	Amplitude Modulation
6	YTM Peaking
7	Penlift at Bandcross

Figure 3-3. HP-IB Only Functions (3 of 3)

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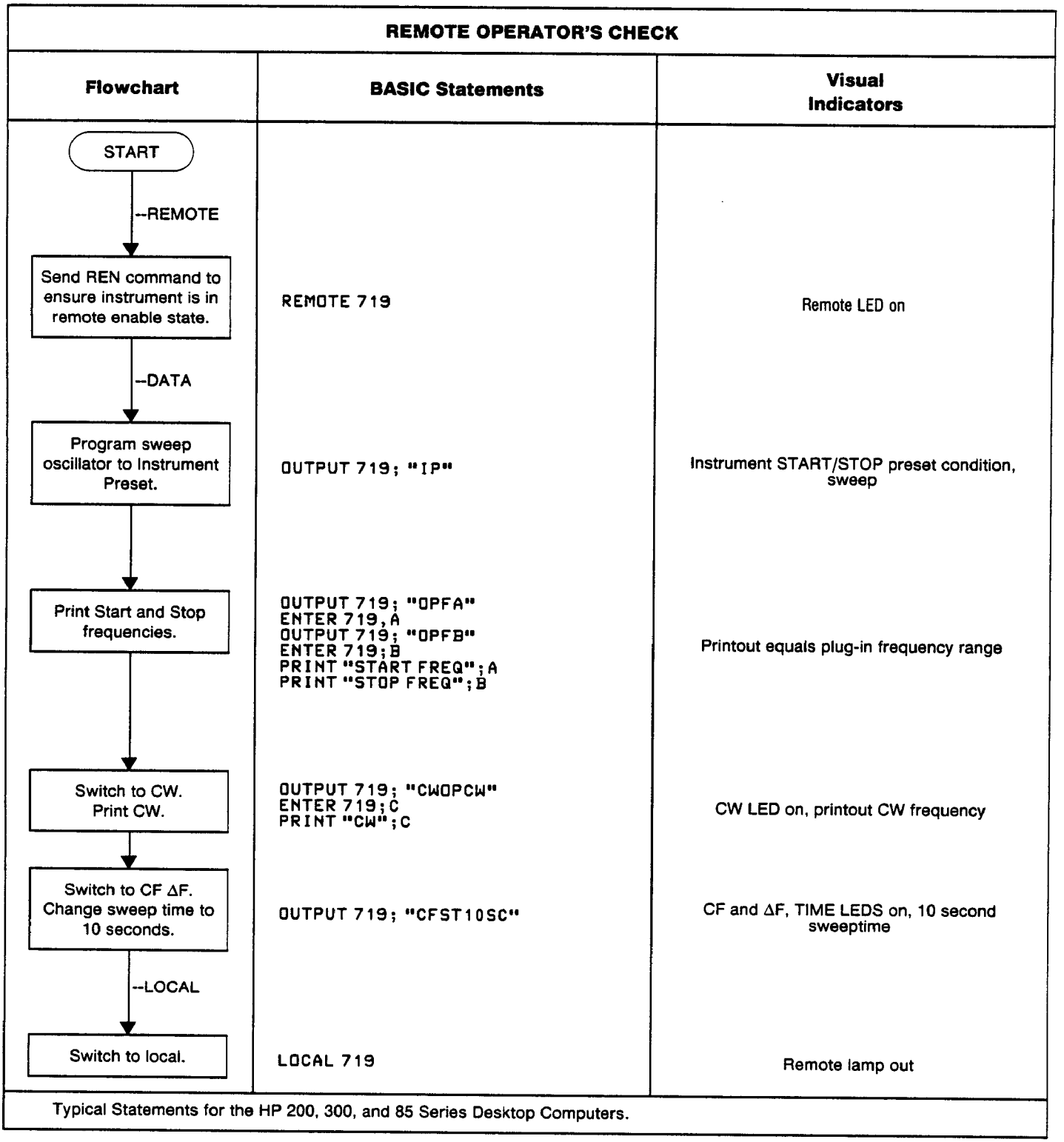


Figure 3-4. Remote Operator's Check

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Table 3-2. Sweep Oscillator Operating Characteristics

FREQUENCY RANGE	Set automatically when plug-in installed
SWEEP MODES	START-STOP CENTER FREQUENCY - ΔF Marker → Center frequency Marker Sweep CW Frequency
MARKERS	5 settable frequency markers amplitude and intensity
SWEEP TIME	Range .01 – 100 seconds
POWER	Control power level with 83500 Series Plug-ins

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Hewlett-Packard Interface Bus (HP-IB) Operation

The HP 8350B Sweep Oscillator can be operated remotely via the Hewlett-Packard Interface Bus (HP-IB). Bus compatibility, programming capability, and data formats are described in the following paragraphs. For complete information on specific program code syntax, functions, limits, etc., please see Functional Block Index Table 3-1.

All front panel functions except for the LINE switch are programmable through the HP-IB. Also provided are special HP-IB only functions to aid the programmer. Complete descriptions of all HP-IB programmable functions are contained within the functional blocks.

To verify that the sweep oscillator's HP-IB interface is functional, a quick check is provided in Figure 3-4, Remote Operators' Check. This tests that the HP 8350B can respond and send to the controller the fundamental HP-IB bus messages. The following information gives a general description of the HP-IB and defines the terms, concepts, and messages used in an HP-IB system.

For more information about the HP-IB, refer to any of the following documents:

IEEE Interface Standard 488-1975

ANSI Interface Standard MC1.1

"Improving Measurements in Engineering and Manufacturing" (HP Part No. 5952-0058)

"Condensed Description of the Hewlett-Packard Interface Bus" (HP Part No. 59401-90030)

General HP-IB Description

The HP-IB is a parallel bus of 16 active signal lines grouped into three sets according to function, to interconnect up to 15 instruments. Figure 3-5 is a diagram of the interface connections and bus structure. Table 3-3 defines the function of each signal line.

Table 3-3. The Bus Signals

Name	Mnemonic	Description
Data Input/Output	DIO1-8	The eight data lines for the byte of data.
Data Valid	DAV	Indicates the data lines have a valid byte of data.
Not Ready for Data	NRFD	Indicates that the listening devices are not ready to accept further data.
Not Data Accepted	NDAC	Indicates that the listening devices have not completely accepted the present byte of data.
Attention	ATN	Enables a device to interpret data on the bus as a controller command (command mode) or a data transfer (data mode).
Interface Clear	IFC	Initializes the HP-IB system to an idle state (no activity on the bus).
Service Request	SRQ	Alerts the controller to a need for communication.
Remote Enable	REN	Places instruments under remote program control.
End or Identify	EOI	Indicates last data transmission during a data transfer sequence; used with ATN to poll devices for their status.

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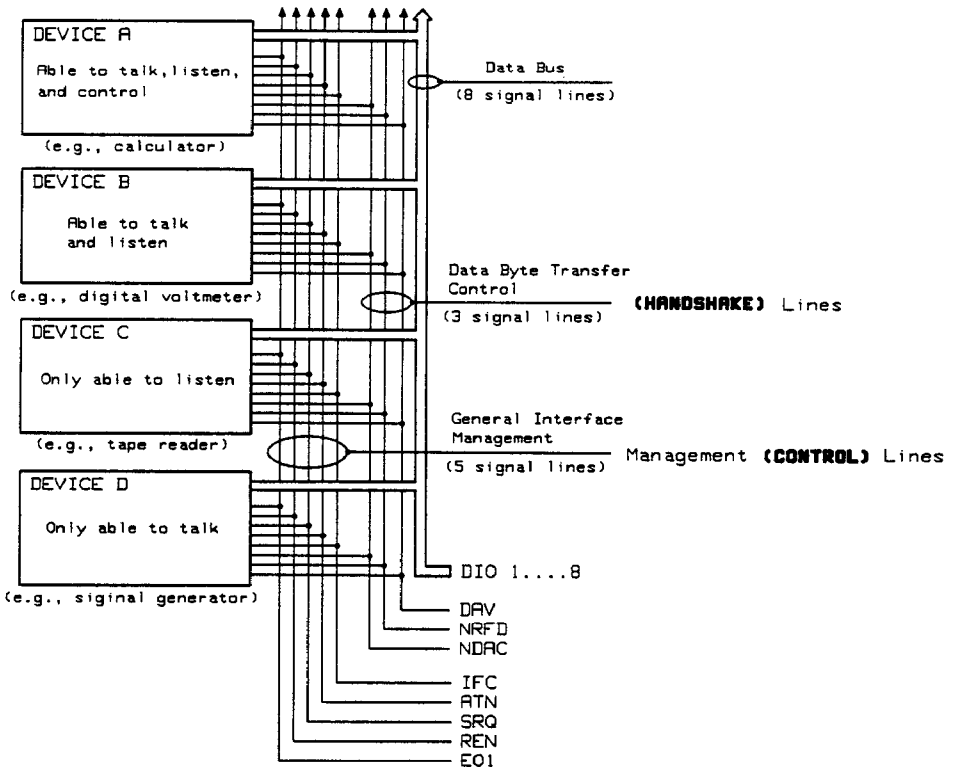


Figure 3-5. Interface Connections and Bus Structure

Eight signal lines form the first set and are termed "data" lines. The data lines carry coded messages which represent addresses, program data, measurements, and status bytes. The same data lines are used for input and output messages in bit-parallel, byte-serial form. Normally, a seven-bit ASCII code represents each piece (byte) of data, leaving the eighth bit available for parity checking.

Data transfer is controlled by means of an interlocked "handshake" technique which permits data transfer (asynchronously) at the rate of the slowest device participating in that particular conversation. The three data byte transfer control lines which implement the handshake (DAV, NRFD, NDAC) form the second set of lines.

The remaining five general interface management lines form the third set and are used in such ways as activating all the connected devices at once, clearing the interface, allowing a device to request service, etc.

Definition of HP-IB Terms and Concepts

The following list defines the terms and concepts that describe HP-IB system operations.

Byte: A unit of information consisting of 8 binary digits (bits).

Device: Any unit that is compatible with the IEEE Standard 488-1975.

Device Dependent: An action a device performs in response to information sent on the HP-IB. The action is characteristic of an individual devices' design and may vary from device to device.

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Addressing: The set of characters sent by a controller to specify which device will send information on the bus and which device(s) will receive that information. A device may also have its address fixed so that it may receive information (listen only) or send information (talk only).

Polling: The process by which a controller can identify a device that needs interaction with it. The controller may poll devices for their operational condition one at a time, which is termed a serial poll, or as groups of devices simultaneously, which is termed a parallel poll.

Basic Device Communication Capability

Devices which communicate along the interface bus fall into three basic categories.

Talkers: Devices which send information on the bus when they have been addressed.

Listeners: Devices which receive information sent on the bus when they have been addressed.

Controllers: Devices that can specify the talker and listener(s) for an information transfer. The controller can be an active controller or a system controller. The active controller is defined as the current controlling device on the bus. The system controller can take control of the bus even if it is not the active controller. Each system can have only one system controller, even if several controllers have system control capability.

HP-IB System Messages

The transfer of information via the HP-IB occurs from one device to one or more devices, consider the transfer of information via the HP-IB a message that can be transferred from one device or to more devices. There are twelve types of messages on the HP-IB. The following describes each of the HP-IB System Messages.

- **The Data Message:** The actual information which is sent from the talker to one or more listeners on the HP-IB. The information or data can be in a numeric or a string of characters.
- **The Trigger Message:** This causes the listening device(s) to perform a device-dependent action when addressed.
- **The Clear Message:** This causes either the listening device(s) or all of the devices on the bus to return to a predefined device-dependent state.
- **The Remote Message:** This causes the listening device(s) to switch from local front panel control to remote program control when addressed to listen. This message remains in effect so that devices subsequently addressed to listen will go into remote operation.
- **The Local Message:** This clears the remote message from listening device(s) and returns the device(s) to local front panel control.
- **The Local Lockout Message:** This prevents the user of a device from interferring with remote program control.
- **The Clear Lockout/Set Local Message:** This causes all devices on the bus to be removed from local lockout and revert to local. This message also clears the remote message for all devices on the bus.

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- **The Request Service Message:** A device can send this message at any time to signify that the device needs some type of interaction with a controller. The message is cleared by sending the device's Status Byte message if the device no longer needs service.

- **The Status Byte Message:** A byte that represents the status of a single device on the bus. Within this byte, the seventh most significant bit (bit 6 of bits 0 through 7) indicates whether the device has sent a Require Service message. The remaining bits indicate the present operational conditions defined by the device. This byte is sent from a talking device in response to a serial poll operation performed by a controller.

- **The Status Bit Message:** A byte that represents the operational conditions of a group of devices on the bus. Each device responds on a particular bit of the byte thus identifying a device-dependent condition. This bit is typically sent by devices in resonse to a parallel poll operation by a controller.

  This message can also be used by a controller to specify the particular bit and logic level that a device will respond with when a parallel poll operation is performed. Thus more than one device can respond on the same bit.

- **The Pass Control Message:** This transfers the bus management responsibilities from the active controller to another controller.

- **The Abort Message:** The system controller sends this message to unconditionally assume control of the bus. This message terminates all bus communications but does not implement the Clear message.

A summary of the twelve HP-IB messages, their related commands and mnemonics are provided in Table 3-4.

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Table 3-4. Twelve HP-IB Messages

HP-IB Message	Appli-cable	HP 8350B Response	Related Comments	Interface Function	Message Type	Sample Statements BASIC (200, 300, 85 series)
Data	Yes	Input data controls all front panel functions (except the Line switch) plus special HP-IB only functions. Output data includes information as to present instrument mode, values of selected functions, and the instrument status byte.		T6 L4 AH1 SH1	Input Data	`OUTPUT 719,"..."`
					Output Data	`ENTER 719;A,...`
Trigger	Yes	Responds by triggering a sweep if and only if in the single sweep trigger mode.	GET	DT1	System Trigger	`TRIGGER 7`
					Device Trigger	`TRIGGER 719`
Clear	Yes	Clears the instrument status byte and the extended status byte.	DCL SDC	DC1	System Clear	`RESET 7`
					Device Clear	`CLEAR 719`
Remote	Yes	Removes the 8350 from local front panel control to remote HP-IB control. All functions remain the same as in local and the keyboard is non-responsive except the LOCAL key.	REN	RL1	System Remote	`REMOTE 7`
					Device Remote	`REMOTE 719`
Local	Yes	Removes the HP 8350 from remote HP-IB control to local front panel control. All functions remain the same as in the remote state.	GTL	RL1	System Local	`LOCAL 7`
					Device Local	`LOCAL 719`
Local Lockout	Yes	Functions the same as the remote message except that the entire front panel is disabled including the LOCAL key.	LLO	RL1		`LOCAL` `LOCKOUT 7`
Clear Lockout/ Set Local	Yes	Removes the HP 8350 from local lockout and remote HP-IB control to local front panel control. All functions remain the same as in the remote state.	REN	RL1		`LOCAL 7`
Require Service	Yes	The HP 8350 can set the HP-IB SRQ (Service Request) line if one of the following instrument conditions exists and has been enabled by the Request Mask value. Testable conditions include: parameter value altered, syntax error, end of sweep, power failure, and RF unleveled.	SRQ	SR1		`STATUS 719; A IF BIT (A,6) = 1 THEN Srq`
Status Byte	Yes	Responds to a Serial Poll with one 8-byte with the seventh most significant bit (bit 6 of bits 0 through 7) set if the HP 8350A is Requesting Service. Bit 2 indicates a status change has occurred that can be detected only by analyzing the extended status byte which is accessible with the Output Status function only.	SPE SPD	T6		`STATUS 719; A or A = S POLL (719)`
Status Bit	No	The HP 8350 does not respond to a Parallel Poll	PP0			
Pass Control	No	The HP 8350 does not have the ability to take or pass control of the HP-IB	C0			
Abort	Yes	Responds by terminating all Listener or Talker functions	IFC	T6 L4		`ABORT TO 7`

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HP-IB Addressing

Certain messages require that a specific talker and listener be designated. Each instrument on the bus has its own distinctive listen and/or talk address which distinguishes it from other devices. Devices can be listen only, talk only, and both talker and listener.

Addressing usually takes the form of a "universal unlisten command, device talk address, device(s) listen address(es)". The universal unlisten command removes all listeners from the bus, thereby allowing only the listener(s) designated by the device(s) listen address(es) to receive information. The information is sent by the talker designated by the talk address. The system controller may designate itself as either talker or listener.

Table 3-5 lists all the possible talk and listen addresses on the bus. The device address is typically set via five binary bits which are the same for both listen and talk addresses, with the sixth and seventh bits used to determine when the address is listen (bits are 0,1) or talk (bits are 1,0). Some controllers distinguish between listen and talk automatically, requiring only the 5-bit code equivalent to designate a device.

HP 8350B HP-IB MESSAGE RESPONSES

The HP 8350B responds to the twelve bus messages as shown in Table 3-4.

HP 8350B HP-IB Compatibility

Table 3-5 lists the HP 8350B Sweep Oscillator's HP-IB capability, which is compatible with IEEE Standard 488-1975.

Compatible Universal and Addressed HP-IB Commands

The HP 8350B will respond to the following universal and addressed commands, which are sent in the command modes (ATN true).

Mnemonic	Command	ASCII Code
Universal:		
DCL	Device Clear	DC4
LLO	Local Lockout	DC1
MLA	My Listen Address	(selectable)
MTA	My Talk Address	(selectable)
SPD	Serial Poll Disable	EM
SPE	Serial Poll Enable	CAN
UNL	Unlisten	?
UNT	Untalk	–
Addressed:		
GET	Group Execute Trigger	BS
GTL	Go to Local	SOH
SDC	Selected Device Clear	EOT

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Remote Mode

Remote Capability. The HP 8350B communicates on the bus in both remote and local modes. In remote, its front panel controls are disabled except for the LINE switch and LOCAL key. The HP 8350B can be addressed to listen or talk. When addressed to listen, the HP 8350B will automatically stop talking and respond to the following bus messages: Data, Trigger, Clear, Remote, Local, Local Lockout, Clear Lockout/Set Local, and Abort. When addressed to talk, the HP 8350B will automatically stop listening and send one of the following messages: Data, Require Service, or Status Byte.

Displays. The REM light is on when the HP 8350B is in the remote mode. The ADRS'D light is on when the HP 8350B is currently addressed to talk or listen. All other displays function the same as in local front panel control.

Local-to-Remote Change. The HP 8350B switches to remote upon receipt of the two part Remote message. The two parts of the Remote message are:

Remote Enable (REN)
Addressed to Listen (MLA)

The sweep oscillator's output signal and all control settings remain unchanged with the local-to-remote transition.

Table 3-5. Possible HP-IB Addresses

ASCII Listen Address	Characters Talk Address	Address Code (Binary) 5 4 3 2 1	Equivalent Decimal Value
SP	@	0 0 0 0 0	00
!	A	0 0 0 0 1	01
"	B	0 0 0 1 0	02
#	C	0 0 0 1 1	03
$	D	0 0 1 0 0	04
%	E	0 0 1 0 1	05
&	F	0 0 1 1 0	06
'	G	0 0 1 1 1	07
(	H	0 1 0 0 0	08
)	I	0 1 0 0 1	09
*	J	0 1 0 1 0	10
+	K	0 1 0 1 1	11
,	L	0 1 1 0 0	12
-	M	0 1 1 0 1	13
.	N	0 1 1 1 0	14
/	O	0 1 1 1 1	15
0	P	1 0 0 0 0	16
1	Q	1 0 0 0 1	17
2	R	1 0 0 1 0	18
3	S	1 0 0 1 1	19
4	T	1 0 1 0 0	20
5	U	1 0 1 0 1	21
6	V	1 0 1 1 0	22
7	W	1 0 1 1 1	23
8	X	1 1 0 0 0	24
9	Y	1 1 0 0 1	25
:	Z	1 1 0 1 0	26
;	[	1 1 0 1 1	27
<	/	1 1 1 0 0	28
=	]	1 1 1 0 1	29
>	↑	1 1 1 1 0	30

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Table 3-6. HP 8350B Interface Functions

Code	Function
SH1	Source handshake capability
AH1	Acceptor handshake capability
T6	Basic talker; Serial Poll; Unaddress to talk if addressed to listen
L4	Basic listener; Unaddressed to listen if addressed to talk
SR1	Service Request capability
RL1	Remote; Local capability
PP0	No Parallel Poll capability
DC1	Device clear capability
DT1	Device trigger capability
C0	No controller capability
E1	Open collector bus drivers

Local Mode

Local Capability. In local, the HP 8350B can send a Require Service message, send a Status Byte, and respond to the Remote message.

NOTE: The HP 8350B can respond to all HP-IB messages except the Data Message while in local. However, most of these messages would not normally be used in the local mode.

Remote-to-Local Change. The HP 8350B returns to local control upon receipt of the Local or Clear Lockout/Set Local message. It can also be set to local by pressing the front panel LOCAL key (assuming that local lockout is not in effect). The sweep oscillator's output signal and all control settings remain unchanged with the remote-to-local transition.

Local Lockout. When a data transmission is interrupted, which can happen by returning the HP 8350B to local with the front panel LOCAL key, the data could be lost. This would leave the HP 8350B in an unknown state. To prevent this, a local lockout is recommended to disable the LOCAL key. Local lockout remains in effect until the HP 8350B is returned to the local state by either turning the LINE switch off/on or by programming the Local Message.

HP 8350B Address Assignment Information

The HP 8350B has a primary address only that is determined by an internal storage register. The register is initialized at the factory by utilizing the address bits A5 through A1 from switches located on the HP 8350B A8 HP-IB Assembly. Note that these switches are factory preset to decimal 19 (Listen address of "3", Talk address of "S"). The HP 8350B HP-IB address can be seen and changed from the front panel in local mode by pressing **[SHIFT] [LCL]**.

The decimal equivalent of the talk/listen address will be displayed in the FREQUENCY/TIME display. Refer to Table 3-5 for interpretation of the equivalent decimal value into separate talk and listen address characters. To change the address refer to function block labled "Instrument State" for further information.

Receiving The Data Message

The HP 8350B accepts program codes that contain information for programming all of the front panel and special HP-IB only functions (except the LINE switch). The HP 8350B will respond to the data message when in remote and addressed to listen.

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Input Syntax. The HP 8350B responds to program codes in a data message in the order in which they are received. Each function is programmed with a string of ASCII coded characters that follow one of the following sequences:

[Function Code] [Numeric Value] [Units terminator] [EOS]
[Function Code] [Numeric Value] [EOS]
[Function Code] [EOS]

Function Codes. Function codes are typically 2 to 4 character mnemonics. For functions that have a numeric value associated with it, passing the function code only will enable and activate the function for further data entry.

Numeric Value. These are either a single decimal digit, a set of 14 characters or less representing a number, or a string of binary bytes. If the numeric value is a single digit (0 through 9), it represents a storage register. A string of 14 characters maximum can be expressed in exponential, decimal, or integer form. Acceptible numeric formats are referenced in further sections by the following format syntax:

Exponential	±d***d.d***E±dd
Decimal	±d***d.d***d
Integer	±d***d
Single Digit	d
Double Digit	dd
Binary String	b*b
Binary Byte	b

Where the character 'd' indicates a leading or trailing zero, a space, or numeric digit (0 through 9), the characters '***' indicate a variable number of the previous characters. The character 'b' indicates an 8 bit binary byte. Numeric values that are not binary in nature are scaled by the appropriate units terminator.

Units Terminator. These are 2 character codes that terminate and scale the associated numeric value. Frequency values can be entered in GHz, MHz, kHz, or Hz. Sweep time values can be entered in Seconds or milliseconds. Power values can be entered in dBm or dB. If a units terminator is not passed, the HP 8350B assumes the numeric value is in the fundamental units of Hz or Seconds.

End Of String Message (EOS). This can be the ASCII character Line Feed (LF, decimal 10), the bus END command (EOI and ATN true), or another function code string.

NOTE: The HP-IB program code syntax typically mirrors that of the local front panel keystroke sequence.

Valid Characters. The alpha program codes can be either upper or lower case since the HP 8350B can accept either type. Spaces, unnecessary signs (+,-), leading zeroes, and carriage returns (CR) are ignored.

Program Codes. See Table 3-7 for the summary of input programming codes that are acceptible via the Data message.

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Sending The Data Message

The HP 8350B can send Data messages when in remote and addressed to talk. The available output modes are:

Learn String
Micro Learn String
Mode String
Interrogate Function
Active Function
Status

Each function is activated by the HP 8350B receiving a Data message with the appropriate function code (refer to Table 3-7). The Learn String, Micro Learn String, Mode String, and Status functions send a Data message consisting of a string of 8-bit binary bytes terminated using the bus END command (EOI and ATN true) with the last byte. The Interrogate and Active functions send a Data message consisting of a 14 character ASCII string representing the numeric value and terminated with a Carriage Return (CR)/Line Feed (LF).

Binary Syntax. [b***b] [EOI]

Numeric Syntax. [±d.dddddE±dd] [CR] [LF]

The character 'b' indicates an 8-bit binary byte and 'd' indicate a decimal digit (0 through 9). The characters '***' indicate a variable number of the previous characters. Note that the binary output format may include bytes that could be misinterpreted as the ASCII codes for Carriage Return or Line Feed commands. Therefore, avoid using a Carriage Return or Line Feed to terminate a binary string or byte. To terminate a binary string or byte use the bus END command (EOI and ATN true), or another function code string. EOI and ATN operate independently of the HP-IB Data lines and therefore cannot be confused with ASCII coding.

Receiving The Trigger Message

The HP 8350B responds to the Group Execute Trigger (GET) command to the HP-IB bus select code and a Selective Device Trigger to the HP 8350B HP-IB address. The effect of the GET command is to trigger the sweep if presently in the External Sweep Trigger mode only, otherwise no action is taken. The response is as if a data message consisting of the Single Sweep Trigger (T4) program code were transmitted.

Receiving The Clear Message

The HP 8350B responds to both Device Clear (DCL) and Selective Device Clear (SDC) by resetting all HP-IB handshake lines to the inactive state. The effect is to remove the HP 8350B from any talker or listener control functions. The HP 8350B responds by clearing the status byte and the extended status byte.

Receiving The Remote Message

The remote message causes the HP 8350B to switch to remote mode. It has two parts: 1) remote enable and 2) address-to-listen. The sweep oscillator's output and all other controls do not change with the local-to-remote transition.

The REM light turns on only when the HP 8350B is in remote mode and after receiving its first data message. The ADRS'D light turns on when the HP 8350B is addressed to talk or listen.

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Receiving The Local Message

The HP 8350B returns to front panel control when it receives the local message. Its output and all other controls do not change with the remote-to-local transition.

When the HP 8350B goes to local mode, the front panel REM indicator turns off. However, the ADRS'D indicator would still illuminate if the HP 8350B were addressed.

The local message is the means by which the controller sends the Go To Local (GTL) bus command. The front panel LCL key can also return the HP 8350B to local mode. However, pressing the LCL key might interrupt a Data message to the HP 8350B and this would leave the HP 8350B in a state unkown to the controller. This situation could be avoided by sending the local lockout message which disables the LCL key.

Receiving The Local Lockout Message

After receiving the local lockout message, the HP 8350B front panel LCL key is disabled in addition to all the other front panel keys. With local lockout in effect, the HP 8350B can be returned to local only by the controller or by turning the HP 8350B front panel LINE switch off/on.

Receiving The Clear Lockout/Set Local Message

The HP 8350B responds to the Clear Lockout/Set Local message in the same way as to the local message. Hence it returns to local front panel control. The HP 8350B need not be addressed to listen to receive this message.

Sending The Request Service Message

The HP 8350B sends a Request Service message (RQS) whenever one of the following conditions exist and if it has been preprogrammed to send the message by the Request Mask (RM) function:

Error in syntax
Parameter value modified to default value
Front panel entry complete
Hardware failure
End of sweep

The HP 8350B can send a require service message in either the local or remote mode. Further information pertaining to the instrument state can be obtained by conducting a serial poll or by executing the output status function, both of which access status byte information. The RQS state and the bus SRQ line are cleared only by executing a serial poll.

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Table 3-7. HP-IB Program Codes

Code	Description	Code	Description
AKm	Amplitude Marker On/Off	M4	Marker #4
ALmn	Alternate Sweep On/Off	M5	Marker #5
A1	Internal Leveling	SHM0	All Markers Off
A2	External Crystal Leveling	SHMO	All Markers Off
A3	External Power Meter Leveling	SHM1	Marker Delta
BK	Backspace	SHM2	Counter Interface Enable
CAm	Amplitude Crystal Marker On/Off (83522/83525 Only)	SHM3	Counter Interface Disable
		SHSP	Permanent Marker Sweep
CF	Center Frequency	NT	Network Analyzer Trigger (HP 8410B)
CLm	Intensity Crystal Marker On/Off (83522/83525 Only)	OA	Output Active Parameter
		OH	Output Harmonic Number
CS	Clear Status Bytes	OI	Output Software Revision Number
CW	CW Frequency	OL	Output Learn String
SHCF	Coarse CW Resolution	OM	Output Mode String
SHDF	Fine CW Resolution	OP	Output Interrogated Parameter
SHCW	Swept CW	OS	Output Status Bytes
C1	1 MHz Crystal Marker Frequency (83522/83525 Only)	OX	Output Micro Learn String
C2	10 MHz Crystal Marker Frequency (83522/83525 Only)	PL	Power Level
		PSm	Power Sweep On/Off
C3	50 MHz Crystal Marker Frequency (83522/83525 Only)	RCn	Recall Register
		RE	Extended Status Byte Mask
C4	External Crystal Marker Frequency (83522/83525 Only)	RFm	RF Power On/Off
		RM	Request Status Byte Mask
DB	dB	RPm	RF Blanking On/Off
DF	Delta F Frequency Span	RS	Reset Sweep
DM	dBm	R2	Second Extended Status Byte Mask
DN	Step Down/Decrement	SC	Seconds
DPm	Display Blanking On/Off	SF	Frequency Step Size
DUm	Display Update On/Off	SG	Single Sweep
E	Exponent Power Of 10	SH	Shift Function
FA	Start Frequency	SLm	Slope On/Off
FB	Stop Frequency	SM	Manual Sweep
Flm	CW Filter In/Out	SP	Power Step Size
F1	−20 MHz/V FM	SS	Step Size
F2	−6 MHz/V FM	SHSS	Default Step Size
GZ	GHz	ST	Sweep Time (Continuous Sweep)
HZ	Hz	SVn	Save Register
IL	Input Learn String	SHSV	Enable Save
IP	Instrument Preset	SHRC	Disable Save
IX	Input Micro Learn String	SX	External Sweep
KZ	KHz	S1	Sweep Time (Continuous Sweep)
MC	Marker To Center Frequency	TS	Take Sweep
MDm	Square-Wave Amplitude Modulation On/Off	T1	Internal Sweep Trigger
		T2	Line Sweep Trigger
MO	Marker Off	T3	External Sweep Trigger
MPm	Marker 1-2 Sweep On/Off	T4	Single Sweep
MZ	MHz	UP	Step Up/Increment
MS	Milliseconds	VR	CW Vernier
M0	Marker Off	SHVR	Offset
M1	Marker #1	SHFA	Frequency Display Multiplier
M2	Marker –2	SHFB	Frequency Display Offset
M3	Marker #3	0-9+−	Acceptable Numeric Data

NOTES

1. **Program codes of the form "XXm" use "m" to turn the function On or Off (1 or 0). For the storage register functions the "n" is 1 through 9.**
2. **The HP 8350B ignores spaces, plus signs, negative signs (except when valid) and any unexpected characters. Program codes can be upper or lower case alpha characters.**

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Sending The status byte Message

After receiving a Serial Poll Enable command (SPE) and when addressed to talk, the HP 8350B responds by sending its status byte message as indicated in Table 3-8. Two additional status bytes are available but must be accessed via the output status function. When the seventh most significant bit (bit 6, Request Service) of the status byte is true (one), an SRQ has occurred. See Service Request for the conditions causing a Service Request. Bit 2 indicates whether a change has occurred in the extended status byte. If Bit 2 is true, then the additional status bytes should be accessed via the output status function to determine the cause of the status change. All other bits indicate the present status of the noted function. The bits are true (one) if and only if the associated function/condition is true. To select an SRQ for a particular set of circumstances, the status byte can be masked with the request mask function. The mask for each byte is determined by summing the decimal values of each selected function/condition that is desired. The default request mask value is '00000000' or decimal 0. Also, SRQ generation due to conditions indicated in the first and second status bytes can be masked by using the RE and R2 functions. The default mask values are binary 11111111, or decimal 255. See Table 3-8 for decimal values of each status byte and extended status byte bits.

Table 3-8. Status Byte Information

STATUS BYTE (#1)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	N/A	REQUEST SERVICE (RQS)	SRQ on Syntax Error	SRQ on End of Sweep	N/A	SRQ on Change in Extended Status Byte	N/A	SRQ on Front Panel Key Pressed
EXTENDED STATUS BYTE (#2)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	Airflow Failure	*RF Unleveled	Power Failure/on	N/A	N/A	N/A	N/A	Self Test Failed
SECOND EXTENDED STATUS BYTE (#3)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	N/A	N/A	N/A	N/A	N/A	N/A	N/A	SRQ on Numeric Parameter Altered to Default Value

*** Bit/Functions not usable with 86200 Series Plug-ins and 11869A Adapter.**

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Sending The Status Bit Message

The HP 8350B does not respond to the Parallel Poll Enable (PPE) bus command and thus cannot send a status bit message.

Receiving the Pass Control Message

The HP 8350B does not have the ability to take or pass control thus it cannot respond to the pass control message.

Receiving the Abort Message

The HP 8350B responds to the abort message (IFC true) by stopping all talker or listener functions.

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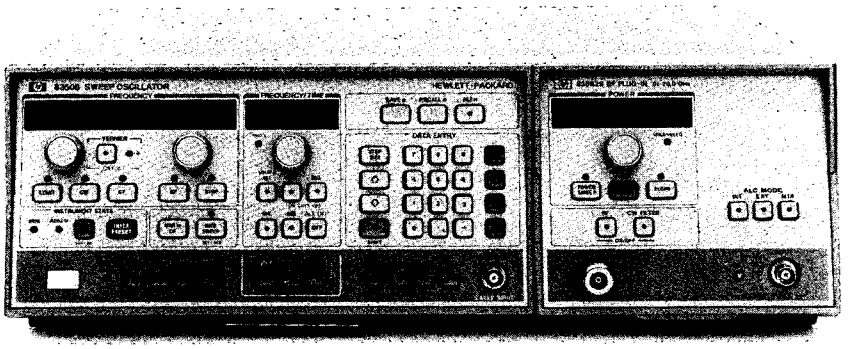
DESIGNED FOR HP-IB SYSTEMS

Programming Note

8350B/0000-2
Supersedes: None

AUGUST 1983

Quick Reference Guide
for the HP 8350B Sweep Oscillator



INTRODUCTION

This programming note is a reference guide for the remote operation of the HP 8350B Sweep Oscillator and HP 83500 Series Plug-ins. This note is intended for use by those familiar with HP-IB programming and the basic functions of the HP 8350B Sweep Oscillator. For complete programming information refer to the HP 8350B Operating and Service manual.

INPUT DATA

The 8350B Sweep Oscillator and 83500 Series Plug-ins accept programming codes that contain information for programming all of the front panel and special HP-IB only functions except the Line switch and Set HP-IB Address. The programming data string consists of a string of ASCII coded characters composed of one or more the following control fields:

- Sweep Mode/Limits
- Frequency Markers
- Sweep Trigger
- Modulation/Blanking
- Step Size
- Instrument State/Registers
- Power Level
- Power Control
- ALC Modes
- Crystal Markers (83522/83525 Plug-ins only)
- Special HP-IB Only Functions

Input Syntax

The 8350B responds to program codes in the order in which they are received. Each function is programmed with a string of ASCII coded characters that follow one of the following sequences.

- [Function Code] [Numeric Value] [Numeric terminator]
- [Function Code]

NOTE

The HP-IB program code sequence typically mirrors that of the local front panel keystroke sequence.

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Function Codes (Prefix Activate)

Function codes are typically 2 to 4 character mnemonics. For a function that has a numeric value associated with it, passing the function code only will enable and activate the function for further data entry.

Numeric Value (Numeric Format)

These are either a single decimal digit, a set of 14 characters or less representing a number, or a string of binary bytes. A string of 14 characters maximum can be expressed in exponential, decimal, or integer form. Acceptible numeric formats are referenced in later sections by the following format syntax:

Format #1:	Exponential	±d***d.d***dE±dd
Format #2:	Decimal	±d***d.d***d
Format #3:	Integer	±d***d
Format #4:	Single Digit	d
Format #5:	Double Digit	dd
Format #6:	Binary String	b***b
Format #7:	Binary Byte	b

The character 'd' indicates a leading or trailing zero, a space, or a numeric digit (0 through 9). The character 'b' indicates an 8-bit binary byte. The characters "***" indicate a variable number of the previous character. Numeric values that are not binary in nature are scaled by the appropriate numeric terminator.

Numeric Terminators

Numeric terminators are of 2 types, mnemonic and fundamental terminators. Mnemonic terminators are 2-character codes that terminate and scale the associated numeric value. Thus, frequency values can be entered in GHz (GZ), MHz (MZ), kHz (KZ), or Hz (HZ); sweep time values can be entered in seconds (SC) or milliseconds (MS) and power values can be entered in dB or dBm (DB or DM). Fundamental terminators consist of the ASCII characters Line Feed or Next Line (LF or NL, decimal 10), semicolon (';', decimal 59), or comma (',', decimal 44), and may be used in lieu of a mnemonic terminator. However, when this is done the 8350B assumes the numeric value is in the fundamental units of Hz, seconds, or dB, depending on the active function.

Valid Characters

The alpha program codes can be either upper or lower case since the 8350B will accept either type (they can be interchanged). Spaces, unnecessary signs (+,−), leading zeroes, and carriage returns (CR) are ignored. Characters containing a parity bit will have that bit cleared by the 8350B.

Programming Data

See Table 1 for Input Programming Codes.

NOTE

If using an 83500 Series Plug-in that has Option 002 (70 dB or 55 dB Step Attenuator), the lifetime of the Step Attenuator will be reduced if using the Alternate Sweep function that alternates between two power levels using different Step Attenuator settings. When using the Alternate Sweep function the Sweep time of the first sweep will be limited to a minimum of 1 second. Rapid power level programming between step attenuator settings can cause a similar problem.

Instrument Preset

Instrument Preset turns off all functions then sets the following:

- Sweep Mode: Start/Stop
  Start = minimum specified frequency
  Stop = maximum specified frequency
- Sweep Type: Timed, minimum sweep time
- Sweep Trigger: Internal
- Vernier/Offset: set to 0 MHz
- Markers: all values set to center of frequency span, all off
- Modulation/Blanking: Display Blanking on
- Frequency Step Size: set to default value (10% of span)
- Status Bytes: cleared
- Display Multiplier: set to 1
- Display Offset: set to 0 MHz

83500 Series Plug-ins:

- Power Level: maximum specified power (switch selectable to minimum power)
- Power Sweep/Slope: set to 0 dB
- RF/CW Filter: on/enabled
- FM Sensitivity: determined by internal switch
- Power Step Size: set to default value (1 dB)
- Crystal Markers: (If applicable) 50 MHz, off

Instrument Preset does not affect Storage Registers, HP-IB address, or Service Request Mask value.

OUTPUT DATA

The 8350B has several output modes that allow the user to learn and interrogate the present instrument state. The following output modes are available:

- Learn String
- Micro Learn String
- Mode String
- Interrogate Function
- Active Function
- Status

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The program codes and syntax to enable each function are shown in Table 1. The Learn String, Micro Learn String, Mode String, and Status functions send a Data message consisting of a string of 8-bit binary bytes. These messages are terminated by asserting the EOI signal in parallel with the last byte of the message to be sent. The Interrogate and Active functions send a Data message consisting of a 14 character ASCII string representing the numeric value in exponential form terminated with a Line Feed (LF).

Binary Syntax: [b***b] [EOI]

Numeric Syntax: [±d.ddddd E±dd] [LF] [EOI]

Where the character 'b' indicates an 8-bit binary byte and 'd' indicates a decimal digit (0 through 9). Note that the binary output format could have bytes that may be misinterpreted as Line Feeds so the user should defeat the ASCII LF as a valid character string terminator and rely on the byte count.

Learn String

Selected with the "OL" program code, the 8350B outputs a Learn String of 90 bytes in length. This binary data string completely describes the present instrument state (does not include the Storage Registers) of the 8350B and 83500 Series Plug-in. The information is packed and encoded for minimal storage requirements thereby making data analysis difficult. When stored in an ASCII character data string, the Learn String can later be input to the 8350B to restore that instrument state (See Table 1 for Input Learn String information). The length of the Learn String is fixed, independent of the functions selected and the Plug-in used.

Format: 90 [8 bit bytes] [EOI]

Micro Learn String

Selected with the "OX" program code, the 8350B outputs a Micro Learn String of 8 bytes in length. This binary data string completely describes the present CW frequency, Vernier, Sweep Output voltage, and Power Level of the 8350B and 83500 Series Plug-in. The information is packed and encoded for minimal storage requirements thereby making data analysis difficult. When stored in an ASCII character data string, the Micro Learn String can later be input to the 8350B to restore that instrument state for rapid frequency programming (See Table 1 for Input Micro Learn String information). Note the 8350B must be in CW mode and the CW Filter should be off when using this function. The length of the Micro Learn String is fixed, independent of the functions selected and the Plug-in used.

Format: 8 [8 bit bytes] [EOI]

Mode String

Selected with the "OM" program code, the 8350B outputs a Mode String of 8 bytes in length. This binary data string describes all presently active functions of the 8350B and 83500 Series Plug-in. The information passed includes only the active functions with no numeric values included. Use the Active or Interrogate Function if numeric values are desired. The length of the Mode String is fixed, independent of the functions selected and the Plug-in used.

Format: 8 [8 bit bytes] [EOI]

Interrogate Function

Selected with the "OP" program code and the program code for the function to be interrogated, the 8350B will output the present numeric value of the selected function. The units of the output data are Hz, dBm, dB, or sec., implied with the function selected.

Format: [±d.ddddd E±dd] [LF] [EOI]

Active Function

Selected with the "OA" program code, the 8350B will output the present numeric value of the presently active function (ie. enabled for modification from the keyboard or step keys). The units of the output data are Hz, dBm, dB, or sec., implied with the function selected.

Format: [±d.ddddd E±dd] [LF] [EOI]

Status

Selected with the "OS" program code, the 8350B will output 3 sequential bytes, 8 bits wide, giving the present instrument status. The first status byte is equivalent to the Status Byte of the Serial Poll, the second and third status bytes are the Extended Status Bytes which provide additional information. See Table 2 for a description of each Status Byte. Status Byte values are cleared upon execution of a Serial Poll (Status Byte message), Device Clear Message, Power On, and/or the "CS" (Clear Status Byte) program code.

TRIGGER

The 8350B responds to HP-IB Commands Group Execute Trigger (GET) and Selective Device Trigger (SDT) when it is in the SINGLE SWEEP mode. Receipt of either command causes the 8350B to start a sweep if the sweep had been previously reset; if not, the command is ignored. The Trigger commands are primarily used to begin a sweep when the 8350B is in SINGLE SWEEP mode.

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Table 1. Input Programming Codes (1 of 5)

MODE/ MODIFIERS	FUNCTION	PROGRAM CODE			NUMERIC VALUE		
		PREFIX ACTIVATE	NUMERIC FORMAT	SUFFIX	SCALE	RANGE	RESOLUTION
		SWEEP LIMITS/MODE					
Start/Stop Sweep	START	FA	1, 2, 3, 4	GZ	GHz	Plug-in Frequency Limits	Same as current ΔF Resolution
	STOP	FB					
Center Frequency /ΔF Sweep	CF	CF		MZ	MHz		.00038% of band (262,144 points across band)
	ΔF	DF					See Note 1
CW Frequency	CW	CW		KZ	kHz		.00038% of band (262,144 points across band)
	SWEPT CW	SHCW					
Frequency Offset	OFFSET	SHVR		HZ	Hz		
Frequency Vernier	VERNIER	VR				± .05% of band	
Display Offset	DISPLAY OFFSET	SHFB				0-999GHz	5 digits maximum
Display Multiplier	DISPLAY MULTIPLIER	SHFA	3			1-99	
Coarse CW Control Knob Resolution	COARSE CONTROL	SHCF				Plug-in Frequency Limits	.0015% of band (16,384 points across band)
Fine CW Control Knob Resolution	FINE CONTROL	SHDF					.00038% of band (262,144 points across band)
Note 1: ΔF Resolution: 0.1% of band (1024 points across band); 0.12% of band for 1/8 band or less (8192 points across band); 0.0015% of band for 1/64 band or less (16,384 points across band).							
		FREQUENCY MARKERS					
Turn On and Set Marker Frequency	MARKER 1	M1	1, 2, 3, 4	GZ	GHz	Plug-in Frequency Limits	0.4% of selected sweep width (256 points across sweep)
	MARKER 2	M2		MZ	MHz		
	MARKER 3	M3		KZ	kHz		
	MARKER 4	M4		HZ	Hz		
	MARKER 5	M5					
Turn Off A Frequency Marker	M1 OFF	M1		M0 or MØ			
	M2 OFF	M2					
	M3 OFF	M3					
	M4 OFF	M4					
	M5 OFF	M5					
Turn Off All Markers	ALL OFF	SHMØ					
Turn On and Set Mkr Δ	MKRΔ, Marker "m", Marker "n"	SHM1	Mm Mn			where: m, n: 1-5	

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Table 1. Input Programming Codes (2 of 5)

MODE/ MODIFIERS	FUNCTION	PROGRAM CODE			NUMERIC VALUE		
		PREFIX ACTIVATE	NUMERIC FORMAT	SUFFIX	SCALE	RANGE	RESOLUTION
FREQUENCY MARKERS (Cont'd)							
Turn Off Mkr Δ	MKRΔ OFF	MØ					
Active Marker to Center Frequency	MKR→ CF	MC					
Marker 1-2 Sweep	MARKER SWEEP ON	MP1					
	MARKER SWEEP OFF	MPØ					
Marker 1 to Start Marker 2 to Stop	M1 → ST M2 → SP	SHMP					
SWEEP TRIGGER TYPE							
Sweep Trigger Mode	INTERNAL	T1					
	LINE	T2					
	EXTERNAL	T3					
	SINGLE	T4					
Sweep Type	EXTERNAL SWEEP	SX					
	MANUAL SWEEP FREQUENCY	SM	1, 2, 3, 4	GZ	GHz	Present Start/ Stop Frequency	.1% of selected sweep width (980 points across sweep)
				MZ	MHz		
				KZ	kHz		
				HZ	Hz		
	SWEEP TIME	ST	1, 2, 3, 4	SC	sec.	See Plug-in Typically .01 to 100 sec.	.1% of Current Sweep time
				MS	10^{-3} sec.		
MODULATION/BLANKING							
Amplitude Frequency Markers	AMPTD MKR ON	AK1					
	AMPTD MKR OFF	AKØ					
Display Blanking	DISP BLANK ON	DP1					
	DISP BLANK OFF	DPØ					
RF Blanking	RF BLANK ON	RP1					
	RF BLANK OFF	RPØ					
Square Wave Modulation	⊔⊓ MOD ON	MD1					
	⊔⊓ MOD OFF	MDØ					
STEP FUNCTIONS							
Setting Frequency Step Size	FREQUENCY STEP SIZE	SF	1, 2, 3, 4	GZ	GHz	0 to 100% of Plug-in BW	Corresponds to Current Frequency Mode
				MZ	MHz		
				KZ	kHz		
				HZ	Hz		

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Table 1. Input Programming Codes (3 of 5)

MODE/ MODIFIERS	FUNCTION	PROGRAM CODE			NUMERIC VALUE		
		PREFIX ACTIVATE	NUMERIC FORMAT	SUFFIX	SCALE	RANGE	RESOLUTION
STEP FUNCTIONS (Cont'd)							
Setting Power Step Size[2]	POWER STEP SIZE	SP	1, 2, 3, 4	DB or DM	dB	See Plug-in	.006 dB
Resetting Step Sizes To Default Values[3]	DEFAULT STEP SIZES	SHSS					
Increment Active Parameter	STEP UP ↑	UP					
Decrement Active Parameter	STEP DOWN ↓	DN					
2. These codes/functions do not apply to 86200 Series Plug-ins. 3. Both frequency and power step size.							
INSTRUMENT STATE							
Instrument Preset	INSTR PRESET	IP					
Saving An Instrument State	SAVE n	SV	4		1	Registers 1 through 9	
Recalling An Instrument State	RECALL n	RC					
Lock Registers	SAVE LOCK	SHSV					
Unlock Registers	SAVE UNLOCK	SHRC					
Alternate Sweep Mode	ALT n ON	AL1	4		1	Registers 1 through 9	
	ALT n OFF	ALØ					
Undergo Self Test	SELF TEST #nn	SH	3		1	00-99	
SPECIAL HP-1B FUNCTIONS							
Status Bytes And Service Requests	OUTPUT STATUS BYTES	OS					
	SERVICE REQUEST MASK	RM	7			1 byte	
	REQUEST EXTENDED STATUS BYTE MASK	RE	7			1 byte	
	REQUEST SECOND EXTENDED STATUS BYTE MASK	R2	7			1 byte	
	CLEAR STATUS BYTES	CS					
Full Learn String	OUTPUT LEARN STRING	OL					
	INPUT LEARN STRING	IL	6			90 bytes	
Micro Learn String[4]	OUTPUT MICRO LEARN STRING	OX					
	INPUT MICRO LEARN STRING[5]	IX	6			8 bytes	
Active Mode String	OUTPUT MODE STRING	OM	6			8 bytes	
4. Must be in CW code, CW Filter off. 5. Exit this mode via "M0" code.							

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Table 1. Input Programming Codes (4 of 5)

MODE/ MODIFIERS	FUNCTION	PROGRAM CODE			NUMERIC VALUE		
		PREFIX ACTIVATE	NUMERIC FORMAT	SUFFIX	SCALE	RANGE	RESOLUTION
SPECIAL HP-1B FUNCTIONS (Cont'd)							
Output Active Parameter Value	OUTPUT ACTIVE VALUE	OA					
Output Interrogated Parameter Value	OUTPUT INTERROGATED VALUE	OP	Interrogated Parameter Code				
Current Harmonic Number	OUTPUT HARMONIC NUMBER	OH					
Mainframe and Plug-in Software Revision Number	OUTPUT SOFTWARE REVISION NUMBER (OUTPUT IDENTITY)	OI					
Numeric Display Update	DISPLAY UPDATE ON	DU1					
	DISPLAY UPDATE OFF	DUØ					
Single Sweep Start/Stop	RESET SWEEP	RS					
	TAKE SWEEP	TS					
Network Analyzer Trigger (8410B)	NETWORK TRIGGER	NT					
PLUG-IN POWER LEVEL[6]							
Set Output Power Level	POWER LEVEL	PL	1, 2, 3, 4	DB or DM	dBm	Plug-in Power Limits	.006 dB
Set ALC Power Level	ALC CONTROL	SHPS	1, 2, 3, 4	DB or DM	dBm	Plug-in Power Limits Without Using the Attenuator	.006 dB
Set Attenuator	ATTENUATOR CONTROL	SHSL	1, 2, 3, 4	DB or DM	dB	0-55 dB[7]	5 dB
						0-70 dB	10 dB
Power Sweep Mode	POWER SWEEP ON	PS1	1, 2, 3, 4	DB or DM	dB/Swp	See Plug-in	.1 dB/sweep
	POWER SWEEP OFF	PSØ					
Power Slope Mode	SLOPE ON	SL1	1, 2, 3, 4	DB or DM	dB/GHz	0-5 dB	.1 dB/GHz
	SLOPE OFF	SLØ					
6. These codes/functions do not apply to 86200 Series Plug-ins. 7. 83592C, 83594A and 83595A Plug-ins only.							
PLUG-IN ALC/SIGNAL CONTROL[8]							
ALC Leveling Modes	INTERNAL	A1					
	EXTERNAL (CRYSTAL)	A2					
	EXTERNAL POWER METER	A3					
8. These codes/functions do not apply to 86200 Series Plug-ins.							

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Table 1. Input Programming Codes (5 of 5)

MODE/ MODIFIERS	FUNCTION	PROGRAM CODE			NUMERIC VALUE		
		PREFIX ACTIVATE	NUMERIC FORMAT	SUFFIX	SCALE	RANGE	RESOLUTION
PLUG-IN ALC/SIGNAL CONTROL (Cont'd)[8]							
RF Power	RF ON	RF 1					
	RF OFF	RF Ø					
CW Filter	FILTER ON	FI 1					
	FILTER OFF	FI Ø					
8. These codes/functions do not apply to 86200 Series Plug-ins.							
PLUG-IN CRYSTAL MARKERS[9]							
Crystal Marker Frequency	1 MHz	C1					
	10 MHz	C2					
	50 MHz	C3					
	EXTERNAL INPUT	C4					
Amplitude Markers	AMPL MKR ON	CA 1					
	AMPL MKR OFF	CA Ø					
Intensity Markers	INTEN MKR ON	CI 1					
	INTEN MKR OFF	CI Ø					
9. These codes/functions do not apply to 86200 Series Plug-ins.							
PLUG-IN SPECIAL FUNCTIONS[10]							
FM Input Sensitivity	−20 MHz/V	F1					
	−6 MHz/V	F2					
Crossover Coupled FM[12]	Crossover Coupled	D1					
Direct Coupled FM[12]	Direct Coupled	D2					
Peak Output Power[11]	PEAK	SHPL					
10. These codes/functions do not apply to 86200 Series Plug-ins. 11. 83590 Series Plug-in Only. 12. Direct Coupled FM sensitivity is −20MHz/V only. Crossover Coupled FM sensitivity can be either −20 MHz/V or −6 MHz/V.							

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CLEAR

The 8350B responds to both Device Clear (DCL) and Selective Device Clear (SDC) by clearing all three status bytes and initializing the interface so that it is ready to receive HP-IB programming codes. This is necessary if the instrument state prior to sending HP-IB commands is unknown. It is good practice to execute DCL or SDC at the beginning of any program.

REMOTE/LOCAL CHANGES

The 8350B goes to the Remote state when the LREN line is true (low) and the 8350B receives its listen address. In Remote, all front panel functions are disabled except the LINE switch and the LOCAL key. The LOCAL function can also be disabled via the Local Lockout (LLO) command.

The 8350B goes to the Local state when it receives the Go To Local (GTL) command or when the LREN line is set false (high). If the Local Lockout (LLO) command has not been executed, the 8350B can also be set to Local by pressing the LOCAL key. In Local, the front panel is active but the instrument will still respond to HP-IB programming codes.

SERVICE REQUEST

The 8350B can initiate a Service Request (SRQ) whenever one of the following conditions exists:

- Error in syntax
- End of sweep
- Change in Extended Status Byte bit(s)
- Front panel key pressed

Further information can be obtained by conducting a Serial Poll or by executing the Output Status command, both of which access Status Byte information. The SRQ is cleared only by executing a Serial Poll. To select an SRQ for a particular set of circumstances, the Request Mask function can be used to determine which of the bits in the first Status Byte can cause an SRQ. The mask value is determined by summing the decimal values of each selected function/condition that is desired. The default Request Mask at power on is '00000000' or decimal 0. SRQ generation due to conditions indicated by the first and second Extended Status Bytes can be masked by using the "RE" and "R2" functions respectively, in conjunction with masking bit 2 of the first Status Byte. The "RE" and "R2" default mask values at power on are "11111111" or decimal 255. All mask values are reset to the default values only at power on or by execution of the DCL or SDC commands.

STATUS BYTE

The 8350B responds to a Serial Poll by sending its status byte as indicated in Table 2. The Extended Status Bytes are available but must be accessed via the Output Status command. When Bit 6 (Request Service) of the Status Byte is true (one), an SRQ has occurred. See **Service Request** for the conditions causing a Service request. Bit 2 indicates whether a change has ocurred in the Extended Status Bytes. If Bit 2 is true, then the extended status bytes should be accessed via the Output Status function to determine the cause of the status change. All other bits (5, 4, 0) indicate the present status of the noted function. The bits are true (one) only if the associated function/condition is true.

STATUS BIT

The 8350B does not respond to a Parallel Poll.

PASS CONTROL

The 8350B does not have the ability to take or pass control.

ABORT

The 8350B responds to the Abort message (Interface Clear - IFC true) by stopping all Listener or Talker functions.

ADDRESS ASSIGNMENT INFORMATION

The 8350B basic address is factory preset to decimal 19. In the Local mode, this address can be changed from the front panel by pressing the SHIFT and then the LOCAL keys. FREQUENCY TIME display will show the current address; a new one can be entered via the 8350B keyboard.

The new address will remain until changed by the operator because of the 8350B's non-volatile memory. However, should battery Power to the A3 Microprocessor be interrupted, the address will default to the HP-IB address switch setting. This switch is located on the 8350B A8 HP-IB Assembly.

INTERFACE FUNCTION CODES

AH1	Acceptor Handshake — full capability
T6	Basic Talker — Serial Poll capability
L4	Basic Listener — Unaddressed if MLA
SR1	Service Request — full capability
RL1	Remote Local — complete capability
PP0	Parallel Poll — no capability
DC1	Device Clear — full capability
DT1	Device Trigger — full capability
C0	Controller — no capability
SH1	Source Handshake — full capability
E1	Driver Electronics — open collector

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Table 2. 8350B Status Byte Descriptions

STATUS BYTE (#1)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	N/A	Request Service (RQS)	SRQ on Syntax Error	SRQ on End of Sweep	N/A	SRQ on Change in Extended Status Bytes	N/A	SRQ on Any Front Panel Key Pressed
EXTENDED STATUS BYTE (#2)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	Airflow Failure	*RF Unleveled	Power Failure/On	N/A	N/A	N/A	N/A	Self Test Failed
SECOND EXTENDED STATUS BYTE (#3)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	N/A	N/A	N/A	N/A	N/A	N/A	N/A	SRQ on Numeric Parameter Altered to Default Value

* Bit/Function not usable with 86200 Series Plug-ins and 11869A Adapter.

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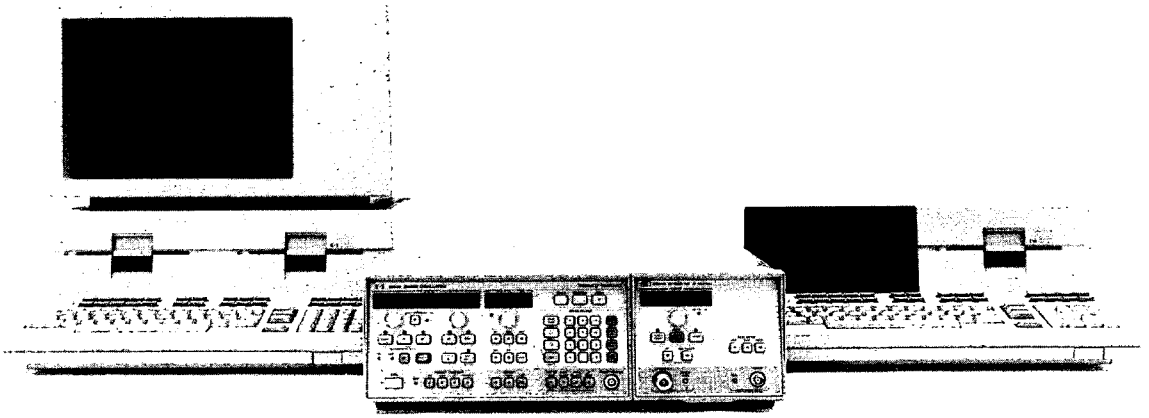
DESIGNED FOR HP-IB SYSTEMS

Programming Note

8350B/9816A/9826A/9836A-1
Supersedes: None

SEPTEMBER 1983

Introductory Operating Guide for the HP 8350B Sweep Oscillator with the HP 9816A, 9826A or 9836A Desktop Computer (BASIC)



INTRODUCTION

This programming note is a guide to the remote operation of the HP 8350B Sweep Oscillator. Included in this guide are the system connections for remote operation and sample programs that demonstrate the capabilities of the 8350B and provide a starting point to those who want to create programs tailored to their specific measurement needs.

The HP 8350B is a fully programmable sweeper compatible with the Hewlett Packard Interface Bus (HP-IB). A controller such as the HP 9816A, 9826A or 9836A (also known as Series 200 computers) allows complete control of the sweep mode, frequency limits, frequency markers, power level, and all other front panel controls.

The HP 9816A, 9826A and 9836A Desktop Computers are ideal instrument controllers based on a 16-bit microprocessor featuring multi-language capability, mini-disc mass storage, Alpha and Graphics mode Display, built-in standard HP-IB interface, and expandable memory and interfacing capability. This note demonstrates the HP-IB control of the 8350B via the enhanced BASIC 2.0 programming language system. For clarity, only the 9826A is referenced in the sample program explanations, although all the sample programs will run on the 9816A and the 9836A as well.

REFERENCE INFORMATION

For further information on the HP Interface Bus, the following should prove helpful:

Tutorial Description of the Hewlett-Packard Interface Bus (HP Lit. No. 5952-0156)

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Condensed Description of the Hewlett-Packard Interface Bus (HP Lit. No. 59401-90030)

Complete reference information on the 8350B Sweep Oscillator can be found in the 8350B Operating and Service Manual (HP Part No. 08350-90034), and the 8350B Quick Reference Guide (HP Part No. 5953-8866).

For information on operating the 9826A, the following references are available:

9826A Operating Manual (HP Part No. 09826-90000)

BASIC Language Reference (HP Part No. 09826-90055)

BASIC Programming Techniques (HP Part No. 09826-90010)

BASIC Interfacing Techniques (HP Part No. 09826-90020)

EQUIPMENT REQUIRED

To perform all the example programs as described in this programming note, you will need the following equipment and accessories:

HP 8350B Sweep Oscillator with:

Any HP 83500 Series Plug-in

NOTE

An HP 86200 Series Plug-in with the HP 11869A Adapter can be used but all references to power level and power control are not applicable.

HP 9826A Desktop Computer with:

98601A ROM-based BASIC 2.0 Language System.

98611A RAM-based BASIC 2.0 Language System.

For extended memory:

98256A 256 K Byte External RAM Memory Board

For hard copy output:

A Thermal Graphics Printer which is compatible with the HP 9826A such as the HP 2673A

Two HP-IB Cables (HP 10833A or HP 10631A)

NOTE

The following equipment is not required for the programs to function but rather for a visual display of the 8350B functions.

HP 8755S Frequency Response Test Set with:

HP 8755C Swept Amplitude Analyzer

HP 180TR or 182T Display Unit

HP 11664A or HP 11664B Detector

Two 1.2 meter BNC cables (HP 11170C variety)

NOTE

The HP 8755C may be replaced by the HP 8756A Scalar Network Analyzer or any appropriate Oscilloscope with Crystal/Schottky Detector, Attenuator, and BNC cabling. Refer to Appendix A for 8756A based system operation.

Any test device within the frequency range of the 8350B.

SETUP

Figure 1 shows the system connection. All that is required is to:

1. Connect the 24-pin HP-IB connector of the built-in HP-IB interface of the 9826A to the 8350B and the printer.

   Refer to O/S Manuals for more details on interconnects.

   CAUTION

   Do not attempt to mate black metric threaded screws on one connector with silver English threaded nuts on another connector, or vice versa, as damage may result. (A metric conversion kit which will convert one cable and one or two instruments to metric hardware is available by ordering HP Part No. 5060-0138.)

2. Following the instructions in the BASIC Operating Manual for the HP 9826A, load the BASIC language system, if required.

3. The HP-IB select code is assumed to be preset to 7. This programming note assumes the HP-IB address of the 2673A Graphics Printer is 01.

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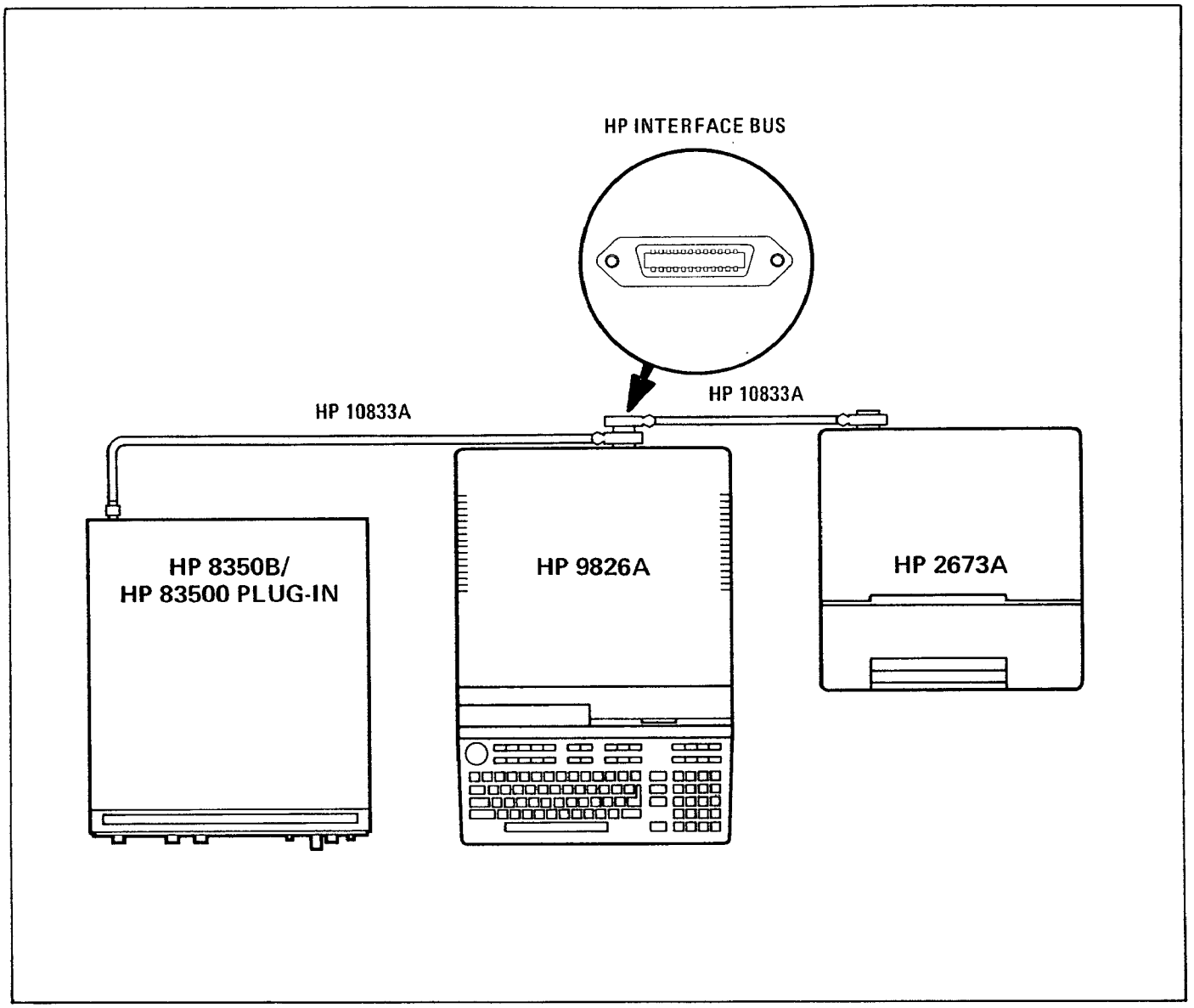


Figure 1. System Connection

4. All programs within this guide expect the 8350B HP-IB address to be decimal 19. The 8350B HP-IB address is factory preset to decimal 19.

   To find the present HP-IB address use the front panel "Set HP-IB Address" function by pressing:

   [SHIFT] [LCL]

   The FREQUENCY/TIME display will indicate the present decimal address. If the number displayed is not 19, it may be reset to 19 by pressing:

   [1] [9] [GHz]

   The non volatile memory of the HP 8350B will maintain this HP-IB address until another address is entered.

CHECK OUT

If your computer has a RAM-based operating system and power has been turned off, then follow instructions to reload the system. When the message "BASIC Ready 2.0" reappears, turn on the rest of the equipment.

The 8350B should undergo a turn-on self test consisting of the red LED numeric displays being blanked and all yellow indicator LED's on. Then the 8350B sweep controls are set to its last state before the power was turned off. If the 8350B fails

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the power-up self test an error message will be displayed in the far left LED display. Check section 8 of the 8350B Operating and Service Manual for error message explanations and diagnostics.

To verify that the HP-IB connections and interface are functional:

1. Press **[SHIFT] [PAUSE]** to reset the 9826A.

2. Type in **SCRATCH [EXECUTE]** to clear any previous programs in memory.

3. Press **[EDIT] [EXECUTE]** then type in the following program:

```
10    !HP-IB TEST
20    So=719
30    ABORT 7
40    CLEAR So
50    PRINT "9826 IS ACTIVE CONTROLLER"
60    REMOTE So
70    PRINT "8350 IS IN REMOTE MODE"
80    END
```

When several instruments are connected to the HP Interface Bus, an **ABORT** command abruptly terminates all bus activity and resets all devices on the bus to turn-on states and the 9826A recovers the active control of the bus. The **CLEAR** command sets all (or only selected) instruments to a predefined device-dependent state. The **REMOTE** command is used to put all (or selected) instruments into the remote mode.

Run the program and verify that the REMote light is lit on the 8350B. If it is not, verify that the 8350B address is set to 19 and the interface cable is properly connected.

If the 9826A display indicates an error message, it is possible the program was entered incorrectly. If the 9826A accepts the REMOTE statement but the 8350B REMote light does not turn on, perform the operational checks as outlined in the respective Operating and Service Manuals to find the defective device.

All the 8350B functions available through the front panel keys are programmable via HP-IB. When the 8350B is in REMOTE mode, all the front panel keys are disabled except the LOCAL key. But, when the **LOCAL LOCKOUT** command is set on the bus, even the LOCAL key is disabled. The **LOCAL** command, executed from the 9826A, is then the only way to return all (or selected) instruments to front panel control.

Press **[EDIT] [EXECUTE]** then continue the above program and type in the following commands:

```
80    PAUSE
90    REMOTE So
100   LOCAL LOCKOUT 7
110   PRINT "LOCAL LOCKOUT MODE"
120   PAUSE
130   LOCAL 7
140   PRINT "RETURN TO LOCAL"
150   PAUSE
160   REMOTE 7
170   OUTPUT So;"IP"
180   PRINT "INSTRUMENT PRESET COMPLETED"
190   END
```

To verify and investigate the different remote modes do the following:

1. Press **[SHIFT] [PAUSE]** to reset the 9826A.

2. Press **[INSTR] [PRESET]** on the 8350B.

3. Press **[SHIFT] [CLR] [LN]** and **[RUN]** on the 9826A.

4. With the 9826A displaying the "ACTIVE CONTROLLER" and "REMOTE" messages, verify that the 8350B REMote light is lit. From the front panel, attempt to change the start frequency and verify that this is impossible. Verify that the INSTR PRESET key and all other keys except LOCAL are disabled. Now press the **[LCL]** key and verify that the 8350B REMote light is off and that you can modify any of the 8350B functions.

5. Press **[CONTINUE]** on the 9826A. With the 9826A displaying "LOCAL LOCKOUT MODE" verify that the 8350B REMote light is again lit. Again attempt to change the start frequency and perform an instrument preset. Verify that this is impossible. Now press the 8350B **[LCL]** key and verify that still no action is taken.

6. Press **[CONTINUE]** on the 9826A. With the 9826A displaying "RETURN TO LOCAL", verify that the 8350B REMote light is off. Also verify that all sweep functions now can be modified via the front panel controls.

7. Press **[CONTINUE]** on the 9826A. Verify that the 8350B has undergone an Instrument Preset and the REMote light is on. The Output **(OUTPUT719)** statement does two things: one, it performs a **REMOTE 719**, and second, it passes instructions to the 8350B.

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Note that the 8350B LCL key produces the same result as programming **LOCAL 719** or **LOCAL 7**. Be careful as the LOCAL 7 command places all instruments on the HP-IB in the local state as opposed to just the 8350B alone. **REMOTE 7** places all instruments on the HP-IB under remote control again.

PROGRAMMING EXAMPLES

The following sample programs show the various ways of controlling the 8350B. In remote control situations the 8350B Sweep Oscillator interacts with the system HP-IB controller in two basic ways:

1. "Listen Mode": The 8350B listens to the control commands instructing it to modify the present instrument state. This commands the 8350B to do a specific event just like setting a front panel function.

2. "Talk Mode": The 8350B informs the controller of the present instrument state with a numeric value or a string of characters. This allows the user to interrogate or learn any 8350B function.

Each programming example is structured using the following format:

1. A general description of the functions exercised.

2. The program listing.

3. Instructions for operating the system and an explanation of the program.

As stated earlier, refer to Appendix A for 8756A based system operation.

EXAMPLE PROGRAM 1: Setting Up a Typical Sweep

In a swept operation, the sweeper is programmed for the proper sweep frequency range, sweep time, power level, and marker frequencies for a test measurement. This program sets up the 8350B for a general purpose situation using several dedicated format and image statements.

To program a function on the 8350B, the controller must pass specific program codes and data to the instrument. The statement that allows this is the **OUTPUT** statement. The alphanumeric data string of the output statement can be a concatenation of character strings and/or variables. The data can be specific codes, free field formatted data, or reference a specific **IMAGE** statement. For example, to program the Start Frequency (**FA**), one program code sequence is **FA**, followed by the frequency in GHz, then **GZ**. If the frequency is to be 2.345 GHz, then the string "**FA2.345GZ**" will suffice. However, if the frequency was not fixed then a variable F could indicate the frequency in GHz and the program string could be "**FA**"; **F**; "**GZ**". Finally, using an image statement will allow a specific number of digits to be passed, thereby avoiding any unexpected round off errors.

PROGRAM 1

```
10    !SETTING UP A SWEEP
20    So=719
30    PRINT CHR$(12)
40    OUTPUT So;"IP MD1 FA2.345GZ FB6.789GZ"
50    PRINT "START FREQUENCY : 2.345 GHz"
60    PRINT "STOP  FREQUENCY : 6.789 GHz"
70    DISP "ENTER SWEEP TIME in msec";
80    INPUT T
90    OUTPUT So;"ST";T;"MS"
100   PRINT "SWEEP  TIME : ";T;" msec"
110   IMAGE "PL",SDD,"DB"
120   DISP "ENTER POWER LEVEL in dBm";
130   INPUT P
140   PRINT "POWER LEVEL : ";P;" dBm"
150   OUTPUT So USING 110;P
160   PAUSE
170   IMAGE "M1",K,"GZ"
180   OUTPUT So USING 170;3.40
190   PRINT "MARKER No.1 : 3.40 GHz"
200   PAUSE
210   OUTPUT So;"M24560E6"
220   PRINT "MARKER No.2 : 4.56 GHz"
230   PRINT "SETTING COMPLETED"
240   END
```

PROGRAM 1 EXPLANATION AND OPERATION

The equipment set-up is the same as in the check-out description. Reset the HP 9826A, scratch its memory and enter the above program. Then perform the following:

1. Run the program and observe that the 9826A CRT display is cleared (line 30) by printing a Form Feed. Then the 8350B is set to START/STOP Frequency mode. This first programming sequence is the most common format used to program the 8350B: "**FA2.345GZFB6.789GZ**" is sent on the same line after the **OUTPUT So** command. Then the values of Start and Stop frequencies are printed on the CRT display (lines 40 to 60).

2. When a parameter is subject to change, the value is entered from the controller keyboard into a variable. In this example, the sweep time is entered in milliseconds into the variable T. Then, the Sweep Time is programmed using the following format: "**ST**"; **T**; "**MS**" and the value of the Sweep Time is printed on the CRT display (lines 70 to 100).

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3. When a parameter is to be entered in a specific format, an image statement is used to select the number of digits and sign to be passed. The free format to program POWER LEVEL on the HP 8350B allows two digits after the decimal point. In this example, the **IMAGE** statement changes this format, suppressing the two digits after the decimal point. The S causes the output of a leading plus or minus sign. The two D's cause the two digits of the value to be output. The value entered by the user is displayed on the CRT, then rounded by the 9826A to the nearest 1 dB resolution, and then sent to the 8350B. The value printed can be compared to the value in the 8350B POWER display (lines 110 to 160).

   To enter another Power Level, type in **CONT 110** then EXECUTE and enter the new value of POWER LEVEL.

4. Press **[CONTINUE]** and Marker 1 is set to a fixed value using an **IMAGE** Statement (lines 170 to 200). Press **[CONTINUE]** again and Marker 2 is set to 4560 MHz using a full data format: the value of the frequency is sent in Hz and it is not necessary to terminate the programming sequence with a units terminator. The default terminator in this case is Hertz. Then the Marker 1 and 2 values are displayed on the CRT (lines 210 to 240).

   When a typical sweep like the above example is set up, the complete front panel state may be saved for later use in non-volatile memories called Registers 1 through 9. This can be done remotely as a part of the above program by pressing **[EDIT] [EXECUTE]** on 9826A, and adding the following lines:

```
240   PAUSE
250   OUTPUT So;"SV1"
260   OUTPUT So;"IP"
270   PRINT "SETTING STORED IN REGISTER 1"
280   PAUSE
290   OUTPUT So;"SHSV"
300   LOCAL So
310   PRINT "SAVE REGISTERS LOCKED"
320   PAUSE
330   OUTPUT So;"RC1"
340   PRINT "RECALL REGISTER 1"
350   PAUSE
360   OUTPUT So;"SHRC"
370   LOCAL So
380   PRINT "SAVE/RECALL REGISTERS UNLOCKED"
390   END
```

   Then press **[RUN]** and enter new values for the typical sweep. When "SETTING COMPLETED" is displayed, press **[CONTINUE]**. The 9826A will save in Register 1 the previous sweep and then put the 8350B in the Instrument Preset State (lines 250 to 280).

   Press **[CONTINUE]** and all the registers will be locked. Attempt to store a new setting in any register (e.g. SAVE 1) and verify that an error message **E030** is displayed. Once the registers are in lock mode, the Instrument Preset command or ON/OFF function will not affect the contents of the registers (lines 290 to 320).

   Press **[CONTINUE]** and verify that the 8350B has returned to its original setting stored in Register 1 (lines 330 to 350).

   Press **[CONTINUE]** again on the 9826A. Verify that the lock has been removed from all the registers by attempting to store a new setting (lines 360 to 390).

EXAMPLE PROGRAM 2: A Stepped CW Sweep

Many automatic measurement systems make measurements at a sequence of CW test frequencies instead of digitizing an analog sweep. A stepped CW Sweep can be accomplished in several ways with the 8350B:

1. Program sequential CW frequencies.
2. Program the frequency sweep range then enable the manual sweep mode. Perform a stepped manual sweep by repetitively programming the step up function.
3. Program the Swept CW frequency to the start frequency, the Step Size to an appropriate value, then repetitively program the step up function.

Considering the speed of programming the above approaches, methods 2 and 3 are most efficient time wise. This program illustrates a stepped sweep using these approaches.

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PROGRAM 2

```
10    !STEPPED CW
20    INTEGER D
30    So=719
40    PRINT CHR$(12)
50    OUTPUT So;"IP MD1"
60    DISP "ENTER START FREQUENCY in GHz";
70    INPUT A
80    DISP "ENTER STOP  FREQUENCY in GHz";
90    INPUT B
100   IF A>B THEN GOTO 60
110   DISP "ENTER STEP SIZE in GHz";
120   INPUT S
130   IF S>B-A THEN 100
140   D=(B-A)/S
150   PRINT "THE 8350B IS STEPPED SWEEPING...."
160   PRINT "....PRESS PAUSE TO STOP THE SWEEP"
170   OUTPUT So;"SS";S;"GZ CW";A;"GZ"
180   FOR I=1 TO D
190   OUTPUT So;"UP";
200   NEXT I
210   GOTO 170
220   END
```

PROGRAM 2 EXPLANATION

Lines

10-20: Assign variable D to be an integer.

30-50: Enter the 8350B address into **So** and clear the 9826A CRT display. Set the 8350B to a predefined instrument state, with the square wave modulation enabled.

60-100: Enter the Start frequency into variable A and the Stop frequency into variable B. if A>B other values must be entered.

110-130: Enter the Frequency Step Size into variable S and compare it to the full sweep. If S>B-A, enter another step value.

140: Calculate the number of steps and assign the value to integer D.

150-170: Program the frequency step size and set the CW frequency to the start value. Display the information for the user on the Controller's CRT.

180-210: Increment the 8350B frequency from start to stop frequency. When the stop fre-quency is reached, program the 8350B back to the start frequency and begin the cycle again.

Set up the equipment as shown in Figure 2 by adding the 8755C, the 180TR or 182T, the 11664B, and a test device like a 4 to 6 GHz Bandpass Filter. It is important that the two rear panel connections from the 8350B to the 8755C/ 182T are made and the square wave modulation is enabled for a proper CRT display. For the example measurement set the following front panel controls:

On the 8755C:

Channel 1:
Display ..... OFF
(press all the display push buttons so that they are all out)
Channel 2:
Dilsplay..... B
db/DIV..... 10 dB
Reference Level..... −10 dB
Ref. Level Vernier ..... OFF

On the 182T or 180TR:

Magnifier XI
Display ..... INT

Reset the 9826A, scratch the 9826A memory and type in the above program. Then perform the following:

1. Run the program and enter the start frequency. Then press **[CONTINUE]**, enter the stop frequency, then press **[CONTINUE]** again.

2. Enter the frequency step size and press **[CONTINUE]**.

The 8350B is now being stepped in frequency between the start and stop frequencies.

The sweep may not cover the full screen; however, this is normal. In CW mode, the 8350B delivers on the sweep output connector a voltage proportional to the frequency value. Thus, if the frequency is at the low end of the RF plug-in's range, the trace will be at the very left of the analyzer CRT and if the frequency is at the high end of the plug-in's range, the trace will be at the very right of the analyzer CRT.

To obtain a full screen sweep on the CRT, the 8350B must be set in Manual Sweep and Start/ Stop Frequency modes. The program can be modified to do this by typing in the following lines:

NOTE

The previous program is only modified from line 170 and beyond.

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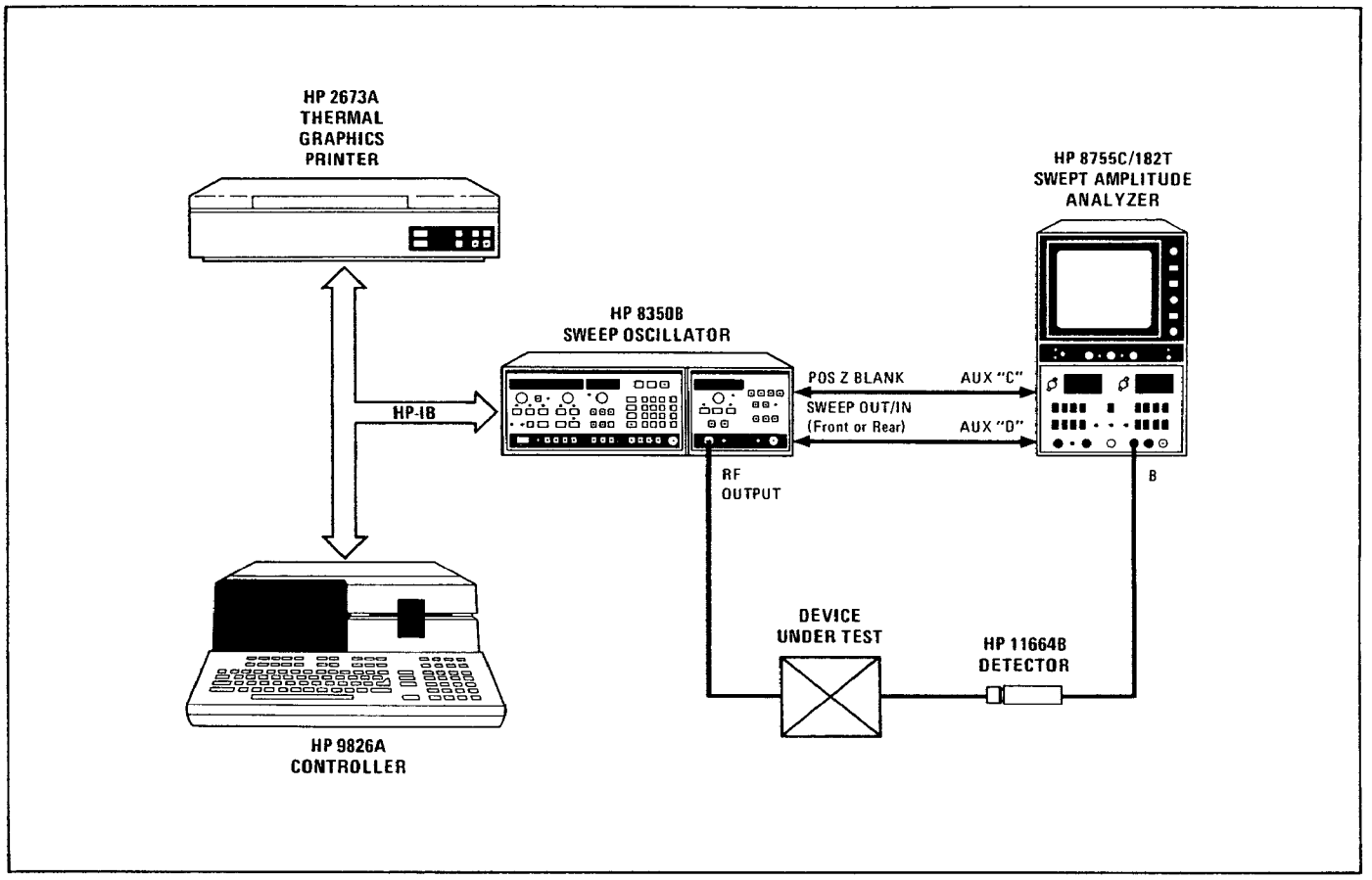


Figure 2. Equipment Setup

PROGRAM 2 (continued)

```
170   OUTPUT So;"SS";S;"GZ FA";A;"GZ FB";B;"GZ"
180   OUTPUT So;"SM";A;"GZ"
190   FOR I=1 TO D
200   OUTPUT So;"UP";
210   NEXT I
220   GOTO 180
230   END
```

Lines

170: Program the frequency step size and set the Start and Stop frequencies.

180: Place the 8350B in Manual Sweep mode and set to the start frequency.

190-220: Increment the 8350B frequency with the **UP** function. When the Stop frequency is reached, program the 8350B back to the start frequency and begin the cycle again.

RUN the modified program and note the sweep is now occupying the full screen on the analyzer's CRT.

EXAMPLE PROGRAM 3: Learning An Instrument State

Being able to save a specific instrument state is helpful when it is needed several times in a test or measurement procedure. The user could save the instrument state by manually logging the important sweep parameters (such as frequency range, power level, ALC modes, etc.) then setting them again at the appropriate time. A somewhat simpler approach is to save the instrument state in one of the 8350B internal storage registers, then recall it when needed. (See example program 1). Another solution is to use the Output Learn String function of the 8350B so that the 9826A can learn and then store a data string that describes the present instrument state on a disk or in its internal memory. Once an instrument state is stored or learned, the 8350B can then be restored to that state using the Input Learn String function. The power of these instrument Learn String functions is demonstrated by the following program.

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PROGRAM 3*

```
10    !LEARN STRING
20    So=719
30    PRINT CHR$(12)
40    OPTION BASE 1
50    DIM A$[100]
60    OUTPUT So;"IP MD1"
70    LOCAL So
80    PRINT "CHANGE FRONT PANEL SETTING"
90    PAUSE
100   BEEP 1000,.1
110   OUTPUT So;"OL"
120   ENTER So USING "#,90A";A$
130   LOCAL So
140   PRINT "CHANGE FRONT PANEL SETTING AGAIN..."
150   PAUSE
160   BEEP 2000,.1
170   OUTPUT So;"IL"&A$
180   PRINT "ORIGINAL SETTING HAS BEEN RESTORED"
190   END
```

PROGRAM 3 EXPLANATION:

Lines

10-30: Assign **So** to the 8350B address and clear the 9826A CRT.

40: Define the first element of any array to be at index number 1.

50: Set the length of the A$ string to 100 characters.

60-90: Set the 8350B to a predefined state via instrument present and enable the square wave modulation.

Return the 8350B to local control and ask the user to change the instrument setting. Wait for the user to press **[CONTINUE]**.

100-110: Send an audible beep and program the 8350B to output the current instrument settings (the learn string) into the 9826A.

120: Read the 90 character learn string into A$ ignoring the line feed on the string terminator.

130-150: Return the 8350B to local control and ask the user to again change the 8350B front panel state.

160-180: Send an audible beep, and input the learn string to the 8350B causing it to return to the state set by the user during lines 60-90 of the program.

Set up the equipment as in example 2 using the analyzer's CRT display to verify the sweep settings.

Reset the 9826A, scratch the 9826A memory, then type in the above program. Then run the program. The 8350B will undergo an instrument preset, enable the square wave modulation, then return to local front panel control. Perform the following:

1. Adjust the 8350B to a preferred instrument state, then press **[CONTINUE]** on the 9826A.
2. Turn the 8350B off, or press **[INSTR] [PRE-SET]**, or change the instrument settings in any way desired.
3. Press **[CONTINUE]** on the 9826A. Verify on the analyzer's CRT display and/or the 8350B front panel that the original instrument state has been restored.

EXAMPLE PROGRAM 4: Interrogating the Present Value of a Function

While the 8350B Learn String enables the user to save a string of characters that completely defines the present instrument state, the information is densely packed and encoded to save memory space. If the user wishes to determine the actual value of a specific parameter, say the Start Frequency, it would require a tedious process to extract a numeric value from several characters within the Learn String. An easier approach is to use the Output Interrogated Parameter function of the 8350B. With this function the 9826A instructs the 8350B to output the present numeric value of a specified function. Any function that has a numeric value associated with it can be interrogated even if this function is not presently active. The following program demonstrates the capability of the interrogate function.

*83500 Series Plug-ins with firmware revision no. 3 or above, only. Interrogate the firmware revision number of an HP 83500 series RF plug-in by pressing **[SHIFT]**, **[9]**, **[9]** on the HP 8350 Sweeper mainframe. The firmware revision number will appear in the plug-in POWER display.

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PROGRAM 4

```
10    !OUTPUTS FROM 8350B
20    So=719
30    PRINT CHR$(12)
40    OUTPUT So;"IP MD1"
50    LOCAL So
60    DISP "ADJUST START FREQUENCY WITH KNOB"
70    PAUSE
80    OUTPUT So;"OA"
90    ENTER So;A
100   PRINT "ACTIVE: Start Freq=";A/1.E+6;"MHz"
110   LOCAL So
120   DISP "ADJUST STOP FREQUENCY WITH KNOB"
130   PAUSE
140   OUTPUT So;"OA"
150   ENTER So;B
160   PRINT "ACTIVE: Stop  Freq=";B/1.E+6;"MHz"
170   DISP "PRESS CONTINUE TO OUTPUT THE
       SWEEP TIME"
180   PAUSE
190   OUTPUT So;"OPST"
200   ENTER So;T
210   PRINT "INTERROGATED: Sweep Time=";
       1000*T;"msec"
220   DISP
230   END
```

PROGRAM 4 EXPLANATION:

Lines

10-40: Assign **So** to the 8350B address. Clear the 9826A CRT, and set the 8350B in the Instrument Preset state and enable the 8350B square wave modulation.

50-70: Return the 8350B to local control, and ask the user to change the Start Frequency. Wait for the user to press **[CONTINUE]**.

80-100: Program the 8350B to output the numeric value associated with the last active function. (In this case, START FREQUENCY). Enter this value into the variable A, and display the frequency in MHz to the user.

NOTE

The value displayed on the 9826A CRT may have higher resolution than the value displayed on the 8350B LED display.

110-130: Return the 8350B to local control and ask the user to change the Stop Frequency. Wait for the user to press **[CONTINUE]**.

140-160: Same as lines 80-100 for Stop Frequency.

170-180: Prompt the user and wait for the user to press **[CONTINUE]**.

190-210: Program the 8350B to output the current value of a specified parameter. In this case, the desired parameter is the Sweep Time. (Note that it does not have to be the active parameter). Store this value into variable T, and display the sweeptime in milliseconds to the user.

220: Clear the display line on the 9826A.

The equipment required is the same as in the previous example. Reset the 9826A and scratch the 9826A memory. Now type in the above program and run it. Then perform the following:

1. Adjust the Start Frequency value with the knob. Then press **[CONTINUE]**.

2. Start Frequency (the current active parameter) value will be displayed on the 9826A CRT. Now, adjust the Stop Frequency value with the appropriate knob. Then press **[CONTINUE]**.

NOTE

The resolution of start and stop frequencies may be different. This is normal because the frequency resolution changes as the sweep width (ΔF) is changed.

3. Stop Frequency value will be displayed. Press **[CONTINUE]** to display the present Sweep Time.

EXAMPLE PROGRAM 5: Using Service Requests, Status Bytes, and Request Mask

Certain error conditions of the 8350B can be detected by the 9826A so that corrective action can be taken. A few examples of detectable error conditions are numeric data entry out of range, programming syntax error, and power failure. If an error condition exists, the user can instruct the 8350B to request service from the 9826A by initiating a Service Request (SRQ). The 9826A can detect whether an SRQ has taken place on the bus by analyzing bit 1 of its interrupt status register (Register 4 on the 9826A HP-IB interface see — Table 1). Two methods are available for analyzing the status of the HP-IB interface of the 9826A. 1) periodically read the interrupt status

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register (Register 4). 2) enable the bit 1 of the Interrupt Enable Mask (Register 5) to interrupt the program when bit 1 is set. In either case, the user must determine which device on the bus requested service. This can be done using a SPOLL command to sequentially analyze the status byte of each instrument on the bus. By definition of the IEEE-488 bus, the instrument that requested service will have bit 6 of its status byte (REQUEST SERVICE) true. Once it is determined that the 8350B has requested service, the specific error condition(s) is then determined by analyzing the Status Bytes of the 8350B.

The 8350B has three Status Bytes, each consisting of 8 bits with each bit indicating the present status of a particular function or condition. See Table 2 for a complete description of the conditions associated with each status byte bit. The user can analyze all the conditions of the status bytes for every SRQ, or more simply, instruct the 8350B to issue an SRQ only if a specific set of error conditions exists. The set of error conditions is determined by a numeric value generated by summing the decimal values of each bit to be checked in the first Status Byte. Its binary equivalent is sent to the 8350B using the Request Mask function (RM) and CHR$. The CHR$ function converts a numeric value into an ASCII character. The default Request Mask at power on is "00000000" or decimal 0. SRQ generation due to conditions indicated by the first and second Extended Status Bytes can be masked by using the "RE" and "R2" functions respectively, in conjunction with masking bit 2 of the first Status Byte. The "RE" and "R2" default mask values at power on are "11111111" or decimal 255. All mask values are reset to the default values only at power on or by execution of the Device Clear (DCL) or Selective Device Clear (SDC) commands.

The following program demonstrates the capability of the SRQ and two of the three Status Bytes to detect an error condition. This specific example analyzes an SRQ on front panel entries and SRQ on parmeters modified to default values when the instrument is in local mode.

Table 1. HP-IB Status Registers 4 and 5 of the 9826A Controller

Status Register 4: Interrupt Status
Status Register 5: Interrupt Enable Mask

BIT #	15 (MSB)[1]	14	13	12	11	10	9	8
DECIMAL VALUE	32 768	16 364	8 192	4 096	2 048	1 024	512	256
FUNCTION	Active Controller	Parallel Poll Configuration Change	My Talk Address Received	My Listen Address Received	EOI Received	SPAS	Remote/ Local Change	Talker/ Listener Address Change
BIT #	7	6	5	4	3	2	1	0 (LSB)[2]
DECIMAL VALUE	128	64	32	16	8	4	2	1
FUNCTION	Trigger Received	Handshake Error	Unrecognized Universal Command	Secondary Command While Addressed	Clear Received	Unrecognized Addressed Command	SRQ Received	IFC Received

1. MSB: Most Significant Bit
2. LSB: Least Significant Bit

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Table 2. 8350B Status Byte Descriptions

STATUS BYTE (#1)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	N/A	Request Service (RQS)	SRQ on Syntax Error	SRQ on End of Sweep	N/A	SRQ on Change in Extended Status Bytes	N/A	SRQ on Any Front Panel Key Pressed
EXTENDED STATUS BYTE (#2)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	Airflow Failure	* RF Unleveled	Power Failure/on	N/A	N/A	N/A	N/A	Self Test failed
SECOND EXTENDED STATUS BYTE (#3)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	N/A	N/A	N/A	N/A	N/A	N/A	N/A	SRQ on Numeric Parameter Altered to Default Value

*Bit/Function not usable with 86200 Series Plug-ins and 11869A Adapter.

PROGRAM 5

```
10    !STATUS BYTES
20    So=719
30    ABORT 7
40    CLEAR So
50    PRINT CHR$(12)
60    OUTPUT So;"RM"&CHR$(5)
70    OUTPUT So;"RE"&CHR$(0)
80    OUTPUT So;"R2"&CHR$(1)
90    OUTPUT So;"IP CS MD1 FA3GZ FB"
100   ON INTR 7 GOSUB Statusbyte1
110   ENABLE INTR 7;2
120   LOCAL So
130   PRINT "ENTER A STOP FREQUENCY WITH
       8350B DATA ENTRY KEYS"
140   GOTO 140
150 Statusbyte1:    STATUS 7,4;A
160   B=SPOLL(So)
170   IF BIT(B,0)=1 THEN PRINT "FRONT PANEL SRQ"
180   IF BIT(B,2)=1 THEN PRINT "SRQ on Extended
       Status Bytes"
190   IF BIT(B,2)=1 THEN GOSUB Statusbyte3
200   ENABLE INTR 7;2
210   RETURN
220 Statusbyte3:   OUTPUT So;"OS"
230   ENTER So USING "#,B";E,F,G
240   IF BIT(G,0)=1 THEN PRINT
       "PARAMETER ALTERED"
250   PRINT
260   LOCAL So
270   RETURN
280   END
```

PROGRAM 5 EXPLANATION

Lines

10-20: Assign the 8350B address to the variable **So.**

30: Terminate all Listener or Talker functions of all instruments on the bus.

40: Clear the status bytes of 8350B and initialize the interface so that it is ready to receive HP-IB programming codes.

50: Clear the 9826A CRT display.

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60: Set a Request Mask on 8350B on bit 0 (decimal value 1) and 2 (decimal value 4) of the first status byte. The binary equivalent of 5 (decimal values 4 + 1) is sent using CHR$.

70: Set a Request Mask of decimal value 0 on the 8350B's first extended status byte. This sets all the bits of this byte to zero and any service requests it might generate will be ignored.

80: Set a Request Mask on 8350B on bit 0 (decimal value 1) of the second extended status byte.

90: Preset the 8350B to a predetermined state and clear the status bytes via the **CS** command. Enable the square wave modulation, set the Start Frequency to 3 GHz and activate the Stop Frequency.

100: When the 9826A receives an interrupt, the program execution is continued on subroutine "Statusbyte1".

110: Enable an interruption on bit 1 (decimal value 2) of the 9826A Status register 5.

120-130: Return the 8350B to local control and display a prompt on the 9826A.

140: The program execution remains on line 140 waiting for an interruption. Note that this line can be the beginning of a user program.

150: Read the current state of the interrupt status register (register 4) on the 9826A and store its value in the variable A. Normally the variable A would then be examined to see what caused the interrupt, but since line 110 made bit 1 the only bit that could cause an interrupt, this is unnecessary.

160: Read the current state of the first status byte of the 8350B, and in so doing clear it. Note that it is unnecessary to examine bit 6 of B to see if the 8350B is the instrument that requested service because the 8350B is the only instrument on the bus in this example.

170: Test bit 0 of the first status byte, and print a prompt.

180: Test bit 2 of the first status byte, and print a prompt.

190: Test bit 2 of the first Status byte again and continue program execution with "Statusbyte3" if necessary.

200: Re-enable an interruption on bit 1 of the 9826A status register 5.

210: Return main program execution to line 110 of the main program.

220: Program the 8350B to output all three status bytes.

230: Fast transfer the three status bytes, in binary form into variables E, F, and G. The value of the variable E will be zero since the first status byte was cleared by the **SPOLL** command.

240: Test bit 0 of the second extended status byte and print a prompt if necessary.

250-270: Print a space on the 9826A CRT, then send the program execution back to line 200 of the subroutine "Statusbyte1".

Set-up the equipment as shown in figure 2, and use the analyzer's CRT display to verify the settings. Reset the 9826A and scratch its memory. Then type in and run the above program. Then perform the following:

1. The 8350B is set in START/STOP Frequency mode with Start Frequency at 3 GHz.

2. The 8350B is in local mode but the program is still running. Thus, if any front panel key is pressed an interruption occurs and the prompt "FRONT PANEL SRQ" is displayed and the program execution goes back to line 140. It remains in line 140 waiting for another interrupt. Note the 8350B is still in LOCAL.

3. An "SRQ ON EXTENDED STATUS BYTES" and "PARAMETER ALTERED" interrupt may be generated by entering a Stop Frequency that is out of the range of the plug-in. For example, enter **[9] [9] [GZ]** and the parameter will be modified to the default value of the plug-in. The prompt "PARAMETER ALTERED" will also be displayed.

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HP-IB PROGRAM CODES (1 of 2)

CODE	DESCRIPTION
AKm	Amplitude Marker On/Off
ALmn	Alternate Sweep On/Off
A1	Internal Leveling
A2	External Crystal Leveling
A3	External Power Meter Leveling
BK	Backspace
CAm	Amplitude Crystal Marker On/Off (83522/83525 Only)
CF	Center Frequency
Clm	Intensity Crystal Marker On/Off (83522/83525 Only)
CS	Clear Status Bytes
CW	CW Frequency
C1	1 MHz Crystal Marker Frequency (83522/83525 Only)
C2	10 MHz Crystal Marker Frequency (83522/83525 Only)
C3	50 HMz Crystal Marker Frequency (83522/83525 Only)
C4	External Crystal Marker Frequency (83522/83525 Only)
D1	Crossover Coupled FM
D2	Direct Coupled FM
DB	dB or dBm
DF	Delta F Frequency Span
DM	dB or dBm
DN	Step Down/Decrement
DPm	Display Blanking On/Off
DUm	Display Update On/Off
E	Exponent Power Of 10
F1	20 MHz/V FM Input Sensitivity
F2	6 MHz/V FM Input Sensitivity
FA	Start Frequency
FB	Stop Frequency
Flm	CW Filter In/Out
GZ	GHz
HZ	Hz
IL	Input Learn String
IP	Instrument Preset
IX	Input Micro Learn String
KZ	KHz
MC	Marker To Center Frequency
MDm	Square Wave Amplitude Modulation On/Off
MO	Marker Off
MPm	Marker 1-2 Sweep On/Off
MS	Milliseconds
MZ	MHz
M0	Marker Off
M1	Marker #1
M2	Marker #2
M3	Marker #3
M4	Marker #4
M5	Marker #5
NT	Network Analyzer Trigger (8410B)
OA	Output Active Parameter
OH	Output Harmonic Number
OI	Output Software Revision Number
OL	Output Learn String
OM	Output Mode String
OP	Output Interrogated Parameter
OS	Output Status Bytes
OX	Output Micro Learn String
PL	Power Level
PSm	Power Sweep On/Off
RCn	Recall Register

NOTES

1. **Program codes of the form "XXm" use "m" to turn the function On or Off (1 or 0). For the storage register functions the "n" is 1 through 9.**
2. **The 8350B ignores spaces, plus signs, negative signs (except for vernier, offset, and power values), and any unexpected characters. Program codes can be upper or lower case alpha characters.**

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HP-IB PROGRAM CODES (2 of 2)

CODE	DESCRIPTION
RE	First Extended Status Byte Service Request Mask
RFm	RF Power On/Off
RM	Service Request Mask
RPm	RF Blanking On/Off
RS	Reset Sweep
R2	Second Extended Status Byte Service Request Mask
SC	Seconds
SF	Frequency Step Size
SG	Single Sweep
SH	Shift Function
SLm	Slope On/Off
SM	Manual Sweep
SS	Step Size
ST	Sweep Time (Continuous Sweep)
SVn	Save Register
SX	External Sweep
TS	Take Sweep
T1	Internal Sweep Trigger
T2	Line Sweep Trigger
T3	External Sweep Trigger
T4	Single Sweep
UP	Step Up/Increment
VR	CW Vernier
	SHIFT KEY FUNCTIONS
SHCF	Coarse CW Resolution
SHCW	Swept CW
SHDF	Fine CW Resolution
SHFA	Frequency Display Multiplier
SHFB	Frequency Display Offset
SHM	All Markers Off
SHM0	All Markers Off
SHM1	Marker Delta
SHM2	Counter Interface Enable
SHM3	Counter Interface Disable
SHMP	Permanent Marker Sweep
SHPL	Peak Output Power
SHPS	Independent ALC Control
SHSL	Independent Attenuator Control
SHRC	Save Unlock
SHSS	Default Step Size
SHSV	Save Lock
SHVR	Frequency Offset
0–9 + –	Acceptable Numeric Data

NOTES

1. **Program codes of the form "XXm" use "m" to turn the function On or Off (1 or 0). For the storage register functions the "n" is 1 through 9.**
2. **The 8350B ignores spaces, plus signs, negative signs (except for vernier, offset, and power values), and any unexpected characters. Program codes can be upper or lower case alpha characters.**

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APPENDIX A

INTRODUCTION

Appendix A is a guide to the remote operation of 8350B/8756A based system. As mentioned in the main operating guide, the HP 8755S Scalar Network Analyzer may be replaced by the HP 8756A Scalar Network Analyzer. Included in this section are a description of the function of the 8756 System Interface, the system connections for remote operation, and modified sample programs to demonstrate some of the capabilities of the 8350B/8756A based system.

REFERENCE INFORMATION

Complete reference information on the 8756A Scalar Network Analyzer can be found in the 8756A Operating and Service Manual (HP Part No. 08756-90001) the 8756A Quick Reference Guide (HP Part No. 5953-8857), and the 8756A Introductory Operating Guide (HP Part No. 5953-8858).

8756 SYSTEM INTERFACE

The 8756 Rear Panel has a control port called the 8756 SYSTEM INTERFACE. This connector is physically the same as that defined for the Hewlett-Packard Interface Bus, but is specifically used by the 8756A to directly control an HP-IB Sweep Oscillator (HP 8350B or 8340A) or an HP-IB plotter (HP 7470A or 9872C) through their respective HP-IB ports. Sweep Oscillator or Plotter HP-IB commands from a system controller (such as the HP 9826A) may be passed through the HP 8756A's HP-IB to the 8756 SYSTEM INTERFACE.

The transfer of commands and data is performed by first sending a Pass through **PTd** command to the HP 8756A, where d is 19 decimal for passing through to the HP-IB Sweep Oscillator or 05 decimal for passing through to the HP-IB Plotter.

Subsequent addressing of the 8756 SYSTEM INTERFACE address will pass through commands to the instrument selected. The **PTd** command may be sent at any time.

The address of the 8756 SYSTEM INTERFACE is determined by complementing the least significant bit of the current HP 8756A address. For example, since the HP 8756A default address is 16 decimal = 10000 binary, the default 8756 SYSTEM INTERFACE address is 17 decimal = 10001 binary. As another example, if the HP 8756A address is 7 decimal = 111 binary, then the SYSTEM INTERFACE address becomes 6 decimal = 110 binary.

An example of pass through commands to the HP-IB Sweep Oscillator with address 19 decimal using the default HP 8756A address is:

1. Address device 16 (the HP-IB of the HP 8756A); send the characters **PT19** or **PT19 [cr] [lf]**.

2. Address device 17 (the 8756 SYSTEM INTERFACE); send sweeper HP-IB commands.

3. Address device 16. This returns the HP 8756A to its normal HP-IB operation.

When the HP 8350B Sweep Oscillator is connected to the 8756 SYSTEM INTERFACE, and when the PRESET key on the 8756A or 8350B is pressed or when the command **IP** is sent via the HP-IB the following conditions are initialized in the 8350B:

a. Instrument Preset.
b. Sweep time set to 200 ms.
c. 8350B Square wave modulation ON; RF Output ON/OFF depending on plug-in internal switch setting.

SYSTEM CONFIGURATION

Set up the equipment as shown in Figure 3. Connect the controller (e.g. 9826A) to the HP-IB Connector on the rear panel of the 8756A. Then connect the 8350B to 8756A System Interface.

MODIFIED SAMPLE PROGRAMS

The following modified sample programs show the various ways of controlling the 8350B via the 8756 System Interface.

Each programming example is structured using the following format:

1. Each will refer to a sample program and explanation already given in the main operating guide.

2. A modified program listing.

3. An explanation of the modified or added lines of the program listing, and instructions for operating the system when necessary.

For more detail on these programs refer to the main operating guide.

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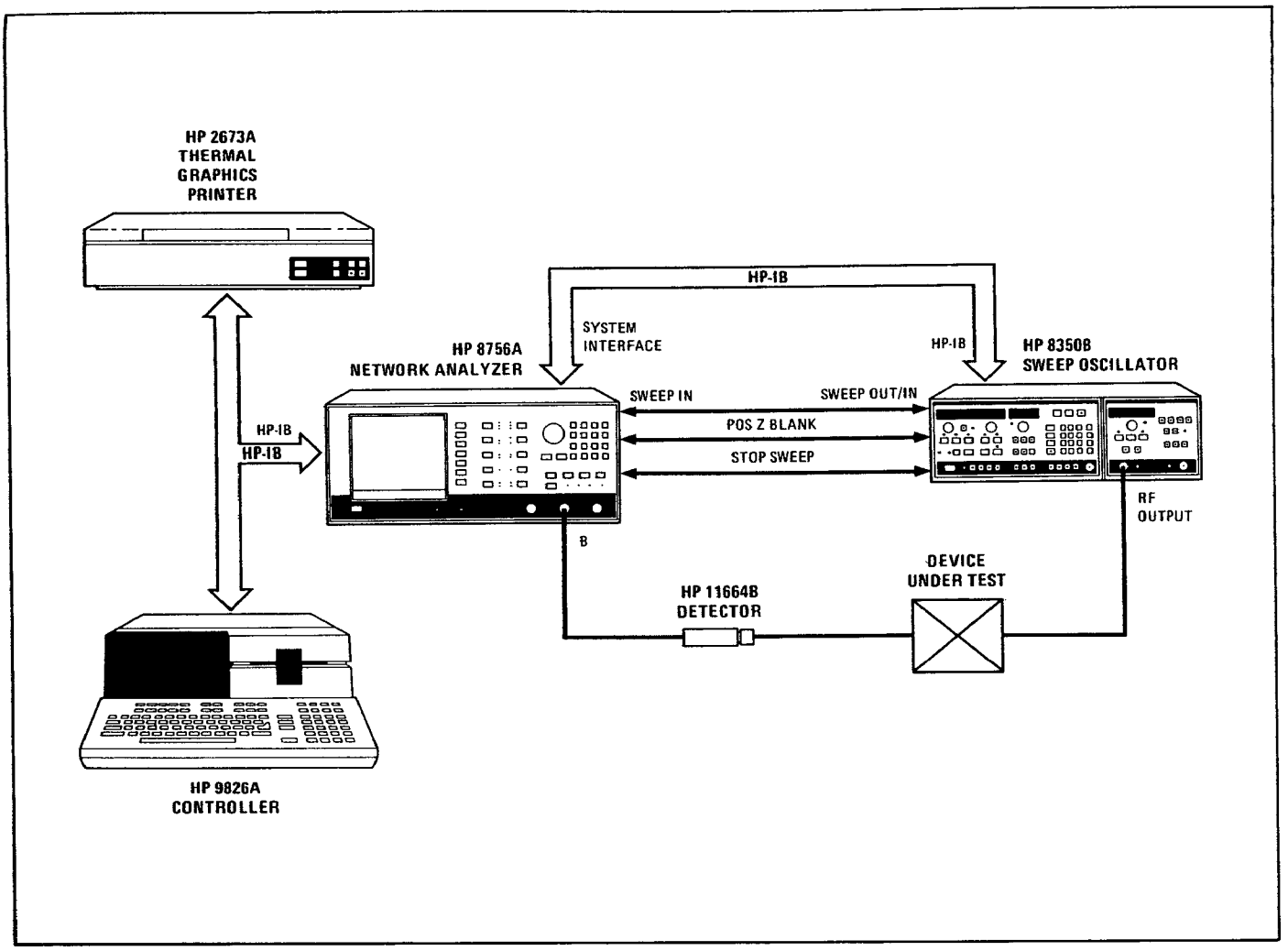


Figure 3. Equipment Setup

CHECK OUT

```
10    !HP-IB TEST
20    So=719
21    Rcvr=716
22    Sysint=717
23    So=Sysint
24    OUTPUT Rcvr;"PT19"
30    ABORT 7
40    CLEAR Rcvr
50    PRINT "9826 IS ACTIVE CONTROLLER"
60    REMOTE Rcvr
70    PRINT "8350B/8756A SYSTEM
       IS IN REMOTE MODE"
80    PAUSE
90    REMOTE Rcvr
100   LOCAL LOCKOUT 7
110   PRINT "LOCAL LOCKOUT MODE"
120   PAUSE
130   LOCAL 7
140   PRINT "RETURN TO LOCAL"
150   PAUSE
160   REMOTE 7
170   OUTPUT Rcvr;"IP"
180   PRINT "INSTRUMENT PRESET COMPLETED"
190   END
```

EXPLANATION OF MODIFIED OR ADDED LINES

Lines

21: Assign **Rcvr** to the 8756A Scalar Network Analyzer address.

22: Assign **Sysint** to the 8756 SYSTEM INTERFACE address.

23: Assign **So** to **Sysint** (=717) and data will be transferred via 8756 SYSTEM INTERFACE to the 8350B Sweep Oscillator.

24: Send a Pass Through "**PT19**" command to the 8756A Scalar Network Analyzer, where "19" is the address of the 8350B Sweep Oscillator.

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40: Clear all status bytes, the Request Mask, the HP-IB of the HP 8756A and the 8756 SYSTEM INTERFACE.

60-90: Put the 8756A/8350B system in **REMOTE** mode and display a message to the user.

170: Set the 8756A/8350B system to a predefined state via Instrument Preset.

To verify and investigate the different remote modes do the following:

1. Press **[SHIFT] [PAUSE]** to reset the 9826A.

2. Press **[SHIFT] [CLR] [LN]** and **[RUN]** on the 9826A.

3. With the 9826A displaying "ACTIVE CONTROLLER" and "REMOTE" messages, verify that the 8350B/8756A System REMote lights are lit. From the front panel, attempt to change the start frequency and verify that this is impossible. Verify that the INSTR PRESET key and all other keys except LOCAL are disabled. Since the 8756A controls the 8350B Sweeper via the 8756 SYSTEM INTERFACE, only the 8756A LOCAL key can put 8350B/8756A system in LOCAL mode. Now press the LOCAL key on the 8756A and verify that the REMote lights on both the 8350B and the 8756A are off and that you can modify any of the 8350B or the 8756A functions.

4. Press **[CONTINUE]** on the 9826A. With the 9826A displaying "LOCAL LOCKOUT MODE" verify that the 8350B/8756A system REMote lights are again lit. Again attempt to change the start frequency and perform an instrument preset. Verify that this is impossible. Now press the 8756A LOCAL key and verify that still no action is taken.

5. Press **[CONTINUE]** on the 9826A. With the 9826A displaying "RETURN TO LOCAL", verify that the 8350B/8756A REMote lights are off. Also verify that all functions now can be modified via the front panel controls.

6. Press **[CONTINUE]** on the 9826A. Verify that the 8350B/8756A system has undergone an Instrument Preset and the REMote lights are on.

EXAMPLE PROGRAM 1: Setting up a typical sweep

```
10    !SETTING UP A SWEEP
20    So=719
21    Rcvr=716
22    Sysint=717
23    So=Sysint
24    OUTPUT Rcvr;"PT19"
30    PRINT CHR$(12)
31    OUTPUT Rcvr;"IP"
40    OUTPUT So;"FA2.345GZ FB6.789GZ"
41    OUTPUT Rcvr
50    PRINT "START FREQUENCY : 2.345 GHz"
60    PRINT "STOP  FREQUENCY : 6.789 GHz"
70    DISP "ENTER SWEEP TIME in msec
       (minimum 200 msec)";
80    INPUT T
90    PRINT "SWEEP  TIME : ";T;" msec"
100   OUTPUT So;"ST";T;"MS"
101   OUTPUT Rcvr
110   IMAGE "PL",SDD,"DB"
120   DISP "ENTER POWER LEVEL in dBm";
130   INPUT P
140   PRINT "POWER LEVEL : ";P;" dBm"
150   OUTPUT So USING 110;P
151   OUTPUT Rcvr
160   PAUSE
170   IMAGE "M1",K,"GZ"
180   OUTPUT So USING 170;3.4
181   OUTPUT Rcvr
190   PRINT "MARKER No.1 : 3.4  GHz"
200   PAUSE
210   OUTPUT So;"M2 4560E6,"
211   OUTPUT Rcvr
220   PRINT "MARKER No.2 : 4.56 GHz"
230   PRINT "SETTING COMPLETED"
240   PAUSE
250   OUTPUT So;"SV1"
260   OUTPUT Rcvr;"IP"
270   PRINT "SETTING STORED IN REGISTER 1"
280   PAUSE
290   OUTPUT So;"SHSV"
300   LOCAL Rcvr
310   PRINT "SAVE REGISTERS LOCKED"
320   PAUSE
330   OUTPUT So;"RC1"
331   OUTPUT Rcvr
340   PRINT "RECALL REGISTER 1"
350   PAUSE
360   OUTPUT So;"SHRC"
370   LOCAL Rcvr
380   PRINT "SAVE/RECALL REGISTERS UNLOCKED"
390   END
```

EXPLANATION OF MODIFIED OR ADDED LINES

Lines

21: Assign **Rcvr** to the 8756A Scalar Network Analyzer address.

22: Assign **Sysint** to the 8756 SYSTEM INTERFACE address.

23: Assign **So** to **Sysint** (=717) and data will be transferred via 8756 SYSTEM INTERFACE to the 8350B Sweep Oscillator.

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24: Send a Pass Through "**PT19**" command to the 8756A Scalar Network Analyzer, where "19" is the address of the 8350B Sweep Oscillator.

31, 260: Set the 8756A/8350B system to a predefined state via instrument preset.

41, 101, 151, 181, 211, 331: Address the 8756A to return the Scalar Network Analyzer from Pass Through mode to its normal HP-IB operation.

300, 370: Put the 8756A/8350B system in **LOCAL** mode.

The statement in line 250 saves the 8350B Sweeper settings in Register 1, and line 330 recalls the saved settings of Register 1. If you desire to save both the 8350B and 8756A settings, then lines 250 and 330 should be modified as follows:

250 OUTPUT Rcvr; "SV1"

330 OUTPUT Rcvr; "RC1"

EXAMPLE PROGRAM 2: A Stepped CW Sweep

```
10    !STEPPED CW
20    INTEGER D
30    So=719
31    Rcvr=716
32    Sysint=717
33    So=Sysint
34    OUTPUT Rcvr;"PT19"
40    PRINT CHR$(12)
50    OUTPUT Rcvr;"IP C1C0 C2AS"
60    DISP "ENTER START FREQUENCY in GHz";
70    INPUT A
80    DISP "ENTER STOP  FREQUENCY in GHz";
90    INPUT B
100   IF A>B THEN GOTO 60
110   DISP "ENTER STEP SIZE in GHz";
120   INPUT S
130   IF S>B-A THEN 100
140   D=(B-A)/S
150   PRINT "THE 8350B IS STEPPED SWEEPING...."
160   PRINT "....PRESS PAUSE TO STOP THE SWEEP"
170   OUTPUT So;"SS";S;"GZ SHCW";A;"GZ"
171   OUTPUT Rcvr
180   FOR I=1 TO D
190   OUTPUT So;"UP"
191   OUTPUT Rcvr
192   WAIT .3
200   NEXT I
210   GOTO 170
220   END
```

EXPLANATION OF MODIFIED OR ADDED LINES

Lines

31: Assign **Rcvr** to the 8756A Scalar Network Analyzer address.

32: Assign **Sysint** to the 8756 SYSTEM INTERFACE address.

33: Assign **So** to **Sysint** (=717) and data will be transferred via 8756 SYSTEM INTERFACE to the 8350B Sweep Oscillator.

34: Send a Pass Through "**PT19**" command to the 8756A Scalar Network Analyzer, where "19" is the address of the 8350B Sweep Oscillator.

50: Set the 8756A/8350B system to a predefined state via Instrument Preset, turn off Channel 1 and autoscale Channel 2 of the 8756A.

170: Program the frequency step size and set the Swept CW (**SHCW**) frequency to the start value.

171, 191: Address the 8756A to return the Scalar Network Analyzer out of Pass Through mode to its normal HP-IB operation.

192: Program a **WAIT** time of 300 milliseconds.

NOTE

The sweep displayed will be a line for each frequency covering the full screen; however, this is normal for this mode of operation. In SHIFT CW mode, the 8350B delivers on its sweep output connector a 0-10V ramp for each frequency value. The 8756A needs this 0-10V ramp to drive and update its display. Thus, the 8756A will not function with the 8350 Manual Sweep which provides a single voltage for each frequency.

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EXAMPLE PROGRAM 3: Learning An Instrument State

```
10    !LEARN STRING
20    So=719
21    Rcvr=716
22    Sysint=717
23    So=Sysint
24    OUTPUT Rcvr;"PT19"
30    PRINT CHR$(12)
40    OPTION BASE 1
50    DIM A$[100]
60    OUTPUT Rcvr;"IP C1C0 C2AS"
70    LOCAL Rcvr
80    PRINT "CHANGE FRONT PANEL
       SETTING ON 8350B"
90    PAUSE
100   BEEP 1000,.1
110   OUTPUT So;"OL"
120   ENTER So USING "#,90A";A$
130   LOCAL Rcvr
140   PRINT "CHANGE FRONT PANEL
       SETTING AGAIN..."
150   PAUSE
160   BEEP 2000,.1
170   OUTPUT So;"IL"&A$
171   OUTPUT Rcvr
180   PRINT "ORIGINAL SETTING HAS BEEN RESTORED"
190   END
```

EXPLANATION OF MODIFIED OR ADDED LINES

Lines

21: Assign **Rcvr** to the 8756A Scalar Network Analyzer address.

22: Assign **Sysint** to the 8756 SYSTEM INTERFACE address.

23: Assign **So** to **Sysint** (=717) and data will be transferred via 8756 SYSTEM INTERFACE to the 8350B Sweep Oscillator.

24: Send a Pass Through "**PT19**" command to the 8756A Scalar Network Analyzer, where "19" is the address of the 8350B Sweep Oscillator.

60: Set the 8756A/8350B system to a predefined state via Instrument Preset, turn off Channel 1 and autoscale Channel 2 of the 8756A.

70, 130: Put the 8756A/8350B system in **LOCAL** mode.

171: Address the 8756A to return the Scalar Network Analyzer from Pass Through mode to its normal HP-IB operation.

Reset the 9826A, scratch the 9826A memory, then type in the above program. Then run the program. The 8350B/8756A system will undergo an instrument preset, turn off Channel 1 of 8756A, autoscale Channel 2 of 8756A, then return to local front panel control. Perform the following:

1. Adjust the 8350B to a preferred instrument state, then press **[CONTINUE]** on the 9826A.

2. Change the instrument settings of the 8350B in any way desired.

3. Press **[CONTINUE]** on the 9826A. Verify on the analyzer's CRT display and/or the 8350B front panel that the original instrument state has been restored.

NOTE

The OL (Output Learnstring) and the IL (Input Learnstring) commands function only with the 8350B to store and restore the instrument state.

EXAMPLE PROGRAM 4: Interrogating the Preset Value of a Function

```
10    !OUTPUTS FROM 8350B
20    So=719
21    Rcvr=716
22    Sysint=717
23    So=Sysint
24    OUTPUT Rcvr;"PT19"
30    PRINT CHR$(12)
40    OUTPUT Rcvr;"IP"
50    LOCAL Rcvr
60    DISP "ADJUST START FREQUENCY WITH KNOB"
70    PAUSE
80    OUTPUT So;"OA"
90    ENTER So;A
91    OUTPUT Rcvr
100   PRINT "ACTIVE: Start Freq=";A/1.E+6;"MHz"
110   LOCAL Rcvr
120   DISP "ADJUST STOP FREQUENCY WITH KNOB"
130   PAUSE
140   OUTPUT So;"OA"
150   ENTER So;B
151   OUTPUT Rcvr
160   PRINT "ACTIVE: Stop  Freq=";B/1.E+6;"MHz"
170   DISP "PRESS CONTINUE TO OUTPUT
       THE SWEEP TIME"
180   PAUSE
190   OUTPUT So;"OPST"
200   ENTER So;T
201   OUTPUT Rcvr
210   PRINT "INTERROGATED: Sweep Time=";
       1000*T;"msec"
220   DISP
230   END
```


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21: Assign **Rcvr** to the 8756A Scalar Network Analyzer address.

22: Assign **Sysint** to the 8756 SYSTEM INTERFACE address.

23: Assign **So** to **Sysint** (=717) and data will be transferred via 8756 SYSTEM INTERFACE to the 8350B Sweep Oscillator.

24: Send a Pass Through "**PT19**" command to the 8756A Scalar Network Analyzer, where "19" is the address of the 8350B Sweep Oscillator.

40: Set the 8756A/8350B system to a pre-defined state via Instrument Preset.

50, 110: Put the 8756A/8350B system in **LOCAL** mode.

91, 151, 201: Address the 8756A to return the Scalar Network Analyzer from Pass Through mode to its normal HP-IB operation.

EXAMPLE PROGRAM 5: Using Service Requests, Status Bytes, and Request Masks

```
10    !STATUS BYTES
20    So=719
30    ABORT 7
40    CLEAR So
50    PRINT CHR$(12)
60    OUTPUT So;"RM"&CHR$(5)
70    OUTPUT So;"RE"&CHR$(0)
80    OUTPUT So;"R2"&CHR$(1)
90    OUTPUT So;"IP CS MD1 ST200MS FA3GZ FB"
100   ON INTR 7 GOSUB Statusbyte1
110   ENABLE INTR 7;2
120   LOCAL So
130   PRINT "ENTER A STOP FREQUENCY
       WITH 8350B DATA ENTRY KEYS"
140   GOTO 140
150 Statusbyte1:    STATUS 7,4;A
160   B=SPOLL(So)
170   IF BIT(B,0)=1 THEN PRINT "FRONT PANEL SRQ"
180   IF BIT(B,2)=1 THEN PRINT "SRQ on Extended
       Status Bytes"
190   IF BIT(B,2)=1 THEN GOSUB Statusbyte3
200   ENABLE INTR 7;2
210   RETURN
220 Statusbyte3:   OUTPUT So;"OS"
230   ENTER So USING "#,B";E,F,G
240   IF BIT(G,0)=1 THEN PRINT
       "PARAMETER ALTERED"
250   PRINT
260   LOCAL So
270   RETURN
280   END
```

EXPLANATION OF MODIFIED OR ADDED LINES

Line

90: Preset the 8350B to a predetermined state, and clear the Status Bytes via the "**CS**" command. Enable the squarewave modulation and set the Sweep Time to 200 ms (minimum sweep time required by the 8756A). Set the Start Frequency 3 GHz, and activate the Stop Frequency.

NOTE

Set up the equipment as shown in Figure 2 of this guide by replacing the 8755S with the 8756A Scalar Network Analyzer.

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COMPANY

ADDRESS

TECHNICAL CONTACT PERSON

PHONE NO. EXT.

MODEL NO. SERIAL NO.

MODEL NO. SERIAL NO.

P.O. NO. DATE

Accessories returned with unit

☐ NONE ☐ CABLE(S)

☐ POWER CABLE ☐ ADAPTER(S)

OTHER _____

over

HEWLETT PACKARD

Should one of your HP instruments need repair, the HP service organization is ready to serve you. However, you can help us serve you more effectively. When sending an instrument to HP for repair, please fill out this card and attach it to the product. Increased repair efficiency and reduced turn-around time should result.

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PHONE NO. EXT.

MODEL NO. SERIAL NO.

MODEL NO. SERIAL NO.

P.O. NO. DATE

Accessories returned with unit

☐ NONE ☐ CABLE(S)

☐ POWER CABLE ☐ ADAPTER(S)

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HEWLETT PACKARD

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COMPANY

ADDRESS

TECHNICAL CONTACT PERSON

PHONE NO. EXT.

MODEL NO. SERIAL NO.

MODEL NO. SERIAL NO.

P.O. NO. DATE

Accessories returned with unit

☐ NONE ☐ CABLE(S)

☐ POWER CABLE ☐ ADAPTER(S)

OTHER _____

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COMPANY

ADDRESS

TECHNICAL CONTACT PERSON

PHONE NO. EXT.

MODEL NO. SERIAL NO.

MODEL NO. SERIAL NO.

P.O. NO. DATE

Accessories returned with unit

☐ NONE ☐ CABLE(S)

☐ POWER CABLE ☐ ADAPTER(S)

OTHER _____

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HEWLETT PACKARD

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TECHNICAL CONTACT PERSON

PHONE NO. EXT.

MODEL NO. SERIAL NO.

MODEL NO. SERIAL NO.

P.O. NO. DATE

Accessories returned with unit

☐ NONE ☐ CABLE(S)

☐ POWER CABLE ☐ ADAPTER(S)

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ADDRESS

TECHNICAL CONTACT PERSON

PHONE NO. EXT.

MODEL NO. SERIAL NO.

MODEL NO. SERIAL NO.

P.O. NO. DATE

Accessories returned with unit

☐ NONE ☐ CABLE(S)

☐ POWER CABLE ☐ ADAPTER(S)

OTHER _____

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Service needed

☐ CALIBRATION ONLY

☐ REPAIR ☐ REPAIR & CAL

OTHER _____

_____

Observed symtoms/problems

FAILURE MODE IS:

☐ CONSTANT ☐ INTERMITTENT

SENSITIVE TO:

☐ COLD ☐ HEAT ☐ VIBRATION

FAILURE SYMPTOMS/SPECIAL CONTROL SETTINGS_____

_____

_____

_____

_____

_____

_____

_____

If unit is part of system list model number(s) of other interconnected instruments. _____

_____

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Service needed

☐ CALIBRATION ONLY

☐ REPAIR ☐ REPAIR & CAL

OTHER _____

_____

Observed symtoms/problems

FAILURE MODE IS:

☐ CONSTANT ☐ INTERMITTENT

SENSITIVE TO:

☐ COLD ☐ HEAT ☐ VIBRATION

FAILURE SYMPTOMS/SPECIAL CONTROL SETTINGS_____

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If unit is part of system list model number(s) of other interconnected instruments. _____

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Service needed

☐ CALIBRATION ONLY

☐ REPAIR ☐ REPAIR & CAL

OTHER _____

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Observed symtoms/problems

FAILURE MODE IS:

☐ CONSTANT ☐ INTERMITTENT

SENSITIVE TO:

☐ COLD ☐ HEAT ☐ VIBRATION

FAILURE SYMPTOMS/SPECIAL CONTROL SETTINGS_____

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If unit is part of system list model number(s) of other interconnected instruments. _____

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Service needed

☐ CALIBRATION ONLY

☐ REPAIR ☐ REPAIR & CAL

OTHER _____

_____

Observed symtoms/problems

FAILURE MODE IS:

☐ CONSTANT ☐ INTERMITTENT

SENSITIVE TO:

☐ COLD ☐ HEAT ☐ VIBRATION

FAILURE SYMPTOMS/SPECIAL CONTROL SETTINGS_____

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If unit is part of system list model number(s) of other interconnected instruments. _____

_____

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Service needed

☐ CALIBRATION ONLY

☐ REPAIR ☐ REPAIR & CAL

OTHER _____

_____

Observed symtoms/problems

FAILURE MODE IS:

☐ CONSTANT ☐ INTERMITTENT

SENSITIVE TO:

☐ COLD ☐ HEAT ☐ VIBRATION

FAILURE SYMPTOMS/SPECIAL CONTROL SETTINGS_____

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If unit is part of system list model number(s) of other interconnected instruments. _____

_____

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Service needed

☐ CALIBRATION ONLY

☐ REPAIR ☐ REPAIR & CAL

OTHER _____

_____

Observed symtoms/problems

FAILURE MODE IS:

☐ CONSTANT ☐ INTERMITTENT

SENSITIVE TO:

☐ COLD ☐ HEAT ☐ VIBRATION

FAILURE SYMPTOMS/SPECIAL CONTROL SETTINGS_____

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If unit is part of system list model number(s) of other interconnected instruments. _____

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Section IV. Performance Tests

INTRODUCTION

The HP 8350B Sweep Oscillator mainframe, together with an RF plug-in, form a complete RF source with the frequency range determined by the RF plug-in. Therefore, the specifications used as the performance standards against which the HP 8350B is tested are dependent on the RF plug-in installed. Refer to Section I, Table 1-1, of the operating and service manual for the specific RF plug-in installed for complete specifications.

The procedures in this section together with the procedures detailed in Section IV of the RF plug-in operating and service manual will verify the performance of the HP 8350B.

Performance of the HP 8350B Sweep Oscillator can be verified to three different levels, Operation Verification, Limited Calibration and Certified Calibration. A description and the requirements for each of these levels is detailed in the paragraphs below.

None of the tests require access to the interior of the HP 8350B Sweep Oscillator or the RF plug-in.

OPERATION VERIFICATION

Operation verification is a subset of the total performance tests indicated for the HP 8350B Sweep Oscillator/RF plug-in combination. It tests the functions required for operation with that RF plug-in and provides the user an 80% confidence level that the instrument is meeting its specifications. Both the HP 86200 and 83500 Series RF plug-ins can be used to verify the operation of the HP 8350B Sweep Oscillator.

Operational verification of the HP 8350B Sweep Oscillator consists of performing the following tests:

- Frequency Range and Accuracy Test (RF plug-in manual)
- Output Amplitude Test (RF plug-in manual)
- Any other test(s) referred to in the paragraph titled OPERATION VERIFICATION in Section IV of the HP 83500 Series RF plug-in operating and service manual.
- Power Supply Tests (in this section)
- Tuning Voltage Test (in this section)
- HP-IB Operation Verification (in this section)

Completion of these tests provide assurance that the HP 8350B Sweep Oscillator and the RF plug-in are functioning properly and will meet the needs of an incoming inspection.

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LIMITED CALIBRATION

Limited calibration consists of performing **all** of the tests indicated in Section IV of a multi-band RF plug-in (HP 83590 series only) manual and **all** of the tests in this section. A multi-band HP 83590 Series RF plug-in is required to fully load the power supplies and exercise the analog and digital control lines of the sweep oscillator mainframe.

After completion of these HP 8350B Sweep Oscillator/HP 83590 series RF plug-in performance tests, the HP 8350B has limited calibration and may be used with any calibrated RF plug-in. The sweep oscillator and RF plug-in are considered independently calibrated and do not require further performance testing.

CERTIFIED CALIBRATION

For calibration measurements to be considered traceable to the National Bureau of Standards (NBS), or other internationally recognized standards, the following conditions must apply:

1. The HP 8350B Sweep Oscillator/HP 83500 Series RF plug-in combination must be calibrated using the performance tests referred to in Section IV of the HP 8350B Sweep Oscillator manual and the HP 83500 Series RF plug-in operating and service manual. The HP 8350B Sweep Oscillator/HP 83500 Series RF plug-in combination is considered to be a unique source and cannot be separated without breaking the traceability chain.

2. The calibration measurements must be made in a test environment which assures that the measurements are traceable to NBS through an unbroken chain of measurement standards, according to established procedures, and with measurement error/uncertainty known and appropriately allowed for at each level of the traceability path.

NOTE: It is not necessary to use an HP 83590 Series RF plug-in to certify the sweep oscillator/RF plug-in combination because the combination is considered a single instrument and the HP 8350B does not need to be loaded/exercised to its fullest capability.

TEST RECORDS

Results of the performance tests may be tabulated on the Performance Test Record at the end of Section IV of this manual and Section IV of the RF plug-in operating and service manual. The test records list all of the tested specifications and their acceptable limits. There is also a test record in the HP 83500 Series RF plug-in operating and service manuals for recording the results of an Operational Verification with a column for recording pass/fail indications.

CALIBRATION CYCLE

The performance tests, as referred to above, should be performed in intervals of one year or less for the HP 8350B. For plug-in calibration cycle, see the respective RF plug-in operating and service manual.

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NOTE: Allow the HP 8350B Sweep Oscillator and RF plug-in to warm up for one hour prior to doing any performance tests.

EQUIPMENT REQUIRED

The test equipment required for performance testing the HP 8350B Sweep Oscillator/RF plug-in combination are listed in Section I of this manual and Section I of the RF plug-in manual. Any equipment which satifies the critical specifications given in the tables may be substituted for the recommended model.

Table 4-1. Performance Tests

4-1.	Power Supply Tests
4-2.	Tuning Voltage Test

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4-1. Power Supply Tests

SPECIFICATIONS

+20 VDC	±10 mV
−10 VDC	± 5 mV
−40 VDC	±20 mV

DESCRIPTION

A Digital Voltmeter (DVM) is used to check the +20V, −10V, and −40V power supplies within the tolerances shown above. If they do not meet these tolerances , refer to Section V, +20V, −10V, −40V Power Supply Adjustments.

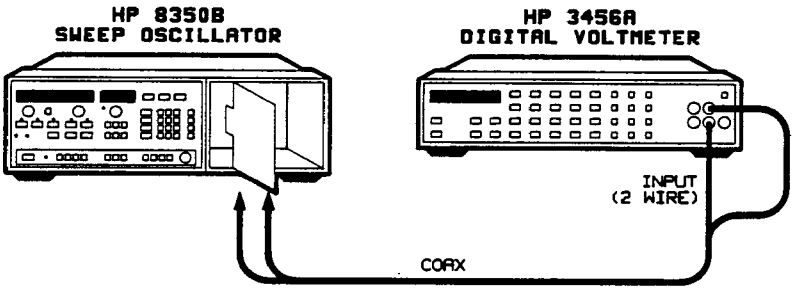


Figure 4-1. Power Supply Test Setup

EQUIPMENT

Special Service Board	HP Part Number 08350-60069
Digital Voltmeter	HP 3456A

PROCEDURE

1. Plug the Special Service Board into the HP 8350B mainframe plug-in interface connector, located at the back of the RF plug-in tunnel.
2. Set the HP 8350B LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.
3. Connect DVM LO to +20V RETURN and DVM HI to +20V. The DVM display should be +20.000V ±10 mV. Record the results on the test record.
4. Move the DVM probes to −40V RETURN (LO) and +40V (HI). The DVM display should be −40.000V ±20 mV. Record the results on the test record.
5. Move the DVM probes to −10V RETURN (LO) and −10V (HI). The DVM display should be −10.000V ±5mV. Record the results on the test record.

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4-2. Tuning Voltage Test

SPECIFICATIONS

CW 0 GHz:	VTUNE 0.000 ± 4.0 mV
CW 5 GHz:	VTUNE 5.000 ± 4.0 mV
CW 10 GHz:	VTUNE 10.000 ± 4.0 mV

DESCRIPTION

Ensure that the HP 8350B Tuning Voltage output conforms to the tolerances given above. If it does not, refer to Section V, Adjustments, and perform the following adjustments:

+10V REF DAC Power Supply Adjustments
Sweep Time Adjustments
Manual Sweep Adjustments
Retrace Adjustments
Frequency Control Adjustments
Marker DAC Adjustments

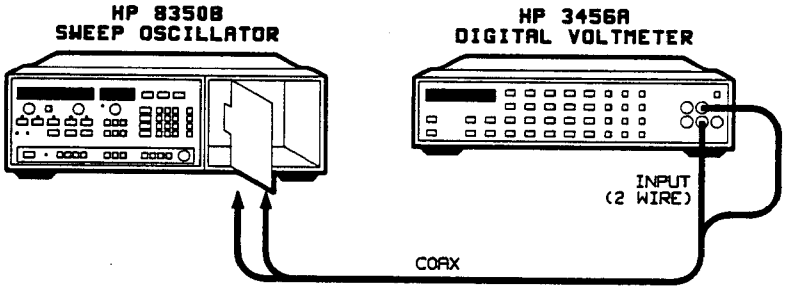


Figure 4-2. Tuning Voltage Check Test Setup

EQUIPMENT

Special Service Board	HP Part Number 08350-60069
Digital Voltmeter	HP 3456A

PROCEDURE

1. Plug the special service board into the HP 8350B mainframe plug-in interface connector, located at the back of the RF plug-in tunnel.
2. Set HP 8350B LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.

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3. Connect DVM LO to VTUNE RETURN and DVM HI to VTUNE.

4. Press **[CW] [0] [GHz]**. The DVM display for VTUNE should be 0.000V ±4 mV. Record the results on the test record.

5. Press **[CW] [5] [GHz]**. The DVM display for VTUNE should be 5.000V ±4 mV. Record the results on the test record.

6. Press **[CW] [1] [0] [GHz]**. The DVM display for VTUNE should now be 10.000V ±4 mV. Record the results on the test record.

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Table 4-2. HP-IB Operation Verification Program Using the HP 200, 300, and 85 Series Desktop Computers (1 of 2)

NOTE: Comments included in the program are for clarity only! They are not required for the proper operation of the program.

Execute the following program:

```
10   !HP-IB OPERATION VERIFICATION TEST
20   !HP BASIC 4.0 SERIES 200/300. 01AUG86
21   !!
30   PRINT IS 1                !SETS THE DISPLAY AS PRINTER
40   PRINT CHR$(12)            !CLEARS THE DISPLAY
41   DIM A$[3], B$[3]
50   So=719                    !THE ADDRESS OF THE SWEEP
51                             !OSCILLATOR IS ON INTERFACE
60                             !INTERFACE SELECT CODE 7
61                             !WITH PRIMARY ADDRESS 19.
70   ON TIMEOUT 7,15,0, CAL Hpib
71   CLEAR So
80   REMOTE So
90   PRINT "CHECK REMOTE LIGHT, PRESS CONTINUE IF ON."
100  PAUSE
110  OUTPUT So; "IP;"          !SETS 8350 TO INSTR PRESET
120  WAIT 10.0
130  OUTPUT So; "ST 100 MS;"           !SWEEP TIME 100 ms
140  WAIT 2.0
150  OUTPUT So; "OPST;]                !INTEROGATES SWEEP TIME
160  ENTER So;A                        STORES READING IN A
161  !
170  IF A=.1 THEN
180    CALL Check_data(So)             !CALLS SUBROUTINE
190  ELSE
200    PRINT "PROGRAMMABILITY OR READ ERROR. HP-IB TEST FAILS."
210  STOP
220  END IF
221  !
223  CALL Check_(So)                   !CALLS SUBROUTINE
224  PRINT "HANDSHAKE LINES CHECKED."
226  !
227  OUTPUT So;"IP;"
230  LOCAL So !RETURNS THE 50B TO LOCAL MODE
231  !
240  End: PRINT "END OF TEST. HP-IB IS VERIFIED."
250     END
251  !!!!!!
260  SUB Check_data(So)
270  OUTPUT So; "RM"&CHR$(170)
280  OUTPUT So; "SH 00 M1 0114 M3"
290  ENTER So;A$
300  WAIT .2
301  !
```


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Table 4-2. HP-IB Operation Verification Program Using the HP 200, 300, and 85 Series Desktop Computers (2 of 2)

```
311  OUTPUT So; "RM"&CHR$(85)
320  OUTPUT So; "SH 00 M1 0114 M3"
330  ENTER So;B$
340  WAIT .2
341  !
350  IF A$[1,2]="AA" AND B$[1,2]="55" THEN
360     PRINT "DATA LINES CHECKED."
370   ELSE
380     PRINT "DATA BUS ERROR. HP-IB TEST FAILS."
390  STOP
400  END IF
401  !
410  SUBEND
411  !!!
420  SUB Hpib
430  PRINT "INTERFACE TIMEOUT ERROR."
440  PRINT "CHECK HP-IB CABLE/CONNECTIONS."
450  STOP
460  SUBEND
461  !!!
470  SUB Check_status (So)
480  OUTPUT So; "RM"&CHR$(5)
490  OUTPUT So; "RE"&CHR$(1)
500  OUTPUT So; "IP CS"
510  ON INTR 7 GOTO Statusbyte1
520  ENABLE INTR 7;66
522  !
530  Statusbyte1: STATUS 7,4;A
540  B=SPOLL(So)
550  IF A=64 THEN
560     PRINT "HANDSHAKE LINE ERROR. HP-IB TEST FAILS."
570  ELSE
580     IF BIT(B,0)=1 THEN PRINT "FRONT PANEL SRQ."
590  END IF
591  !
600  ENABLE ITNR 7;66
610  SUBEND
620  !!!!!!
```

NOTE: For further information regarding programming notes refer to the information under the title PROGRAMMING NOTES.

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Table 4-3. Performance Test Record

HP 8350B Sweep Oscillator Tested by _____

Serial No. _____ Date _____

Humidity* _____ Temperature* _____

(*optional)

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	LOWER LIMIT	MEASURED VALUE	UPPER LIMIT
4-1. Power Supply Tests	3.	+20V REG	+19.990V	_____	+20.010V
	4.	−40V REG	−39.980V	_____	−40.020V
	5.	−10V REG	−9.995V	_____	−10.005V
4-2. Tuning Voltage Test	4.	CW 0 GHz	−0.996V	_____	+0.004V
	5.	CW 5 GHz	+4.996V	_____	+5.004V
	6.	CW 10 GHz	+9.996V	_____	+10.004V
Table 4-2. HP-IB Operation Verification*		Functional Test Only Pass/Fail		_____	

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Section V. Adjustments

INTRODUCTION

This section provides adjustment procedures for the HP 8350B Sweep Oscillator. These procedures should not be performed as routine maintenance but should be used after replacement of a part or component. Table 5-I lists all of the adjustments by reference designation, adjustment name, adjustment paragraph, and description. Each procedure includes a test setup illustration and one or more adjustment location illustrations.

NOTE: Allow the HP 8350B Sweep Oscillator to warm up for 30 minutes prior to making any adjustments.

SAFETY CONSIDERATIONS

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition. Service and adjustments should be performed only by a skilled person who is aware of the hazard involved.

WARNING

Adjustments in this section are performed with power supplied to the instrument while protective covers are removed. There are voltages at points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Adjustments should be performed only by a skilled person who is aware of the hazard involved.

WARNING

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

NOTE: Use a non-metallic adjustment tool whenever possible.

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Table 5-1. Adjustable Components

Reference Designation	Adjustment Name	Adjustment Paragraph	Description
A4R2	ΔF OFFSET	5-8	Sets low end of band frequency accuracy (OFFSET) in ΔF sweep mode.
A4R15	ΔF2	5-8	Sets frequency accuracy (GAIN) in ΔF sweep mode for ΔF settings <1/8 and ≥1/64 of RF plug-in band.
A4R18	ΔF3	5-8	Sets frequency accuracy (GAIN) in ΔF sweep mode for ΔF settings <1/64 of RF plug-in band.
A4R22	VERNIER	5-8	Sets symmetry (GAIN) of VERNIER control at low end of VERNIER range.
A4R25	ΔF1	5-8	Sets high end of band frequency accuracy (GAIN) in ΔF sweep mode for ΔF settings ≥1/8 of RF plug-in band.
A4R27	CW	5-8	Sets frequency accuracy (GAIN) in CW sweep mode.
A4R28	MKR	5-9	Sets marker frequency accuracy (GAIN).
A4R44	CW OFFSET	5-8	Sets symmetry (OFFSET) of VERNIER at high end of VERNIER range.
A4R59	+10V REF	5-4	Adjusts +10V REF DAC power supply.
A5R2	10 mSEC	5-5	Sets sweep time accuracy for sweep times <1 second.
A5R25	1 SEC	5-5	Sets sweep time accuracy for sweep times from 1 second to 100 seconds.
A5R43	MANUAL	5-6	Sets sweep ramp accuracy in MANual sweep mode.
A5R77	SWEEP RETRACE	5-7	Sets forward sweep plus retrace sweep time.
A7R10	+20V	5-1	Adjusts +20V REG power supply
A7R21	−10V	5-1	Adjusts −10V REG power supply
A7R39	−40V	5-1	Adjusts −40V REG power supply
A7R58	AIRFLOW BAL	5-2	Adjusts airflow detection circuit temperature threshold.
A7R105	+5VA	5-3	Adjusts the output of A7U16 (+5VA REG)
A7R106	+5VB	5-3	Adjusts the output of A7U10 (+5VB REG)

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EQUIPMENT REQUIRED

Table 1-4 lists the equipment required for the adjustment procedures. If the test equipment recommended is not available, other equipment may be used if its performance meets the critical specifications listed in Table 1-4. The specific equipment required for each adjustment is referenced in each procedure.

NOTE: For accurate adjustments, a coaxial cable with attached minimum length probes must be used.

RELATED ADJUSTMENTS

Interactive adjustments are noted in the adjustment procedure. Table 5-3 indicates, by paragraph numbers, the adjustments that must be performed if an assembly has been repaired or replaced or if an adjustment has been made on an assembly. Table 5-2 lists the adjustment procedures included in this section.

Table 5-2. Adjustments

Paragraph	Adjustment
5-1	+20V, −40V, and −10V POWER SUPPLY ADJUSTMENTS
5-2	AIRFLOW DETECTOR ADJUSTMENT
5-3	+5VA/B POWER SUPPLY ADJUSTMENT
5-4	+10V REF DAC POWER SUPPLY ADJUSTMENT
5-5	SWEEP TIME ADJUSTMENTS
5-6	MANUAL SWEEP ADJUSTMENT
5-7	SWEEP RETRACE TIME ADJUSTMENTS
5-8	FREQUENCY CONTROL ADJUSTMENTS
5-9	MARKER DAC ADJUSTMENT

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Table 5-3. Related Adjustments

Assembly Changed or Repaired	Related Assemblies	Perform the Following Adjustments
A1 Front Panel	A1	None
A2 Front Panel Interface	A2	None
A3 Microprocessor	A3	None
A4 Scaling and Marker	A4, A5	5-4 5-6 5-8 5-9
A5 Sweep Generator	A6, A7	5-4 5-6 5-7
A6 Rectifier	A6, A7	5-1 5-2 5-3
A7 Regulator	A7	5-1 5-2 5-3
A8 HP-IB Interface	A8	None

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5-1. +20V, −40V, AND −10V Power Supply Adjustments

REFERENCE

A7 Regulator

DESCRIPTION

The +20V, −40V, and −10V power supplies are adjusted under load for the proper voltage levels with an HP 83500 Series RF plug-in or an 11869 RF plug-in adapter installed.

NOTE: Special Service Board (HP Part Number 08350-60069) may be used instead of an RF plug-in or HP 11869A RF plug-in adapter.

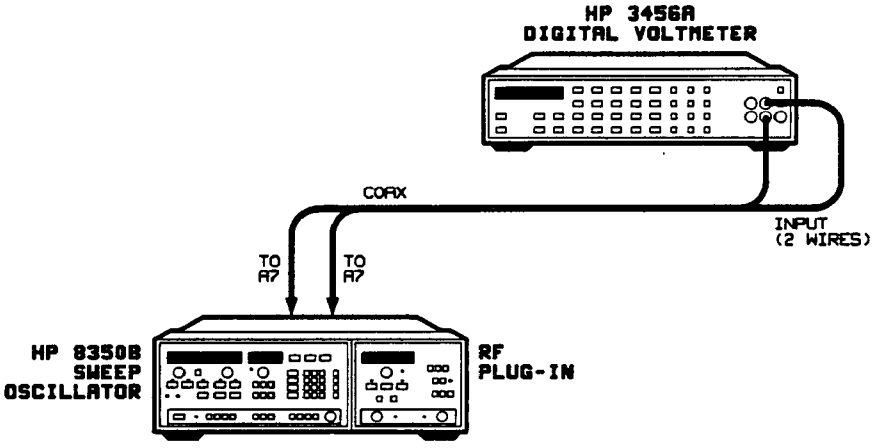


Figure 5-1. +20V, −40V, and −10V Power Supply Adjustments Setup

EQUIPMENT

RF Plug-In	Any HP 83500 Series RF Plug-In, HP 11869 RF Plug-In Adapter, or Special Service Board, HP Part Number 08350-60069.
Digital Voltmeter (DVM)	HP 3456A

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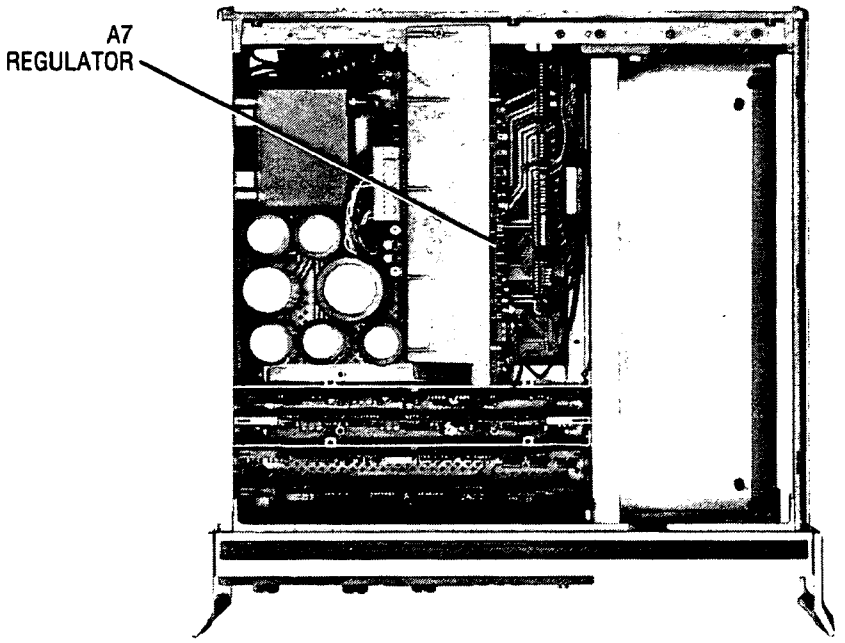
5-1. +20V, −40V, AND −10V Power Supply Adjustments (Cont'd)

PROCEDURE

1. Install an HP 83500 Series RF Plug-In, the HP 11869 RF Plug-In Adapter or the special service board in the HP 8350B mainframe.
2. Set LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.
3. Position the sweep oscillator as shown in Figure 5-1 and remove the top and bottom covers.
4. Connect the DVM input LO terminal to A7TP16 (+20V RETURN SENSE), and input HI terminal to A7TP15 (+20V SENSE). A7DS2 (green LED) should be lit. Refer to Figure 5-2 for A7 regulator component locations.
5. Adjust A7R10 (+20V ADJ) if necessary for a DVM reading of 20.000 ± 0.001 VDC.
6. Connect the DVM input LO terminal to A7TP17 (−40V SENSE) and input HI terminal to A7TP18 (−40V RETURN SENSE). A7DS4 should be lit.
7. Adjust A7R39 (−40V ADJ) if necessary for a DVM reading of −40.000 ± 0.002 VDC.
8. Connect the DVM input LO terminal to A7TP8 (−10 V SENSE) and input HI terminal to A7TP9 (−10V RETURN SENSE). A7DS3 should be lit.
9. Adjust A7R21 (−10V ADJ) if necessary for a DVM reading of −10.000 ± 0.001 VDC.

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5-1. +20V, −40V, AND −10V Power Supply Adjustments (Cont'd)



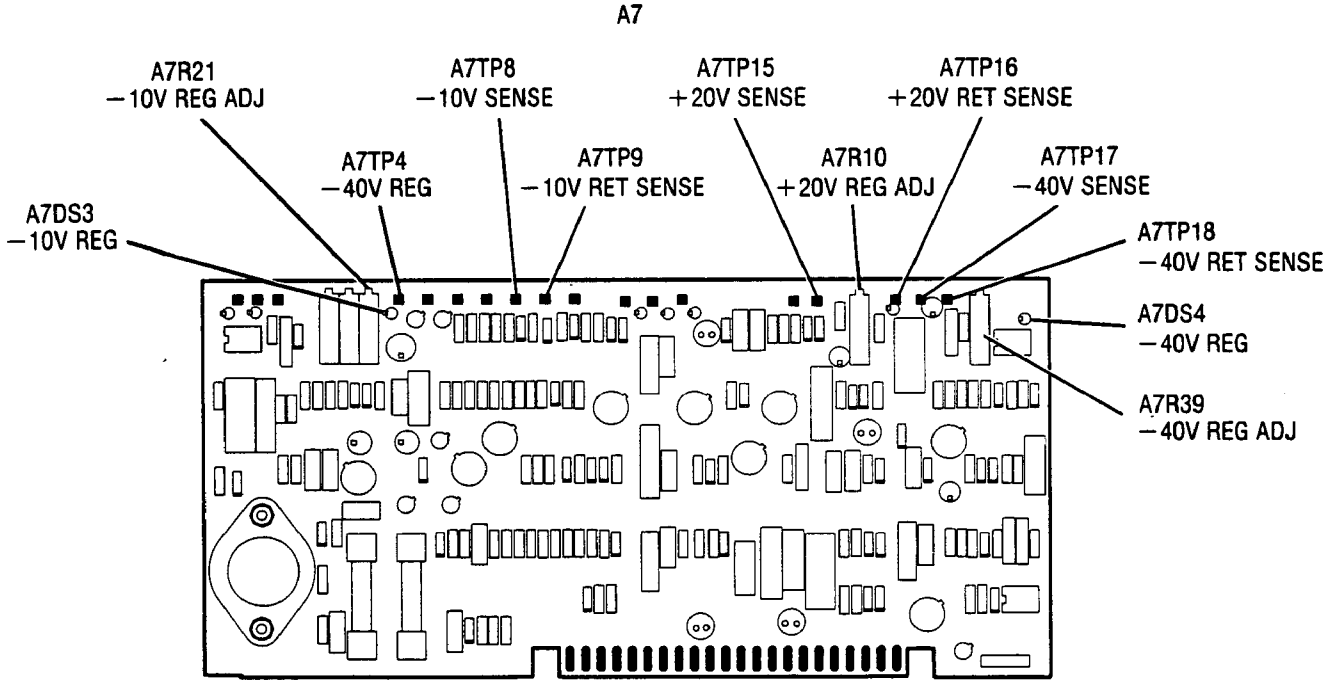


Figure 5-2. Location of +20V, −40V, and −10V Power Supply Adjustments

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5-2. Airflow Detector Adjustment

REFERENCE

A7 Regulator

DESCRIPTION

The airflow detection circuit senses the internal air flow generated by fan B1 and flags the A3 microprocessor if the airflow is restricted. To adjust A7R58 properly, allow the instrument to warm up to operating temperature and jumper A7R53 by a short to remove the hysteresis from comparator A7U11. Then adjust A7R58 until the inputs are balanced which will then cause A7U11 output LPST (Low Power Supply Temperature) to oscillate. LPST is monitored by the A3 microprocessor for the logic state of the airflow detection circuit. This logic state is then applied to the status buffer at hexadecimal location 1000H. A hexadecimal data read command (M3) is entered which then displays the current status buffer state on the FREQUENCY/TIME LEDs. When the display LEDs oscillate between 00H and 02H, indicating LPST is oscillating, A7R58 is adjusted correctly.

PROCEDURE

CAUTION

Before removing or installing RF plug-in (adapter, service board) set the HP 8350B line switch to OFF.

1. Remove the RF plug-in from the sweep oscillator mainframe.
2. Set the LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.
3. Position the sweep oscillator upright and remove the top cover.
4. Short A7TP6 and A7TP7 together. This removes the hysteresis from comparator A7U11. Refer to Figure 5-3 for the location of A7TP6 and A7TP7.
5. Replace the top cover and allow the instrument to operate with top cover in place for 5 minutes.
6. Press **[INSTR PRESET] [SHIFT] [0] [0] [M1] [1] [0] [0] [0] [M3]**. This enables the hexadecimal data in the status buffer (at address location 1000H) to be displayed on the front panel FREQUENCY/TIME LEDs. The LED display should now read 1000 00 or 1000 02.

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5-2. Airflow Detector Adjustment (Cont'd)

7. Adjust A7R58 AIRFLOW BAL until the LED display oscillates between 1000 00 and 1000 02. Refer to Figure 5-3 for A7R58 adjustment location.

NOTE: A7R58 (AIRFLOW BAL) adjustment potentiometer is accessable through the hole in the left support of the RF plug-in opening. This adjustment **MUST** be made with the HP 8350B at normal operating temperature and all covers in place.

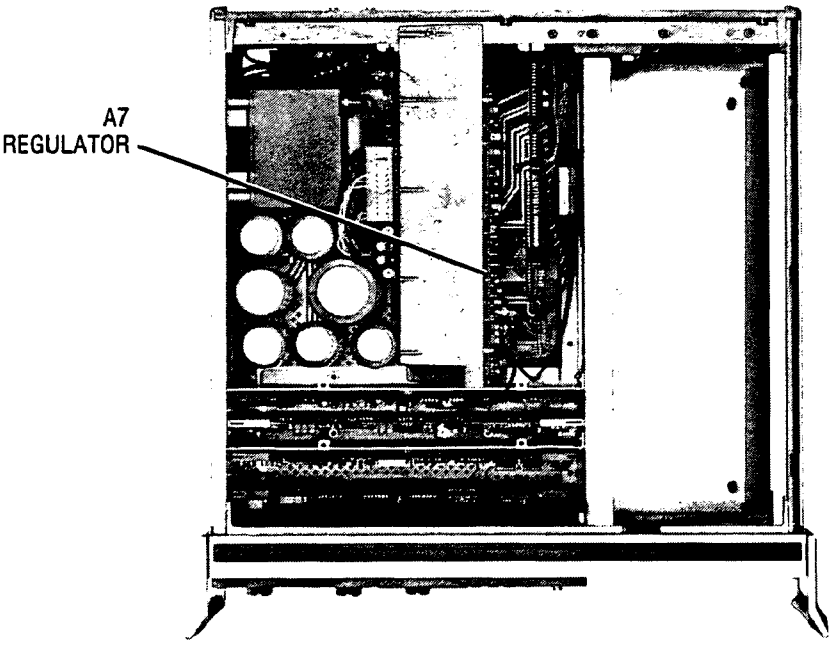
8. Wait 1 minute after adjustment to insure that the display still oscillates. If it does not, and has settled at 1000 00 or 1000 02, repeat steps 6 and 7.

9. Remove jumper from A7TP6 and A7TP7.

10. Verify that the display indicates 1000 00.

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5-2. Airflow Detector Adjustment (Cont'd)



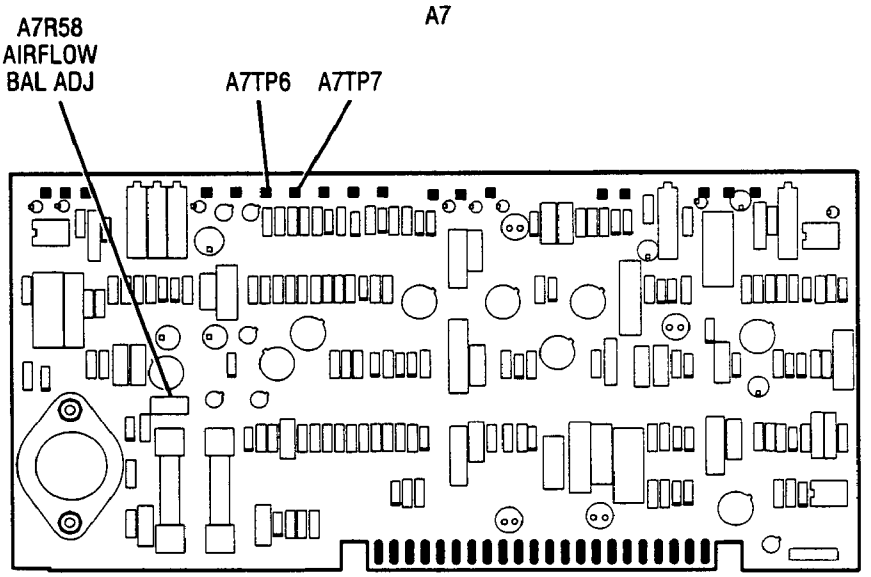


Figure 5-3. Location of AIRFLOW BALance Adjustment

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5-3. +5VA/B Power Supply Adjustment

REFERENCE

A7 Regulator Assembly

DESCRIPTION

A7R106 is adjusted to set the output of A7U10 (+5VB REG) to 5.33 + 0.03 VDC in a no load condition (without an RF plug-in installed).

A7R105 is adjusted to set the output of A7U16 (+5VA REG) to 5.11 + 0.04 VDC in a no load condition (without an RF plug-in installed).

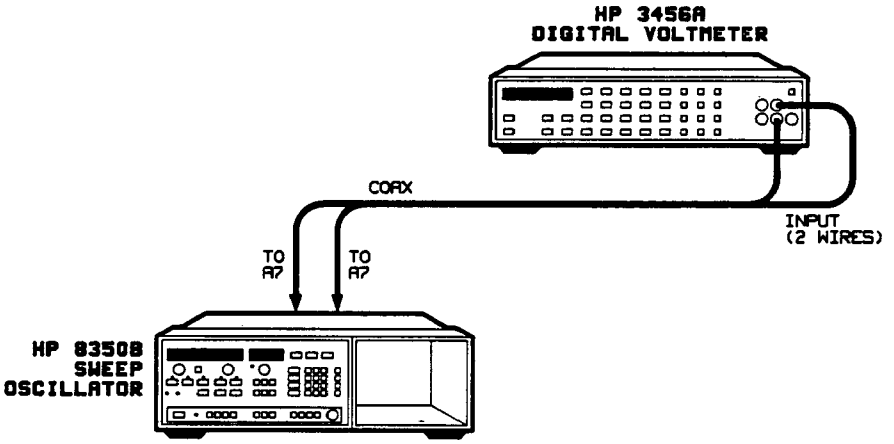


Figure 5-4. +5VA/B Power Supply Adjustment Setup

EQUIPMENT

Digital Voltmeter . . . . . HP 3456A

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5-3. +5VA/B Power Supply Adjustment (Cont'd)

PROCEDURE

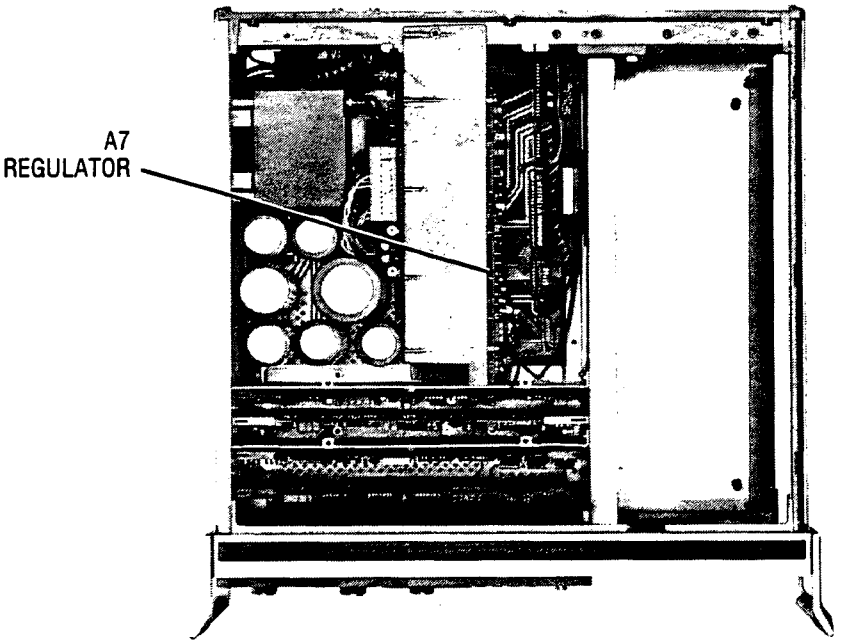
CAUTION

Before removing or installing RF plug-in (adapter, service board) set the HP 8350B line switch to OFF.

1. Remove the RF plug-in from sweep oscillator mainframe.
2. Set the LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.
3. Position the sweep oscillator upright, as shown in Figure 5-4, and remove the top cover.
4. Connect the DVM to A7TP1 (+5VA REG) and +5VA GND REF (Ground 1). +5VA GND REF may be found on the cathode (square pad on P.C. Board) of DS8.
5. The DVM should indicate +5.11 ±0.04 VDC. If it does not, A7R105 must be adjusted as necessary to achieve the proper voltage. Refer to Figure 5-5 for A7R105 component location.
6. Connect the DVM to A7TP2 (+5VB REG) and A7TP3 (+5VB GND REF.). A7DS1 (green LED) should be lit.
7. The DVM should indicate 5.33 ± 0.03 Vdc. If it does not, A7R106 must be adjusted as necessary to achieve the proper voltage. Refer to Figure 5-5 for A7R106 component location.

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5-3. +5VA/B Power Supply Adjustment (Cont'd)



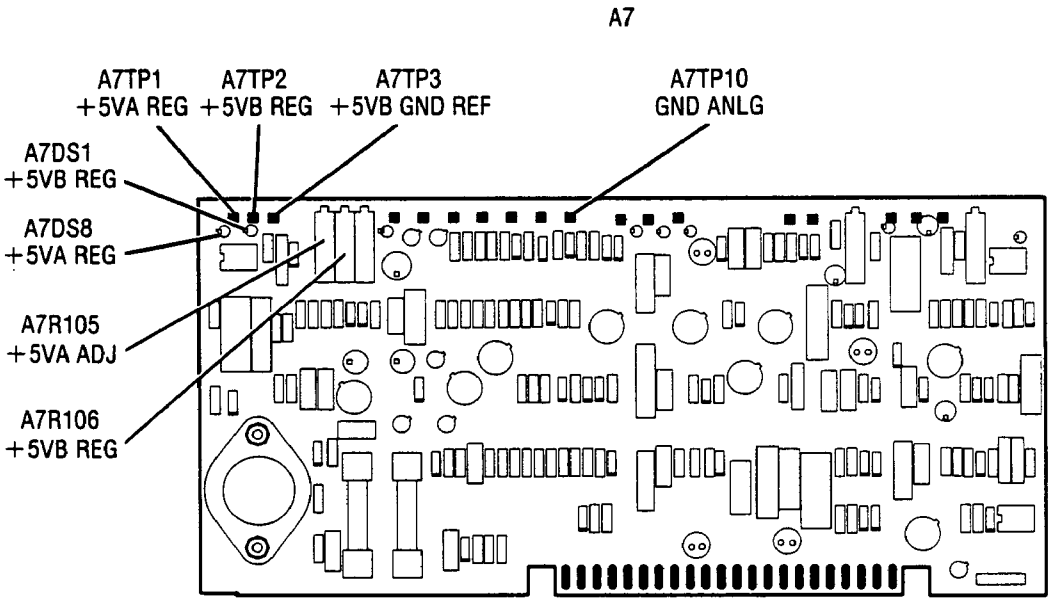


Figure 5-5. Location of +5VA, and +5VB Power Supply Adjustments

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5-4. +10V REF DAC Power Supply Adjustment

REFERENCE

A4 Scaling and Marker Assembly

DESCRIPTION

A4R59 (+10V REF) adjustment is adjusted for the proper voltage level to provide an accurate reference voltage for all Digital-to-Analog Converts (DACs) in the HP 8350B mainframe.

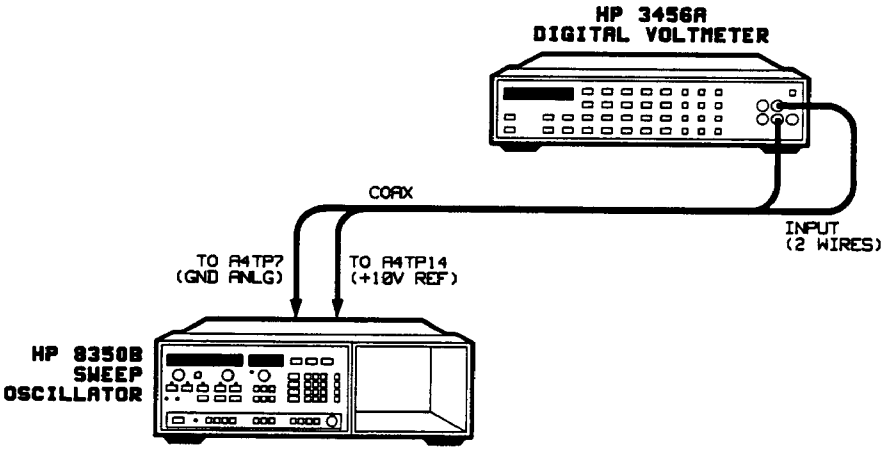


Figure 5-6. +10V REF DAC Power Supply Adjustment Setup

EQUIPMENT

Digital Voltmeter ..... HP 3456A

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5-4. +10V REF DAC Power Supply Adjustment (Cont'd)

PROCEDURE

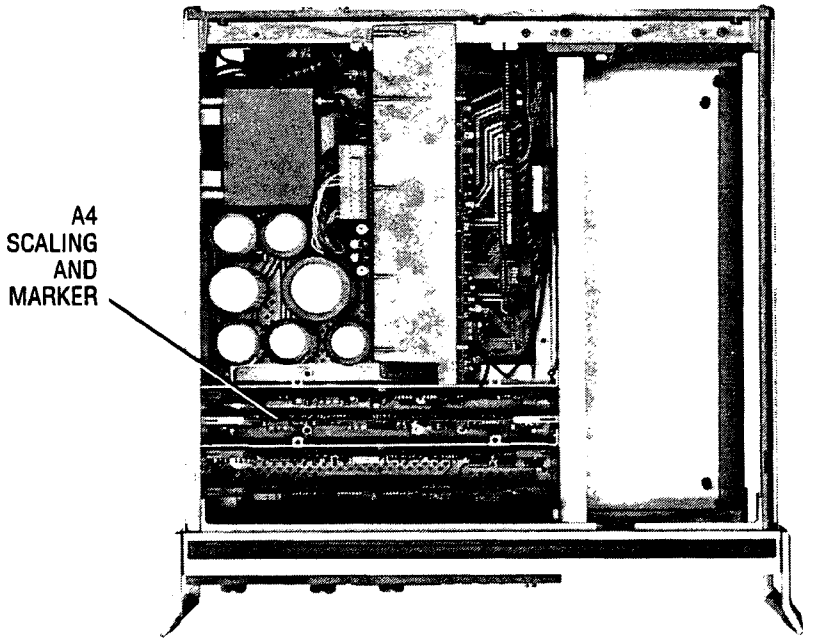
CAUTION

Before removing or installing RF plug-in (adapter, service board) set the HP 8350B line switch to OFF.

1. Remove the RF plug-in from the sweep oscillator mainframe.
2. Set the LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.
3. Position the sweep oscillator upright as shown in Figure 5-6 and remove the top cover and the A4/A5 shield cover.
4. Connect the DVM to A4TP14 (+10V REF) and A4TP7 (GND ANLG) as shown in Figure 5-6.
5. Adjust A4R59 (+10V REF ADJ) for a DVM reading of 10.0000 ± 0.0001 VDC. Refer to Figure 5-7 for location of adjustment.

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5-4. +10V REF DAC Power Supply Adjustment (Cont'd)



A4

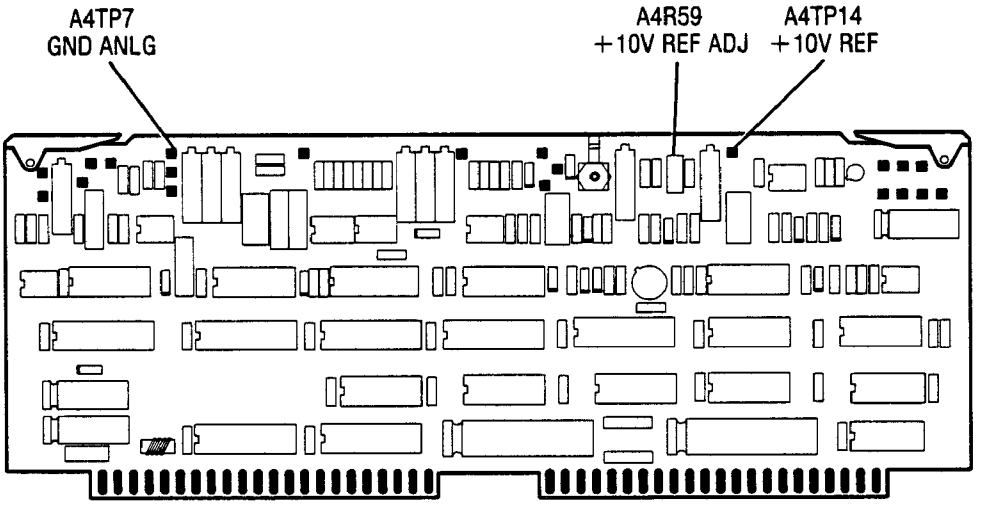


Figure 5-7. Location of +10V REF DAC Power Supply Adjustments

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5-5. Sweep Time Adjustments

REFERENCE

A5 Sweep Generator

DESCRIPTION

Programmable current source A5U2 is a 10-bit DAC whose output current determines the sweep time (slope) of the sweep ramp. Input reference current is supplied by the +10V REF power supply through A5R4 and A5R2 (10 mSEC ADJ) for sweep times < 1 second. For sweep times from 1 second to 100 seconds, input reference current is supplied by the +10V REF power supply through A5R28 and A5R25 (SEC ADJ). HP 8350B rear panel POS Z BLANK BNC output goes low during the forward sweep time and is monitored by a time interval counter (returns high during sweep retrace). A5R2 is adjusted during a 10 ms sweep and A5R25 is adjusted during a 1 second sweep to give the proper forward sweep times for a fast and slow sweep.

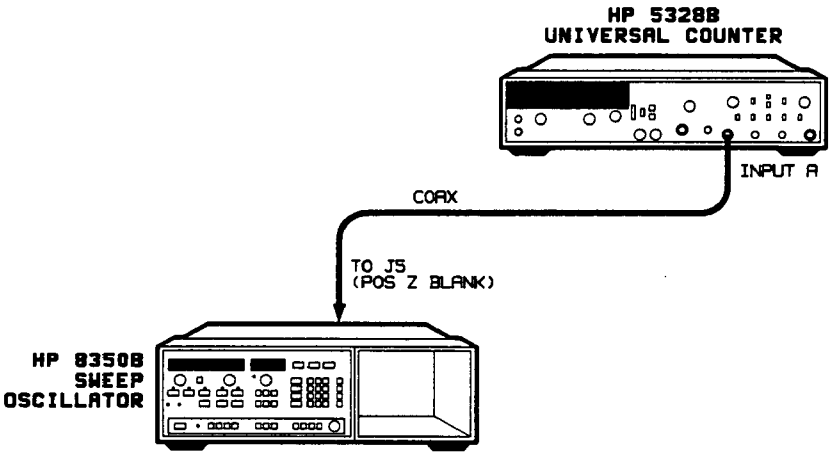


Figure 5-8. Sweep Time Adjustments Setup

EQUIPMENT

Universal Counter . . . . . HP 5328B

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5-5. Sweep Time Adjustments (Cont'd)

PROCEDURE

CAUTION

Before removal of RF plug-in (adapter, service board) set the HP 8350B line switch to OFF.

1. Remove the RF plug-in from the sweep oscillator mainframe.
2. Set the HP 8350B LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.

NOTE: The validity of this adjustment procedure is based in part on the accuracy of the +10V REF DAC power supply. Proper adjustment of the +10V REF DAC power supply is necessary before proceeding with this adjustment procedure.

3. Connect POS Z BLANK BNC output on the rear panel of the HP 8350B to INPUT A on the HP 5328B Universal Counter and set the HP 5328B controls as follows:

FUNCTION	TI A→B
SAMPLE RATE	CCW
OSC (rear panel)	INT
ARM ON/OFF (rear panel)	OFF
STORAGE ON/OFF (rear panel)	ON
POWER	ON
Input Amplifier Control Switch	COM A
Channel A SLOPE	−
Channel A Coupling	DC
Channel A ATTEN	X10
Channel A Trigger LEVEL A	CW
Channel B SLOPE	+
Channel B Coupling	DC
Channel B ATTEN	X10
Channel B Trigger LEVEL B	CW

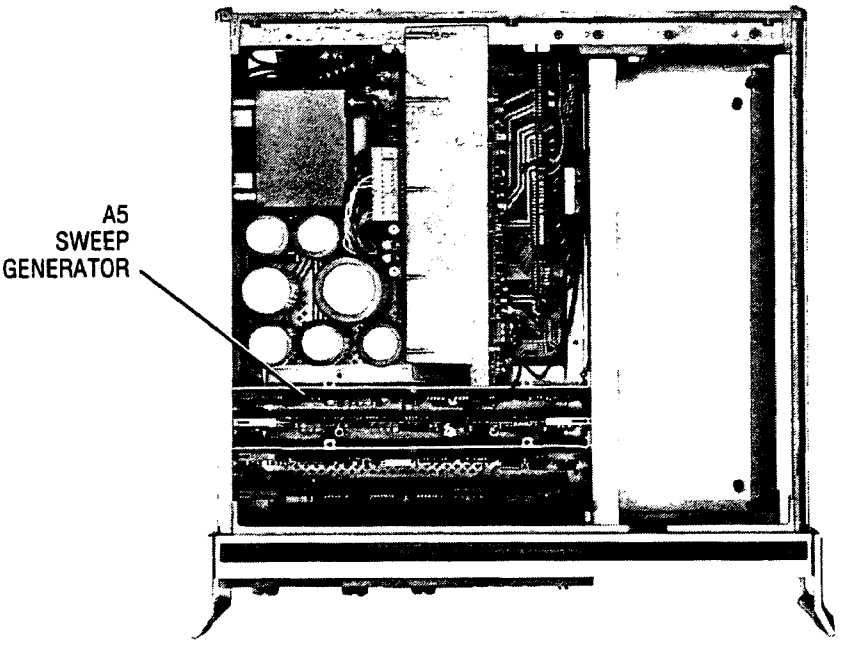
4. Position the sweep oscillator upright as shown in Figure 5-8 and remove the top cover.
5. Press **[INSTR PRESET] [SWEEP TIME] [1] [0] [ms]**.
6. Set the HP 5328B FREQUENCY RESOLUTION, N control to 10 KHz. From the CW position, adjust Channel A and B trigger LEVELS CCW until just past the point where both triggering LEDs blink.

NOTE: The setting of the HP 5328B triggering controls is critical for an accurate time interval measurement.

7. Adjust A5R2 (10 mSEC ADJ) for a counter reading of 10.000 ± 0.020 ms. Refer to Figure 5-9 for location of the adjustment.
8. Press **[INSTR PRESET] [SWEEP TIME] [1] [s]**.
9. Adjust A5R25 (1 SEC ADJ) for a counter reading of 1000 ± 5 ms.

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5-5. Sweep Time Adjustments (Cont'd)



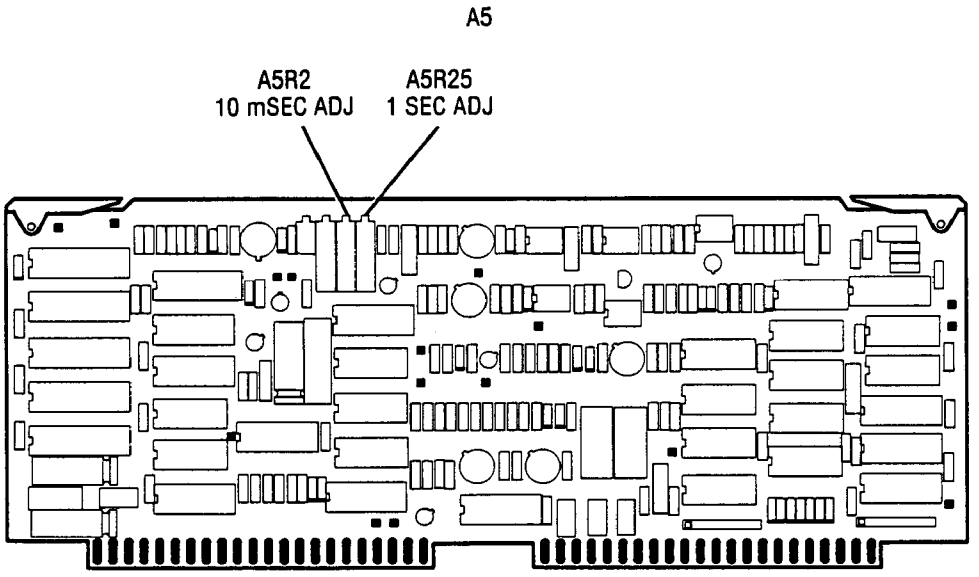


Figure 5-9. Location of Sweep Time Adjustments.

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5-6. Manual Sweep Adjustment

REFERENCE

A4 Scaling and Marker
A5 Sweep Generator

DESCRIPTION

A5R43 MANUAL sweep adjust sets the gain of sweep ramp generator output amplifier A5U3 (when operating in a linear mode during MANUAL SWEEP). The adjustment is made with the A5 sweep generator sweep ramp DAC, A5U2, at the high end of its range so that the upper limit of the manual sweep voltage is the same as the +10V clamped level which limits normal sweeps. The output is monitored at A4TP11 (VTUNE) which is the point at which the reference sweep voltage is sent to the RF plug-in.

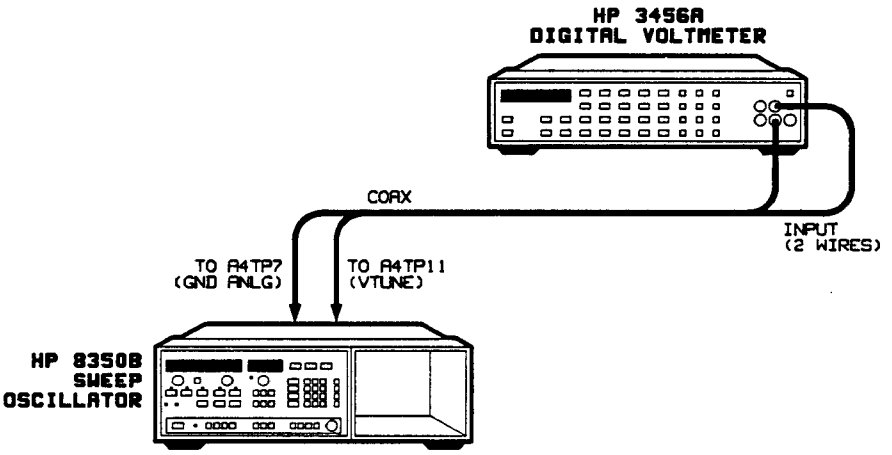


Figure 5-10. Manual Sweep Adjustment Setup

EQUIPMENT

Digital Voltmeter . . . . . HP 3456A

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5-6. Manual Sweep Adjustment (Cont'd)

PROCEDURE

CAUTION

Before removing or installing RF plug-in (adapter, service board) set the HP 8350B line switch to OFF.

1. Remove the RF plug-in from the sweep oscillator mainframe.
2. Set the LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.
3. Position the sweep oscillator upright, as shown in Figure 5-10, and remove the top cover.

NOTE: The validity of this adjustment procedure is based in part on the accuracy of the Sweep Time Adjustments. Proper adjustment of the forward sweep times is necessary before proceeding with this adjustment procedure.

4. Connect the DVM to A4TP11 (VTUNE) and A4TP7 (GND ANLG).
5. Press **[INSTR PRESET]**.
6. Press **[SHIFT] [0] [0] [M1] [2] [0] [1] [6] [M2] [GHz] [9]**. The FREQUENCY/TIME display should indicate C9. This sets the control line outputs from A5U8 to the A5 sweep generator circuits for a manual sweep condition.
7. Press **[M1] [2] [0] [1] [7] [M2] [BK SP] [dBm]**. The FREQUENCY/TIME display should indicate FE. This sets the sweep ramp generator DAC A5U2 to 4 bits below its maximum level.
8. Adjust A5R43 (MANUAL) adjust until the voltage clamps at the upper limit. The adjustment is set correctly at the point when the voltage just clamps at the maximum level (typically about +10 VDC).

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5-6. Manual Sweep Adjustment (Cont'd)

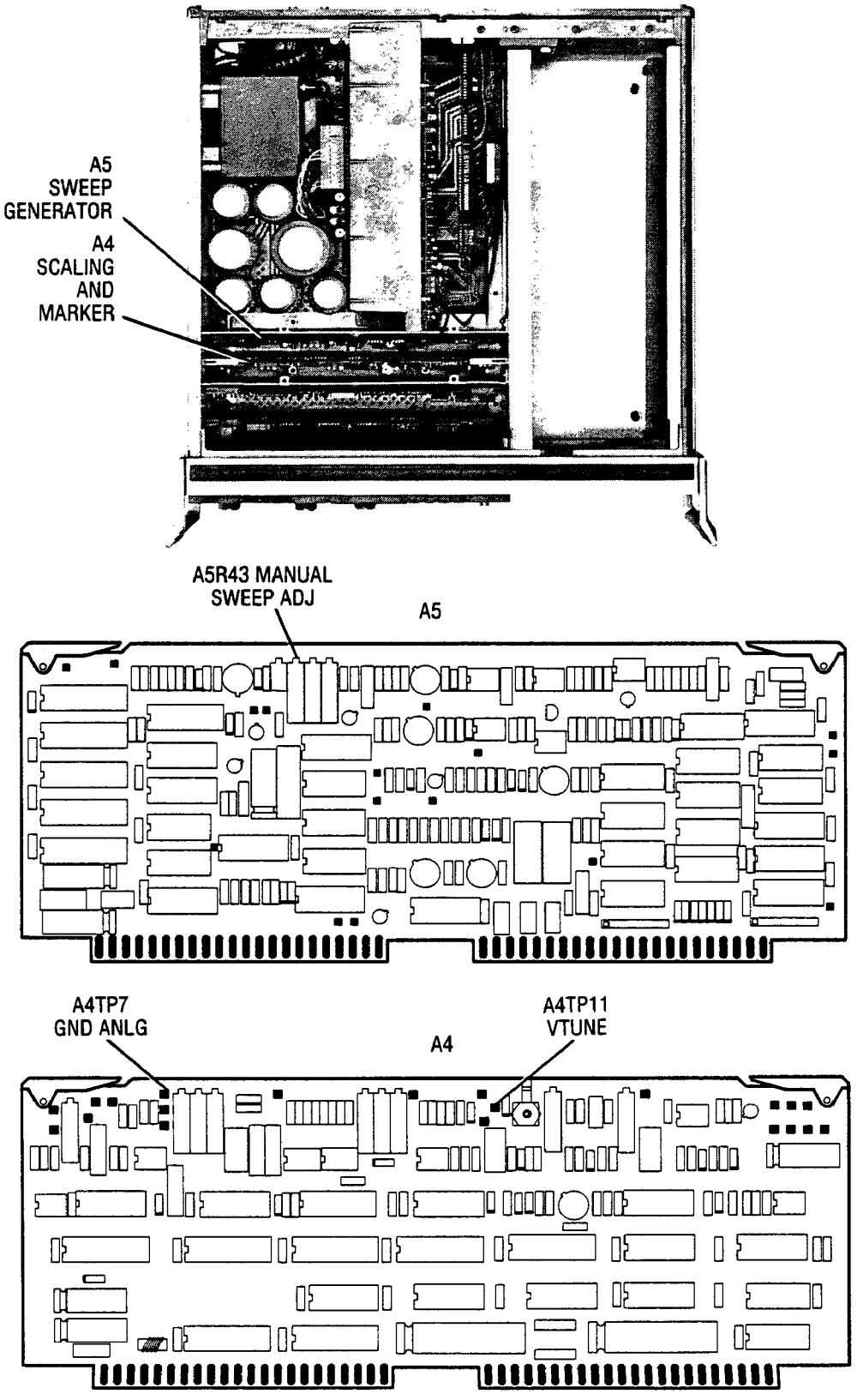


Figure 5-11. Location of Manual Sweep Adjustment.

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5-7. Sweep Retrace Time Adjustments

REFERENCE

A5 Sweep Generator

DESCRIPTION

The integrating capacitors, which are used to generate the sweep ramp on the A5 sweep generator assembly, discharge through A5R77 and A5R20 during sweep retrace. By monitoring forward sweep time plus retrace time at the rear panel POS Z BLANK output (high=sweep retrace, low=forward sweep) with a time interval counter, A5R77 is adjusted during a 10 ms sweep to give a total sweep plus retrace time of 15.00 ± 1.0 ms. This insures that the sweep oscillator will trigger on the line frequency repetitively.

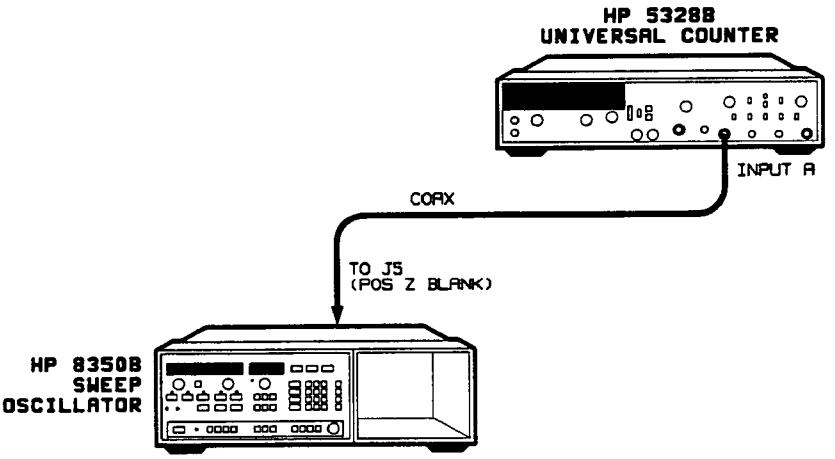


Figure 5-12. Sweep Retrace Time Adjustments Setup

EQUIPMENT

Universal Counter . . . . . HP 5328B

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5-7. Sweep Retrace Time Adjustments (Cont'd)

PROCEDURE

CAUTION

Before removing or installing RF plug-in (adapter, service board) set the HP 8350B line to OFF.

1. Remove the RF plug-in from the sweep oscillator mainframe.
2. Set the HP 8350B LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.

NOTE: The validity of this adjustment procedure is based in part on the accuracy of the sweep time adjustments. Proper adjustment of the forward sweep times is necessary before proceeding with this adjustment procedure.

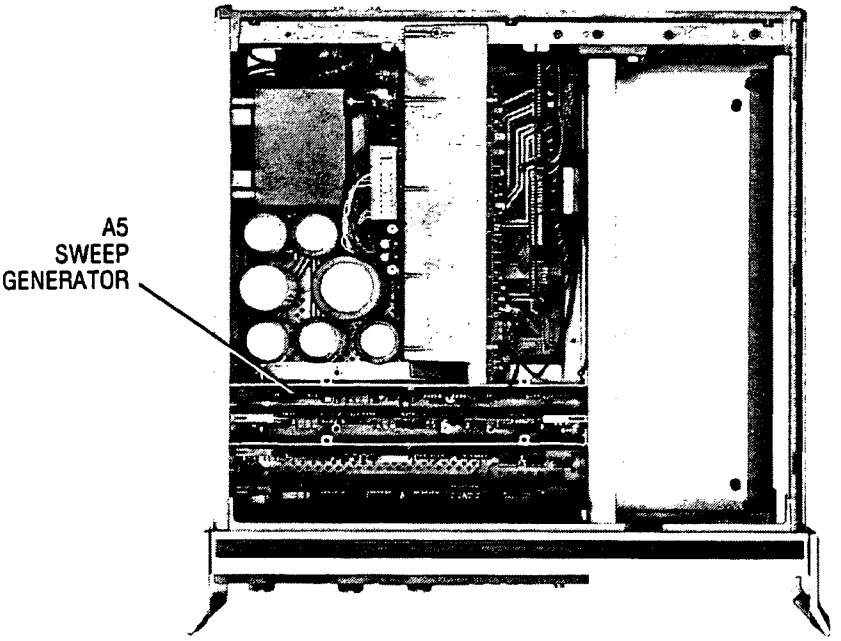
3. Connect POS Z BLANK output on the rear panel of the HP 8350B to INPUT A on the HP 5328B Universal Counter and set the HP 5328B controls as follows:

FUNCTION	PER A
SAMPLE RATE	CCW
OSC (rear panel)	INT
ARM ON/OFF (rear panel)	OFF
STORAGE ON/OFF (rear panel)	ON
POWER	ON
Input Amplifier Control Switch	SEP
Channel A SLOPE	–
Channel A Coupling	DC
Channel A ATTEN	X10
Channel A Trigger LEVEL A	CW

4. Position the sweep oscillator upright as shown in Figure 5-12.
5. Press **[INSTR PRESET] [SWEEP TRIGGER] [INT] [SWEEP TIME] [1] [0] [ms]**.
6. Set the HP 5328B FREQUENCY RESOLUTION, N control to 10 KHz. Adjust Channel A trigger LEVEL until the Channel A triggering LED blinks.
7. A5R77 is adjusted to give a counter reading of 15.0 ± 1.0 ms. Refer to Figure 5-13 for A5R77 component location.

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5-7. Sweep Retrace Time Adjustment (Cont'd)



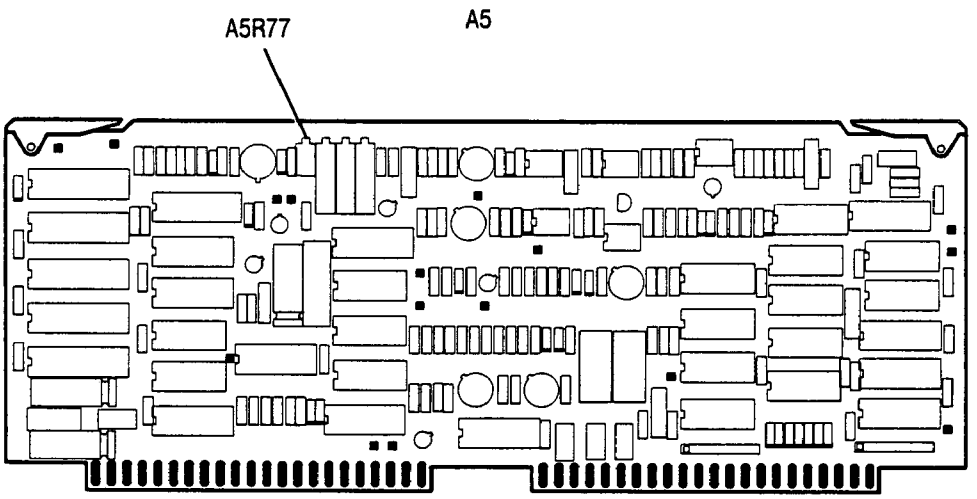


Figure 5-13. Location of Sweep Retrace Time Adjustments.

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5-8. Frequency Control Adjustments

REFERENCE

A4 Scaling and Marker Assembly

DESCRIPTION

The vernier DAC, A4U10, is calibrated for symmetrical frequency operation with no RF plug-in installed. With the HP 8350B tuned to −200 MHz in CW mode, the accuracy of the low end of the vernier frequency range is set with A4R44 (CW OFFSET), and the accuracy of the high end of the vernier frequency range is set with A4R22. CW frequency accuracy at the high end of the frequency band is adjusted at a CW frequency of 10.2 GHz with A4R27 (CW). The A4 ΔF generation circuits are then adjusted for frequency accuracy on each of the three ΔF frequency ranges (full-band range, 1/8-band range, and 1/64-band range in ΔF sweeps). The high and low end accuracy of the full RF plug-in band ΔF range is adjusted by A4R2 ΔF (OFFSET) and A4R25 (ΔF1). The VERNIER then adjusts the center frequency to the exact center of the band in a 0 GHz ΔF sweep mode. At this point, the ΔF sweep range is narrowed to 1.299 GHz, just below the switch point at 1.3 GHz where the resolution scaling of the A4 ΔF generation circuits change from full-band to < 1/8-band range. A4R15 (ΔF2) is adjusted to calibrate the resolution accuracy for ΔF sweeps in this range. The ΔF sweep range is narrowed again to 162.4 MHz, just below the switch point at 162.5 MHz where the resolution scaling of the A4 ΔF generation circuits changes to < 1/64-band range. A4R18 (ΔF3) is then adjusted to calibrate the resolution accuracy in the narrowest ΔF sweep range.

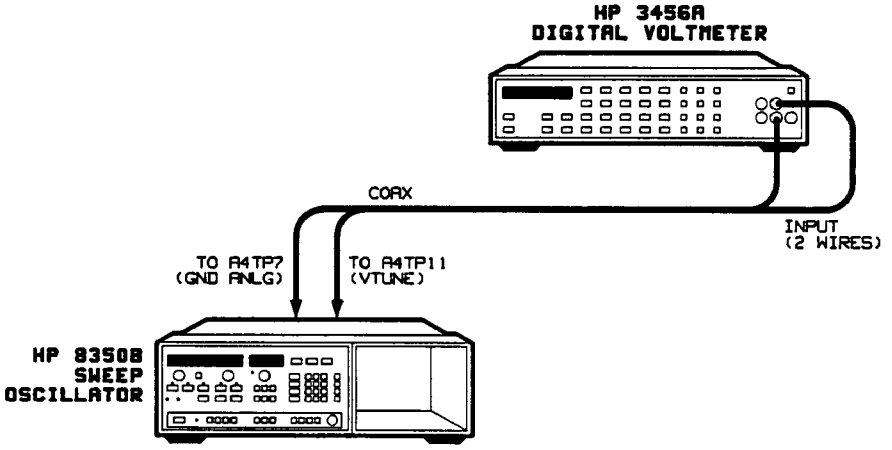


Figure 5-14. Frequency Control Adjustments Setup

EQUIPMENT

Digital Voltmeter HP3456A

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5-8. Frequency Control Adjustments (Cont'd)

PROCEDURE

CAUTION

Before installing or removing RF plug-in (adapter, service board) set the HP 8350B line switch to OFF.

1. Remove the RF plug-in from the sweep oscillator mainframe.
2. Position the sweep oscillator upright, as shown in Figure 5-14, and remove the top cover.
3. Set the LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.

Vernier Calibration

NOTE: The validity of this adjustment procedure is based in part on the accuracy of the +10V REF DAC power supply. Proper adjustment of the +10V REF DAC power supply is necessary before proceeding with this adjustment procedure.

4. Connect the DVM to A4TP11 (VTUNE) and A4TP7 (GND ANLG).
5. Press **[INSTR PRESET] [CW] [-] [2] [0] [0] [MHz]**. This sets the sweep ramp circuits at the start of sweep.
6. Press **[SHIFT] [0] [0] [M1] [3] [0] [0] [0] [M2] [0] [1]**. The FREQUENCY/TIME display should indicate 01. This sets the A4U10 DAC input lines to 01H.
7. Adjust A4R44 (CW OFFSET) for a DVM reading of −0.20508 ± 0.00002 VDC. Refer to Figure 5-15 for adjustment location.
8. Press **[BK SP] [BK SP]**. The FREQUENCY/TIME display should indicate FF. This sets A4U10 DAC to its maximum level.
9. Adjust A4R22 (VERNIER) for a DVM reading of −0.19492 ± 0.00002 VDC.
10. Press **[8] [0]**. The FREQUENCY/TIME display should indicate 80. This sets A4U10 DAC to mid-range.
11. Insure that the DVM reading is −0.20000 ± 0.00002 VDC.
12. Press **[INSTR PRESET] [CW] [1] [0] [.] [2] [GHz]**.
13. Adjust A4R27 (CW) for a DVM reading of 10.2000 ± 0.0001 VDC.

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5-8. Frequency Control Adjustments (Cont'd)

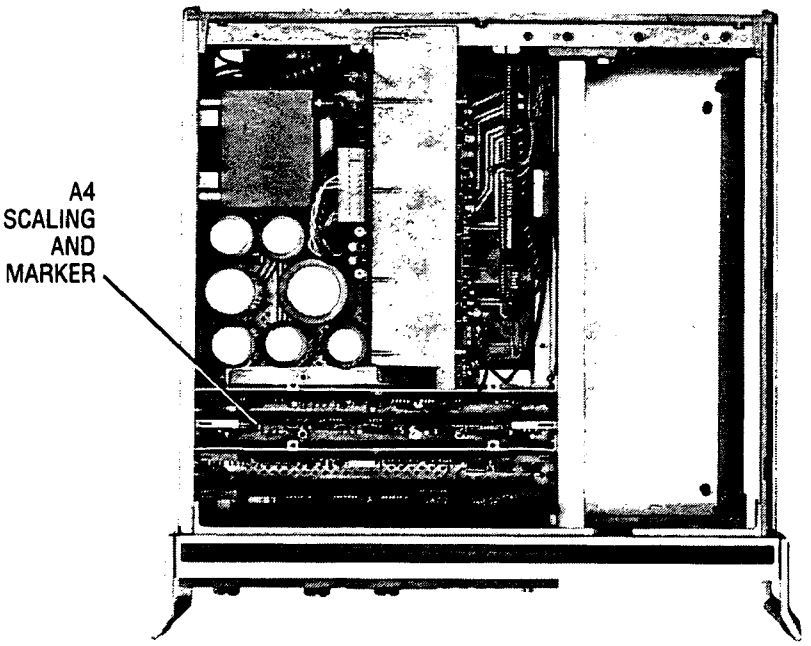
ΔF Generation Adjustments

NOTE: The validity of this adjustment is based in part on the accuracy of the VSW1 input from the A5 sweep generator assembly. Proper adjustment of the A5 sweep generator circuits is necessary before proceeding with this adjustment procedure.

14. Press **[INSTR PRESET] [ΔF] [1] [0] [.] [4] [GHz] [MAN] [1] 0] [.] [2] [GHz]**.
15. Adjust A4R25 (ΔF1) for a DVM reading of 10.2000 ± 0.0001 VDC.
16. Press **[-] [2] [0] [0] [MHz]**.
17. Adjust A4R2 (ΔF OFFSET) for a DVM reading of −0.2000 ± 0.0001 VDC.
18. Press **[ΔF] [0] [GHz]**.
19. Insure that the DVM reading is 5.00000 ± 0.00005 VDC. If it is not, press **[VERNIER]**, rotate **[CW VERNIER]** until the DVM reading is 5.00000 ± 0.00005 VDC. Steps 20 through 23 need not be performed if the DVM reads within the above tolerance.
20. Press **[ΔF] [1] [.] [2] [9] [9] [GHz]**.
21. Adjust A4R15 (ΔF2) for a DVM reading of 4.35064 ± 0.00005 VDC.
22. Press **[ΔF] [1] [6] [2] [.] [4] [MHz]**.
23. Adjust A4R18 (ΔF3) for a DVM reading of 4.91883 ± 0.00005 VDC.

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5-8. Frequency Control Adjustments (Cont'd)



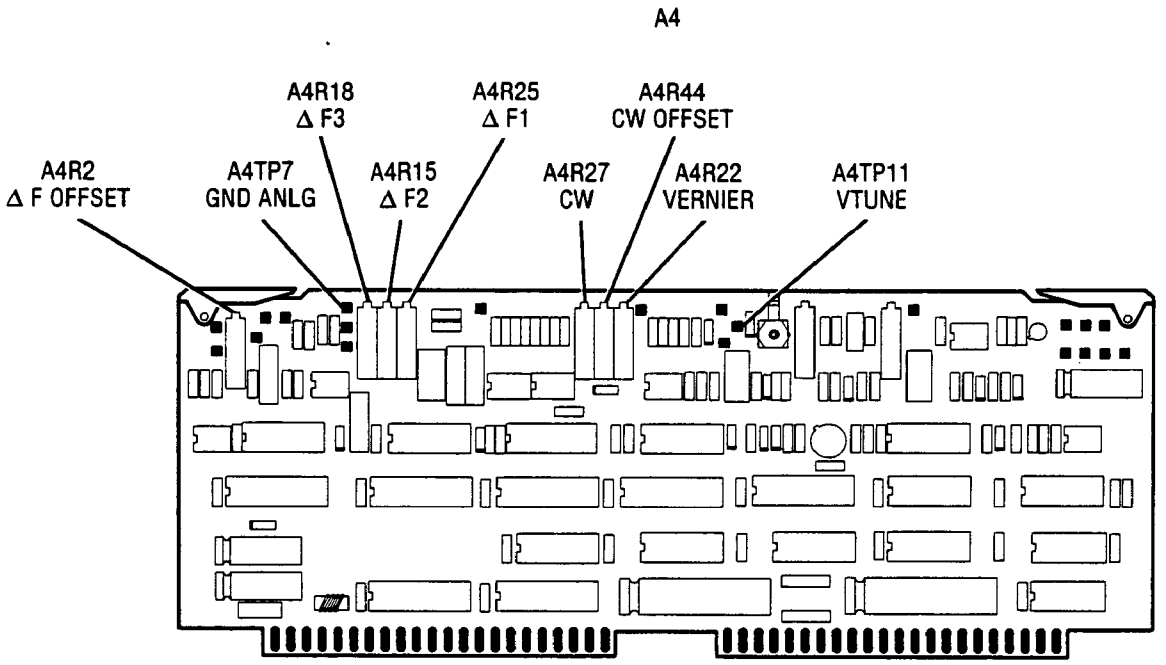


Figure 5-15. Location of Frequency Control Adjustments.

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5-9. Marker DAC Adjustment

REFERENCE

A4 Scaling and Marker Assembly

DESCRIPTION

The HP 8350B is set, without an RF plug-in installed, for a stop frequency of 10 GHz with a single marker also set to 10 GHz. The rear panel POS Z BLANK BNC output (high = sweep retrace, low = forward sweep) is monitored by an oscilloscope and A4R28 (MKR) is adjusted to set the reference voltage for marker DAC A4U12 so that the marker DAC output is calibrated to match the end of the sweep ramp.

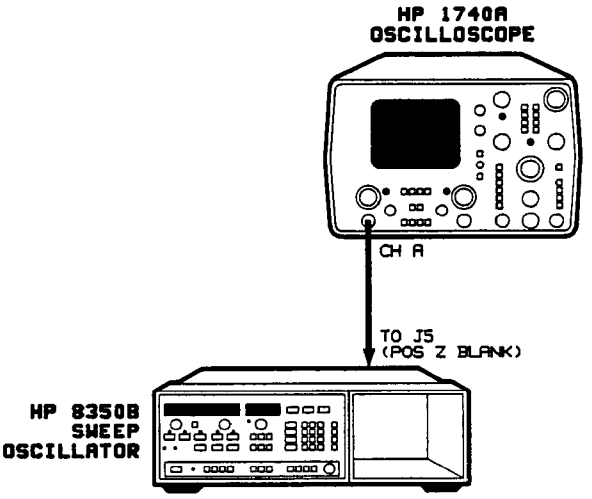


Figure 5-16. Marker DAC Adjustment Setup

EQUIPMENT

Oscilloscope . . . . . HP 1740A

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5-9. Marker DAC Adjustment (Cont'd)

PROCEDURE

CAUTION

Before removing or installing RF plug-in (adapter, service board) set the HP 8350B line switch to OFF.

1. Remove the RF plug-in from the sweep oscillator mainframe.
2. Set the HP 8350B LINE switch to ON and allow the sweep oscillator to warm up for 30 minutes.
3. Connect POS Z BLANK BNC output on the rear panel of the HP 8350B to Channel A on the HP 1740A oscilloscope and set the HP 1740A controls as follows:

Channel Controls

Channel Displayed ..... Channel A
Trigger on Channel ..... A

Trigger Controls

AUTO/NORM ..... Normal
Trigger Level ..... Negative
POS/NEG ..... Negative
AC/DC ..... DC

4. Set oscilloscope horizontal sweep control to 5 µs/div.
5. Position the sweep oscillator upright as shown in Figure 5-16 and remove top cover.
6. Press **[INSTR PRESET] [M1] [1] [0] [GHz]**.
7. Preset A4R28 fully clockwise to insure that a marker will occur before the end of the sweep ramp is reached. Refer to Figure 5-18.
8. Adjust A4R28 so the pulse width is approximately 18 µs. This adjustment is not critical.

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5-9. Marker DAC Adjustment (Cont'd)

9. Set oscilloscope horizontal sweep control to .1 ms/div. Press **[TIME] [1] [s]** on sweep oscillator.

10. Adjust A4R28 so the pulse width is 500 ± 100 µs (5 divisions ± 1 division on oscilloscope). Refer to Figure 5-17.

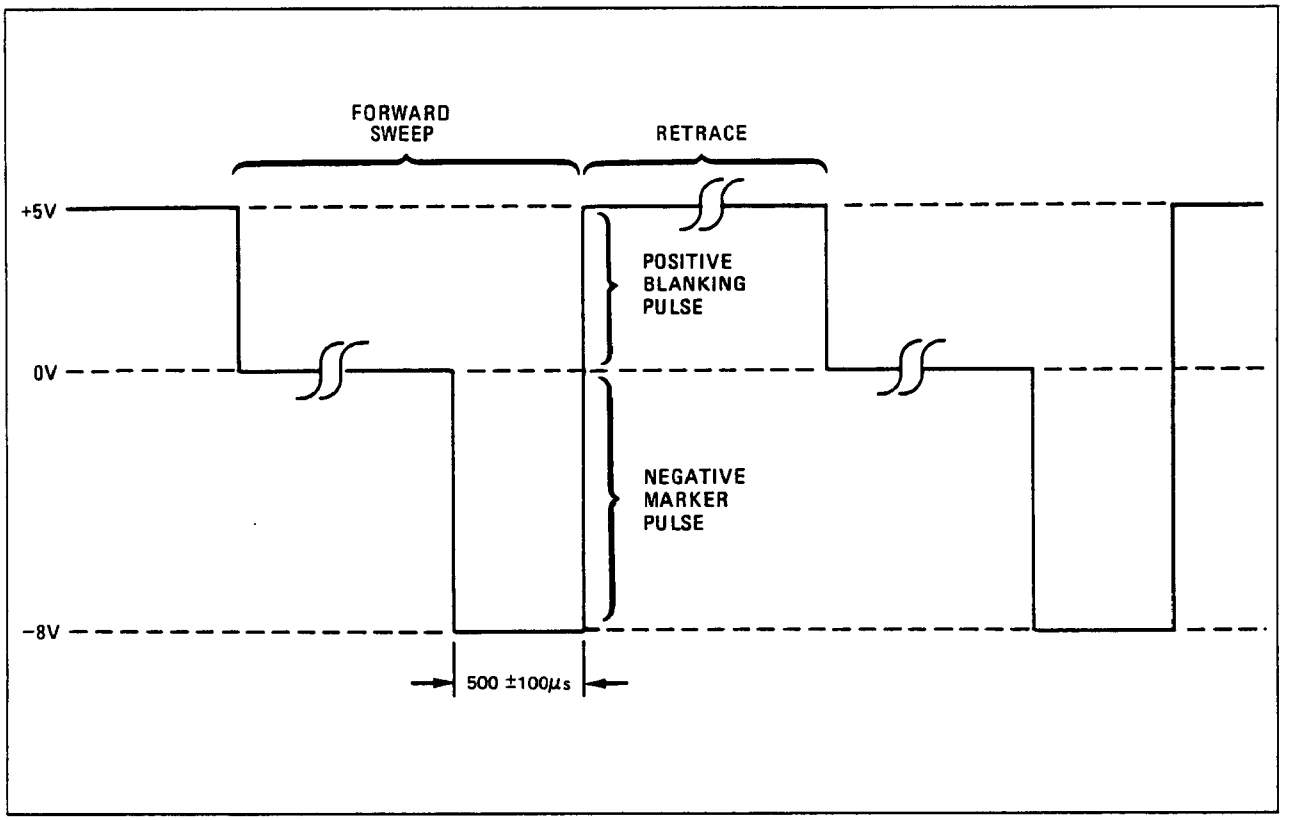


Figure 5-17. Marker DAC Adjustment Waveform

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5-9. Marker DAC Adjustment (Cont'd)

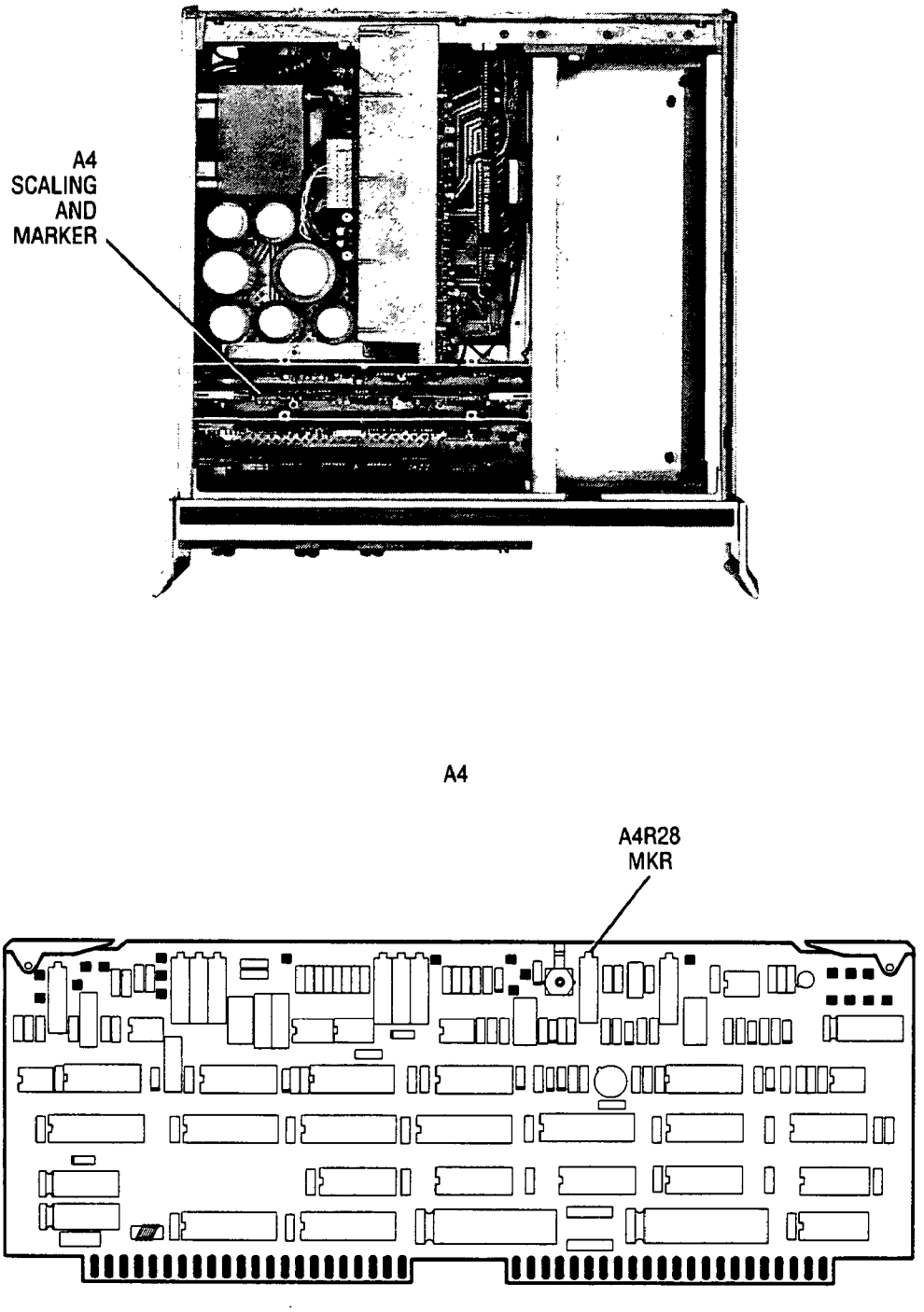


Figure 5-18. Location of Marker DAC Adjustment

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Section VI. Replaceable Parts

INTRODUCTION

This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list, reference designator definitions, and the manufacturer's code list. Table 6-2 lists replaceable parts in reference designator order.

REPLACEABLE PARTS LIST

Table 6-2 is the list of replaceable parts and is organized as follows:

1. Electrical assemblies and their components in alpha-numerical order by reference designation.
2. Miscellaneous parts, at the end of the list for each major assembly.
3. Chassis-mounted parts, in alphanumerical order by reference designation, at the end of the parts list.
4. Illustrated parts locations.

The information given for each part consists of the following:

1. The Hewlett-Packard part number.
2. The total quantity (Qty) in the instrument. This quantity is given only once, at the first appearance of the part in the list.
3. The description of the part.
4. A typical manufacturer of the part in a five-digit code.
5. The manufacturer part number.

ORDERING INFORMATION

To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

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

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Table 6-1. Reference Designations, Abbreviations and Manufacturers Code List(1 of 4)

REFERENCE DESIGNATIONS

A . . . . . Assembly
AT . . . . . Attenuator, Isolator, Limiter, Termination
B . . . . . Fan, Motor
C . . . . . Capacitor
CP . . . . . Coupler
CR . . . . . Diode, Diode Thyristor, Step Recovery Diode (SCR), Varactor
DC . . . . . Directional Coupler
DS . . . . . Annunciator, Lamp, Light Emitting Diode (LED), Signaling Device (Audible or Visible)
E . . . . Miscellaneous Electrical Part
F . . . . . Fuse
FL . . . . . Filter
H . . . . . Hardware
J . . . . . Electrical Connector (Stationary Portion), Jack
K . . . . . Relay
L . . . . . Coil, Inductor
M . . . . . Meter
MP . . . . . Miscellaneous Mechanical Part
P . . . . . Electrical Connector (Movable Portion), Plug
Q . . . . . Silicon Controlled Rectifier (SCR), Transistor, Triode Thyristor
R . . . . . Resistor
RT . . . . . Thermistor
S . . . . . Switch
T . . . . . Transformer
TB . . . . . Terminal Board
TP . . . . . Test Point
U . . . . . Integrated Circuit, Microcircuit
V . . . . . Electron Tube
VR . . . . . Breakdown Diode (Zener), Voltage Regulator
W . . . . . Cable, Transmission Path, Wire
X . . . . . Socket
Y . . . . . Crystal Unit (Piezoelectric, Quartz)
Z . . . . . Tuned Cavity, Tuned Circuit

ABBREVIATIONS

A

A . . . . . Across Flats, Acrylic, Air (Dry Method), Ampere
AC . . . . . Actinium, Alternating Current, Alumina-Ceramic
ADJ . . . . . Adjust, Adjustment
AG . . . . . Silver
AL . . . . . Aluminum
ALC . . . . . Alcohol, Automatic Level Control
AMP . . . . . Amperage
AMPL . . . . . Amplifier
ANDZ . . . . . Anodized
ANLG . . . . . Analog
ASSY . . . . . Assembly
ASTBL . . . . . Astable
ATTEN . . . . Attenuation, Attenuator
AWG . . . . . American Wire Gauge

B

BCKT . . . . . Bracket
BD . . . . . Board, Bundle
BE . . . . . Baume, Beryllium
BE-CU . . . . . Beryllium Copper
BFR . . . . . Before, Buffer
BIN . . . . . Bin Box (Container), Binary
BLK . . . . . Black, Blank, Block
BNC . . . . . Type of Connector
BSC . . . . . Basic
BVR . . . . . Reverse, Breakdown Voltage

C

C . . . . . Capacitance, Capacitor, Center Tapped, Centistoke, Ceramic, Cermet, Circular Mil Foot, Closed Cup, Cold, Compression
CAP . . . . . Capacitor, Capacity
CBL . . . . . Cable
CER . . . . . Ceramic
CFM . . . . . Cubic Feet Per Minute
CH . . . . . Center Hole
CHAM . . . . . Chamfer
CHAN . . . . . Channel
CNTR . . . . . Container, Counter
COAX . . . . . Coaxial
COM . . . . . Commercial, Common
CONN . . . . . Connect, Connection, Connector
CONT . . . . . Contact, Continuous, Control, Controller
CONV . . . . . Converter
CP . . . . . Cadmium Plate, Candle Power, Centipoise, Conductive Plastic, Cone Point
CRP . . . . . Crepe, Crimp
CTR . . . . . Center
CURRNT . . . . . Current

D

D . . . . . Deep, Depletion, Depth, Diameter, Direct Current
D/A . . . . . Digital-to-Analog
DAP . . . . . Diallyl Phthalate
DB . . . . . Decibel, Double Break
DC . . . . . Direct Current, Double Contact
DBL . . . . . Double
DCDR . . . . . Decoder
DEG . . . . . Degree
DIA . . . . . Diameter
DIEL . . . . . Dielectric
DIFF . . . . . Differential
DIP . . . . . Dual In-Line Package
DO . . . . Package Type Designation
DRVR . . . . . Driver

E

E . . . . . Enamel (Insulation, Enhancement, Extension)
E-MODE . . . . . Enhancement Mode
EPROM . . . . . Eraseable Programmable Read Only Memory
EXCL . . . . . Excluding, Exclusive
EXT . . . . . Extended, Extension, External, Extinguish
EXTR . . . . . Extractor

F

F . . . . . Fahrenheit, Farad, Female, Film, (Resistor), Fixed, Flange, Flint, Flourine, Frequency
FDTHRU . . . . . Feed Through
FEM . . . . . Female
FF . . . . . Flange, Female Connection; Flip Flop
FIG . . . . . Figure
FL . . . . . Flash, Flat, Fluid
FLEX . . . . . Flexible
FLG . . . . . Flange
FLTR . . . . . Filter, Floater
FT . . . . . Current Gain Bandwidth
FM . . . . . Flange, Male Connection; Foam, Frequency Modulation Product (Transition Frequency); Feet, Foot
FXD . . . . . Fixed

G

GEN . . . . . General, Generator
GHZ . . . . . Gigahertz

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Table 6-1. Reference Designations, Abbreviations and Manufacturers Code List (2 of 4)

... GP ... General Purpose Group
GL ..... Glass
GRN ..... Green
GRV ..... Grooved

H

H ..... Henry, Hermaphrodite, High, Hole Diameter, Hot, Hub Inside Diameter, Hydrogen
HD ..... Hand, Hard, Head, Heavy Duty
HEX ..... Hexadecimal, Hexagon, Hexagonal
HGT ..... Height
HP-IB ..... Hewlett-Packard Interface Bus
HZ ..... Hertz

I

IC ..... Collector Current, Integrated Circuit
ID ..... Identification, Inside Diameter
IF ..... Forward Current, Intermediate Frequency
IMPD ..... Impedance
IN ..... Inch, Indium
INP ..... Input
INS ..... Insert, Inside, Insulation, Insulator
INT ..... Integral, Intensity, Internal
INTL ..... Internal, International
INV ..... Invert, Inverter

J

JFET ..... Effect Transistor

K

K ..... Kelvin, Key, Kilo, Potassium
KB ..... Knob

L

LCH ..... Latch
LED ..... Light Emitting Diode
LG ..... Length, Long
LIN ..... Linear, Linear Taper, Linearity
LK ..... Link, Lock
LKG ..... Leakage, Locking
LKWR ..... Lockwasher
LS ..... Loudspeaker, Low Power Schottky, Series Inductance
LUM ..... Luminous

M

M ..... Male, Maximum, Mega, Mil, Milli, Mode, Momentary, Mounting Hole Centers, Mounting Hole Diameter
MA ..... Milliampere
MACH ..... Machined
MAGTD ..... Magnitude
MAX ..... Maximum
MCD ..... Millacandela
MET ..... Metal, Metallic, Metallized, Metallurgical
MICPROC ..... Microprocessor
MIN ..... Miniature, Minimum, Minor, Minute
MLD ..... Mold, Molded
MNT ..... Minute (Angle)
MM ..... Magnetized Material (Restricted Articles Code), Millimeter
MO ..... Metal Oxide, Millionce, Molybdenum
MOD ..... Model, Modified Modular, Modulated, Modulator
MOM ..... Momentary, Motherboard
MONO/ASTBL ..... Monostable/ Astable
MONOSTBL ..... Monostable
MTG ..... Mounting
MTLC ..... Metallic
MTR ..... Meter
MULTIPLXR ..... Multiplexer
MULTR ..... Multiplier
MUW ..... Music Wire
MV ..... Millivolt, Multivibrator
MW ..... Milliwatt

N

N ..... Fan Out, Intrinsic Stand OffRatio, Nano, Nanosecond, Nitrogen, None
NAND ..... Logic Not-AND
N-CHAN ..... N-Channel Metal Oxide Semiconductor
NB ..... Niobium
NCH ..... Notched
NEG ..... Negative
NH ..... Nanohenry
NM ..... Nanometer, Nonmetallic
NMOS .... N-Channel Metal Oxide Semiconductor
NO ..... Normally Open, Number
NPN ..... Negative Positive Negative (Transistor)
NS ..... Nanosecond, Non-Shorting, Nose
NYL ..... Nylon (Polyamide)

O

OCTL ..... Octal
OD ..... Olive Drab, Outside Diameter
OP ..... Operational
OPT ..... Optical, Option, Optional
OR ..... Logic OR, Output Register
ORN ..... Orange
OXD ..... Oxide

P

P ..... Peak, Phosphorus, Pico, Picosecond, Pitch, Plastic, Plug, Pole, Polyester, Power, Probe, Pure
PAN-HD ..... Pan Head
PC ..... Picocoulomb, Piece, Printed Circuit
P.C. ..... Printed Circuit
PCB ..... Printed Circuit Board
PD ..... Pad, Palladium, Pitch Diameter, Power Dissipation
PF ..... Picofarad; Pipe, Female Connection; Power Factor
PKG ..... Package
PL ..... Phase Lock, Plain, Plate, Plug
PL-MTG ..... Plate Mounting
PLSTC ..... Plastic
PN ..... Part Number
PNP ..... Positive Negative Positive (Transistor)
P/O ..... Part Of
POLYC ..... Polycarbonate
POLYE ..... Polyester
POLYI ..... Polyimide
POS ..... Position, Positive
POZI ..... Pozidrive Recess
PRIM ..... Primary
PRCN ..... Precision
PRL ..... Parallel
PROM ..... Programmable Read Only Memory
PRP ..... Purple, Purpose
P/S ..... Power Supply
PT ..... Part, Pint, Platinum, Point, Pulse Time
PVC ..... Polyvinyl Chloride
PW ..... Power Wirewound, Pulse Width
PWR ..... Power
PWW ..... Precision Wirewound

Q

QUAD ..... Set of Four

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Table 6-1. Reference Designations, Abbreviations, and Manufacturers Code List (3 of 4)

R

R . . . . . Range, Red, Resistance, Resistor, Right, Ring, Rosin, Rubber-Resin, Run Torque
RAM . . . . Random Access Memory
RBN . . . . . Ribbon
RCPT . . . . . Receptacle
RCVR . . . . . Receiver
RECT . . . . Rectangle, Rectangular, Rectifier
REG . . . . . Register, Regular, Regulated, Regulation, Regulator
RES . . . . . Research, Resistance, Resistor, Resolution
RET . . . . . Retaining
RETRIG . . . . . Retriggerable
RF . . . . . Radio Frequency
RFI . . . . . Radio Frequency Interference
RELTR . . . . . Regulator
RKR . . . . . Rocker
RND . . . . . Round
RPG . . . . . Rotary Pulse Generator
RR . . . . . Rear
RVT . . . . . Rivet, Riveted

S

S . . . . . Saybolt, Seconds Universal, Scattering Parameter, Schottky, Screw Size, Second, Shorting, Side, Siemens, Silicone, Silk (Insulation), Soft, Solid, Square Mil Foot, Standard Threaded, Start Torque, Stearine, Steel, Strut Center Spacing, Stud Size, Sulfur
SCR . . . . . Screw, Scrub, Silicon Controlled Rectifier
SEC . . . . . Secondary
SEL . . . . . Select, Selected
SER . . . . . Serial, Series
SGL . . . . . Single
SHFT . . . . . Shaft
SHLDR . . . . . Shoulder
SI . . . . . Silicon, Square Inch
SIG . . . . . Signal, Significant
SIP . . . . . Single In-Line Package
SKT . . . . . Skirt, Socket
SLDR . . . . . Solder
SM . . . . . Samarium, Seam, Small, Square Meter, Sub Modular, Subminiature
SMB . . . . . Subminiature, B Type (Snap-On Connector)
SNP . . . . . Snap
SPCL . . . . . Special
SPST . . . . . Single Pole Single Throw
SQ . . . . . Square
SST . . . . . Stainless Steel
STAT . . . . . Status
STDF . . . . . Standoff
STRP . . . . . Strapped, Strip
SUBMIN . . . . . Subminiature
SYNCHRO . . . . . Synchronous
SZ . . . . . Size

T

T . . . . . Tab Width, Taper, Teeth, Temperature, Tera, Tesla, Thermoplastic (Insulation), Thickness, Time, Timed, Tooth, Turns Ratio, Typical
TA . . . . . Ambient Temperature, Tantalum
TBAX . . . . . Tube Axial
TC . . . . . Thermoplastic
TFE . . . . . Polytetrafluro - ethylene, Teflon
THD . . . . . Thread, Threaded
THERM . . . . . Thermometer
THK . . . . . Thick
THKNS . . . . . Thickness
THRD . . . . . Thread
TNG . . . . . Tongue, Training
TO . . . . . Package Type
TPG . . . . . Tapping
TPL . . . . . Triple
TRIG . . . . . Trigger, Triggerable, Triggering, Trigonometry
TRMR . . . . . Trimmer
TRN . . . . . Turn, Turns
TTL . . . . . Tan Translucent, Transistor, Transistor Logic

U

UCD . . . . . Microcandela
UNCT . . . . . Undercut
UF . . . . . Microfarad
UL . . . . . Microliter, Underwriters' Laboratories, Inc.

V

V . . . . . Vanadium, Variable, Violet, Volt, Voltage
VA . . . . . Volt Ampere
VDC . . . . . Volts, Direct Current
VID . . . . . Video
VREG . . . . . Voltage Regulator
VRRM . . . . . Repetitive Peak Inverse Voltage

W

W . . . . . Watt, Wattage, White,
WB . . . . . Wide Band Wide, Width, Wire
WD . . . . . Width, Wood

X

X . . . . . By (Used With Dimensions), Reactance
XSTR . . . . . Transistor

Y

YEL . . . . . Yellow
YIG . . . . . Yytrium-iron-garnet
YTM . . . . . YIG Tuned Multiplier

Z

Z . . . . . Impedance
ZN-P . . . . . Zinc Plate
ZNR . . . . . Zener

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Table 6-2. Reference Designators, Abbreviations and Manufacturers Code List (4 of 4)

Mfr Code	Manufacturer Name	Address		Zip Code
00046	UNITRODE CORP	LEXINGTON	MA	02173
01339	GETTIG ENGRG & MFG CO INC	SPRING MILLS	PA	16875
01380	AMP INC	HARRISBURG	PA	17111
01461	GOE ENGINEERING CO INC	ONTARIO	CA	91761
01607	ALLEN-BRADLEY CO INC	EL PASO	TX	79935
01698	TEXAS INSTRUMENTS INC	DALLAS	TX	75265
01854	RCL ELECTRONICS INC	NORTHBROOK	IL	60062
02010	AVX CORP	GREAT NECK	NY	11021
02037	MOTOROLA INC	ROSELLE	IL	60195
02123	EG & G INC	WELLESLEY	MA	02181
02180	PRECISION MONOLITHICS INC	SANTA CLARA	CA	95054
02210	MILTON ROSS CO	SOUTHHAMPTON	PA	18966
02414	BURNDY CORP	NORWALK	CT	06856
02483	CTS CORP	ELKHART	IN	46514
02499	IRC INC	BOONE	NC	28607
02608	THERMALLOY INC	DALLAS	TX	75234
02685	LOBAUGH ROLLIN J	SOUTH SAN FRANC	CA	94080
02805	COOPER INDUSTRIES INC	HOUSTON	TX	77210
02883	SILICONIX INC	SANTA CLARA	CA	95054
02910	SIGNETICS CORP	SUNNYVALE	CA	94086
02946	DUPONT E I DE NEMOURS & CO	WILMINGTON	DE	19801
02995	NORTH AMERICAN PHILIPS CORP	NEW YORK	NY	10017
03123	MICRO-OHM CORP	EL TORO	CA	92630
03285	ANALOG DEVICES INC	NORWOOD	MA	02062
03325	PIEZO TECHNOLOGY INC	ORLANDO	FL	32854
03334	NV PHILIPS ELCOMA	EINDHOVEN		02876
03394	METHODE ELECTRONICS INC	CHICAGO	IL	60656
03406	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95052
03418	MOLEX INC	LISLE	IL	60532
03794	ADVANCED MICRO DEVICES INC	SUNNYVALE	CA	94086
03799	HARRIS CORP	MELBOURNE	FL	32901
03811	INTEL CORP	SANTA CLARA	CA	95054
03981	PENN ENGINEERING & MFG CORP	DOYLESTOWN	PA	18901
04055	OVERLAND PRODUCTS CO	PHOENIX	AZ	68025
04200	SPRAGUE ELECTRIC CO	LEXINGTON	MA	02173
04486	ITT CORP	NEW YORK	NY	10022
04504	GENERAL INSTRUMENT CORP	CLIFTON	NJ	07012
04559	ELASTIC STOP NUT DIVOF HARVARD	UNION	NJ	07083
04568	BECKMAN INDUSTRIAL CORP	FULLERTON	CA	92635
04703	LITTELFUSE INC	DES PLAINES	IL	60016
04726	3M CO	ST PAUL	MN	55144
04990	GRAYHILL INC	LA GRANGE	IL	60525
05115	CENTRAL FASTENERS, INC	BROADVIEW	IL	60153
05176	AMERICAN SHIZUKI CORP	CANOGA PARK	CA	91304
05250	RICHMOND DIVISION OF DIXICO INC	REDLANDS	CA	92373
05524	DALE ELECTRONICS INC	COLUMBUS	NE	68601
05769	ITT SEALECTRO CORP	TRUMBULL	CT	06611
05792	INTL ELECTRONIC RESEARCH CORP	BURBANK	CA	91502
05826	AMER PRCN IND INC DELEVAN DIV	AURORA	NY	14052
06900	JUDD WIRE	BURLINGTON	MA	01803
07608	WRIGHT ENGINEERED PLASTICS	WINDSOR	CA	95492
08017	FORCE ELECTRONICS	SANTA CLARA	CA	
08474	RICHARDSON ELECTRONICS	FRANKLIN PARK	IL	
09538	TUSONIX	TUCSON	AZ	85740
09694	ELECTRONIC ESSENTIALS	WOODSIDE	NY	
10456	PLASTEC PRODUCTS INC	FORT COLLINS	CO	
11113	STATEK	ORANGE	CA	

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	08350-60136	1	BOARD ASSEMBLY-FRONT PANEL	28480	08350-60074
A1	1990-0738	1	DISPLAY-NUM-SEG 5-CHAR .152-H RED		
A2	1990-0738	1	DISPLAY-NUM-SEG 5-CHAR .152-H RED		
A3	1990-0738	1	DISPLAY-NUM-SEG 5-CHAR .152-H RED		
C1	0180-0229	1	CAP-FXD 33uF ±10% 10 V TA	04200	150D336X9010B2-DYS
C2	0180-2214	1	CAP-FXD 90uF +75% -10% 16 V AL-ELCTLT	04200	30D906G016CC2-DSM
C3	0160-3879	1	CAP-FXD 0.01uF +80% -20% 100 V CER Y5V	09538	805-504 Y5V 103Z
C4	0160-3879	1	CAP-FXD 0.01uF +80% -20% 100 V CER Y5V	09538	805-504 Y5V 103Z
C5	0160-3879	1	CAP-FXD 0.01uF +80% -20% 100 V CER Y5V	09538	805-504 Y5V 103Z
DS1	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS2	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS3	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS4	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS5	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS6	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS7	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS8	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS9	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS17	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS18	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS19	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS23	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS24	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS25	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS27	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS28	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS29	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS30	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS31	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS32	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS33	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS34	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS35	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS36	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS37	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
J1	1251-8736	1	CONN-POST TYPE .100-PIN-SPCG 6-CONT	02946	67997-603
J2	1251-7447	1	CONN-POST TYPE .100-PIN-SPCG 34-CONT	02946	67997-634
J3	08360-60097	1	FRONT PANEL WIRING ASSEMBLY	28480	08360-60097
J4	1251-8736	1	CONN-POST TYPE .100-PIN-SPCG 6-CONT	02946	67997-606
J5	1251-8736	1	CONN-POST TYPE .100-PIN-SPCG 6-CONT	02946	67997-606
J6	1251-8736	1	CONN-POST TYPE .100-PIN-SPCG 6-CONT	02946	67997-606
J7	1252-0718	1	CONN-POST TYPE .100-PIN-SPCG 5-CONT	01380	641215-5
J8	1252-0718	1	CONN-POST TYPE .100-PIN-SPCG 5-CONT	01380	641215-5
J9	1252-0718	1	CONN-POST TYPE .100-PIN-SPCG 5-CONT	01380	641215-5
L1	08503-80001	1	COIL-TOROID	28480	08503-80001
L2	08503-80001	1	COIL-TOROID	28480	08503-80001
Q1	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q2	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q3	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q4	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q5	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q6	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q7	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q8	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
R1	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R2	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R3	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R4	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R5	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R6	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R7	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R8	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
S1-S50	5060-9436	50	SWITCH-PB SPST-NO MOM	04486	5560-9436
U1	1820-2266	1	IC-INTERFACE DRVR -888-BIT	02910	NE590F
U2	1820-2266	1	IC-INTERFACE DRVR -888-BIT	02910	NE590F
VR1	1902-0551	1	DIODE-ZNR 6.2V 5% PD=1W IR=10UA	02037	SZ40145-8RL
XA1	1200-0846	1	SOCKET-IC-SIP 15-CONT SIP DIP-SLDR	01380	643115-1
XA2	1200-0846	1	SOCKET-IC-SIP 15-CONT SIP DIP-SLDR	01380	643115-1
XA3	1200-0846	1	SOCKET-IC-SIP 15-CONT SIP DIP-SLDR	01380	643115-1
			A1 MISCELLANEOUS PARTS		
	0380-1233	11	SPACER-SPECIALTY .450 IN LG; .175 IN OD	00000	ORDER BY DESCRIPTION
	1450-0588	3	LAMP HOUSING POLYCARBONATE; WHITE; 1.1	28480	1450-0588
	0360-0031	2	TERMINAL-CRIMP R-TNG #6 22-16-AWG RED	28480	0360-0031
	08350-00016	3	CONNECTOR STRIP-15 PN	28480	08350-00016
			ORDER RPGS AND ASSOCIATED HARDWARE SEPARATELY. NOT INCLUDED WITH THE A1 BOARD. SEE FIGURE 6-1.		

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2	08350-60084	1	FRONT PANEL INTERFACE BOARD ASSEMBLY	28480	08350-60084
C1	0160-4822	1	CAP-FXD 1000pF ±5% 100 V CER C0G	02010	SA201A102JAAH
C2	0160-4822	1	CAP-FXD 1000pF ±5% 100 V CER C0G	02010	SA201A102JAAH
C3	0180-0374	1	CAP-FXD 10uF ±10% 20 V TA	04200	150D106X9020B2-DYS
C4-C13	0160-4832	10	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C15	0180-2214	1	CAP-FXD 90uF +75% -10% 16 V AL-ELCTLT	04200	30D906G016CC2-DSM
C16	0180-2214	1	CAP-FXD 90uF +75% -10% 16 V AL-ELCTLT	04200	30D906G016CC2-DSM
C17	0160-4835	1	CAP-FXD 0.1uF ±10% 50 V CER X7R	02010	SA115C104KAAH
J3	1251-8683	1	CONN-POST TYPE .100-PIN-SPCG 34-CONT	02946	66506-076
J4	1251-8262	1	CONN-POST TYPE .100-PIN-SPCG 50-CONT	04726	3596-6002
L1	08503-80001	1	COIL-TOROID	28480	08503-80001
L2	08503-80001	1	COIL-TOROID	28480	08503-80001
MP1	1480-0073	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	04559	99-012-062-0250
MP2	4040-0750	2	EXTR-PC BD RED POLYC .062-IN-BD-THKNS	28480	4040-0750
Q1	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q2	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q3	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q4	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q5	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q6	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
R1	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R2	0757-0405	1	RESISTOR 162 ±1% .125W TF TC=0±100	02995	SFR25H
R3	0698-4037	1	RESISTOR 46.4 ±1% .125W TF TC=0±100	02995	SFR25H
R4	0698-4037	1	RESISTOR 46.4 ±1% .125W TF TC=0±100	02995	SFR25H
R5	0698-4037	1	RESISTOR 46.4 ±1% .125W TF TC=0±100	02995	SFR25H
S1	3101-2243	1	SWITCH-DIP RKR 8-1A 0.05A 30VDC	04990	76YY22318S
S2	3101-2243	1	SWITCH-DIP RKR 8-1A 0.05A 30VDC	04990	76YY22318S
TP1-TP26	0360-2359	26	TERMINAL-TEST POINT .230IN ABOVE	04055	230.100
U1	1810-0206	1	NETWORK-RES 8-SIP 10.0K OHM X 7	02483	750-81
U2	1820-1416	1	IC SCHMITT-TRIG TTL/LS INV HEX 1-INP	01698	SN74LS14N
U3	1820-1112	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG	01698	SN74LS74AN
U4	1820-1112	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG	01698	SN74LS74AN
U5	1820-2096	1	IC CNTR TTL/LS BIN ASYNCHRO	01698	SN74LS393N
U6	1820-2096	1	IC CNTR TTL/LS BIN ASYNCHRO	01698	SN74LS393N
U7	1820-1759	1	IC DRVR TTL/LS BUS DUAL 4-INP	03406	DM74LS467N
U8	1820-1112	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG	01698	SN74LS74AN
U9	1820-1416	1	IC SCHMITT-TRIG TTL/LS INV HEX 1-INP	01698	SN74LS14N
U10	1820-1759	1	IC DRVR TTL/LS BUS DUAL 4-INP	03406	DM74LS467N
U11	1820-1759	1	IC DRVR TTL/LS BUS DUAL 4-INP	03406	DM74LS467N
U12	1820-1759	1	IC DRVR TTL/LS BUS DUAL 4-INP	03406	DM74LS467N
U13	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U14	1810-0280	1	NETWORK-RES 10-SIP 10.0K OHM X 9	05524	MSP10A01
U15	1820-1873	1	IC BFR TTL/LS INV OCTL 2-INP	03406	DM81LS98N
U16	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U17	1820-1197	1	IC GATE TTL/LS NAND QUAD 2-INP	01698	SN74LS00N
U18	1810-0332	1	NETWORK-RES 8-SIP 680.0 OHM X 7	02483	750-81
U19	1820-2096	1	IC CNTR TTL/LS BIN ASYNCHRO	01698	SN74LS393N
U20	1820-2096	1	IC CNTR TTL/LS BIN ASYNCHRO	01698	SN74LS393N
U21	1906-0092	1	DIODE-ARRAY 25V 400MA	04200	ND946
U22	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U23	1820-1216	1	IC DCDR TTL/LS BIN 3-TO-8-LINE 3-INP	01698	SN74LS138N
U24	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U25	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U26	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U27	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U28	1820-1417	1	IC GATE TTL/LS NAND QUAD 2-INP	01698	SN74LS26N
U29	1810-0247	1	NETWORK-RES 16-DIP 220.0 OHM X 8	02483	761-3-R220
U30	1810-0265	1	NETWORK-RES 16-DIP 680.0 OHM X 8	03744	4116R-001-681
U31	1820-1216	1	IC DCDR TTL/LS BIN 3-TO-8-LINE 3-INP	01698	SN74LS138N
U32	1810-0283	1	NETWORK-RES 16-DIP 270.0 OHM X 8	02483	SERIES 760
U33	1810-0283	1	NETWORK-RES 16-DIP 270.0 OHM X 8	02483	SERIES 760
U34	1810-0283	1	NETWORK-RES 16-DIP 270.0 OHM X 8	02483	SERIES 760
U35	1810-0283	1	NETWORK-RES 16-DIP 270.0 OHM X 8	02483	SERIES 760
U36	1810-0204	1	NETWORK-RES 8-SIP 1.0K OHM X 7	02483	750-81
U37	1810-0799	1	NETWORK-CAPACITOR SIP NETWORK CAPACITOR	28480	1810-0799
VR1	1902-0041	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	28480	1902-0041
VR2	1902-0551	1	DIODE-ZNR 6.2V 5% PD=1W IR=10UA	02037	SZ40145-8RL
			A2 MISCELLANEOUS PARTS		
	1480-0073	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0750	1	EXTR-PC BD RED POLYC .062-IN-BD.THKNS	28480	4040-0750

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3	**08350-60131**	**1**	**MICROPROCESSOR BOARD ASSEMBLY**	**28480**	**08350-60131**
C1	0180-2214	1	CAP-FXD 90uF +75% -10% 16 V AL-ELCTLT	04200	30D906G016CC2-DSM
C2	0180-2214	1	CAP-FXD 90uF +75% -10% 16 V AL-ELCTLT	04200	30D906G016CC2-DSM
C3	0180-0229	1	CAP-FXD 33uF ±10% 10 V TA	04200	150D336X9010B2-DYS
C4	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C5	0160-5865	1	CAP-FXD 36pF ±5% 200 V CER C0G	02010	SA102A360JAAH
C6	0160-5865	1	CAP-FXD 36pF ±5% 200 V CER C0G	02010	SA102A360JAAH
C7	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C8	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C9	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C10	0160-4803	1	CAP-FXD 68pF ±5% 100 V CER C0G	02010	SA102A680JAAH
C11	0160-4803	1	CAP-FXD 68pF ±5% 100 V CER C0G	02010	SA102A680JAAH
C12	0160-4822	1	CAP-FXD 1000pF ±5% 100 V CER C0G	02010	SA201A102JAAH
C13	0160-4822	1	CAP-FXD 1000pF ±5% 100 V CER C0G	02010	SA201A102JAAH
C14	0160-4835	1	CAP-FXD 0.1uF ±10% 50 V CER X7R	02010	SA115C104KAAH
C15	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C16-C29	0160-4832	14	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C30	0160-4822	1	CAP-FXD 1000pF ±5% 100 V CER C0G	02010	SA201A102JAAH
C31	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C32	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C33	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C34	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C35	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C36	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C37	0160-4803	1	CAP-FXD 68pF ±5% 100 V CER C0G	02010	SA102A680JAAH
C38	0160-4803	1	CAP-FXD 68pF ±5% 100 V CER C0G	02010	SA102A680JAAH
C39	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
CR1	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR2	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR3	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR4	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
DS1	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS2	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS3	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS4	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
J1	1251-6135	1	CONN-POST TYPE .100-PIN-SPCG 11-CONT	02946	68000-611
J3	1251-5618	1	CONN-POST TYPE .100-PIN-SPCG 8-CONT	02946	68000-608
J4	1251-5041	1	CONN-POST TYPE .100-PIN-SPCG 5-CONT	02946	68000-605
L1	08503-80001	1	COIL-TOROID	28480	08503-80001
MP1	1480-0073	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	04559	99-012-062-0250
MP2	4040-0751	2	EXTR-PC BD ORN POLYC .062-IN-BD-THKNS	28480	4040-0751
MP3	8150-0013	1	WIRE 22AWG G/W 300V PVC 7X30 105C	28480	8150-0013
MP5	1200-0567	4	SOCKET-IC-DIP 28-CONT DIP DIP-SLDR	02414	DILB28P-308T
Q1	1853-0405	1	TRANSISTOR PNP SI PD=360MW FT=850MHZ	02037	2N4209
Q2	1853-0405	1	TRANSISTOR PNP SI PD=360MW FT=850MHZ	02037	2N4209
Q3	1854-0019	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
Q4	1854-0019	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
Q5	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q6	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q7	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
R1	0757-0416	1	RESISTOR 511 ±1% .125W TF TC=0±100	02995	SFR25H
R2	0757-0416	1	RESISTOR 511 ±1% .125W TF TC=0±100	02995	SFR25H
R3	0698-3155	1	RESISTOR 4.64K ±1% .125W TF TC=0±100	02995	SFR25H
R4	0698-3155	1	RESISTOR 4.64K ±1% .125W TF TC=0±100	02995	SFR25H
R5	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R6	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R7	0698-3430	1	RESISTOR 21.5 ±1% .125W TF TC=0±100	02995	SFR25H
R8	0698-3430	1	RESISTOR 21.5 ±1% .125W TF TC=0±100	02995	SFR25H
R9	0698-3430	1	RESISTOR 21.5 ±1% .125W TF TC=0±100	02995	SFR25H
R10	0698-3430	1	RESISTOR 21.5 ±1% .125W TF TC=0±100	02995	SFR25H
R11	0757-0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R12	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R13	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R14	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R15	0757-0416	1	RESISTOR 511 ±1% .125W TF TC=0±100	02995	SFR25H
R16	0757-0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R17	0757-0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R18	0698-3437	1	RESISTOR 133 ±1% .125W TF TC=0±100	02995	SFR25H
R19	0757-0416	1	RESISTOR 511 ±1% .125W TF TC=0±100	02995	SFR25H
R20	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R21	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R22	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R23	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R54	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R55	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
S1	3101-2243	1	SWITCH-DIP RKR 8-1A 0.05A 30VDC	04990	76YY22318S
TP1-TP27	0360-2359	28	TERMINAL-TEST POINT .230IN ABOVE	04055	230.100
TP32	0360-2359	1	TERMINAL-TEST POINT .230IN ABOVE	04055	230.100
U1	1810-0203	1	NETWORK-RES 8-SIP 470.0 OHM X 7	02483	750-81
U2	1820-2096	1	IC CNTR TTL/LS BIN ASYNCHRO	01698	SN74LS393N
U3	1820-1197	1	IC GATE TTL/LS NAND QUAD 2-INP	01698	SN74LS00N
U4	1820-1425	1	IC SCHMITT-TRIG TTL/LS NAND QUAD 2-INP	01698	SN74LS132N
U5	1820-2358	1	IC-MPU; CLK FREQ=2 MHZ	02037	MC6800B00S
U6	1810-0280	1	NETWORK-RES 10-SIP 10.0K OHM X 9	05524	MSP10A01
U7	1818-0990	1	IC CMOS 4096 (4K) STAT RAM 320-NS 3-S	03799	HM1-6514-9
U8	1818-0990	1	IC CMOS 4096 (4K) STAT RAM 320-NS 3-S	03799	HM1-6514-9
U9			SEE NOTE BELOW		
U10			SEE NOTE BELOW		
U11			SEE NOTE BELOW		
U12	08350-80003	1	CLOCK PROM		
U13	1810-0280	1	NETWORK-RES 10-SIP 10.0K OHM X 9	05524	MSP10A01
U14	1818-0990	1	IC CMOS 4096 (4K) STAT RAM 320-NS 3-S	03799	HM1-6514-9
U15	1818-0990	1	IC CMOS 4096 (4K) STAT RAM 320-NS 3-S	03799	HM1-6514-9
U16	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U17	1820-0681	1	IC GATE TTL/S NAND QUAD 2-INP	01698	SN74S00N
U18	1820-1199	1	IC INV TTL/LS HEX 1-INP	01698	SN74LS04N
U19	1820-1204	1	IC GATE TTL/LS NAND DUAL 4-INP	01698	SN74LS20N
U20	1820-1917	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS240N
U21	1820-0681	1	IC GATE TTL/S NAND QUAD 2-INP	01698	SN74S00N
U22	1820-2075	1	IC TRANSCEIVER TTL/LS BUS OCTL	01698	SN74LS245N
U23	1820-1216	1	IC DCDR TTL/LS BIN 3-TO-8-LINE 3-INP	01698	SN74LS138N
U24	1820-1216	1	IC DCDR TTL/LS BIN 3-TO-8-LINE 3-INP	01698	SN74LS138N
U25	1820-2075	1	IC TRANSCEIVER TTL/LS BUS OCTL	01698	SN74LS245N
U26	1820-1917	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS240N
U27	1820-1917	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS240N
U28	1810-0280	1	NETWORK-RES 10-SIP 10.0K OHM X 9	05524	MSP10A01
U29	1820-1917	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS240N
U30	1810-0338	1	NETWORK-RES 16-DIP 100.0 OHM X 8	02483	761-3-R100
U31	1810-0338	1	NETWORK-RES 16-DIP 100.0 OHM X 8	02483	761-3-R100
U32	1820-1917	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS240N
U33	1810-0338	1	NETWORK-RES 16-DIP 100.0 OHM X 8	02483	761-3-R100
U34	1820-1425	1	IC SCHMITT-TRIG TTL/LS NAND QUAD 2-INP	01698	SN74LS132N
U35			SEE NOTE BELOW		
U36	1820-1197	1	IC GATE TTL/LS NAND QUAD 2-INP	01698	SN74LS00N
VR1	1902-0551	1	DIODE-ZNR 6.2V 5% PD=1W IR=10UA	02037	SZ40145-8RL
W1	8159-0005	1	RESISTOR 0 CWM	01339	L-2007-1
Y1	0410-0787	1	CRYSTAL-QUARTZ 10.7 MHZ HC-18/U-HLDR	28480	0410-0787
			A3 MISCELLANEOUS PARTS		
	1200-0567	4	SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
	1480-0073	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0751	1	EXTR-PC BD ORN POLYC .062-IN-BD-THKNS	28480	4040-0751
	08350-60101		FIRMWARE REPLACEMENT KIT	28480	08350-60101
			NOTE: U9, U10, U11, U35 NOT SEPARATELY REPLACEABLE		

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4	08350-60091	1	ASSEMBLY SCALER MARKER BOARDD	28480	08350-60091
C1	0180-2214	1	CAP-FXD 90uF +75% -10% 16 V AL-ELCTLT	04200	30D906G016CC2-DSM
C2	0180-2214	1	CAP-FXD 90uF +75% -10% 16 V AL-ELCTLT	04200	30D906G016CC2-DSM
C3	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C4	0180-2144	1	CAP-FXD 200uF +75% -10% 25 V AL-ELCTLT	04200	30D207G025DH9-DSM
C5	0180-2144	1	CAP-FXD 200uF +75% -10% 25 V AL-ELCTLT	04200	30D207G025DH9-DSM
C6	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C7	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C8	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C9	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C10	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C11	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C12	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C13	0180-0100	1	CAP-FXD 4.7uF ±10% 35 V TA	04200	150D475X9035B2-DYS
C14	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C15	0160-4812	1	CAP-FXD 220pF ±5% 100 V CER C0G	02010	SA101A221JAAH
C16	0160-4835	1	CAP-FXD 0.1uF ±10% 50 V CER X7R	02010	SA115C104KAAH
C17	0160-4835	1	CAP-FXD 0.1uF ±10% 50 V CER X7R	02010	SA115C104KAAH
C18	0160-4808	1	CAP-FXD 470pF ±5% 100 V CER C0G	02010	SA101A471JAAH
C19	0180-0100	1	CAP-FXD 4.7uF ±10% 35 V TA	04200	150D475X9035B2-DYS
C20	0180-0100	1	CAP-FXD 4.7uF ±10% 35 V TA	04200	150D475X9035B2-DYS
C21	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C22	0160-4812	1	CAP-FXD 220pF ±5% 100 V CER C0G	02010	SA101A221JAAH
C23	0180-3020	1	CAP-FXD 120uF ±10% 50 V	04200	109D127X9050F2
C24	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C25	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C26	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C27	0160-4808	1	CAP-FXD 470pF ±5% 100 V CER C0G	02010	SA101A471JAAH
C28	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C30	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C31	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C32	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C33	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C34	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C35	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C36	0160-4830	1	CAP-FXD 2200pF ±10% 100 V CER X7R	02010	SA101C222KAAH
C37	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C38	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C39	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C40	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C41	0160-4822	1	CAP-FXD 1000pF ±5% 100 V CER C0G	02010	SA201A102JAAH
C42	0160-4822	1	CAP-FXD 1000pF ±5% 100 V CER C0G	02010	SA201A102JAAH
C43	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C44	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C45	0160-4812	1	CAP-FXD 220pF ±5% 100 V CER C0G	02010	SA101A221JAAH
C46	0180-0374	1	CAP-FXD 10uF ±10% 20 V TA	04200	150D106X9020B2-DYS
C47	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C48	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C49	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C50	0160-4801	1	CAP-FXD 100pF ±5% 100 V CER C0G	02010	SA102A101JAAH
CR1	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	28480	1901-0033
CR2	1901-0535	1	DIODE-SCHOTTKY SM SIG	02062	50825511
CR3	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	28480	1901-0033
CR4	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	28480	1901-0033
CR5	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	28480	1901-0033
CR6	1901-0535	1	DIODE-SCHOTTKY SM SIG	02062	50825511
CR7	1901-0535	1	DIODE-SCHOTTKY SM SIG	02062	50825511
J1	1250-0543	1	CONNECTOR-RF SMB M PC 50-OHM	05769	51-053-0349-BE8
L1	08503-80001	1	COIL-TOROID	28480	08503-80001
L2	9100-1654	1	INDUCTOR RF-CH-MLD 1.1MH ±5%	05826	2500-30
L3	9100-1654	1	INDUCTOR RF-CH-MLD 1.1MH ±5%	05826	2500-30
L5	9100-1642	1	INDUCTOR RF-CH-MLD 270UH ±5%	05826	2500-00
MP1	1480-0073	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	04559	99-012-062-0250
MP2	4040-0752	2	EXTR-PC BD YEL POLYC .062-IN-BD-THKNS	28480	4040-0752
Q1	1854-0023	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
R1	0699-0642	1	RESISTOR 10K ±0.1% .1W TF TC=0±5	02995	5023ZA10K00B
R2	2100-3052	1	RESISTOR-TRMR 50 10% TKF SIDE-ADJ 17-TRN	04568	89PR50
R3	0757-0438	1	RESISTOR 5.11K ±1% .125W TF TC=0±100	02995	SFR25H
R5	0699-0642	1	RESISTOR 10K ±0.1% .1W TF TC=0±5	02995	5023ZA10K00B
R6	0757-0346	1	RESISTOR 10 ±1% .125W TF TC=0±100	05524	CMF-55-1, T-1
R7	0757-0395	1	RESISTOR 56.2 ±1% .125W TF TC=0±100	02995	SFR25H

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R8	0811-3362	1	RESISTOR 825 ±0.1% .05W PN TC=0±10	03123	140
R9	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R10	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R11	0698-6619	1	RESISTOR 15K ±0.1% .125W TF TC=0±25	02995	5033R
R12	0698-6619	1	RESISTOR 15K ±0.1% .125W TF TC=0±25	02995	5033R
R13	0811-3315	1	RESISTOR 3.94K ±0.25% .125W PN TC=0±2	03123	135
R14	0698-8167	1	RESISTOR 18K ±0.1% .125W TF TC=0±25	02995	5033R
R15	2100-3095	1	RESISTOR-TRMR 200 10% TKF SIDE-ADJ	04568	89PR200
R16	0698-6631	1	RESISTOR 2.5K ±0.1% .125W TF TC=0±25	02995	5033R
R17	0698-6630	1	RESISTOR 20K ±0.1% .125W TF TC=0±25	02995	5033R
R18	2100-3052	1	RESISTOR-TRMR 50 10% TKF SIDE-ADJ 17-TRN	04568	89PR50
R19	0698-6346	1	RESISTOR 300 ±0.1% .125W TF TC=0±25	02995	5033R
R21	0811-1641	1	RESISTOR 6.71K ±0.1% .25W PN TC=0±5	01854	7010
R22	2100-3164	1	RESISTOR-TRMR 10 20% TKF SIDE-ADJ 17-TRN	04568	89PR10
R23	0757-0395	1	RESISTOR 56.2 ±1% .125W TF TC=0±100	02995	SFR25H
R24	0698-6977	1	RESISTOR 30K ±0.1% .125W TF TC=0±25	02995	5033R
R25	2100-3095	1	RESISTOR-TRMR 200 10% TKF SIDE-ADJ	04568	89PR200
R26	0698-0085	1	RESISTOR 2.61K ±1% .125W TF TC=0±100	02995	SFR25H
R27	2100-3109	1	RESISTOR-TRMR 2K 10% TKF SIDE-ADJ 17-TRN	04568	89PR2K
R28	2100-3095	1	RESISTOR-TRMR 200 10% TKF SIDE-ADJ	04568	89PR200
R29	0698-3150	1	RESISTOR 2.37K ±1% .125W TF TC=0±100	02995	SFR25H
R30	0698-3152	1	RESISTOR 3.48K ±1% .125W TF TC=0±100	02995	SFR25H
R31	0811-2037	1	RESISTOR 2.4K ±1% .25W PN TC=0±10	01854	7010
R32	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R33	0757-0279	1	RESISTOR 3.16K ±1% .125W TF TC=0±100	02995	SFR25H
R34	0757-1094	1	RESISTOR 1.47K ±1% .125W TF TC=0±100	02995	SFR25H
R35	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R36	0811-1642	1	RESISTOR 8.825K ±0.1% .25W PN TC=0±5	01854	7010
R37	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R38	0698-0083	1	RESISTOR 1.96K ±1% .125W TF TC=0±100	02995	SFR25H
R39	0698-3446	1	RESISTOR 383 ±1% .125W TF TC=0±100	02995	SFR25H
R40	0699-0059	1	RESISTOR 5K ±0.1% .1W TF TC=0±5	02995	5023Z
R41	0699-0059	1	RESISTOR 5K ±0.1% .1W TF TC=0±5	02995	5023Z
R42	0698-3157	1	RESISTOR 19.6K ±1% .125W TF TC=0±100	02995	SFR25H
R43	0698-6362	1	RESISTOR 1K ±0.1% .125W TF TC=0±25	02995	5033R
R44	2100-3122	1	RESISTOR-TRMR 100 10% TKF SIDE-ADJ	04568	89PR100
R46	0698-3437	1	RESISTOR 133 ±1% .125W TF TC=0±100	02995	SFR25H
R47	0698-3157	1	RESISTOR 19.6K ±1% .125W TF TC=0±100	02995	SFR25H
R48	0757-0444	1	RESISTOR 12.1K ±1% .125W TF TC=0±100	02995	SFR25H
R49	0757-0465	1	RESISTOR 100K ±1% .125W TF TC=0±100	02995	SFR25H
R50	0757-0419	1	RESISTOR 681 ±1% .125W TF TC=0±100	02995	SFR25H
R51	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R52	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R53	0757-0438	1	RESISTOR 5.11K ±1% .125W TF TC=0±100	02995	SFR25H
R54	0757-0438	1	RESISTOR 5.11K ±1% .125W TF TC=0±100	02995	SFR25H
R55	0757-0438	1	RESISTOR 5.11K ±1% .125W TF TC=0±100	02995	SFR25H
R56	0757-0416	1	RESISTOR 511 ±1% .125W TF TC=0±100	02995	SFR25H
R57	0757-0416	1	RESISTOR 511 ±1% .125W TF TC=0±100	02995	SFR25H
R58	0757-0416	1	RESISTOR 511 ±1% .125W TF TC=0±100	02995	SFR25H
R59	2100-3103	1	RESISTOR-TRMR 10K 10% TKF SIDE-ADJ	04568	89PR10K
TP1-TP21	0360-2359	21	TERMINAL-TEST POINT .230IN ABOVE	04055	230.100
U1	1826-1048	1	IC OP AMP PRCN 8-DIP-C PKG	02180	OP-07CZ
U2	1826-1048	1	IC OP AMP PRCN 8-DIP-C PKG	02180	OP-07CZ
U3	1826-1048	1	IC OP AMP PRCN 8-DIP-C PKG	02180	OP-07CZ
U4	1826-1048	1	IC OP AMP PRCN 8-DIP-C PKG	02180	OP-07CZ
U5	1826-1048	1	IC OP AMP PRCN 8-DIP-C PKG	02180	OP-07CZ
U6	1826-1048	1	IC OP AMP PRCN 8-DIP-C PKG	02180	OP-07CZ
U7	1826-0448	1	D/A 10-BIT 16-PLASTIC CMOS	03285	AD7533LN(SEL)
U8	1826-0796	1	ANALOG SWITCH 4 SPST 16 -CERDIP	02180	SW-02FQ
U9	1826-0797	1	D/A 12-BIT 18-CBRZ CMOS	03285	AD7541BD(SEL)
U10	1826-0188	1	D/A 8-BIT 16-CERDIP BPLR	02037	MC1408L-8
U11	1826-0065	1	IC COMPARATOR PRCN 8-DIP-P PKG	03406	LM311N
U12	1826-0448	1	D/A 10-BIT 16-PLASTIC CMOS	03285	AD7533LN(SEL)
U13	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U14	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U15	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U16	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U17	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U18	1816-1089	1	IC TTL LS 64-BIT STAT RAM 80-NS 3-S	03794	AM27LS03PC
U19	1820-1437	1	IC MV TTL/LS MONOSTBL CLEAR DUAL	01698	SN74LS221N
U20	1820-1216	1	IC DCDR TTL/LS BIN 3-TO-8-LINE 3-INP	01698	SN74LS138N

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
U21	1820-1194	1	IC CNTR TTL/LS BIN UP/DOWN SYNCHRO	01698	SN74LS193N
U22	1820-1419	1	IC COMPTR TTL/LS MAGTD 4-BIT	01698	SN74LS85N
U23	1816-1089	1	IC TTL LS 64-BIT STAT RAM 80-NS 3-S	03794	AM27LS03PC
U24	1820-1112	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG	01698	SN74LS74AN
U25	1820-1918	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS241N
U26	1820-1917	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS240N
U27	1820-1201	1	IC GATE TTL/LS AND QUAD 2-INP	01698	SN74LS08N
U28	1826-1048	1	IC OP AMP PRCN 8-DIP-C PKG	02180	OP-07CZ
VR1	1902-3171	1	DIODE-ZNR 11V 5% DO-35 PD=.4W TC=+.062%		
VR2	1902-0041	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W		
VR3	1902-3149	1	DIODE-ZNR 9.09V 5% DO-35 PD=.4W		
VR4	1902-0551	1	DIODE-ZNR 6.2V 5% PD=1W IR=10UA	02037	SZ40145-8RL
VR5	1902-0625	1	DIODE-ZNR 1N829 6.2V 5% DO-35 PD=.4W	02037	1N829
VR6	1902-0625	1	DIODE-ZNR 1N829 6.2V 5% DO-35 PD=.4W	02037	1N829
VR7	1902-0625	1	DIODE-ZNR 1N829 6.2V 5% DO-35 PD=.4W	02037	1N829
			A4 MISCELLANEOUS PARTS		
	1480-0073	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	28480	1480-0073
	4040-0752	2	EXTR-PC BD YEL POLYC .062-IN-BD-THKNS	28480	4040-0752

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Table 6–2. Replaceable Parts

Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
A5	08350–60135	1	BD AY SWP GEN	28480	08350–60135
C1	0180–2214	1	CAP–FXD 100uF ±20% 16 V AL–ELCTLT		
C2	0180–2214	1	CAP–FXD 100uF ±20% 16 V AL–ELCTLT		
C3	0180–4169	1	CAP–FXD 47uF ±10% 35 V TA		
C4	0180–4169	1	CAP–FXD 47uF ±10% 35 V TA		
C5	0180–3888	1	CAP–FXD 15uF ±10% 25 V TA	04200	173D156X9025X
C6	0180–3888	1	CAP–FXD 15uF ±10% 25 V TA	04200	173D156X9025X
C7	0160–3742	1	CAP–FXD 1uF ±5% 50 V POLYC–MET	13171	
C8	0180–3020	1	CAP–FXD 120uF ±10% 50 V	04200	109D127X9050F2
C11	0180–3622	1	CAP–FXD 0.1uF ±10% 35 V TA	04200	173D104X9035U
C12	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	09939	RPA10X7R222K100V
C13	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	09939	RPA10X7R222K100V
C15	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C17	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C18	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C19	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C20	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C21	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C23	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	09939	RPA10X7R222K100V
C24	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C26	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C28	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C29	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C30	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C31	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C32	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C33	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C34	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C35	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C36	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C37	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C38	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C39	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	09939	RPA10X7R222K100V
C40	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C41	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C42	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C43	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C44	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C45	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C47	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C49	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C52	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C54	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C55	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C56	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C57	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C58	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C59	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C60	0180–2071	1	CAP–FXD 0.022uF ±10% 35 V TA	04200	150D223X9035A2–DYS
C61	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C62	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C63	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C64	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C65	0160–4812	1	CAP–FXD 220pF ±5% 100 V CER C0G	09939	RPA10C0G221J100V
C66	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C67	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	09939	RPA10X7R222K100V
C68	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	09939	RPA10X7R222K100V
C69	0160–4812	1	CAP–FXD 220pF ±5% 100 V CER C0G	09939	RPA10C0G221J100V
C70	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C71	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C72	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
C73	0180–4225	1	CAP–FXD 0.33uF ±10% 35 V TA		
C74	0160–4791	1	CAP–FXD 10pF ±5% 100 V CER C0G	09939	RPA10C0G100D100
C75	0160–4791	1	CAP–FXD 10pF ±5% 100 V CER C0G	09939	RPA10C0G100D100
C76	0160–4791	1	CAP–FXD 10pF ±5% 100 V CER C0G	09939	RPA10C0G100D100
C77	0180–4129	1	CAP–FXD 1uF ±10% 35 V TA	04200	173D105X9035V

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Table 6–2. Replaceable Parts

Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
C78	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	09939	RPA10X7R103K100V
CR1	1901–0050	1	DIODE–SWITCHING 80V 200MA 2NS DO–35		
CR4	1901–0050	1	DIODE–SWITCHING 80V 200MA 2NS DO–35		
CR5	1901–0050	1	DIODE–SWITCHING 80V 200MA 2NS DO–35		
CR6	1901–0376	1	DIODE–GEN PRP 35V 50MA DO–35	11946	S303
CR7	1901–0050	1	DIODE–SWITCHING 80V 200MA 2NS DO–35		
CR8	1901–0376	1	DIODE–GEN PRP 35V 50MA DO–35	11946	S303
CR9	1901–0050	1	DIODE–SWITCHING 80V 200MA 2NS DO–35		
CR10	1901–0050	1	DIODE–SWITCHING 80V 200MA 2NS DO–35		
CR11	1901–0050	1	DIODE–SWITCHING 80V 200MA 2NS DO–35		
CR14	1901–0954	1	DIODE–CUR RGLTR 1N5285 270UA DO–7	03171	
CR15	1901–0033	1	DIODE–GEN PRP 180V 200MA DO–35		
CR16	1901–0033	1	DIODE–GEN PRP 180V 200MA DO–35		
CR17	1901–0033	1	DIODE–GEN PRP 180V 200MA DO–35		
CR18	1901–0033	1	DIODE–GEN PRP 180V 200MA DO–35		
J1	8159–0005	1	RESISTOR 0 CWM	01339	L–2007–1
J4	1251–4926	1	CONN–POST TYPE .100–PIN–SPCG 8–CONT	02946	67996–608
L1	08503–80001	1			
L2	9100–1655	1	INDUCTOR RF–CH–MLD 1.2MH ±5%	05826	2500–32
L3	08503–80001	1			
L4	08503–80001	1			
L5	08503–80001	1			
MP1	08350–20135	1			
MP2	4040–0753	2	EXTR–PC BD GRN POLYC .062–IN–BD–THKNS	10456	
MP3	1480–0073	2	PIN–ROLL .062–IN–DIA .25–IN–LG BE–CU	04559	99–012–062–0250
Q1	1854–1030	1	TRANSISTOR–DUAL NPN TO–78 PD=750MW		
Q2	1854–0477	1	TRANSISTOR NPN 2N2222A SI TO–18 PD=500MW		
Q3	1853–0451	1	TRANSISTOR PNP 2N3799 SI TO–18 PD=360MW		
Q4	1854–0477	1	TRANSISTOR NPN 2N2222A SI TO–18 PD=500MW		
Q5	1853–0316	1	TRANSISTOR–DUAL PNP PD=500MW	13127	LS352
Q6	1854–0477	1	TRANSISTOR NPN 2N2222A SI TO–18 PD=500MW		
R1	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R2	2100–3056	1	RESISTOR–TRMR 5K 10% TKF SIDE–ADJ 17–TRN	04568	89PR5K
R3	0698–3156	1	RESISTOR 14.7K ±1% .125W TF TC=0±100	05524	CMF–55–1
R4	0698–8046	1	RESISTOR 16K ±0.1% .125W TF TC=0±25	05524	CMF–55–1, T–9
R5	0757–0394	1	RESISTOR 51.1 ±1% .125W TF TC=0±100	05524	CMF–55–1
R6	0757–0438	1	RESISTOR 5.11K ±1% .125W TF TC=0±100	05524	CMF–55–1
R7	0698–3154	1	RESISTOR 4.22K ±1% .125W TF TC=0±100	05524	CMF–55–1
R8	0698–8822	1	RESISTOR 6.81 ±1% .125W TF TC=0±100	05524	CMF–55–1
R9	0698–7929	1	RESISTOR 9.09K ±0.1% .125W TF TC=0±50	05524	CMF–55–1, T–2
R10	0699–0273	1	RESISTOR 2.15K ±0.1% .125W TF TC=0±25	05524	CMF–55–1
R11	0698–6619	1	RESISTOR 15K ±0.1% .125W TF TC=0±25	05524	CMF–55–1, T–9
R12	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R13	0757–0199	1	RESISTOR 21.5K ±1% .125W TF TC=0±100	05524	CMF–55–1
R14	0698–3443	1	RESISTOR 287 ±1% .125W TF TC=0±100	05524	CMF–55–1
R15	0698–3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	05524	CMF–55–1
R16	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R17	0757–0441	1	RESISTOR 8.25K ±1% .125W TF TC=0±100	05524	CMF–55–1
R18	0757–0419	1	RESISTOR 681 ±1% .125W TF TC=0±100	05524	CMF–55–1
R19	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R20	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R22	0698–7276	1	RESISTOR 46.4K ±1% .05W TF TC=0±100	05524	CMF–50–2
R25	2100–3163	1	RESISTOR–TRMR 1M 20% TKF SIDE–ADJ 17–TRN	04568	89PR1M
R26	0698–3450	1	RESISTOR 42.2K ±1% .125W TF TC=0±100	05524	CMF–55–1
R27	0698–3450	1	RESISTOR 42.2K ±1% .125W TF TC=0±100	05524	CMF–55–1
R28	0698–3162	1	RESISTOR 46.4K ±1% .125W TF TC=0±100	05524	CMF–55–1
R29	0698–3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	05524	CMF–55–1
R30	0757–0424	1	RESISTOR 1.1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R31	0698–3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	05524	CMF–55–1
R32	0698–3150	1	RESISTOR 2.37K ±1% .125W TF TC=0±100	05524	CMF–55–1
R33	0698–3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	05524	CMF–55–1
R34	0698–3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	05524	CMF–55–1
R35	0698–3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	05524	CMF–55–1
R36	0757–0123	1	RESISTOR 34.8K ±1% .125W TF TC=0±100	05524	CMF–55–1
R37	0757–0123	1	RESISTOR 34.8K ±1% .125W TF TC=0±100	05524	CMF–55–1
R38	0698–3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	05524	CMF–55–1

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Table 6–2. Replaceable Parts

Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
R39	0698–8958	1	RESISTOR 511K ±1% .125W TF TC=0±100	01074	H8
R40	0698–3159	1	RESISTOR 26.1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R41	0757–0199	1	RESISTOR 21.5K ±1% .125W TF TC=0±100	05524	CMF–55–1
R42	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	05524	CMF–55–1
R43	2100–3161	1	RESISTOR–TRMR 20K 10% TKF SIDE–ADJ	04568	89PR20K
R44	0757–0123	1	RESISTOR 34.8K ±1% .125W TF TC=0±100	05524	CMF–55–1
R45	0698–6320	1	RESISTOR 5K ±0.1% .125W TF TC=0±25	05524	CMF–55–1, T–9
R46	0757–1094	1	RESISTOR 1.47K ±1% .125W TF TC=0±100	05524	CMF–55–1
R47	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R48	0698–7276	1	RESISTOR 46.4K ±1% .05W TF TC=0±100	05524	CMF–50–2
R49	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R52	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R53	0698–3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	05524	CMF–55–1
R54	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	05524	CMF–55–1
R55	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	05524	CMF–55–1
R56	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	05524	CMF–55–1
R57	0698–3450	1	RESISTOR 42.2K ±1% .125W TF TC=0±100	05524	CMF–55–1
R58	0698–3450	1	RESISTOR 42.2K ±1% .125W TF TC=0±100	05524	CMF–55–1
R59	0698–3243	1	RESISTOR 178K ±1% .125W TF TC=0±100	05524	CMF–55–1
R60	0698–3243	1	RESISTOR 178K ±1% .125W TF TC=0±100	05524	CMF–55–1
R61	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	05524	CMF–55–1
R62	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	05524	CMF–55–1
R63	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	05524	CMF–55–1
R65	0757–0290	1	RESISTOR 6.19K ±1% .125W TF TC=0±100	05524	CMF–55–1
R66	0699–0273	1	RESISTOR 2.15K ±0.1% .125W TF TC=0±25	05524	CMF–55–1
R67	0698–3154	1	RESISTOR 4.22K ±1% .125W TF TC=0±100	05524	CMF–55–1
R68	0757–0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	05524	CMF–55–1
R69	0757–0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	05524	CMF–55–1
R71	0698–3449	1	RESISTOR 28.7K ±1% .125W TF TC=0±100	05524	CMF–55–1
R72	0698–3449	1	RESISTOR 28.7K ±1% .125W TF TC=0±100	05524	CMF–55–1
R73	0698–3266	1	RESISTOR 237K ±1% .125W TF TC=0±100	05524	CMF–55–1
R74	0757–0288	1	RESISTOR 9.09K ±1% .125W TF TC=0±100	05524	CMF–55–1
R75	0698–6317	1	RESISTOR 500 ±0.1% .125W TF TC=0±25	05524	CMF–55–1, T–9
R76	0698–6317	1	RESISTOR 500 ±0.1% .125W TF TC=0±25	05524	CMF–55–1, T–9
R77	2100–0545	1	RESISTOR–TRMR 1K 10% TKF SIDE–ADJ 17–TRN	04568	67XR
TP1	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP2	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP3	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP4	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP5	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP6	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP7	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP8	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP9	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP10	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP11	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP12	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP13	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP14	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP15	1460–2201	1	SPRING RADIAL TEST POINT	12646	
TP16	1460–2201	1	SPRING RADIAL TEST POINT	12646	
U1	1820–1730	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG COM		
U2	1826–0938	1	D/A 10–BIT 18–CERDIP BPLR		
U3	1826–0961	1	IC OP AMP LOW–BIAS–H–IMPD 8 PIN DIP–P		
U4	1826–1048	1	IC OP AMP PRCN 8 PIN DIP–C		
U5	1826–1048	1	IC OP AMP PRCN 8 PIN DIP–C		
U6	1826–0547	1	IC OP AMP LOW–BIAS–H–IMPD DUAL 8 PIN		
U8	1820–1730	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG COM		
U9	1826–0796	1	ANALOG SWITCH 4 SPST 16 –CERDIP		
U10	1826–0796	1	ANALOG SWITCH 4 SPST 16 –CERDIP		
U11	1826–0961	1	IC OP AMP LOW–BIAS–H–IMPD 8 PIN DIP–P		
U12	1826–1048	1	IC OP AMP PRCN 8 PIN DIP–C		
U13	1826–1048	1	IC OP AMP PRCN 8 PIN DIP–C		
U14	1820–1416	1	IC SCHMITT–TRIG TTL/LS INV HEX 1–INP		
U15	1820–1112	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG	06347	HD74LS74AP
U16	1820–1730	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG COM		

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Table 6–2. Replaceable Parts

Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
U17	1826–0796	1	ANALOG SWITCH 4 SPST 16 –CERDIP		
U18	1820–1201	1	IC GATE TTL/LS AND QUAD 2–INP	06347	HD74LS08P
U19	1826–1128	1	IC OP AMP PRCN DUAL 8 PIN DIP–P		
U20	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	06347	HD74LS00P
U21	1820–1202	1	IC GATE TTL/LS NAND TPL 3–INP	06347	HD74LS10P
U22	1820–1201	1	IC GATE TTL/LS AND QUAD 2–INP	06347	HD74LS08P
U23	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	06347	HD74LS00P
U24	1820–1730	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG COM		
U25	1820–1200	1	IC INV TTL/LS HEX	06347	HD74LS05P
U26	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	06347	HD74LS00P
U27	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	06347	HD74LS00P
U28	1820–1201	1	IC GATE TTL/LS AND QUAD 2–INP	06347	HD74LS08P
U29	1820–1423	1	IC MV TTL/LS MONOSTBL RETRIG DUAL	06347	HD74LS123P
U30	1820–2024	1	IC DRVR TTL/LS BUS OCTL		
U31	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	06347	HD74LS00P
U32	1820–1423	1	IC MV TTL/LS MONOSTBL RETRIG DUAL	06347	HD74LS123P
U33	1820–1199	1	IC INV TTL/LS HEX 1–INP	06347	HD74LS04P
U34	1826–0065	1	IC COMPARATOR PRCN 8 PIN DIP–P		
U35	1826–0065	1	IC COMPARATOR PRCN 8 PIN DIP–P		
U36	1820–1199	1	IC INV TTL/LS HEX 1–INP	06347	HD74LS04P
U37	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	06347	HD74LS00P
U38	1820–1423	1	IC MV TTL/LS MONOSTBL RETRIG DUAL	06347	HD74LS123P
U39	1820–1216	1	IC DCDR TTL/LS BIN 3–TO–8–LINE 3–INP	06347	HD74LS138P
U40	1820–1244	1	IC MUXR/DATA–SEL TTL/LS 4–TO–1–LINE DUAL	06347	HD74LS153P
U41	1820–1440	1	IC LCH TTL/LS R–BAR S–BAR QUAD	06344	MB74LS279M
U42	1820–1200	1	IC INV TTL/LS HEX	06347	HD74LS05P
U43	1820–1244	1	IC MUXR/DATA–SEL TTL/LS 4–TO–1–LINE DUAL	06347	HD74LS153P
U44	1810–0206	1	NETWORK–RES 8–SIP 10.0K OHM X 7	06252	750–81
U45	1810–0206	1	NETWORK–RES 8–SIP 10.0K OHM X 7	06252	750–81
U46	1820–3200	1	IC CNTR CMOS/HC BIN ASYNCHRO		
U47	1258–0233	1	JUMPER 8 POSITION PACKAGE; FOUR OPEN	08017	69145–208–M
VR1	1902–0579	1	DIODE–ZNR 5.1V 5% PD=1W IR=10UA	02688	
VR2	1902–3171	1	DIODE–ZNR 11V 5% DO–35 PD=.4W TC=+.062%	02688	
VR3	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W	02688	
VR4	1902–0551	1	DIODE–ZNR 6.2V 5% PD=1W IR=10UA	02688	1N4735AD041
VR5	1902–3203	1	DIODE–ZNR 14.7V 5% DO–35 PD=.4W	02688	
VR6	1902–3203	1	DIODE–ZNR 14.7V 5% DO–35 PD=.4W	02688	
VR7	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W	02688	
VR8	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W	02688	
VR9	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W	02688	
VR10	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W	02688	
VR11	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W	02688	
VR12	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W	02688	
VR13	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W	02688	
Y1	0410–1561	1	CRYSTAL–QUARTZ 444.44 KHZ	11113	CX–1H 444.44 KHZ (A)
Y2	0410–1560	1	CRYSTAL–QUARTZ 512.0 KHZ	11113	CX–1H 512 KHZ (C)

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6	**08350-60121**	**1**	**RECTIFIER BOARD ASSEMBLY**	**28480**	**08350-60121**
C1	0160-0970	1	CAP-FXD 0.47uF ±10% 80 V POLYE-FL	05176	HEW-238T
C2	0160-0970	1	CAP-FXD 0.47uF ±10% 80 V POLYE-FL	05176	HEW-238T
C3	0160-0970	1	CAP-FXD 0.47uF ±10% 80 V POLYE-FL	05176	HEW-238T
C4	0160-0970	1	CAP-FXD 0.47uF ±10% 80 V POLYE-FL	05176	HEW-238T
C5	0160-0970	1	CAP-FXD 0.47uF ±10% 80 V POLYE-FL	05176	HEW-238T
C6	0160-0970	1	CAP-FXD 0.47uF ±10% 80 V POLYE-FL	05176	HEW-238T
C7	0160-0970	1	CAP-FXD 0.47uF ±10% 80 V POLYE-FL	05176	HEW-238T
C8	0160-6831	1	CAP-FXD 0.2uF ±10% 200 V POLYE-MET	05176	HEW238T
C10	0180-0374	1	CAP-FXD 10uF ±10% 20 V TA	04200	150D106X9020B2-DYS
C11	0180-0374	1	CAP-FXD 10uF ±10% 20 V TA	04200	150D106X9020B2-DYS
C12	0160-0970	1	CAP-FXD 0.47uF ±10% 80 V POLYE-FL	05176	HEW-238T
C13	0180-0374	1	CAP-FXD 10uF ±10% 20 V TA	04200	150D106X9020B2-DYS
C15	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C16	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
CR1	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR2	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR3	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR4	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR5	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR6	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR7	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR8	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR9	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR10	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR11	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR12	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR13	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR14	1901-0662	1	DIODE-PWR RECT 100V 6A	02037	MR751
CR15	1901-0767	1	DIODE-PWR RECT 400V 6A	02037	MR754
CR16	1901-0767	1	DIODE-PWR RECT 400V 6A	02037	MR754
CR17	1901-0767	1	DIODE-PWR RECT 400V 6A	02037	MR754
CR18	1901-0767	1	DIODE-PWR RECT 400V 6A	02037	MR754
CR19	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	03406	
CR20	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	03406	
CR21	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	03406	
CR22	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	03406	
CR23	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	03406	
CR24	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	03406	
CR25	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35	03406	
F1	2110-0002	1	FUSE (INCH) 2A 250V NTD FE UL	04703	312 002
F2	2110-0002	1	FUSE (INCH) 2A 250V NTD FE UL	04703	312 002
MP1	2110-0643	2	FUHLR-CLP-TYP 15A 250V	09694	FH-8000
MP2	08350-20121	1			
MP3	1480-0073	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	04559	99-012-062-0250
MP4	4040-0754	2	EXTR-PC BD BLU POLYC .062-IN-BD-THKNS	10456	
MP5	1205-0519	1	TRANSITOR MOUNT 1.547 IN LG PLASTIC BODY	02608	8180E1
MP6	2420-0001	2	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK	05115	
MP7	6960-0079	1	PLUG-HOLE BDR-HD FOR .187-D-HOLE NYL	01924	207-120241-07-0101
MP10	0340-1252	8	INSULATOR-XSTR SLBL-LAC-CMPD	03724	TO-19-07
Q1	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q2	1854-0361	1	TRANSISTOR NPN 2N4239 SI TO-5 PD=6W	02037	2N4239
Q3	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q4	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q5	1884-0019	1	THYRISTOR-SCR 2N3669 TO-3 VRRM=200	08474	2N3669
R1	0757-0439	1	RESISTOR 6.81K ±1% .125W TF TC=0±100	02995	SFR25H
R2	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R3	0698-3438	1	RESISTOR 147 ±1% .125W TF TC=0±100	02995	SFR25H
R4	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R5	0698-0084	1	RESISTOR 2.15K ±1% .125W TF TC=0±100	02995	SFR25H
R6	0698-3260	1	RESISTOR 464K ±1% .125W TF TC=0±100	02995	SFR25H
R7	0757-1000	1	RESISTOR 51.1 ±1% .5W TF TC=0±100	02995	5053R
R8	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R9	0757-0438	1	RESISTOR 5.11K ±1% .125W TF TC=0±100	02995	SFR25H
R10	0757-0438	1	RESISTOR 5.11K ±1% .125W TF TC=0±100	02995	SFR25H
R11	0757-1000	1	RESISTOR 51.1 ±1% .5W TF TC=0±100	02995	5053R
R12	0757-0814	1	RESISTOR 511 ±1% .5W TF TC=0±100	02995	5053R
R13	0698-3415	1	RESISTOR 19.6K ±1% .5W TF TC=0±100	02995	5053R
R14	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R15	0698-7236	1	RESISTOR 1K ±1% .05W TF TC=0±100	02995	5063J

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R16	0698-3447	1	RESISTOR 422 ±1% .125W TF TC=0±100	02995	SFR25H
U1	1826-0065	1	IC COMPARATOR PRCN 8 PIN DIP-P	03406	LM311N
VR1	1902-3002	1	DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=-.074%	02037	
VR2	1902-3333	1	DIODE-ZNR 46.4V 5% DO-35 PD=.4W	02037	
VR3	1902-0197	1	DIODE-ZNR 82V 5% PD=1W IR=5UA	02037	

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7		1	**REGULATOR BOARD ASSEMBLY (NOT SEPARATELY REPLACEABLE)**		
	08350-60057		REGULATOR/HEAT SINK ASSEMBLY REPLACEMENT KIT	28480	08350-60057
C1	0180-2661	1	CAP-FXD 1uF ±10% 50 V TA	04200	199D1135
C2	0180-0183	1	CAP-FXD 10uF +75% -10% 50 V AL-ELCTLT	04200	30D106G050CB2-DSM
C3	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C4	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C5	0160-4846	1	CAP-FXD 1500pF ±5% 100 V CER C0G	02010	SA201A152JAAH
C6	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C7	0180-2210	1	CAP-FXD 2uF +50% -10% 150 V AL-ELCTLT	04200	30D205F150BB2-DSM
C8	0180-3831	1	CAP-FXD 10uF ±10% 35 V TA	04200	299D106X9035DB1
C9	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C10	0160-4824	1	CAP-FXD 680pF ±5% 100 V CER C0G	02010	SA101A681JAAH
C11	0160-4835	1	CAP-FXD 0.1uF ±10% 50 V CER X7R	02010	SA115C104KAAH
C12	0160-4835	1	CAP-FXD 0.1uF ±10% 50 V CER X7R	02010	SA115C104KAAH
C13	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C14	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C15	0160-4824	1	CAP-FXD 680pF ±5% 100 V CER C0G	02010	SA101A681JAAH
C16	0160-4574	1	CAP-FXD 1000pF ±10% 100 V CER X7R	02010	SA101C102KAAH
C17	0180-2610	1	CAP-FXD 10uF ±10% 75 V TA	04200	150D106X9075R2
C18	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C19	0180-0374	1	CAP-FXD 10uF ±10% 20 V TA	04200	150D106X9020B2-DYS
C20	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C21	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C22	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C23	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C24	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C25	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C26	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C27	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C28	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C29	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C30	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C34	0180-3087	1	CAP-FXD 1.5uF ±20% 60 V TA	04200	150D155X0060B2
C35	0160-4574	1	CAP-FXD 1000pF ±10% 100 V CER X7R	02010	SA101C102KAAH
C36	0180-3831	1	CAP-FXD 10uF ±10% 35 V TA	04200	299D106X9035DB1
C37	0180-0291	1	CAP-FXD 1uF ±10% 35 V TA	04200	150D105X9035A2-DYS
C43	0180-3831	1	CAP-FXD 10uF ±10% 35 V TA	04200	299D106X9035DB1
C44	0180-3831	1	CAP-FXD 10uF ±10% 35 V TA	04200	299D106X9035DB1
C46	0180-0116	1	CAP-FXD 6.8uF ±10% 35 V TA	04200	150D685X9035B2-DYS
C50	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C51	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C52	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C53	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C54	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C55	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C56	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C58	0180-0116	1	CAP-FXD 6.8uF ±10% 35 V TA	04200	150D685X9035B2-DYS
C59	0180-3831	1	CAP-FXD 10uF ±10% 35 V TA	04200	299D106X9035DB1
CR1	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35		
CR3	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR4	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35		
CR5	1901-0033	1	DIODE-GEN PRP 180V 200MA DO-35		
CR6	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR7	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR8	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR9	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR10	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR11	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR12	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR13	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR14	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR17	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR18	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR19	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR20	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR21	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR22	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR23	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR24	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR26	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR27	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR28	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004
CR29	1901-0743	1	DIODE-PWR RECT 1N4004 400V 1A DO-41	04504	1N4004

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
DS1	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS2	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS3	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS4	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS5	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS6	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS7	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS8	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
F1	2110-0476	1	FUSE (INCH) 4A 125V NTD BI	02805	GMW-4
F2	2110-0056	1	FUSE (INCH) 6A 250V NTD FE UL	04703	312 006
F3	2110-0051	1	FUSE (INCH) 10A 250V NTD FE UL	02805	ABC-10 AMP
F4	2110-0476	1	FUSE (INCH) 4A 125V NTD BI	02805	GMW-4
F5	2110-0332	1	FUSE (INCH) 3A 125V NTD BI	02805	GMW 3
F6	2110-0425	1	FUSE (INCH) 2A 125V NTD BI	02805	GMW 2A
MP3	1251-8463	8	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	01380	3-332070-4
MP5	1205-0202	1	THERMAL LINK DUAL TO-18-CS	02123	259-18-40
MP6	0380-0321	6	SPACER-RVT-ON .125-IN-LG .152-IN-ID		
MP8	2110-0643	2	FUHLR-CLP-TYP 15A 250V	09694	FH-8000
MP12	1205-0011	4	HEAT SINK TO-5/TO-39-CS	05792	TXBF-032-025B
MP14	2420-0001	2	NUT-HEX-W/LKWR 6-32-THD .109-IN-THK		
MP15	1205-0519	1	TRANSITOR MOUNT 1.547 IN LG PLASTIC BODY	02608	8180E1
MP16	1200-0173	7	INSULATOR-XSTR DAP-GL	02210	A-10001 DAP
Q1	1855-0421	1	TRANSISTOR J-FET 2N5114 P-CHAN D-MODE	02883	2N5114
Q2	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q3	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q4	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q5	1884-0344	1	THYRISTOR-SCR VRRM=400	02037	SCR2143
Q7	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q8	1854-0271	1	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ		
Q10	1884-0019	1	THYRISTOR-SCR 2N3669 TO-3 VRRM=200	08474	2N3669
Q11	1884-0344	1	THYRISTOR-SCR VRRM=400	02037	SCR2143
Q12	1884-0344	1	THYRISTOR-SCR VRRM=400	02037	SCR2143
Q13	1884-0344	1	THYRISTOR-SCR VRRM=400	02037	SCR2143
Q14	1884-0344	1	THYRISTOR-SCR VRRM=400	02037	SCR2143
Q15	1884-0344	1	THYRISTOR-SCR VRRM=400	02037	SCR2143
Q17	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
R1	0698-3132	1	RESISTOR 261 ±1% .125W TF TC=0±100	02995	SFR25H
R2	0757-0420	1	RESISTOR 750 ±1% .125W TF TC=0±100	02995	SFR25H
R3	0757-0416	1	RESISTOR 511 ±1% .125W TF TC=0±100	02995	SFR25H
R4	0757-0438	1	RESISTOR 5.11K ±1% .125W TF TC=0±100	02995	SFR25H
R5	0757-0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R6	0698-0084	1	RESISTOR 2.15K ±1% .125W TF TC=0±100	02995	SFR25H
R7	0698-0085	1	RESISTOR 2.61K ±1% .125W TF TC=0±100	02995	SFR25H
R8	0757-0278	1	RESISTOR 1.78K ±1% .125W TF TC=0±100	02995	SFR25H
R9	0698-8805	1	RESISTOR 10.35K ±0.1% .125W TF TC=0±25	02995	5033R
R10	2100-3123	1	RESISTOR-TRMR 500 10% TKF SIDE-ADJ	04568	89PR500
R11	0698-8608	1	RESISTOR 4.525K ±0.1% .125W TF TC=0±25	02995	5033R
R12	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R13	0811-1078	1	RESISTOR .22 ±5% 3W PWI TC=0±90	05524	CW-2B-39
R14	0698-3440	1	RESISTOR 196 ±1% .125W TF TC=0±100	02995	SFR25H
R15	0757-0288	1	RESISTOR 9.09K ±1% .125W TF TC=0±100	02995	SFR25H
R16	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R17	0757-0821	1	RESISTOR 1.21K ±1% .5W TF TC=0±100	02995	5053R
R18	0698-0085	1	RESISTOR 2.61K ±1% .125W TF TC=0±100	02995	SFR25H
R19	0757-0278	1	RESISTOR 1.78K ±1% .125W TF TC=0±100	02995	SFR25H
R20	0698-8640	1	RESISTOR 4.734K ±0.1% .125W TF TC=0±25	02995	5033R
R21	2100-3154	1	RESISTOR-TRMR 1K 10% TKF SIDE-ADJ 17-TRN	04568	89PR1K
R22	0698-6361	1	RESISTOR 8K ±0.1% .125W TF TC=0±25	02995	5033R
R23	0698-3547	1	RESISTOR 1 ±5% .5W CC TC=0+412	01607	EB10G5
R24	0757-0421	1	RESISTOR 825 ±1% .125W TF TC=0±100	02995	SFR25H
R25	0757-0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R26	0698-3136	1	RESISTOR 17.8K ±1% .125W TF TC=0±100	02995	SFR25H
R27	0757-1000	1	RESISTOR 51.1 ±1% .5W TF TC=0±100	02995	5053R
R28	0757-0465	1	RESISTOR 100K ±1% .125W TF TC=0±100	02995	SFR25H
R29	0811-1553	1	RESISTOR .68 ±5% 2W PWI TC=0±800	02499	SPH
R30	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R31	0698-3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	02995	SFR25H
R32	0757-0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R34	0757-0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R36	0698-3338	1	RESISTOR 1.5K ±5% 2W MO TC=0±200	02499	GS-3
R37	0698-6977	1	RESISTOR 30K ±0.1% .125W TF TC=0±25	02995	5033R

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R39	2100-3122	1	RESISTOR-TRMR 100 10% TKF SIDE-ADJ	04568	89PR100
R40	0698-6619	1	RESISTOR 15K ±0.1% .125W TF TC=0±25	02995	5033R
R41	0757-0421	1	RESISTOR 825 ±1% .125W TF TC=0±100	02995	SFR25H
R43	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R44	0757-0346	1	RESISTOR 10 ±1% .125W TF TC=0±100	05524	CMF-55-1, T-1
R45	0698-6582	1	RESISTOR 2.222K ±0.1% .125W TF TC=0±50	02995	5033R
R46	0699-0407	1	RESISTOR 1.749K ±0.1% .25W TF TC=0±25	02995	5043R
R47	0757-0421	1	RESISTOR 825 ±1% .125W TF TC=0±100	02995	SFR25H
R48	0698-3406	1	RESISTOR 1.33K ±1% .5W TF TC=0±100	02995	5053R
R49	0698-3406	1	RESISTOR 1.33K ±1% .5W TF TC=0±100	02995	5053R
R50	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R51	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R52	0698-0084	1	RESISTOR 2.15K ±1% .125W TF TC=0±100	02995	SFR25H
R53	0698-3435	1	RESISTOR 38.3 ±1% .125W TF TC=0±100	02995	SFR25H
R54	0698-6362	1	RESISTOR 1K ±0.1% .125W TF TC=0±25	02995	5033R
R55	0698-6362	1	RESISTOR 1K ±0.1% .125W TF TC=0±25	02995	5033R
R56	0698-3158	1	RESISTOR 23.7K ±1% .125W TF TC=0±100	02995	SFR25H
R57	0698-3154	1	RESISTOR 4.22K ±1% .125W TF TC=0±100	02995	SFR25H
R58	2100-3534	1	RESISTOR-TRMR 100 10% TKF TOP-ADJ 17-TRN	04568	67WR
R59	0757-0199	1	RESISTOR 21.5K ±1% .125W TF TC=0±100	02995	SFR25H
R60	0698-8167	1	RESISTOR 18K ±0.1% .125W TF TC=0±25	02995	5033R
R61	0698-6360	1	RESISTOR 10K ±0.1% .125W TF TC=0±25	02995	5033R
R62	0698-6366	1	RESISTOR 800 ±0.1% .125W TF TC=0±25	02995	5033R
R64	0698-8416	1	RESISTOR 44K ±0.25% .125W TF TC=0±50	02995	5033R
R65	0698-6619	1	RESISTOR 15K ±0.1% .125W TF TC=0±25	02995	5033R
R66	0698-7929	1	RESISTOR 9.09K ±0.1% .125W TF TC=0±50	02995	5033R
R67	0698-6366	1	RESISTOR 800 ±0.1% .125W TF TC=0±25	02995	5033R
R68	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R69	0698-3153	1	RESISTOR 3.83K ±1% .125W TF TC=0±100	02995	SFR25H
R70	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R71	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R72	0757-0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R74	0757-0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R76	0757-0424	1	RESISTOR 1.1K ±1% .125W TF TC=0±100	02995	SFR25H
R78	0698-8812	1	RESISTOR 1 ±1% .125W TF TC=0±100	05524	CMF-55-1
R79	0698-3547	1	RESISTOR 1 ±5% .5W CC TC=0+412	01607	EB10G5
R81	0698-7576	1	RESISTOR 217 ±0.1% .125W TF TC=0±25	02995	5033R
R82	0698-8522	1	RESISTOR 2.517K ±0.1% .125W TF TC=0±25	01607	FC55
R83	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R84	0698-3443	1	RESISTOR 287 ±1% .125W TF TC=0±100	02995	SFR25H
R85	0698-7576	1	RESISTOR 217 ±0.1% .125W TF TC=0±25	02995	5033R
R86	0698-3940	1	RESISTOR 2.39K ±0.1% .125W TF TC=0±25	02995	5033R
R87	0698-6348	1	RESISTOR 3K ±0.1% .125W TF TC=0±25	02995	5033R
R89	0757-0420	1	RESISTOR 750 ±1% .125W TF TC=0±100	02995	SFR25H
R90	0757-0346	1	RESISTOR 10 ±1% .125W TF TC=0±100	05524	CMF-55-1, T-1
R91	0757-0346	1	RESISTOR 10 ±1% .125W TF TC=0±100	05524	CMF-55-1, T-1
R92	0757-0346	1	RESISTOR 10 ±1% .125W TF TC=0±100	05524	CMF-55-1, T-1
R93	0757-0346	1	RESISTOR 10 ±1% .125W TF TC=0±100	05524	CMF-55-1, T-1
R94	0757-0346	1	RESISTOR 10 ±1% .125W TF TC=0±100	05524	CMF-55-1, T-1
R95	0757-0346	1	RESISTOR 10 ±1% .125W TF TC=0±100	05524	CMF-55-1; T-1
R96	0757-0346	1	RESISTOR 10 ±1% .125W TF TC=0±100	05524	CMF-55-1, T-1
R97	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R98	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R99	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R100	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R101	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R102	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R103	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R105	2100-3154	1	RESISTOR-TRMR 1K 10% TKF SIDE-ADJ 17-TRN	04568	89PR1K
R106	2100-3109	1	RESISTOR-TRMR 2K 10% TKF SIDE-ADJ 17-TRN	04568	89PR2K
TP1	1460-2201	1	RADIAL TEST PT		
TP2	1460-2201	1	RADIAL TEST PT		
TP3	1460-2201	1	RADIAL TEST PT		
TP4	1460-2201	1	RADIAL TEST PT		
TP5	1460-2201	1	RADIAL TEST PT		
TP6	1460-2201	1	RADIAL TEST PT		
TP7	1460-2201	1	RADIAL TEST PT		
TP8	1460-2201	1	RADIAL TEST PT		
TP9	1460-2201	1	RADIAL TEST PT		
TP10	1460-2201	1	RADIAL TEST PT		

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
TP11	1460-2201	1	RADIAL TEST PT		
TP12	1460-2201	1	RADIAL TEST PT		
TP13	1460-2201	1	RADIAL TEST PT		
TP14	1460-2201	1	RADIAL TEST PT		
TP15	1460-2201	1	RADIAL TEST PT		
TP16	1460-2201	1	RADIAL TEST PT		
TP17	1460-2201	1	RADIAL TEST PT		
TP18	1460-2201	1	RADIAL TEST PT		
U2	1826-1081	1	IC OP AMP PRCN 8-DIP-P PKG	03406	LF411ACN
U8	1826-1048	1	IC OP AMP PRCN 8-DIP-C PKG	02180	OP-07CZ
U11	1826-0098	1	IC COMPARATOR PRCN 8-TO-99 PKG	03406	LM211H
U17	1826-0065	1	IC COMPARATOR PRCN 8-DIP-P PKG	03406	LM311N
U19	1826-1048	1	IC OP AMP PRCN 8-DIP-C PKG	02180	OP-07CZ
VR1	1902-0025	1	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%		
VR2	1902-0625	1	DIODE-ZNR 1N829 6.2V 5% DO-35 PD=.4W	02037	1N829
VR3	1902-3203	1	DIODE-ZNR 14.7V 5% DO-35 PD=.4W		
VR4	1902-0556	1	DIODE-ZNR 20V 5% PD=1W IR=5UA		
VR5	1902-3345	1	DIODE-ZNR 51.1V 5% DO-35 PD=.4W		
VR6	1902-0244	1	DIODE-ZNR 30V 5% PD=1W IR=5UA		
VR7	1902-3171	1	DIODE-ZNR 11V 5% DO-35 PD=.4W TC=+.062%		
VR8	1902-3257	1	DIODE-ZNR 23.7V 2% DO-35 PD=.4W		
VR9	1902-3224	1	DIODE-ZNR 17.8V 5% DO-35 PD=.4W		
VR10	1902-3188	1	DIODE-ZNR 12.7V 2% DO-35 PD=.4W		
VR11	1902-3105	1	DIODE-ZNR 5.62V 2% DO-35 PD=.4W		
VR12	1902-3105	1	DIODE-ZNR 5.62V 2% DO-35 PD=.4W		
VR13	1902-3188	1	DIODE-ZNR 12.7V 2% DO-35 PD=.4W		
VR14	1902-3224	1	DIODE-ZNR 17.8V 5% DO-35 PD=.4W		
VR15	1902-0625	1	DIODE-ZNR 1N829 6.2V 5% DO-35 PD=.4W	02037	1N829
			A7 MISCELLANEOUS PARTS		
	0380-0321	6	SPACER .125L .152ID		
	1200-0173	7	INS XSTR TO-5		
	1205-0011	4	HEATSINK T05/T039		
	1251-8463	36	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-8463
	1251-3172	2	CONNECTOR-SGL CONT SKT .03-IN-BSC-SZ RND	28480	1251-3172
	1205-0202	2	THERMAL LINK DUAL TO-18-CS	28480	1205-0202
	2110-0643	4	FUSEHOLDER-CLIP TYPE .25D-FUSE	28480	2110-0643
	2360-0115	2	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
	2420-0001	2	NUT-HEX 6-32		
	0050-2072	1	CASTING-AL		
			NOTE: FOR REGULATOR HEATSINK PART NUMBERS AND LOCATIONS, SEE FIGURE 6-10.		

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8	**08350-60086**	**1**	**HP-IB INTERFACE BOARD ASSEMBLY**	**28480**	**08350-60086**
C1	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C4	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C5	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C6	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C8	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C10	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C12	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C13	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C14	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C15	0180-2214	1	CAP-FXD 90uF +75% -10% 16 V AL-ELCTLT	04200	30D906G016CC2-DSM
C18	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C20	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C22	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C23	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
DS1	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS2	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS3	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
DS4	1990-0485	1	LED-LAMP LUM-INT=2MCD IF=30MA-MAX BVR=5V	01542	HLMP-1503
J1	1200-1256	1	SOCKET-IC-DIP 24-CONT DIP DIP-SLDR	01380	2-641614-2
L1	08503-80001	1	COIL-TOROID	28480	08503-80001
S1	3101-2340	1	SWITCH-DIP RKR 5-1A 0.05A 30VDC	04990	76PSB05S
TP1	0360-2359	1	TERMINAL-TEST POINT .230IN ABOVE	04055	230.100
TP2	0360-2359	1	TERMINAL-TEST POINT .230IN ABOVE	04055	230.100
TP3	0360-2359	1	TERMINAL-TEST POINT .230IN ABOVE	04055	230.100
TP4	0360-2359	1	TERMINAL-TEST POINT .230IN ABOVE	04055	230.100
U1	1810-0338	1	NETWORK-RES 16-DIP 100.0 OHM X 8	02483	761-3-R100
U2	1820-1199	1	IC INV TTL/LS HEX 1-INP	01698	SN74LS04N
U3	1820-1144	1	IC GATE TTL/LS NOR QUAD 2-INP	01698	SN74LS02N
U4	1820-1197	1	IC GATE TTL/LS NAND QUAD 2-INP	01698	SN74LS00N
U5	1820-1730	1	IC FF TTL/LS D-TYPE POS-EDGE-TRIG COM	01698	SN74LS273N
U6	1820-2748	1	IC-GPIB TALKER/LISTENER (E-VERSION)	03811	D8291A
U7	1820-2096	1	IC CNTR TTL/LS BIN ASYNCHRO	01698	SN74LS393N
U8	1820-3513	1	IC-INTERFACE XCVR INSTRUMENT BUS IEEE	03406	DS75161AN
U9	1820-2024	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS244N
U10	1820-2024	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS244N
U11	1820-1202	1	IC GATE TTL/LS NAND TPL 3-INP	01698	SN74LS10N
U12	1820-1416	1	IC SCHMITT-TRIG TTL/LS INV HEX 1-INP	01698	SN74LS14N
U13	1820-3431	1	IC-INTERFACE XCVR INSTRUMENT BUS IEEE	03406	DS75160AN
U14	1820-2024	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS244N
U15	1820-1216	1	IC DCDR TTL/LS BIN 3-TO-8-LINE 3-INP	01698	SN74LS138N
U16	1820-1130	1	IC GATE TTL/S NAND 13-INP	01698	SN74S133N
U17	1820-1130	1	IC GATE TTL/S NAND 13-INP	01698	SN74S133N
U18	1810-0280	1	NETWORK-RES 10-SIP 10.0K OHM X 9	05524	MSP10A01
U19	1820-2075	1	IC TRANSCEIVER TTL/LS BUS OCTL	01698	SN74LS245N
U20	1820-1416	1	IC SCHMITT-TRIG TTL/LS INV HEX 1-INP	01698	SN74LS14N
U21	1820-1416	1	IC SCHMITT-TRIG TTL/LS INV HEX 1-INP	01698	SN74LS14N
U22	1820-1416	1	IC SCHMITT-TRIG TTL/LS INV HEX 1-INP	01698	SN74LS14N
U23	1810-0338	1	NETWORK-RES 16-DIP 100.0 OHM X 8	02483	761-3-R100
U24	1820-1416	1	IC SCHMITT-TRIG TTL/LS INV HEX 1-INP	01698	SN74LS14N
U25	1820-1416	1	IC SCHMITT-TRIG TTL/LS INV HEX 1-INP	01698	SN74LS14N
VR1	1902-0551	1	DIODE-ZNR 6.2V 5% PD=1W IR=10UA	02037	SZ40145-8RL

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Table 6-2. Replaceable Parts

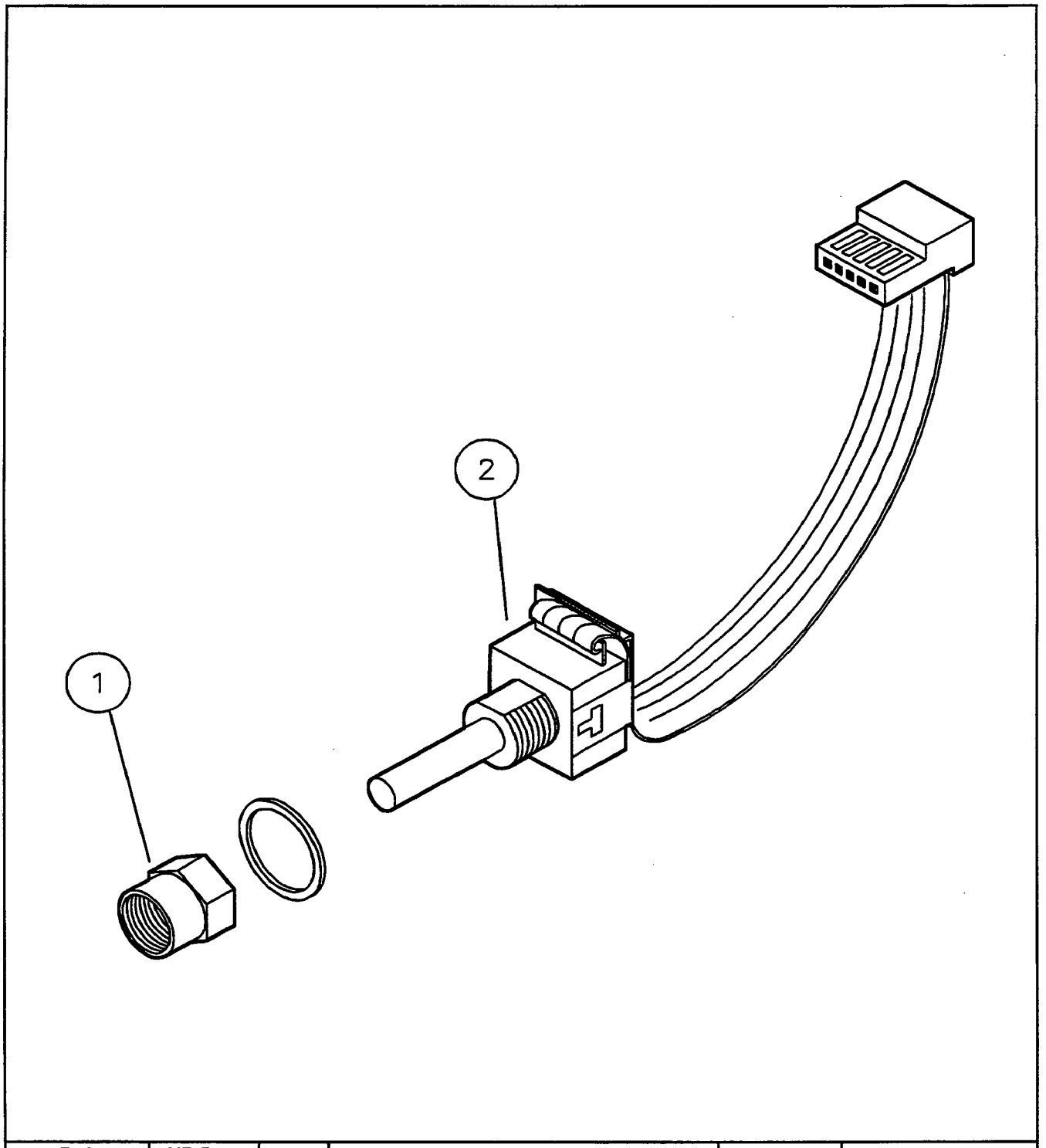
Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9	**08350-60076**	**1**	**BD ASSY**	**28480**	**08350-60076**
F1	2110-0333	1	FUSE (INCH) 1.5A 125V NTD BI	02805	GMW 1-1/2
F2	2110-0332	1	FUSE (INCH) 3A 125V NTD BI	02805	GMW 3
F3	2110-0046	1	FUSE (INCH) .5A 125V NTD BI	02805	TYPE GMW-1/2
J1	1251-7891	1	CONN-POST TYPE 2.54-PIN-SPCG 64-CONT	02946	76270-364
J2	1252-1348	1	CONN-POST TYPE .156-PIN-SPCG 16-CONT	03418	26-48-1173
J3	1251-5927	1	CONN-POST TYPE .100-PIN-SPCG 26-CONT	02946	67997-626
J4	1251-8735	1	CONN-POST TYPE .100-PIN-SPCG 8-CONT	02946	67997-608
J5	1251-4684	1	CONN-POST TYPE .156-PIN-SPCG 3-CONT	03418	26-60-5031
J6	1251-6091	1	CONN-POST TYPE 2.5-PIN-SPCG 2-CONT	03418	22-11-1021
J7	1251-4836	1	CONN-POST TYPE 2.5-PIN-SPCG 2-CONT	03418	22-12-1022
MP1	0380-0342	2	STANDOFF-RVT-ON .125-IN-LG 6-32-THD	01461	
MP3	1251-8463	6	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	01380	3-332070-4
MP5	0590-0970	2	THREADED INSERT-NUT 6-32 .062-IN-LG STL	03981	KF2-632-Z
XA2	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XA3P1	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XA3P2	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XA4P1	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XA4P2	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XA5P1	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XA5P2	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XA6	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XA7	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XA8	1251-1365	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	03394	220-626-03
XF1	1251-8463		CONNECTOR-SGL CPMT .04	28480	1251-8463
XF2	1251-8463		CONNECTOR-SGL CPMT .04	28480	1251-8463
XF3	1251-8463		CONNECTOR-SGL CPMT .04	28480	1251-8463

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS MOUNTED COMPONENTS		
B1	08350-60015	1	FAN SHIELD ASSY	28480	08350-60015
B1	08350-60032	1	400 HZ FAN ASSY (OPT. 400)	28480	08350-60032
C1	0180-2317	3	CAPACITOR FXD 3600UF +75-10% 40VDC AL	00853	539-7445-02
C2	0180-2317		CAPACITOR-FXD 3600UF +75-10% 40VDC AL	00853	539-7445-02
C3	0180-2317		CAPACITOR-FXD 3600UF +75-10% 40VDC AL	00853	539-7445-02
C4	0180-2495	1	CAPACITOR-FXD 8700UF +75-10% 40VDC AL	28480	0180-2495
C5	0180-3017	1	CAPACITOR-FXD .045F +75-10% 25VDC AL	28480	0180-3017
C6	0180-2603	1	CAPACITOR-FXD 7200UF +75-10% 50VDC AL	28480	0180-2603
C7	0180-2922	1	CAPACITOR-FXD 2600UF +75-10% 100VDC AL	28480	0180-2922
C8	0160-4065	1	CAPACITOR-FXD .1UF −20% 250VAC AC(RMS)	28480	0160-4065
CR1	1901-0033	4	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
CR2	1901-0033		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
CR3	1901-0033		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
CR4	1901-0033	4	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
F1	2110-0002	1	FUSE 2A 250V NTD 1.25X.25 UL	75915	312002
F1	2110-0055	1	FUSE 4A 250V NTD 1.25X.25 UL	75915	312004
FL1	0960-0443	1	LINE MODULE FILTERED	28480	0960-0443
S1	3101-2269	1	SWITCH TGI SUBMIN DPDT 3A 250VAC	28480	3101-2269
S2	3103-0090	1	SWITCH THRM FIX +160F 12A OPN-ON-RISE	28480	3103-0090
T1	9100-4227	1	TRANSFORMER 6V HPIL XFORMER WITH 100KHZ		
T1	9100-4337	1	TRANSFORMER, POWER (OPT. 400)	28480	9100-4337
			CONNECTORS AND CABLES		
J1	1250-0083	7	CONNECTOR F BNC FEM SGL-HOLD-FR 50-OHM	28480	1250-0083
J2			P/O W4, PLUG-IN INTERFACE		
J3			P/O W6, PLUG-IN POWER SUPPLY INTERFACE		
J4			P/O W5, HP-IB INTERFACE		
J5	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J6	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J7	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J8	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J9	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J10	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J11	1250-0118	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J12	1250-0118	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J13			P/O W7, AUX. PROGRAMMING		
J14	1251-6781	1	CONNECTOR 3-PIN M CIRC AUDIO	28480	1251-6781
W1	08350-60003	1	CABLE ASSY, RIBBON 34C A1/A2 INTERCONNECT	28480	08350-60003
W2	08350-60004	1	CABLE ASSY, RIBBON 50C A1/A2 INTERCONNECT	28480	08350-60004
W3*	08350-60006	1	CABLE ASSY, COAX/BROWN (V TUNE)	28480	08350-60006
W4	08350-60052	1	CABLE ASSY, RIBBON 64C, PLUG-IN INTERFACE	28480	08350-60052
W5	08350-60018	1	CABLE ASSY, RIBBON 26C (HP-IB INTERFACE)	28480	08350-60018
W6*	08350-60112	1	CABLE ASSY 17 PIN, PLUG-IN PS INTERFACE	28480	08350-60112
W7	08350-60002	1	CABLE ASSY RIBBON 25C PROGRAMMING INTERFACE	28480	08350-60002
W8*	08350-60007	1	CABLE ASSY COAX/ORANGE FM IN	28480	08350-60007
W9*	08350-60008	1	CABLE ASSY COAX/YELLOW	28480	08350-60008
W10	08350-60098	2	CABLE ASSY JACK/BATTERY	28480	08350-60098
W11	08350-60097	1	FRONT PANEL CABLE ASSEMBLY	28480	08350-60097
W12	08350-60095	1	CABLE ASSEMBLY RP BNC	28480	08350-60095
W13	08350-60109		JACK/BATTERY CABLE ASSEMBLY	28480	08350-60109
W14	8120-1378		POWER CORD 3C 903 8		
			*W3, W6, W8 AND W9 ARE COMMON TO J3 (PART OF PLUG-IN INTERFACE)		
			MISCELLANEOUS PARTS		
	0360-1190	6	TERMINAL-SLDR LUG PL-MTG FOR-#3/8-SCR	28480	0360-1190
	0590-0106	4	NUT-HEX-PLSTC LKG 2.56-THD .143-IN-THK	00000	ORDER BY DESCRIPTION
	2190-0009	1	WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
	2190-0016	9	WASHER-LK INTL T 3/8 IN. .377 IN-ID	28480	2190-0016
	2360-0055	4	SCREW MACH 6-32. 188-IN-LG BDG-HD-SET	00000	ORDER BY DESCRIPTION
	2360-0198	4	SCREW-MACH 6-32 .438-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
	2360-0333	8	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
	2420-0001	8	NUT-HEX-W/LKWR 6-32 THD. 109-IN-THK	00000	ORDER BY DESCRIPTION
	2950-0001	9	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION

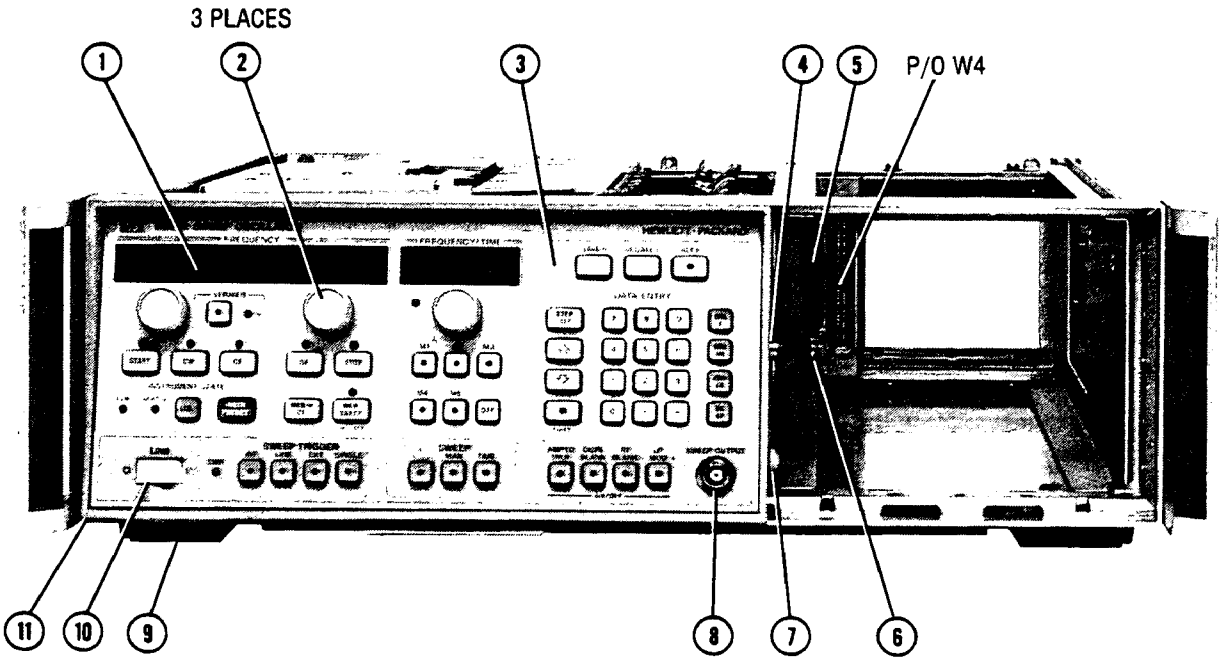
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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08350-20081	3	NUT-HEX	28480	08350-20081
2	0960-0859	3	ROTARY PULSE GENERATOR	28480	0960-0859

Figure 6-1. Rotary Pulse Generator (RPG), Parts Identification

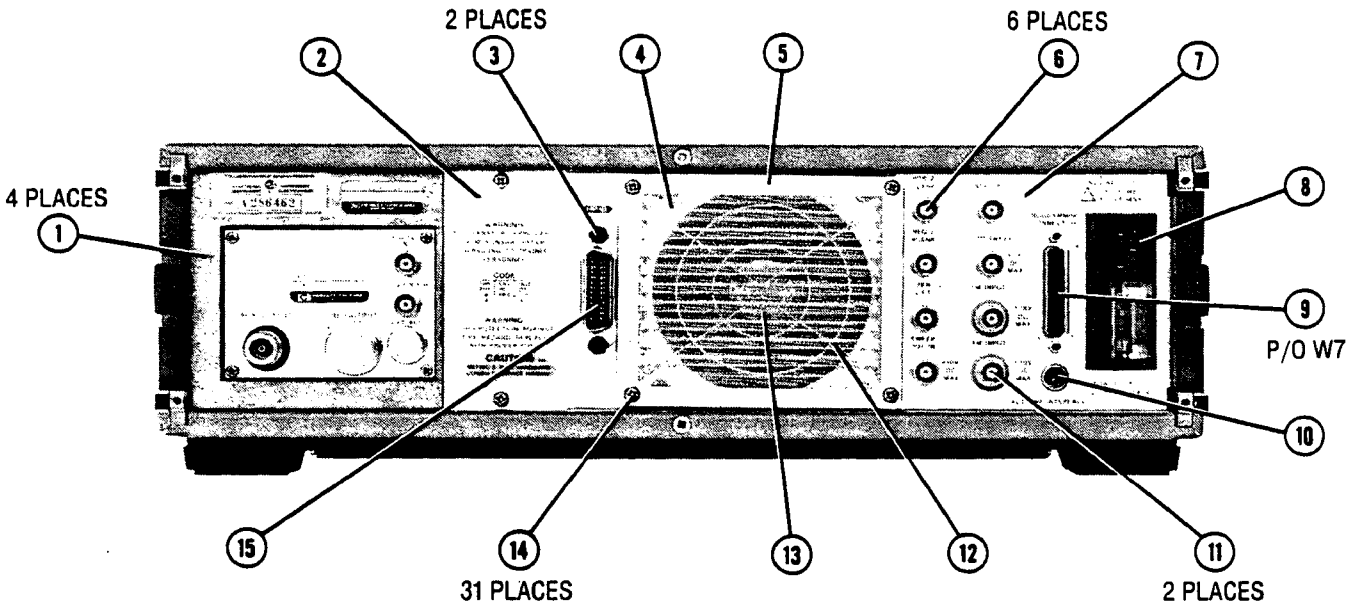
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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08350-20064	1	DISPLAY WINDOW	28480	08350-20064
2	0370-3023	3	KNOB-ROUND	28480	0370-3023
3	08350-00036	1	PANEL, FRONT DRESS	28480	08350-00036
4	08620-20061	1	LATCH BEARING	28480	08620-20061
	08620-20062	1	SCREW-LATCH BEARING	28480	08620-20062
5	08350-60010	1	CABLE ASSEMBLY	28480	08350-60010
	1251-7182	1	SPACER ALIGNMENT	28480	1251-7182
6	08350-20014	2	GUIDE PIN	28480	08350-20014
	2360-0115	31	SCREW MACH 6-32	28480	2360-0115
7	0361-1088	1	RIVET-PUSH IN .275-IN-LG	02768	254-090401-00-0101
8	1250-0083	1	CONN-RF BNC F	24931	28JR 130-1
9	5040-7201	4	FOOT-BOTTOM	28480	5040-7201
10	08350-60130	1	ACTUATOR SW AY	28480	08350-60130
11	08350-20083	1	FRONT PANEL FRAME	28480	08350-20083

Figure 6-2. Front Panel, Parts Identification

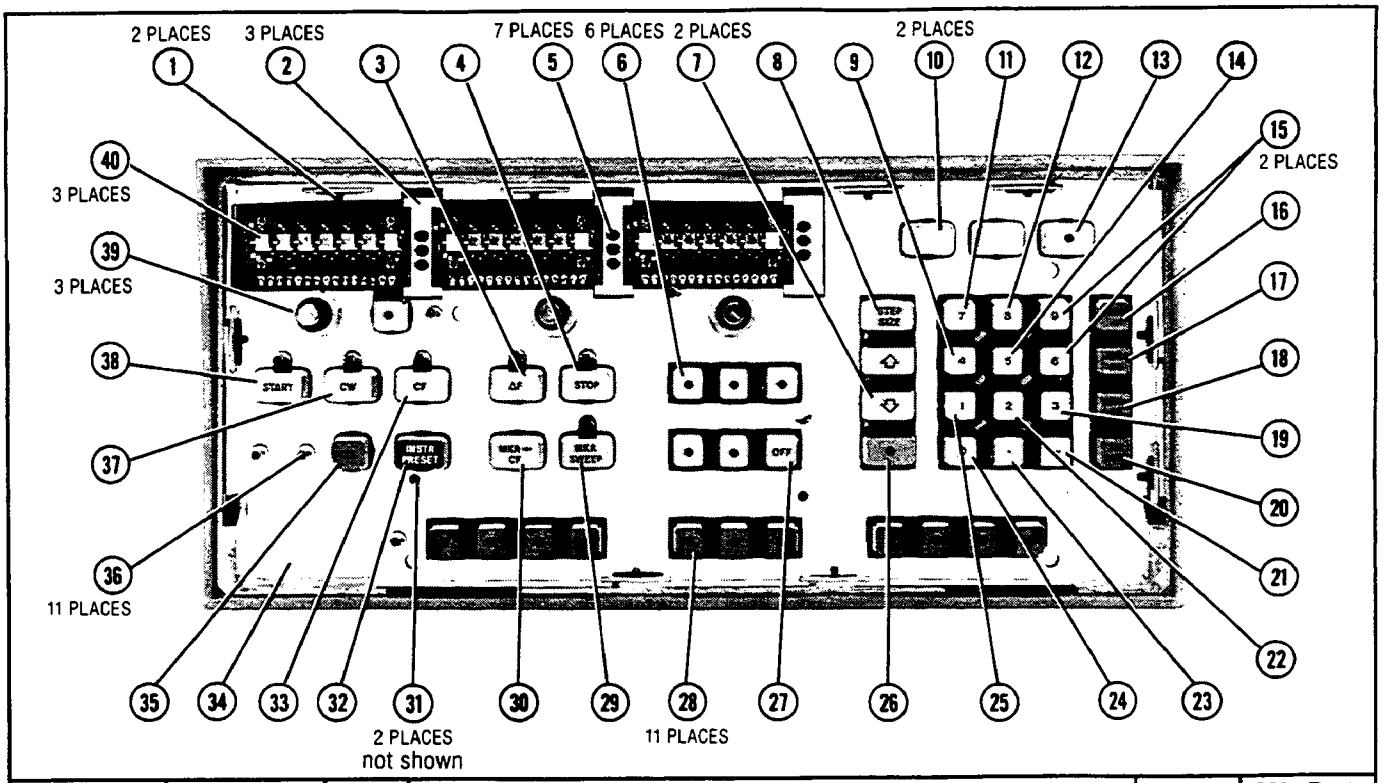
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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08350-20040	1	ADJUSTABLE FRAME	28480	08350-20040
2	08350-00026	1	ACCESS PANEL	28480	08350-00026
3	0380-0643	2	STANDOFF-HEX .255-IN-LG 6-32 THD	28480	0380-0643
	2190-0017	2	WSHR-LK HLCL NO. 8 .168-IN.-ID	28480	2190-0017
	0360-0001	1	TERM-SLDR LUG-MTG FOR #6-SCR	28480	0360-0001
	2420-0003	1	NUT-HEX-DBL-CHAM 6-32-THD .094-IN.-THK	28480	2420-0003
4	2360-0184	3	SCREW-MACH 6-32 .438-IN.-LG 82 DEG	28480	2360-0184
	0360-0042	1	TERM-SLDR LUG PL-MTG FOR #6 SCR	28480	0360-0042
	2420-0001	3	NUT-HEX-WILKSR 6-32-THD .109-IN.-THK	28480	2420-0001
6	1250-0083	6	CONN-RF BNC F	24931	28JR130-1
	2190-0016	8	WSHR-LK INTL T 3/8-IN .377-IN.-ID	28480	2190-0016
	0360-1190	5	TERM-SLDR LUG PL-MTG FOR #3/8 SCR	28480	0360-1190
	2950-0001	8	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN.-THK	28480	2950-0001
7	08350-00035	1	PANEL, REAR SHEET	28480	08350-00035
8	0960-0443	1	LINE MODULAR FILTER		
9			P/O W7 (SEE CHASSIS PARTS)		
10	1251-6781	1	CONNECTOR RCPT 3 M	28480	1251-6781
11	1250-0118	2	CONN-RF BNC F	24931	C140-7
	5040-0345	4	INSULATOR-CONN	28480	5040-0345
12	08350-80057	1	FAN GRILL - NOT USED ON OPTION 400	28480	08350-80057
13	3160-0288	1	FAN TBAX 45 CFM 115V 50/60 HZ		
	3160-0317 (OPT 400)	1	FAN TBAX 40 CFM 115V 440 HZ	92702	MBCZ206 F-6-5
	08350-00019	1	GASKET, RUBBER	28480	08350-00019
14	2360-0115	31	SCREW-MACH 6-32 .312-IN.-LG - NOT USED ON OPTION 400	28480	2360-0115
15			P/O W/5 (SEE CHASSIS PARTS) - OPTION 400 INSTRUMENTS ONLY		
	2360-0205	2	SCREW, MACHINED 632 0.750PNPD	28480	2360-0205
	3050-0139	4	WASHER, FLAT 0.171D8	28480	3050-0139
	3160-0300	1	FINGER GUARD	28480	3160-0300

Figure 6-3. Rear Panel, Parts Identification

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Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
1	2200-0168	2	FLATHEAD SCREW	28480	2200-0168
2	1450-0588	3	LAMP HOUSING, POLYCARBONATE	28480	1450-0588
3	5041-1773	1	KEY [ΔF]	28480	5041-1773
4	5041-1777	1	KEY [STOP]	28480	5041-1777
5	1990-0486	7	LED-VISIBLE IF=60mA MAX	28480	1990-0486
6	5041-0285	6	KEY [•]	28480	5041-0285
7	5041-4580	2	KEY [◆]	28480	5041-4580
8	5041-1771	1	KEY [STEP SIZE]	28480	5041-1771
9	5041-1760	1	KEY [4]	28480	5041-1760
10	5041-0277	2	KEY [ ]	28480	5041-0277
11	5041-1763	1	KEY [7]	28480	5041-1763
12	5041-1764	1	KEY [8]	28480	5041-1764
13	5041-0286	1	KEY [$BU]	28480	5041-0286
14	5041-1761	1	KEY [5]	28480	5041-1761
15	5041-1762	2	KEY [9] [6]	28480	5041-1762
16	5041-1766	1	KEY [GHz S]	28480	5041-1766
17	5041-1767	1	KEY [MHz ms]	28480	5041-1767
18	5041-1940	1	KEY [dBm dB]	28480	5041-1940
19	5041-1759	1	KEY [3]	28480	5041-1759
20	5041-1769	1	KEY [BK SP]	28480	5041-1769
21	5041-1770	1	KEY [-]	28480	5041-1770
22	5041-1758	1	KEY [2]	28480	5041-1758
23	5041-1755	1	KEY [.]	28480	5041-1755
24	5041-1756	1	KEY [0]	28480	5041-1756
25	5041-1757	1	KEY [1]	28480	5041-1757
26	5041-0451	1	KEY [•] (blue)	28480	5041-0451
27	5041-1765	1	KEY [OFF]	28480	5041-1765
28	5041-0318	11	KEY [•] (dark gray)	28480	5041-0318
29	5041-1951	1	KEY [MKR SWEEP]	28480	5041-1951
30	5041-2088	1	KEY [MKR→CF]	28480	5041-2088
31	2200-0091	2	Screw - Mach 4-40 .562-IN.-LG	28480	2200-0091
32	5041-0720	1	KEY [INSTR PRESET] (GREEN)	28480	5041-0720
33	5041-1772	1	KEY [CF]	28480	5041-1772
34	08350-00038	1	SUB PANEL, FRONT	28480	08350-00038
35	5041-0726	1	KEY [LCL]	28480	5041-0726
36	1990-0487	11	LED-VISIBLE IF=20mA MAX	28480	5082-4584
37	5041-1774	1	KEY [CW]	28480	5041-1774
38	5041-1776	1	KEY [START]	28480	5041-1776
39	08350-60078	3	RPG	28480	08350-60078
40	1990-0738	3	DSPLY NUM .15 HI	28480	1990-0738

Figure 6-4. Sub Panel, Parts Identification

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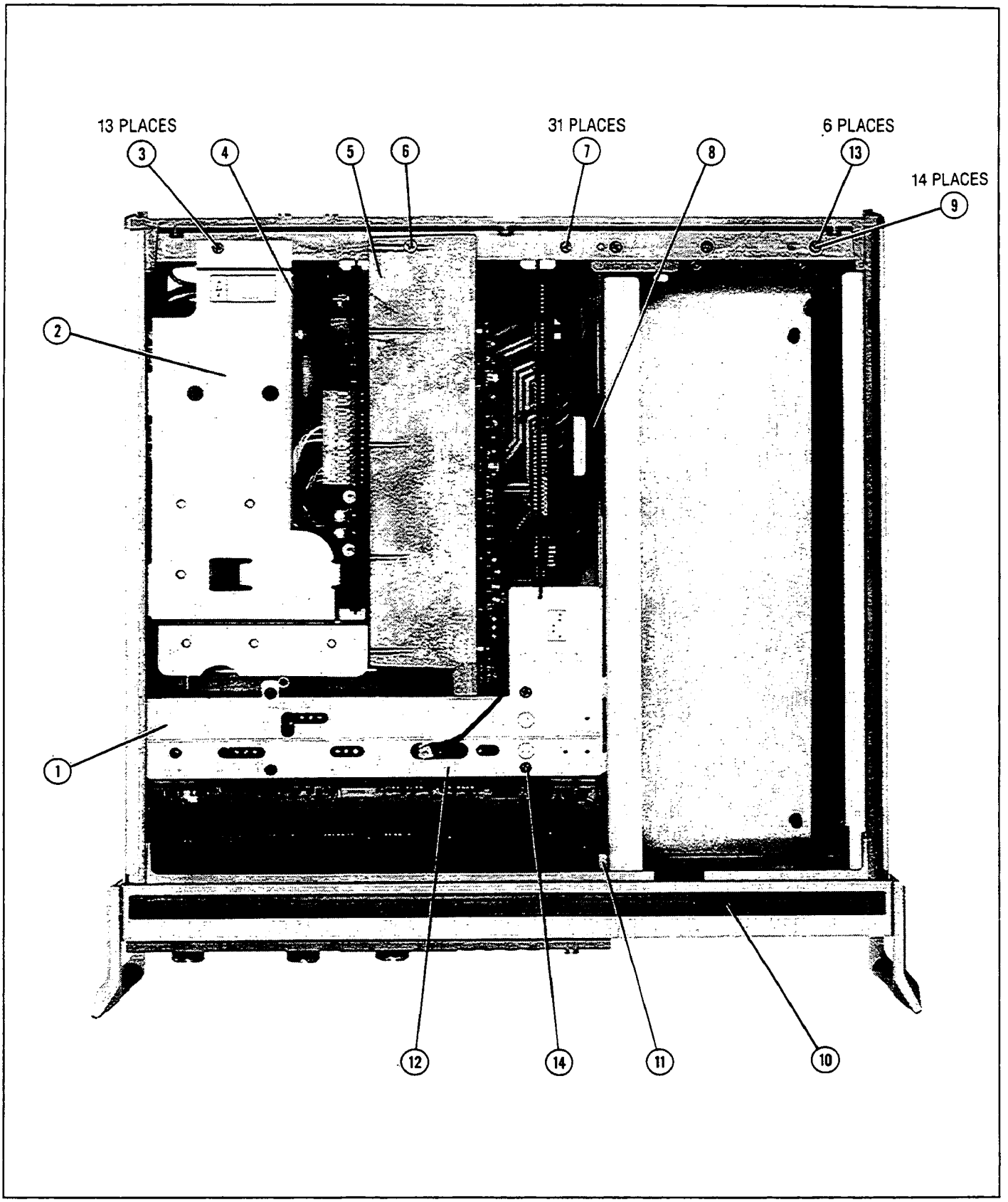


Figure 6-5. Top View with Covers, Parts Identification (1 of 2)

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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08350-00046	1	COVER, SHIELD	28480	08350-00046
2	08350-00042	1	CAPACITOR COVER	28480	08350-00042
3	2360-0117	13	SCREW-MACH 6-32 .375-IN.-LG	28480	2360-0117
4	0400-0018	.50 FT.	GROMMET, CAP COVER	03296	G-51H-A
5	0050-2072	1	HEATSINK	28480	0050-2072
6	2360-0183	1	SCREW-MACH, 6-32 .375-IN.LG 82 DEG	28480	2360-0183
7	2360-0115	31	SCREW-MACH 6-32 .312-IN.LG	28480	2360-0115
8	08350-00022	1	INSTL SHT-BATTERY PACK	28480	08350-00022
	08672-60092	1	BATTERY PACK	28480	08672-60092
	85660-20138	1	BATTERY HOLDER	28480	85660-00054
	85660-00054	1	BATTERY CLAMP	28480	85660-00054
	0363-0160	2	CONTACTS-ELECTRIC	28480	0363-0160
	0624-0291	4	SCREW-TPG 2-28 .312-IN.-LG	28480	0624-0291
9	2360-0115	14	SCREW-MACH, 6-32 .25-IN.-LG	28480	2360-0115
10	5040-7202	1	TRIM STRIP, TOP	28480	5040-7202
11	08620-20062	1	BEARING SCREW	28480	08620-20062
	08350-20006	1	BRACKET, PLUG LATCH	28480	08350-20006
	2580-0002	1	NUT-HEX, 6-32-THD .094-IN.-THK	28480	2580-0002
	2190-0009	1	WASHER		2190-0009
12	0400-0233	1	GROMMET-ELLIPSE	28480	0400-0233
13	3050-0227	6	WASHER-FLAT NO. 6.147 IN.-ID.	28480	3050-0227
14	3050-0227		WASHER		3050-0227
	2360-0115		SCREW		2360-0115

Figure 6-5. Top View with Covers, Parts Identification (2 of 2)

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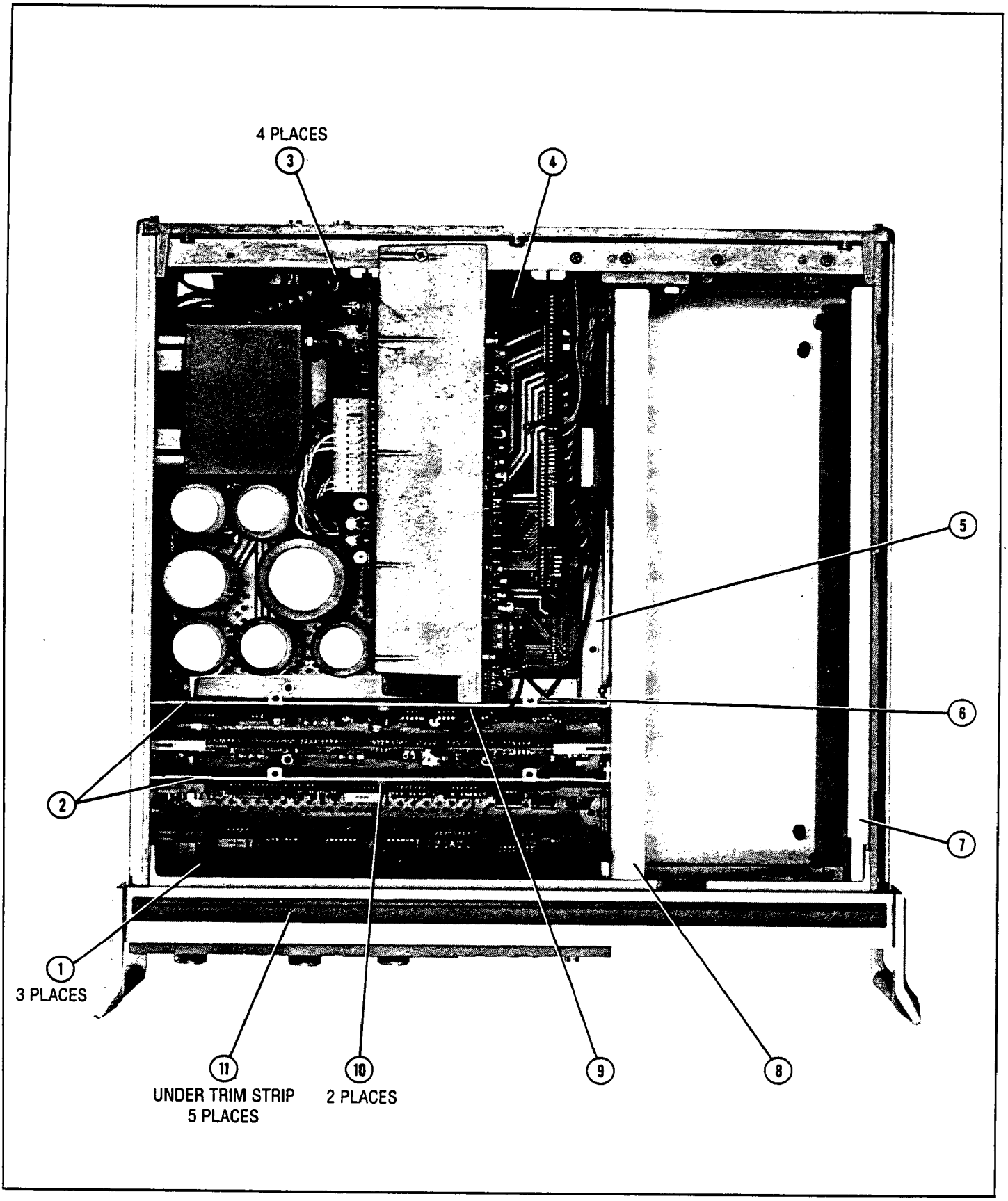


Figure 6-6. Top View without Covers, Parts Identification (1 of 2)

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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	0960-0859	3	Rotary Pulse Generator	28480	0960-0859
2	08350-00039	1	Gusset Shield-Front	28480	08350-60039
	08350-00040	1	Gusset Shield-Rear	28480	08350-60040
3	1901-0033	4	Diode - Gen 180V 200ma DO-7	07263	FDH3369
4	08350-00015	1	Fan/Shield Assembly	28480	08350-00015
	08350-60032	1	400 Hz Fan Assembly (Opt 400 only)	28480	03350-60032
5	08350-00006	1	Bracket-PC Support	28480	08350-00006
6	1400-0510	1	Cable Clamp	02768	8511-01-00-9909
7	08350-00008	1	Support, Right	28480	08350-00008
8	08350-00049	1	Support, Left	28480	08350-00007
9	2360-0115	31	Screw-Mach 6-32 .312-in.lg	28480	2360-0115
10	0403-0026	2	Glide Nylon - fits 0.192 hole	28480	207-120241-03-0101
11	2360-0322	5	Screw-Mach 6-32 .375-in.lg 82 deg	28480	2360-0322

Figure 6-6. Top View Without Covers, Parts Identification (2 of 2)

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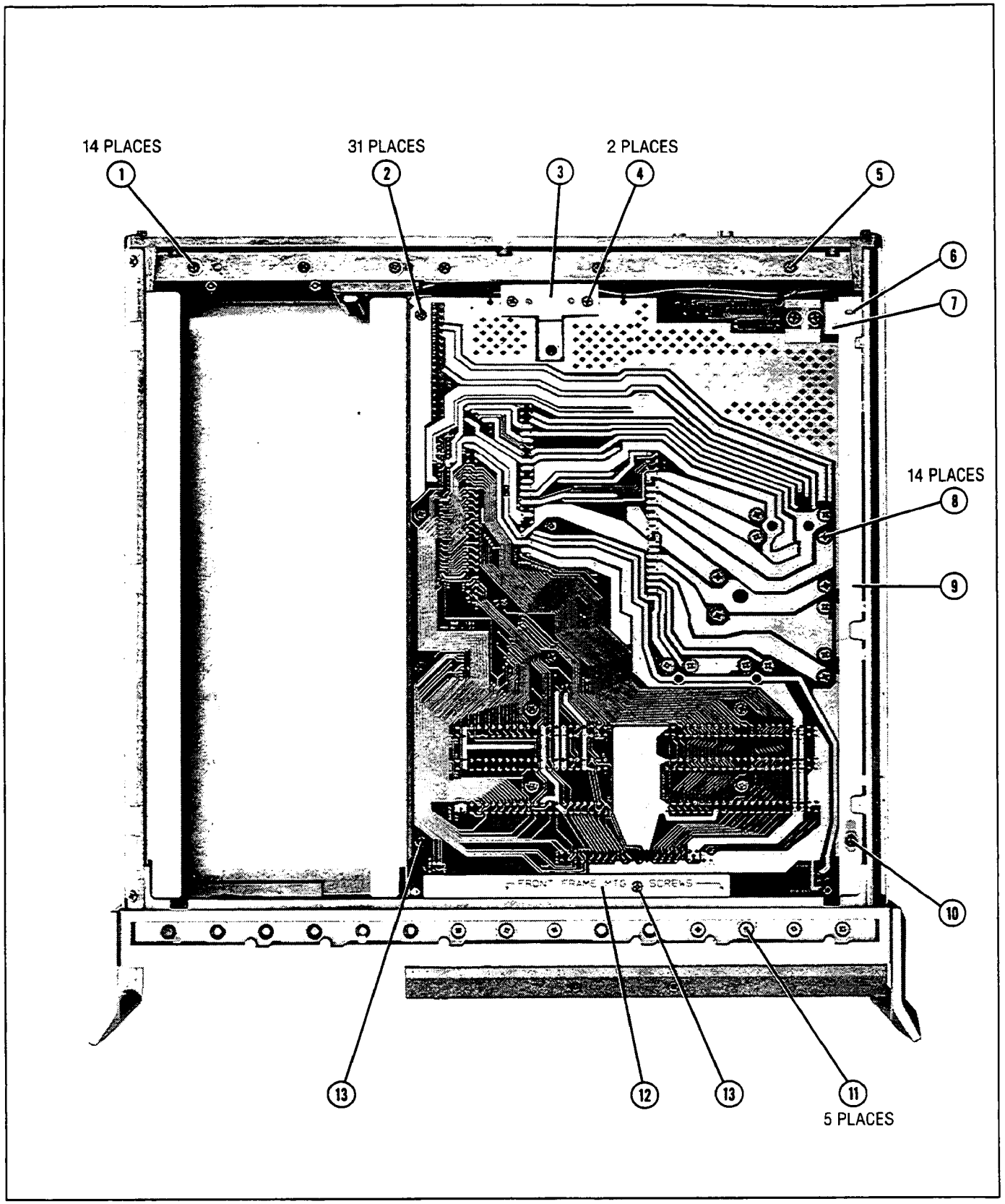


Figure 6-7. Bottom View, Parts Identification (1 of 2)

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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08350-60078	3	ROTARY PULSE GENERATOR		08350-60078
2	08350-00039	1	GUSSET SHIELD-FRONT	28480	08350-60039
	08350-00040	1	GUSSET SHIELD-REAR	28480	08350-60040
3	1901-0033	4	DIODE - GEN 180V 200MA DO-7	07263	FDH3369
4	08350-00015	1	FAN/SHIELD ASSEMBLY	28480	08350-00015
	08350-60032	1	400 HZ FAN ASSEMBLY (OPT 400 ONLY)	28480	03350-60032
5	08350-00006	1	BRACKET-PC SUPPORT	28480	08350-00006
6	1400-0510	1	CABLE CLAMP	02768	8511-01-00-9909
7	08350-00008	1	SUPPORT, RIGHT	28480	08350-00008
8	08350-00049	1	SUPPORT, LEFT	28480	08350-00007
9	2360-0115	31	SCREW-MACH 6-32 .312-IN.LG	28480	2360-0115
10	0403-0026	2	GLIDE NYLON - FITS 0.192 HOLE	28480	207-120241-03-0101
11	2360-0322	5	SCREW-MACH 6-32 .375-IN.LG 82 DEG	28480	2360-0322

Figure 6-6. Top View Without Covers, Parts Identification (2 of 2)

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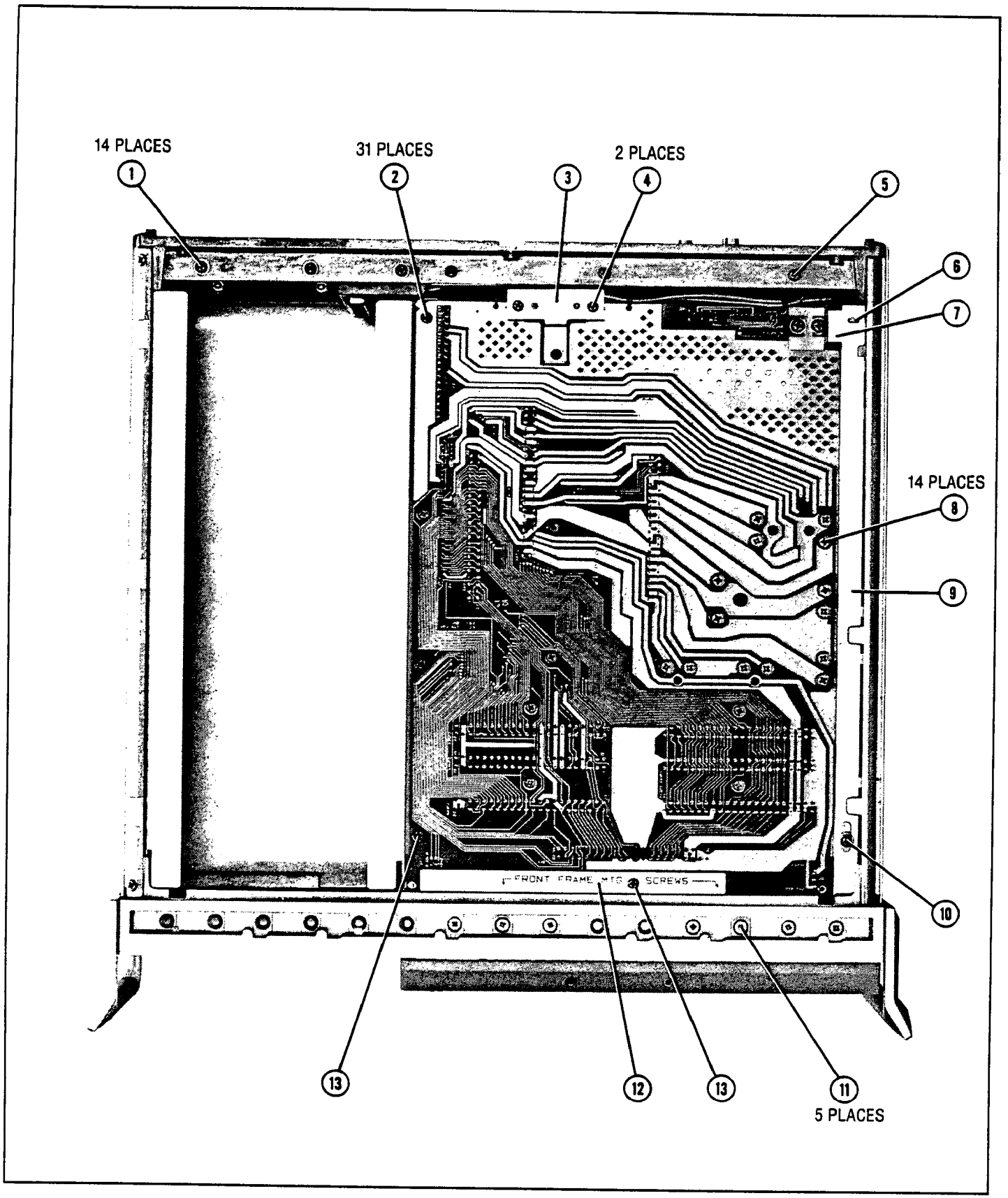


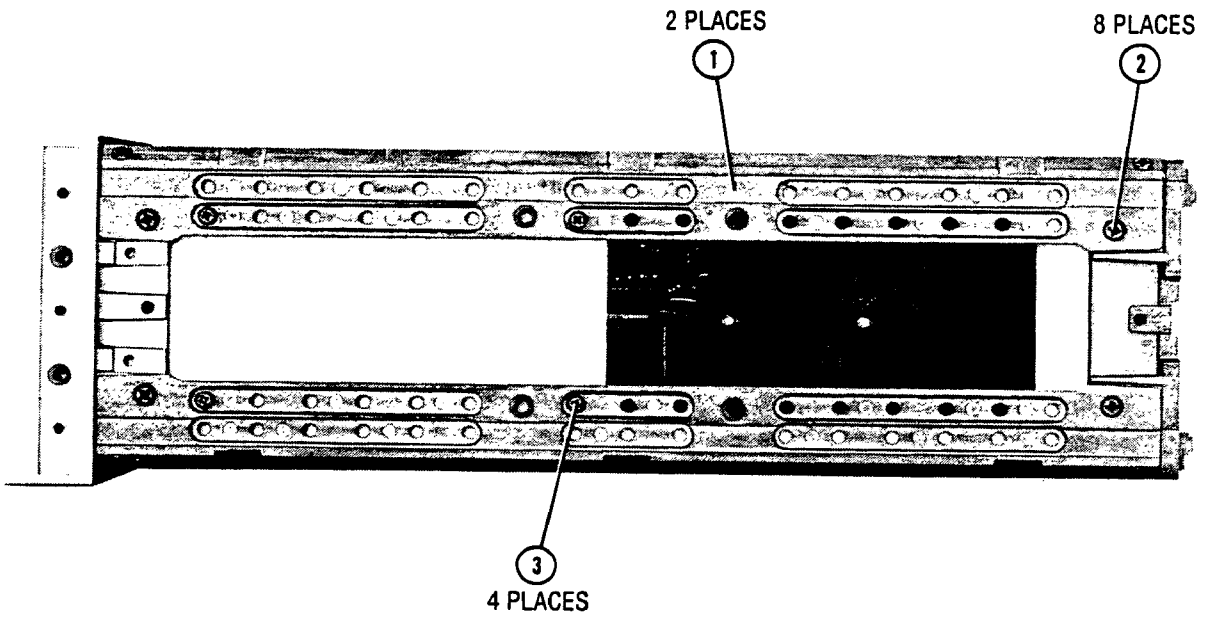
Figure 6-7. Bottom View, Parts Identification (1 of 2)

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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	2360-0113	14	SCREW-MACH 6-32 .25-IN.-LG	28480	2360-0113
2	2360-0115	31	SCREW-MACH 6-32 .312-IN.LG	28480	2360-0115
3	08350-00018	1	BRACKET, THERM SWITCH MNT	28480	08350-00018
	3103-0090	1	SWITCH - THRM FXD +150F 5A OPN-ON-RISE		
	4040-1770	1	SWITCH CAP	28480	40401770
4	2360-0115	2	SCREW - MACH 2-56 .188-IN.-LG	28480	2360-0115
5	2360-0115	13	SCREW - MACH 6-32 .375-IN.LG	28480	2360-0115
6	3101-2269	1	SWITCH - TOGGLE DPDT 3A 250 VC	09353	9201-P3-H-Z-Q
	08350-00047	1	SWITCH-BKT	28480	08350-00047
8	2360-2113	14	SCREW-MACH 4-40 10-32 .312-IN.-LG	28480	2360-0113
9	08350-00045	1	LEVER, SWITCH, ACTUATOR	28480	08350-00045
10	2360-0199	2	SCREW - MACH 6-32 .438-IN.LG	28480	2360-0199
	2190-0006	2	WASHER - LK NO. 6 .141-IN.-ID	28480	2190-0006
	3050-0227	1	WASHER - FL MTLC NO. 6 .149-IN.-ID	28480	3050-0227
	3050-0647	2	WASHER - SHLDR NO. 6 .14-IN.ID	06540	2638-24850-N140
11	2360-0322	5	SCREW - MACH 6-32 .375-IN.-LG 100 DEG	28480	2360-0322
12	08350-00013	1	BRACKET - CONN MOUNT	28480	08350-00013
13	2360-0115	2	SCREW - PAN HEAD 6/32 .312 IN.		
	3050-0010	2	WASHER - FLAT .147 ID		

Figure 6-7. Bottom View, Parts Identification (2 of 2)

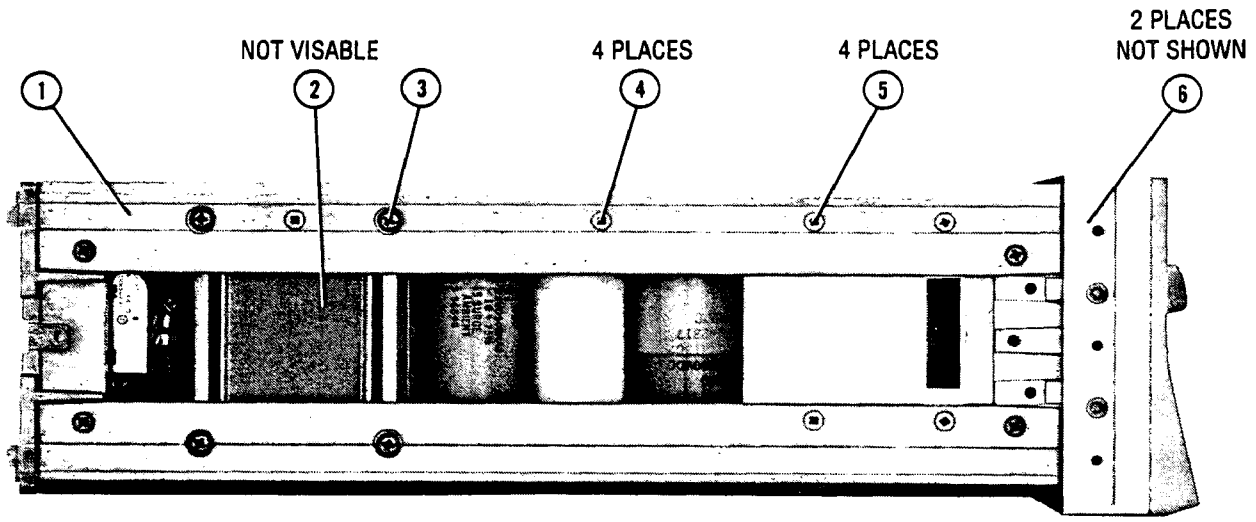
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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1 2 3	5021-5836 0515-1331 2360-011578	2 8 4	STRUTS MR FL HD SCREWS 6-32 PN H0 SCREWS		

Figure 6-8. Right Side View, Parts Identification

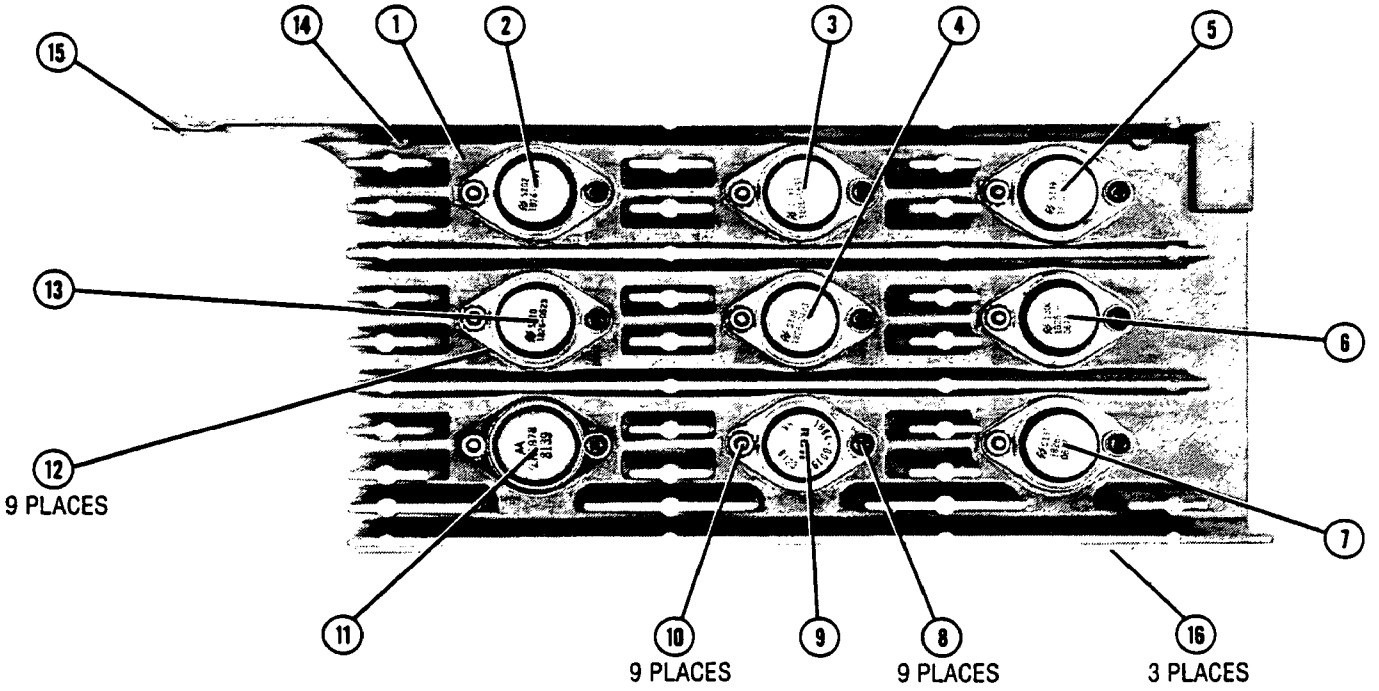
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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08350-20047	1	SIDE CASTING		
2	08350-00044	1	MAG SHIELD		
3	2680-0170	4	10-32 4.0 PAN HD SCW		
	3050-0021	4	.188 ID FLAT WASHER		
	3050-0226	4	.204 ID FLAT WASHER		
	2190-0034	4	LK WASHER .194 ID		
	2740-0002	4	10-32 HEX NUT		
	1401-0216	2	PROTECTIVE CAP		
4	0515-1331	4	M4 FL HD SCREW		
5	2360-0360	4	6-32 FL HD SCREWS (TO GUSSETTS)		
6	5001-0439	2	TRIM STRIP		

Figure 6-9. Left Side View, Parts Identification

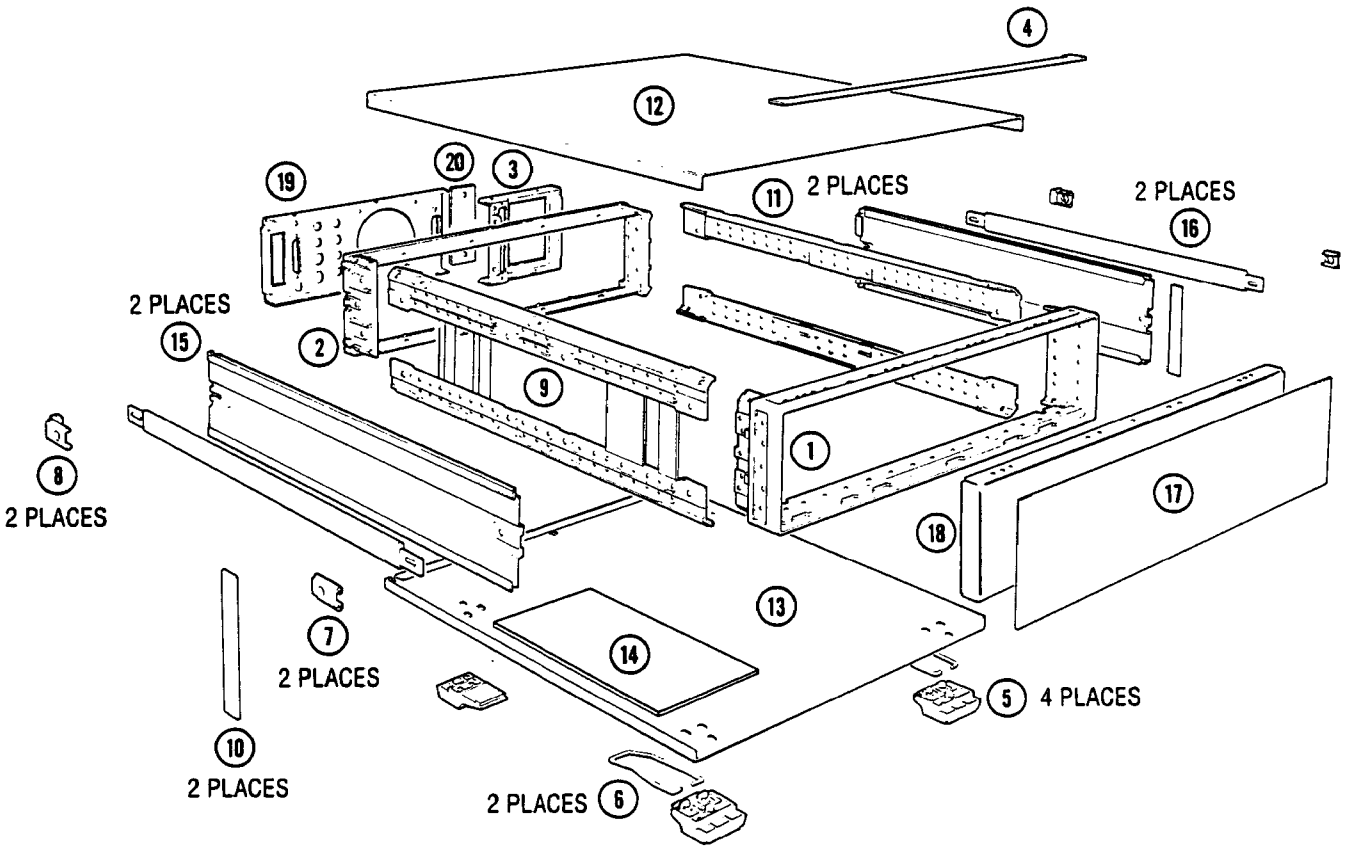
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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	08350-60057		REGULATOR/HEAT SINK REPLACEMENT KIT	28480	08350-60057
1		1	HEAT SINK (NOT SEPARATELY REPLACEABLE)		
2	1826-0631	2	(U7), IC REG-ADJ-POS 1.2/33V TO-3	27014	LM350K
3	1826-0631		(U5), IC REG-ADJ-POS 1.2/33V TO-3	27014	LM350K
4	1826-0423	1	(U13), IC REG-ADJ-POS 1.2/37V TO-3	27014	LM317K
5	1853-0387	1	(Q16), TRANSISTOR-PNP SI DARL TO-3 PD=150W	28480	MJ2500
6	1826-0677	2	(U10), IC REG-ADJ-POS 1.2/32V TO-3	27014	LM338K
7	1826-0677		(U16), IC REG-ADJ-POS 1.2/32V TO-3	27014	LM338K
8	2200-0143	9	SCREW-MACH 4-40 .375-IN.-LG	28480	2200-0143
	1884-0019	9	WASHER-LK HLCL NO.4 .115-IN.-ID	28480	1884-0019
	1884-0019	9	WASHER-FL MTLC NO. 4 .125-IN.-ID	28480	1884-0019
	0340-1189	9	INSULATOR BUSHING .115 D	28480	0340-1189
9	1184-0019	1	(Q9), THYRISTOR-SCR TO-3	01921	2N3669
10	08350-20004	9	CONNECTOR PIN, THREADED	28480	08350-20004
	1200-0147	9	INSULATOR BUSHING .115 D	28480	1200-0147
	2260-0009	9	NUT, HEX 4-40 THD. 094-IN.THK	28480	2260-0009
11	1854-0743	1	(Q6),TRANSISTOR-NPN S1 TO-3 PD =150W	01295	2N5878
12	0340-1189	9	INSULATOR-TRANSISTOR, ALUMINUM	76530	0340-1189
	6040-0454	—	THERMAL COMPOUND; 4-OZ. TUBE	92895	530 1977
13	1826-0523	1	(U15), IC REG-ADJ-NEG 1.2/37V TO-3	27014	LM337K
14	2360-0121	6	SCREW-MACH 6-32 1-IN.-LG	78480	2360-0121
15	2360-0183	1	SCREW-MACH 6-32 .375-IN-LG 82 DEG FH	28480	2360-0183
16	2360-0115	3	SCREW-MACH 6-32 .438-IN-LG 82-DEG FH	28480	2360-0184

Figure 6-10. Regulator Heatsink, Parts Identification

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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08350-20099	1	FRONT FRAME		
2	08350-20087	1	REAR FRAME		
3	08350-20040	1	FRAME, PLUG-IN INTERFACE		
4	5041-8802	1	TOP TRIM, FRONT FRAME		
5	5041-8801	4	FOOT		
6	1460-1345	2	TILT STAND		
7	5041-8819	2	FRONT CAP, STRAP HANDLE		
8	5041-8820	2	REAR CAP, STRAP HANDLE		
9	08350-20047	1	SIDE CASTING		
10	5001-0539	2	SIDE TRIM, FRONT FRAME		
11	5021-5836	2	CORNER STRUT		
12	5062-3734	1	TOP COVER		
13	5062-3746	1	BOTTOM COVER		
14	08350-00033	2	INSULATOR		
15	5062-3836	2	SIDE COVER		
16	5062-3703	2	STRAP HANDLE		
17	08350-00036	1	FRONT DRESS PANEL		
18	08350-00038	1	FRONT SUB PANEL		
19	08350-00035	1	REAR PANEL		
20	08350-00026	1	ACCESS PANEL		
*	08350-00051	1	INFO TRAY		
*	08350-90039	1	INFO CARD		

*NOT PICTURED

Figure 6-11. Chassis Parts Identification

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Section VII. Manual Backdating

INTRODUCTION

This manual has been written for and applies directly to instruments with serial numbers prefixed as indicated on the title page. Earlier versions of the instrument (serial numbers prefixed lower than the ones indicated on the title page) may be slightly different in design or appearance.

There is a separate manual available documenting earlier versions of the HP 8350B. If your instrument was manufactured before the printing of this manual, you can order a separate manual that documents these earlier versions. (HP Part Number 08350–90034).

The purpose of this section of the manual is to provide information so this manual can be corrected so that it applies to the instruments with the serial prefix numbers listed below. To perform the adaptation, refer to Table 7–1 and make the manual backdating changes listed opposite your instrument serial number or serial number prefix.

For additional important information about serial number coverage, refer to INSTRUMENTS COVERED BY THE MANUAL in Section I.

Table 7-1. Manual Backdating Changes by Serial Number Prefix

Serial Prefix	Make Manual Changes
3239A	H
3116A	G, H
3115A	F, G, H
3103A	C, F, G, H
2933A	F, G, H
2851A	D, F, G, H
2749A	B, D, E, F, G, H
2722A	B, D, E, F, G, H
2717A	B, D, E, F, G, H
2638A	A, B, D, E, F, G, H

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When replacing a part, cross–reference it to the following table. If the part does not appear in this table, use the original part number in Table 6–2.

Parts Cross-Reference Table

Ref. Desig.	HP Part Number	Replace with HP Part Number	New Description	Serial Prefix Affected or Assembly
A3	08350–60131	08350–60085	MICROPROCESSOR ASSEMBLY	2749A and below
A6	1252–1349	N/A	CONNECTOR – POST–TYPE0.156–PIN–SPCQ 13–CONT.	2638A and below
A7	08350–60132	08350–60090	REGULATOR BOARD ASSEMBLY	2851A and below
A7C8 and A7C36 and A7C43 and A7C44 and A7C59	0180–3831	0180–2697	CAPACITOR–FXD 10UF±10% 25VDC TA	2851A and below
A7Q5 and A7Q11 – A7Q15	1884–0344	1883–0244	THYRISTOR–SCR VRRM=400	2851A and below
A7TP1 – A7TP18	1460–2201	0360–2050	CONNECTOR–SGL CONT	2851A and below
Fig. 6–2, #4	NONE	08620–20061	N/A	2722A08445
Fig. 6–3, #5	08350–80057	3150–0054	FINGER GUARD – FAN	2642A and below
Fig. 6–3, #12	08350–80057	08350–80047	FINGER GUARD – FAN	2642A and below
Fig. 6–5, #11	08350–20097 08350–20098 3050–0139 2580–0003	08350–20006 08620–20062 2190–0009 2580–0002	BRACKET–LATCH SCREW–LATCH ROLLER WSHR FL .172 ID 8 NUT HEX 8–32	2722A08445 2722A08445 2722A08445 2722A08445
T1	9100–4603	9100–4277	TRANSFORMER	2638A and below
T1	9100–4337	9100–4603	TRANSFORMER	2722A and below
T1	08350–60064		TRANSFORMER REPLACEMENT KIT	2722A and below
A5	08350–60077	08350–60135	SWEEP GENERATOR ASSEMBLY	3116A and below
A1	08350-60074	08350-60136	A1 FRONT PANEL ASSEMBLY	3239A and below

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CHANGE A

The following pages apply directly to the instruments with the serial prefix opposite this lettered change in Table 7-1 and should be used when servicing them.

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Ref. Desig.	HP Part Number	CD	Qty.	Description	Mfr. Code	Manufacturer's Part Number
1	0960-0683	1	3	Rotary Pulse Generator		0960-0683
2	08350-00039	3	2	Gusset Shield-Front	28480	08350-60039
	08350-00040			Gusset Shield-Rear	28480	08350-60040
3	1901-0033	2	4	Diode - Gen 180V 200ma DO-7	07263	FDH3369
4	08350-00003	8	1	Fan/Shield Assembly	28480	08350-0003
	08350-60032	9	1	400 Hz Fan Assembly (Opt 400 only)	28480	03350-60032
5	08350-00006	1	1	Bracket-PC Support	28480	08350-00006
6	1400-0510	8	1	Cable Clamp	02768	8511-01-00-9909
7	08350-00008	3	1	Support, Right	28480	08350-00008
8	08350-00007	2	1	Support, Left	28480	08350-00007
9	2360-0115	4	31	Screw-Mach 6-32 .312-in.lg	28480	2360-0115
10	0403-0026	6	2	Glide Nylon - fits 0.192 hole	28480	207-120241-03-0101
11	2360-0322	7	5	Screw-Mach 6-32 .375-in.lg 82 deg	28480	2360-0322

Figure 6-6. Top View Without Covers, Parts Identification (2 of 2)

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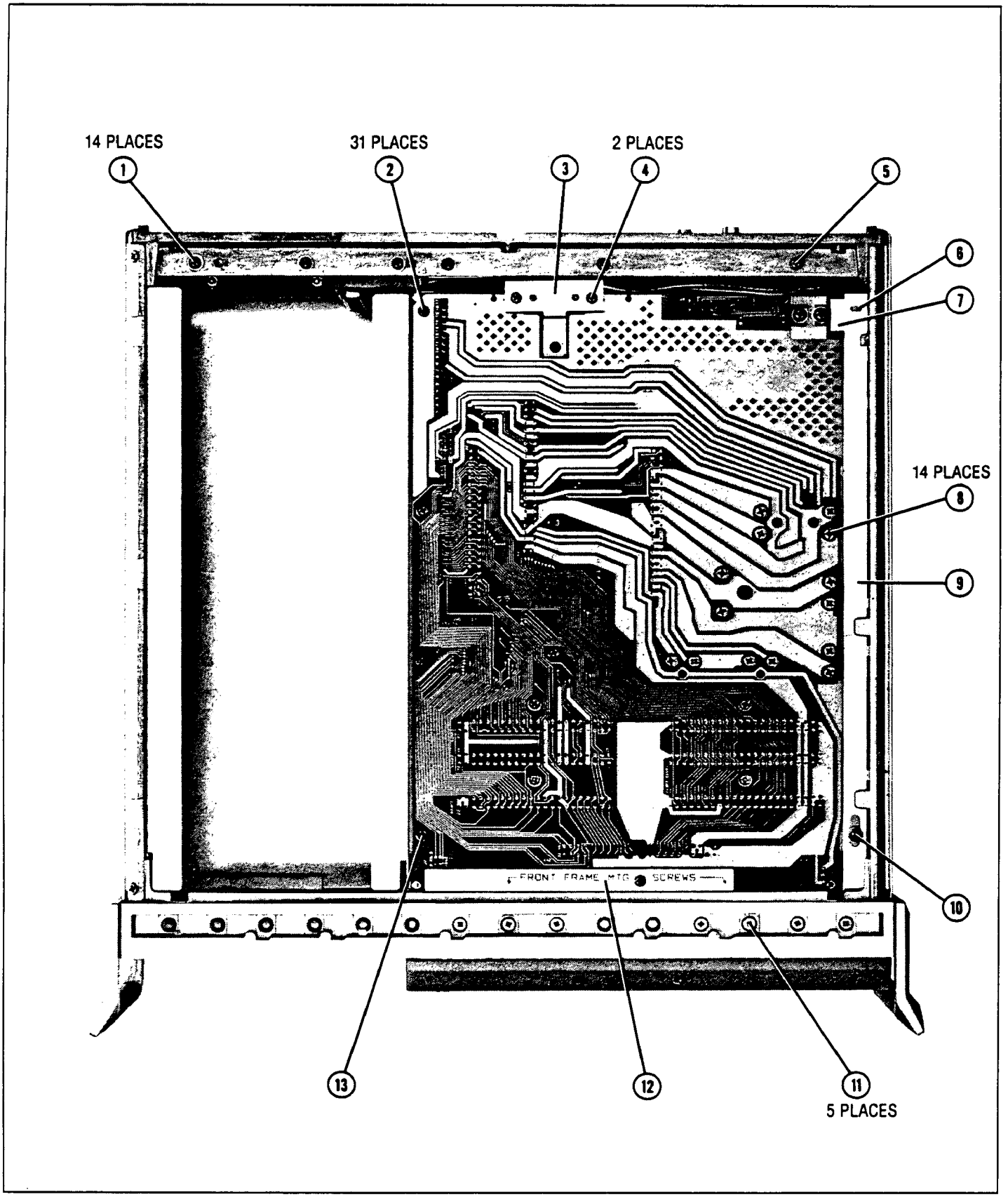


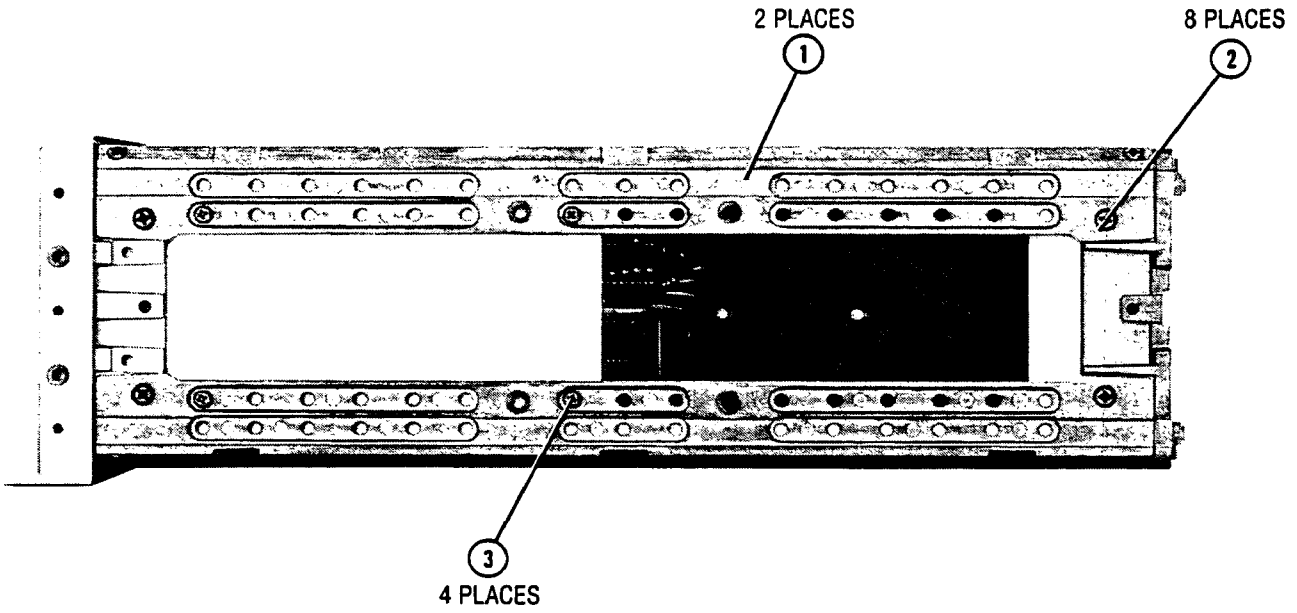
Figure 6-7. Bottom View, Parts Identification (1 of 2)

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Ref. Desig.	HP Part Number	CD	Qty.	Description	Mfr. Code	Manufacturer's Part Number
1	2360-0113	2	14	Screw-Mach 6-32 .25-in.-lg	28480	2360-0115
2	2360-0115	4	31	Screw-Mach 6-32 .312-in.lg	28480	2360-0113
3	08350-00018	5	1	Bracket, Therm Switch Mnt	28480	08350-00018
	3103-0090	2	1	Switch - Thrm Fxd +150F 5A Opn-On-Rise	82647	
	4040-1770	3	1	Switch Cap	28480	40401770
4	2360-0115	6	2	Screw - Mach 2-56 .188-in.-lg	28480	2360-0115
5	2360-0115	6	13	Screw - Mach 6-32 .375-in.lg	28480	2360-0115
6	08350-00009	4	1	Bracket - Toggle DPDT 3A 250 VC	09353	9201-P3-H-Z-Q
	08350-00047	0	1	Switch-Bkt	28480	08350-00047
7	08350-00041	4	1	Switch-Bkt	28480	08350-00041
8	2360-2113	6	14	Screw-Mach 4-40 10-32 .312-in.-lg	28480	2360-0113
9	08350-00045	8	1	Lever, Switch, Actuator	28480	08350-00045
10	2360-0199	4	2	Screw - Mach 6-32 .438-in.lg	28480	2360-0199
	2190-0006	1	2	Washer - Lk No. 6 .141-in.-id	28480	2190-0006
	3050-0227	3	1	Washer - Fl Mtlc No. 6 .149-in.-id	28480	3050-0227
	3050-0647	1	2	Washer - Shldr No. 6 .14-in.id	06540	2638-24850-N140
11	2360-0322	7	5	Screw - Mach 6-32 .375-in.-lg 100 deg	28480	2360-0322
12	08350-00013	0	1	Bracket - conn Mount	28480	08350-00013
13	2360-0115	4	2	Screw - Pan head 6/32 .312 in.		
	3050-0010	2	2	Washer - flat .147 ID		

Figure 6-7. Bottom View, Parts Identification (2 of 2)

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Reference Designation	HP Part Number	CD	Qty.	Description
1	5021-5836		2	Struts
2	0515-1331		8	M4 Fl Hd Screws
3	2360-0115		4	6-32 Pn H0 Screws

Figure 6-8. Right Side View, Parts Identification

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CHANGE B

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A6P1

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	GND DIG			I
23	+5VA	IN	A7P1-2, 24	I
2	PWON	OUT	DIST.	G
24	L LINETRG	OUT	A5P2-15	H
3	PL	OUT	J7, J13-10	F
25	L PL	IN	A5P2-35	F
4	−40V	OUT	A7P1-20	E
26	−40V	OUT	A7P1-20	E
5	−40V UNREG RET		A7P1-43	E
27	−40V	OUT	A7P1-20	E
6	−40V UNREG RET		A7P1-43	E
28	−40V UNREG RET		A7P1-43	E
7	+20V UNREG	OUT	A7P1-18, 40	A
29	+20V UNREG	OUT	A7P1-18, 40	A
8	+20V UNREG	OUT	A7P1-18, 40	A
30	+20V UNREG	OUT	A7P1-18, 40	A
9	+20V RET		A7P1-15	A
31	+20V RET		A7P1-15	A
10	+20V RET		A7P1-15	A
32	+20V RET		A7P1-15	A
11	+5V RET			D
33	+5V RET			D
12	+5V RET			D
34	+5V RET			D
13	+5V UNREG	OUT	A7P1-3, 26	D
35	+5V RET			D
14	+5V UNREG	OUT	A7P1-3, 26	D
36	+5V UNREG	OUT	A7P1-3, 26	D
15	+5V UNREG	OUT	A7P1-3, 26	D
37	+5V UNREG	OUT	A7P1-3, 26	D
16	−10V UNREG	OUT	A7P1-42	C
38	−10V UNREG	OUT	A7P1-10, 32	C
17	±10V RET		A7P1-13, 35	C
39	±10V RET		A7P1-13, 35	C
18	±10V RET		A7P1-13, 35	C
40	±10V RET		A7P1-13, 35	C
19	+10V UNREG	OUT	A7P1-42	C
41	+10V UNREG	OUT	A7P1-42	C
20	−15V UNREG	OUT	A7P1-37	B
42	−15V UNREG	OUT	A7P1-37	B
21	±15V RET			B
43	±15V RET			B
22	+15V UNREG	OUT	A7P1-29	B
44	+15V UNREG	OUT	A7P1-29	B

NOTES

1. Switch connections shown are actually connections that are determined by line voltage selector PC board positioning. Board position shown is for 120 VAC line voltage. Instructions for line voltage selection are provided in Section II, Installation.
2. See A7 Regulator service information next to the A6/A7 block diagram.

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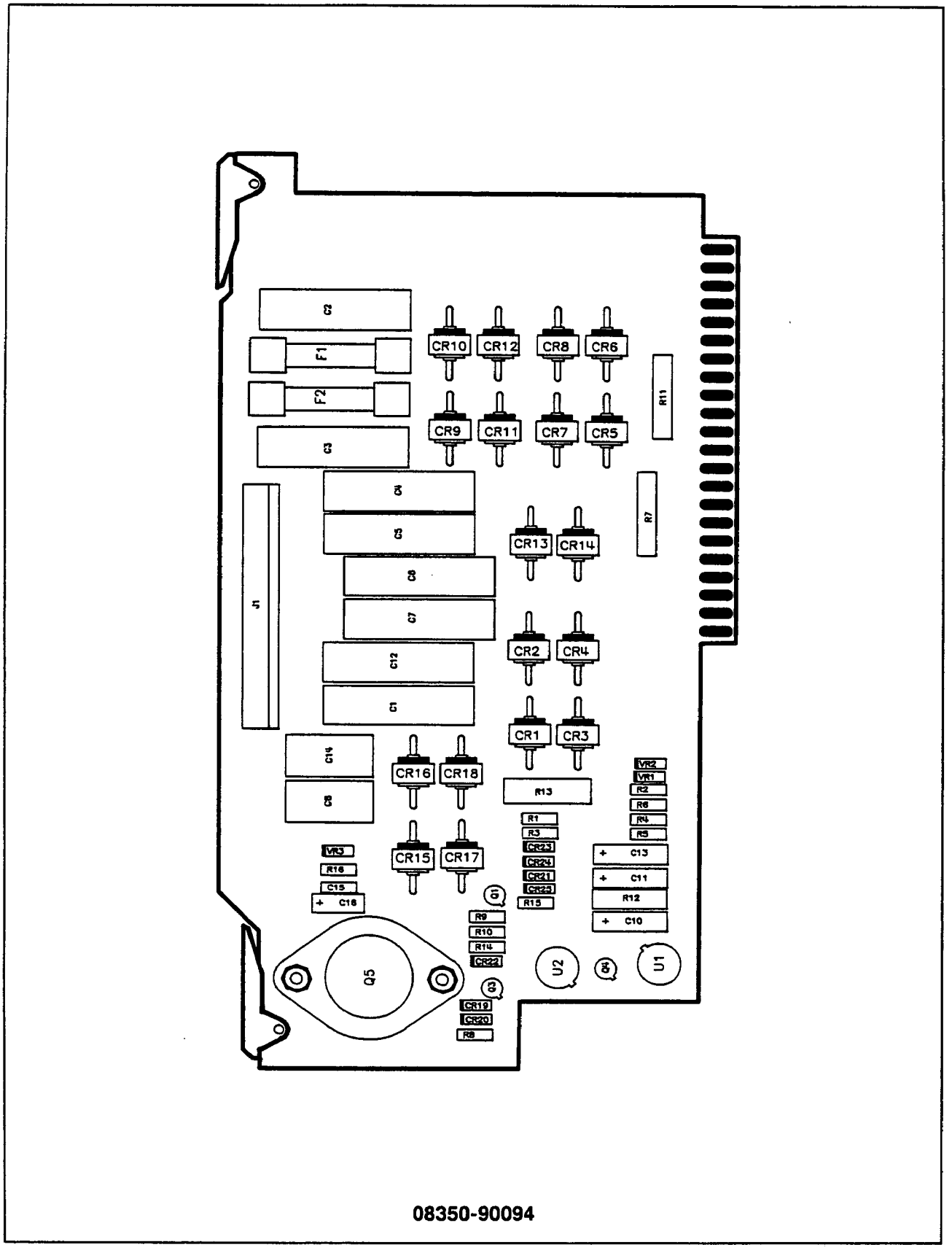


Figure 8-42. A6 Rectifier Component Location Diagram

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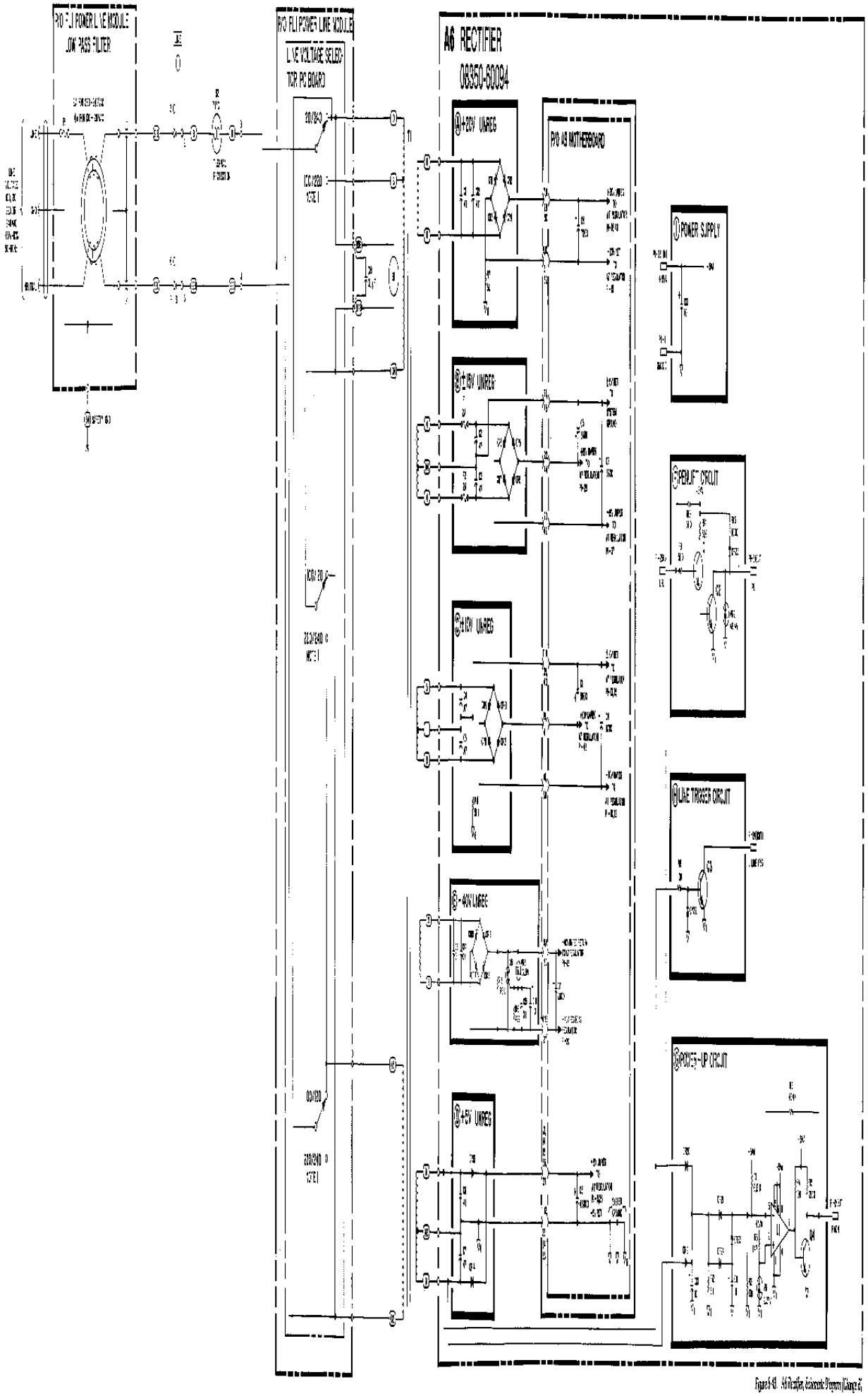


Figure 5-13. A6 Rectifier, Schematic Diagram (Change 2)

5-167/5-168

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CHANGE C

Serial prefix 3103A documents a change from firmware revision 7.0 to revision 8.0. No change to the documentation is required.

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CHANGE D

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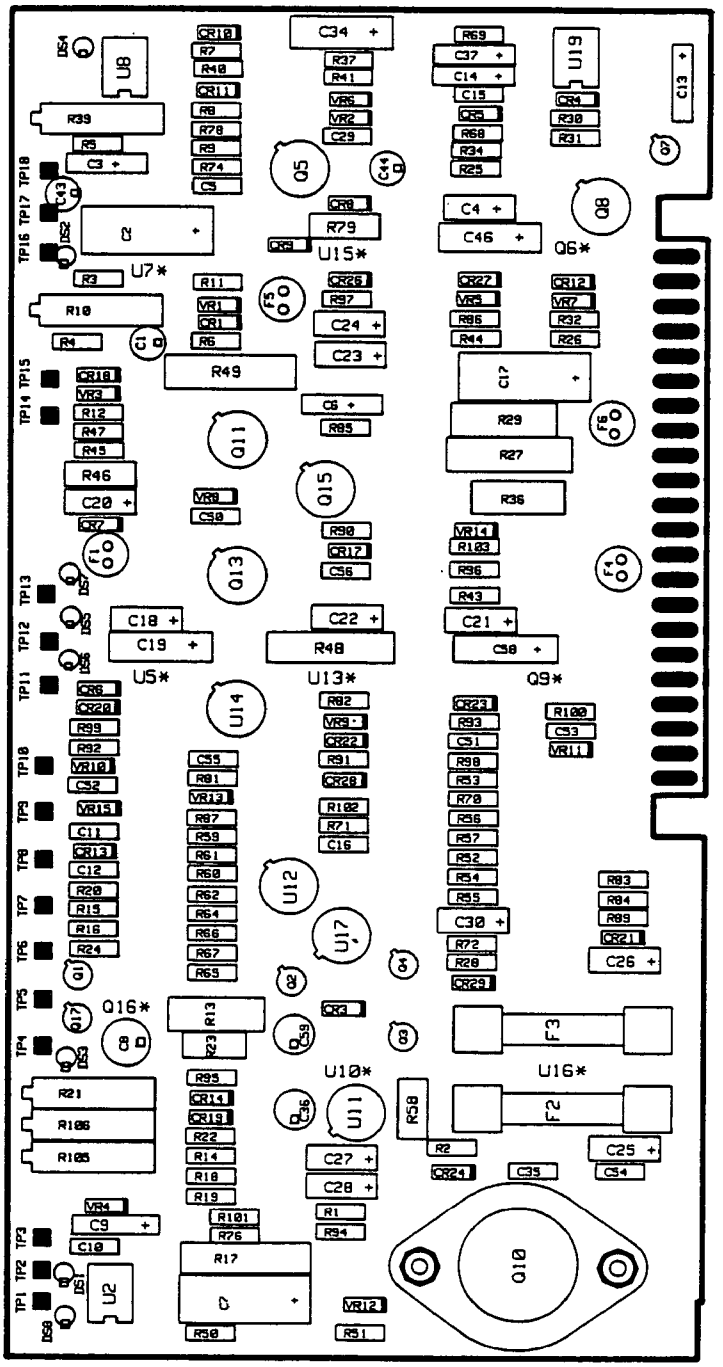
NOTES

1. See block diagram for fuses mounted on Motherboard.
2. The state of power supply failure and airflow flags L PSF and L PST are read by the A3 Microprocessor and stored with the status byte at hex address 1000. Performing a hex data read from the front panel will give 01 if L PSF is true (low), 02 if LPST is true (low), and 03 if both are true.
3. The return for each supply is shown in the function blocks.
4. These components are not visible on the component side of the printed circuit assembly but the connections to these components are shown on the lower component location figure.

A7P1

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	GND DIG			J
23	GND DIG			J
2	+5VA	OUT	DIST.	G
24	+5VA	OUT	DIST.	G
3	+5V UNREG	IN	A6P1-13, 14	G
25	+5VAFP	OUT	A9E8	G
4	L PST	OUT	A3P2-9	B
26	+5V UNREG	IN	A6P1-13, 14	G
5	+5VB	OUT	J2-18, 50	G
27	L PSF	OUT	A3P2-11	A
6	+5VB	OUT	J2-18, 50	G
28	+5VB	OUT	J2-18, 50	G
7	+5VB GNDREF		J2-21	G
29	+15V UNREG	IN	A6P1-22, 44	D
8	+15V	OUT	DIST.	D
30	+15V	OUT	DIST.	D
9	GND ANLG			J
31	GND ANLG			J
10	−10V UNREG	IN	A6P1-16, 38	F
32	−10V UNREG	IN	A6P1-16, 38	F
11	−10V	OUT	J3-13	F
33	−10V	OUT	J3-13	F
12	−10V RET SENSE		J3-12	F
34	−10V SENSE		J3-4	F
13	±10V RET		A6P1-17, 18	E, F
35	±10V RET		A6P1-17. 18	E, F
14	−15V	OUT	DIST.	H
36	−15V	OUT	DIST.	H
15	+20V RET		A6P1-9, 10	C
37	−15V UNREG	IN	A6P1-20, 42	H
16	+20V RET SENSE		J3-6	C
38	+20V SENSE		J3-15	C
17	+20V	OUT	J3-7	C
39	+20V	OUT	J3-7	C
18	+20V UNREG	IN	A6P1-7, 8	C
40	+20V UNREG	IN	A6P1-7, 8	C
19	+10V	OUT	J3-8	E
41	+10V	OUT	J3-8	E
20	−40V	OUT	J3-11	I
42	+10V UNREG	IN	A6P1-19, 41	E
21	−40V RET SENSE		J3-10	I
43	−40V UNREG RET		A6P1-5, 6	I
22	−40V SENSE		J3-2	I
44	−40V RET		J3-1	I

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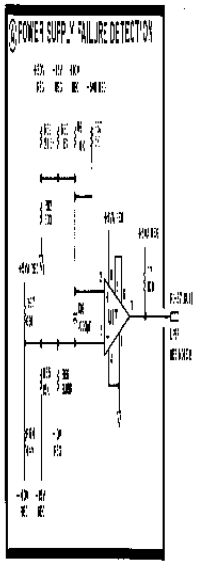


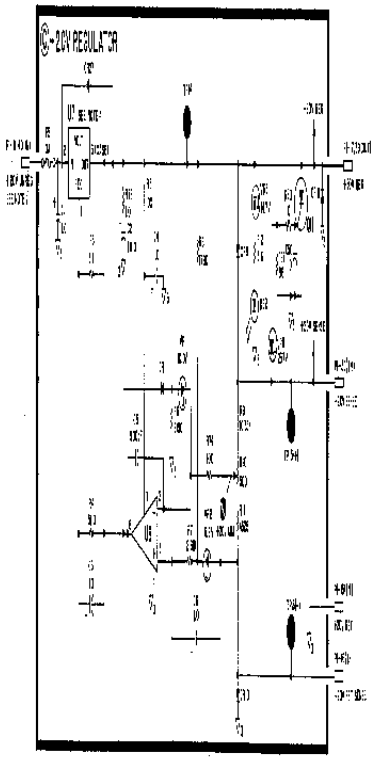
08350-60090

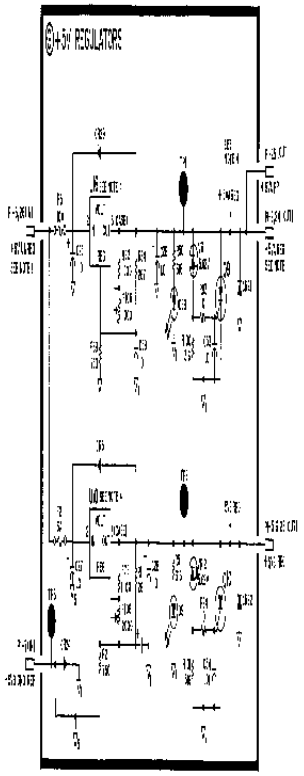
Figure 8-44. A7 Regulator Component Location Diagram

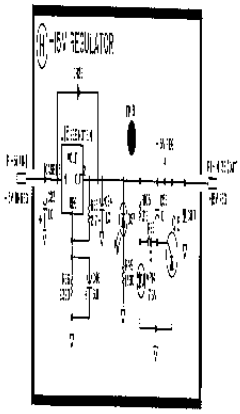
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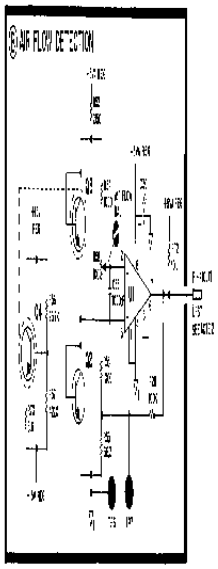
A7 REGULATOR
08360-60090

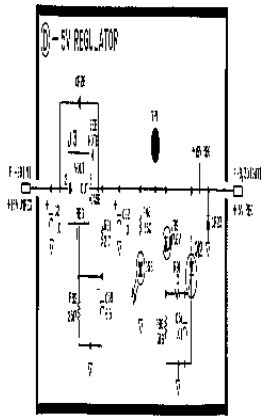


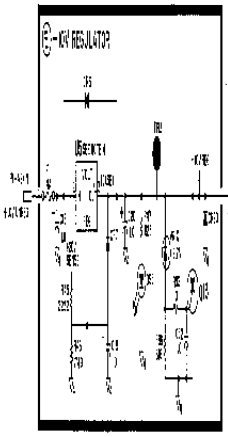


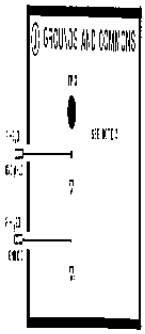


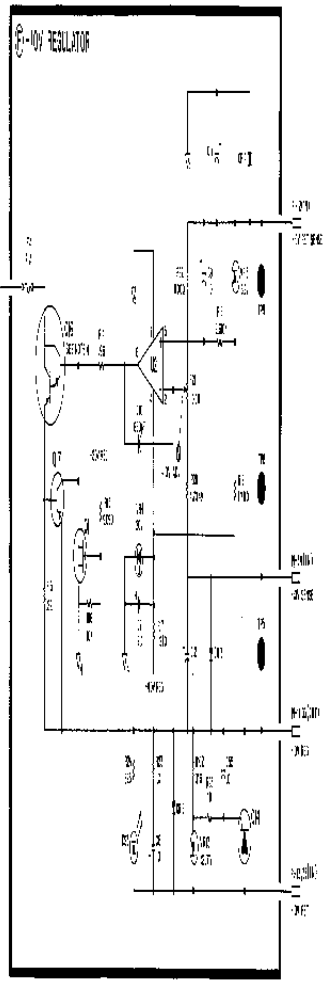












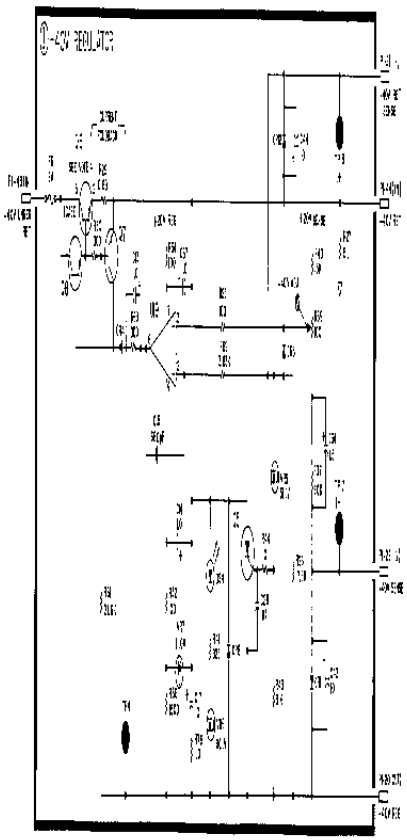


Figure 8-45. A7 Regulator Schematic Diagram (Sheet 2)

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CHANGE E

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NOTES

1. The following key entries provide front panel access for a data write/read operation to/from the addressed location:

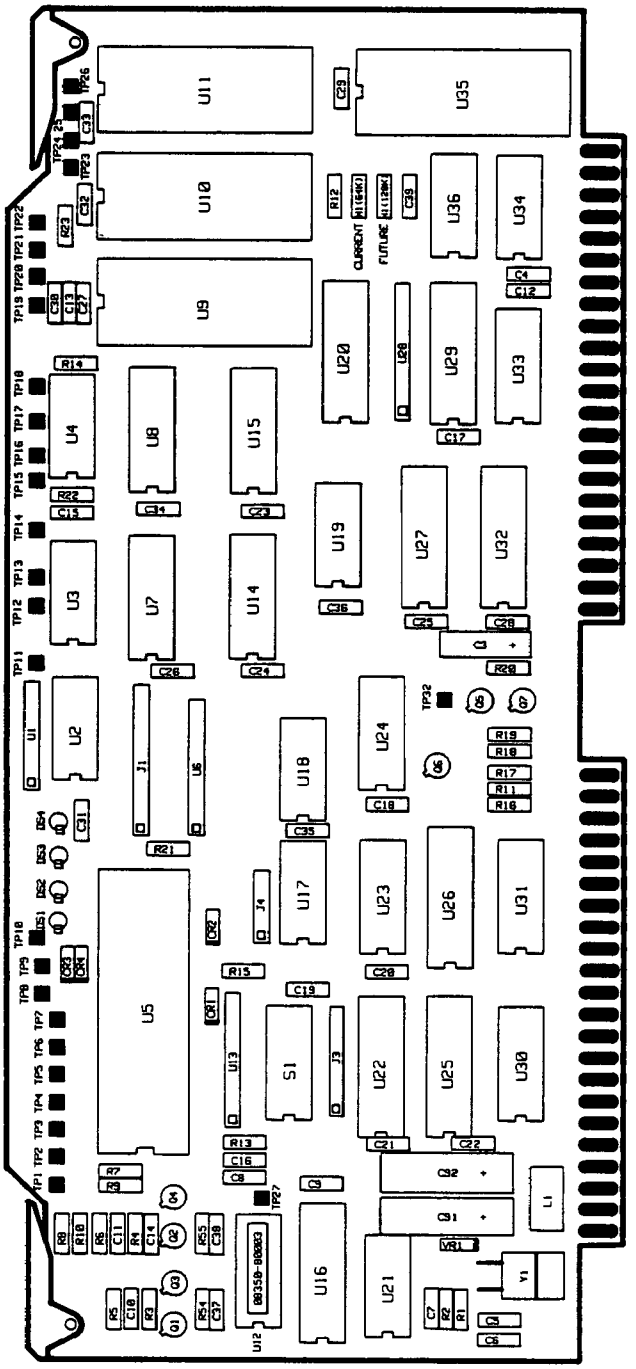
Function	Key Entry
*Hex Address Entry	**[SHIFT] [0] [0]** (enter hex address)
Hex Data WRITE	**[M2]** (enter data: two hex digits)
Hex Data READ	**[M3]**
Hex Data Rotation Write	**[M4]**
Hex Addressed Fast Read	**[M5]**

   *To address a different location, press **[M1]** and enter the new address, or use the increment keys [▲] [▼] to step to the new address.

2. +5VCCP is the RAM power supply. This voltage is maintained by +5V BAT when the main power is turned off.

3. RAM/ROM self-test error codes are listed next to the associated RAM or ROM.

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08350-60085

Figure 8-22. A3 Microprocessor Component Location Diagram

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A3 MICROPROCESSOR
08350-60085

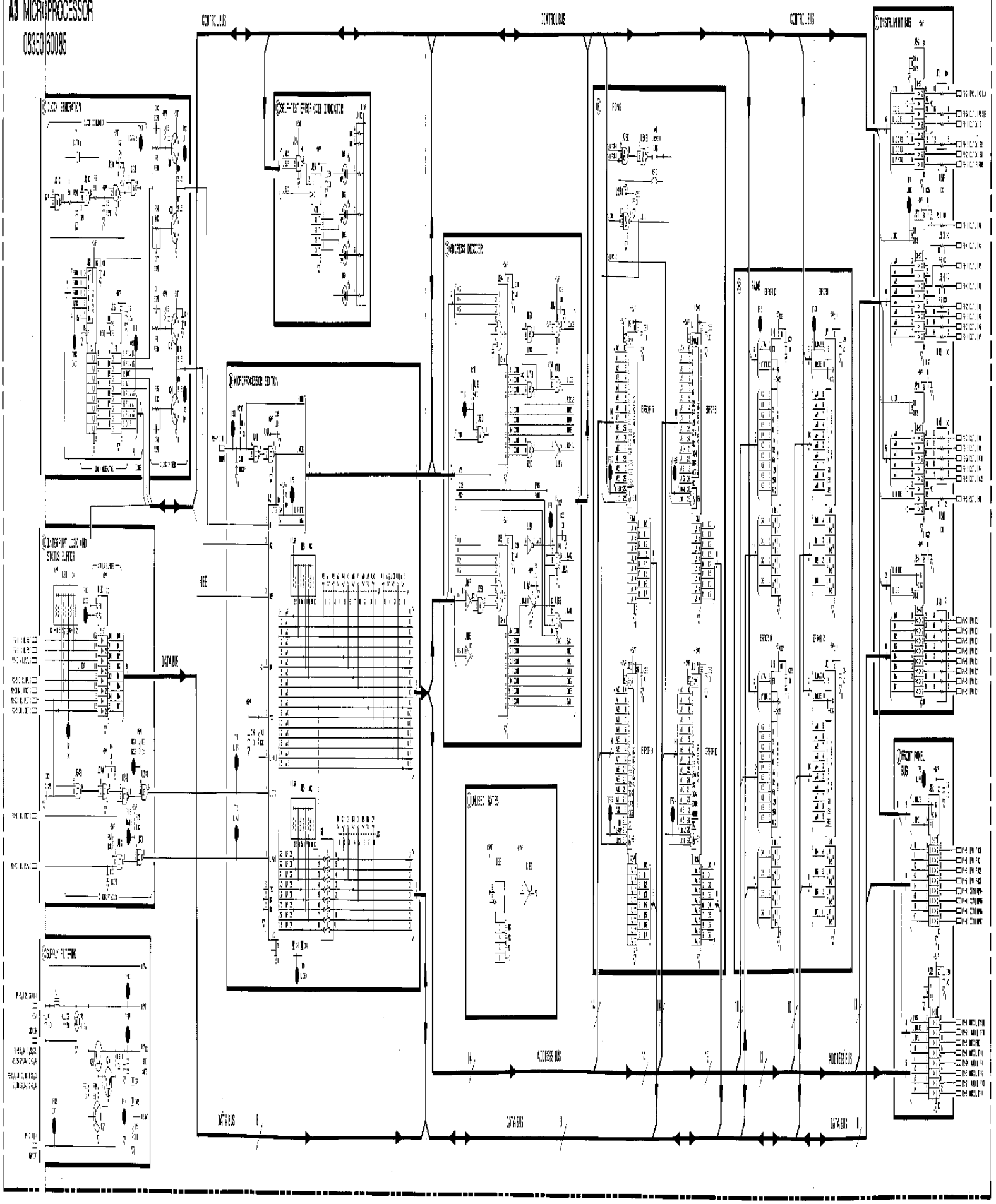


Figure 6-22. A3 Microprocessor Schematic Diagram (Sheet 1 of 1)

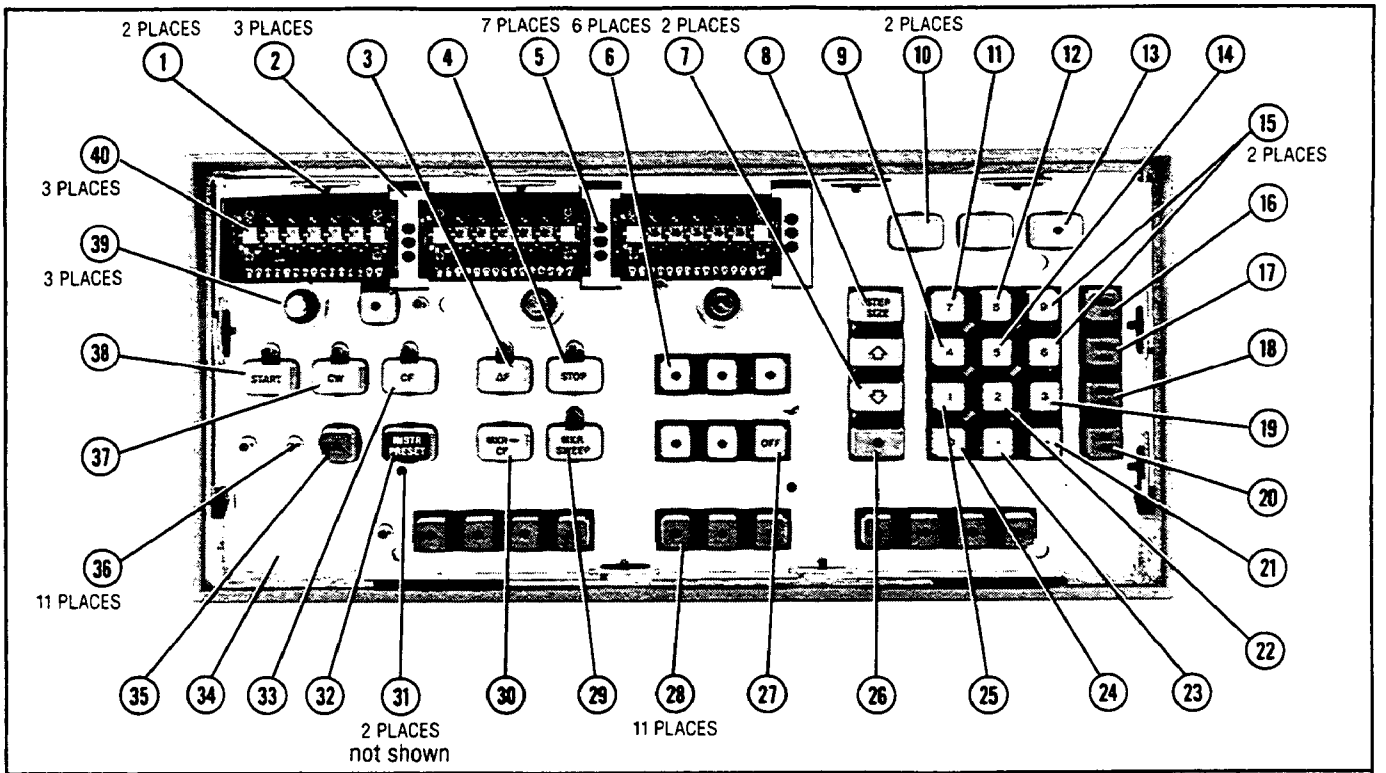
6-42

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Replace page 6–29 with the following page.

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Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
1	2200-0168	2	FLATHEAD SCREW	28480	2200-0168
2	1450-0588	3	LAMP HOUSING, POLYCARBONATE	28480	1450-0588
	08350-20079	9	NUT PLATE	28480	08350-20079
3	5041-1773	1	KEY [ΔF]	28480	5041-1773
4	5041-1777	1	KEY [STOP]	28480	5041-1777
5	1990-0486	7	LED-VISIBLE IF=60mA MAX	28480	1990-0486
6	5041-0285	6	KEY [•]	28480	5041-0285
7	5041-4580	2	KEY [◆]	28480	5041-4580
8	5041-1771	1	KEY [STEP SIZE]	28480	5041-1771
9	5041-1760	1	KEY [4]	28480	5041-1760
10	5041-0277	2	KEY [ ]	28480	5041-0277
11	5041-1763	1	KEY [7]	28480	5041-1763
12	5041-1764	1	KEY [8]	28480	5041-1764
13	5041-0286	1	KEY [$BU]	28480	5041-0286
14	5041-1761	1	KEY [5]	28480	5041-1761
15	5041-1762	2	KEY [9] [6]	28480	5041-1762
16	5041-1766	1	KEY [GHz S]	28480	5041-1766
17	5041-1767	1	KEY [MHz ms]	28480	5041-1767
18	5041-1940	1	KEY [dBm dB]	28480	5041-1940
19	5041-1759	1	KEY [3]	28480	5041-1759
20	5041-1769	1	KEY [BK SP]	28480	5041-1769
21	5041-1770	1	KEY [-]	28480	5041-1770
22	5041-1758	1	KEY [2]	28480	5041-1758
23	5041-1755	1	KEY [.]	28480	5041-1755
24	5041-1756	1	KEY [0]	28480	5041-1756
25	5041-1757	1	KEY [1]	28480	5041-1757
26	5041-0451	1	KEY [•] (blue)	28480	5041-0451
27	5041-1765	1	KEY [OFF]	28480	5041-1765
28	5041-0318	11	KEY [•] (dark gray)	28480	5041-0318
29	5041-1951	1	KEY [MKR SWEEP]	28480	5041-1951
30	5041-2088	1	KEY [MKR→CF]	28480	5041-2088
31	2200-0091	2	Screw - Mach 4-40 .562-IN.-LG	28480	2200-0091
32	5041-0720	1	KEY [INSTR PRESET] (GREEN)	28480	5041-0720
33	5041-1772	1	KEY [CF]	28480	5041-1772
34	08350-00038	1	SUB PANEL, FRONT	28480	08350-00038
35	5041-0726	1	KEY [LCL]	28480	5041-0726
36	1990-0487	11	LED-VISIBLE IF=20mA MAX	28480	5082-4584
37	5041-1774	1	KEY [CW]	28480	5041-1774
38	5041-1776	1	KEY [START]	28480	5041-1776
39	08350-60078	3	RPG	28480	08350-60078
40	1990-0738	3	DSPLY NUM .15 HI	28480	1990-0738

Figure 6-4. Sub Panel, Parts Identification

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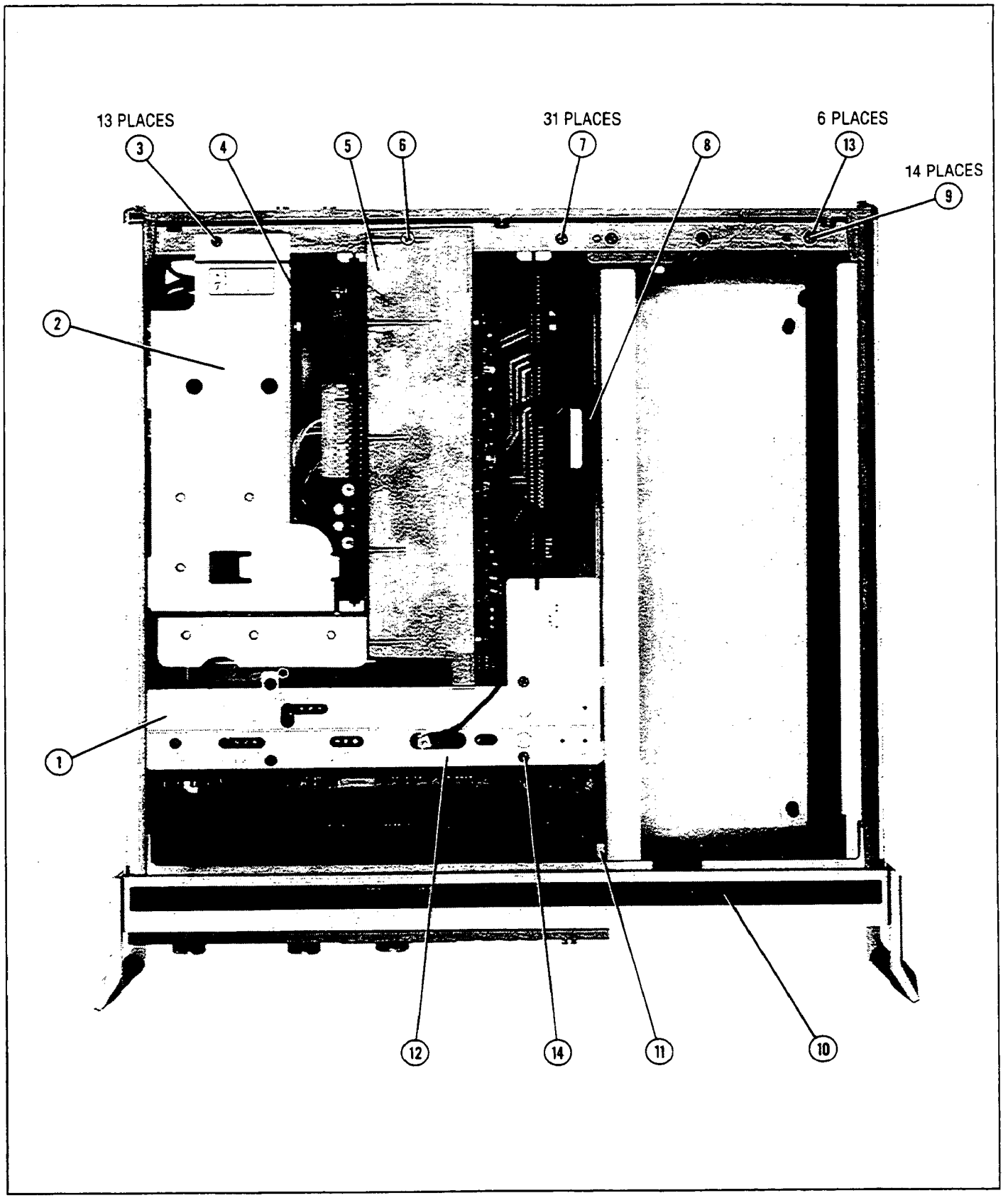


Figure 6-5. Top View with Covers, Parts Identification (1 of 2)

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Change G

The part number for the A5 Sweep Generator assembly that was shipped with your instrument is 08350–60077. The following pages document that version of the A5 assembly. However, for replacement of the complete A5 assembly, use the part numbers given in chapter 6.

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Table 6–2. Replaceable Parts

Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
A5	08350–60077	1	SWEEP GENERATOR BOARD ASSEMBLY	28480	08350–60077
C1	0180–2214	1	CAP–FXD 90uF +75% –10% 16 V AL–ELCTLT	04200	30D906G016CC2–DSM
C2	0180–2214	1	CAP–FXD 90uF +75% –10% 16 V AL–ELCTLT	04200	30D906G016CC2–DSM
C3	0180–0097	1	CAP–FXD 47uF ±10% 35 V TA	04200	150D476X9035S2–DYS
C4	0180–0097	1	CAP–FXD 47uF ±10% 35 V TA	04200	150D476X9035S2–DYS
C5	0180–1746	1	CAP–FXD 15uF ±10% 20 V TA	04200	150D156X9020B2–DYS
C6	0180–1746	1	CAP–FXD 15uF ±10% 20 V TA	04200	150D156X9020B2–DYS
C7	0160–3742	1	CAP–FXD 1uF ±5% 50 V POLYC–MET	05176	HEW–576
C8	0180–3020	1	CAP–FXD 120uF ±10% 50 V	04200	109D127X9050F2
C11	0180–1743	1	CAP–FXD 0.1uF ±10% 35 V TA	04200	150D104X9035A2–DYS
C12	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	02010	SA101C222KAAH
C13	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	02010	SA101C222KAAH
C15	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C17	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C18	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C19	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C20	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C21	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C23	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	02010	SA101C222KAAH
C24	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C26	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C28	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C29	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C30	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C31	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C32	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C33	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C34	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C35	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C36	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C37	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C38	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C39	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	02010	SA101C222KAAH
C40	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C41	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C42	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C43	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C44	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C45	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C47	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C49	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C52	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C54	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C55	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C56	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C57	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C58	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C59	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C60	0180–2071	1	CAP–FXD 0.022uF ±10% 35 V TA	04200	150D223X9035A2–DYS
C61	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C62	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C63	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C64	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C65	0160–4812	1	CAP–FXD 220pF ±5% 100 V CER C0G	02010	SA101A221JAAH
C66	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C67	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	02010	SA101C222KAAH
C68	0160–4830	1	CAP–FXD 2200pF ±10% 100 V CER X7R	02010	SA101C222KAAH
C69	0160–4812	1	CAP–FXD 220pF ±5% 100 V CER C0G	02010	SA101A221JAAH
C70	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C71	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C72	0160–4832	1	CAP–FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
C73	0180–2205	1	CAP–FXD 0.33uF ±10% 35 V TA	04200	150D334X9035A2–DYS
C74	0160–4791	1	CAP–FXD 10pF ±5% 100 V CER C0G	02010	SA102A100JAAH
C75	0160–4791	1	CAP–FXD 10pF ±5% 100 V CER C0G	02010	SA102A100JAAH
C76	0160–4791	1	CAP–FXD 10pF ±5% 100 V CER C0G	02010	SA102A100JAAH
C77	0180–0291	1	CAP–FXD 1uF ±10% 35 V TA	04200	150D105X9035A2–DYS

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Table 6-2. Replaceable Parts

Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
C78	0160-4832	1	CAP-FXD 0.01uF ±10% 100 V CER X7R	02010	SA101C103KAAH
CR1	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR2	1906-0268	1	DIODE-DUAL 30V 20MA	03799	ID101
CR4	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR5	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR6	1901-0376	1	DIODE-GEN PRP 35V 50MA DO-35	00046	1N3595
CR7	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR8	1901-0376	1	DIODE-GEN PRP 35V 50MA DO-35	00046	1N3595
CR9	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR10	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR11	1901-0050	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	03334	BAV10 SELECTED
CR12	1901-0538	1	DIODE-DUAL 70V 200MA	02037	MSD6150
CR14	1901-0954	1	DIODE-CUR RGLTR 1N5285 270UA DO-7	02037	1N5285
J1	8159-0005	1	RESISTOR 0 CWM	01339	L-2007-1
J4	1251-4926	1	CONN-POST TYPE .100-PIN-SPCG 8-CONT	02946	67996-608
L1	08503-80001	1	COIL-TOROID	28480	08503-80001
L2	9100-1655	1	INDUCTOR RF-CH-MLD 1.2MH ±5C>05826	2500-32	
L3	08503-80001	1	COIL-TOROID	28480	08503-80001
L4	08503-80001	1	COIL-TOROID	28480	08503-80001
L5	08503-80001	1			
MP1	1480-0073	2	PIN-ROLL .062-IN-DIA .25-IN-LG BE-CU	04559	99-012-062-0250
MP2	4040-0753	2	EXTR-PC BD GRN POLYC .062-IN-BD-THKNS		
0342	0698-8958	1	RESISTOR 511K ±1% .125W TF TC=0±100	02995	SFR25H
Q1	1854-1030	1	TRANSISTOR-DUAL NPN TO-78 PD=750MW		
Q2	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q3	1853-0451	1	TRANSISTOR PNP 2N3799 SI TO-18 PD=360MW		
Q4	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
Q5	1853-0316	1	TRANSISTOR-DUAL PNP PD=500MW	13127	LS352
Q6	1854-0477	1	TRANSISTOR NPN 2N2222A SI TO-18 PD=500MW	02037	2N2222A
R1	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R2	2100-3056	1	RESISTOR-TRMR 5K 10% TKF SIDE-ADJ 17-TRN	04568	89PR5K
R3	0698-3156	1	RESISTOR 14.7K ±1% .125W TF TC=0±100	02995	SFR25H
R4	0698-8046	1	RESISTOR 16K ±0.1% .125W TF TC=0±25	02995	5033R
R5	0757-0394	1	RESISTOR 51.1 ±1% .125W TF TC=0±100	02995	SFR25H
R6	0757-0438	1	RESISTOR 5.11K ±1% .125W TF TC=0±100	02995	SFR25H
R7	0698-3154	1	RESISTOR 4.22K ±1% .125W TF TC=0±100	02995	SFR25H
R8	0698-8822	1	RESISTOR 6.81 ±1% .125W TF TC=0±100	05524	CMF-55-1
R9	0698-7929	1	RESISTOR 9.09K ±0.1% .125W TF TC=0±50	02995	5033R
R10	0699-0273	1	RESISTOR 2.15K ±0.1% .125W TF TC=0±25	02995	5033R
R11	0698-6619	1	RESISTOR 15K ±0.1% .125W TF TC=0±25	02995	5033R
R12	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R13	0757-0199	1	RESISTOR 21.5K ±1% .125W TF TC=0±100	02995	SFR25H
R14	0698-3443	1	RESISTOR 287 ±1% .125W TF TC=0±100	02995	SFR25H
R15	0698-3444	1	RESISTOR 316 ±1% .125W TF TC=0±100	02995	SFR25H
R16	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R17	0757-0441	1	RESISTOR 8.25K ±1% .125W TF TC=0±100	02995	SFR25H
R18	0757-0419	1	RESISTOR 681 ±1% .125W TF TC=0±100	02995	SFR25H
R19	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R20	0757-0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R22	0698-7276	1	RESISTOR 46.4K ±1% .05W TF TC=0±100	02995	5063J
R25	2100-3163	1	RESISTOR-TRMR 1M 20% TKF SIDE-ADJ 17-TRN	04568	89PR1M
R26	0698-3450	1	RESISTOR 42.2K ±1% .125W TF TC=0±100	02995	SFR25H
R27	0698-3450	1	RESISTOR 42.2K ±1% .125W TF TC=0±100	02995	SFR25H
R28	0698-3162	1	RESISTOR 46.4K ±1% .125W TF TC=0±100	02995	SFR25H
R29	0698-3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	02995	SFR25H
R30	0757-0424	1	RESISTOR 1.1K ±1% .125W TF TC=0±100	02995	SFR25H
R31	0698-3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	02995	SFR25H
R32	0698-3150	1	RESISTOR 2.37K ±1% .125W TF TC=0±100	02995	SFR25H
R33	0698-3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	02995	SFR25H
R34	0698-3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	02995	SFR25H
R35	0698-3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	02995	SFR25H
R36	0757-0123	1	RESISTOR 34.8K ±1% .125W TF TC=0±100	02995	SFR25H
R37	0757-0123	1	RESISTOR 34.8K ±1% .125W TF TC=0±100	02995	SFR25H
R38	0698-3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	02995	SFR25H
R40	0698-3159	1	RESISTOR 26.1K ±1% .125W TF TC=0±100	02995	SFR25H
R41	0757-0199	1	RESISTOR 21.5K ±1% .125W TF TC=0±100	02995	SFR25H

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Table 6–2. Replaceable Parts

Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
R42	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R43	2100–3161	1	RESISTOR–TRMR 20K 10% TKF SIDE–ADJ	04568	89PR20K
R44	0757–0123	1	RESISTOR 34.8K ±1% .125W TF TC=0±100	02995	SFR25H
R45	0698–6320	1	RESISTOR 5K ±0.1% .125W TF TC=0±25	05524	CMF–55–1, T–9
R46	0757–1094	1	RESISTOR 1.47K ±1% .125W TF TC=0±100	02995	SFR25H
R47	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R48	0698–7276	1	RESISTOR 46.4K ±1% .05W TF TC=0±100	02995	5063J
R49	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R52	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R53	0698–3160	1	RESISTOR 31.6K ±1% .125W TF TC=0±100	02995	SFR25H
R54	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R55	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R56	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R57	0698–3450	1	RESISTOR 42.2K ±1% .125W TF TC=0±100	02995	SFR25H
R58	0698–3450	1	RESISTOR 42.2K ±1% .125W TF TC=0±100	02995	SFR25H
R59	0698–3243	1	RESISTOR 178K ±1% .125W TF TC=0±100	02995	SFR25H
R60	0698–3243	1	RESISTOR 178K ±1% .125W TF TC=0±100	02995	SFR25H
R61	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R62	0757–0442	1	RESISTOR 10K ±1% .125W TF TC=0±100	02995	SFR25H
R63	0757–0280	1	RESISTOR 1K ±1% .125W TF TC=0±100	02995	SFR25H
R65	0757–0290	1	RESISTOR 6.19K ±1% .125W TF TC=0±100	02995	SFR25H
R66	0699–0273	1	RESISTOR 2.15K ±0.1% .125W TF TC=0±25	02995	5033R
R67	0698–3154	1	RESISTOR 4.22K ±1% .125W TF TC=0±100	02995	SFR25H
R68	0757–0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R69	0757–0401	1	RESISTOR 100 ±1% .125W TF TC=0±100	02995	SFR25H
R71	0698–3449	1	RESISTOR 28.7K ±1% .125W TF TC=0±100	02995	SFR25H
R72	0698–3449	1	RESISTOR 28.7K ±1% .125W TF TC=0±100	02995	SFR25H
R73	0698–3266	1	RESISTOR 237K ±1% .125W TF TC=0±100	02995	SFR25H
R74	0757–0288	1	RESISTOR 9.09K ±1% .125W TF TC=0±100	02995	SFR25H
R75	0698–6317	1	RESISTOR 500 ±0.1% .125W TF TC=0±25	05524	CMF–55–1, T–9
R76	0698–6317	1	RESISTOR 500 ±0.1% .125W TF TC=0±25	05524	CMF–55–1, T–9
R77	2100–0545	1	RESISTOR–TRMR 1K 10% TKF SIDE–ADJ 17–TRN	04568	67XR
TP1	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP2	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP3	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP4	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP5	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP6	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP7	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP8	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP9	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP10	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP11	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP12	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP13	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP14	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP15	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
TP16	0360–2359	1	TERMINAL–TEST POINT .230IN ABOVE	04055	230.100
U1	1820–1730	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG COM	01698	SN74LS273N
U2	1826–0938	1	D/A 10–BIT 18–CERDIP BPLR	02180	DAC–10FX
U3	1826–0371	1	IC OP AMP LOW–BIAS–H–IMPD 8–TO–99 PKG	03406	LF256H
U4	1826–1048	1	IC OP AMP PRCN 8–DIP–C PKG	02180	OP–07CZ
U5	1826–1048	1	IC OP AMP PRCN 8–DIP–C PKG	02180	OP–07CZ
U6	1826–0785	1	IC OP AMP LOW–BIAS–H–IMPD DUAL 8–DIP–C	02037	MC34002BU
U8	1820–1730	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG COM	01698	SN74LS273N
U9	1826–0796	1	ANALOG SWITCH 4 SPST 16 –CERDIP	02180	SW–02FQ
U10	1826–0796	1	ANALOG SWITCH 4 SPST 16 –CERDIP	02180	SW–02FQ
U11	1826–0371	1	IC OP AMP LOW–BIAS–H–IMPD 8–TO–99 PKG	03406	LF256H
U12	1826–1048	1	IC OP AMP PRCN 8–DIP–C PKG	02180	OP–07CZ
U13	1826–1048	1	IC OP AMP PRCN 8–DIP–C PKG	02180	OP–07CZ
U14	1820–1416	1	IC SCHMITT–TRIG TTL/LS INV HEX 1–INP	01698	SN74LS14N
U15	1820–1112	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG	01698	SN74LS74AN
U16	1820–1730	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG COM	01698	SN74LS273N
U17	1826–0796	1	ANALOG SWITCH 4 SPST 16 –CERDIP	02180	SW–02FQ
U18	1820–1201	1	IC GATE TTL/LS AND QUAD 2–INP	01698	SN74LS08N
U19	1826–1196	1	IC OP AMP HS DUAL 8–TO–99 PKG	03285	AD644JH

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Table 6–2. Replaceable Parts

Ref. Desig.	HP Part Number	Qty	Description	Mfr Code	Mfr. Part Number
U20	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	01698	SN74LS00N
U21	1820–1202	1	IC GATE TTL/LS NAND TPL 3–INP	01698	SN74LS10N
U22	1820–1201	1	IC GATE TTL/LS AND QUAD 2–INP	01698	SN74LS08N
U23	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	01698	SN74LS00N
U24	1820–1730	1	IC FF TTL/LS D–TYPE POS–EDGE–TRIG COM	01698	SN74LS273N
U25	1820–1200	1	IC INV TTL/LS HEX	01698	SN74LS05N
U26	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	01698	SN74LS00N
U27	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	01698	SN74LS00N
U28	1820–1201	1	IC GATE TTL/LS AND QUAD 2–INP	01698	SN74LS08N
U29	1820–1423	1	IC MV TTL/LS MONOSTBL RETRIG DUAL	01698	SN74LS123N
U30	1820–2024	1	IC DRVR TTL/LS BUS OCTL	01698	SN74LS244N
U31	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	01698	SN74LS00N
U32	1820–1423	1	IC MV TTL/LS MONOSTBL RETRIG DUAL	01698	SN74LS123N
U33	1820–1199	1	IC INV TTL/LS HEX 1–INP	01698	SN74LS04N
U34	1826–0065	1	IC COMPARATOR PRCN 8–DIP–P PKG	03406	LM311N
U35	1826–0065	1	IC COMPARATOR PRCN 8–DIP–P PKG	03406	LM311N
U36	1820–1199	1	IC INV TTL/LS HEX 1–INP	01698	SN74LS04N
U37	1820–1197	1	IC GATE TTL/LS NAND QUAD 2–INP	01698	SN74LS00N
U38	1820–1423	1	IC MV TTL/LS MONOSTBL RETRIG DUAL	01698	SN74LS123N
U39	1820–1216	1	IC DCDR TTL/LS BIN 3–TO–8–LINE 3–INP	01698	SN74LS138N
U40	1820–1244	1	IC MUXR/DATA–SEL TTL/LS 4–TO–1–LINE DUAL	01698	SN74LS153N
U41	1820–1440	1	IC LCH TTL/LS R–BAR S–BAR QUAD	01698	SN74LS279AN
U42	1820–1200	1	IC INV TTL/LS HEX	01698	SN74LS05N
U43	1820–1244	1	IC MUXR/DATA–SEL TTL/LS 4–TO–1–LINE DUAL	01698	SN74LS153N
U44	1810–0206	1	NETWORK–RES 8–SIP 10.0K OHM X 7	02483	750–81
U45	1810–0206	1	NETWORK–RES 8–SIP 10.0K OHM X 7	02483	750–81
U46	1820–3200	1	IC CNTR CMOS/74HC BIN ASYNCHRO	02037	MC74HC4060N
U47	1258–0233	1	JUMPER 8 POSITION PACKAGE; FOUR OPEN	08017	69145–208–M
VR1	1902–0579	1	DIODE–ZNR 5.1V 5% PD=1W IR=10UA		
VR2	1902–3171	1	DIODE–ZNR 11V 5% DO–35 PD=.4W TC=+.062C>		
VR3	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W		
VR4	1902–0551	1	DIODE–ZNR 6.2V 5% PD=1W IR=10UA	02037	SZ40145–8RL
VR5	1902–3203	1	DIODE–ZNR 14.7V 5% DO–35 PD=.4W		
VR6	1902–3203	1	DIODE–ZNR 14.7V 5% DO–35 PD=.4W		
VR7	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W		
VR8	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W		
VR9	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W		
VR10	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W		
VR11	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W		
VR12	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W		
VR13	1902–0041	1	DIODE–ZNR 5.11V 5% DO–35 PD=.4W		
Y1	0410–1561	1	CRYSTAL–QUARTZ 444.44 KHZ	11113	CX–1H 444.44 KHZ (A)
Y2	0410–1560	1	CRYSTAL–QUARTZ 512.0 KHZ	11113	CX–1H 512 KHZ (C)
			A5 MISCELLANEOUS PARTS		
	1480–0073	2	PIN–ROLL .062–IN–DIA .25–IN–LG BE–CU	28480	1480–0073
	4040–0753	2	EXTR–PC BD GRN POLYC .062–IN–BD–THKNS	28480	4040–0753
	1251–4932	1	CONNECTOR–SGL CONT SKT .021–IN–BSC–SZ	28480	1251–4932

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NOTES

1. The following key entries provide front panel access for a data write/read operation to/from the addressed location:

Function	Key Entry
*Hex Address Entry	**[SHIFT] [0] [0]** (enter hex address)
Hex Data WRITE	**[M2]** (enter data: two hex digits)
Hex Data READ	**[M3]**
Hex Data Rotation Write	**[M4]**
Hex Addressed Fast Read	**[M5]**

*To address a different location, press **[M1]** and enter the new address, or use the increment keys **[▲] [▼]** to step to the new address.

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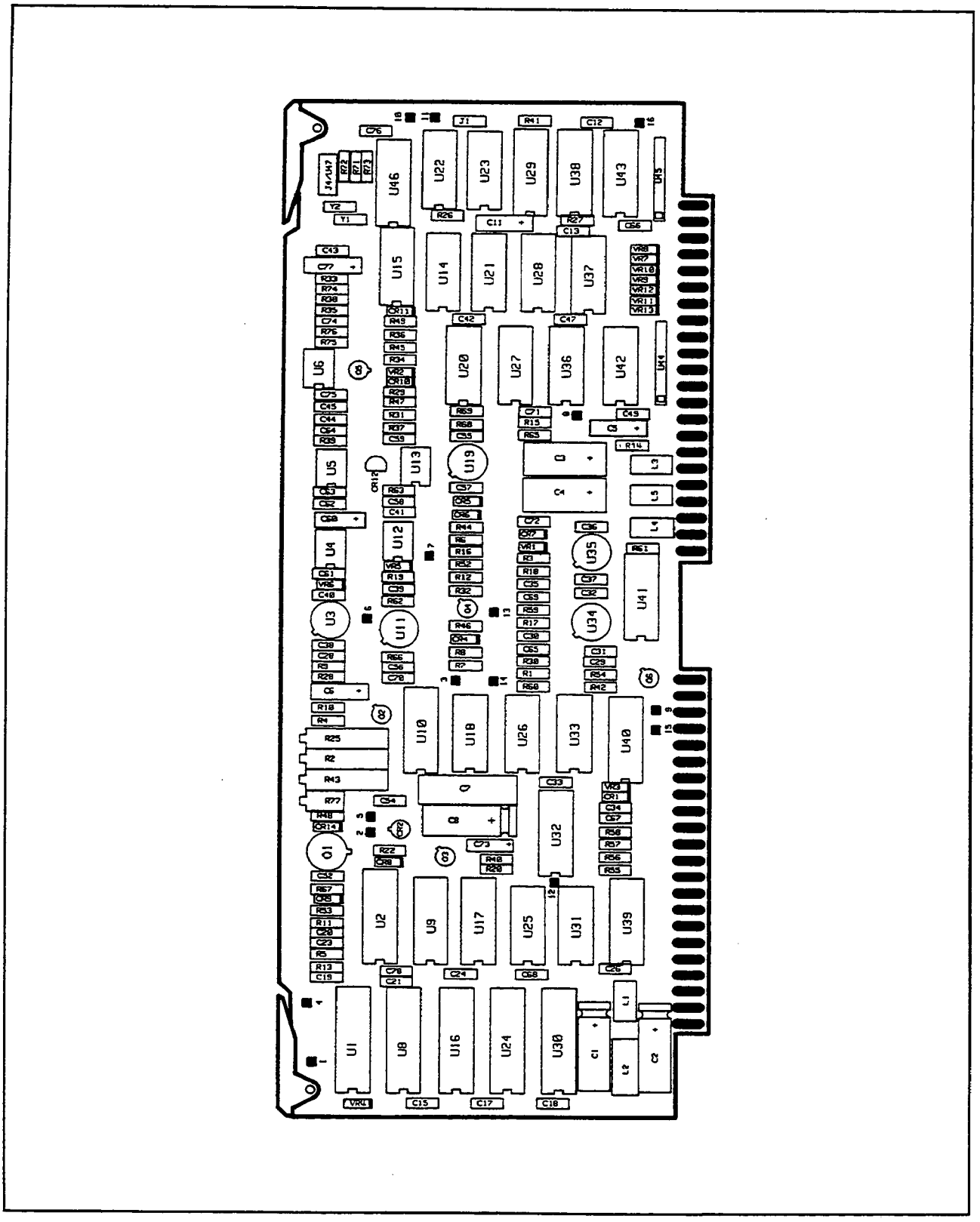


Figure 8–37. A5 Sweep Generator Component Location Diagram

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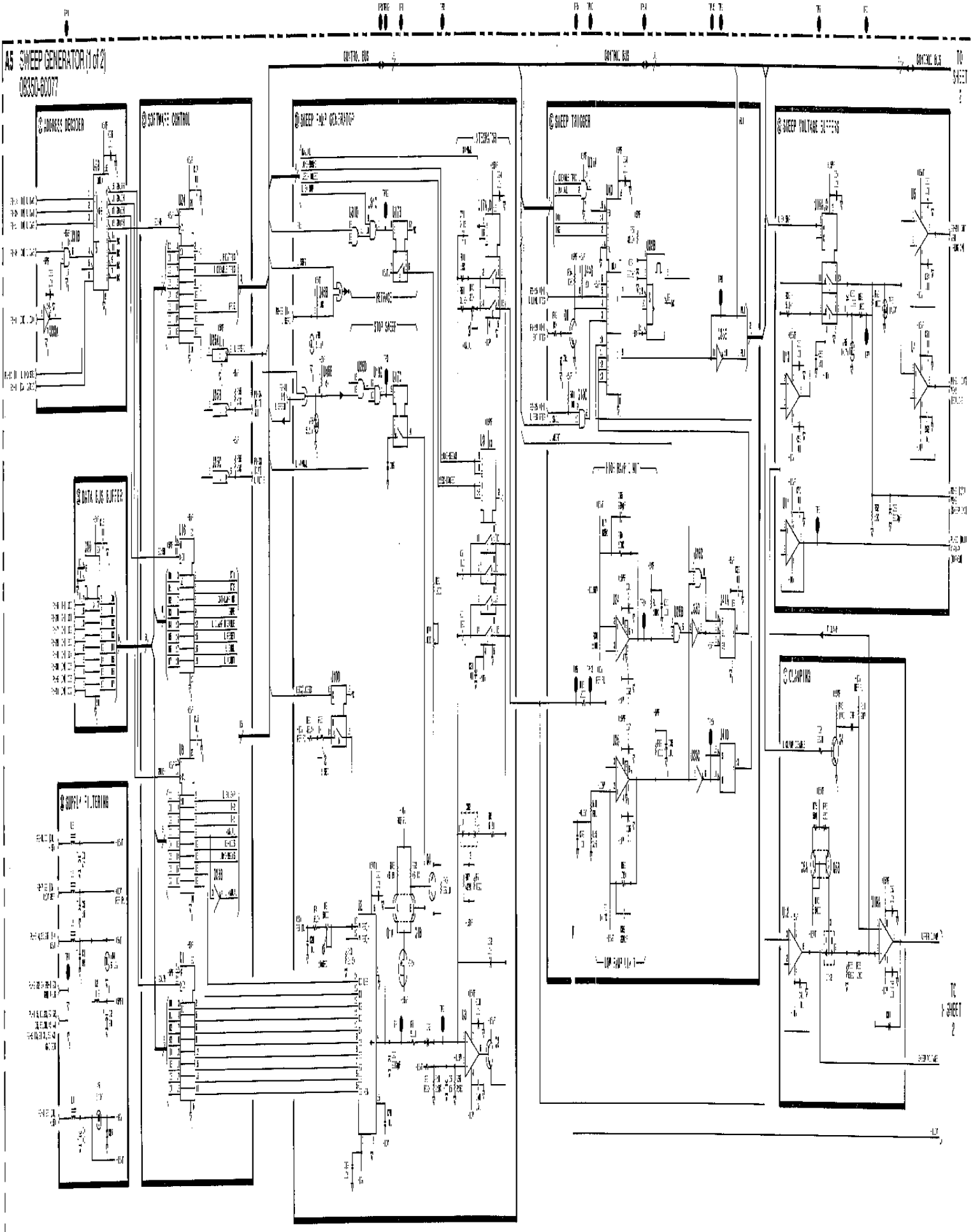
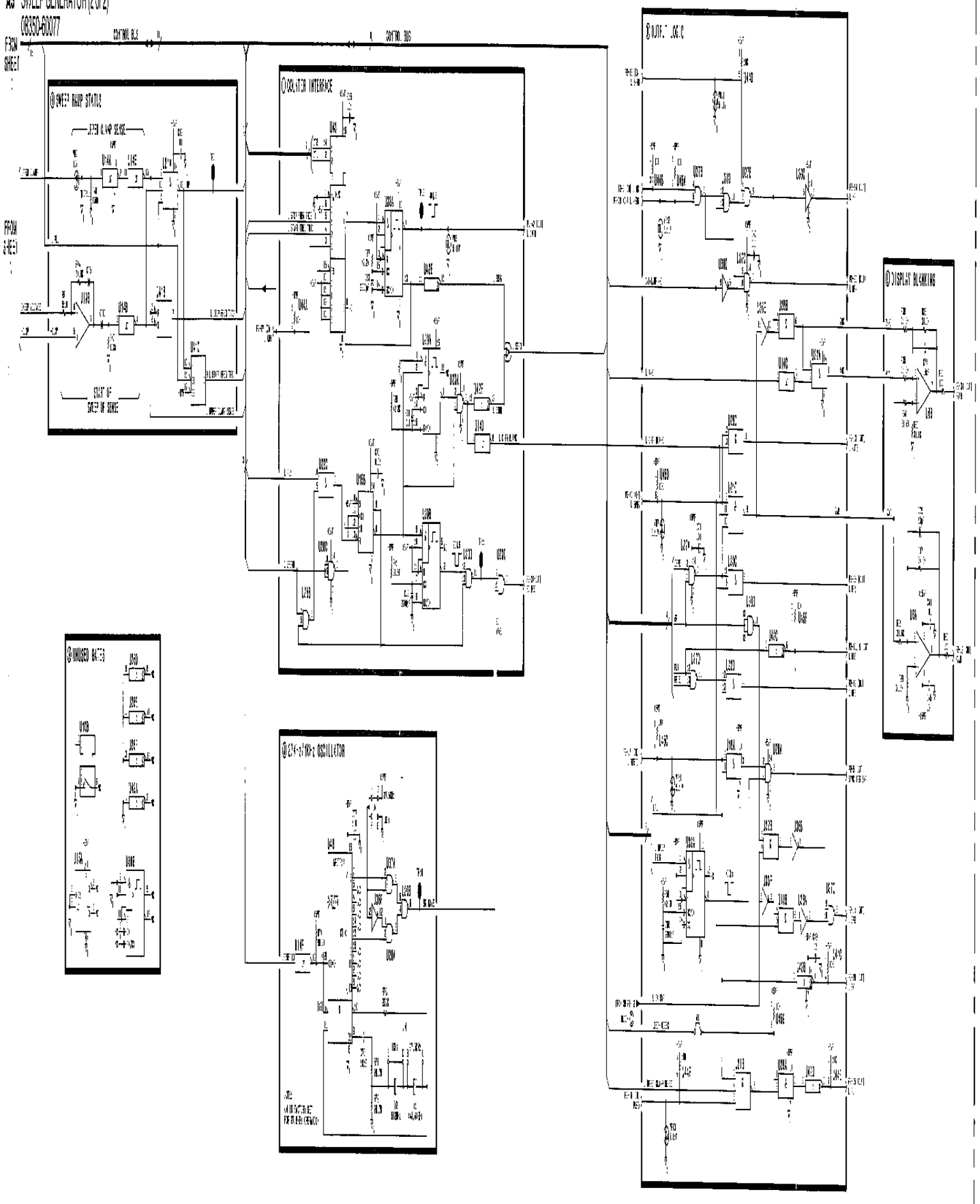


Figure 2-32. A5 Sweep Generator Schematic Diagram (1 of 2, Change 6)

8-125/8-126

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A5 SWEEP GENERATOR (2 of 2)
08350-60077



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Change H

The part number for the A1 Front Panel assembly that was shipped with your instrument is 08350-60074. The following pages document that version of the A1 assembly. However, for replacement of the complete A1 assembly, use the part documented in chapter 6 (08350-60136).

The part number for the rotary pulse generator (with plug) that was shipped with your instrument is 08350-60078. This assembly is documented in the following pages. Use this part number for replacement purposes *unless* you have also replaced the A1 assembly with the part number documented in chapter 6 (08350-60136). In that case, you can use either the 08350-60078 or the part documented in chapter 6 (0960-0859).

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Table 6-2. Reference Designators, Abbreviations and Manufacturers Code List (4 of 4)

Mfr Code	Manufacturer Name	Address		Zip Code
00046	UNITRODE CORP	LEXINGTON	MA	02173
01339	GETTIG ENGRG & MFG CO INC	SPRING MILLS	PA	16875
01380	AMP INC	HARRISBURG	PA	17111
01461	GOE ENGINEERING CO INC	ONTARIO	CA	91761
01607	ALLEN-BRADLEY CO INC	EL PASO	TX	79935
01698	TEXAS INSTRUMENTS INC	DALLAS	TX	75265
01854	RCL ELECTRONICS INC	NORTHBROOK	IL	60062
02010	AVX CORP	GREAT NECK	NY	11021
02037	MOTOROLA INC	ROSELLE	IL	60195
02123	EG & G INC	WELLESLEY	MA	02181
02180	PRECISION MONOLITHICS INC	SANTA CLARA	CA	95054
02210	MILTON ROSS CO	SOUTHHAMPTON	PA	18966
02414	BURNDY CORP	NORWALK	CT	06856
02483	CTS CORP	ELKHART	IN	46514
02499	IRC INC	BOONE	NC	28607
02608	THERMALLOY INC	DALLAS	TX	75234
02685	LOBAUGH ROLLIN J	SOUTH SAN FRANC	CA	94080
02805	COOPER INDUSTRIES INC	HOUSTON	TX	77210
02883	SILICONIX INC	SANTA CLARA	CA	95054
02910	SIGNETICS CORP	SUNNYVALE	CA	94086
02946	DUPONT E I DE NEMOURS & CO	WILMINGTON	DE	19801
02995	NORTH AMERICAN PHILIPS CORP	NEW YORK	NY	10017
03123	MICRO-OHM CORP	EL TORO	CA	92630
03285	ANALOG DEVICES INC	NORWOOD	MA	02062
03325	PIEZO TECHNOLOGY INC	ORLANDO	FL	32854
03334	NV PHILIPS ELCOMA	EINDHOVEN		02876
03394	METHODE ELECTRONICS INC	CHICAGO	IL	60656
03406	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95052
03418	MOLEX INC	LISLE	IL	60532
03794	ADVANCED MICRO DEVICES INC	SUNNYVALE	CA	94086
03799	HARRIS CORP	MELBOURNE	FL	32901
03811	INTEL CORP	SANTA CLARA	CA	95054
03981	PENN ENGINEERING & MFG CORP	DOYLESTOWN	PA	18901
04055	OVERLAND PRODUCTS CO	PHOENIX	AZ	68025
04200	SPRAGUE ELECTRIC CO	LEXINGTON	MA	02173
04486	ITT CORP	NEW YORK	NY	10022
04504	GENERAL INSTRUMENT CORP	CLIFTON	NJ	07012
04559	ELASTIC STOP NUT DIVOF HARVARD	UNION	NJ	07083
04568	BECKMAN INDUSTRIAL CORP	FULLERTON	CA	92635
04703	LITTELFUSE INC	DES PLAINES	IL	60016
04726	3M CO	ST PAUL	MN	55144
04990	GRAYHILL INC	LA GRANGE	IL	60525
05115	CENTRAL FASTENERS, INC	BROADVIEW	IL	60153
05176	AMERICAN SHIZUKI CORP	CANOGA PARK	CA	91304
05250	RICHMOND DIVISION OF DIXICO INC	REDLANDS	CA	92373
05524	DALE ELECTRONICS INC	COLUMBUS	NE	68601
05769	ITT SEALECTRO CORP	TRUMBULL	CT	06611
05792	INTL ELECTRONIC RESEARCH CORP	BURBANK	CA	91502
05826	AMER PRCN IND INC DELEVAN DIV	AURORA	NY	14052
06900	JUDD WIRE	BURLINGTON	MA	01803
07608	WRIGHT ENGINEERED PLASTICS	WINDSOR	CA	95492
08017	FORCE ELECTRONICS	SANTA CLARA	CA	
08474	RICHARDSON ELECTRONICS	FRANKLIN PARK	IL	
09538	TUSONIX	TUCSON	AZ	85740
09694	ELECTRONIC ESSENTIALS	WOODSIDE	NY	
10456	PLASTEC PRODUCTS INC	FORT COLLINS	CO	
11113	STATEK	ORANGE	CA	

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Table 6-2. Replaceable Parts

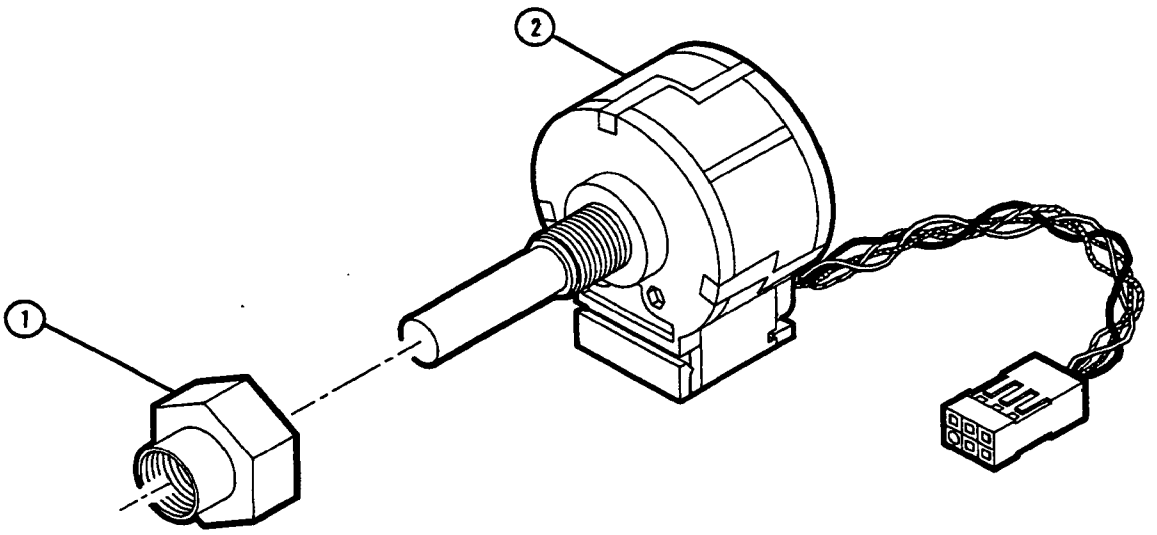
Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	08350-60074	1	BOARD ASSEMBLY-FRONT PANEL	28480	08350-60074
A1	1990-0738	1	DISPLAY-NUM-SEG 5-CHAR .152-H RED		
A2	1990-0738	1	DISPLAY-NUM-SEG 5-CHAR .152-H RED		
A3	1990-0738	1	DISPLAY-NUM-SEG 5-CHAR .152-H RED		
C1	0180-0229	1	CAP-FXD 33uF ±10% 10 V TA	04200	150D336X9010B2-DYS
C2	0180-2214	1	CAP-FXD 90uF +75% -10% 16 V AL-ELCTLT	04200	30D906G016CC2-DSM
C3	0160-2055	1	CAP-FXD 0.01uF +80% -20% 100 V CER Y5V	09538	805-504 Y5V 103Z
C4	0160-2055	1	CAP-FXD 0.01uF +80% -20% 100 V CER Y5V	09538	805-504 Y5V 103Z
C5	0160-2055	1	CAP-FXD 0.01uF +80% -20% 100 V CER Y5V	09538	805-504 Y5V 103Z
DS1	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS2	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS3	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS4	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS5	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS6	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS7	1990-0486	1	LED-LAMP LUM-INT=2MCD IF=25MA-MAX BVR=5V	01542	HLMP-1301
DS8	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS9	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS17	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS18	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS19	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS23	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS24	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS25	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS27	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS28	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS29	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS30	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS31	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS32	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS33	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS34	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS35	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS36	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
DS37	1990-0670	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	01542	HLMP-6400
J1	1251-7447	1	CONN-POST TYPE .100-PIN-SPCG 34-CONT	02946	67997-634
J2	1251-5926	1	CONN-POST TYPE .100-PIN-SPCG 50-CONT	02946	67997-650
J3	1251-8736	1	CONN-POST TYPE .100-PIN-SPCG 6-CONT	02946	67997-606
J4	1251-8736	1	CONN-POST TYPE .100-PIN-SPCG 6-CONT	02946	67997-606
J5	1251-8736	1	CONN-POST TYPE .100-PIN-SPCG 6-CONT	02946	67997-606
L1	08503-80001	1	COIL-TOROID	28480	08503-80001
L2	08503-80001	1	COIL-TOROID	28480	08503-80001
Q1	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q2	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q3	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q4	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q5	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q6	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q7	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
Q8	1853-0281	1	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	02037	2N2907A
R1	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R2	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R3	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R4	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R5	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R6	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R7	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
R8	0757-0180	1	RESISTOR 31.6 ±1% .125W TF TC=0±100	02995	SFR25H
S1-S50	5060-9436	50	SWITCH-PB SPST-NO MOM	04486	5560-9436
U1	1820-2266	1	IC-INTERFACE DRVR -888-BIT	02910	NE590F
U2	1820-2266	1	IC-INTERFACE DRVR -888-BIT	02910	NE590F
VR1	1902-0551	1	DIODE-ZNR 6.2V 5% PD=1W IR=10UA	02037	SZ40145-8RL
XA1	1200-0846	1	SOCKET-IC-SIP 15-CONT SIP DIP-SLDR	01380	643115-1
XA2	1200-0846	1	SOCKET-IC-SIP 15-CONT SIP DIP-SLDR	01380	643115-1
XA3	1200-0846	1	SOCKET-IC-SIP 15-CONT SIP DIP-SLDR	01380	643115-1
			A1 MISCELLANEOUS PARTS		
	0380-1233	11	SPACER-SPECIALTY .450 IN LG; .175 IN OD	00000	ORDER BY DESCRIPTION
	1450-0588	3	LAMP HOUSING POLYCARBONATE; WHITE; 1.1	28480	1450-0588
	08350-60078	3	ROTARY PULSE GENERATOR	28480	08350-60078
	0360-0031	2	TERMINAL-CRIMP R-TNG #6 22-16-AWG RED	28480	0360-0031
	08350-00016	3	CONNECTOR STRIP-15 PN	28480	08350-00016
			ORDER RPGS AND ASSOCIATED HARDWARE SEPARATELY. NOT INCLUDED WITH THE A1 BOARD. SEE FIGURE 6-1.		

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Table 6-2. Replaceable Parts

Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS MOUNTED COMPONENTS		
B1	08350-60015	1	FAN SHIELD ASSY	28480	08350-60015
B1	08350-60032	1	400 HZ FAN ASSY (OPT. 400)	28480	08350-60032
C1	0180-2317	3	CAPACITOR FXD 3600UF +75-10% 40VDC AL	00853	539-7445-02
C2	0180-2317		CAPACITOR-FXD 3600UF +75-10% 40VDC AL	00853	539-7445-02
C3	0180-2317		CAPACITOR-FXD 3600UF +75-10% 40VDC AL	00853	539-7445-02
C4	0180-2495	1	CAPACITOR-FXD 8700UF +75-10% 40VDC AL	28480	0180-2495
C5	0180-3017	1	CAPACITOR-FXD .045F +75-10% 25VDC AL	28480	0180-3017
C6	0180-2603	1	CAPACITOR-FXD 7200UF +75-10% 50VDC AL	28480	0180-2603
C7	0180-2922	1	CAPACITOR-FXD 2600UF +75-10% 100VDC AL	28480	0180-2922
C8	0160-4065	1	CAPACITOR-FXD .1UF −20% 250VAC AC(RMS)	28480	0160-4065
CR1	1901-0033	4	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
CR2	1901-0033		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
CR3	1901-0033		DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
CR4	1901-0033	4	DIODE-GEN PRP 180V 200MA DO-35	9N171	1N645
F1	2110-0002	1	FUSE 2A 250V NTD 1.25X.25 UL	75915	312002
F1	2110-0055	1	FUSE 4A 250V NTD 1.25X.25 UL	75915	312004
FL1	0960-0443	1	LINE MODULE FILTERED	28480	0960-0443
S1	3101-2269	1	SWITCH TGI SUBMIN DPDT 3A 250VAC	28480	3101-2269
S2	3103-0090	1	SWITCH THRM FIX +160F 12A OPN-ON-RISE	28480	3103-0090
T1	9100-4227	1	TRANSFORMER 6V HPIL XFORMER WITH 100KHZ		
T1	9100-4337	1	TRANSFORMER, POWER (OPT. 400)	28480	9100-4337
			CONNECTORS AND CABLES		
J1	1250-0083	7	CONNECTOR F BNC FEM SGL-HOLD-FR 50-OHM	28480	1250-0083
J2			P/O W4, PLUG-IN INTERFACE		
J3			P/O W6, PLUG-IN POWER SUPPLY INTERFACE		
J4			P/O W5, HP-IB INTERFACE		
J5	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J6	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J7	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J8	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J9	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J10	1250-0083		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
J11	1250-0118	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J12	1250-0118	2	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J13			P/O W7, AUX. PROGRAMMING		
J14	1251-6781	1	CONNECTOR 3-PIN M CIRC AUDIO	28480	1251-6781
W1	08350-60003	1	CABLE ASSY, RIBBON 34C A1/A2 INTERCONNECT	28480	08350-60003
W2	08350-60004	1	CABLE ASSY, RIBBON 50C A1/A2 INTERCONNECT	28480	08350-60004
W3*	08350-60006	1	CABLE ASSY, COAX/BROWN (V TUNE)	28480	08350-60006
W4	08350-60052	1	CABLE ASSY, RIBBON 64C, PLUG-IN INTERFACE	28480	08350-60052
W5	08350-60018	1	CABLE ASSY, RIBBON 26C (HP-IB INTERFACE)	28480	08350-60018
W6*	08350-60112	1	CABLE ASSY 17 PIN, PLUG-IN PS INTERFACE	28480	08350-60112
W7	08350-60002	1	CABLE ASSY RIBBON 25C PROGRAMMING INTERFACE	28480	08350-60002
W8*	08350-60007	1	CABLE ASSY COAX/ORANGE FM IN	28480	08350-60007
W9*	08350-60008	1	CABLE ASSY COAX/YELLOW	28480	08350-60008
W10	08350-60098	2	CABLE ASSY JACK/BATTERY	28480	08350-60098
W11	08350-60097	1	FRONT PANEL CABLE ASSEMBLY	28480	08350-60097
W12	08350-60095	1	CABLE ASSEMBLY RP BNC	28480	08350-60095
W13	08350-60109		JACK/BATTERY CABLE ASSEMBLY	28480	08350-60109
W14	8120-1378		POWER CORD 3C 903 8		
			*W3, W6, W8 AND W9 ARE COMMON TO J3 (PART OF PLUG-IN INTERFACE)		
			MISCELLANEOUS PARTS		
	0360-1190	6	TERMINAL-SLDR LUG PL-MTG FOR-#3/8-SCR	28480	0360-1190
	0590-0106	4	NUT-HEX-PLSTC LKG 2.56-THD .143-IN-THK	00000	ORDER BY DESCRIPTION
	2190-0009	1	WASHER-LK INTL T NO. 8 .168-IN-ID	28480	2190-0009
	2190-0016	9	WASHER-LK INTL T 3/8 IN. .377 IN-ID	28480	2190-0016
	2360-0055	4	SCREW MACH 6-32. 188-IN-LG BDG-HD-SET	00000	ORDER BY DESCRIPTION
	2360-0198	4	SCREW-MACH 6-32 .438-IN-LG 100 DEG	00000	ORDER BY DESCRIPTION
	2360-0333	8	SCREW-MACH 6-32 .25-IN-LG 100 DEG	28480	2360-0333
	2420-0001	8	NUT-HEX-W/LKWR 6-32 THD. 109-IN-THK	00000	ORDER BY DESCRIPTION
	2950-0001	9	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION

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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08350-20081	3	NUT-HEX	28480	08350-20081
2	0960-0683	3	ROTARY PULSE GENERATOR	28480	0960-0683
3	08350-60078	3	ROTARY PULSE GENERATOR (WITH PLUG)	28480	08350-60078

Figure 6-1. Rotary Pulse Generator (RPG), Parts Identification

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Ref Desig	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	08350-60078	3	Rotary Pulse Generator		08350-60078
2	08350-00039	1	Gusset Shield-Front	28480	08350-60039
	08350-00040	1	Gusset Shield-Rear	28480	08350-60040
3	1901-0033	4	Diode - Gen 180V 200ma DO-7	07263	FDH3369
4	08350-00015	1	Fan/Shield Assembly	28480	08350-00015
	08350-60032	1	400 Hz Fan Assembly (Opt 400 only)	28480	03350-60032
5	08350-00006	1	Bracket-PC Support	28480	08350-00006
6	1400-0510	1	Cable Clamp	02768	8511-01-00-9909
7	08350-00008	1	Support, Right	28480	08350-00008
8	08350-00049	1	Support, Left	28480	08350-00007
9	2360-0115	31	Screw-Mach 6-32 .312-in.lg	28480	2360-0115
10	0403-0026	2	Glide Nylon - fits 0.192 hole	28480	207-120241-03-0101
11	2360-0322	5	Screw-Mach 6-32 .375-in.lg 82 deg	28480	2360-0322

Figure 6-6. Top View Without Covers, Parts Identification (2 of 2)

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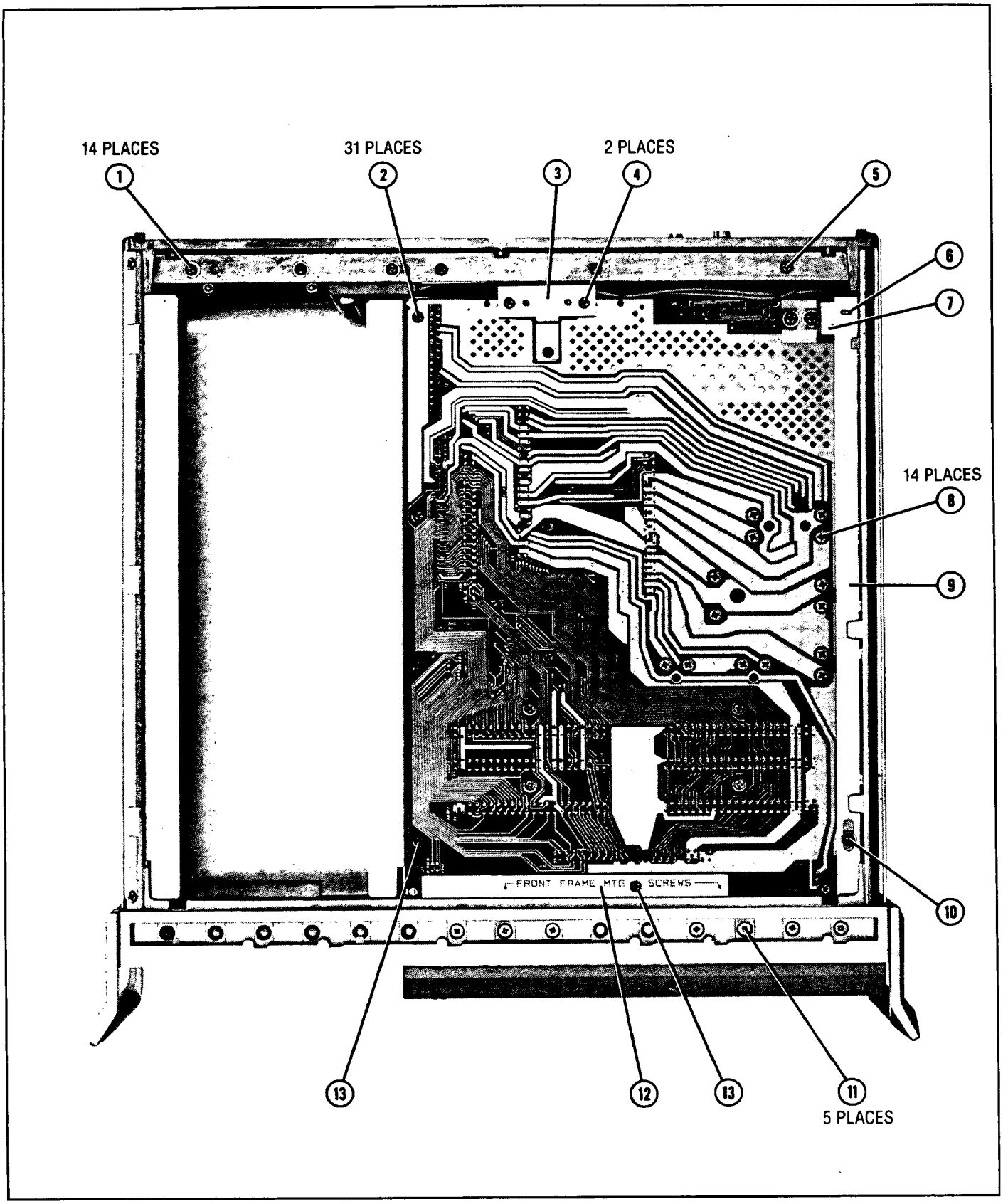


Figure 6-7. Bottom View, Parts Identification (1 of 2)

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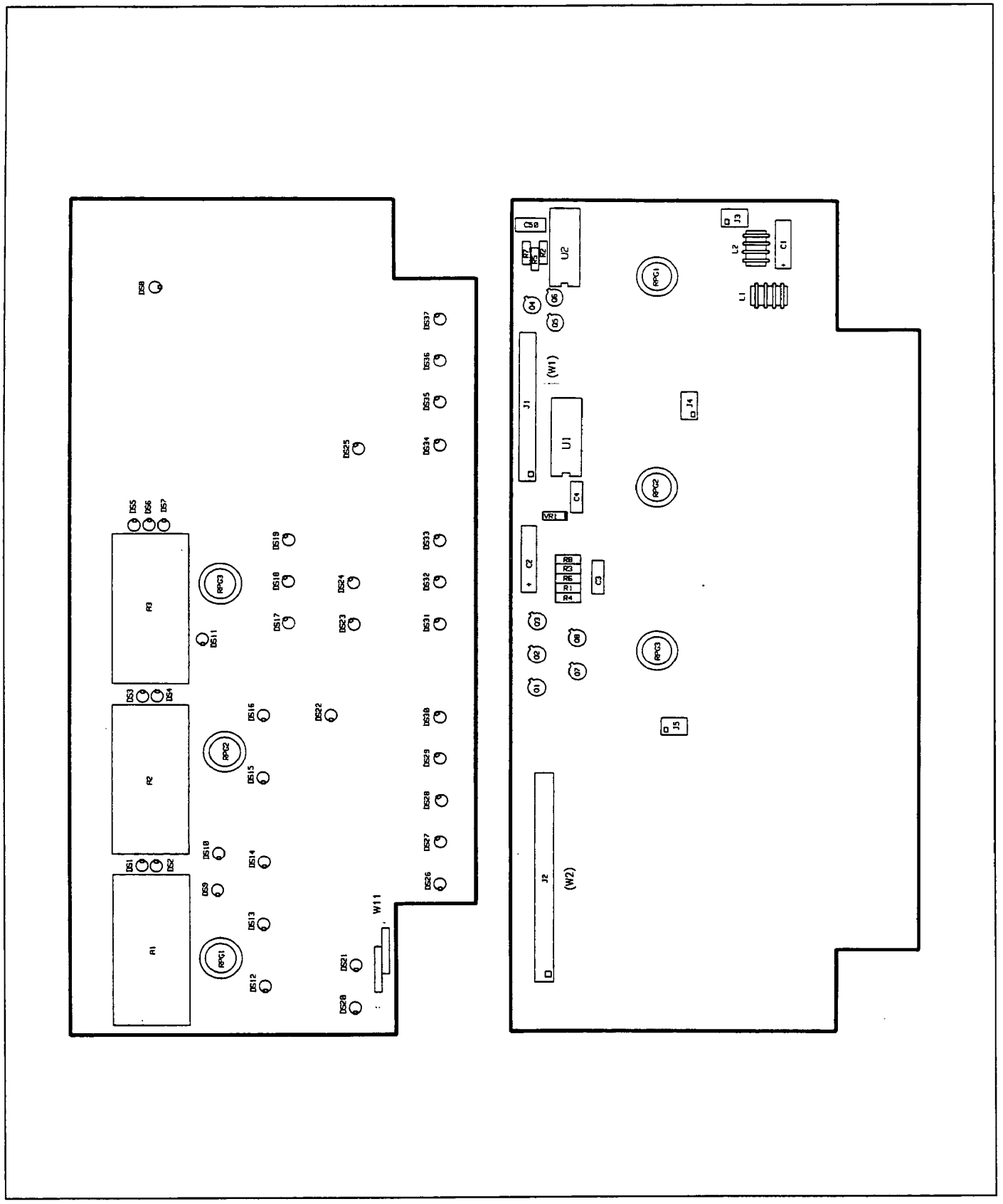


Figure 8-10. A1 Front Panel, Component Locations

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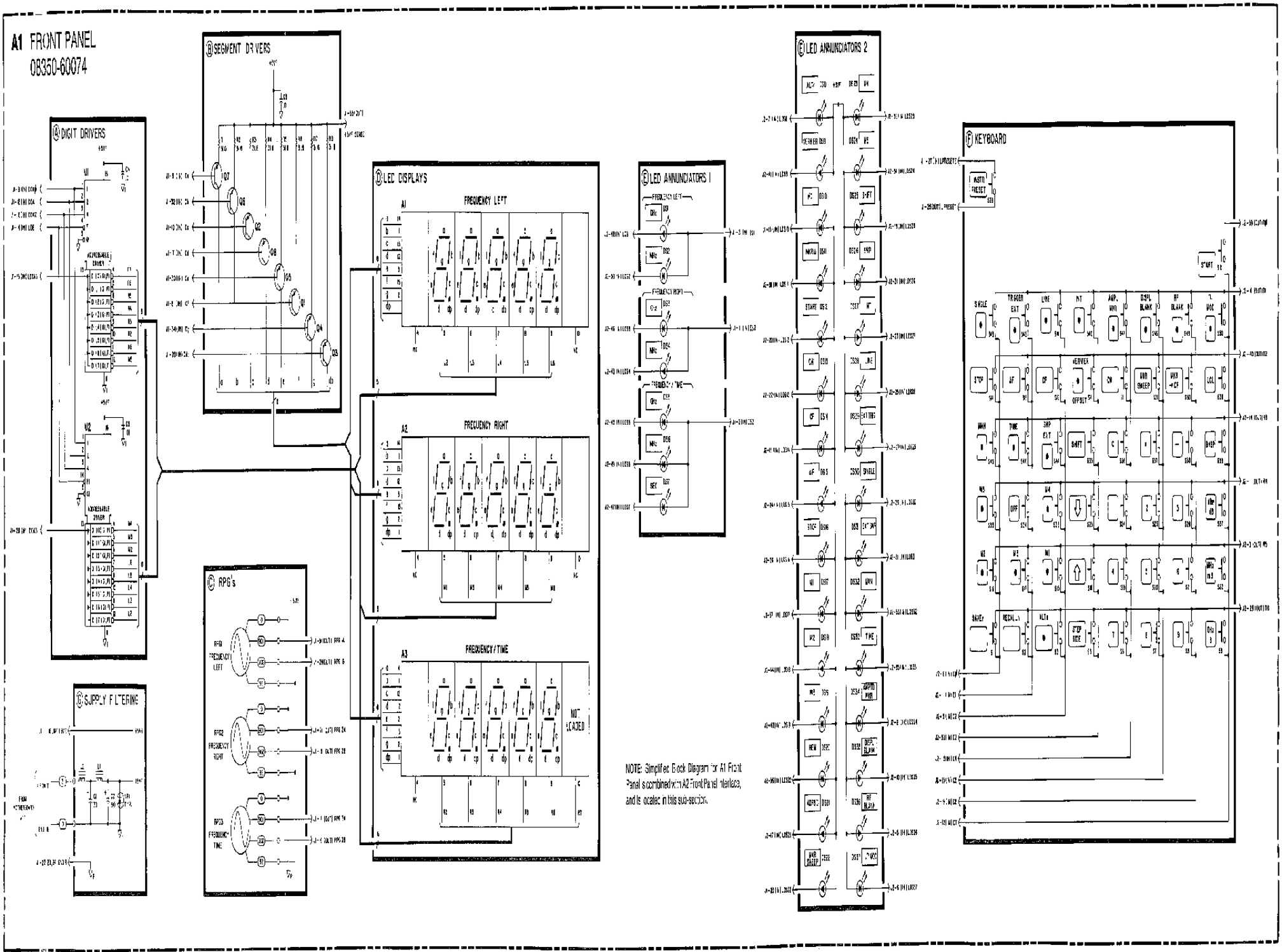


Figure 6-11. A1 Front Panel, Schematic Diagram (Change H)

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Section VIII. Service

INTRODUCTION

This section provides instructions for troubleshooting and repairing the HP 8350B Sweep Oscillator. Information includes circuit descriptions, troubleshooting procedures, block diagrams, component location diagrams, and schematics for each PC board assembly. The service instructions are first covered in an overall instrument application and then further in this section divided into specific board assembly areas.

SCHEMATIC DIAGRAM NOTES

Figure 8-1, Schematic Diagram Notes, provides definitions to schematic symbols.

INTERCONNECT CABLES AND MNEMONICS

All interconnect cables and their associated connectors are listed in Table 8-30, HP 8350B Cable List, located at the end of the A9 motherboard service section.

Figure 8-54, Motherboard Wiring List, alphabetically lists and defines all HP 8350B signal mnemonics, references the point-to-point distribution of each signal to and from the PC board sockets and the cable connectors on the A9 motherboard assembly, and identifies the signal source. This figure is located within the A9 service section. Pin assignments for the RF plug-in interface cables are listed in Figures 8-54 and 8-55.

RECOMMENDED TEST EQUIPMENT

Test equipment required to maintain the HP 8350B is listed Section I. If the equipment listed is not available, equipment that meets the minimum specifications shown may be substituted.

WARNING

The special service board, when connected to the HP 8350B mainframe, has voltages exposed that are capable of causing death. The special service board should only be used by a skilled person who is aware of the hazard involved.

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Table 8-1. Service Information Index

Information	Figure No.	Information	Figure No.
A1 Front Panel Assembly		A5 Sweep Generator	
Circuit Description (Includes A1 and A2)	—	Circuit Description	—
Troubleshooting (Includes A1 and A2)	—	Troubleshooting	—
A1 Component Locations	8-10	Block Diagram	8-32
Block Diagram (Includes A1 and A2)	8-9	Component Location	8-37
A1 Schematic	8-11	A5 Schematic (2 fold-outs)	8-38
A2 Front Panel Interface Assembly		A6 Rectifier Assembly	
Circuit Description (Includes A1 and A2	—	Circuit Description (Includes A6 and A7)	—
Troubleshooting (Includes A1 and A2)	—	Troubleshooting (Includes A6 and A7)	—
Block Diagram (Includes A1 and A2)	8-9	A6 Component Locations	8-42
A2 Component Locations	8-16	A6 Schematic	8-43
A2 Schematic	8-17	A7 Regulator Assembly	
A3 Microprocessor Assembly		Block Diagram (Includes A6 and A7)	8-40
Circuit Description	—	A7 Component Locations	8-44
Troubleshooting	8-18	A7 Schematic	8-45
Block Diagram	8-19		
Component Locations	8-22	A8 HP-IB Interface Assembly	
A3 Schematic	8-23	Circuit Description	—
		Troubleshooting	—
A4 Scaling and Marker Assembly		Block Diagram	8-47
Circuit Description	—	Self-Test Block Diagram	8-47A
Troubleshooting	—	Component Locations	8-49
Block Diagram	8-27	A8 Schematic	8-50
Component Locations	8-30		
A4 Schematic	8-31	A9 Motherboard	
		Component Locations	8-51
		Wiring List	8-53
		Major Assemblies Locations	8-52
		Cable List (*Table)	*8-30

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BASIC COMPONENT SYMBOLOGY

R, L, C — Resistance is in ohms, inductance is in microhenries, capacitance is in microfarads, unless otherwise noted.

P/O — Part of.

Indicates a factory selected component.

Panel Control.

Screwdriver adjustment.

Encloses front panel designation.

Encloses rear panel designation.

Circuit assembly borderline.

Other assembly borderline.

Heavy line with arrows indicates path and direction of main signal.

Indicates path and direction of main feedback.

Earth ground symbol.

Assembly ground. May be accompanied by a number or letter to specify a particular ground.

Chassis ground.

n — Represents n number of transmission paths.

Test Point: Terminal provided for test probe.

Pin Edge Connector output of PC board.

Indicates wire or cable color code. Color code same as resistor color code. First number indicates base color, second and third numbers indicate colored stripes.

Indicates shielding conductor for cables.

Indicates a plug-in connection.

Indicates a soldered or mechanical connection.

Connection symbol indicating a male connection.

Connection symbol indicating a female connection.

Resistor.

Variable Resistor.

General purpose diode.

Breakdown Diode: Zener

Light-Emitting Diode.

SCR (Silicon Controlled Rectifier).

FET: Field Effect Transistor (N-channel).

FET: Field Effect Transistor-Guarded gate- (N channel).

Dual Transistor.

Transistor NPN

Transistor PNP

Electrolytic Capacitor.

Toroid: Magnetic core inductor.

Operational Amplifier.

Fuse

Pushbutton Switch.

Toggle Switch.

Thermal Switch.

Summing Point.

Oscillator; RPG (Rotary Pulse Generator).

Fan, Motor.

Toroidal Transformer

Figure 8-1. Schematic Diagram Notes

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Overall Theory of Operation & Troubleshooting

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Overall Instrument Troubleshooting

WARNING

With the AC power cable connected, the AC line voltage is present at the terminals of power line module FL1 (mounted on rear panel) and at the LINE switch, whether the LINE switch is on or off. With the covers removed, these terminals are exposed. Care must be taken to avoid contact with these terminals.

With the covers removed, terminals are exposed that have voltages capable of causing death. Any maintenance or repair of the opened instrument under voltage should be carried out only by a skilled person who is aware of the hazard involved.

After disconnecting AC line power cord, allow a minimum of 30 seconds for the power supplies to discharge before removing the protective cover.

INTRODUCTION

Troubleshooting is generally divided into two maintenance levels in this manual. The first level isolates the problem to a circuit or assembly. Self-tests, together with the Overall Block Diagram, Table 8-4 Error Code to Assembly, and Table 8-5 Assembly to Circuit/Component Troubleshooting Guide, helps to isolate the problem source to a particular assembly. Table 8-4 is a comprehensive quick reference guide that lists all mainframe self-test error codes, what test has failed, and indicates the assembly(ies) which may be at fault.

The second maintenance level isolates the trouble to the component. Operator-initiated tests, schematic diagrams, circuit descriptions for each assembly, and Table 8-5 aid in troubleshooting to the component level. Table 8-5 is a comprehensive troubleshooting guide that provides information necessary to isolate a problem to a single assembly in instances where several assemblies may be at fault. It also provides information necessary to isolate a problem to a specific circuit and in many cases to a single component.

ERROR CODES

The A3 Microprocessor generates an error code if one of the self-tests performed during Instrument Self-Test fails. An error code may be displayed at each of the following locations.

A3 Microprocessor Error Code LEDs

Primary error code indicator is used for all error codes. If different error code indication occurs between different displays, the error code indicated by the A3 microprocessor is correct. To convert from the binary error code shown on the A3 error code LEDs to decimal error code, refer to Table 8-2.

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SWEEP TRIGGER Annunciators

Used only for error codes E006 through E015. Provides front panel indication if part of front panel is operational. Error code display is identical to display on the A3 microprocessor. If error code is displayed, verify the same error code is displayed on the A3 microprocessor.

FREQUENCY Display

Used for error codes E030, E016, and E001 through E005. Viewing of these error codes requires that the front panel is operational. If an error code is displayed, verify that the same error code is displayed on the A3 microprocessor.

Instrument-Initiated Tests

Initial troubleshooting should begin by initiating an Instrument Self-Test and checking for error codes. This self test is automatically initiated at power on, or can be selected by pressing the INSTR PRESET key.

Instrument-Initiated TestsInitial troubleshooting should begin by initiating an Instrument Self-Test and checking for error codes. This self test is automatically initiated at power on, or can be selected by pressing the INSTR PRESET key.

Fail Instrument Preset. Refer to Table 8-4, Error Code to Assembly, for a list of error codes and troubleshooting hints. Table 8-4 is a comprehensive quick reference guide that lists all mainframe Self-Test error codes, what test has failed, and indicates the assembly(ies) which may be at fault. Error codes are listed in the order that the corresponding instrument Self-Test was made. Table 8-5, Assembly to Circuit/Component Troubleshooting Guide, references each assembly and describes what functions are verified by the Instrument Self-Test. Table 8-5 is a comprehensive troubleshooting guide that provides information necessary to isolate a problem to a single assembly in instances where several assemblies may be at fault. It also provides information necessary to isolate a problem to a specific circuit and in many cases to a single component.

Pass Instrument Preset. If the HP 8350B passes the Instrument Preset self test, the instrument is functionally operating, but the analog voltages are not verified for accuracy.

Self-Tests

Self tests are available to aid in troubleshooting the HP 8350B. The HP 8350B provides instrument-initiated and operator-initiated checks. These checks verify the proper functioning of the majority of the 8350B's digital circuitry and a portion of the analog devices. Self-tests do not check analog accuracy. In order to verify the calibration of the HP 8350B perform the performance tests in Section IV of this manual.

Troubleshooting Example:

The following troubleshooting example will show how to use Table 8-4 (Error Code to Assembly) and Table 8-5 (Assembly to Circuit/Component Troubleshooting Guide) to efficiently determine the cause of error code related failures.

The HP 8350B displays E003 (Error 3)

Table 8-4 provides the following information:

- The unit has failed the Tuning Voltage vs. Marker Self-Test.
- The SHIFT 10 command will place the HP 8350B in a repetitive self-test mode identical to the original Error 3 self-test performed by the instrument.

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- The A5 sweep generator or the A4 scaling and marker assembly may cause the problem.
- Table 8-5, A4 assembly, tuning voltage versus marker — Error 3 description will explain how to determine which assembly is at fault and how to troubleshoot it.

Now refer to Table 8-5, A4 assembly, Error 3. This part of Table 8-5 contains references to several specific areas in the A4 Scaling and Marker Circuit Description. The "Error Code 3" description is referred to first. This section contains the following instructions:

- First verify that the +10V reference supply at A4TP14 is +10V ± .001V. Then press **[SHIFT] [1] [0]** to initiate the tuning voltage vs. marker repetitive self-test.
- Verify that A4TP1 is 0V. If A4TP1 is not 0V the A5 sweep generator assembly is at fault. Refer to Table 8-5, A5 assembly, Error 3 for troubleshooting information.
- IF A4TP1 is 0V the failure is on the A4 scaling and marker assembly, check the ΔF DAC, CW/CF DAC, and vernier DAC circuits. The self-test for each DAC is listed and described in the A4 Circuit Description, Troubleshooting, "Scaling Failure" section. Compare the DAC outputs at A4TP11 with waveforms listed in Figure 8-28 (located on the A4 schematic fold-out).

Now refer back to Table 8-5. The DAC tests mentioned above are listed along with test instructions for other related circuitry. Helpful troubleshooting tips are also included: "If any DAC output is wrong check that each of its inputs are being sequentially strobed by a logic 'one'. If the DAC is receiving data properly check its reference voltage. If both of the above are good, replace DAC."

In the example scenario, the following occurs: After entering the SHIFT 10 self-test, you will find that the CW DAC output at A4TP8 does not match the waveform in Figure 8-28. Measure U9 pin 17 and verify a +10V reference. Examine all U9 input pins and make sure each one receives a strobe pulse. In this example the strobe pulse on U9 pin 10 is incorrect. The pulse amplitude is only .8V. Suspect A4 U15 or A4 U9.

To facilitate more in-depth troubleshooting, place any bit pattern on the output lines of a data latch, or latches (like A4U15 and A4U17A). To do this, perform the hex data write command located in the paragraphs labeled Operator-Initiated Tests.

Table 8-2. Microprocessor Error Code LED's to Decimal Error Code Chart

A3 Self Test LED Indication				Error Code
DS1	DS2	DS3	DS4	
ON	ON	ON	ON	15
ON	ON	ON	OFF	14
ON	ON	OFF	ON	13
ON	ON	OFF	OFF	12
ON	OFF	ON	ON	11
ON	OFF	ON	OFF	10
ON	OFF	OFF	ON	9
ON	OFF	OFF	OFF	8
OFF	ON	ON	ON	7
OFF	ON	ON	OFF	6
OFF	ON	OFF	ON	5
OFF	ON	OFF	OFF	4
OFF	OFF	ON	ON	3
OFF	OFF	ON	OFF	2
OFF	OFF	OFF	ON	1

Error Codes 5 and below are displayed on the front panel in decimal form.

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FRONT PANEL DISPLAY FAILURE

It is possible to have a front panel failure without generating an error code. Initiate the Instrument Preset self test and check for any activity from the A3 microprocessor LEDs. If the LEDs do not cycle on then off, the Instrument Preset was not initiated. Check the +5V power supply, then refer to the A3 microprocessor service paragraphs. If the LEDs cycle on then off, this indicates that the HP 8350B has passed the Instrument Preset self test. The front panel display problem could be caused by the A1 front panel, A2 front panel interface, or the RF plug-in. Front panel operation is verified if the front panel displays are operational without the RF plug-in installed. Check front panel operation as follows.

1. Remove RF plug-in.
2. Initiate Instrument Preset (Error code E001 should be displayed).
3. Press **[START]** key. The HP 8350B front panel displays should indicate a start/stop frequency sweep of 0 MHz to 10.000 GHz.

OPERATOR-INITIATED TESTS

The microprocessor services several operator-initiated tests to check functions which are not exercised during self-test. Initiate the test by making the appropriate key entry indexed in Table 8-4. For further description of these tests, refer to Table 8-5.

HEXADECIMAL

Hexadecimal is the number system used to locally address HP 8350B logic components. Available programmed checks are indexed in Table 8-4.

The hexadecimal system uses 16 digits: 0 through 9 and A through F. Since 16 is the fourth power of 2, 4-bit binary numbers can be expressed with one hexadecimal digit, making local programming easier. Table 8-3 provides hexadecimal conversion.

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Table 8-3. Hexadecimal Equivalents

HEXADECIMAL	BINARY	DECIMAL
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
b	1011	11
C	1100	12
d	1101	13
E	1110	14
F	1111	15

When the HP 8350B is in the Hex Data WRITE mode, several front panel keyboard pushbuttons function as hexadecimal digits. See Figure 8-2.

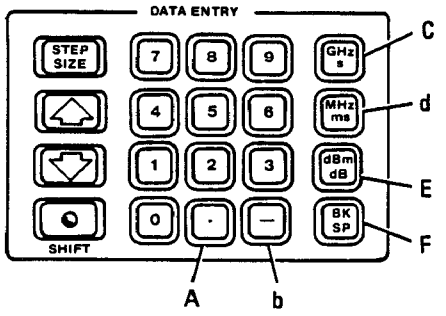


Figure 8-2. Hex Entry Keys

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Access to much of the HP 8350B digital circuitry can be achieved through local programming:

Function	Key Entry
Access to Hex Entry*	**[SHIFT] [0] [0]**
Enter Hex Address	**[M1] then the desired address**
Hex Data WRITE	**[M2] then the two desired data bits**
Hex Data READ	**[M3]**
Hex Data Rotation Write	**[M4]**
Hex Addressed Fast Read	**[M5]**

*To address a different location, press **[M1]** and enter the new address, or use the increment keys **[▲]** or **[▼]** to step to the new address.

NOTE: Before addressing an HP 8350B component, determine whether or not the microprocessor can READ or WRITE to that particular device. The majority of HP 8350B digital chips do NOT have both READ and WRITE capabilities.

By entering the hex address location of a specific device, that device can be exercised. (Addresses are supplied next to the mnemonic on each schematic. Also, circuit descriptions usually include address decoder tables to define the addresses used on that particular assembly). Hex address entry must be made prior to any of the following:

HEX DATA WRITE, **[M2]**, allows the operator to write any combination of hex data bytes to the addressed device. The outputs can then be checked to see if the device is functioning properly.

HEX DATA WRITE EXAMPLE: Refer to the CW/CF circuit, Block C of the A4 Scaling and Marker schematic (Figure 8-31). This circuit is typical of the kind of circuit used with the Hex Data Write command. Data latches A4U15 and A4U17A provide a binary number on their output lines when each, in turn, receives a pulse on its clock input. A4U9 is a programmable current source that interprets the binary number supplied by the data latches and sources a corresponding amount of current at pin 1. To place any desired bit pattern follow these instructions:

1. Determine the address of the data latches. Referring to the A4 schematic the address is the number adjacent to the clock input line. The addresses are 3001 for A4U15 and 3002 for A4U17A. The "H" after these numbers indicate that they are expressed in hexadecimal.

   Press **[INSTR PRESET]**.

2. Enter the address for A4U15 by pressing:

[SHIFT] [0] [0]	Access to Hex Entry
[M1] [3] [0] [0] [1]	Address Data Latch A4U15

3. Enter the hexadecimal equivalent of the desired Binary number by pressing **[M2]** (hex write command) and then enter a two-digit hexadecimal number through the data entry keyboard. The first number will be output on D4 — D7 lines, the second on D0 — D3. Refer to Table 8-3 for a binary to hexadecimal conversion chart. Use data entry **[.] [-] [GHz/S] [MHz/ms] [dBm/dB]** and **[BK SP]** keys to enter the hexadecimal values A, B, C, D, E, and F respectively (Refer to Figure 8-2, Hex Entry Keys).

4. Press the **[▲]** key. This increments the selected address from 3001 to 3002, thereby addressing A4U17A.

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5. Enter the hexadecimal equivalent of the desired binary number by pressing **[M2]** followed by entering a 0 (A4U17A does not use D4 – D7 lines so the first number entered is a "Don't Care" number) followed by a single hexadecimal digit.

6. The entire command looks like this:

[SHIFT] [0] [0]	Access Hex Entry
[M1] [3] [0] [0] [1]	Address 3001H
[M2] [0] [0]	Write Hex Number
[▲]	Increment address to 3002H.
[M2] [0] [n]	Write Hex number on D0 to D3 line.

7. Adjacent shorts between traces may be found by alternating between **[5] [5]** (0101 0101) and **[.] [.]**, which enters AA (1010 1010).

To enter a new address, press **[M1]** and the new address; or use the **[▲] [▼]** keys to step to the new address.

HEX DATA READ, **[M3]**, allows the operator to continuously read the outputs of an addressed device.

HEX DATA READ EXAMPLE: Refer to the A3 Microprocessor schematic, Figure 8-23, Block B, Interrupt Logic and Status Buffer. This circuit is typical of the kind of circuit used with the hex data read command. U20 with its associated circuitry is a status buffer on the A3 microprocessor board. This buffer monitors requests and conditions throughout the HP 8350B. One of the status inputs is L PST, airflow failure. This data is read during calibration of the airflow circuit. To accomplish this READ proceed as follows:

1. Determine the address of the part which is to be read. Referring to the A3 Microprocessor schematic, Block B, the address is the number adjacent to the enable line. In this case the enable line is L SBE and the address is 1000H. The "H" after the number means it is expressed in hexadecimal.

2. Press **[INSTR PRESET]**.
   Enter the address of U2O by pressing:

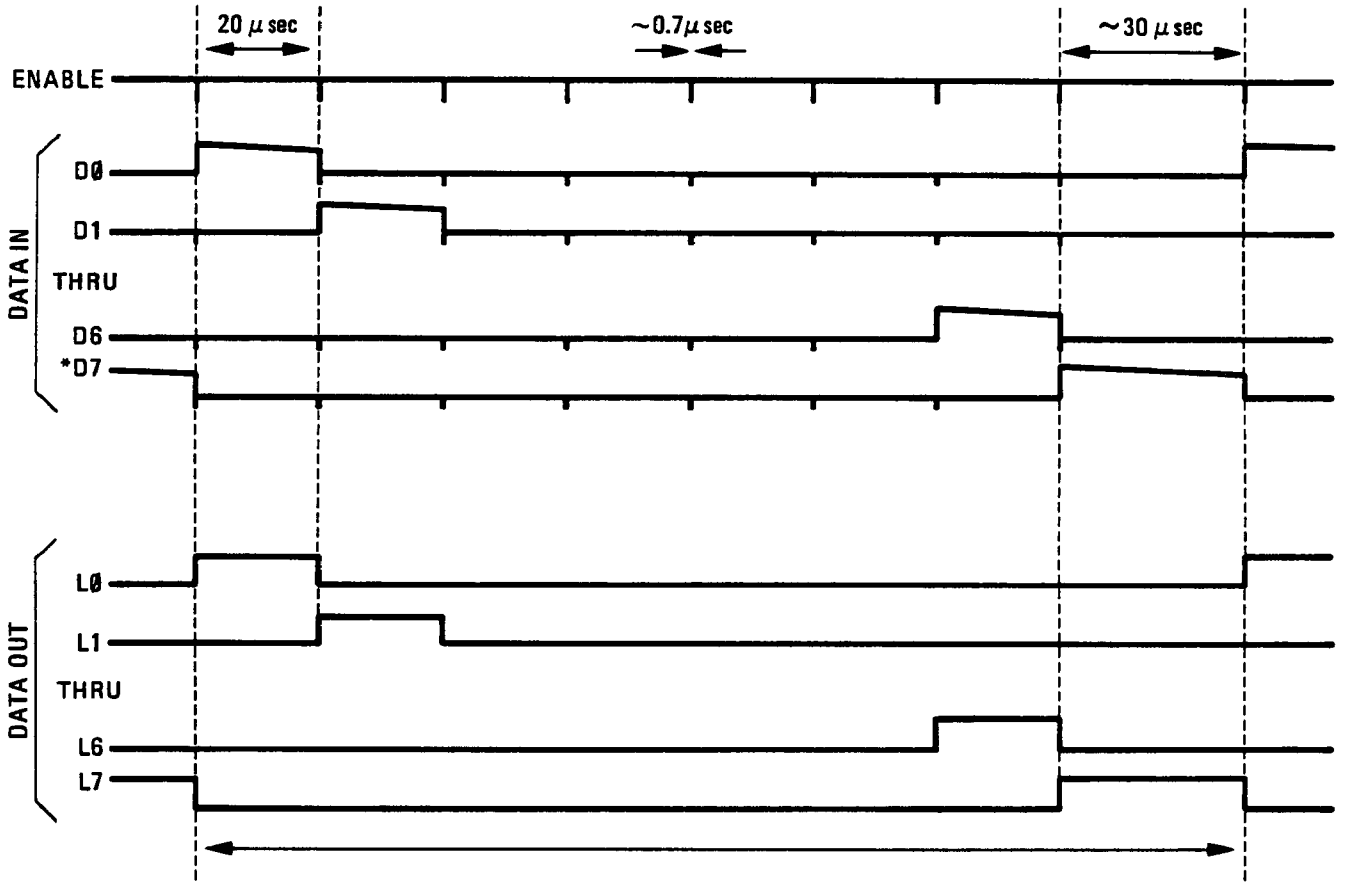
[SHIFT] [0] [0]	Access Hex Entry.
[M1] [1] [0] [0] [0]	Enter Status Buffer address.

3. Command the data to be read and displayed by pressing **[M3]**.

4. The airflow failure (L PST) line is on the D1 line of the status buffer. After an Instrument Preset command all other status buffer lines should be at logic low potential. Therefore a logic high on PST will cause a binary 0000 0010 to be output (this state indicates over temperature). This binary number is converted to a hexadecimal 02 by the microprocessor and is displayed on the FREQUENCY/TIME front panel display. If the L PST line is low the display will read 00, indicating instrument airflow is normal.

HEX DATA ROTATION WRITE, **[M4]**, strobes a 1' (high state) through a column of zeroes (low states) to the addressed device. In effect, hex data rotation write is a rapid WRITE mode, exercising the addressed device in real time. The microprocessor inputs the data continuously, without servicing interrupts from the rest of the instrument. Latch enable lines, inputs, and outputs can be checked in this mode. Figure 8-3 illustrates the appropriate waveforms.

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*DURATION OF LAST BIT PULSE IS APPROXIMATELY 30 μSEC DUE TO DELAY BETWEEN RECYCLE.

Figure 8-3. Hex Data Rotation Write — Bit Pattern

HEX ADDRESSED FAST READ, **[M5]**, provides an operator-initiated check for verification of the data bus, in which the addressed device is clocked in real time. Latch outputs can be traced from the on-board location back through the data bus to the microprocessor. At each buffer, verify TTL level response to the enable pulse. Enable line waveforms are shown in Figure 8-4.

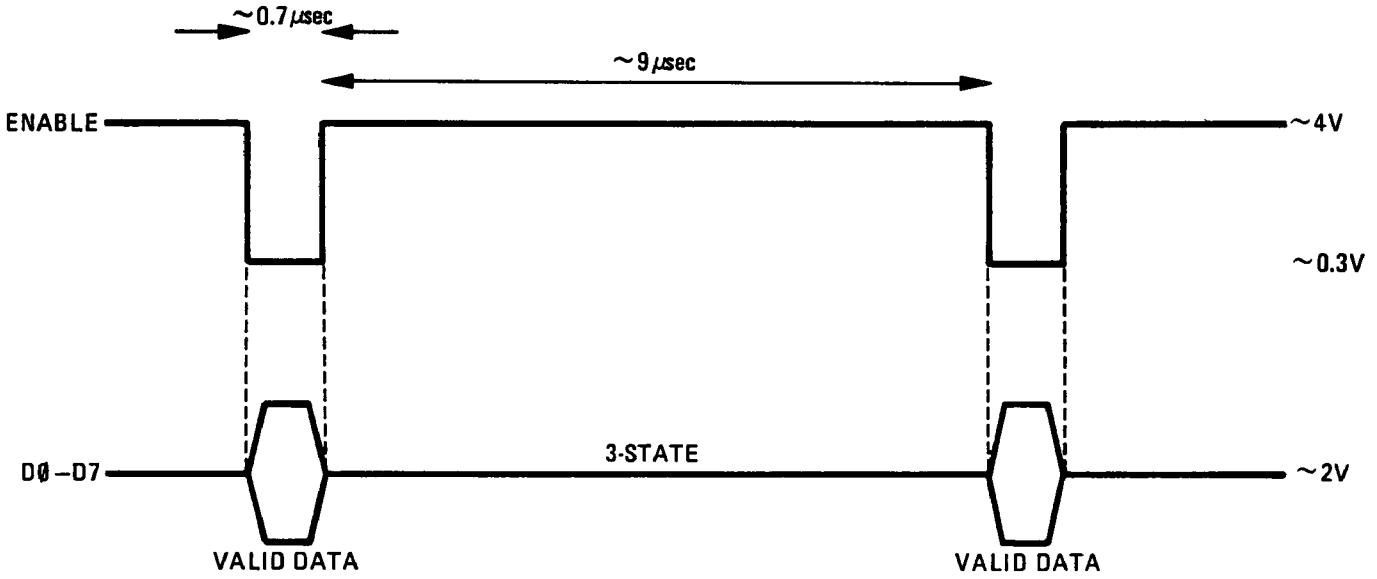


Figure 8-4. Hex Addressed Fast Read — Timing Diagram

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Table 8.4 Error Code to Assembly

Error Code	Function Tested	Operator Initiated Self-Test	Probable Assembly at Fault
E099 to E050	Plug-in	Refer to Plug-in manual	Refer to appropriate Plug-in manual, Section VIII, for troubleshooting information.
E030	None	None	A SAVE command has been attempted when the SAVE-LOCK is engaged.
E016	Airflow	None	E016 will not appear until unit has been on at least 10 minutes. Make sure fan filter is clean and clear of obstructions.
E015[1]	Microprocessor Operation	None (Use Free Run)	Refer to Table 8-5, A6 assembly, or A3 Microprocessor assembly troubleshooting guide. With no Plug-in installed, an E015 could be caused by a W4 short, A2, A3 or A6 assemblies.
E012[1] E011[1] E014[1] E013[1]	RAM Operation RAM Operation RAM Operation RAM Operation	SHIFT 07	Refer to Table 8-5, A3 Microprocessor assembly. Troubleshooting guide. **NOTE:** **The instrument self-tests corresponding to E012[1] and E001 are performed simultaneously. This also applies to E014[1] and E013[1].**
E010[1] E009[1] E008[1] E007[1]	ROM Operation ROM Operation ROM Operation ROM Operation	SHIFT 06	Refer to Table 8-5, A3 Microprocessor assembly. Troubleshooting guide.
E006[1]	Front Panel Bus	SHIFT 08	Trouble may be either the A2 Front Panel Interface or A3 Microprocessor assemblies. Refer to Table 8-5. A2 and A3 Troubleshooting guides.
E005	Instrument Bus	SHIFT 09	Shorted or open Instrument Bus lines. Isolate to assembly by removing RF Plug-in, A4 Scaling and Marker, and A5 Sweep Generator one at a time. After removal of each assembly, turn power on and see if E005 ceases. If it does not disconnect RF Plug-in 64 pin interface cable from the HP 8350B Motherboard. If E005 still occurs, refer to Table 8-5. A3 Microprocessor and A8 HP-IB Interface assembly Troubleshooting guides.
E004	Power Supplies	None	Check power supply LEDs on the A7 Regulator to determine which supply is faulty. Turn HP 8350B power supply off, remove RF Plug-in, and turn power on. Verify RF Plug-in was not causing problem. Check appropriate fuses. Refer to Table 8-5, A7 assembly.
E003	Tuning Voltage vs. Markers	SHIFT10	Trouble is either with the A5 Sweep Generator or the A4 Scaling and Marker assembly. Refer to Table 8-5, A4 assembly for information that may be used to isolate the problem to the proper assembly, circuit, and component.
E002	Sweep vs. Markers	SHIFT 11	Usually caused by the A5 Sweep Generator assembly, but may be caused by the A4 Scaling and Marker assembly. Refer to Table 8-5 A5 and, if necessary, A4 assembly troubleshooting guides.
E001	RF Plug-in Bus	SHIFT 12	E001 is normally displayed when an RF Plug-in is not installed. If the Plug-in is installed E001 indicates an open in the Instrument Bus between the HP 8350B and the RF Plug-in. Make sure the RF Plug-in is making good contact. Ensure that the RF Plug-in interface cables are plugged into the HP 8350B Motherboard properly and are making good contact. Check Motherboard receptacles for bent pins. Refer to RF Plug-in Digital Interface service sheet for further troubleshooting. If HP 11869 Adapter is installed, refer to Adapter A1 Logic service sheet for further troubleshooting.

[1] This Error code cannot be displayed on the Front Panel. The A3 microprocessor assembly Error Code LEDs will display the Error Code as shown in Table 8-3.

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Table 8-5. Assembly to Circuit/Component Troubleshooting Guide (1 of 6)

Assy.	Failure	Probable Cause	Operator Initiated Self-Test	Troubleshooting Hints/Location of Associated Circuits
A1	Singular Key	Open Key	SHIFT 04 Key Code test. Refer to A1/A2 Circuit Description "Keyboard Failure" section for description of test.	Refer to A1 schematic.
	RPG failure: 1. No response. 2. Response in only one direction.	Bad RPG Cable (A1-J1 to A2-J3).	None.	Check +5V and GND to RPG. If these are good, check the two out outputs for variable frequency pulses at the RPG and at the J1 connector. If signals are at both places, suspect the Interface Cable or the A2 assembly.
	3. Response in the wrong direction.	RPG miswired		
	LED failure	Bad LED (or A1-J2 to A2-J4 cable)	Press and hold **[INST PRESET]**. All good LEDs will light.[1]	Refer to A1 schematic and Figure 8-10 to determine location of bad LED.
	Display Failure: 1. Dark segments. 2. Shorted segments.	Bad Display Module or Interface Cable	SHIFT 05 Display Exercise	SHIFT 05 cycles information through displays. Refer to "Digital Display Failure" section of A1/A2 Circuit Description.
A2	Multiple keys failed: 1. 6 keys fail 2. 7 keys fail 3. 8 keys fail	Keyboard Interface circuit or Interface Cable (A1-J2 to A2-J4).	SHIFT 04 Key Code test	Refer to A2 schematic Block H, Keyboard Interface.
	RPG failed 1. No response 2. Displayed response is in wrong direction.	RPG Interface circuit	SHIFT 17 RPG Self Test. Refer to the "Rotary Generator (RPG) Failure" section of the A1/A2 Circuit Description.	Refer to A2 schematic Block G, RPG interface.
	LED failure	Annunciator Interface circuit.	SHIFT 18 Front Panel Lamps test	Refer to A2 schematic Block D, Annunciator Interface. Refer to A1/A2 Circuit Description, "Annunciator Failure".
	Front Panel Bus Error 6	Refer to A1/A2 Preliminary checks, Sec. A, "Front Panel Self-Test Fail".	Self Test engages automatically Refer to Figure 8-12 for waveforms.	Refer to A2 schematic.
	Front Panel Interrupt failed. Error 15 FPIRQ held low. Front Panel Interrupt Control. No Error code. FPIRQ never goes low.	"FP Interrupt Timer (Block C) or "Front Panel and Retrace Interrupt Control" (Block E) circuit failure.	Refer to A1/A2 Circuit Description, Troubleshooting procedure, "Front Panel Interrupt Timer and Interrupt Control" for test information.	Refer to A2 schematic, Blocks C and E. Refer to Figure 8-17.
	Front Panel Bus No Error Code	Refer to A1/A2 Circuit Description, Preliminary Checks Section B, "Front Panel Self-Test Pass".	Refer to A1/A2 Circuit Description, Preliminary Checks. Section B, "Front Panel Test Pass".	Refer to A2 schematic.

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Table 8-5. Assembly to Circuit/Component Troubleshooting Guide (2 of 6)

Assy.	Failure	Probable Cause	Operator Initiated Self-Test	Troubleshooting Hints/Location of Associated Circuits
A3	ROM Failure: Error 7	Faulty Address Decoder (Block E) or A3 U9 is bad.	Free Run. Refer to A3 Circuit Description, Troubleshooting, "Free Run Test."	Always check the Enable and Write lines to each ROM. If these lines are active when measured on the IC pins, replace the ROM.
	Error 8	Faulty Address Decoder or A3 U11 is bad.		
	Error 9	Faulty Address Decoder or A3 U35 is bad.		
	Error 10	Faulty Address Decoder or A3 U10 is bad.		
	RAM Failure: Error 11	Faulty Address Decoder or A3 U7 is bad.	Free Run. Refer to A3 Circuit Description Troubleshooting, "Free Run Test."	RAMs are powered separately by a circuit in Block K, supply filtering. It is this circuit that switches the RAMs over to battery power when the 8350B is turned off. Ensure that +5V supply is present at the RAMs. Check RAM enable and Write lines at the IC pins. If all of the above lines are operating properly, replace the appropriate RAM.
	Error 12	Faulty Address Decoder or A3 U8 is bad.		
	Error 13	Faulty Address Decoder or A3 U14 is bad.		
	Error 14	Faulty Address Decoder or A3 U15 is bad.		
	Error 15 Perform these tests in the order listed.	Clock Generation Circuit Failure.	None.	Refer to A3 schematic, Block A. Verify a 10.7 MHz sine wave of 3.5V P-P at A3TP27. Check A3 U5 microprocessor pins 3 and 37 for phase 1 and phase 2 clocks. Refer to Figure 8-15 for waveforms. Refer to A3 Troubleshooting Description.
		Address Decoder Circuit signal is bad.	Free Run. Refer to A3 Circuit Description, Troubleshooting, "Free Run Test."	Refer to A3 schematic, Block E. Verify L ROM 1,2 against waveform in Figure 8-17. Verify all lines at A3 U9 IC pins.
		Address Lines.	Free Run	Refer to A3 schematic, Block D. Verify divide by two output on all address lines.
		Data Lines	Free Run	Ground A3TP12. Inject signal from A3TP11 onto each data line, check for shorts with scope. Verify all lines at A3 U9 IC pins.

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Table 8-5. Assembly to Circuit/Component Troubleshooting Guide (3 of 6)

Assy.	Failure	Probable Cause	Operator Initiated Self-Test	Troubleshooting Hints/Location of Associated Circuits
A3 (cont'd)	Perform these tests in the order listed.	Interrupt Logic and Status Buffer.	Ground A3TP21. Press **[INSTR PRESET]**. If Error 15 ceases suspect one of the following L PIIRQ (P1-20) held low. L IBIRQ (P1-33) held low. L FPIRQ (P1-1) held low. A3 U20 or U34 bad.	If one of the interrupt lines is being held low refer to the "Motherboard Wiring List" at the end of Section VIII. Determine the assembly that the interrupt comes from and troubleshoot that assembly.
			Remove Ground from A3TP21 and place on A3TP16. Press **[INSTR PRESET]**. If Error 15 ceases suspect the following: L PINMI (P1-40) held low. W4 short, A3 U4 bad.	L PINMI originates at pin 19 of W4 (64 pin Plug-in connector). It is not used but a W4 short may pull it low.
		A3 U9 bad (ROM).	None	This ROM contains the Instrument Self-Test programming. If it is bad, has a bent pin, or is not getting +5V. Error 15 will result. Make sure Enable and Write lines are active.
		Microprocessor Dead (A3 U5)	None	Check for bent pins and VCC. If these are good, replace Microprocessor. This is to be done after all other Error 15 tests have veen completed.
	Front Panel Bus Error 6	Faulty Address Decoder (Block E) or Front Panel Bus circuit (Block J)	Free Run. Refer to A3 Circuit Description Troubleshooting, "Free Run Test."	Refer to A3 Circuit Description Troubleshooting "Error 6 Front Panel Bus" Description and A3 schematic.
	Instrument Bus Error 5	Faulty Address Decoder Circuit (Block E), or Instrument Bus (Block I).	Free Run.	Refer to A3 Circuit Description. Troubleshooting, "Error 5 Instrument Bus" Description. Refer to A3 schematic Block I.
A4	Tuning Voltage vs. Markers Error 3	Refer to A4 Circuit Description. Troubleshooting. "Error Code E003" and check the following DAC circuits accordingly.	All of the Self-Tests below are fully described in the A4 Circuit Description. Troubleshooting "Scaling Failure" section. Read each description before performing tests.	The A4 schematic, Figure 8-28, shows proper waveforms for each Self-Test.
	1. Tuning Voltage failure	DAC Circuit or Summing Amp. listed below.	SHIFT 10 Tuning Voltage vs. Markers. Refer to A4 "Scaling Failure", "Tuning Voltage vs. Marker" Test description.	Refer to A4 schemtic, Figure 8-28 for proper waveform. If waveform is incorrect perform CW, Vernier, and ΔF DAC Tests, if the DAC circuits are good, check the summing Amp. circuit.

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Table 8-5. Assembly to Circuit/Component Troubleshooting Guide (4 of 6)

Assy.	Failure	Probable Cause	Operator Initiated Self-Test	Troubleshooting Hints/Location of Associated Circuits
A4 (cont'd)	1. Tuning Voltage failure	CW DAC, Op-Amp, Data Latch, or related circuitry. Refer to A4 Circuit Description, "CW, CF Generation".	SHIFT 13 CW DAC test Refer to "Scaling Failure", "CW, CF Generation" test description.	If any DAC output is incorrect check that each of its inputs are being sequentially strobed by a logic one. If the DAC is receiving this strobe on all lines check its reference voltage. If both of the above are corrrect, suspect DAC, or in circuits where an Op-Amp follower is present, suspect DAC or Op-Amp.
		ΔF DAC, Op-Amp, Data Latches, or related circuitry. Refer to A4 Circuit Description, "ΔF Generation".	SHIFT 14 Δ DAC test SHIFT 15 Sweep vs. ΔF test. Refer to "Scaling Failure". "ΔF Generation".	
		VERNIER DAC, Data Latch, or related circuity. Refer to A4 Circuit Description, "Vernier".	SHIFT 19 VERNIER DAC test. Refer to "Scaling Failure", "Vernier".	
		Summing Amp or related circuitry. Refer to A4 Circuit Description, "Summing Amplifier."	None Press **[INSTR PRESET]**	Remove RF Plug-in. If the signal at TP11 is incorrect and the above DAC circuits have been checked. Remove cable from J1. Check power supply voltages at U4 pins 4 and 7. Remove VR1, CR1, and C27 one at a time. If the problem persists suspect U4 or self test switch U8.
		Self Test Switch A4U8		
	2. Marker failure	Marker Counter or related circuitry. Refer to A4 Circuit Description, "Marker Pulse Generation".	SHIFT 16 Marker Counter test. Jumper A4TP7 (GND) to A4TP13. For description of SHIFT 16 test, refer to "Scaling Failure", "Marker DAC" test description.	Refer to A4 schematic. Block H. Refer to Figure 8-28 for proper waveform. Ensure that a divide by two pulse pattern is being generated by A4 U21.
		Marker RAMs		Refer to A4 schematic, Block K. Verify a Logic "one" sequentially strobes across all of the Marker RAM outputs.
		Marker DAC, Op-Amp, or related circuitry.		Refer to A4 schematic Block L. If all DAC inputs are receiving a sequentially strobing logic "one" check the DAC output against the waveform shown in Figure 8-28. If the output is not the same, verify +10V reference at pin 15. If these are correct, suspect the DAC or following Op-Amp.
		Comparitor and Marker Pulse Generator circuit.	No shift test. Refer to A4 Circuit Description, Troubleshooting, "Marker Pulse Generator" and "Active Marker" description.	Refer to A4 schematic. Block J. Refer to Figure 8-29 for proper waveforms.

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Table 8-5. Assembly to Circuit/Component Troubleshooting Guide (5 of 6)

Assy.	Failure	Probable Cause	Operator Initiated Self-Test	Troubleshooting Hints/Location of Associated Circuits
A4 (cont'd)	Sweep vs. Marker failure Error 2	Analog Switch A4 U8 (Block I) may be open or have internal current leakage. (Marker circuit verified by E003 test)	SHIFT 11 Sweep vs. Marker test. Refer to A4 Circuit Description, Troubleshooting, "Error Code E002" description for instructions.	Refer to A4 schematic, Figure 8-28. If the waveform is not correct at A4 P1-20, suspect the A5 Sweep Generator assembly. See A5 troubleshooting guide below.
A5	Tuning Voltage vs. Marker Error 3	Sweep DAC (A5 U2), Analog Switches U10, U17, or U9.	SHIFT 11 Sweep vs. Marker test. Refer to A5 Circuit Description, Troubleshooting, "Error Code E003".	Refer to A5 schematic, Figure 8-34 for proper waveforms. If DAC output is wrong make sure that a logic "one" is sequentially strobed across the inputs. If the input lines are good suspect U2 or Op-Amp U3. Internal leakage by U10, U17 or U9 may also cause this error.
	Sweep vs. Marker Error 2		SHIFT 11 Sweep vs. Marker test. Refer to A5 Circuit Description, Troubleshooting, "Error Code E002".	
	No Sweep	Sweep Ramp Generator circuit, (Block D), Sweep Trigger circuit (Block E), or U42 causing bad L SSRQ signal. (Block I on page 2 of schematic)	No shift test. Use start-stop sweep mode. Internal Sweep. Refer to A5 Circuit Description, Troubleshooting section, "No Sweep Ramp." "Sweep Ramp Generator Check" and "Sweep Trigger Check" sections for troubleshooting information.	Refer to A5 schematic.
	Instrument Bus failure. Error 5	Address Decoder circuit (Block A) Data bus buffer (Block B)	SHIFT 09 Instrument Bus Self-Test. Refer to A5 Circuit Description, Troubleshooting, "Error Code 005" for instructions.	Refer to A5 schematic. Blocks A and B. Examine Data lines and Address Decoder lines with scope. Make sure no lines are inactive or shorted.
A6	Pen Lift (PL) failure	Pen Lift circuit	None Refer to A6/A7 Circuit Description on. "Penlift" for information.	Make sure L PL is present at A6 P1-25. If no signal is there suspect the A5 assembly. Refer to A6 schematic Block F. It is normal for pen lift to be disabled during sweep times <1 second.
	Error 15 8350B Front Panel has no display.	Power-on circuit failed.	None Refer to A6/A7 Circuit Description, Troubleshooting, "Error Code 15 A6" for PWON test.	Refer to A6 schematic, Block G.

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Table 8-5. Assembly to Circuit/Component Troubleshooting Guide (6 of 6)

Assy.	Failure	Probable Cause	Operator Initiated Self-Test	Troubleshooting Hints/Location of Associated Circuits
A7	All supplies failed Fan (B1) operates.	A6 assembly not plugged into Mother-board properly.		
	+15V and −15V supplies failed.	+15V and −15V fuses, located on the A6 assembly.) A6F1 and A6F2), blown.		Refer to A6 component layout. Figure 8-42.
	+20V, −40V, +10V, and −10V supplies failed.	+20V power supply failed.	Refer to A6/A7 Circuit Description "+20V Power Supply".	Refer to A7 schematic, Figure 8-45, Block C. Refer to A6/A7 Circuit Description Troubleshooting, "Power Supply Circuits". After repairing any power supply, verify all power suply voltage levels. Refer to Section V "Adjustments" for test and calibration procedures.
	Single Supply failed. Error 4[2]	Troubleshoot appropriate supply.	Refer to A6/A7 Circuit Description under appropriate supply heading.	Refer to A7 schematic. Refer to A6/A7 Circuit Description. Troubleshooting, "Power Supply Circuits". After repairing any power supply, verify all power supply voltage levels. Refer to Section V "Adjustments" for test and calibration procedures.
	Error 4 displayed, all supplies function.	Power Supply Detection Circuit, A7 U17 may be bad.	Refer to A6/A7 Circuit Description "Power Supply Failure Detection".	Refer to A7 schematic, Block A.
	Airflow Detection circuit failed.	A7Q2, A7Q3, A7Q4, or A7U11 failed. Thermal link mechanically broken.	Refer to A6/A7 Circuit Description, "Power Supply Failure Detection" for theory of operation. Refer to Hex Data Read example in the beginning of Section VIII.	Refer to A7 schematic, Block B. This circuit must be re-calibrated after repair. Refer to Section V, "Adjustments" for test and calibration procedures.
A8	Instrument Bus failure. Error 5	Address Decoder, Self-Test circuit, or HP-IB Status Indicator Circuit.	SHIFT 09 Refer to A8 Circuit Description, Troubleshooting, "Instrument Bus Failure".	Refer to A8 schematic.
	HP-IB fails to operate properly. No Error Code	A8-U6, U8, or U13.	Refer to A8 Circuit Description, Troubleshooting "HP-IB Interface Failure".	Refer to A8 schematic.
		HP-IB Cable	Check HP-IB cable at the side for bent pins. Make sure HP-IB interface connector on rear panel is clean.	

1. It is normal for the "SWP" LED to stay off. The "SWP" LED only lights during forward sweeps.
2. When the +5VA power supply is not functional, the front panel LED's and displays will be dead. The A3 microprocessor Error Code LED's will not function.

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HP 8350B SWEEP OSCILLATOR

Overall Block Diagram

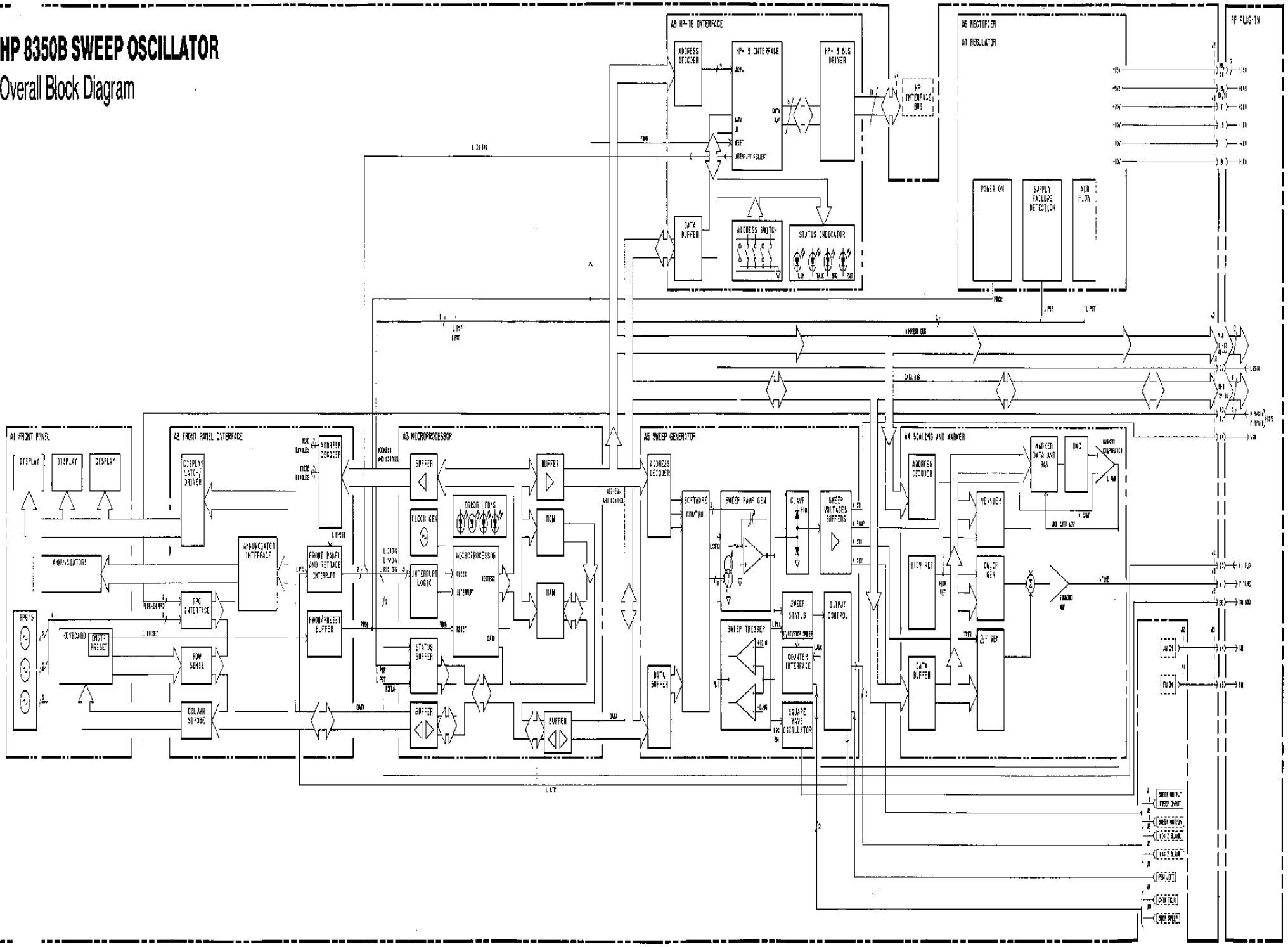


Figure 8-8. 8350B Overall Block Diagram

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Overall Block Diagram, Circuit Description

INTRODUCTION

The HP 8350B is a microprocessor-based sweep oscillator that provides the necessary controls and power supplies for the RF plug-in. The flexibility of a microprocessor-based instrument allows the HP 8350B to learn what plug-in is installed, and adapt its outputs accordingly.

The A1 front panel assembly contains the data and function keys and Rotary Pulse Generators (RPG) for operator control. The A1 assembly also contains the displays and annunciators.

The A2 front panel interface assembly contains all the necessary circuitry to interface the front panel with the microprocessor.

The A3 microprocessor assembly uses two buffered digital busses to control all functions of the HP 8350B. All communication between the microprocessor and the front panel is on the front panel bus. The A3 microprocessor communicates with the rest of the HP 8350B and the RF plug-in via the instrument bus. Each bus contains its buffered address, data, and control lines.

The A5 sweep generator assembly provides a 0 to +10V sweep ramp which is scaled for frequency tuning the RF plug-in by the A4 scaling and marker assembly. The sweep ramp is also used to synchronize sweep related events (i.e. blanking, and markers).

The A6 rectifier and A7 regulator assemblies provide power supplies for both the sweep oscillator and RF plug-in. Due to voltage accuracy requirements for some supplies in the RF plug-in, these supplies are accurately regulated by sensing the voltage level in the RF plug-in.

The A8 HP-IB interface assembly provides the communication interface with an external controller, and provides the capability of externally programming both the HP 8350B and RF plug-in operation.

A1 FRONT PANEL/A2 FRONT PANEL INTERFACE

The A2 front panel interface assembly contains all the latching, decoding, timing, and driver circuitry necessary for interfacing the front panel keyboard, controls, annunciators, and digital displays to the A3 microprocessor assembly. The front panel keyboard is connected in a matrix of rows and columns. The A2 front panel interface strobes the columns and senses each row to determine what key, if any, is closed. The A2 front panel interface then notifies the A3 microprocessor of any keyboard entries. Direction and amount of rotation of the three front panel RPGs (Rotary Pulse Generators) is decoded by the RPG interface circuit on the A2 assembly. This information is also read by the microprocessor, and is used to update the HP 8350B. While the data for the digital displays is latched on the A2 front panel interface, the digital displays must be continuously strobed by the microprocessor to maintain a display. Both the annunciators and digital displays are updated by the microprocessor if the state of the instrument changes. The front panel interrupt circuit requests an interrupt when the front panel needs service or when the A5 sweep generator assembly is doing a sweep retrace (when a complete update of the instrument is initiated).

A3 MICROPROCESSOR

All data processing in the HP 8350B is performed by the A3 microprocessor assembly.This assembly consists of the microprocessor, ROM (Read Only Memory), RAM (Random Access Memory), and the necessary devices for clock generation, address decoding, buffering, and handling of interrupts.

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The microprocessor is controlled by a software program stored in ROM. With this software, the microprocessor is capable of performing data transfers (read or write) and internally processes data it has accessed. All data transfers must go through the microprocessor.

The A3 microprocessor communicates with the rest of the HP 8350B and the RF plug-in through two buffered digital busses (Front Panel and Instrument). Each bus uses a separate block of address space.

The front panel bus provides the interface to the front panel. This bi-directional interface updates the microprocessor whenever any new data is entered from the front panel. All front panel annunciators and displays are updated through the front panel bus. Since all the interface circuits for the front panel are located on A2, the front panel bus only connects between A2 and the A3 microprocessor.

The instrument bus provides the interface between the microprocessor and the rest of the HP 8350B and the RF plug-in. This bus is used for bi-directional data transfers between the microprocessor the Hewlett-Packard Interface Bus (HP-IB) interface or the RF plug-in. This bus structure allows the microprocessor to interface with an external controller over the HP-IB, and both write and read data to/from the RF plug-in. Only the output of data is necessary for the control of the A5 sweep generator and A4 marker and scaling assembly.

At initial power on, or whenever INSTR PRESET is pressed, the microprocessor performs an instrument self-test routine stored in ROM. Refer to the Overall Block Diagram Troubleshooting information for a description of the test. Upon completion of the instrument self-test, the microprocessor goes into an idle loop, and waits for an interrupt request from one of the assemblies or the RF plug-in. The microprocessor then reads the status buffer to determine the reason for the interrupt, and then performs the appropriate service which is stored in ROM. Upon completion of the service routine, the microprocessor again enters an idle loop, and waits for another interrupt.

A5 SWEEP GENERATOR

The A5 sweep generator assembly produces a 0V to +10V sweep voltage that (after scaling) is used for sweeping the RF plug-in frequency. The sweep voltage is also routed to the front and rear panels (sweep out) for driving the X-axis of monitoring instruments. The sweep voltage is generated by supplying a constant, but programmable, current to an integrator. The integrator converts this current to a sweep voltage. The sweep voltage is limited by two comparators in the sweep trigger circuit. The sweep ramp generator produces a ramp that sweeps from −0.95V to +10.8V in amplitude. This voltage is clamped by the clamping circuit at 0V and +10V. The unclamped ramp is buffered and used by the sweep ramp status and sweep trigger circuits. The 0V to +10V clamped ramp is buffered and forms four outputs.

A number of real-time digital lines interface the HP 8350B and the RF plug-in. These lines provide the proper sequencing of events during bandswitch points (i.e. stop sweep, blanking). The output control circuit provides the necessary blanking and penlift pulses. The counter interface circuit provides the necesary timing and sequencing of events for interfacing the HP 8350B with an external counter such as the HP 5343A. This interface allows the counting of the Start, Stop, or Marker frequencies while the HP 8350B is in a swept operation.

A4 SCALING AND MARKER

The A4 scaling and marker assembly provides a scaled tuning voltage to the RF plug-in, and generates marker pulses for the five HP 8350B frequency markers (M1 through M5).

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The VTUNE output is the sum of three scaling DACs. These DACs are programmed by the microprocessor and updated each sweep retrace. The ΔF generation DAC scales the sweep voltage (VSW1) to provide a symmetrical output with a center voltage of 0V, and is proportional to the frequency range swept. This swept output is summed with the CW,CF and vernier DAC outputs, which set the center frequency, to provide a scaled tuning voltage for the RF plug-in installed.

The marker circuits generate markers in respect to the sweep voltage (VRAMP). Marker data is loaded into marker RAM's by the microprocessor during every sweep retrace. This data is used to control the marker DAC. The marker comparator monitors both the marker DAC output and VRAMP. When both inputs are equal, a marker output pulse is generated.

A6 RECTIFIER AND A7 REGULATOR

The A6 rectifier and A7 regulator assemblies not only supply power for the HP 8350B, but also provide power for the RF plug-in. All supplies are overvoltage protected and current limited.

The +20V, −10V, and −40V supplies are used only in the RF plug-in. They provide power for the RF microcircuits, and are also used for reference voltages to control frequency and power. Therefore, these supplies must be well regulated (independent of voltage drops through connectors and traces). For these supplies, their respective voltages are sensed in the RF plug-in, and regulated at that point. The remainder of the supplies are regulated by conventional three-terminal regulators.

The power on circuit resets the microprocessor at initial power on. The supply failure circuit flags the microprocessor if a power supply output goes low, and the microprocessor responds by displaying error code E004. The air flow circuit detects if the air flow from the fan is too low and flags the microprocessor to display error code E016.

A8 HP-IB INTERFACE

The A8 HP-IB interface assembly provides the interface between the external HP-IB bus and the internal instrument bus. The interface consists mainly of a Large Scale Intergrated (LSI) circuit and associated buffers. The LSI circuit handles the specified handshake with the HP-IB controller and stores information in internal registers until it is processed by either the HP 8350B microprocessor or the external HP-IB controller. Status indicators are provided to indicate the present status of an HP-IB operation (Listen, Talk, Service Request, or Remote). An address switch is provided to select the HP-IB address of the HP 8350B.

Self test circuitry is also on the A8 assembly, and is used to verify operation of the instrument bus during the instrument bus self test. This test is performed during the instrument self-test.

RECOMMENDED TEST EQUIPMENT

Test equipment required to maintain the HP 8350B is listed in Section I. If the equipment listed is not available, equipment that meets the minimum specifications shown may be substituted.

WARNING

The special service board, when connected to the HP 8350B mainframe, has *voltages* exposed that are capable of causing death. The special service board should only be used by a skilled person who is aware of the hazard involved.

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HP 8350B MAINFRAME CALIBRATION TESTS

The majority of the HP 8350B digital circuitry and a portion of the analog devices are verified by the instrument self-test. However, analog circuit accuracy is not checked by instrument self-test and must be verified with the performance tests given in Section IV of this manual. If the results of the performance tests do not meet the instrument specifications, refer to Section V, Adjustments.

AFTER-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 cord plug. The reading must be less than one ohm. Flex the power cord while making this measurement to determine whether intermittent discontinuities exist.

Check resistance from instrument enclosure to line and neutral (tied together) with the line switch ON and the power source disconnected. The minimum acceptable resistance is 2 megohms. Replace any component which results in failure to meet this minimum.

Check line fuse to verify that a correctly rated fuse is installed.

PREVENTATIVE MAINTENENCE AND DISSASSEMBLY PROCEDURES

The following paragraphs and figures provide written instructions and/or illustrations to aid in servicing the instrument.

Air Filter Cleaning

WARNING

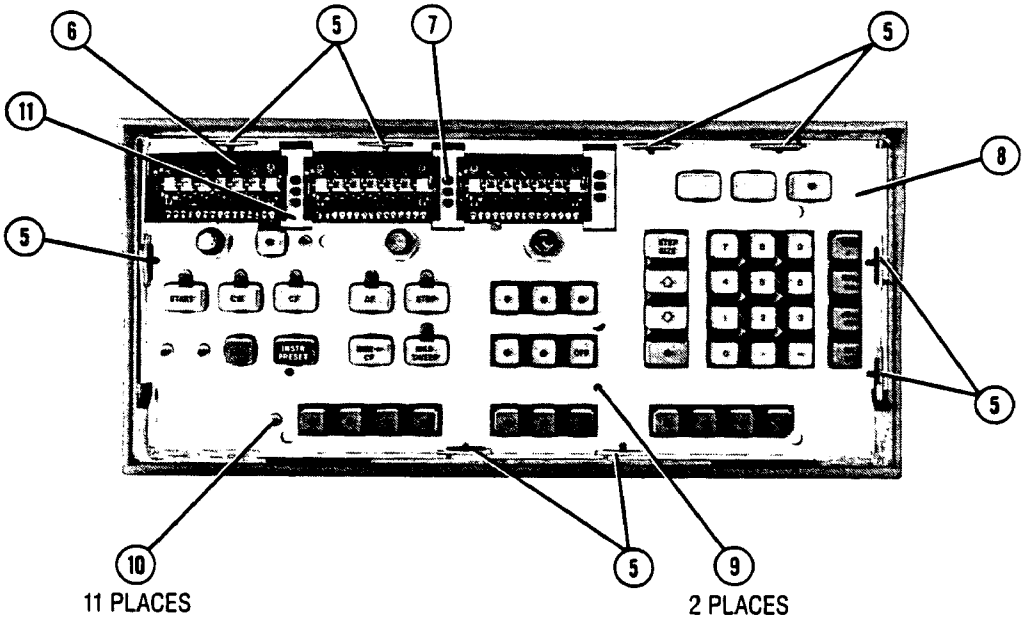
The following procedure must be performed periodically to retain the safety features which have been designed into the instrument.

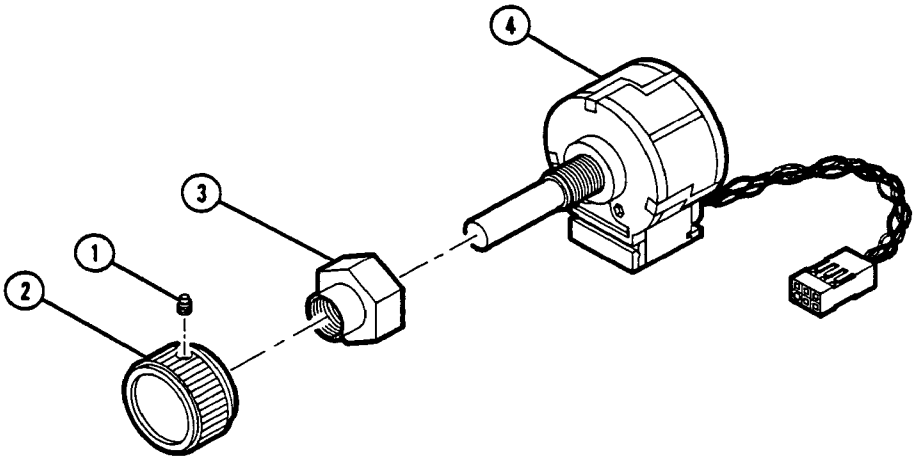
The metal filter, attached to the cooling fan (rear panel), will require periodic cleaning. Due to the variety of environmental conditions, the interval between cleanings cannot be estimated. Error signal E016 indicates increased temperatures in the cooling system caused by reduced air flow. When this error is displayed, a clogged filter may be the reason. Clean as follows:

1. Disconnect line power cord.
2. Remove four screws holding air filter to rear panel.
3. Brush dust off screen. Blow compressed air in the opposite direction of normal air flow; or wash with mild soap and water, then dry.

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Front Panel Disassembly





1. Turn LINE switch to OFF and remove AC power cord from rear panel.
2. Remove top and bottom covers, trim strip, and RF plug-in.
3. Remove seven flat-head screws from front frame: three under top trim; two from bottom of frame (note arrows on bracket); and two from left support, inside plug-in opening.
4. Remove A2 assembly and disconnect ribbon cables.
5. Remove push-on plug (located next to A2) connecting front panel +5V (red) and ground (black) wires to the mother board.
6. The front panel assembly is now free from the cabinet. From inside the box, gently push the front panel assembly through the frame.

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7. Remove retaining clips from the five dress panel studs (backside of A1 assembly).

8. Loosen two set screws **1** to remove each of the round front panel knobs **2.** Remove the exposed hex nuts **3** with a 7/16'' socket. Also remove the lock washers.

9. Ease dress panel from assembly by pushing gently on the dress panel studs protruding from A1.

NOTE: In the following step, removal of hex screws is facilitated by using a hex balldriver, HP Part Number 8710-0523, CD7.

10. Remove nine screws **7** from hold down plate **10.** Remove two screws from back of A1 assembly. Remove hold-down plate **10** and A1 assembly from frame.

RPG Replacement

11. Disconnect push-on plug from the back of A1, corresponding to the defective RPG.

12. Remove RPG **6.**

13. To install new RPG, reverse the procedure.

14. To reassemble front panel, reverse steps 1 through 10. When replacing the hold-down plate and dress panel, carefully position the yellow LEDs **12** before applying pressure to the plates.

Numeric Display Replacement

The numeric display consists of three interlocking chips. To replace the center chip one of the outer chips must first be removed.

15. Gently lift up and out on the outermost display chip **8.** To free the chip, lift up slightly on the white plastic light housing **13.**

16. To install new display chips, reverse the procedure. Take care when replacing light housings to avoid bending fragile LED leads **12.** Be careful not to place white plastic light housings back in upside down or the LEDs will not be properly aligned.

NOTE: Display assemblies may crack if flexed. Do not bend. Also, to prevent display assembly from pivoting, always apply pressure across two points.

17. Apply pressure on the chip until it is firmly seated in the socket.

18. Replace hold-down plate and dress panel. Carefully align yellow LEDs **12** before seating either plate.

    The following procedure checks display continuity before reassembling front panel.

    a. Connect +5V (red) and ground (black) plug to motherboard.

    b. Replace A2 and reconnect ribbon cables.

    c. Apply AC line power to HP 8350B.

    d. Press **[SHIFT] [0][5]** to initiate display exercise routine (see A1/A2 service paragraph). This routine should reveal any connection problems.

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20. Remove AC power cord. Reverse steps 1 through 8 to reassemble front panel.

Keyboard Switch Replacement

21. Remove button from defective switch.
22. Cut off plastic feedthrough nubs" from backside of A1 assembly. Remove switch.
23. Replace new switch. Melt plastic pins with soldering iron to hold switch to pc board. Replace key.
24. To reassemble front panel reverse steps **1** through **10**. Carefully align dress panel and hold down plate **10** before applying pressure to avoid bending the yellow LEDs **12**.
25. Verify proper functioning of new switch by performing the key code test. Press **[SHIFT] [0] [4]**. Then press the key corresponding to the new switch. The proper key code, listed in Table 8-8 of the A1/A2 service paragraphs, should appear in the front panel FREQUENCY/TIME display window.

Regulator/Heat Sink Replacement

1. Remove AC power cord.
2. Set instrument on its top side. Remove HP 8350B bottom cover.
3. Remove three aligned screws: one connecting thermal switch bracket to heat sink **2**; two connecting heat sink to motherboard **1**.
4. Remove top cover. Remove screw from top of heatsink.
5. Lift heat sink and A7 assembly from mainframe box.
6. To replace regulator heatsink, reverse above procedure.

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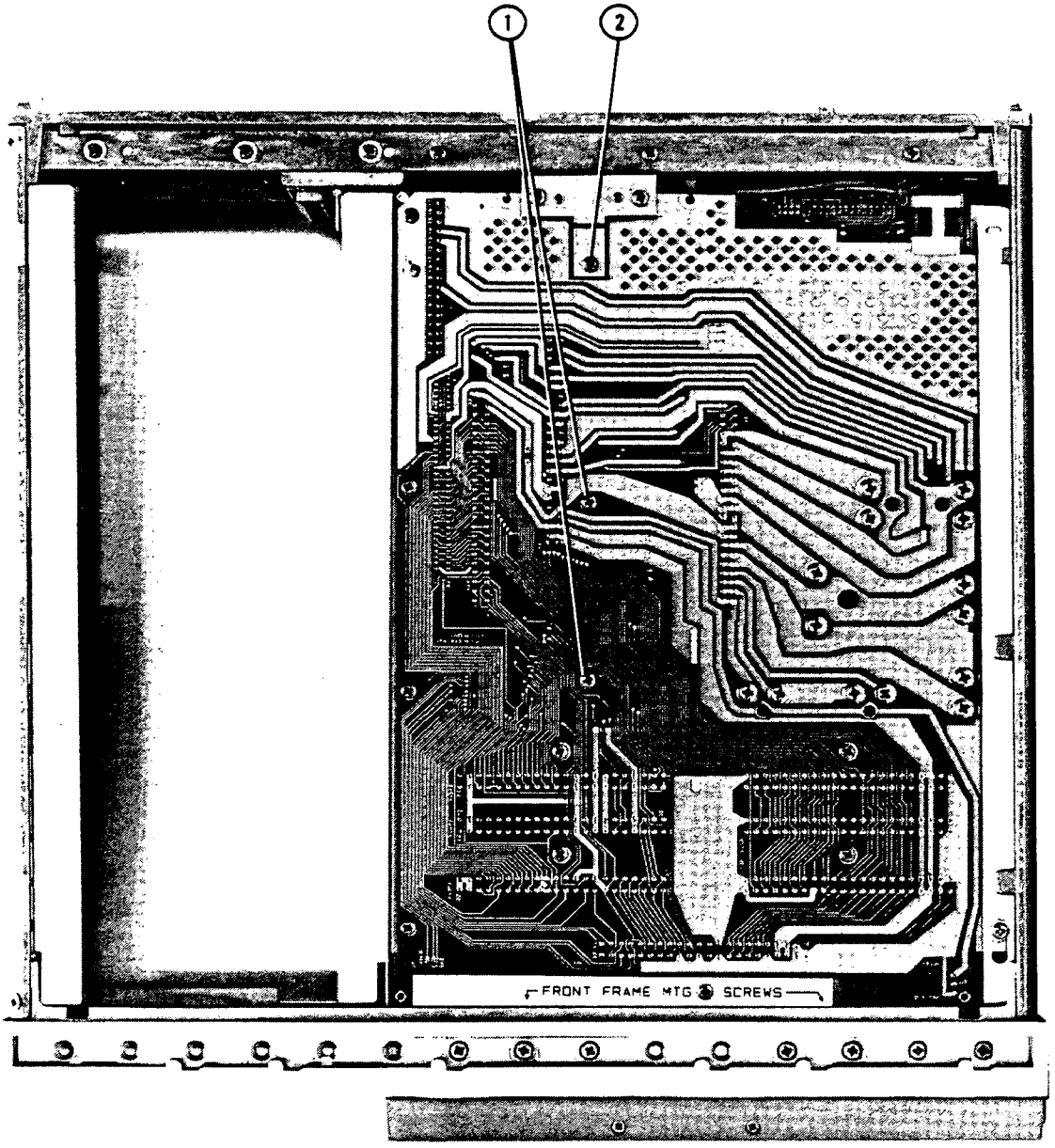


Figure 8-6. Regulator/Heat Sink Replacement

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A1 Front Panel
A2 Front Panel Interface

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A1 Front Panel and A2 Front Panel Interface Circuit Description

NOTE: Because of the electrical and physical structure of the A1/A2 interface, the two boards are discussed simultaneously. Therefore, block diagram, circuit descriptions, and troubleshooting procedures have been combined and appear in only one place in this section of the manual.

The A2 front panel interface assembly contains all the necessary circuitry to allow bidirectional communication between the A3 microprocessor assembly and the A1 front panel functions. Table 8-6 indexes the rate of data transfer between the microprocessor and the various front panel registers. The A1/A2 block diagram is shown in Figure 8-9. The following circuit description is broken down by front panel function: address decoder, keyboard, RPGs, interrupt circuitry, digital display, and annunciators.

Table 8-6. A2 Activity Rate

ACTIVITY	RATE (approximate)
Refresh Display	1.8 kHz
[Each display has an individual refresh rate of 110 Hz. (1.8 kHz-16 digits)]	
Detect key closures	30 Hz
Read RPGs	110 Hz
Update Annunciators:	55 Hz, GHz, MHz

NOTE: All reference designations refer to A2 components unless otherwise noted.

ADDRESS DECODER A2: B

Three-to-eight decoders, U23 and U31 interpret the front panel bus address lines, LFPA0 through LFPA2. Decoder outputs enable the particular devices to be addressed by the microprocessor during data transfer. Decoding activity is determined by three enable lines: FPE (Front Panel Enable) and LFPSTB (Low=Front Panel Strobe) allow access to the front panel; LFPRD (Low=Front Panel Read) determines the direction of data flow (read or write) at the addressed device. Note that all A2 latches are unidirectional. U23 decodes all READ enables while U31 decodes all WRITE enables, allowing the overlap of 1800 series addresses. Only fourteen of the sixteen possible enable lines from U23 and U31 are used: LRE1-4, LRE6-8,LWE1-6, and LWE8. Table 8-7 provides decoding information.

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Table 8-7. Address Decoding

Mnemonic	Address	Location	Read/Write	Test Point	Description
LRE1	1800H	U15	Read	23	Read Keybord Row Sense
LRE2	1801H	U10	Read	9	Read RPG Sign/Digit and Digital Counter
LRE3	1802H	U11	Read	11	Read RPG1/RPG2 Counts
LRE4	1803H	U12	Read	16	Read RPG3/PIRPG Counts
LRE5					Not Used
LRE6	1805H	U8B	Read	4	Clear Retrace Interrupt
LRE7	1806H	U5A/B U6A/B	Read	8	Reset RPG Counters
LRE8	1807H	U7	Read	26	Read Column Data (Self-Test)
LWE1	1800H	U16	Write	25	Latch Keyboard Column Data
LWE2	1801H	U13	Write	22	Latch Annunciator Data
LWE3	1802H	U25	Write	21	Latch Annunciator Data
LWE4	1803H	U27	Write	17	Latch Annunciator Data
LWE5	1804H	U26	Write	20	Latch Annunciator Data
LWE6	1805H	U24	Write	18	Latch Annunciator Data
LWE7					Not Used
LWE8	1807H	U8A	Write	10	Enables Display/Clears Front Panel Interrupt

KEYBOARD A1: F A2: A H

The microprocessor periodically uses the keyboard interface circuits for scanning the keyboard state. Coded data is loaded into the column strobing latch U16 by the microprocessor. The resulting row data from the keyboard matrix F is read back when U15 is enabled. The microprocessor scans the keyboard interface at a rate of 30 Hz to determine whether a keyboard pushbutton has been pressed.

Two additional signals are scanned through the keyboard interface:

LPRESET. When the line power is cycled or **[INSTR PRESET]** is pressed, the microprocessor resets and initiates self-test. In either case PWON is driven low to reset latches and flip-flops. However, the microprocessor must determine which action caused the reset in order to execute the appropriate RAM initialization routine. If **[INSTR PRESET]** has been pressed, LPRESET signal will be detected at U15, bit 7. This will cause the microprocessor to preset all sweep oscillator and RF plug-in band, sweep operations. If the instrument ON/OFF switch is toggled, the microprocessor restores all previous instrument conditions. SAVE/RECALL registers are not cleared by either operation.

LSTPADV. Low Step Up Advance increments the step up function for the active mode (i.e., SAVE/RECALL registers).

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RPG (ROTARY PULSE GENERATION) A2: G

RPG interface circuitry senses the direction of rotation and counts the pulsed output of four RPGs: three on the 8350B front panel and one on the 83500 series RF plug-in. There are two pulse train outputs from each RPG. The lead/lag phase relationship of the pulse train pair is sensed by a flip-flop (U3A/B, U4A/B) which translates the RPG direction (+,-) of rotation. See Figure 8-13. The microprocessor reads the flip-flop outputs and increments or decrements the numeric display accordingly.

One pulse train output from each RPG clocks a four-bit counter (U5A/B, U6A/B). When LRE4 goes low, the counter outputs are latched into the data bus and read by the microprocessor. Data is then written to the display control latch (U22) and eventually used to update the display segments. RE7 resets the counters after each READ enable.

FRONT PANEL INTERRUPT ROUTINE A2: C E

The following signals used to interrupt the microprocessor are discussed below:

LDE: Low=Display Enable, TP6.
LRTS: Low=Retrace Strobe.
LRE6: Low=Read Enable 6, TP4.
LWE8: Low=Write Enable 8, TP10.
LFPIRQ: Low=Front Panel Interrupt Request.
DSPCLK: Display Clock, TP3.
LDCINCR: Low=Digit Counter Increment, TP7.
LRTCIRQ: Low=Retrace Interrupt Request, TP5.

A series of three digital counters (U20A, U20B, and U19A) perform divide-by-two functions. LFPSTB is being used as an 973 kHz time base, tracking the microprocessor I/O strobe data transfer timing signal. Therefore, LFPSTB clocks the counters during each machine cycle of the microprocessor.

DSPCLK pulses at approximately 1.8 kHz (973 kHz / 512). Each rising pulse resets LDCINCR low, to increment the digit counter F, and sets the interrupt request (LFPIRQ) to the microprocessor. At this time LDE is high to disable the displays while the microprocessor services the interrupt. High LDE also resets and holds the FP interrupt timer. LWE8 sets LDE low to enable the displays, and simultaneously latches the new data into U22 F. LWE8 also resets LFPIRQ to clear the interrupt request.

LRTS, from the A5 sweep generator assembly, occurs coincident with the sweep retrace and sets LFPIRQ and LRTCIRQ low. The microprocessor senses that the interrupt is a function of the retrace (LRTCIRQ) and initiates a complete update of the instrument. LRE6 clears the retrace interrupt request.

DIGITAL DISPLAY CONTROL A1: A A2: F

Each time LFPIRQ is set low, LDCINCR increments digit counter U19B and the microprocessor executes the front panel interrupt service routine. During the routine, the microprocessor refreshes one display digit. Digit drivers, A1U1 and A1U2 decode the outputs of digit counter UI9B to determine which digit will be updated. The refresh rate per digit is approximately 110 Hz, fast enough to maintain a flicker-free display.

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With each low-to-high transition of LWE8, U22 latches data which determines the segment states for the active digit. Resistor and diode networks, U30, U29, and U21, bias segment drivers A1Q1 through A1Q8. A low data bit to U22 activates the corresponding segment driver, producing a 30 mA current source. A high data bit input (greater than or equal to 2V) turns off the segment driver. Figure 8-7 shows the simplified schematic.

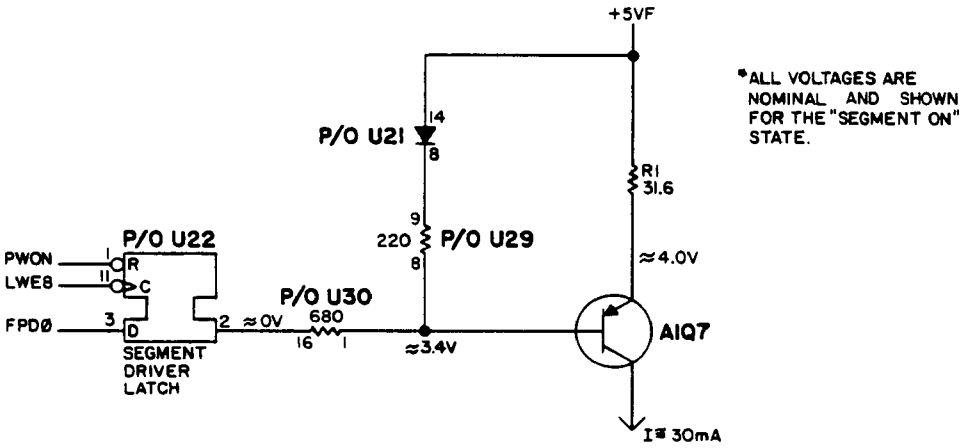


Figure 8-7. Typical Segment Driver Schematic

ANNUNCIATORS A1: E A2: D

Five latches (U13, U24-U27) with current limiting resistors, latch and buffer data to control the front panel annunciators (with the exception of SWP). Q1 through Q6 provide three constant current sources to ensure uniform intensity in the unit annunciators (i.e., GHz, MHz, sec). LPRESETE signal is stored in the annunciator function block.

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TROUBLESHOOTING

NOTE: Because of the electrical and physical structure of the A1/A2 interface, the two assemblies are discussed simultaneously. Therefore, the block diagram, circuit descriptions, and troubleshooting procedures have been combined and appear only in one place in this section of the manual.

Since the 8350B instrument self-test, does not detect all possible front panel failures, A1/A2 troubleshooting information is divided into two major sections. Front Panel Self-Test Fail; Front Panel Self-Test Pass. Each section outlines suspect areas and component level troubleshooting.

PRELIMINARY CHECKS

Perform a brief visual inspection of the A2 assembly for physical or heat damage. Check the following: +5V supply at TP 15; that LPRESET (TP 1) and PWON (TP 2) are both high during normal instrument operation; that all S1 switches are closed and all S2 switches open for NORMAL operation; that A1/A2 ribbon cable connections are firmly seated over the correct pins.

NOTE: All reference designations refer to A2 components unless otherwise noted.

NOTE: Timing diagrams referenced for A1/A2 troubleshooting are located next to the A2 component location diagram.

FRONT PANEL SELF-TEST FAIL

The A2 front panel interface assembly is exercised and checked as part of the self-test routine performed at each "turn-on" or Instrument Preset.

If the microprocessor detects a front panel failure, the instrument self-test sequence will be aborted and the front panel self-test will be cycled continuously. In this mode, all front panel annunciators will be lit, and a single numeral 8' with its decimal point will flicker sequentially from right to left across the digit display. The error code E006 will not appear in the front panel digital display, however, the error code LEDs on the A3 microprocessor board and the sweep trigger annunciators will display the code in its binary form: 0110 (OFF ON ON OFF).

The front panel error code indicates a possible failure in the address decoder, data bus, column latch, or the self-test buffer. To troubleshoot these areas place A2 on extender boards. Push **[INSTR PRESET]** to allow the failure to begin the repetitive test. Troubleshoot as described below.

Address Decoder

During the front panel self-test, each of the read enables (U23) is addressed to enable in sequence, followed by each write enable (U31). The write enable sequence starts with LWE2 enabled first and LWE1 enabled last. (Note: additional pulses appear on the LWE1, LWE2, LWE5, and LWE8 lines slightly later and throughout the cycle).

Set the oscilloscope at a sweep speed of 50 microseconds/division and externally trigger from LRE1 (TP23). Verify proper pulse location and duration of each address decoder line. Refer to Figure 8-12. If any lines cannot be verified, check the LFPRD, LFPSTB, FPE, and address lines for activity. If any of these signals are missing, trace the lines back to the A3 microprocessor assembly and the front panel buffers, A3U22 and A3U32. If the microprocessor busses and control lines appear dead, perform the free run test described in the A3 Troubleshooting paragraphs.

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Data Bus, Column Latch, and Self-Test Buffer

To verify proper functioning of keyboard column latch U16, a binary I' is stepped through each column (C0-C7) while a 0' is written to the other seven. After a delay, LRE8 is pulsed low. The latched data is read back to the microprocessor through the self-test buffer (U7) and verified. The next LWE1 pulse clears the bit and shifts the 1' to the next column. This exercise thoroughly checks the data bus and partially verifies the address bus, address decoder block, and FPE and LFPRD lines.

Check the inputs and outputs of U7 against Figure 8-12. This exercise thoroughly checks the data bus and partially verifies the address bus, address decoder block, and FPE and LFPRD lines.

FRONT PANEL SELF-TEST PASS

If an error code E005 or lower, or no error code, occurs during power-up or INSTR PRESET, the front panel self-test routine has been successfully performed. This verifies that the front panel's data bus, address bus, keyboard column buffer, self test buffer, and part of the address decoder block are functioning correctly.

If symptoms apparent at the front panel indicate a failure in the keyboard, RPGs, annunciators, or digital display, refer to the appropriate section below for further troubleshooting. If the entire front panel does not respond, but the A3 microprocessor assembly has been verified, refer to the interrupt control section below and address decoder troubleshooting outlined earlier.

The following troubleshooting procedures utilize the repetitive mode of the front panel self-test. The routine can be initiated as follows:

1. If the 8350B responds to front panel commands, enter **[SHIFT] [0] [8]**. Refer to the waveforms located next to the A2 schematic diagram fold out, Figure 8-12.
2. If the 8350B does not respond to front panel commands, connect a jumper between LTEST (A3 U20,pin 11) and GND (A3TP14). Press **[INSTR PRESET]** or cycle the line power.

Keyboard Failure

Since the instrument passed the front panel self-test, the keyboard column latches and data bus are functioning properly. If the keyboard is not working, suspect the LRE1 line, the keyboard row sense driver (U15), or the keyboard matrix.

1. Initiate the front panel self-test and check the LRE1 line against Figure 8-12. If it is faulty, go back and troubleshoot the address decoder block.
2. Initiate the front panel self-test. While pressing a key, check that the appropriate row line (input to U15) follows the corresponding column line. See Figure 8-12. If these are normal, suspect U15. If this test fails, the problem lies in the keyboard matrix or interconnecting lines. initiate the key code test. (If the instrument fails to execute the key code test, troubleshoot the keyboard matrix).
3. Enter **[SHIFT] [0] [4]** to initiate key code test. Press any key and the appropriate code, indexed in Table 8-8, should appear in the digital display. If a depressed key is not being detected, the code will not light up. If two keys are shorted together, both will produce the same code. The key code test should detect most keyboard failures. Further matrix troubleshooting should be performed with a continuity checker.

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Table 8-8. Key Codes

Pushbutton	Keycode	Column (U16)	Row (U15)
START	20	7	0
CW	24	4	2
CF	22	2	2
Delta F	23	1	2
STOP	21	0	2
VERNIER/OFFSET	25	3	2
LCL	1b	7	2
INSTR PRESET	*		
MKR→CF	26	6	2
MKR SWEEP	27	5	2
M1	10	2	5
M2	11	0	5
M3	12	1	5
M4	13	2	4
M5	14	0	4
OFF	15	1	4
SAVEn	18	0	6
RECALLn	19	1	6
ALTn	1A	2	6
STEP SIZE	1C	3	6
Up Arrow	1d	3	5
Down Arrow	1E	3	4
0	0	4	3
1	1	4	4
2	2	5	4
3	3	6	4
4	4	4	5
5	5	5	5
6	6	6	5
7	7	4	6
8	8	5	6
9	9	6	6
.	A	5	3
-	b	6	3
GHz/s	C	7	6
MHz/ms	d	7	5
dB/dBm	E	7	4
BKSP	F	7	3
SHIFT	1F	3	3
INT (Sweep Trig)	28	3	1
LINE (Sweep Trig)	29	2	1
EXT (Sweep Trig)	2A	1	1
SINGLE (Sweep Trig)	2b	0	1
EXT (Sweep)	2C	2	3
MAN (Sweep)	2d	0	3
TIME (Sweep)	2E	1	3
AMPL MKR	30	4	1
DSPL BLANK	31	5	1
RF BLANK	32	6	1
⊔⊓ MOD	33	7	1

* Note: INSTR PRESET is not scanned through the Keyboard Matrix. It is enabled through Addr 1805, Data Bit 7 (Low to Enable). INSTR PRESET will abort the Key Code Test.

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Rotary Pulse Generator (RPG) Failure

If an RPG effects no front panel changes, check its +5VR supply and inspect wires for damage. Place A2 on extender boards. The RPG outputs are accessible at the inputs of U9. Carefully probe the two pin connections corresponding to the suspected RPG. Slowly rotate the RPG in each direction while observing the waveforms on a scope, and compare them to those in Figure 8-13. If no activity is seen, check continuity of RPG leads and A1/A2 interconnect ribbons. Before replacing the RPG, perform the RPG self-test described below.

During the RPG self-test the actual RPG outputs are switched out of the circuit (S1 open). Data written to the keyboard column Latch (U16) by the microprocessor is switched in (S2 closed) to pulse the RPG sign latches (U3/4) and counters (U5/6) repetitively.

CAUTION

The following steps must be performed in the order given or the instrument will lock up.

The RPG self-test is initiated by performing the following steps:

1. Turn off the line power.
2. Place A2 on an extender board.
3. Open all S1 switches.
4. Turn the line power on.
5. Enter **[SHIFT] [1] [7]** (The digit display will go blank).
6. Close all S2 switches to place the front panel interface in the TEST mode.

To examine the waveforms in the RPG interface, externally trigger the oscilloscope from the Q output of the RPG sign latch (U4, pin 5). Set the oscilloscope at a sweep speed of 100 to 200 microseconds/division. TP11 or TP8 will sometimes provide adequate triggering.

CAUTION

Use IC TEST CLIP, HP Part Number 1400-0734 when probing IC pins.

Read/Write Enables. The four read enable lines associated with the RPG circuitry (LRE2, LRE3, LRE4, and LRE7) are each pulsed low. Since the keyboard column latches are used to pulse the RPG circuitry, the LWE1 line is pulsed rapidly, and should be checked for activity. See Figure 8-15 for typical waveforms. If the enable lines cannot be verified, troubleshoot the address decoder block as described earlier.

RPG Counters. In the TEST mode, U5 and U6 count the number of pulses produced by keyboard column latch U16. Each 4-bit binary counter begins at 0 (Binary: 0000). They are clocked sixteen times, counting to 15 (Binary: 1111) and then overflow back to 0. Waveforms for each of the four counters are identical. See Figure 8-15. If the enable lines have been verified but the counters fail, replace the defective counter.

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Table 8-9. RPG Counter Test Points

Function	Frequency Left RPG	Frequency Right RPG	Frequency/ TIME RPG	Plug-in RPG
Clock	U5,pin 1	U5,pin 13	U6,pin 1	U6,pin 13
Counter (1) (LSB)	U5,pin 3	U5,pin 11	U6,pin 3	U6,pin 11
Counter (2)	U5,pin 4	U5,pin 10	U6,pin 4	U6,pin 10
Counter (4)	U5,pin 5	U5,pin 9	U6,pin 5	U6,pin 9
Counter (8) (MSB)	U5,pin 6	U5,pin 8	U6,pin 6	U6,pin 8

RPG Sign Latches. U3 and U4 are D flip-flops whose outputs depend on whether the RPG is being rotated clockwise or counter-clockwise. Refer to Figure 8-13. During the RPG exercise, data is written to the Keyboard Column latches to test both states of the latches. First, a low is written to all four latches, and the counters run through their range. A high is then written to the latches, the counters run their range again, and the cycle repeats. Verify the waveforms in Figure 8-15. The four RPG sign latches all have identical waveforms. If the enable lines have been verified but the latches fail, replace the defective latch.

Table 8-10. RPG Sign Latch Test Points

Function	Frequency Left RPG	Frequency Right RPG	Frequency/ TIME RPG	Plug-in RPG
Clock	U4,pin 11	U4,pin 3	U3,pin 11	U3,pin 3
D Input	U4,pin 12	U4,pin 2	U3,pin 12	U3,pin 2
Sign Output	U4,pin 9	U4,pin 5	U3,pin 9	U3,pin 5

Exit the RPG self-test as follows:

1. Turn off the line power.
2. Close all S1 switches and open all S2 switches to return the front panel to NORMAL operation.
3. Turn line power on. Press **[INSTR PRESET]**.

Annunciator Failure

Several self-tests are available to test the annunciators:

1. Press **[INSTR PRESET]** and hold. All LEDs should turn on. This is the easiest way to test for burned out LEDs.

2. Annunciator self-test is initiated by entering **[SHIFT] [1] [8]**. During this test, all front panel annunciators (except SWP) are turned on and off together at a 1 Hz rate. LEDs which are locked on or off, or groups of annunciators addressed by a faulty enable line are easily identified. Table 8-11, annunciator address decoding, cross references annunciators with the appropriate address.

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3. Hex Address Write/Read: By entering the address of a group of annunciators, data can be written to light any combination of LEDs. To initiate the test enter **[SHIFT] [0] [0]**. Then enter an address between 1801 and 1805. Refer to Table 8-11. Press **[M2]**, and enter the two hex digits of data to be written to that address:

   - Enter **[0] [0]** (0000 0000) to light all LEDs in the addressed group.
   - Press **[BK SP] [BK SP]**, which enters FF, (1111 1111) and turns off all LEDs in the addressed group.
   - By alternating between **[5] [5]** (0101 0101) and **[.] [.]**, which enters AA, (1010 1010), adjacent shorts can be found.

To enter a new address, press **[M1]** and the new address; or use the **[▲] [▼]** keys to step to the new address.

Table 8-11. Annunciator Address Decoding

Mnemonic	Address	Data Bit	Description/Explanation
LDS1	1801	2	GHz (Frequency Left)
LDS2	1801	6	MHz
LDS3	1801	4	GHz (Frequency Right)
LDS4	1801	3	MHz
LDS5	1801	5	GHz (Frequency/Time)
LDS6	1801	0	MHz
LDS7	1801	1	sec
(NC)	1801	7	
LDS8	1803	0	ALTn
LDS9	1801	7	VERNIER/OFFSET
LDS10	1805	3	VERNIER/OFFSET #0
LDS11	1802	2	MKR Delta
LDS12	1803	5	START
LDS13	1803	3	CW
LDS14	1803	6	CF
LDS15	1803	2	Delta F
LDS16	1804	4	STOP
LDS17	1802	1	M1
LDS18	1802	0	M2
LDS19	1802	6	M3
LDS20	1802	4	REM
LDS21	1803	1	ADRS'D
LDS22	1805	4	MARKER SWEEP
LDS23	1804	6	M4
LDS24	1804	5	M5
LDS25	1803	4	Shift
LDS26	Not Addressable		SWP
LDS27	1804	3	INT (Sweep Trig)
LDS28	1804	2	LINE (Sweep Trig)
LDS29	1804	1	EXT (Sweep Trig)
LDS30	1804	0	SINGLE (Sweep Trig)
LDS31	1804	7	EXT (Sweep)
LDS32	1802	3	MAN (Sweep)
LDS33	1802	5	TIME (Sweep)
LDS34	1805	2	AMPTD MKR
LDS35	1803	7	DISPL BLANK
LDS36	1805	0	RF BLANK
LDS37	1805	1	Square-Wave MOD

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Digital Display Failure

The digit exercise routine checks each digit and each segment of the digital display. Enter **[SHIFT] [0] [5]** to initiate the test. Observe the sequence of the front panel digital displays as illustrated in Figure 8-8.

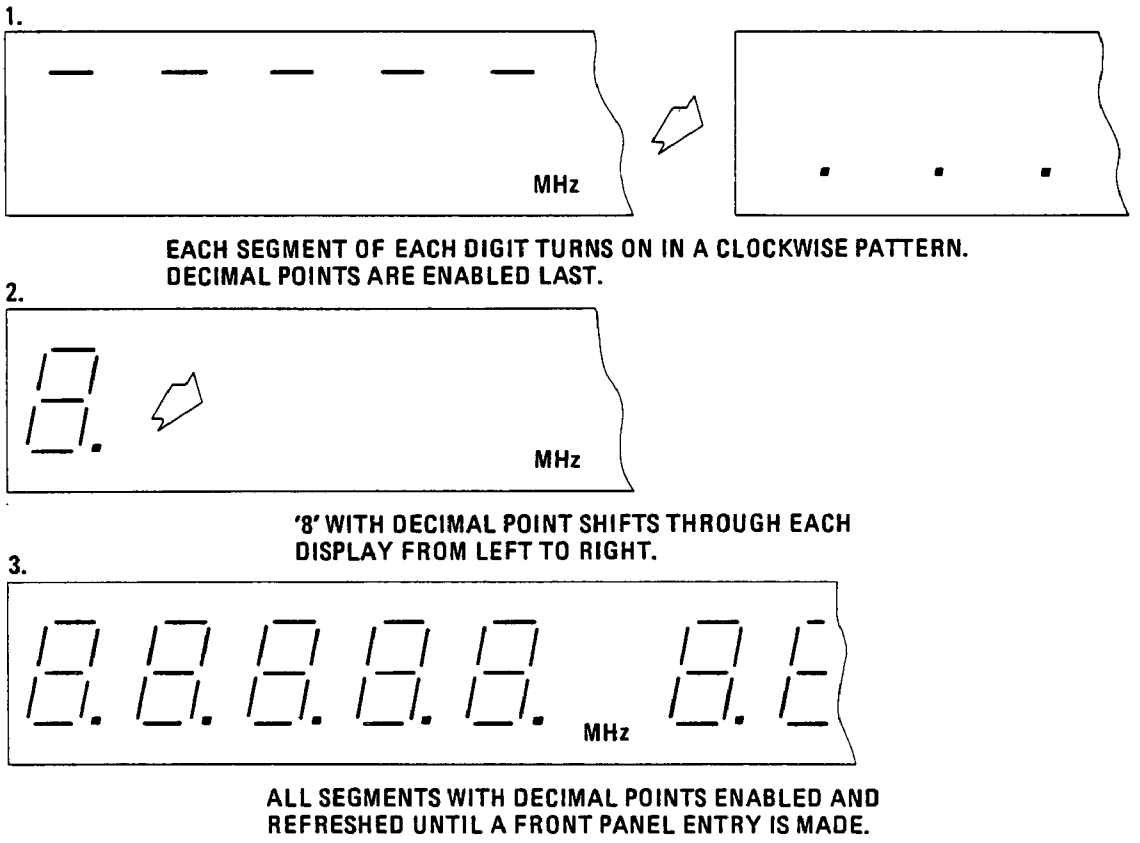


Figure 8-8. Digit Exercise Routine

Digit drivers (A1U1 and A1U2) and segment latch (U22) can be verified while the front panel is in the last enabled state of the digit exercise routine (all segments with decimal points enabled and continuously refreshed). In this mode, U22 outputs should all read low. The outputs of A1U1 and A1U2 should go low sequentially, at a 110 Hz rate.

A missing segment indicates a faulty data line, U22 failure, problems in the Al segment drivers, or bad LED display module. A missing digit indicates a faulty digit counter, digit driver, or problems in the LED display module.

The data written to each digit is stored in RAM on the A3 microprocessor while the test data is taken from ROM. Therefore, if the digit exercise routine appears normal, yet indecipherable or random characters appear in the digital display during normal operation, suspect a RAM failure on the A3 microprocessor.

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Front Panel Interrupt Timer and Interrupt Control

Failures in the front panel interrupt timer or control blocks generally will either prevent front panel interrupts or cause them continuously, resulting in various front panel displays. Usually the front panel will not respond to RPG or keyboard entry.

1. Remove the A5 assembly to prevent retrace interrupts.
2. Press **[INSTR PRESET]**.
3. Check the LFPSTB line (TP13) for pulses at approximately 973 kHz.
4. Check interrupt timer counters (U20A, U20B, and U19A) for divide-by-two sequence. The pulse at TP3 is immediately reset and of extremely short duration.
5. Check LDE (TP6) and LDCINCR (TP7) for the waveforms shown in Figure 8-14. These lines should be set regularly at 560 microsecond intervals, but their active states are of various durations.
6. Finally, check A3TP7 for the waveform in Figure 8-14, to make sure the interrupt requests are being transmitted to the microprocessor.

If A3TP7 remains low, the microprocessor is being continuously interrupted. Connect a jumper between IRQE (A3TP21) and GND (A3TP14) to disable the interrupts, and then examine the circuits above to determine why the interrupts cannot be cleared. Ensure that the Plug-in Interrupt Request (PIIRQ on A3 board) and HP-IB Interrupt Request (L IBIRQ on A3 board) are not requesting service. If necessary, remove the plug-in from the mainframe and A8 from its motherboard socket to make troubleshooting easier. Check L PINMI (Low = Plug-In Non-Maskable Interrupt), U4C pin 10. This line must be inactive (high). L PINMI is not used but is connected to the 64 pin plug-in interface connector via the motherboard and the plug-in interface ribbon cable. A logic low on this line can only be caused by a failure such as a short on the motherboard, a short in the 64 pin plug-in interface connector (or ribbon cable), or a failure on the A3 microprocessor assembly.

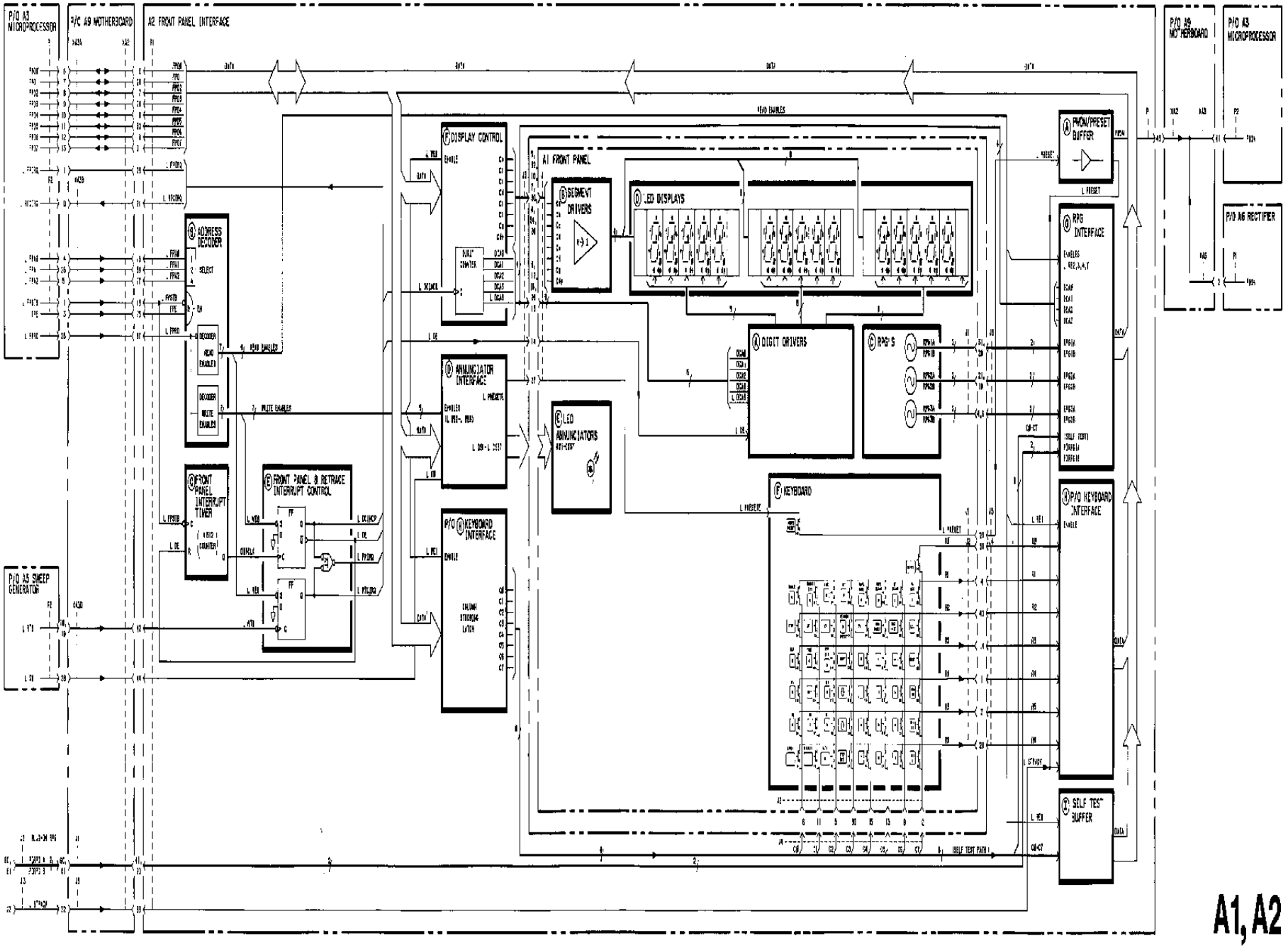
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A2J3	A2J3/A1J1 INTERCONNECT				A1J1
PIN	FUNCTION	SIGNAL	TO/FROM	FUNCTION	PIN
1	D	IC2	→	E	1
2	D	IC3	→	E	2
3	D	IC1	→	E	3
4	G	RPG3A	←	C	4
5	F	Ca	→	B	5
6	G	RPG3B	←	C	6
7	F	Cd	→	B	7
8	F	Cf	→	B	8
9	F	DCA0	→	A	9
10	F	Cc	→	B	10
11		NOT USED			11
12	F	DCA1	→	A	12
13	F	LDCA3	→	A	13
14	E	LDE	→	A	14
15	D	LDS10	→	E	15
16	F	DCA2	→	A	16
17	J	+5VR	→	G	17
18	J	+5VR	→	G	18
19	G	RPG2B	←	C	19
20	D	LDS22	→	E	20
21	G	RPG2A	←	C	21
22	J	GND R		G	22
23	J	GND R		G	23
24	J	GND R		G	24
25	A	LPRESET	←	F	25
26	F	DCA3	→	A	26
27	D	LPRESET	→	F	27
28	F	Cdp	→	B	28
29	G	RPG1B	←	C	29
30	F	Cc	→	B	30
31	G	RPG1A	←	C	31
32	F	Cb	→	B	32
33	F	+5VF SENSE	←	B	33
34	F	Cg	→	B	34

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A2J4	A2J4/A1J2 INTERCONNECT				A1J2
PIN	FUNCTION	SIGNAL	TO/FROM	FUNCTION	PIN
1	H	R4	←	F	1
2	D	LDS34	→	E	2
3	H	R5	←	F	3
4	H	R1	←	F	4
5	H	C2	→	F	5
6	D	LDS37	→	E	6
7	D	LDS8	→	E	7
8	D	LDS36	→	E	8
9	H	C6	→	F	9
10	D	LDS35	→	E	10
11	H	C1	→	F	11
12	H	C7	→	F	12
13	H	C5	→	F	13
14	H	R3	→	F	14
15	H	C4	→	F	15
16	H	C0	→	F	16
17	D	LDS21	→	E	17
18	D	LDS14	→	E	18
19	D	LDS25	→	E	19
20	D	LDS12	→	E	20
21	D	LDS26	→	E	21
22	D	LDS13	→	E	22
23	D	LDS27	→	E	23
24	D	LDS15	→	E	24
25	D	LDS28	→	E	25
26	D	LDS16	→	E	26
27	D	LDS29	→	E	27
28	H	R6	←	F	28
29	D	LDS30	→	E	29
30	H	C3	→	F	30
31	D	LDS31	→	E	31
32	D	LDS23	→	E	32
33	D	LDS32	→	E	33
34	D	LDS24	→	E	34
35	D	LDS33	→	E	35
36	D	LDS20	→	E	36
37	D	LDS17	→	E	37
38	D	LDS11	→	E	38
39	H	R0	←	F	39
40	H	R2	←	F	40
41	D	LDS9	→	E	41
42	D	LDS19	→	E	42
43	D	LDS4	→	E	43
44	D	LDS18	→	E	44
45	D	LDS5	→	E	45
46	D	LDS3	→	E	46
47	D	LDS7	→	E	47
48	D	LDS1	→	E	48
49	D	LDS6	→	E	49
50	D	LDS2	→	E	50

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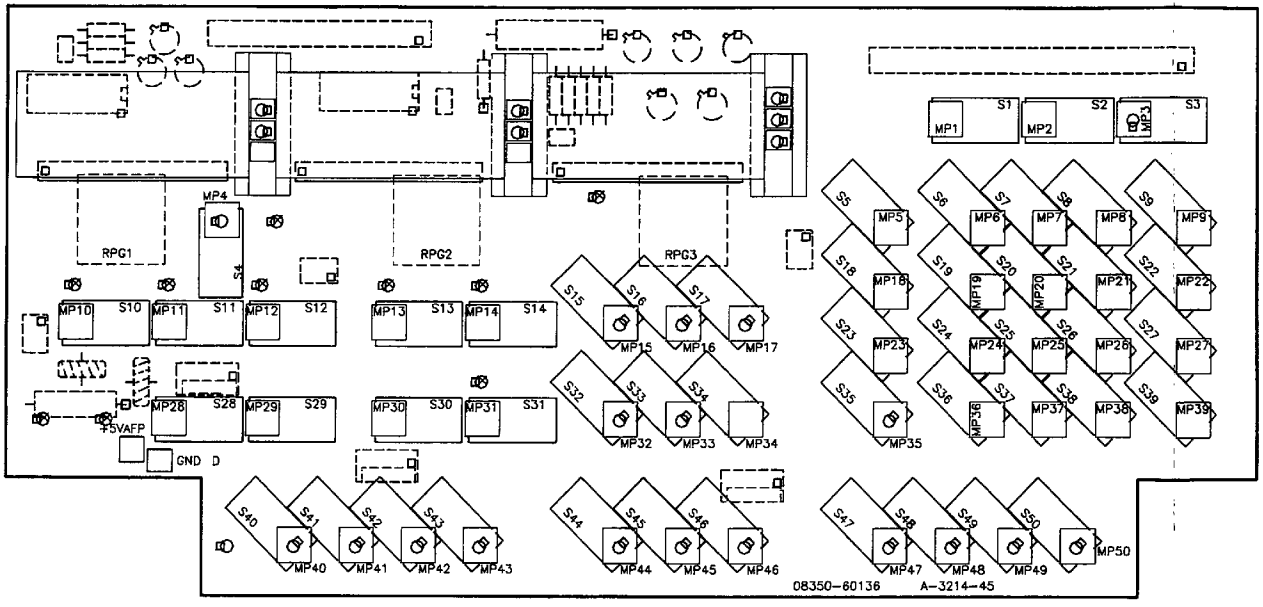
A1, A2

Figure 8-9. A1 Front Panel/A2 Front Panel Interface, Block Diagram

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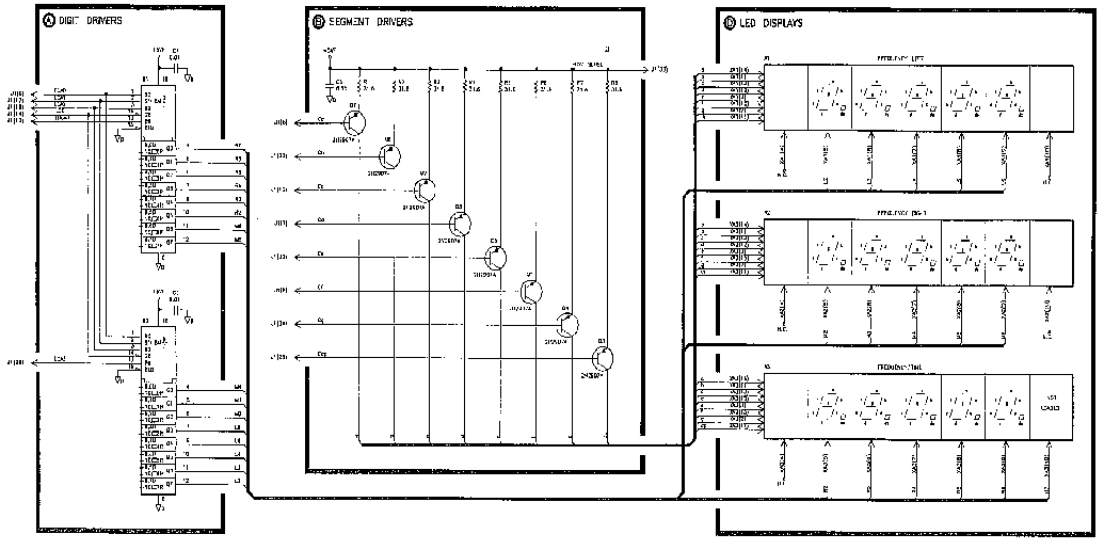
RPG1-3 ARE LOADED AT FRONT PANEL SUB ASSEMBLY.

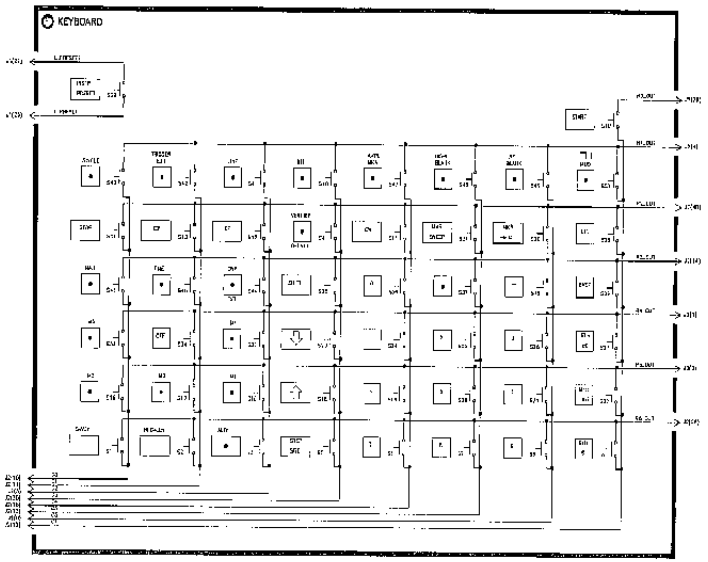
HEWLETT PACKARD

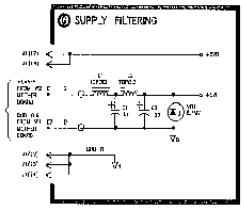
A1 Front Panel

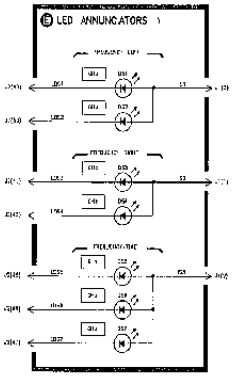
08350-60136

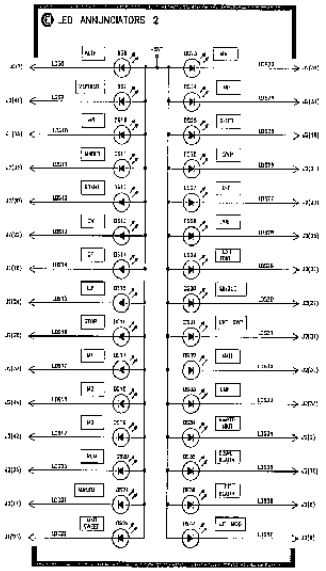
(SHEET 1 of 2)

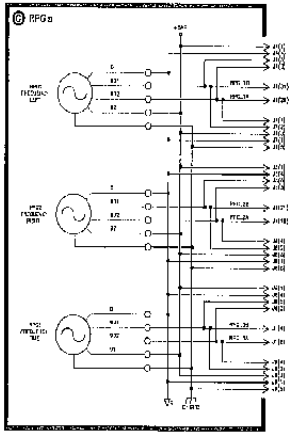


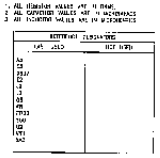












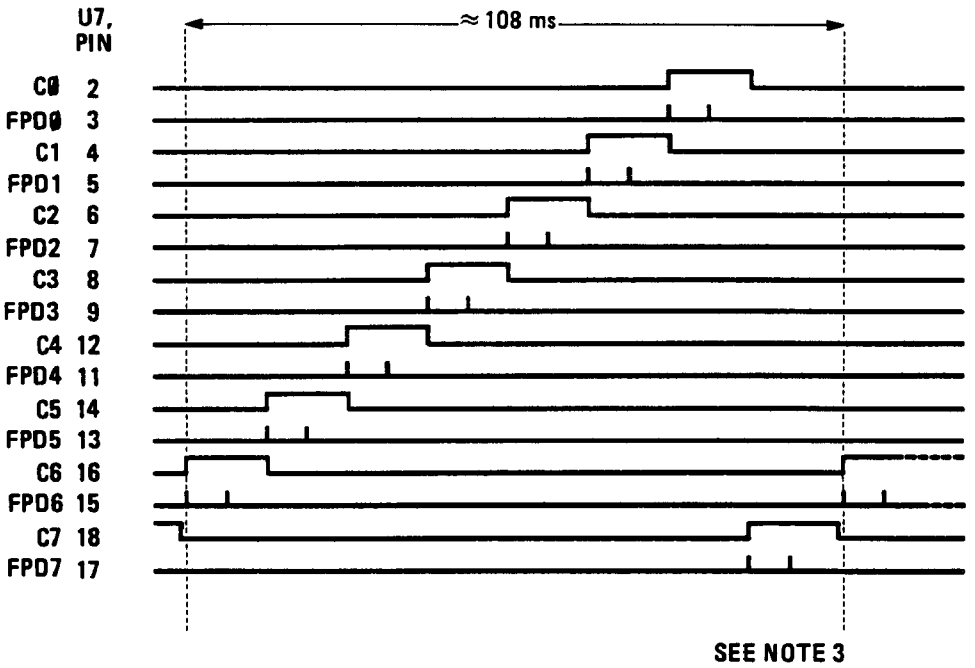
A1 Front Panel

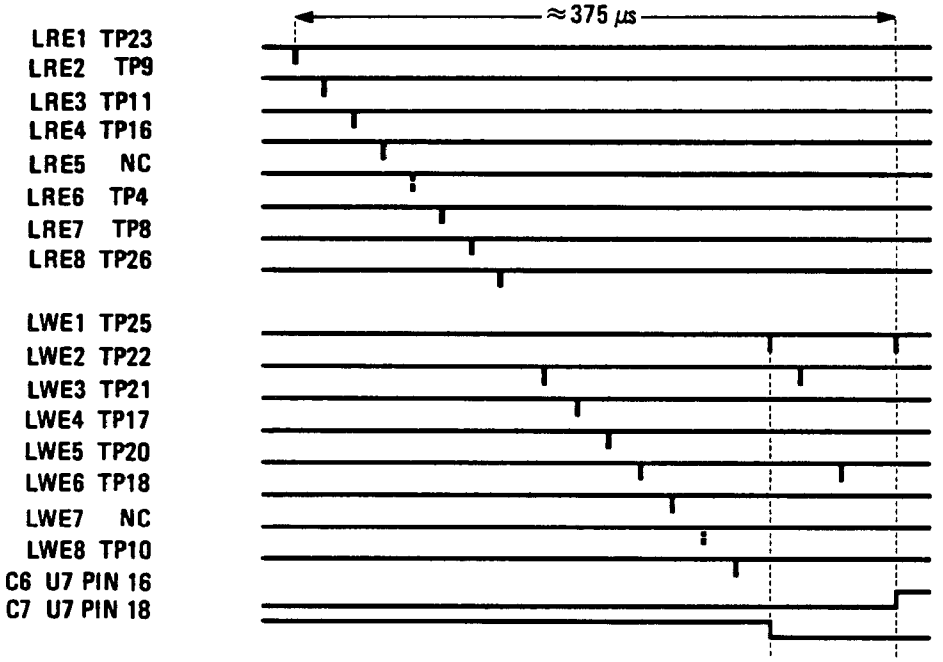
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(SHEET 1 of 1)

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COLUMN STROBING TIMING DIAGRAM





FRONT PANEL CONTROL LINES

TO ACCESS TEST PATTERN:

1. ENTER SHIFT 0 8
2. EXTERNAL TRIGGER AT TP23

Figure 8-12. Front Panel Self Test Timing Diagrams

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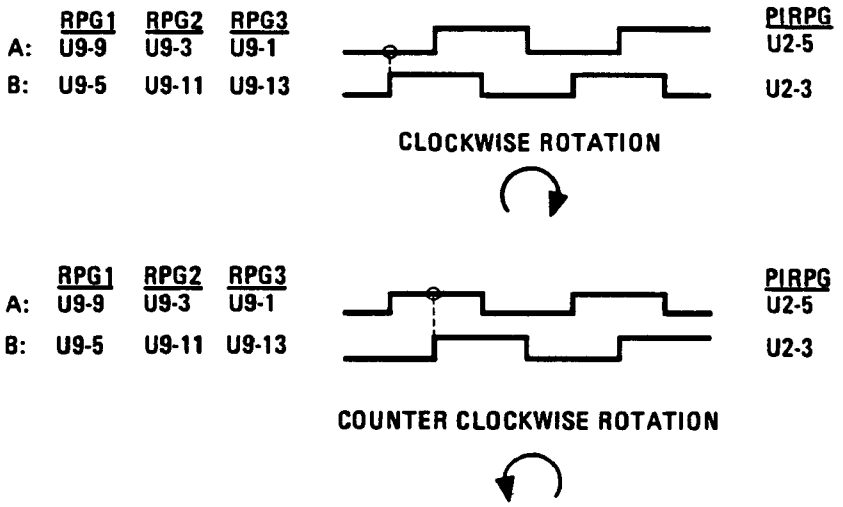


Figure 8-13. RPG Pulse Train

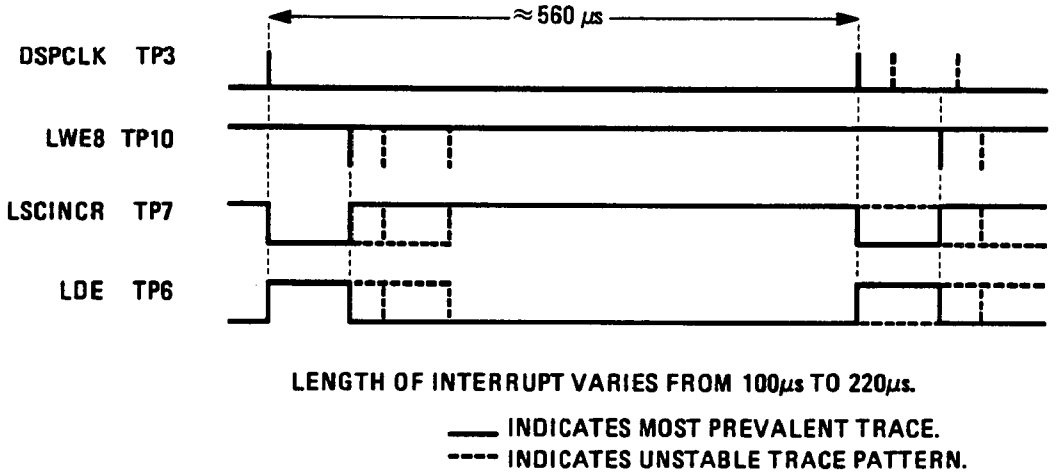
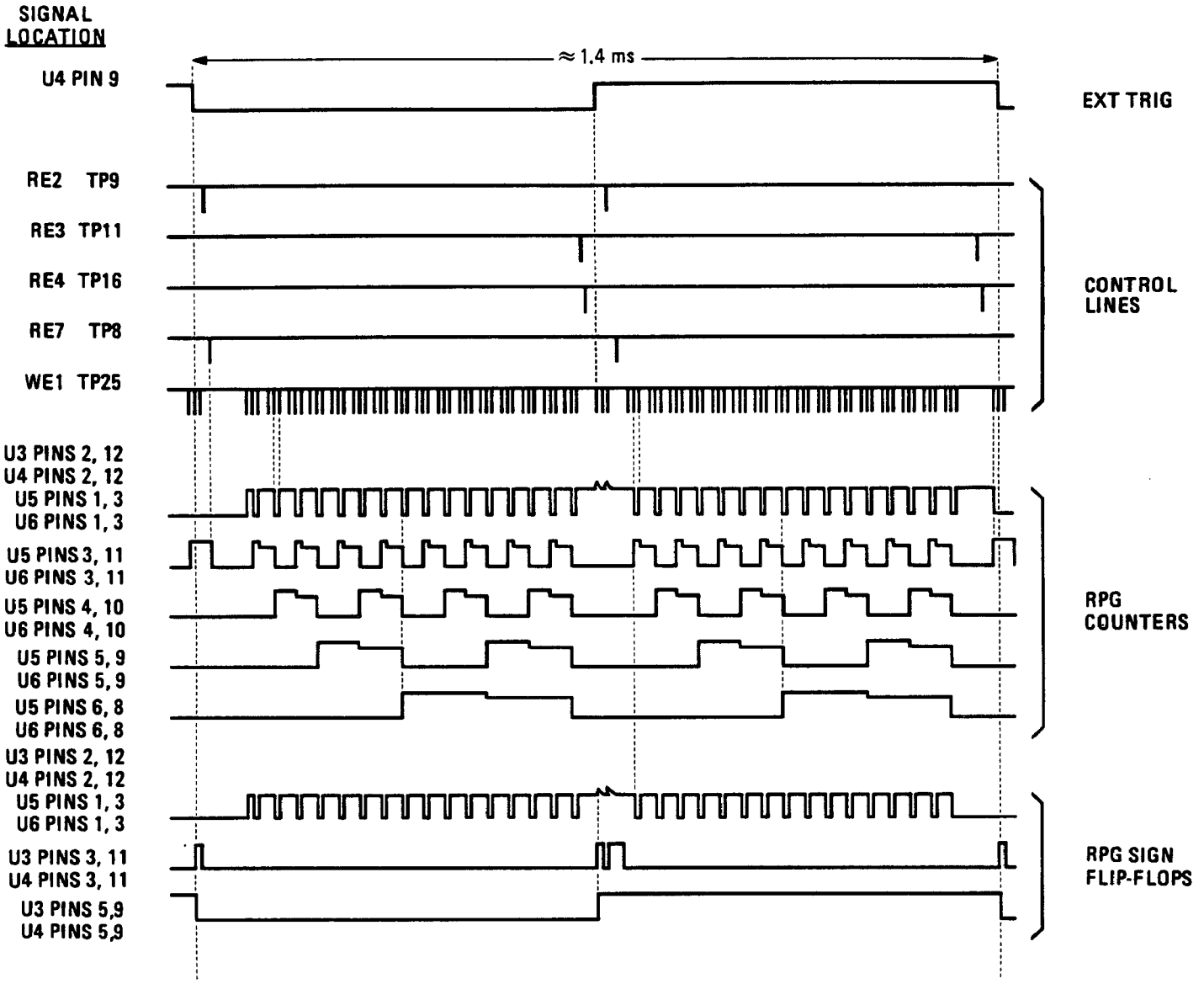


Figure 8-14. Front Panel Interrupt Timing Diagram

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(REFER TO A1/A2 TROUBLESHOOTING FOR RPG SELF-TEST DESCRIPTION.)

Figure 8-15. RPG Interface Timing Diagram

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A2P1

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	GND DIG	IN		J
23	LFPIRQ	OUT	A3P1-1	E
2	GND DIG	IN		J
24	GND DIG	IN		J
3	+5VA	IN	A7P1-2, 24	J
25	+5VA	IN	A7P1-2, 24	J
4	+5VA	IN	A7P1-2, 24	J
26	+5VA	IN	A7P1-2, 24	J
5	GND DIG	IN		J
27	GND DIG	IN		J
6	FPD0	I/O	A3P1-6	
28	FPD1	I/O	A3P1-7	
7	FPD2	I/O	A3P1-8	
29	FPD3	I/O	A3P1-9	
8	FPD4	I/O	A3P1-10	
30	FPD5	I/O	A3P1-11	
9	FPD6	I/O	A3P1-12	
31	FPD7	I/O	A3P1-13	
10	GND DIG	IN		J
30	DNG DIG	IN		J
11				
33	LSTPADV	IN	J13-22	H
12	GND DIG	IN		J
34				
13	LFPSTB	IN	A3P2-1	B
35	GND DIG	IN		J
14	GND DIG	IN		J
36	GND DIG	IN		J
15	FPE	IN	A3P2-3	B
37	LFPRD	IN	A3P2-25	B
16	LFPA0	IN	A3P2-4	B
38	LFPA1	IN	A3P2-26	B
17	LFPA2	IN	A3P2-5	B
39	LFPA3			NOT USED
18	LFPA4			NOT USED
40	GND DIG	IN		J
19	GND DIG	IN		J
41	PIRPGA	IN	J2-60	G
20	PIRPGB	IN	J2-61	G
42	LRTS	IN	A5P2-18, 19	E
21	LRTCIRQ	OUT	A3P2-8	E
43	PWON	IN	A6P1-2	A
22	GND DIG	IN		J
44	LSW	IN	A5P2-28	D

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NOTES

1. The following key entries provide front panel access for a data write/read operation to/from the addressed location:

Function	Key Entry
*Hex Address Entry	**[SHIFT] [0] [0]** (enter hex address)
Hex Data WRITE	**[M2]** (enter data: two hex digits)
Hex Data READ	**[M3]**
Hex Data Rotation Write	**[M4]**
Hex Addressed Fast Read	**[M5]**

   *To address a different location, press **[M1]** and enter the new address, or use the increment keys **[▲] [▼]** to step to the new address.

2. All waveform levels are TTL: High = 4.5V; Low = 0V.

3. During shift 0 8, front panel self-test, control lines LRE1-8 & LWE1-8 are rapidly pulsed within the time frame indicated by the shaded pattern in Figure 8-13. Note the difference in time scales between active control lines and column strobing. Control line pulse duration is approximately .07 µsec.

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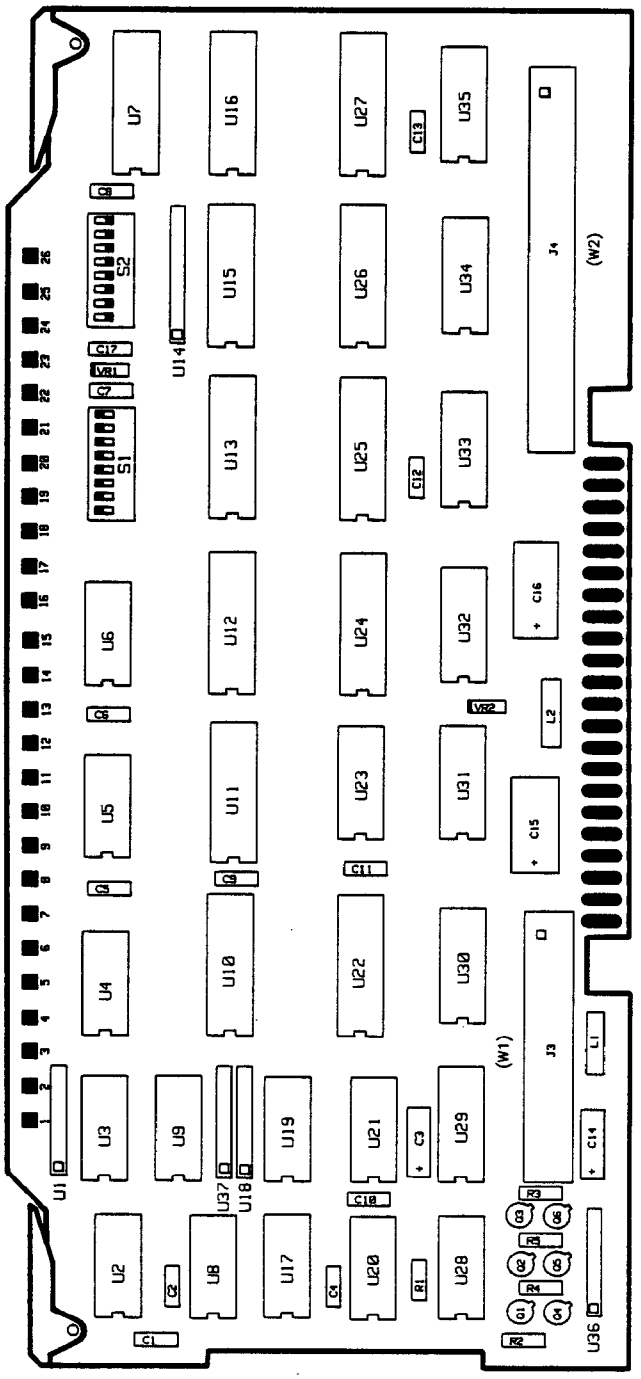


Figure 8-16. A2 Front Panel Interface Component Location Diagram

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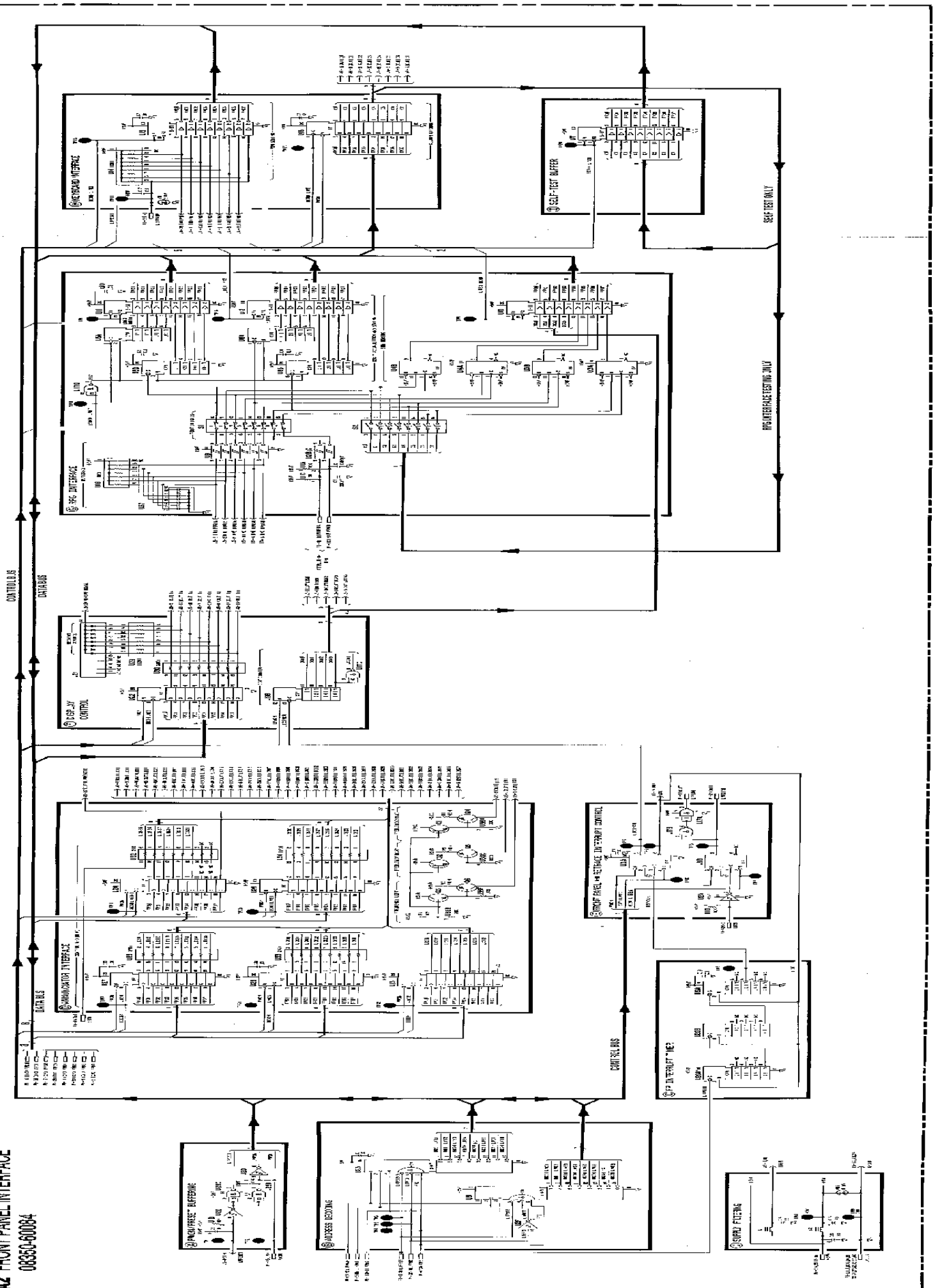


Figure 8-12. A2 Front-Panel Interface, Schematic Diagram

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A3 Microprocessor, Circuit Description

INTRODUCTION

The circuits on the A3 microprocessor assembly form a microprocessor-based machine that controls the internal operation of the HP 8350B and RF plug-in installed. A block diagram of A3 is shown in Figure 8-19. Control of the HP 8350B is implemented over two separate bus systems the front panel bus and instrument bus. Each bus consists of the following logic lines.

- Control Lines. Control direction and timing of data transfer and provide status information.
- Address Lines. Designates device or memory location of data transfer to/from microprocessor.
- Data Lines. Bi-directional logic lines used for communicating between the microprocessor and memory or input/output devices.

The microprocessor uses the front panel bus to read information from the front panel keyboard and Rotary Pulse Generators (RPGs), and write information to the front panel displays and annunciators. The instrument bus is used for communicating with the A4 scaling and marker, A5 sweep generator, A8 HP-IB interface assemblies, and the RF plug-in.

The clock generation circuit provides the two-phase clock for the microprocessor and other timing signals for the remaining circuits on the A3 assembly.

The microprocessor executes a 40K byte program stored in ROM (Read Only Memory). Three types of instructions are implemented.

- Read Data. Transfer data from ROM, RAM, or input device to internal registers in microprocessor.
- Write Data. Transfer data from internal registers to a specific location in RAM or an output device.
- Process Data. Perform arithmetic or logic operations on data loaded in internal registers.

The microprocessor address lines determine the source/destination of microprocessor data. The address decoder circuit decodes the high level bits of the address lines into control lines used to enable data transfers between the microprocessor and specific blocks of memory or other sections of the instrument.

The front panel bus buffer circuit provides the interface between the microprocessor and the A2 front panel interface. The instrument bus buffer circuit provides the interface between the microprocessor and the rest of the instrument.

Figure 8-18 is a flow chart of the program executed by the microprocessor. When the HP 8350B is powered on'', or the INSTR PRESET key is pressed, the self test routine is executed. After completing this routine, the microprocessor enters an ''idle'' loop. The microprocessor continues in the idle loop until there is an interrupt or a status change in the front panel. The cause of an interrupt request can be the HP-IB interface, RF plug-in, sweep retrace, or front panel timed interrupt. When the microprocessor is interrupted, it completes the present instruction before jumping to the interrupt service routine. During this routine, the microprocessor reads the status buffer to determine the source of the interrupt. The microprocessor then jumps to a service routine to communicate with the interrupting device.

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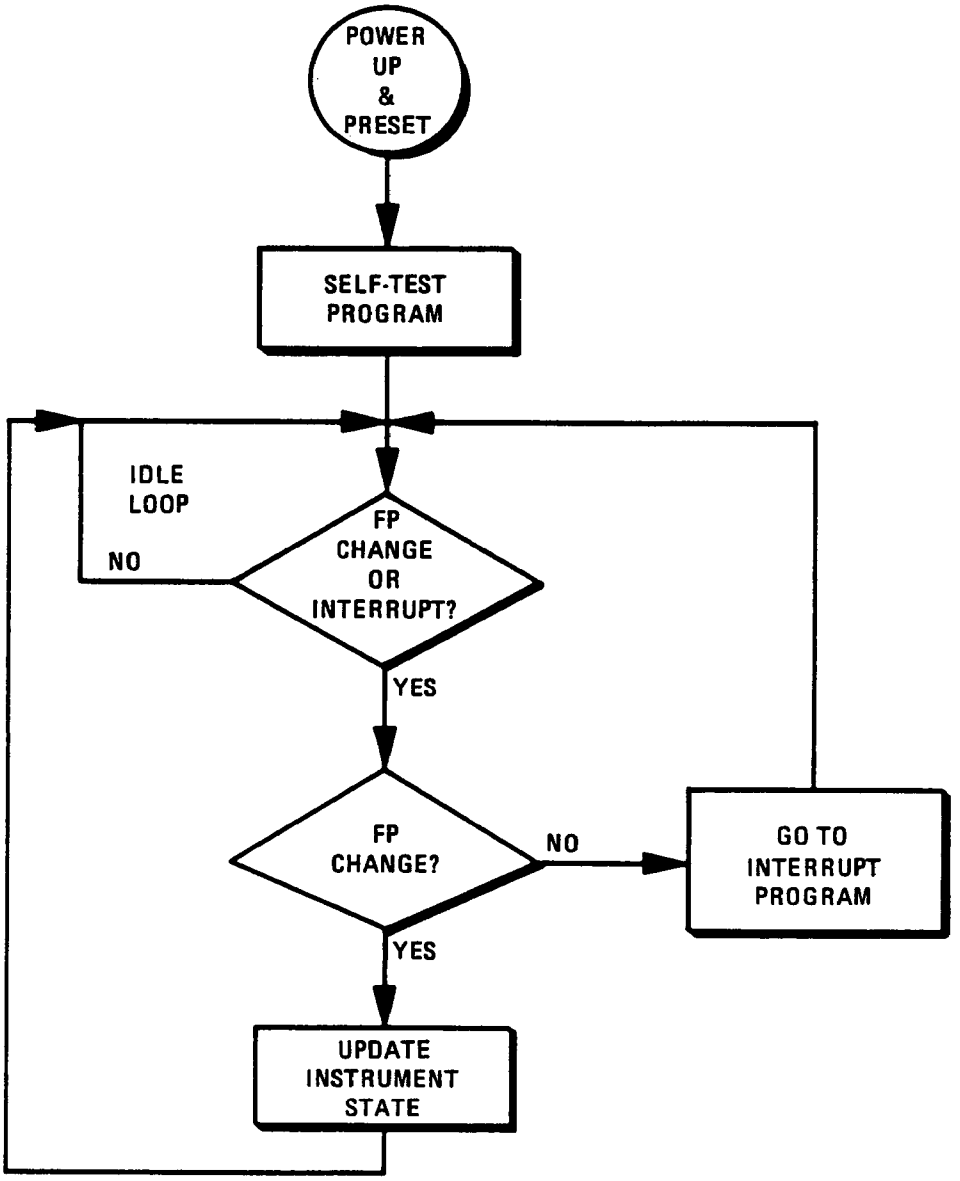


Figure 8-18. HP 8350B Simplified Program Routine (1 of 2)

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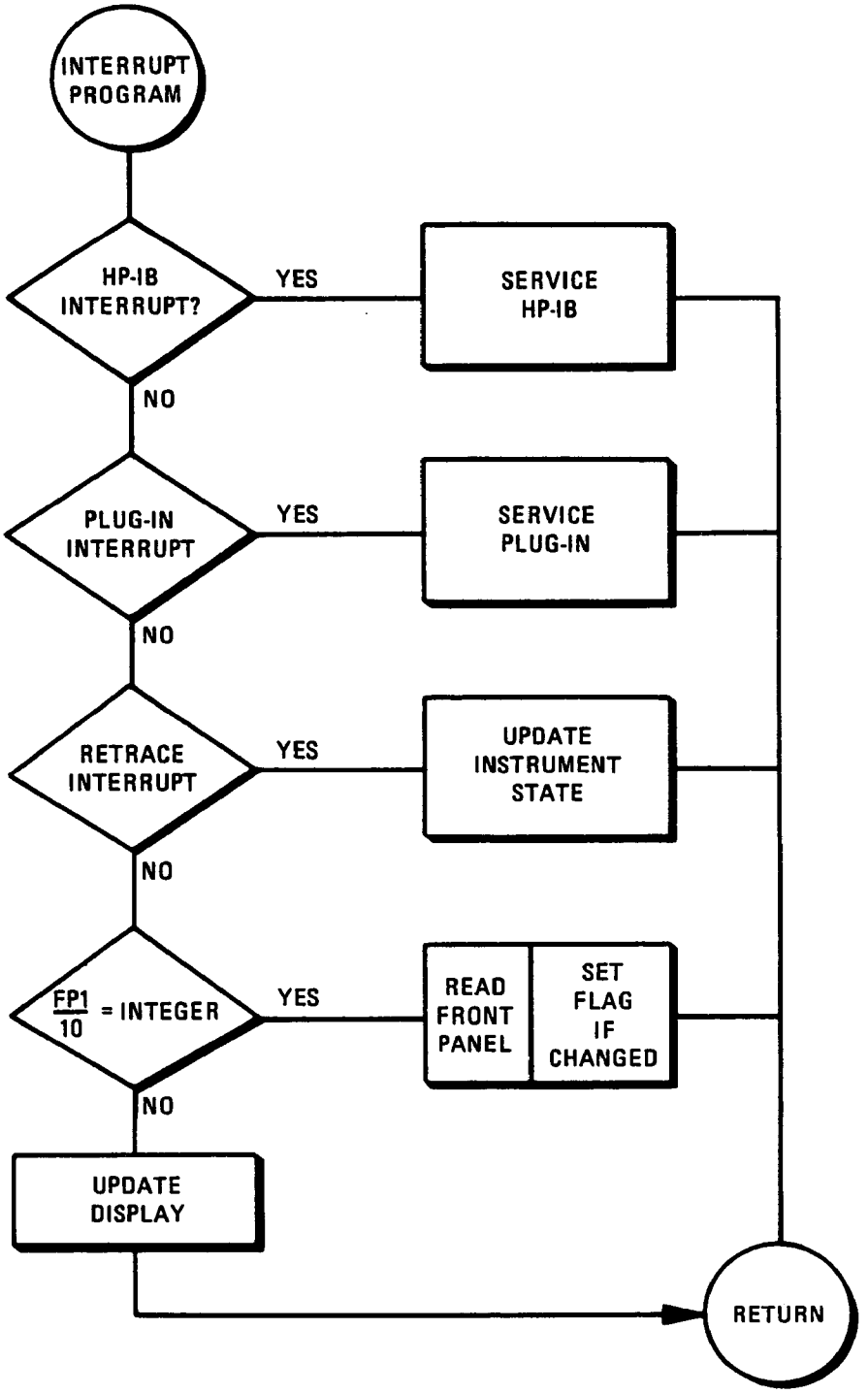


Figure 8-18. HP 8350B Simplified Program Routine (2 of 2)

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Clock Generation A

The clock generation circuit produces five timing signals for use on the A3 microprocessor assembly. Phase 1 (ϕ01) and phase 2 (ϕ02) outputs are a two-phase clock signal for microprocessor U5. The I/O Strobe (IOS) output is used for timing of most I/O (Input/Output) operations. The Address Valid Strobe (AVS) indicates when the microprocessor address lines are valid for decoding. The microprocessor will place data on the data lines after receiving the rising edge of the Data Bus Enable (DBE) signal. Figure 8-20 shows the timing relationship of these signals and their relationship to activity on the microprocessor address and data lines (data bus activity is shown for both a read and write operation).

Clock Oscillator. Crystal Y1 and logic gates U21A, U21C, and U21D form a crystal oscillator with two feedback loops. The basic oscillator is comprised of U21C, Y1, and RC phase shifters R1/C5 and R2/C6. This circuit oscillates at approximately the crystal resonant frequency of 10.7 MHz. At the oscillation frequency, the two RC phase shifters provide enough phase shift to ensure a total loop phase shift of about 360 degrees. Logic gates U21A and U21D provide bias, and stabilization. Logic gate U21B inverts and buffers the oscillator output to the clock generator circuit.

Clock Generator. Latch U16 and 32-by-8 PROM U12 form a small state machine that generates the five main timing signals. The clock oscillator output provides the time base for the state machine operation. Eleven consecutive address locations of U12 contain data that define the state of the five timing signals over eleven clock oscillator cycles. For each address, the lower four bits of data are the logic state of the PROM ϕ01, PROM ϕ02, DBE, and AVS signals. The four higher data bits address the PROM for the next clock oscillator cycle (PROM A0, PROM A1, PROM A2, and IOS). IOS is also used by the address decoder and instrument bus circuits. U16 latches and buffers the U12 outputs during each clock oscillator cycle.

Clock Drivers. Clock drivers Q1/Q3 and Q2/Q4 invert and buffer the PROM ϕ01 and PROM ϕ02 to provide the microprocessor U5 with its two-phase clock signals (ϕ01 and ϕ02). The drivers are identical, so only the circuit for ϕ01 is explained. If the PROM ϕ01 input is a logic low, Q1 is on and Q3 is turned off; this causes a high ϕ01 output (nominally +5V). When PROM ϕ01 changes state to a logic high, Q1 is turned off and Q3 is turned on; this causes ϕ01 to go low (nominally 0.2V). RC combinations R3/C10 and R54/C37 at the base of Q1 and Q3 ensure fast desaturation of the transistor base-emitter junction when the transistor is turned off. Without this RC combination, the switching speed of each transistor would be much slower.

Microprocessor D

The microprocessor circuit executes the program stored in ROM to control the HP 8350B and RF plug-in. Microprocessor U5 is the main element in this circuit, which utilizes the following signals to execute the program stored in ROM.

- **Address Lines (A0-A15).** The microprocessor outputs sixteen address lines that specify an address location, between hexadecimal 0000 and FFFF, for the source or destination of any data transfer. Unless instructed to do otherwise, the microprocessor automatically increments the address location after each read or write operation.
- **Data Lines (D0-D7).** The eight data lines are bi-directional and are used by the microprocessor to communicate with the address location specified by the address bus.
- **L WRITE Line.** The microprocessor L WRITE (Low=Write) output controls the direction of the data transfer on the data bus. A logic high, read, indicates a data transfer from the addressed device to the microprocessor. A logic low, write, indicates a data transfer from the microprocessor to the addressed device.
- **VMA.** The VMA (Valid Memory Address) output indicates when the address bus has a stable and valid address for a data transfer.

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Address lines A0-A9, all data lines, and the L WRITE line all use pull-up resistors (U6, U13, and R21) to pull their high logic levels to +3.6VDC. This ensures that the logic levels on these lines does not exceed the supply voltage of the CMOS RAM.

A low PWON input at TP23 resets microprocessor U5 at "initial power on" or whenever the front panel INSTR PRESET key is pressed. An active low L RES (Low=Reset) input to microprocessor U5, resets the microprocessor, which initializes program execution at address FFFE. (The address of the first program instruction is stored at addresses FFFE and FFFF.) The PWON (Power On) input from the A6 rectifier is buffered by Schmitt trigger logic gates U4B and U4A to provide fast rise and fall time of the L RES microprocessor input. RC combination R14/C30 filters transient noise spikes on the PWON line.

The Data Bus Enable (DBE) input must be a logic high to enable the microprocessor to read or write data. The microprocessor has two interrupt inputs, L NMI (Low=Non-Maskable Interrupt) and L IRQ (Low=Interrupt Request). The difference between the two signals is that L IRQ is ignored (masked) by the microprocessor if an internal flag is cleared, but an active low L NMI always requires a response. When either interrupt input is active low, the microprocessor completes the instruction it is executing then immediately jumps to the interrupt service routine stored in ROM.

A "Free Run Test" of the microprocessor can be performed by setting all eight sections of S1 open and grounding TP9, LDSA (Low= Digital Signature Analysis). This "Free Run Test" isolates the microprocessor from the data bus and forces a CLR B (Clear B Accumulator) instruction into the microprocessor. The result is that the microprocessor increments through its entire address field, generating signatures at various nodes of the A3 assembly. Refer to microprocessor troubleshooting for more detailed information on the "Free Run Test".

Address Decoder E

The address decoder decodes the high level address bits (A10-A15) into control lines that enable data transfers between the microprocessor and specific blocks of memory or other sections of the instrument. Each section that communicates with the microprocessor is given a specific block of address space. Table 8-12 lists the address space allocation for the system.

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Table 8-12. Microprocessor Address Space Allocation

Address Space (Hex)	Amount of Space	Device	Control Line
0000-03FF	1K	RAM	L RAME2 (Low = RAM Enable 2)
0400-07FF	1K	RAM	L RAME1 (Low = RAM Enable 1)
0800-0FFF 1000-17FF	2K 2K	Self Test Counter Status Buffer	L EAC (Low = Error Annunc. Clock) L SBE (Low = Status Buffer Enable)
1800-1FFF	2K	Front Panel Interface	L FPE (Low = Front Panel Enable)
2000-27FF*	2K	A5 Sweep Gen/ A8 HP-IB	L I/OE1 (Low = I/O Enable 1)
2800-2FFF*	2K	RF Plug-in	L I/OE2 (Low = I/O Enable 2)
3000-37FF*	2K	A4 Scaling and Marker	L I/OE3 (Low = I/O Enable 3)
3800-3FFF*	2K	Self Test Counter	L EAR (Low = Error Annunc. Reset)
4000-5FFF*	8K	RF Plug-in ROM	L PIROME (Low = Plug-in ROM Enable)
6000-7FFF	8K	ROM	L ROM5 (Low = ROM 5)
8000-9FFF	8K	ROM	L ROM4 (Low = ROM 4)
A000-BFFF	8K	ROM	L ROM3 (Low = ROM 3)
C000-FFFF	16K	ROM	L ROM1,2 (Low = ROM 1,2)
* In each of these cases the L IBE (Low = Instrument Buffer Enable) control line is also true, enabling the address and data buffers of the instrument bus buffer to be active.			

Most of the control line outputs listed in Table 8-12 are generated directly by 3-to-8 decoders U23 and U24. However, additional decoding is provided to generate the following control lines.

- L RAM1 and L RAM2 are both developed from the L RAM output of U23 pin 15, and further decoding of the A10 address line (L A10 is used to generate L RAM2). Both signals are gated with IOS (Input Output Strobe) and PWON (Power On) control lines through NAND gates U19A and U19B. Because both RAM enable lines are gated with IOS, they are only allowed to be active during a data transfer. Gating with the PWON control line prevents random data from being written into RAM when the line power is turned off.
- L ROM1,2 is developed through decoding of L ROM2 (U24 pin 9) and L ROM 1 (U24 pin 7) control lines with NAND gate U3C and inverter U18B. If either of these lines is active low, L ROM1,2 goes active low.

When AVS (Address Valid Strobe) and VMA (Valid Memory Address) are active high, U24 is enabled to decode address lines A13 through A15 and enable address space in 8K blocks. U23 is is enabled when AVS and VMA are active high and both A14 and A15 are low (first 16K of address space). U23 decodes address lines A11 through A13 to enable address space in 2K blocks.

Two other control lines generated by the address decoder are L IBE (Low=Instrument Buffer Enable) and II/OS (Instrument Input/Output Strobe). L IBE is active low whenever the microprocessor communicates on the instrument bus (Addresses 2000H through 5FFFH), and enables the address and data buffers in the instrument bus buffer. The II/OS control line is a gated I/OS signal that is used to strobe data onto the instrument bus.

When the microprocessor free run test is run, TP12 can be grounded to disable the address decoder circuit (see A3 Troubleshooting at the end of this circuit description). The L A10 address line at TP11 is also useful for troubleshooting, and can be used to provide a pulsed source for checking shorted data or control lines.

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ROMS F

ROMs U9, U10, U11, and U35 store the 40K by 8 bits of program data that is executed by the microprocessor to control the rest of the HP 8350B and the RF plug-in installed. ROMs U10, U11, and U35 store 8K bytes of program, and has a unique ROM enable line that enables each ROM over an 8K block address space. ROM U9 stores 16 K bytes of program information.

L ROM1,2 — Enables ROM U9 for address locations C000 through FFFF.

L ROM3 — Enables ROM U11 for address locations A000 through BFFF.

L ROM4 — Enables ROM U35 for address locations 8000 through 9FFF.

L ROM5 — Enables ROM U10 for address locations 6000 through 7FFF.

RAMS H

Data that is generated and/or processed during program execution is stored in RAM (Random Access Memory) (U14, U15, U7, and U8). Examples of the types of data stored in RAM are the present state of the front panel, the data associated with the nine SAVEn/RECALLn front panel settings, the data used to control the rest of the 8350B, the HP-IB address, the RF plug-in code, etc.

The total RAM storage capacity is 2K by 8 bits. Since each RAM can store 1K by 4 bits, two RAMs are combined to form a 1K by 8 bit memory space. The two pair of RAMs combine to form a 2K by 8 bit memory space. One RAM in each pair (U7 and U14) store the low order four bits (D0-D3) of the data bus, and the high order bits (D4-D7) are stored by the other RAM in each pair (U8 and U15). U14 and U15 store the first 1K of data, and are enabled when control line L RAM1 (Low= RAM Enable 1) is active low. L RAM1 is active low for address locations 0000 to 03FF. U7 and U8 store the second 1K bytes of data and are enabled when control line L RAM2 is active low. L RAM2 is active low for address locations 0400 to 07FF.

The logic level of the L WRITE signal for each RAM determines if data is written to the RAM or the data stored is read by the microprocessor. When L WRITE is active low, the microprocessor writes data into the addressed RAM location. When L WRITE is active high, the microprocessor reads data from the addressed RAM location.

All four RAM power supply connections are to V,CCP which is the battery backup supply.

Front Panel Bus Buffer J

The front panel bus buffer circuit provides the interface for the address, data, and control lines between the microprocessor and the front panel bus. The front panel bus is used to transfer data between front panel circuits and the A3 microprocessor assembly. Bi-directional buffer U22 is a 3-state device that provides the interface for the eight front panel data lines (FPD0-FPD7). Transfer of data through U22 is enabled when control line L FPE (Low=Front Panel Enable) is active low. L FPE is active low for microprocessor addresses 1800 through 1FFF. Direction of data flow is determined by the logic state of the microprocessor L WRITE signal. This signal is high when reading data from the front panel and is low when writing data to the front panel. 3-state buffer U32 drives the five address lines (FPA0-FPA4), and three control lines (FPE, L FPRD, and L FPSTB) associated with the front panel bus. U32 is always enabled. The front panel uses the address lines to select the source/destination of information on the data lines. The control lines manage the data flow. A more detailed functional description of these lines is provided in the A2 front panel interface circuit description.

Interrupt Logic and Status Buffer B

The interrupt logic and status buffer circuit performs the following functions:

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- ORs the following interrupt request signals onto the microprocessor maskable interrupt request control input, L IRQ (Low = Interrupt Request).
- L PIIRQ (Low = Plug-in Interrupt Request)
- L IBIRQ (Low = HP-IB Interrupt Request)
- L FPIRQ (Low = Front Panel Interrupt Request) L FPIRQ also goes active low when there is a L RTCIRQ (Low = Retrace Interrupt Request). So, there is no need to multiplex L RTCIRQ to develop a L IRQ input to the microprocessor.
- Buffer the L PINMI (Low = Plug-in Nonmaskable Interrupt) signal onto the microprocessor nonmaskable interrupt control input, L NMI (Low = Nonmaskable Interrupt). L PINMI and L NMI are reserved for future use and are not used at this time.
- When addressed by the microprocessor, interface the following control lines onto the microprocessor data bus.
- Interrupt Requests: L RTCIRQ (Low=Retrace Interrupt Request), L PIIRQ (Low = Plug-in Interrupt Request), and L IBIRQ (Low=HP-IB Interrupt Request)
- Flags: L PIFLG (Low = Plug-in Flag), and L MFLG (Low=Marker Flag)
- Power Supply Status: L PSF (Low=Power Supply Failure), and L PST (Low=Air Flow Failure)
- L TEST (Low=Test): When active (TP20 jumpered to ground), initiates Front Panel Bus self test. Used if keyboard is not operational.

Interrupt Logic. Quad Schmitt trigger NAND gate U34 ORs several interrupt requests onto the microprocessor interrupt request control input (L IRQ). An active low microprocessor interrupt request (L IRQ) is generated any time one of the interrupt request inputs to U34 is active low. If the microprocessor is enabled to accept interrupts, the microprocessor completes the instruction it is executing, then jumps to the interrupt service routine stored in ROM. The interrupt requests may be disabled by grounding TP21, IRQE (High=Interrupt Request Enable). This forces the U34C output (L IRQ) high (not active) regardless of the state of the interrupt requests.

L PINMI (Low=Plug-In Non-Maskable Interrupt) is not used at this time but is connected to the 64 pin plug-in interface connector for possible future use. L PINMI must never go low. A logic low on this line can only be caused by; a short on the motherboard, a shorted 64 pin plug-in connector, or a failure on the A3 assembly. The circuitry that receives L PINMI was designed to operate in the following manner, however, at this time no valid memory instructions reside in the L PINMI service routine address. A logic low on L PINMI will place the HP 8350B in an undefined state. Schmitt trigger NAND gates U4C and U4D shape and buffer the L PINMI (Low=Plug-in Nonmaskable Interrupt) control line onto the microprocessor nonmaskable interrupt control input, L NMI. When L PINMI is active low, L NMI is active low, causing the microprocessor (after the current instruction is executed) to jump to the interrupt service routine stored in ROM. This interrupt can not be masked, so the microprocessor always responds to an active L PINMI. L PINMI can be disabled by grounding TP16, NMIE (Nonmaskable Interrupt Enable). This forces U4D pin 13 low, causing U4D pin 11 high (not active) regardless of the state of L PINMI.

Status Buffer. Tri-state buffer U20 buffers and inverts the plug-in and marker flags, power supply status lines, the L TEST control line, and all but one of the interrupt requests onto the microprocessor data bus. The combination of these lines is called the status byte. When active low, the L SBE (Low=Status Buffer Enable) control line from the address decoder enables the status byte onto the data bus. L SBE is active low for address locations 1000 through 17FF. The microprocessor periodically reads the status byte during program execution to check the status of the two power supply

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status control lines, as well as the plug-in and marker flags. If either of the power supply status lines is active low for a certain period, the microprocessor writes an error message to the front panel displays. The marker flag is monitored during the Instrument Preset and operator initiated self tests. The marker flag is active low when the marker circuits on the A4 scaling and marker assembly have passed the test routine. The plug-in flag is monitored during the program idle loop, and, when active low, indicates the plug-in requires a low priority of service (i.e. front panel update).

The microprocessor also reads the status byte following an interrupt request. The microprocessor uses the status byte to determine the source of the interrupt request. Note that L FPIRQ is not included in the status byte. If all other interrupt requests are not active, the microprocessor assumes L FPIRQ caused the interrupt request.

The L TEST input is used for front panel troubleshooting and is active low when TP20 is grounded. If L TEST is active low when the microprocessor reads the status byte, the microprocessor jumps to the front panel bus self test. For more details of this test refer to the troubleshooting section for the A2 front panel interface.

Self Test Error Code Indicator C

The self test error code indicator circuit provides a pass/fail indication for the tests in the Self Test Routine (STR). The STR is initiated by any of the following actions:

- Cycling the AC line power
- Pressing the front panel **[INSTR PRESET]** key.
- Programming the Instrument Preset function via HP-IB.

Either of the first two actions cause the PWON (Power On) control line input to go low, which resets microprocessor U5 through U4A and U4B. This results in the microprocessor jumping to and executing the self test routine. The L RES output of U4A is also buffered through NAND gate U3A, and resets the self test counter U2A. With all of the U2A outputs low, LEDs DS1 through DS4 are turned on. The indicator LEDs are binary weighted (8-4-2-1) with DS1 being the Most Significant Bit (MSB). An LED that is turned on indicates a logical one (1).

At the beginning of the self test routine, the microprocessor ensures that the self test counter is reset by setting L EAR (Low = Error Accumulator Reset) active low. The self test counter remains reset until either a self test fails or all tests pass. If a test fails, the microprocessor executes a set of instructions to increment the self test counter with L EAC (Low = Error Accumulator Clock). The microprocessor then continues execution of the test routine for the failed test. The number of L EAC clock pulses generated is equal to 15 minus the test number. For example, if the front panel bus test (Test number 6) fails, the number of L EAC transitions generated is nine (15 − 6). As a result, the self test counter outputs represent the binary complement of nine and the LEDs indicate:

DS1(MSB) = OFF DS2 = ON DS3 = ON DS4(LSB) = OFF

This indication is interpreted as a six (E006). If all tests pass, the self test routine generates fifteen transitions of L EAC, resulting in all of the indicator LEDs being turned off.

The self test routine may also be initiated by programming the instrument preset function through HP-IB. Operation of the self test circuit is the same with the following exceptions. The microprocessor is "programmed" to reset instead of using the PWON control line, and self test counter U2A is reset only by the L EAR control line.

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Supply Filtering K

The supply filtering circuit filters the supply voltages used by the A3 microprocessor, and provides a protected +5V supply (V,CCP) for RAM. The circuit operates in one of two states.

- When AC line power is applied to the 8350B (LINE switch in ON position), transistors Q5 through Q7 are all biased on. Thus, V,CCP approximately equals +5VF and the battery, BT1 (which connects to the circuit at P1-21, +5V BAT), charges through R18.
- When the HP 8350B ON/OFF switch is in the OFF position, transistors Q5 through Q7 are all turned off, and the source for the V,CCP supply is BT1. Thus the RAM is kept active when line power is disconnected.

During the transition between battery-backup and internal power for the RAM, Q5 through Q7 ensure that V,CCP does not drop below the battery voltage.

Instrument Bus Buffer I

The instrument bus buffer circuit interfaces the microprocessor address, data, and control lines onto the instrument bus, which is the main communication bus for the rest of the 8350B (except for the front panel circuits). U25 is a tri-state bi-directional buffer that provides the interface for the eight instrument data lines (ID0-ID7). Transfer of data through U25 is enabled when L IBE (Low=Instrument Bus Enable) is active low (Addresses 2000 through 5FFF). Direction of data flow is determined by the logic state of the microprocessor L WRITE control output (Low=Write, High=Read).

3-state buffers U27 and U29 drive the thirteen address lines (L IA0 through L IA12) and the L IRD (Low=Instrument Bus Read) control line associated with the instrument bus. The logic state of the address lines determine the source/destination of the data transfer and the logic state of L IRD determines direction of data flow at the addressed device. U27 and U29 are enabled by the L IBE control line.

3-state buffer U26 drives the remaining control lines associated with the instrument bus, and is always enabled. Table 8-13 lists these control lines, with definition and function description. All lines associated with the instrument bus (except I/OE3) are reverse-terminated by 100 ohm resistors to reduce ringing.

Table 8-13. Instrument Bus Control Signals

Control Line	Definition	Function
L I/OCLK	Low = I/O Clock	Timing Clock for the A8 HP-IB Interface
L I/OSTB	Low = I/O Strobe	Master Data enable pulse for Instrument Bus
I/OE1	I/O Enable 1	Enable line for A5 Sweep Generator and A8 HP-IB Interface
I/OE2	I/O Enable 2	Enable line for RF Plug-in
I/OE3	I/O Enable 3	Enable line for A4 Scaling and Marker
PIROME	Plug-In ROM Enable	Enable line for RF Plug-in ROM

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TROUBLESHOOTING

Since the A3 microprocessor assembly controls all functions in the HP 8350B, a component failure on this board assembly generally disables the entire instrument. The most likely indications of an A3 microprocessor component failure are as follows:

- Instrument Preset self test failure (Error codes E015 through E006)
- Front Panel Lock-up (Some or all the front panel lights are on; pushbuttons produce no response.)
- Flashing Lights (Front panel lights flash in a random or periodic fashion; pushbuttons will not function properly, but may have an effect.)
- Partial Failure (The instrument works most of the time, but certain front-panel functions do not work.)

Instrument Preset Self Test

Begin troubleshooting by initiating the instrument preset self test, and checking the four LEDs mounted on top of the A3 microprocessor for an error code. When **[INSTR PRESET]** is pressed, or when AC line power is initially turned on, the four LEDs should momentarily turn on; then, either an error code should be displayed, or the four LEDs should turn off (indicating the self test is complete). In addition to indicating which self-test failed, the error code provides additional information about the tests that passed. Any section of circuitry exercised by a test before the indicated failure code is very probably functioning properly and can be eliminated from further troubleshooting procedures. Table 8-4 in the General Troubleshooting section lists all error codes in order of execution.

A list of the error codes for the A3 microprocessor follows:

NOTE: In the event of a front panel failure, the four front panel SWEEP TRIGGER annunciators used to indicate errors may display an incorrect error code, or none at all. Check the four LEDs on the A3 microprocessor to be certain of the error code. Press and hold down the instrument preset button to light ALL the LEDs and insure that none are burned out. Press **[INSTR PRESET]** several times to make sure the same error code appears each time.

No LEDs turn on. Self test not initiated; LEDs do not turn on when **[INSTR PRESET]** key is pressed.

Check that the power supplies are functioning. Check that TP17 is at +5 VDC and free of excessive digital noise. Power for the RAMs is supplied by a special circuit (Q5, Q6, and Q7). This circuit recharges the battery, and prevents it from discharging through the power supply when the power is off. Check pin 18 of the RAMs (U14, U15, U7, and U8) for slightly under 5 VDC. Also make sure that pin 1 of U13 or U6 is at approximately 3.6 VDC.

Next, the clock generation block should be checked. The clock oscillator output (TP27) should be a 10.7 MHz square-wave. The AVS (TP4), IOS (TP10) and DBE lines are driven directly by U16, while the phase 1 (TP2) and phase 2 (TP1) lines are buffered by clock drivers Q1, Q3, Q2, and Q4. These four clock signals run at approximately 973 kHz, completing one cycle for every eleven cycles of the 10.7 MHz clock. Typical waveforms can be found in the circuit description section.

Check the other control lines to the microprocessor. In normal operation, L RES (pin 40), L HALT (pin 2), L NMI (pin 6 or TP8), and VCC (pin 8) should all be at 5.0 VDC. If L NMI is low, it can be forced back high by grounding TP16. If the microprocessor then functions properly, troubleshoot the interrupt circuitry. In normal operation, L IRQ will show periodic interrupts from the front panel at roughly 1370 Hz, plus occasional end-of-sweep interrupts.

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E015 Microprocessor — All of the error code LEDs turn on if the microprocessor cannot execute the first (RAM) self-test. This can be caused by one or more of several different failures. These include malfunctioning of the microprocessor itself, a failure in ROM1,2 (Addresses C000 to FFFF) containing the self-test software or its enable line, or a failure in the address or data busses. In most cases, the free run test must be performed to isolate the failure. Refer to Table 8-5 for Troubleshooting instructions.

E014, E013, E012, E011 RAM — These codes indicate a failure in RAM according to Table 8-14.

Table 8-14. RAM Error Codes.

Error Code	Enable Line	Address (Hexidecimal)	Data Lines	RAM
E014	L RAM1	0400-07FF	D4-D7	U15
E013	L RAM1	0400-07FF	D0-D3	U14
E012	L RAM2	0000-03FF	D4-D7	U8
E011	L RAM2	0000-03FF	D0-D3	U7

The RAM test checks every bit of every RAM address location for both read and write capability. The microprocessor steps through each location, reads its contents, writes the complement, and reads it back. These two words are then checked to assure that the complement was indeed written into RAM and read back. Finally, the original contents of the locations are restored. U8 and U7 are tested simultaneously. U8 contains D0-D3 information and U7 contains D4-D7 information. U15 and U14 are also tested simultaneously. U15 contains D0-D3 information and U14 contains D4-D7 information. The U8/U7 group is tested first. If an error occurs, the microprocessor determines if the most significant bits (D4-D7) or least significant bits (D0-D3) caused the error, and displays the appropriate error code.When a RAM failure is detected,the microprocessor jumps immediately to the beginning of the RAM test and starts over.

Error codes E014 through E011 occur if a RAM cell is locked high or low, or if the RAM's write capability is lost. However, this error also occurs if the RAM Control section or L WRITE line are malfunctioning. It is especally important that L RAM1, L RAM2, and the L WRITE be checked for activity, since a failure in the Address Decoder could cause a RAM error code. For example, if the error code indicates a failure in U7 or U8, there should at least be a short pulse in L RAM2 to check the first cell. If there is not, the problem is probably not in the RAM at all, but in the address decoder. The free run test can be employed to check the address decoder outputs appropriate to RAM.

Also bear in mind that RAM has a power supply distinct from the 5.0 V supplies.

E010, E009, E008, E007 ROM — These codes indicate ROM failures as follows:

E010 — ROM 5 (6000-7FFF) — U10
E009 — ROM 4 (8000-9FFF) — U35
E008 — ROM 3 (A000-BFFF) — U11
E007 — ROM 1,2 (C000-FFFF) — U9

The ROM Test adds together all 8K or 16K bytes in each ROM, ignores the overflow, and compares the result against a check sum stored in a single location. If the check sum for any ROM doesn't agree, the program jumps immediately back to test the first ROM again, and does not test the remaining ROMs.

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The error code isolates the problem down to the individual ROM. However, a failure in the 8K select section of the address decoder could also cause the error, so the enabling lines (L ROM1,2 through L ROM5) should also be checked using the free run test.

E006 Front Panel Bus — This error code usually indicates a failure in the A2 front panel interface or A1 front panel assemblies. A description of the test can be found in the service section for those assemblies. However, it is possible that a failure in one of the front panel bus buffer (U22 or U32) can cause this error code. U32 is an inverting buffer that is always enabled; therefore, the output of each buffer should be the complement of its input.

U22 is a tri-state bi-directional buffer. Check the L WRITE (TP5) and L FPE (TP6) lines for activity, and ensure that identical data appears on both the input and output sides of the buffer when the L FPE is active low.

The free run test can be used to check front panel bus problems related to the A3 microprocessor. Refer to the address decoder and front panel bus sections of the free run test description.

E005 Instrument Bus — This error code indicates a problem in the instrument bus, using the self-test hardware located on the A8 HP-IB assembly. A full description of the test is contained in the service section for that assembly. However, the error code could also be produced by faulty instrument bus buffers on the A3 microprocessor.

U26 is an inverting buffer that is always enabled; hence, inputs and outputs should be complements of each other.

U27 and U28 are inverting tri-state buffers. When enabled by L IBE, outputs should be complements of the inputs.

U25 is a bi-directional tri-state buffer enabled by L IBE and controlled by L WRITE. When enabled, inputs and outputs should be identical.

The free run test can again be employed to isolate instrument bus errors traced back to the A3 board. Refer to the address decoder and instrument bus sections of the free run test description.

Free Run Test

The "Free Run Test" is used to verify the A3 microprocessor assembly. This test may also be used to verify portions of the microprocessor (U5) itself, provided the power supplies, power-on circuits, and clock circuits are functioning properly. This mode of testing is useful for checking the address decoder, the address and data busses, and the ROM containing self test program instructions (A3U9).

The "Free Run Test" is initiated by setting the eight sections of S1 open, and connecting a jumper from L DSA (TP9) to GND (TP14). This isolates the microprocessor from the data bus, so that the program codes from ROM during normal operation have no effect. Instead, the command "Clear Register B" is continuously delivered to ,and executed by, the microprocessor. In this free-run mode, the microprocessor repetitively cycles through every address location (0000 to FFFF) in sequence.

Address Bus — Since the microprocessor increments through all the address locations in binary sequence, the fifteen address lines should show a "divide by two" relationship. The A0 line (least significant bit) toggles at half the rate of the Phase 1 and Phase 2 clocks. A1 toggles at half the rate of A0, A2 at half that, and so on to A15 (the most significant bit) which has a period of approximately 135 ms. Check each line for activity. Any line locked high or low could be caused by a faulty microprocessor output, shorted or opened bus lines, or a faulty input at an address line termination. If the "divide by two" relationship between two adjacent lines is not observed, these lines may be shorted together.

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Address Decoding — As the address lines are sequenced through their range, the various I/O Ports, RAMs, and ROMs are selected in turn by the address decoder circuitry. The proper location and duration of these pulses in relation to the A15 line is shown in the address decoder timing diagram below. These can be checked on a dual-trace oscilloscpe by using a 20 ms/div sweep speed while triggering off the falling edge of the A15 line. TP12 has been provided to disable the VMA line controlling the address decoder. When TP12 is connected to Ground (TP14), all the enabling outputs from the address decoder should go high.

Data Bus — Since every possible I/O port and memory location is addressed while the microprocessor is in the free run mode, each of the data lines (D0 through D7) should show some activity. TP12 can be connected to GND to disable all ROM, RAM, and I/O outputs. In this condition, none of the tri-state drivers are enabled, and the data bus can be driven by an outside source. L A10 (TP11) is a convenient square-wave source while the microprocessor is in the free run test. Connect TP12 to TP14 (DIG GND), and drive each of the data lines (D0 through D7) in turn at J3 with a jumper from TP11. Check each line at one of the data bus terminations (e.g. U22 or U25) for the L A10 signal. Also check all other data lines for adjacent shorts.

Front Panel Bus — The front panel bus is controlled by two buffers on the A3 assembly. U32 is a unidirectional inverting buffer that is always enabled to pass five address lines and three control signals. In the free run mode, the addresses cycle in binary sequence, so the "divide-by-two" sequence should be observed continuously on L FPA0 through L FPA4. FPE should show occasional bursts of activity, being an inverted version of L FPE shown in the address decoder timing diagram. L FPRD should remain in the low (read) state, and L FPSTB should strobe at roughly 973 kHz.

U22 is a bi-directional tri-state buffer passing 8 bits of data. In the free run mode, this buffer is periodically enabled by L FPE to read in data. (Refer to the Address Decoder Timing Diagram.) Data is never written, since L WRITE stays high. The buffers can be easily tested by using L A10 (TP11) as an artificial source of data during free run. Pull the A2 assembly out of the motherboard to disconnect its data drivers. Connect TP11 to one of the front panel data lines (FPD0-FPD7); the extender board pins are convenient. Trigger the oscilloscope off L FPE, and observe the corresponding data line on the microprocessor side using the data bus test pins. The L A10 signal should pass through the buffer only when L FPE goes low and at no other times. Check all data lines for adjacent shorts.

Instrument Bus — The instrument bus terminations on the A3 assembly include four buffers: one for data, two for addressing, and one for control.

U26 is always enabled and passes six inverted control signals. In the free run mode, L I/OCLK should run at 973 kHz. L I/OSTB should run at the same rate, but in bursts corresponding L IBE going low. The others — I/OE1, I/OE2, I/OE3, and PIROME — are inverted versions of the signals shown by the Address Decoder Timing Diagram.

U27 and U29 pass thirteen inverted address lines, plus L WRITE, to the instrument bus when L IBE is low. In the free run mode, the address lines should show the usual "divide-by-two" relationship, but only when L IBE is active low. L IRD should remain low, since the microprocessor only reads during free run.

U25 is a bi-directional tri-state buffer also enabled by L IBE. The buffer is easily checked during free run. Remove the A4, A5, and A8 assemblies from the motherboard and remove the RF plug-in. Connect L A10 (TP11) to the data line in question on the instrument bus side. By triggering off the L IBE line, the L A10 signal should be observed on the corresponding test point of the data bus when U25 is enabled. (Note that data is only read in.) Check all lines to eliminate the possibility of adjacent shorts.

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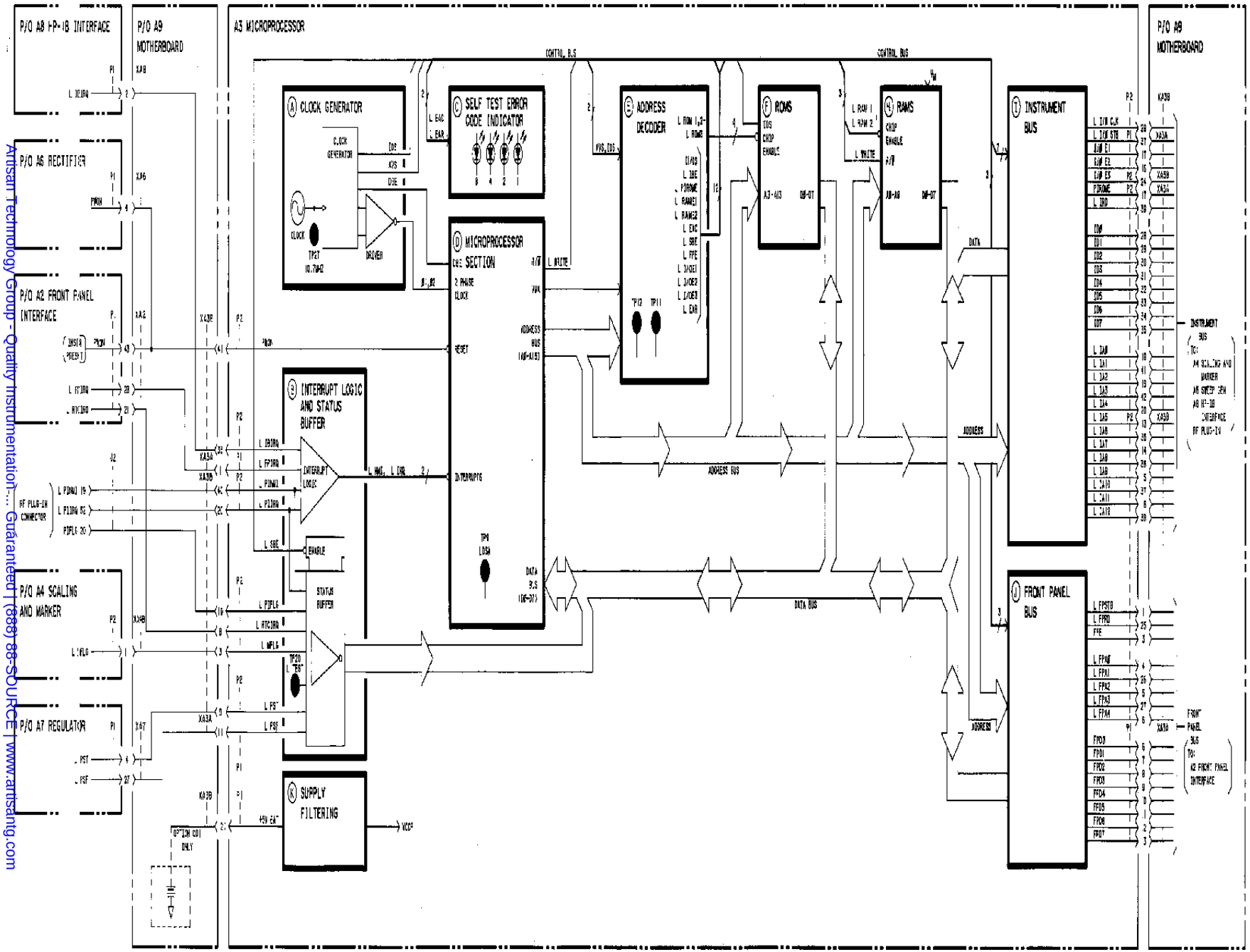


Table 8-15. Instrument Preset Error Codes

Self Test	Error Code	DS1 (8)	DS2 (4)	DS3 (2)	DS4 (1)
Microprocessor	E015	ON	On	ON	On
RAM	E014	ON	On	ON	OFF
	E013	ON	On	OFF	On
	E012	ON	On	OFF	OFF
	E011	ON	OFF	ON	On
ROM	E01C	ON	OFF	ON	OFF
	E01B	ON	OFF	OFF	On
	E01A	ON	OFF	OFF	OFF
	E007	OFF	On	On	On
Front Panel Bus	E006	OFF	On	On	OFF
Instrument Bus	E005	OFF	On	OFF	On
Power Supplies	E004	OFF	ON	OFF	OFF
Time Voltmeter	E003	OFF	OFF	On	ON
Sweep Marker	E002	OFF	OFF	On	OFF
RF Plug-In	E001	OFF	OFF	OFF	ON
Passed Self Preset		OFF	OFF	OFF	OFF

A3

Figure 8-10. A3 Microprocessor, Block Diagram

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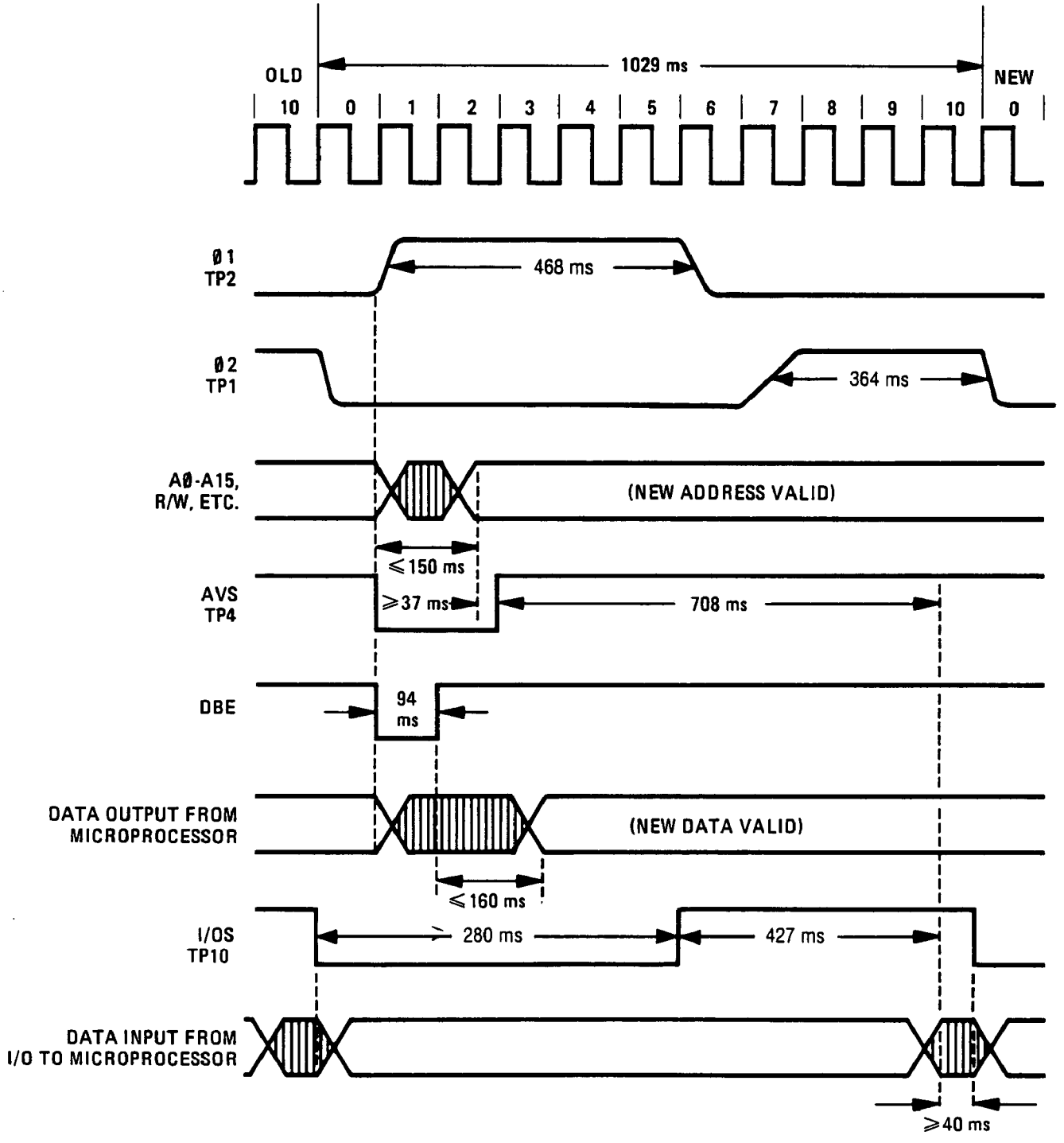


Figure 8-20. A3 Microprocessor Read/Write Timing Diagram

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FREE RUN TEST:

SET 8 SECTIONS OF A3S1 OPEN

JUMPER A3TP9 TO GROUND (A3TP14)

TRIGGER OSCILLOSCOPE ON NEGATIVE EDGE OF A15 (A3J4-1)

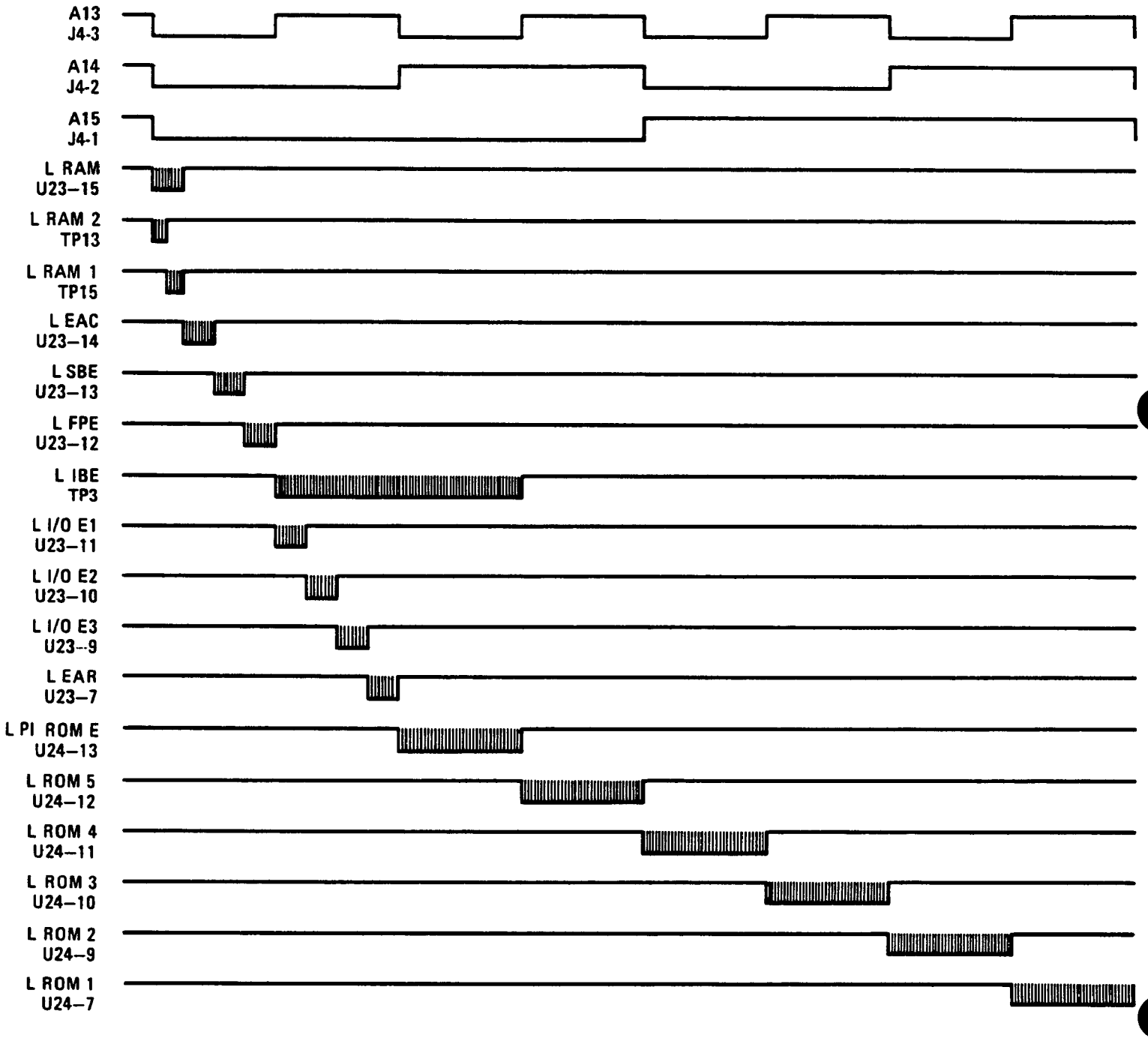


Figure 8-21. Free Run Test, Timing Diagram

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A3P1

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1 23	L FPIRQ GND DIG	IN	A2P1-23	B K
2 24	GND DIG GND DIG			K K
3 25	+5VA +5VA	IN IN	A7P1-2, 24 A7P1-2, 24	K K
4 26	+5VA +5VA	IN IN	A7P1-2, 24 A7P1-2, 24	K K
5 27	GND DIG GND DIG			K K
6 28	FPD0 ID0	I/O I/O	A2P1-28 INST. BUS	J I
7 29	FPD1 ID1	I/O I/O	A2P1-28 INST. BUS	J I
8 30	FPD2 ID2	I/O I/O	A2P1-7 INST. BUS	J I
9 31	FPD3 ID3	I/O I/O	A2P1-29 INST. BUS	J I
10 32	FPD4 ID4	I/O I/O	A2P1-8 INST. BUS	J I
11 33	FPD5 ID5	I/O I/O	A2P1-30 INST. BUS	J I
12 34	FPD6 ID6	I/O I/O	A2P1-9 INST. BUS	J I
13 35	FPD7 ID7	I/O	A2P1-31 INST. BUS	J I
14 36	GND DIG GND DIG			K K
15 37	GND DIG L I/OSTB	 OUT	 INST. BUS	K I
16 38	I/OE2 GND DIG	OUT	INST. BUS	I K
17 39	I/OE1 L IRD	OUT OUT	INST. BUS INST. BUS	I I
18 40	L IA0 GND DIG	OUT	INST. BUS	I K
19 41	L IA2 L IA1	OUT OUT	INST. BUS INST. BUS	I I
20 42	L IA4 L IA3	OUT OUT	INST. BUS INST. BUS	I I
21 43	+5V BAT GND DIG	IN	BT1	K K
22 44	GND DIG GND DIG			K K

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A3P2

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	L FPSTB	OUT	A2P1-13	J
23	GND DIG			K
2	GND DIG			K
24	I/OE3	OUT	INST. BUS	I
3	FPE	OUT	A2P1-15	J
25	L FPRD	OUT	A2P1-37	J
4	L FPA0	OUT	A2P1-16	J
26	L FPA1	OUT	A2P1-38	J
5	L FPA2	OUT	A1P1-17	J
27	L FPA3	OUT	A2P1-39	J
6	L FPA4	OUT	A2P1-18	J
28	GND DIG			K
7	GND DIG			K
29	L I/OCLK	OUT	INST. BUS	I
8	L RTCIRQ	IN	A2P1-21	B
30	GND DIG			K
9	L PST	IN	A7P1-4	B
31	L MFLG	IN	A4P2-11	B
10	GND DIG			K
32	GND DIG			K
11	L PSF	IN	A7P1-27	B
33	L IBIRQ	IN	A8P1-2	B
12	GND DIG			K
34	GND DIG			K
13	L IA5	OUT	INST. BUS	I
35	L IA6	OUT	INST. BUS	I
14	L IA7	OUT	INST. BUS	I
36	L IA8	OUT	INST. BUS	I
15	L IA9	OUT	INST. BUS	I
37	L IA10	OUT	INST. BUS	I
16	L IA11	OUT	INST. BUS	I
38	L IA12	OUT	INST. BUS	I
17	PIROME	OUT	J2-45	I
39	GND DIG			K
18	GND DIG			K
40	L PINMI	IN	J2-19	B
19	L PIFLG	IN	J2-20	B
41	PWON	IN	A6P1-6	D
20	L PIIRQ	IN	J2-52	B
42	N. C.			
21	GND DIG			K
43	GND DIG			K
22	GND DIG			K
44	GND DIG			K

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NOTES

1. The following key entries provide front panel access for a data write/read operation to/from the addressed location:

Function	Key Entry
*Hex Address Entry	**[SHIFT] [0] [0]** (enter hex address)
Hex Data WRITE	**[M2]** (enter data: two hex digits)
Hex Data READ	**[M3]**
Hex Data Rotation Write	**[M4]**
Hex Addressed Fast Read	**[M5]**

   *To address a different location, press **[M1]** and enter the new address, or use the increment keys **[▲] [▼]** to step to the new address.

2. +5VCCP is the RAM power supply. This voltage is maintained by +5V BAT when the main power is turned off.

3. RAM/ROM self-test error codes are listed next to the associated RAM or ROM.

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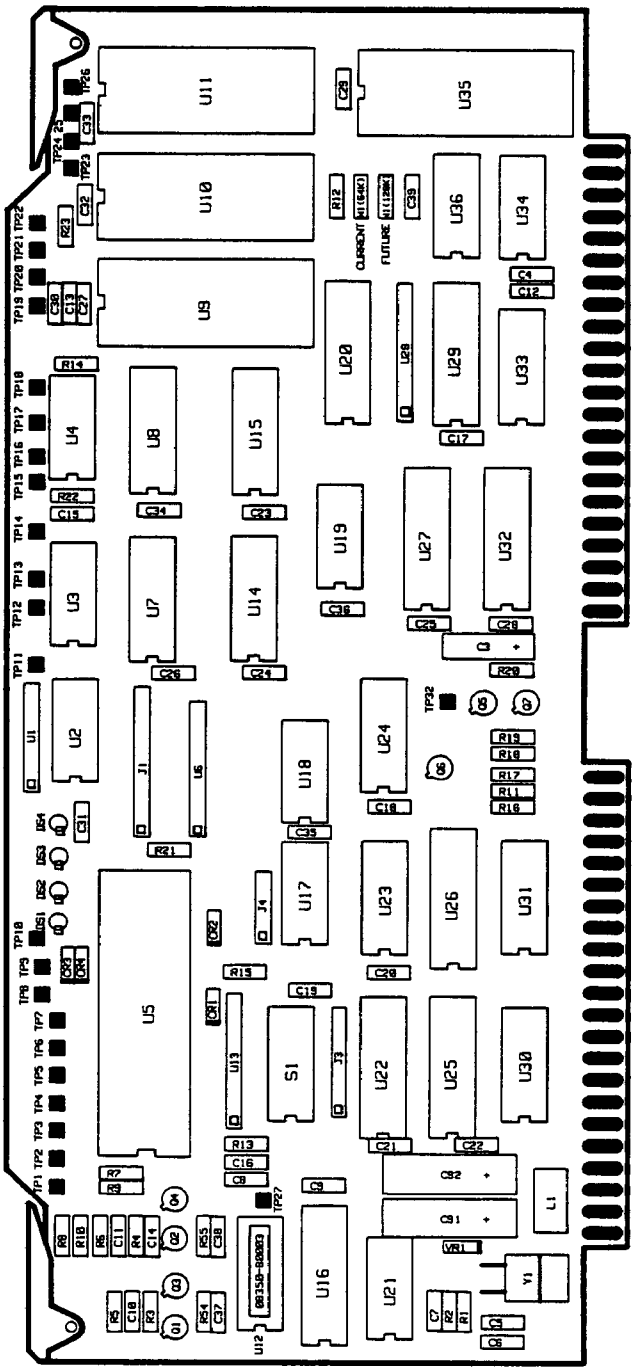


Figure 8-22. A3 Microprocessor Component Location Diagram

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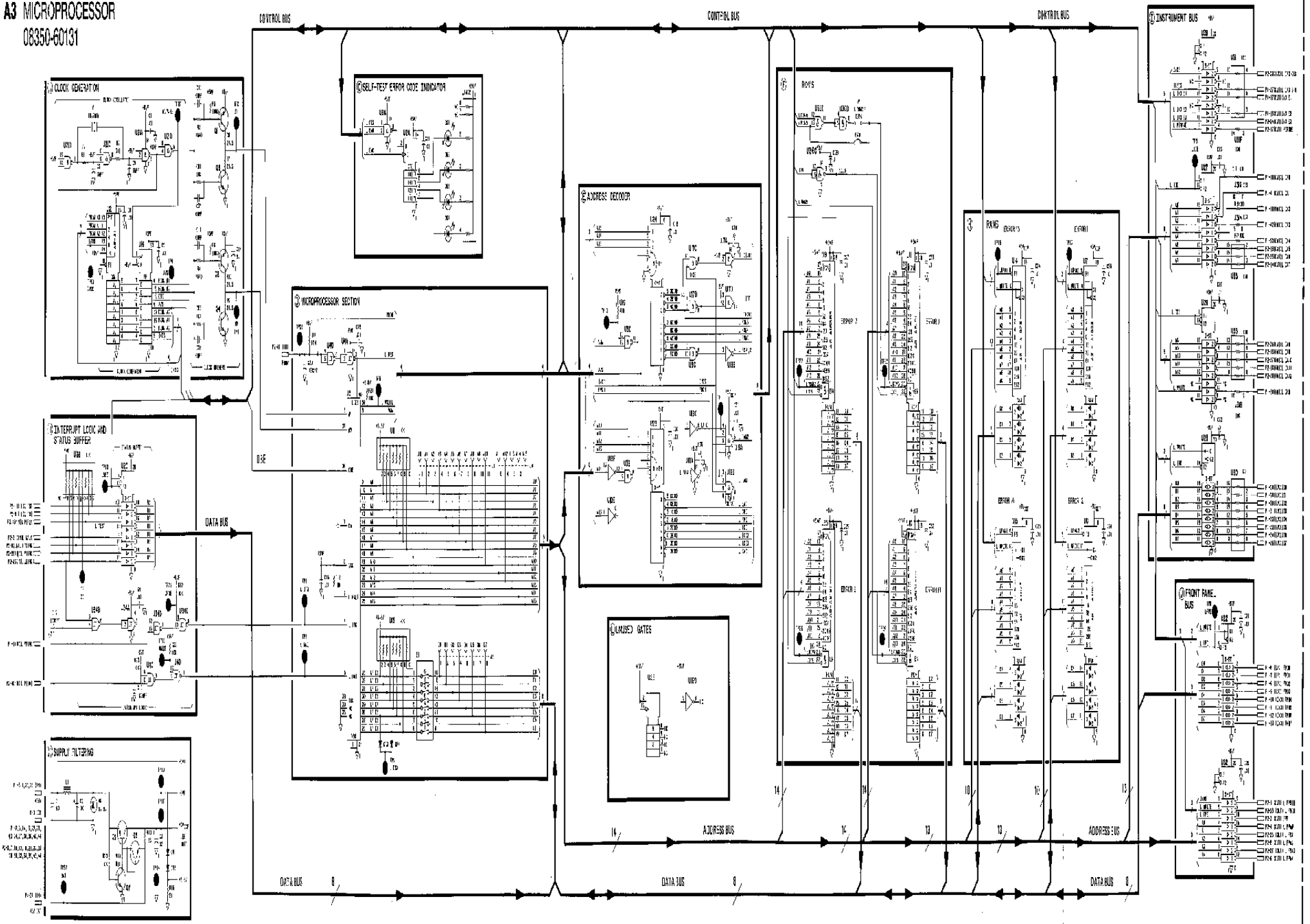


Figure 8-23. A3 Microprocessor Schematic Diagram

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A4 Scaling & Marker

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A4 Scaling and Marker Assembly, Circuit Description

INTRODUCTION

The A4 scaling and marker assembly provides a scaled tuning voltage (VTUNE) to the RF plug-in, and generates marker pulses for the five HP 8350B markers (M1 through M5). A +10V reference supply provides an accurate reference voltage for all Digital-to-Analog Converters (DACs) in the HP 8350B. The address decoder and data buffer provide the interface with the A3 microprocessor.

Scaling Circuits — The VTUNE output is the sum of the three following scaling DAC outputs.

- **CW, CF Generation.** The voltage at TP8 is proportional to CW frequency or the Center Frequency (CF) during swept operation. This output voltage is determined by data written into DAC U9 through data latches U15 and U17A. When in CW mode the CW DAC works in conjunction with the vernier DAC to provide maximum CW resolution at all times.

- **Vernier**. The output current at TP9 is proportional to front panel VERNIER control. This control provides fine adjustment of CW, CF frequency. Data is written to DAC U10 through data latch U16.

- **ΔF Generation.** The output voltage at TP6 is proportional to the frequency range swept (i.e. For a 2 GHz to 3 GHz sweep, ΔF is 1 GHz.) The 0 to +10V sweep ramp (VSW1) at TP1 is scaled by DAC U7 according to data written into data latches U13 and U14. Analog switch U8A/B/C provides further scaling according to the ratio of ΔF sweep to full band sweep.

Marker Circuits — The marker circuits generate a pulse corresponding to each selected marker frequency. A pulse is also generated corresponding to the active marker, that is, the marker whose key annunciator is blinking.

For each marker, two data bytes are neccessary from the A3 microprocessor to generate one marker pulse; one byte corresponding to the beginning of the marker, and one byte corresponding to the end of the marker. Therefore, to generate five separate markers, a total of ten bytes are required. One additional byte, the marker terminator byte, is required to ensure that no more than five marker pulses are generated.

The marker counter in the marker counter and active marker comparator is used to select the address locations of marker RAM. The ten marker bytes plus the marker terminator byte are stored in the marker RAM. The marker bytes are stored in frequency order, not the number order as they are designated on the front panel. The leading edge marker byte for the lowest frequency marker is stored in the lowest RAM address location (hexadecimal 0), followed by the trailing edge byte in the next higher RAM address location (hexadecimal 1). The marker terminator byte is stored in RAM address location hexadecimal A (following the trailing edge of the fifth marker). Refer to Figure 8-18 for the RAM address mapping.

The marker bytes are the digital inputs which program the marker DAC. During the sweep, the output from the marker DAC is compared to a current developed from VRAMP in the comparator and marker pulse generator. From two bytes of information, one marker pulse (L MK) is developed at TP18. Feedback from the comparator and marker pulse generator is provided to increment the marker counter in the marker counter and active marker comparator.

To determine the active marker, the microprocessor compares the output of the marker counter to the known RAM address of the active marker stored in data latch U17B. The L AMK, low active marker pulse is generated when the marker counter output equals the active marker address.

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Table 8-16. Marker RAM Memory Map

Address Location (Hexadecimal)	Data Information
0	Leading edge of first marker (Lowest Frequency Marker)
1	Trailing edge of first marker (Lowest Frequency Marker)
2	Leading edge of second marker
3	Trailing edge of second marker
4	Leading edge of third marker
5	Trailing edge of third marker
6	Leading edge of fourth marker
7	Trailing edge of fourth marker
8	Leading edge of fifth marker (Highest Frequency Marker)
9	Trailing edge of fifth marker (Highest Frequency Marker)
A	Marker Terminator (FF)

Data Buffer A

Data buffer U25 is a 3-state buffer that is always enabled and buffers the instrument data bus lines D0-D7 on the A4 marker and scaling assembly. Since data is only written to (not read from) the A4 assembly, U25 only passes data in one direction.

Address Decoder B

The A4 assembly uses address locations 3000H through 3007H. When the instrument bus contains a valid address for this assembly, 3-to-8 decoder U20 decodes the address to determine which device on the A4 assembly is addressed by the A3 microprocessor.

Tri-state buffer U26 buffers the I/OE3, L IRD, I/OSTB, and instrument address bus lines L IA0 through L IA2. Three to eight decoder U20 is enabled by L I/OE3, L WRITE, and L I/OSTB. U20 decodes address lines L IA0 through L IA2 and generates the low active chip select signals (LEN1-LEN7) for the A4 assembly. See Table 8-17 for an index of the address decoding.

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Table 8-17. Scaling and Marker Address Decoding

Address (Hexadecimal)	Address Decoder Components	Components Addressed	Read or Write	Description
3000	U20, U26	U16	WRITE	Address data latch for Vernier DAC U10.
3001	U20, U26	U15	WRITE	Address data latch for lower 8 bits of CW, CF DAC U9.
3002	U20, U26	U17A, U17B	WRITE	Address data latch for upper 4 bits of CW, CF DAC U9, and Active Marker Comparator U22.
3003	U20, U26	U13	WRITE	Address data latch for lower 8 bits of ΔF DAC U7.
3004	U20, U26	U14	WRITE	Address data latch for upper 2 bits of ΔF DAC U7, Scaling Switch U8A, B, C, Self Test Switch U8D, and MARKER DISABLE Gate U27C.
3005	U20, U26	U21	WRITE	Preset Marker Counter U21 to data input value.
3006	U20, U26	U21, U18, U23	WRITE	Decrement Marker Counter by one count. Address Marker RAM U18, U23.
3007	U20, U26	Not Used		

CW, CF Generation C

The CW, CF generation circuit generates a voltage at TP8 proportional to the selected CW frequency or the center frequency (CF) of a swept frequency setting.

The A3 microprocessor writes the digital equivalent of the CW or CF frequency on the instrument data bus. Since U9 is a 12-bit DAC, two write operations are required to load the DAC. Data flip-flops U15 and U17A latch the data from the instrument data bus when clocked by L EN2 and L EN3. This data is applied to the inputs of Digital to Analog Converter (DAC) U9. U9 is a programmable current source, with the maximum current available determined by the +10V REF input. Operational amplifier U3 provides current-to-voltage conversion with its feedback resistor internal to U9. The DAC current output, and therefore the voltage at TP8, is directly proportional to V REF and the digital value loaded. The output is applied through resistor R40 to the summing junction, U4 pin 2. CW adjustment, R27, sets the gain for the CW signal. When in CW mode the CW/CF circuit is used in conjunction with the vernier circuit to provide a maximum CW resolution at all times.

ΔF Generation D

The ΔF generation circuit generates the scaled ramp portion of the tuning voltage for all swept frequency modes. The A3 microprocessor sends out the digital equivalent of the swept frequency setting on the instrument data bus. Data flip-flops, U13 and U14, latch the data when clocked by LEN4 and LEN5.

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VSW1 is a 0V to +10V ramp from the A5 sweep generator assembly. Operational amplifier U6 offsets and amplifies the VSW1 input to provide a −10V to +10V ramp output. Potentiometer R2 provides an offset adjustment for the ramp output. This −10V to +10V ramp is applied to DAC U7 as the Reference Voltage (V REF). Since V REF is proportional to the sweep ramp, the digital data loaded scales the ramp output at TP3 to provide a ramp proportional to the swept frequency range.

Over wide sweep widths, the inverted, scaled output of U1 is selected by switch U8A and applied to the noninverting input of U2. For narrower sweep widths, the output of U1 is applied through divider network R14, R15, R16 (divide by eight) or R17, R18, R19 (divide by 64) to provide greater resolution. The switching occurs when the swept frequency range is 1/8 or 1/64 of the RF plug-in band. U8 selects the appropriate scaled ΔF signal. Data lines D2 through D4 (DA210 through DA212) are latched by U14 and control the switch settings of U8.

The selected ΔF signal is applied to buffer U2 and then to the summing junction via R36, R50, and R25. Potentiometer R25 (ΔF1) scales the Summing Amplifier input voltage. R15 (ΔF2) and R18 (ΔF3) adjust the divide ratio for the higher resolution settings (narrow sweeps).

Vernier E

The vernier DAC provides a symmetrical output corresponding to a vernier range of + 0.05% of the frequency range of the RF plug-in.

The A3 microprocessor writes the digital equivalent of the CW vernier setting on the front panel of the HP 8350B on the instrument data bus. This data is latched into U16 when clocked by LEN1 and then applied to the digital inputs of DAC U10.

+10 V REF is applied through R10 to pin 14 of DAC U10. This voltage is converted into a current internal to U10 and is scaled according to the digital inputs. The resultant current is then applied to a current divider comprised of R24, R23, and R22 of the summing junction, U4 pin 2. R22 (VERNIER) adjusts the vernier gain, and R44 adjusts the CW offset. The vernier circuit is also used during CW mode to increase CW resolution.

Summing Amplifier F

The outputs from the three scaling DACs are summed together at the summing junction, U4 pin 2. This combined signal is inverted through U4 and becomes VTUNE. CR1 and VR1 are utilized as protection diodes to prevent VTUNE from going higher than +11.0 volts or lower than −0.6 volts. VTUNE exits the assembly via J1 and is applied to the plug-in connector J3 via cable W3. VTUNE is also supplied to the comparator and marker pulse generator through the self test switch, U8D, during the tuning voltage versus marker self-test.

Self Test I

The tuning voltage versus marker DAC self test is initiated at initial power on, during instrument preset, or when **[SHIFT] [1] [0]** is entered. During this test, SELF TEST ENABLE from the ΔF generation circuit goes high engaging switch U8D. The output from summimg amplifier U4 is compared to the output from marker DAC U11, at pin 3. When the value of the combined outputs crosses zero volts, U11 pin 7 goes low. This signal is buffered through U27B and is applied to the A3 microprocessor as LMFLG (Low=Marker Flag). If the microprocessor does not receive the L MFLG signal during power on or instrument preset, error message E003 is displayed on the front panel.

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+10V Reference G

+10V REF is applied through R35 to three parallel resistor zener diode networks, R56 VR5, R57 VR6, R58 VR7. This reduces the noise on the +6.2 volt signal applied to the noninverting input of operational amplifier U5. Feedback is provided through Q1, R13 and R59 . R59 sets the gain for U5, and is adjusted for +10 volts at TP14. Q1 provides current drive capability for the +10 volt supply. +15 VF through R7 and R35 provides initial start-up bias.

Marker Circuits H J K L

The marker circuits produce a Low Marker pulse (L MK) and Marker Flag (L MFLG) output for each marker. LMFLG is used only for self tests. During sweep retrace, the A3 microprocessor loads the marker RAM with two data bytes for each marker position. The marker RAM addressing is controlled by marker counter U21. At the beginning of each forward sweep, marker counter U21 is preset to zero to access the data for the leading edge of the lowest frequency marker. This data byte is used to program marker DAC U12. Operational amplifier U28 provides current-to-voltage conversion with its feedback resistor internal to U12. Marker comparator U11 compares the DAC circuit output with the sweep ramp voltage (VRAMP), and generates a low output when they are equal. The marker counter is incremented, and the marker DAC output is increased to correspond with the marker trailing edge position. This results in the marker comparator output being reset high, and enableing the detection of the marker trailing edge.

Marker Load Cycle — Two enable lines are used during the load cycle. L EN6 which presets marker counter U21, and L EN7 which enables the writing of data to the marker RAM and decrements the marker counter. The following sequence occurs during every sweep retrace.

NOTE: The marker RAM data output is the complement of its data input. For example, to obtain all high outputs (hexadecimal FF), all data inputs must be low (hexadecimal 0 0).

The A3 microprocessor writes the hexadecimal value A on instrument bus data lines D0 through D3. LEN6 is set low, then this value is loaded into marker counter U21. This value appears at the counter output and addresses marker RAM location A (hexadecimal). The A3 microprocessor then writes the marker terminator byte on the instrument bus data lines D0 through D7. With L EN7 now set low, the terminator byte is written to the marker RAM (hexadecimal 00 is loaded so that the RAM data output will be hexadecimal FF). L EN7 simultaneously decrements the marker counter U21 to address the next lower RAM address (9). The A3 microprocessor writes the value of the marker trailing edge for the highest frequency marker on the instrument bus data lines D0 through D7. The low L EN7 value is then stored in RAM location nine. The marker counter output is decremented by one, and the microprocessor writes the leading edge of the highest frequency marker into RAM location eight. The cycle continues until the trailing and leading edges for all five markers are loaded into RAM. The microprocessor then presets the marker counter to zero for the start of sweep. Refer to Figure 8-25 for the RAM loading diagram.

Marker Pulse Generation — Marker DAC U12 operates as a current sink with the maximum current limit determined by the +10 V REF input. The output current is scaled by the data loaded. +10 V REF is connected through R39 and R28 to the +V REF input of U12. Since the marker counter is preset to zero, the resultant current at the DAC output is equivalent to the leading edge of the lowest frequency marker.

This signal is compared to the current developed by VRAMP across R31 and R46 at the inverting input of comparator U11. When the value at U11 pin 3 crosses zero, U11 pin 7 switches low. C36 delays VRAMP to equalize the delay of the sweep ramp created in the ΔF generation circuit. CR5 and CR4 are protection diodes for U11. C41 and R32 provide AC hysteresis to ensure a clean rapid transition from comparator U11.

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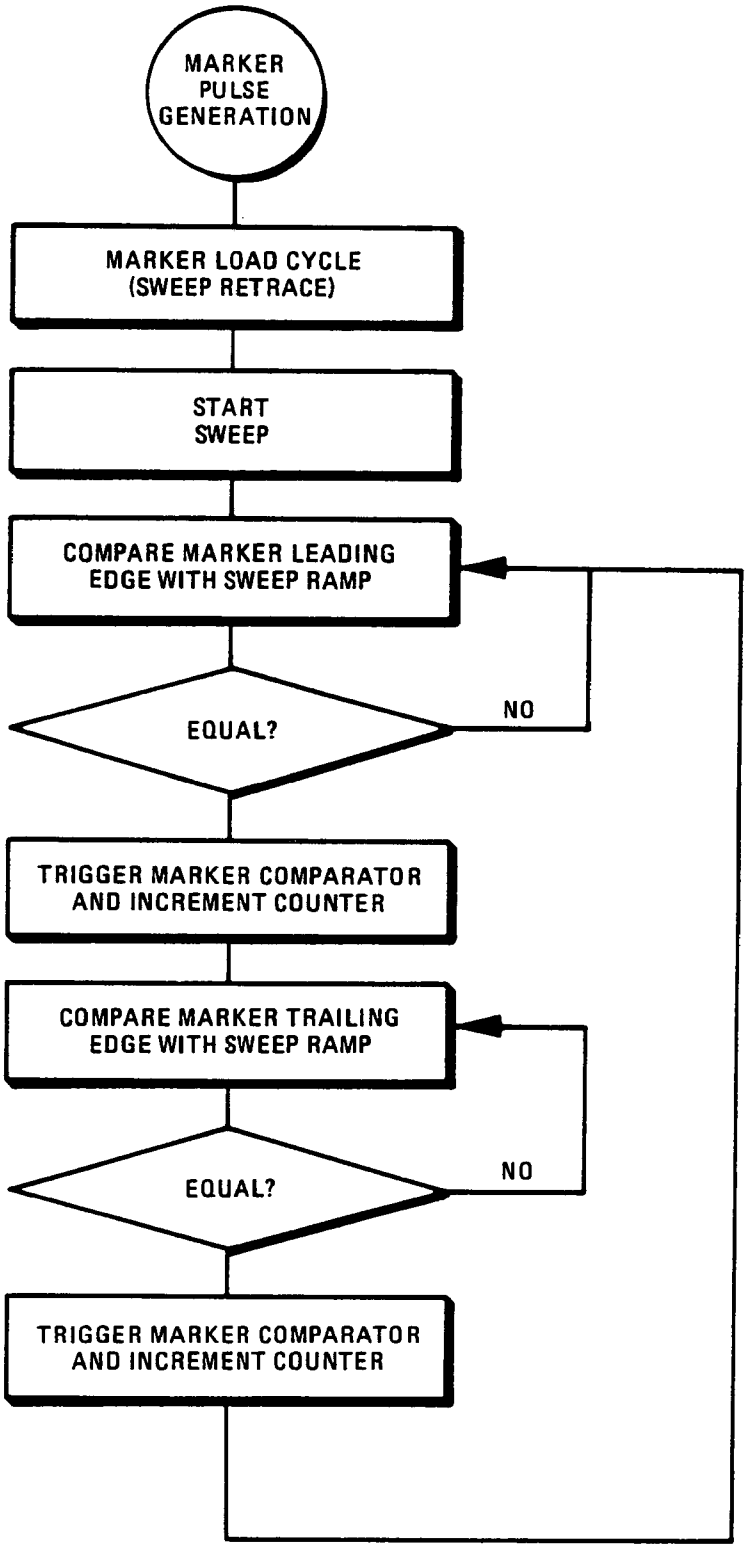


Figure 8-24. Marker Pulse Generation, Flow Diagram

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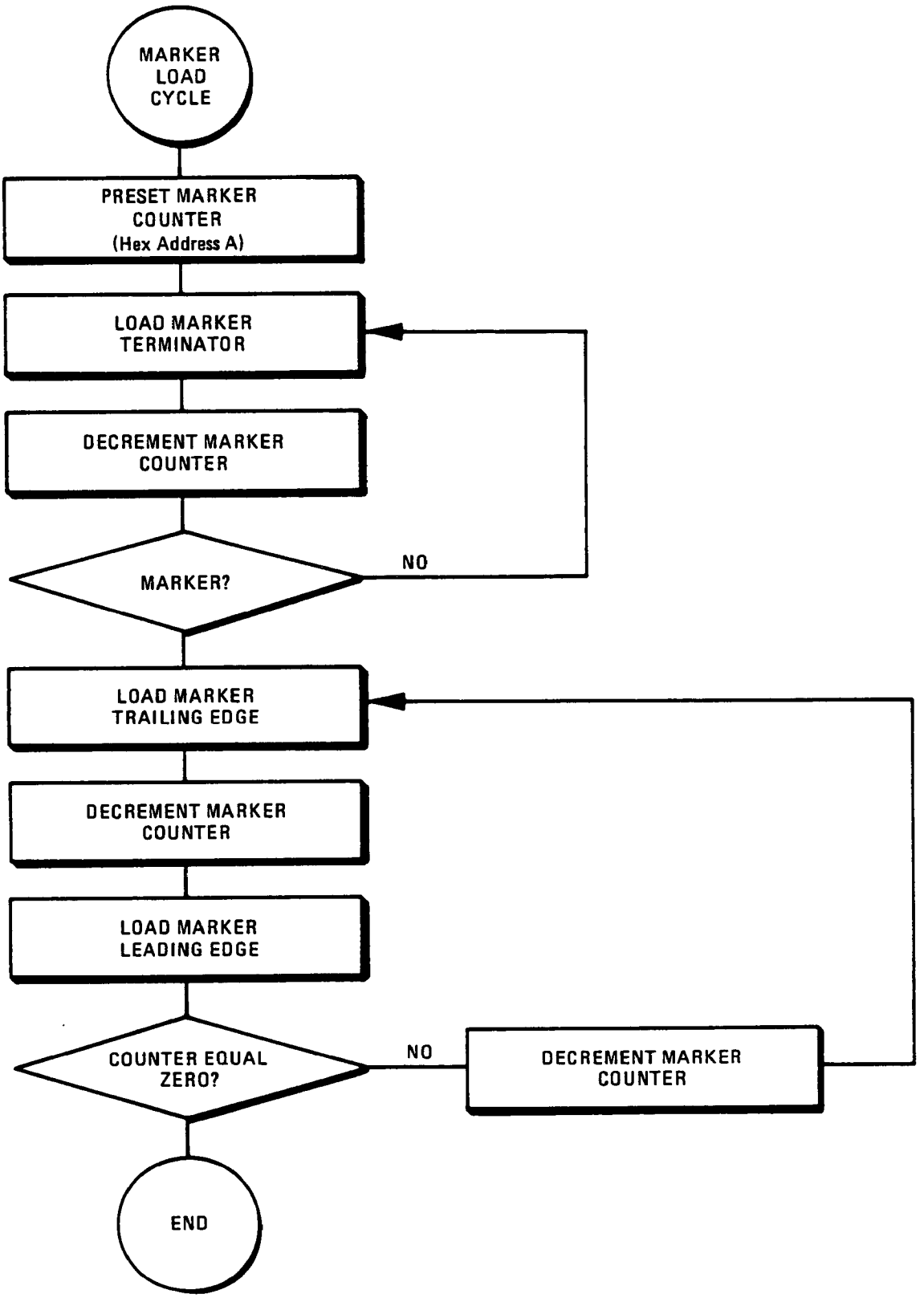


Figure 8-25. Marker Load Cycle, Flow Diagram

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A negative transition at U11 pin 7 triggers monostable multivibrator U19. It's output (a ten microsecond pulse determined by R48 and C42) appears at TP17 and clocks U24A pin 6 low. This is the beginning of the marker pulse L MK. The inverted output of U19B is used to trigger U19A. The output from U19A (a one microsecond pulse determined by R33 and C18) is buffered through U27A and fed back to increment the marker counter U21.

With the counter output incremented by one, the RAM address is incremented, and the data byte corresponding to the marker trailing edge for the lowest frequency marker is output by the marker RAM. The DAC is programmed to the new value, which is greater in value than the marker leading edge value, resulting in comparator U11 being reset. The output of the DAC circuit is compared to the current developed by VRAMP at the inverting input of comparator U11. When the value at U11 pin 3 again crosses zero, U11 output switches low. This causes U19B to trigger again, and its output at TP17 clocks U24A. The L MK output of U24A goes high ending the marker pulse. The inverted output of U19B triggers U19A again and its output is fed back to increment the marker counter which increments the marker RAM address. This address contains the data byte corresponding to the leading edge of the next marker.

This cycle continues through all five markers. After the fifth marker pulse is generated, the marker counter is set to the hexadecimal value A. The RAM is set to hexadecimal address A, which contains the marker terminator byte. This terminator byte programs the marker DAC circuit to sink more current than can be provided from VRAMP. The input to comparator U11 can not cross zero. This ensures that no more marker pulses are generated. The waveform at TP12, as well as other test points, are provided in Figure 8-29.

The marker RAM is loaded with values for five markers during every sweep retrace. If fewer than five markers are selected on the front panel, the values loaded into RAM for the unused markers is the same value as the marker terminator byte. Therefore marker pulses are only generated for each selected marker. The marker counter is reset to zero at the start of each sweep.

During retrace, LBP2 (Low=Blanking Pulse 2) is buffered through U27D and disables the marker pulse components U19A/B, and U24A/B. During CW operation, L MKR DISABLE is buffered through U27D and disables the marker pulse circuit. This ensures that no marker pulses are generated during retrace, CW operation, or manual sweep.

Active Marker — The active marker is determined as follows. During retrace, L EN3 clocks the active marker leading edge marker RAM address into data latch U17B. During the sweep, comparator U22 compares the marker counter output with the active marker address latched in U17B. When the two values are equal, the U22 output goes high. When U24B is clocked for the marker leading edge the Low Active Marker (L AMK) output goes low. When the marker counter is incremented, the U22 output goes low. Therefore, when U24B is clocked for the marker trailing edge, the L AMK output returns high. Refer to Figure 8-29 for timing relationship.

Marker Δ Mode — When marker Δ is selected on the front panel, one intensity or amplitude marker is extended between the last two markers entered. The marker Δ mode is strictly a function of data loaded in marker RAM, and operation of the marker circuits is identical to normal marker operation.

TROUBLESHOOTING

Component failures on the A4 scaling and marker assembly may be classified as either an instrument bus failure, a scaling failure, a marker failure, or a power supply failure. If upon instrument preset, error codes E005, E003, or E002 occur, a failed component may exist on this assembly. There are a total of seven self-tests available specifically for troubleshooting the A4 scaling and marker assembly. Two of these tests (tuning voltage versus marker, and sweep versus marker) are functional checks

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that are performed at initial power on or whenever **[INSTR PRESET]** is pressed. Since these checks only check basic operation (not accuracy), the A4 scaling and marker assembly may have a component failure without generating an error code. Five operator initiated tests are available for checking the operation of each DAC circuit. By using the hex data write feature of the HP 8350B, each DAC may also be individually addressed and loaded from the front panel, and monitored with an oscilloscope. The following troubleshooting information is organized by symptoms (error code or type of failure), with an explanation of applicable self tests and waveforms.

Error Code E005

Instrument Bus Test. Correct instrument bus operation is checked during the instrument preset self tests. If the front panel **[INSTR PRESET]** is pressed and error code E004 or lower occurs, instrument bus operation is verified. If E005 occurs, perform an instrument preset self test with the A4 scaling and marker assembly removed. (This removes the possibility of A4 causing an instrument bus error code.) If E005 still occurs, refer to Table 8-4 to isolate the problem to the assembly level.

If, upon removal of A4, E003 occurs after instrument preset, reinstall the A4 scaling and marker assembly. Press **[INSTR PRESET]**. If E005 reoccurs, the trouble is with A4U25 or A4U26. Set the HP 8350B into the repetitive instrument bus self test by pressing **[SHIFT] [0] [9]**, and checking the data, address and control inputs for activity, adjacent shorts and excessive loading.

Error Code E003

Tuning Voltage versus Marker Test. This test is performed upon instrument preset, and compares the output of the summing amplifier against the output of the marker DAC; when both outputs are equal, a Marker Flag (L MFLG) is generated and sent to the A3 microprocessor.

The CW DAC is programmed so that its output at TP8 is −5 volts. The ΔF DAC is programmed so that its output at TP6 is a 0 to +5V rectangular waveform. The two signals are summed by summing amplifier U4 with the resultant signal at TP11. Self test switch U8D is closed to supply the VTUNE signal to the inverting input of marker comparator U11.

Marker counter U21 is sequentially decremented via LEN7 thereby addressing different marker RAM locations. The RAM is loaded with different values by the A3 microprocessor. The RAM output programs marker DAC U12. The marker DAC output is summed with VTUNE at the inverting input of marker comparator U11. When the combined values of VTUNE and marker DAC output cross zero, the U11 output at TP15 switches low. The pulse is buffered through U27B and sent to the A3 microprocessor as L MFLG (Low=Marker Flag). Note that the marker outputs L MK and L AMK are disabled by L MARKER DISABLE at the U27D pin 13 input.

If error code E003 occurs, a problem exists on either the A5 sweep generator assembly, or in the CW, CF generation, ΔF generation, summing amplifier, self test, marker, or +10 volt reference circuits. Set the HP 8350B into the tuning voltage versus marker repetitive self test by keying **[SHIFT] [1] [0]**. Verify the +10 volt reference supply at A4TP14. Verify that TP1 is at 0V. If TP1 is in error, a problem exists on the A5 sweep generator assembly. Refer to Table 8-5, A5 assembly, Error 3, for troubleshooting information. If TP1 is 0V, check waveforms at A4TP11, A4TP12 and A4TP15 according to Figure 8-28. If a waveform is incorrect, proceed as follows:

- TP11: Perform Δ F DAC, CW/CF DAC, and vernier DAC self tests. Refer to scaling failure description for information on all of these DAC tests.
- TP12: Verify switch U8D is closed, then proceed to marker circuit troubleshooting.
- TP15: Trouble is with marker comparator.

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Error Code E002

Sweep versus Marker Test. This test is performed upon instrument preset, and compares the sweep voltage (VRAMP) from the A5 sweep generator assembly against the output of the marker DAC; when both signals are equal, a marker flag is generated and sent to the A3 microprocessor.

The sweep DAC on the A5 sweep generator is programmed for a delayed stepped output, which can be monitored at A4TP13 (VRAMP). This signal is applied through R31 and R46 to the inverting input of marker comparator U11.

Marker circuit operation is identical with the operation in the tuning voltage versus marker self test, and, if it functions properly in this previous test, should not cause an error code.

If error code E002 occurs, a failure exists either in the A5 sweep generator or self test switch U8D on this assembly. Ensure that self test switch U8D is open. Set the HP 8350B into the sweep versus marker repetitive self-test by pressing **[SHIFT] [1] [1]**. Verify the waveform at A4 P1-20 according to Figure 8-28. If waveform at A4TP13 is incorrect, refer to the troubleshooting procedure for the A5 sweep generator.

Scaling Failure

Provided the instrument bus is operational, a scaling failure is limited to one of the following circuits:

- **CW, CF Generation C**
- **Vernier F**
- **F Generation I**
- **Summing Amplifier M**

Basic operation of the CW, CF generation, ΔF, and summing amplifier circuits is checked during instrument preset. However, not all failures in these circuits may be detected. Separate self tests exist for each of the scaling DACs. A description of each self test follows. For more indepth troubleshooting, any desired bit pattern may be placed on the inputs of any DAC. Refer to the hex data write description in the beginning of this section.

CW, CF Generation.

CW DAC [SHIFT] [1] [3]. Correct operation of the CW, CF generation circuit is verified by implementing the CW DAC repetitive self test **[SHIFT] [1] [3]**. This self test writes a rotating "one" to CW DAC U9. This rotating "one" is a single high bit that is rotated from the least significant to the most significant bit with the remaining bits loaded as zeros. Check for missing bits in the stepped waveform at TP8. (See Figure 8-28.)

Vernier

VERNIER DAC [SHIFT] [1] [9]. This self test writes a rotating one to Vernier DAC U10, and results in a stepped waveform at TP11. (See Figure 8-28.) Increased amplitude is obtained by shorting TP9 to TP10. The waveform should have 8 steps (9 voltage levels).

ΔF Generation

Sweep versus Δ F DAC [SHIFT [1] [5]. This self test writes a rotating one from the least significant to most significant bit of the ΔF DAC U7. VSW1 is applied as a 0 to +10V square-wave. This results in the symmetrical stepped waveform at TP3. Each half (positive and negative) of the waveform should have 10 steps (11 voltage levels).

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The sweep versus Δ F DAC self test can be utilized to verify performance of operational amplifier U6, data latches U13 and U14, DAC U7, and operational amplifier U1 in the ΔF circuitry. To implement the self test press **[SHIFT] [1] [5]** and check for waveforms indicated in Figure 8-28.

Δ F DAC [SHIFT] [1] [4]. This self test writes a rotating one from the least significant to most significant bit of ΔF DAC U7. VSW1 (TP1) is held to a constant +10 volts. This results in the stepped waveform at TP3 (See Figure 8-28). The waveform should have 10 steps (11 voltage levels).

Once proper data latch operation has been confirmed, switches U8A, B, and C, and operational amplifier U2 can be tested. Each switch is enabled separately and the output of U2 is monitored. To test these components, perform the following key strokes:

NOTE: All data entries are in hexadecimal. For hexadecimal values A through F, the key entry shown is the actual key label (e.g. **[BKSP]** equals hexadecimal F).

[SHIFT] [0] [0]	Access to HEX address entry.
[M1] [3] [0] [0] [3]	Addresses data latch U13.
[M2] [BKSP] [BKSP]	Enters hex FF into data latch U14.
[M1] [3] [0] [0] [4]	Addresses data latch U15.
[M2] [0] [7]	Writes ones into the two most significant digits of U7 and enables switch U8A. The output of U2 at TP6 will be a +10V to −10V clamped ramp.
[M2] [0] [-]	Writes ones into the two most significant digits of U7 and enables switch U8C. The output of U2 at TP6 will be a +1.2V to −1.2V clamped ramp.
[M2] [1] [3]	Writes ones into the two most significant digits of U7 and enables switch U8B. The output of U2 at TP6 will be a +0.15V to −0.15V clamped ramp.

Summing Amplifier

Provided the three scaling DACs are operational, the summing amplifier can be checked as follows.

- Remove RF plug-in from HP 8350B.
- Set line switch ON (HP 8350B should cycle through self tests and indicate E001, RF Plug-in error code).
- Monitor A4TP11. Verify the output of operational amplifier U4 is a 0V to +10V clamped ramp.

Self Test

Provided the three scaling DACs and summing amplifier are operational, self test switch U8D can be verified. U8D is enabled when U14 pin 15 is high. To test U8D perform the following key strokes:

NOTE: All data entries are in hexadecimal. For hexadecimal values A through F, the key entry shown is the actual key label (e.g. **[BKSP]** equals hexadecimal F).

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[SHIFT] [0] [0]	Access to HEX address entry self test.
[M1] [3] [0] [0] [1]	Addresses data latch U15.
[M2] [BKSP] [BKSP]	Enters hex FF into data latch U15.
[M1] [3] [0] [0] [2]	Addresses data latch U17A.
[M2] [0] [BKSP]	Enters hex F into data latch U17A.
[M1] [3] [0] [0] [3]	Addresses data latch U13.
[M2] [BKSP] [BKSP]	Enters hex FF into data latch U13.
[M1] [3] [0] [0] [4]	Addresses data latch U14.
[M2] [2] [7]	Writes ones into the two most signifcant digits of U7, enables switch U8A, and enables switch U8D. Monitor TP12 to obtain waveform located in Figure 8-26.

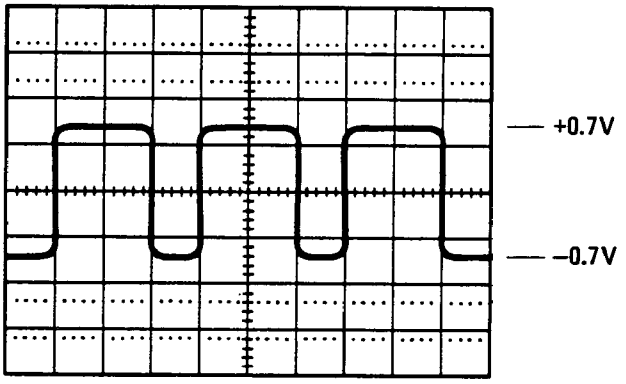


Figure 8-26. Self-Test Waveform

Marker Circuits

NOTE: TP13 must be grounded to obtain valid waveforms for marker DAC self test **[SHIFT] [1] [6]**.

Marker DAC [SHIFT] [1] [6]. This test verifies the operation of marker counter U21, marker RAMs U18 and U23, the marker DAC U12, and operational amplifier U28. The marker counter U21 is incremented sequentially, therefore addressing the different marker RAM locations of U18 and U23. A rotating one is loaded into the RAM locations; consequently, the marker DAC output at TP12 is a stepped response.

Tuning Voltage versus Marker [SHIFT] [1] [0]. Operation of the marker circuits can be verified by initiating the tuning voltage vs marker DAC repetitive self test, **[SHIFT] [1] [0]**. This test checks the performance of marker counter U21, marker RAMs U18 and U23, marker DAC U12, operational amplifier U28, marker comparator U11, and marker flag buffer U27B. To initiate the test, press **[SHIFT] [1] [0]** and check for waveforms in Figure 8-28.

Marker Pulse Generator and Active Marker Checks. The marker pulse generator and active marker comparator circuit can be verified using specific front panel settings. Provided that U21, U18, U23, U12, U11, the front panel, the front panel bus and instrument bus are operational, the following instrument set up will test the marker pulse generator and active marker comparator circuits.

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[INSTR PRESET]

[M1] [1] [GHz]	Initiates Marker M1
[M2] [2] [GHz]	Initiates Marker M2
[M3] [3] [GHz]	Initiates Marker M3
[M4] [4] [GHz]	Initiates Marker M4
[M5] [5] [GHz]	Initiates Marker M5 (Must be entered last to be the active marker)

NOTE: In Figure 8-29, marker M5 is the active marker (last marker entered).

Verify the waveforms located in Figure 8-29.

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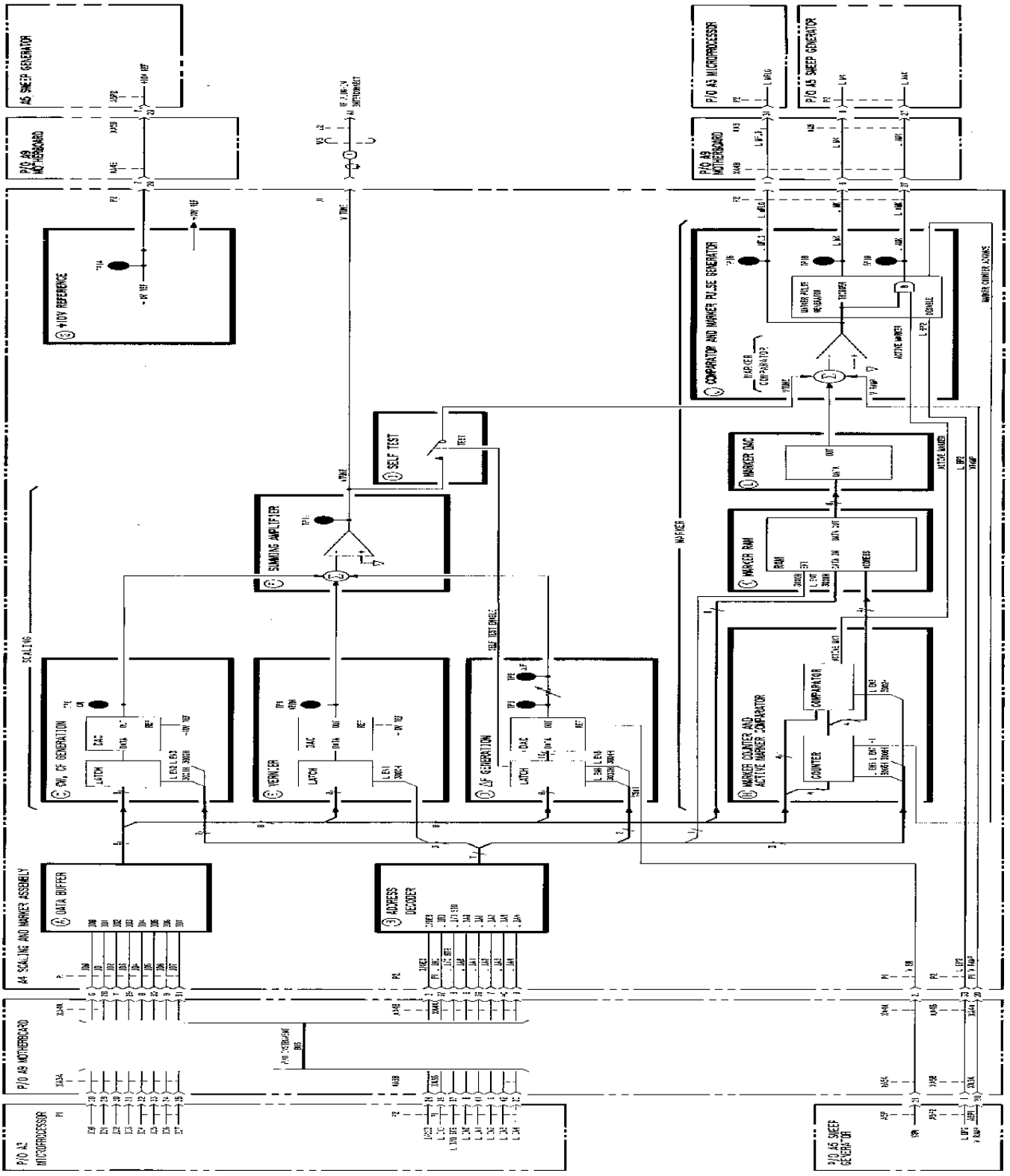


Figure 8-27. A4 Scaling and Marker Assembly, Block Diagram

8-27/8-28

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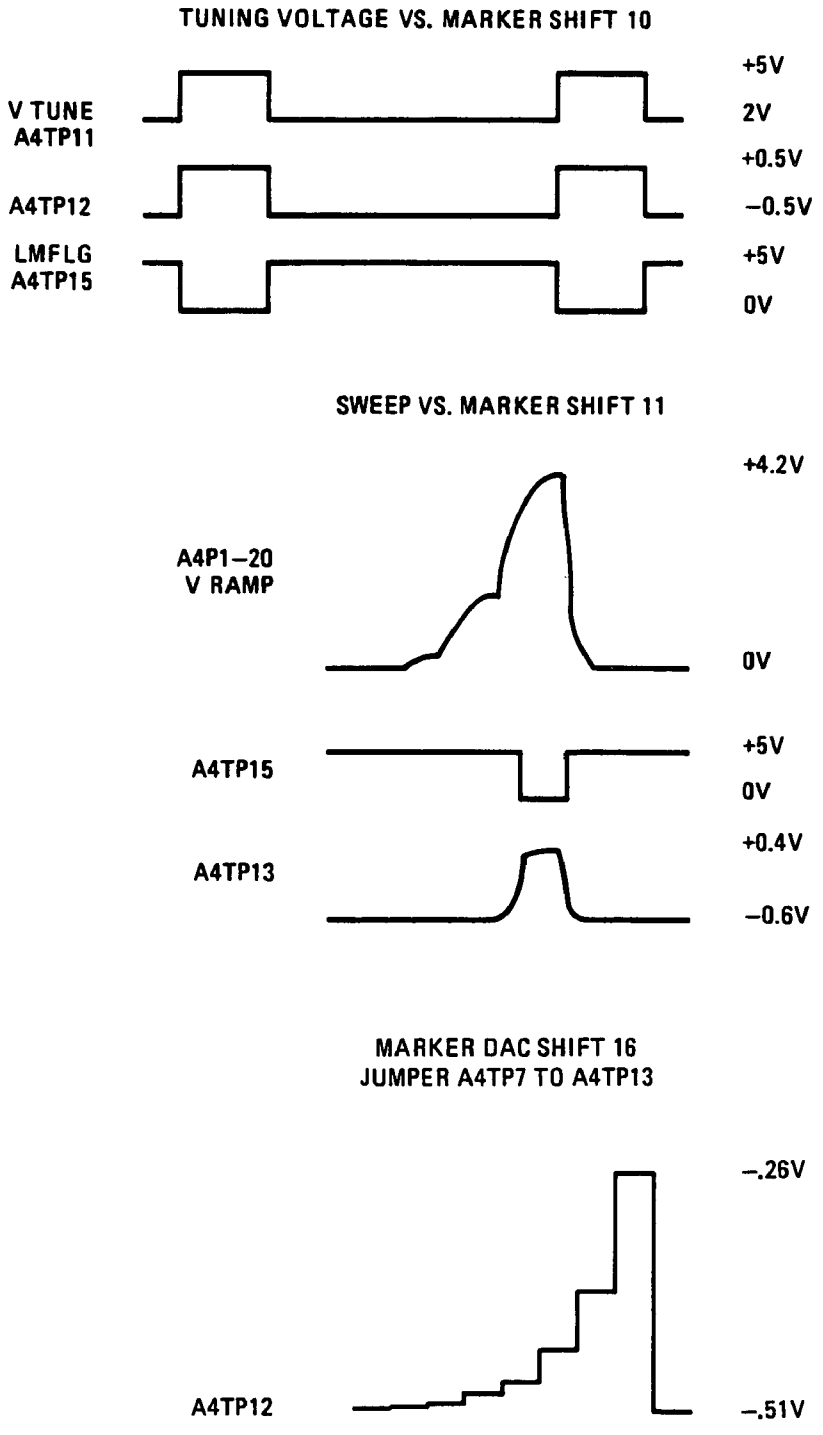


Figure 8-28. Operator Initiated Self Tests (1 of 2)

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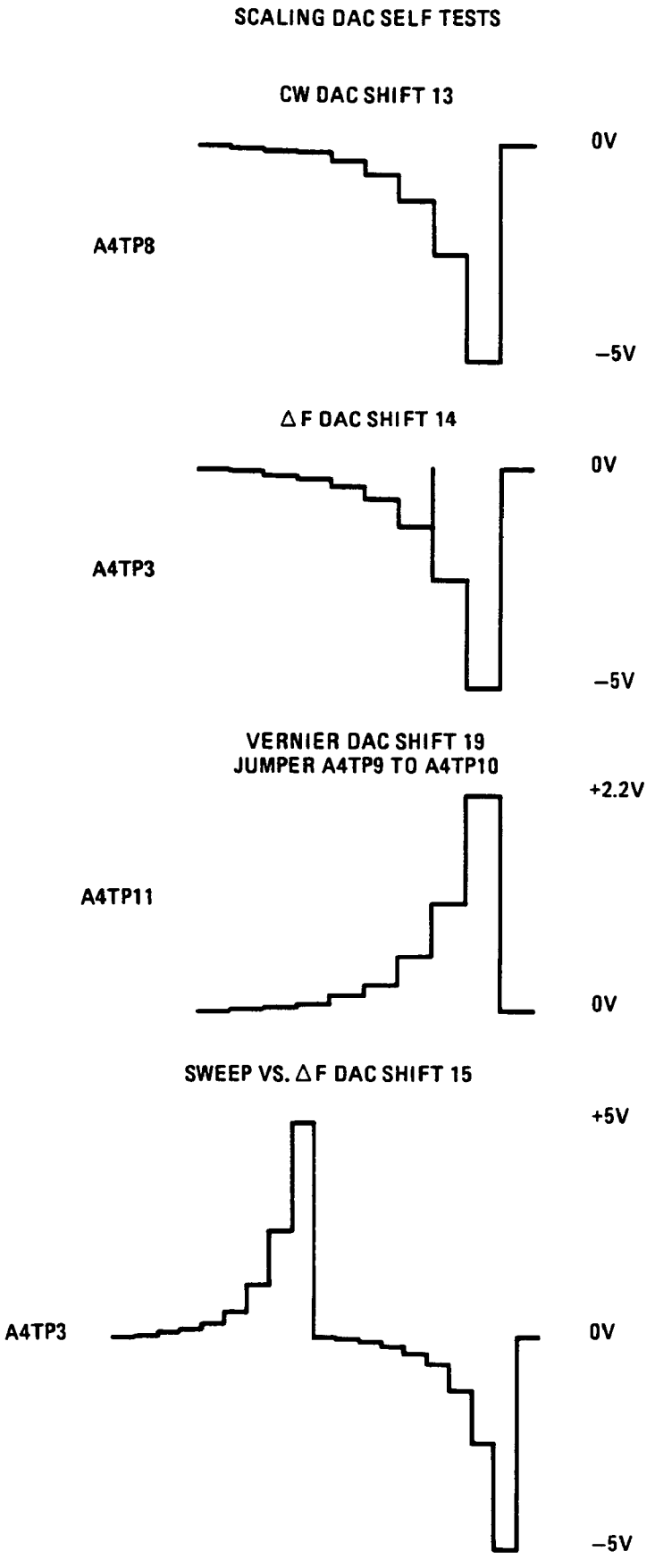


Figure 8-28. Operator Initiated Self Tests (2 of 2)

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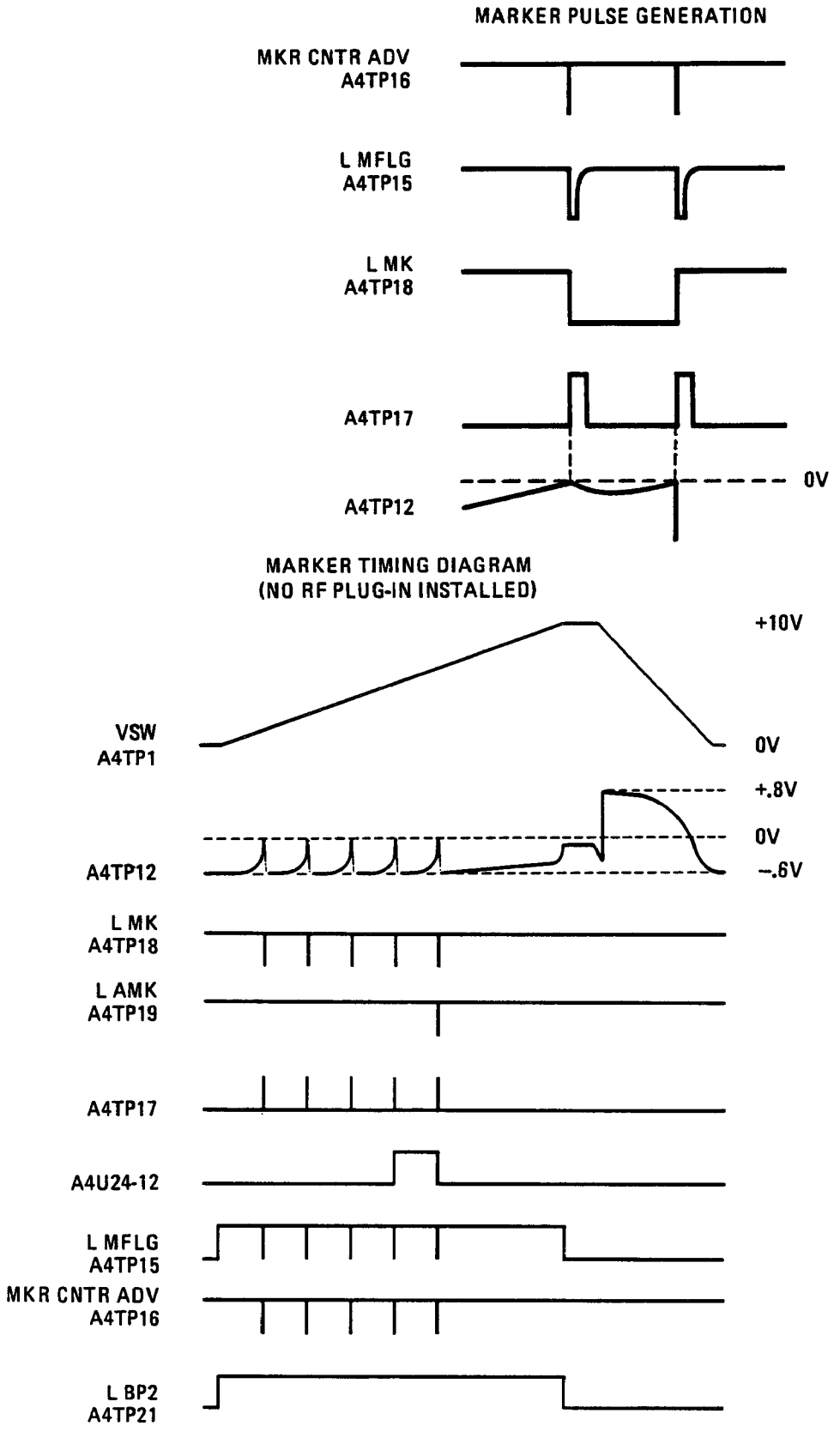


Figure 8-29. Marker Timing Diagrams

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A4P1

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	GND DIG			M
23	GND DIG			M
2	GND ANLG			M
24	GND ANLG			M
3	+5VA	IN	A7P1-2, 24	M
25	+5VA	IN	A7P1-2, 24	M
4	+5VA	IN	A7P1-2, 24	M
26	+5VA	IN	A7P1-2, 24	M
5	GND DIG			M
27	GND DIG			M
6	ID0	IN	A3P1-28	A
28	ID1	IN	A3P1-29	A
7	ID2	IN	A3P1-30	A
29	ID3	IN	A3P1-31	A
8	ID4	IN	A3P1-32	A
30	ID5	IN	A3P1-33	A
9	ID6	IN	A3P1-34	A
31	ID7	IN	A3P1-35	A
10	GND DIG			M
32	GND DIG			M
11	GND ANLG			M
33	GND ANLG			M
12	GND ANLG			M
34	GND ANLG			M
13	L I/OSTB	IN	A3P1-37	B
35	GND DIG			M
14	I/OE2	IN	A3P1-16	NOT USED
36	GND DIG			M
15	I/OE1	IN	A3P1-17	NOT USED
37	L IRD	IN	A3P1-39	B
16	L IA0	IN	A3P1-18	B
38	GND DIG			M
17	L IA2	IN	A3P1-19	B
39	L IA1	IN	A3P1-41	B
18	L IA4	IN	A3P1-20	B
40	L IA3	IN	A3P1-42	B
19	N.C.			
41	GND DIG			M
20	VRAMP	IN	A5P1-20	J
42	N.C.			
21	VSW1	IN	A5P1-20	D
43	N.C.			
22	GND ANLG			M
44	GND DIG			M

A4P2

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	GND ANLG			M
23	GND ANLG			M
2	N.C.			
24	N.C.			
3	I/OE3	IN	A3P2-24	B
25	GND DIG			M
4	−15V	IN	A7P1-14, 36	M
26	−15V	IN	A7P1-14, 36	M
5	N.C.			
27	L AMK	OUT	A5P2-27	J
6	L MK	OUT	A5P2-6	J
28	N.C.			
7	+10V REF	OUT	A5P2-7, 29	G
29	+10V REF	OUT	A5P2-7, 29	G
8	+15V	IN	A7P1-8, 30	M
30	+15V	IN	A7P1-8, 30	M
9	L I/OCLK	IN	A3P2-29	NOT USED
31	GND DIG			M
10	GND DIG			M
32	GND DIG			M
11	L MFLG	OUT	A3P2-31	J
33	L BP2	IN	A5P2-11	J
12	GND DIG			M
34	N.C.			
13	N.C.			
35	N.C.			
14	N.C.			
36	N.C.			
15	N.C.			
37	N.C.			
16	N.C.			
38	N.C.			
17	N.C.			
39	N.C.			
18	N.C.			
40	N.C.			
19	N.C.			
41	N.C.			
20	N.C.			
42	N.C.			
21	GND DIG			M
43	GND DIG			M
22	GND ANLG			M
44	GND ANLG			M

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NOTES

1. The following key entries provide front panel access for a data write/read operation to/from the addressed location:

Function	Key Entry
*Hex Address Entry	**[SHIFT] [0] [0]** (enter hex address)
Hex Data WRITE	**[M2]** (enter data: two hex digits)
Hex Data READ	**[M3]**
Hex Data Rotation Write	**[M4]**
Hex Addressed Fast Read	**[M5]**

*To address a different location, press **[M1]** and enter the new address, or use the increment keys **[▲] [▼]** to step to the new address.

2. Waveforms shown on the schematic are for instrument preset conditions and no RF plug-in installed.

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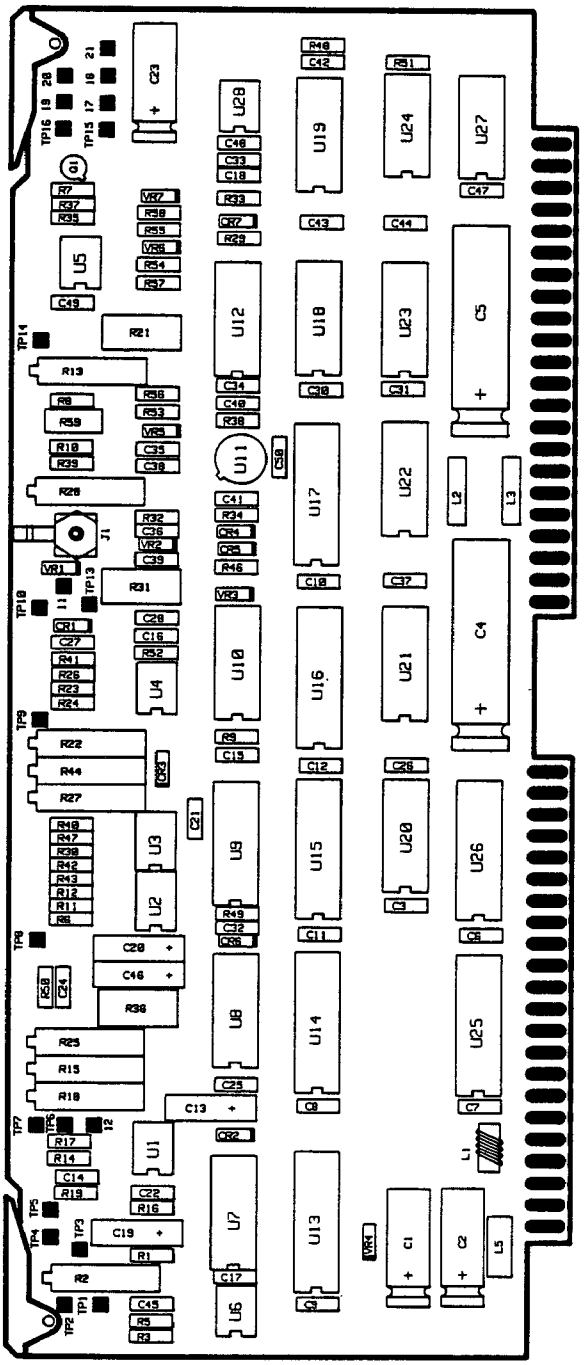


Figure 8-30. A4 Scaling and Marker Component Location Diagram

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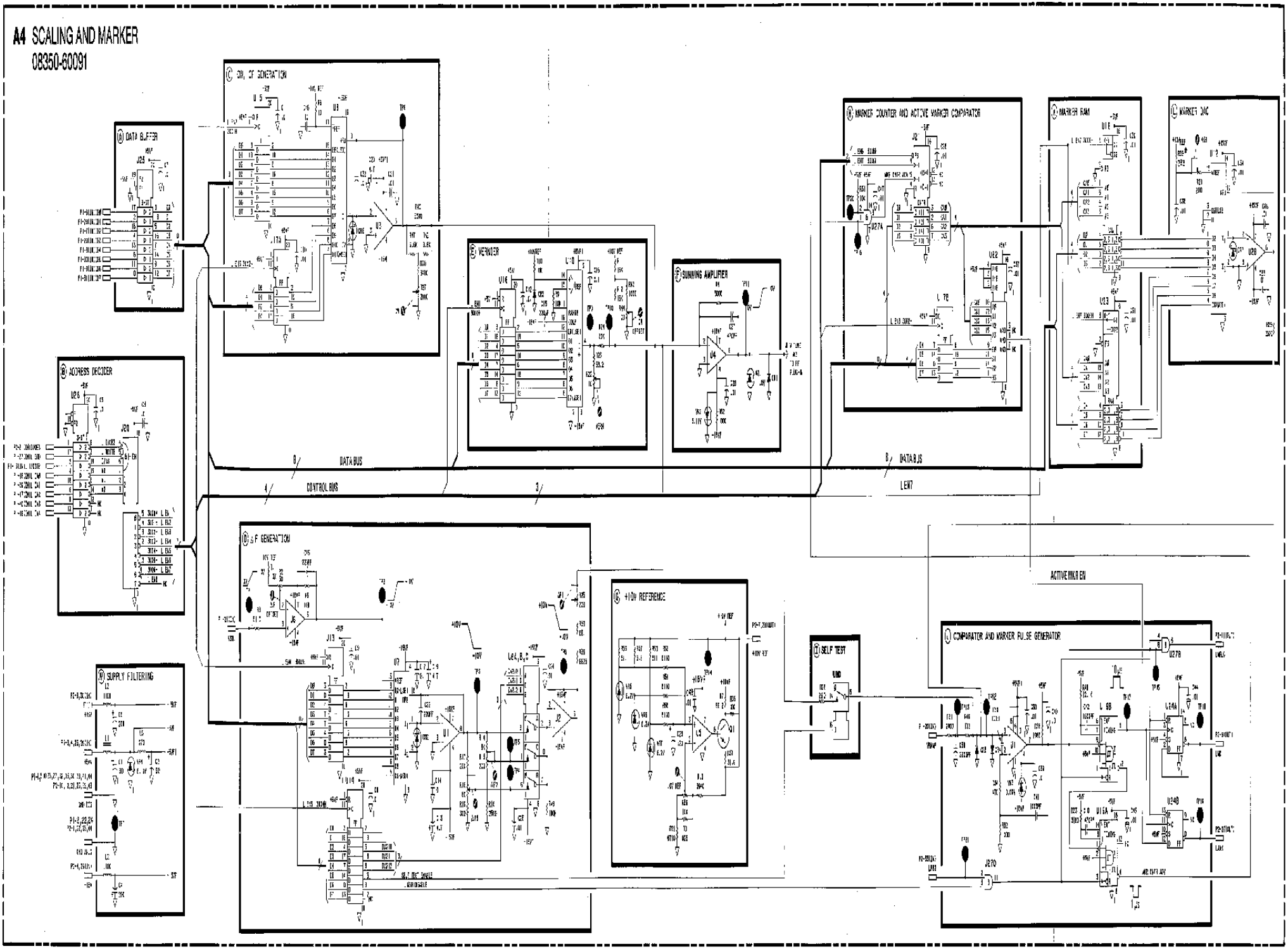


Figure 8-31. A4 Scaling and Marking Assembly, Schematic Diagram

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A5 Sweep Generator

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A5 Sweep Generator, Circuit Description

INTRODUCTION

The A5 sweep generator assembly produces a 0V to +10V sweep ramp that is used primarily to tune the frequency of the RF plug-in. The sweep ramp is also routed to the front and rear panels (sweep out) for driving the X-axis of monitoring instruments. Another function of the sweep generator is to provide timing signals to external instruments. The timing signals are in respect to the start and end of the sweep ramp.

The sweep ramp is generated by supplying a constant but programmable current to the integrator which then converts this constant current to a sweep ramp. The sweep ramp is limited by two comparators in the sweep trigger circuit. The reference voltages at the comparators are set for the upper ramp limit and the lower ramp limit. When the ramp voltage crosses these limits a retrace current source (Q3) is turned on or off. With this current source off, the ramp is a positive going ramp, and with it on, the ramp is a negative going ramp.

In the internal sweep trigger mode, the start of the sweep is triggered from the low ramp comparator. The start of the sweep can also be triggered from the AC line frequency, from an external signal or by the single trigger function.

The ramp generator produces a ramp that sweeps from −.95V to +10.8V in amplitude. This voltage is clamped by the clamping circuit at 0 and +10V. The unclamped ramp is buffered and used by the sweep timing circuit. The 0 to +10V ramp is buffered and forms four outputs: VRAMP, VSW, VSW1, and VSW2.

Address Decoder A

The A5 sweep generator uses address locations 2014H through 2017H. When the instrument bus contains an address for this assembly, 3-to-8 decoder U39 decodes the address to determine which device on the A5 assembly is being addressed by the A3 microprocessor. Table 8-19 provides an index of the address decoding.

Data Bus Buffer B

Data Bus Buffer U30 buffers the eight instrument bus data lines (ID0-ID7) going to the data latches in the software control circuit, and is always enabled. Data can only be written to the software control circuit.

Software Control C

The software control circuit consists of four eight-bit latches (U1, U8, U16, and U24) that store control information generated by the A3 microprocessor. Each latch is individually clocked by an enable line from the address decoder. Table 8-18 lists the control lines stored by the software control circuit. Note that some of these lines are wire ORed in the sweep ramp generator with hardware generated control lines.

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Table 8-18. Software Control Outputs

Mnemonic	Definition	Remarks	Destination
L ABORT	Low = Abort	Resets sweep ramp	E
L ALTE	Low = Alternate Sweep enable	Enable alternate sweep function	J13/J14
ALT1	Alternate Sweep 1	High indicates alternate sweep one is being generated.	J13/J14
L CLAMP DISABLE	Low = Clamp Disable	Disable sweep voltage ramp upper clamp.	F
CT1	Counter Trigger 1	Coded control line for determining counter trigger source.	I
CT2	Counter Trigger 2	Coded control line for determining counter trigger source	I
DBPE	Display Blanking Pulse Enable	Enables BP1 onto LP1 control line.	K
L DISABLE TRIG	Low = Disable Trigger	Disable Sweep trigger circuit.	E
L EX SW	Low = External Sweep	1. Disables integrator (Holds at high level) 2. Switches External Sweep input into VSW Buffer (Disabling VSW thru buffer)	D F
L HPIB/TRIG	Low = HP-IB Triggerr	Trigger SYNC TRG control line.	K
INT/L AMP MK	Intensity/Low = Amplitude Marker	Level determines if Output Logic circuit produces Intensity or RF Marker trigger.	K
MANUAL	Manual Sweep	Changes integrator to a current-to-voltage buffer. Sets buffer again.	D
L MANUAL	Low = Manual	Complement of MANUAL 1. Changes integrator buffer offset value. 2. Disables Sweep	D E
L RESET	Low = Reset	Disable 27 kHz/1 kHz Oscillator	J
RFBE	RF Blanking Enable	Enable PL1 to control RF blanking	K
L SNGL	Low = Single Sweep	Single sweep trigger	E
L SFSRQ	Low = Stop Forward Sweep Request	Stops and holds forward sweep ramp voltage.	D
TM1	Trigger Mode 1	Coded control line for determining trigger source.	E
TM2	Trigger Mode 2	Coded control line for determining trigger source.	E
1ms−999 ms		Selects 1 ms through 999ms sweep time range of integrator.	D
1s−100s		Selects 1s through 100s sweep time range of integrator.	

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Table 8-19. A5 Sweep Generator Address Decoding

Address (Hexadecimal)	Address Decoder Components	Components Addressed	Read or Write	Description
2014	U31B, U33A, U39	U24	WRITE	Software Control
2015	U31B, U33A, U39	U16	WRITE	Software Control
2016	U31B, U33A, U39	U8	WRITE	Data Latch for lower 2 bits of U2 DAC and Software Control.
2017	U31B, U33A, U39	U1	WRITE	Data Latch for upper 8 bits of U2 DAC.

Sweep Ramp Generator D

The sweep ramp generator has four major sections. The programmable current source, the integrator, the retrace, and the stop sweep circuits.

Programmable Current Source. The programmable current source U2 is a 10-bit DAC (Digital-to-Analog Converter). The amount of DAC current determines the sweep time (slope) of the ramp. The maximum DAC current is determined by the reference voltage input (V REF) which is scaled by the data lines D0 through D9 from the software control circuit. The data is generated by the A3 microprocessor and written to latches U1 and U8. Reference current to the DAC is applied to pin 16 from the +10V reference supply through R4 and R2. For longer sweep times (1 second to 100 seconds) analog switch (U10D) closes, supplying additional current to pin 16 of the DAC, and resulting in more current from the DAC. At the same time, analog switch (U9) selects C8 as the integrating capacitor and switches C7 out of the circuit. The amount of current, or sweep time, can be adjusted by potentiometers R2 and R25.

Integrator. The DAC current is applied to the inverting input of the integrating operational amplifier (U3), and charges either integrating capacitor C7 or C8, depending on the sweep time. For faster sweep times (10 msec to 999 msec), C7 is switched in through analog switch U9B (analog switch U9C provides the output for the sweep ramp). The capacitor selected and the current from the DAC are both used to set the sweep time. Voltage divider R9, R10, and R66 provides a −1.6V reference at U3 pin 3.

If the sweep ramp generator is waiting for a start sweep trigger (i.e. HP 8350B is in single sweep or external sweep trigger), the retrace circuit tries to drive the integrator output negative. Since the retrace circuit continues to supply current to the integrator inverting input until the next sweep is triggered, protection is required to ensure the integrator never reverse biases the integrating capacitors. This protection is provided by CR2 and R8. As long as the integrator output is more positive than about −1.6V, CR2B is biased on, keeping CR2A biased off. During retrace (as the integrator output approaches −1.6V), CR2A becomes biased on, shunting current from the integrator inverting input. CR2B remains biased on due to the cathode bias. This results in both anode voltages tracking each other. Since current is flowing through R8, the integrator output is maintained at a slightly more positive level than the integrator input.

Manual Sweep. For manual sweep, the integrating capacitors are switched out and analog switch U17A connects R11, R43, and R53 as feedback resistors for U3. Analog switch U17D provides the output for the manual sweep voltage. U3 now acts as a linear amplifier and the DC voltage out is a function of the current supplied by the DAC.

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Retrace. For retrace, the emitter of Q3 and parallel resistor R40 are switched to +5VF1 by analog switch U17B. This switch is activated by L EX SW (Low = External Sweep), or PL1 (Pen Lift 1), and is disabled by L SSRQ (Low = Stop Sweep Request). For internal sweep trigger mode the PL1 line goes high when the sweep ramp reaches 10.8V and goes low when the ramp sweeps down to −0.95V. The base voltage of Q3 is determined by the collector voltage of Q1B. Q1 is a dual transistor connected as a differential amplifier which senses the DAC current through R5. Higher current through R5 results in a more negative voltage at the base of Q3 turning it on harder. The current through Q3 and R40 discharges the integrating capacitor and also supplies current to the DAC; this results in a negative going ramp or sweep down (retrace). The slope of the ramp, or sweep down time, is determined by the current through Q3 and the parallel resistor R40. R20 and adjustment potentiometer R77 compensate for differences in the gains, or betas, of Q1 and Q3 and the differences in the voltages produced by FET CR14. R77 also provides retrace time adjustment capability. CR14 provides a constant current source at the emitters of Q1 independent of voltage variations in the −15V supply. For small DAC currents, the voltage drop across R5 decreases and both bases of Q1 become close to equal. The collector voltage of Q1B approaches the emitter voltage of Q3, turning it off, and current is supplied only through parallel resistor R40. Therefore, the retrace slope is a direct function of the forward sweep slope.

Stop Sweep. The sweep can be stopped by L SSRQ (Low = Stop Sweep Request) or L SFSRQ (Low = Stop Forward Sweep Request). These signals close analog switch U17C, reverse biasing diode CR8. Since the DAC current cannot flow through reverse biased CR8 to discharge the integrating capacitor, the sweep voltage is held constant and the sweep stopped. CR9 provides a path to ground for the DAC current. The L SSRQ and L SFSRQ functions are disabled for manual sweep by the L MANUAL line to U18D.

Sweep Trigger E

The sweep trigger PL1 output (Pen Lift 1) triggers the start of each sweep, and also triggers the sweep retrace when the sweep voltage reaches −10.8V. Two ramp limit comparators monitor the sweep voltage at TP13. The low ramp limit comparator (U35) enables a sweep trigger when the sweep retrace reaches −0.95V. The high ramp limit comparator (U34) triggers a sweep retrace when the sweep voltage reaches +10.8V. One of four sweep trigger modes is selected by the TM1 and TM2 control inputs to multiplexer U40 (See Table 8-21). The PL1 logic level is controlled by R-S flip-flop U41D when the internal trigger mode is selected, and by R-S flip-flop U41A for all other trigger modes.

High Ramp Limit. High ramp limit comparator U34 produces a logic low at TP14 whenever the sweep voltage at TP13 exceeds +10.8V. This logic low output sets R-S flip-flops U41A and U41D to latch the PL1 output high and initiate a sweep retrace. The +10.8V reference voltage for U34 is supplied by voltage divider R17,R30.

Low Ramp Limit. Low ramp limit comparator U35 produces a logic high whenever the sweep voltage at TP13 is more negative than −0.95V. The output resets R-S flip-flop U41D, and enables the sweep trigger selected by U40 to reset R-S flip-flop U41A. This results in a logic low on the PL1 output.

Internal Trigger. For internal trigger mode, the sweep up voltage is initiated immediately after the sweep retrace is completed. Multiplexer U40 disables timer U32B by selecting +5V as its trigger input (U32 pin 9). U40B selects the U41D output to provide the PL1 control output to the sweep ramp generator. When the sweep retrace voltage reaches −0.95V, Low Ramp limit comparator U35 resets U41D and produces a low PL1 output (initiating the sweep up ramp). A sweep retrace is initiated when the high ramp limit comparator senses the sweep voltage crossing +10.8V and sets U41D (resulting in a logic high on the PL1 output).

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Line, EXT, Single, and Remote Sweep Trigger Modes. Multiplexer U41A selects one of three trigger inputs according to the status of its TM1 and TM2 control inputs (See Table 8-21). A low on the selected trigger line sets the U32B timer output high for 40 microseconds. This output is gated, through U26 by the low ramp limit comparator so that R-S flip-flop U41A is reset by the trigger only when the sweep ramp generator is waiting to start a new sweep. The high ramp limit comparator sets the U41A output low when the sweep voltage reaches +10.8V. U41A is also set by L ABORT (U26B pin 6) if the front panel SINGLE key is pressed during a sweep.

Clamping F

The clamping circuit limits the sweep voltage at 0V and +10V. The sweep voltage (−0.95V to +10.8V) from the integrator is buffered through voltage follower U12, and applied through the clamp diodes (CR12A/B) to the inverting input of U19A.

Low Ramp Clamp. With the sweep voltage at the low end (−0.95V), CR12A is forward biased by current from Q5B. Both CR12 anodes are at −.35V, which reverse biases CR12B. No current flows through R65 or R63, therefore the voltage at that junction is 0V. It remains 0V until CR12B is forward biased, allowing current to flow through R65. CR12B becomes forward biased when the sweep voltage reaches 0V. After CR12B starts to conduct, the voltage at its cathode follows the sweep voltage from U12 pin 6.

High Ramp Clamp. CR4 clamps the the sweep voltage at +10V. A +10V reference voltage is applied to the noninverting input of U19A. When the sweep voltage applied to U19A pin 2 passes through +10V, U19A (which has been saturated positive) changes states, and tries to saturate negative. However, diode CR4 (which is feedback for U19A) starts to conduct, holding the sweep voltage at pin 2 equal to the +10V reference voltage at pin 3.

The high ramp clamp can be disabled, by an active low L CLAMP DISABLE input to the base of Q4. With Q4 off, CR6 is forward biased through R46 to the +15V supply. R46 and R14 now form a voltage divider to set U19A pin 3 at 10.9V. The sweep voltage never exceeds 10.8V. Therefore U19A is always saturated positive and CR4 is never forward biased.

Sweep Voltage Buffers G

The clamped 0V to 10V sweep voltage from the clamping circuit is buffered by voltage followers U11, U13, U4, and U5. The output of U11 is VRAMP, which is used in the marker circuit on the A4 scaling and marker assembly.

When analog switches U10A and U10C are closed by a logic high on the L EXT SW line (Low = External Sweep), the front and rear panel sweep output voltage (VSW2) is provided by U13. The output of U13 also goes to U4 and U5. The U4 output (VSW1) is used by the ΔF DAC on the A4 assembly. The U5 output (VSW) is used in the RF plug-in.

When the L EX SW line is low, analog switches U10A and U10C are open to allow the sweep out/in from the front and rear panels to become the inputs to U4 and U5. VR5 and VR6 are protection diodes.

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TROUBLESHOOTING

Component failures on the A5 sweep generator assembly may affect sweep voltage outputs (VSW, VSW1, VSW2, and VRAMP), blanking, sweep related timing, counter interface, or square-wave modulation. Since the RF plug-in can control operation of the A5 sweep generator, initial troubleshooting should be without the RF plug-in installed. Once the A5 operation is verified without the RF plug-in, troubleshooting can be limited to the interfacing circuits between the RF plug-in and the A5 sweep generator. If upon instrument preset, error codes E005, E003, or E002 occur, a failed component may exist on this assembly. Operation of the A5 sweep generator can be checked through the use of the instrument preset self tests, available operator initiated self tests, and troubleshooting procedures provided. The following troubleshooting information is organized by symptom (error code or type of failure) with an explanation of applicable self tests, and waveforms.

Error Code 005

Instrument Bus Test. Correct instrument bus operation is checked during the instrument preset self tests. If the front panel INSTR PRESET key is pressed and error code E004 or lower occurs, instrument bus operation is verified. If E005 occurs, perform an instrument preset self test with the A5 sweep generator assembly removed. This removes the possibility of A5 causing an instrument bus error code. If E005 still occurs, refer to Table 8-4, Error 5, to isolate the problem to the assembly level.

If upon removal of A5, E003 occurs after instrument preset, reinstall the A5 sweep generator assembly. Press INSTR PRESET . If E005 reoccurs, the trouble is in the data buffer or address decoder circuits. Set the HP 8350B into the repetitive instrument bus self test by pressing **[SHIFT] [0] [9]**, and checking the data, address, and control inputs for activity, adjacent shorts, and excessive loading.

Error Code E002

Sweep versus Marker Test. This test is performed upon instrument preset, and generates a 0V to +4.2V 3-stepped VRAMP output which is compared with the marker position on the A4 scaling and marker assembly. When the marker position and VRAMP are equal, the A4 assembly outputs a marker flag to the microprocessor. If the microprocessor does not receive the flag, error code E002 is generated.

Correct operation of A5 for this self test is verified by initiating a repetitive sweep versus marker self test (**[SHIFT] [1] [1]**) and checking for a 0V to +4.2V 3-stepped ramp at A5TP6 (See Figure 8-34.). If the waveform at A5TP6 is correct, refer to the A4 scaling and marker assembly service paragrahps for further troubleshooting.

The sweep voltage at TP6 generated for this test is the result of the sweep ramp generator being controlled by the A3 microprocessor through the software control circuit. The sweep ramp generator is set to manual sweep mode, the stop sweep and retrace functions are off (A5TP3 and A5TP12 are 0V), and the integrator programmable current source (DAC U2) is programmed sequentially through its three most significant bits. Check sweep voltage waveforms (A5TP5 and A5TP6) for this test in Figure 8-34. If the waveform at A5TP5 is correct, but the waveform at A5TP6 is incorrect, the trouble is in the clamping or sweep voltage buffers circuit.

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Error Code E003

Tuning Voltage versus Marker Test. This test is performed on Instrument Preset or by pressing **[SHIFT] [1] [0]**. While this test checks operation of the A4 scaling and marker assembly, the VSW1 sweep generator output is used on A4 as a DAC reference voltage. For this test the VSW1 output should be 0V. If VSW1 is 0V the A5 assembly is probably operating properly. Suspect the A4 scaling and marker assembly if this is the case. The marker circuit has already been verified by the Error 3 self test (the instrument must pass the Error 3 self test in order to perform the Error 2 self test) so look for a sweep related failure.

No Sweep Ramp

If an RF plug-in is not installed, a no sweep ramp condition is usually caused by the sweep ramp generator circuit, or the sweep trigger circuit. Check the sweep voltage at A5TP5 to determine if the ramp is stopped at the beginning (−1V) or end (+11V) of the sweep. If the voltage at A5TP5 is approximately +11V, check that a retrace sweep is enabled by +5V at A5TP12. If A5TP5 is approximately −1V, check that the retrace circuit is disabled by 0V at A5TP12. Check operation of sweep ramp generator and sweep trigger circuits as follows:

Sweep Ramp Generator Check. Check each of the following test points:

- A5TP2 — Should be approximately −1.2V.
- A5TP3 — Should be approximately 0V (Stop Sweep circuit is off).

Check the voltage level at A5TP3 (Stop Sweep) for a logic low (0V). A logic high (4V to 5V) indicates a failure in circuits before A5TP3. Use the chart below to troubleshoot stop sweep.

Stop Sweep Troubleshooting Chart

Step	IC Number Pin Number	Part Location Schematic Page and Block	Proper Logic Low = 0V High = 4 to 5V	Probable Cause of Wrong Logic Level
A	U18D pin 13 (L Manual)	Page 1 of 2 Block D	High	A5U8 bad
B	U18D pin 12 U26D pin 11	Page 1 of 2 Block D	Low	A5U26D inputs are at wrong logical levels, verify by performing Step C.
C	U26D pin 12	Page 1 of 2 Block D	High	If input is floating (2 to 3V), suspect Resistor Pac A5U45. If input is low, suspect one of the following: A5VR8 (Page 1 of 2, Block D), A5U20, or A5U23 (both page 2 of 2, Block I).
D	U26D pin 13	Page 1 of 2 Block D	High	If input is low, suspect one of the following: A5U25 (Page 1 of 1, Block C), A5U42 (Page 2 of 2, Block I). Make sure A5U42 inputs are not a bad logic level by performing Step E.
E	U42F pin 13	Page 2 of 2 Block I	Low	If logic level is floating, suspect either A5U23 or A5U14.
F	U42F pin 11	Page 2 of 2 Block I	Low	Make sure pin 7 of A5U43 (Block I) is high. Check pins 2 and 14 of A5U43 (CT1 and CT2) for logic low.

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Sweep Trigger Check. Make sure that pins 2 and 14 (TM1 and TM2) of A5U40 are both low. The ramp limit comparators can be checked by forcing A5TP13 high (+15V) and low (−10V). Check the high ramp limit comparator (U34) by jumpering +15VF (U34 pin 8) to A5TP13. Refer to chart below for proper logic levels. Check the low ramp limit comparator (U35) by jumpering −10V (U34 pin 4) to A5TP13. Refer to the chart below for proper logic levels. Refer to A5 schematic, page 1 of 2, Block E.

Sweep Trigger Troubleshooting Chart

Test Point/IC Number IC and Pin Number	Expected Logic Levels (A5TP13 Jumpered to +15V)	Expected Logic Levels (A5TP13 Jumpered to −10V)
A5TP14	Low	High
U26B pin 4	High	High
U26B pin 6	High	Low
U41A pin 2	Low	High
U41A pin 4	High	Low
A5TP9 (PL1)	High	Low
U35 pin 7	Low	High
A5TP15	High	Low
U41D pin 13	High	High

Clamping

The lower clamp (0V) requires that Q5 is conducting to forward bias CR12A. The higher clamp (+10V) requires that Q4 be turned on, and that U19A is operational. CR4 is forward biased when the sweep voltage is greater than +10V, and clamps the ramp at +10V.

Sweep Voltage Buffers

Voltage follower U11 provides the VRAMP output at TP6. U13 is a voltage follower for all sweep modes except external sweep. U13 provides the sweep out voltage at TP7 as well as the drive for voltage followers U4 and U5. The inputs for these voltage followers is the sweep voltage from the clamp circuit.

Address Decoder, Data Buffer, and Software Control

Troubleshooting the address decoder, data buffer, and software control circuits involves using the hexadecimal data write feature of the HP 8350B (See Note 1 next to the A5 component location diagram). Each data flip-flop in the software control circuit should be addressed and data written into it. Check the data flip-flop outputs respond correctly to the data written.

Sweep Ramp Status H

The sweep ramp status circuit generates digital signals that indicate the present status of the sweep voltage. The signals generated are as follows:

- **L UPPER CLAMP SENSE.** Active low when the sweep voltage is in the upper clamp (+10V).
- **L START FREQ TRG.** High-to-low transition used to trigger counter interface circuit when externally counting the start sweep frequency.
- **L STOP FREQ TRG.** High-to-low transition used to trigger counter interface circuit when externally counting the stop sweep frequency.

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- **BP — Blanking Pulse.** Active high from start of upper clamp until start of sweep up voltage.

Start of Sweep Up Sense. Operational amplifier U19B acts as a comparator with its noninverting input referenced to −0.3V. The unclamped sweep voltage (−0.95V to +10.8V) is the inverting input to U19B. While the unclamped sweep voltage is more positive than −0.3V, the U19B output is saturated negative (feedback is removed because CR5 is reverse biased). CR10 is also reverse biased, producing a logic low at the input to Schmitt trigger inverter U14B.

When the unclamped sweep voltage goes more negative then −0.3V, the U19B output goes positive, and CR5 is forward biased to connect feedback resistor R44. CR10 is also forward biased and, when the U19B output reaches a valid logic high, the Schmitt trigger inverter U14B output switches low. This low output is produced prior to the unclamped sweep voltage reaching its negative peak, and lasts until the sweep voltage approaches −0.3V on the sweep up ramp. The start of sweep up sense output sets R-S flip-flop U41B at the end of each sweep retrace, and maintains an active blanking pulse (BP) until just prior to the clamped sweep voltage comes out of its lower clamp.

Upper Clamp Sense. When the sweep voltage is less than +10V, the U19A output from the clamping circuit biases on zener diode VR2. This results in a high logic state for the U20D output (L UPPER CLAMP SENSE). When the sweep voltage exceeds +10V, the U19A output drops to +9.4V, and VR2 is biased off; resulting in an active low L UPPER CLAMP SENSE output.

Start Frequency Trigger. R-S flip-flop U41C is reset at the start of each sweep when blanking pulse B goes low. The leading edge of the U41C low output is used to trigger the counter interface circuit. U41C is set by LPL1 when the sweep voltage reaches its peak (+10.8V); this allows L START FREQ TRG to be generated again on the next sweep.

Stop Frequency Trigger. R-S flip-flop U41B is reset by L UPPER CLAMP SENSE when the sweep voltage reaches +10V; the leading edge of the U41B low output is used to trigger the counter interface circuit. U41B is set at the start of the next sweep by the U41B output, which allows another L STOP FREQ TRG to be generated at the end of the sweep.

Blanking Pulse. The BP (Blanking Pulse) signal is generated by the Triple-input NAND gate U21A. It is active high at all times except when the sweep up voltage is between −0.3V and +10V. The upper clamp sense output initiates the blanking pulse when the sweep up voltage reaches +10V. The PL1 (Low = Pen Lift 1) to U21A maintains the active blanking output for the sweep retrace (+10.8V to −0.95V). The U14B output from the start of sweep up sense circuit keeps BP active high until the sweep up voltage reaches about −0.3V.

Counter Interface I

The counter interface circuit provides digital signals to allow a microwave frequency counter to measure either the start frequency, the stop frequency, or the active marker frequency while in the sweep mode independent of sweep time. While the counter is measuring the frequency, the sweep is stopped. The length of time the sweep is stopped is determined by the gate time of the counter. While the counter is counting, the internal 27.8/1 KHz square-wave AM modulation is disabled and a blanking signal is generated to avoid a bright spot on a display. A muting signal is also generated to disable a recorder.

The counter function is initiated by pressing **[SHIFT] [M2]**. The counter measures whichever function was last active (ie., START, STOP, or ACTIVE MARKER). **[SHIFT] [M3]** shuts off the counter function. Multiplexer U43 selects either the L START FREQ TRG, the L STOP FREQ TRG or the LAMK(Low = Active Marker) line. Control lines CT1 and CT2 set the condition of the multiplexer. When the counter function is not selected, the counter circuit is disabled by +5V at the input of the multiplexer.

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A high-to-low transition on the selected input line initiates the counter interface by triggering the 40 microsecond timer U38A. When the timer is triggered, the L SSRQ (Low = Stop Sweep Request) line stops the sweep and the L CNTR (Low = Counter) line triggers the counter. The counter responds to the L CNTR trigger pulse by setting L SFSRQ (Low = Stop Forward Sweep Request) low within 40 microseconds.

When the inverted L SFSRQ is applied to D flip-flop U15B, it clocks through the high from U38A. This sets the U15B flip-flop outputs pin 8 low, and pin 9 high. The high-to-low transition at pin 8 triggers 20 microsecond timer U29B. After the timer has timed out, pin 12 goes high to disable the square-wave modulation with a low at TP11. The low at pin 8 of flip-flop U15B also puts a low on the L CNTR BLANK line and on L SSRQ, pin 12 U42F. This L SSRQ is wire ORed with the L SSRQ from U42E pin 10. This continues to stop the sweep after 40 microsecond timer U38A has timed out. When the counter has finished counting, it puts a high on the L SFSRQ line resetting flip-flop U15B through U23B. The low at flip-flop U15B pin 9 puts a high at TP11 enabling the square-wave. The high at pin 8 of the flip-flop triggers the 1.5 msec timer U29A. After the timer has timed out, the L SSRQ line goes high allowing the sweep to start and the L CNTR line goes high unblanking the display and enabling the recorder.

The interface circuit is disabled during retrace by a low on the LPL1 line.

27kHz/1 kHz Oscillator J

The 27.775 kHz/1 kHz oscillator circuit is used by the RF plug-in for RF modulation. Square-wave modulation can be set for 27.775 kHz or 1 kHz via J4/U47. The factory setting is for 27.775 kHz. The switching circuit uses J4/U47 to short the unwanted crystal and select the desired crystal. This crystal frequency is digitally divided to 27.775 Hz and 1 kHz by counter U46. J4/U47 also enables U36F, U37A, and U20A/B to pass the desired signal from U46 to the square-wave output. These components are distant from the crystals so the switching is accomplished without allowing the counter outputs to couple to the crystals. The L RESET input is set active low when the front panel MOD key is not selected. This turns off the oscillator and ensures the square-wave output at TP10 is low (not affecting the RF power level).

Output Logic K

The output logic circuit provides several digital outputs that are used for synchronizing events with the sweep ramp. An index of these outputs are provided in Table 8-20.

The pen lift output, LPL, is disabled during sweep times under 1 sec when A5J1 is installed. Removal of A5J1 will allow penlift operation at sweep times below 1 sec.

Display Blanking L

The display blanking circuit provides signals to the rear panel POS Z BLANK and NEG Z BLANK BNC connectors. This information is used for blanking of an external CRT display during retrace, or while the sweep is stopped for band-switching, or frequency counting. The POS Z BLANK output can also intensify the CRT trace for markers and the Δ marker function. The positive and negative blanking outputs accommodate the use of different external displays.

U6A drives the Negative Z-axis Blanking (NZAB) output. It converts the 0V to +5V Z-Axis Blanking (ZAB) input to a −3.5V output during sweep retrace.

U6B drives the Positive Z-axis Blanking (PZAB) output. It converts the ZAB input to +5V during sweep retrace and to −3.5V for intensity markers.

Intensity markers are generated by the ZMK (Z-axis Marker) input to U6B. A higher intensity marker is generated for the active marker by summing ZMK with the AMK (Active Marker) input. This results in a −7V PZAB output for the active marker or the Δ marker function.

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Sweep Ramp Status

The sweep ramp status circuit produces a Blanking Pulse (BP) that is active high at all times except when the sweep ramp is positive going and between 0 and +10V. The L UPPER CLAMP SENSE line is high during sweep up and goes low at +10V then high again when the sweep goes below +10V during retrace. The L START FREQ TRG and L STOP FREQ TRG lines are used by the counter interface circuit. Refer to Figure 8-36 for a timing diagram of the sweep ramp status waveforms.

Counter Interface

To troubleshoot the counter interface circuit without an external counter, connect a cable between rear panel CNTR TRIG and STOP SWEEP connectors. Press **[INSTR PRESET]**. Select marker 3 (press **[M3]**). The FREQUENCY/TIME display should indicate a marker 3 frequency in the center of the frequency band. Then activate the counter interface by pressing **[SHIFT] [M2]**. Check for waveforms shown in Figure 8-35.

Table 8-20. Output Logic Outputs

Signal	Description
AMK	1. L AMK and ZAB and L MP are low.
L BP1	1. L BPRQ is low. or 2. DBPE and BP1 are high.
L BP2	1. BP1 is high.
L MP	1. L ZMRQ is low. or 2. INT/L AMP MK is high and L MKR is low. or 3. INT/L AMP MK is high and L MK is low.
L MUTE	1. L CNTR BLANK or L BPRQ is low.
L PL	1. LP1 is low. or 2. L UPPER CLAMP SENSE is low. or 3. LPLRQ is low.
L RFB	1. L RFBRQ is low. or 2. PL1 and RFBE are high.
L RFM	1. INT/L AMP MK is low AND: a. L MK is low. or b. L MKRQ is low
L RTS	1. PL1 is high.
L SW	1. L PL1 is high.
SYNC TRG	1. U32A pin 4 is low (40 µs pulse triggered by L HPIB TRG) or 2. L RFBRQ is low or 3. L PL1 is low.
ZAB	1. DBPE and BP1 are high. or 2. L CNTR BLANK is low. or 3. L BPRQ is low.
ZMK	1. L MP and ZAB are low.

1 L PL is disabled during sweeptimes less than 1 second when A5 J1 is installed.

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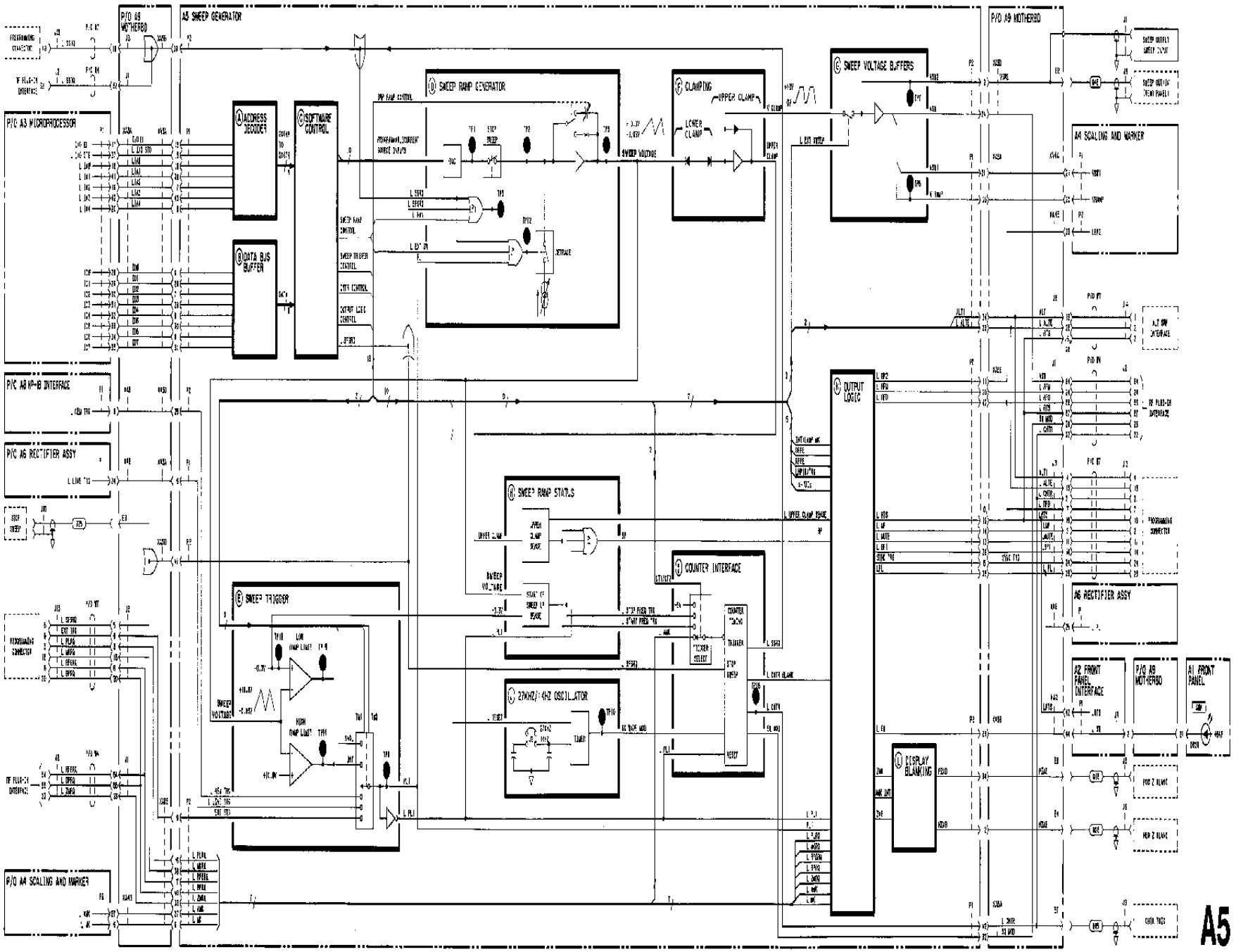


Figure 8-32. A5 Sweep Generator Block Diagram

8-119/8-120

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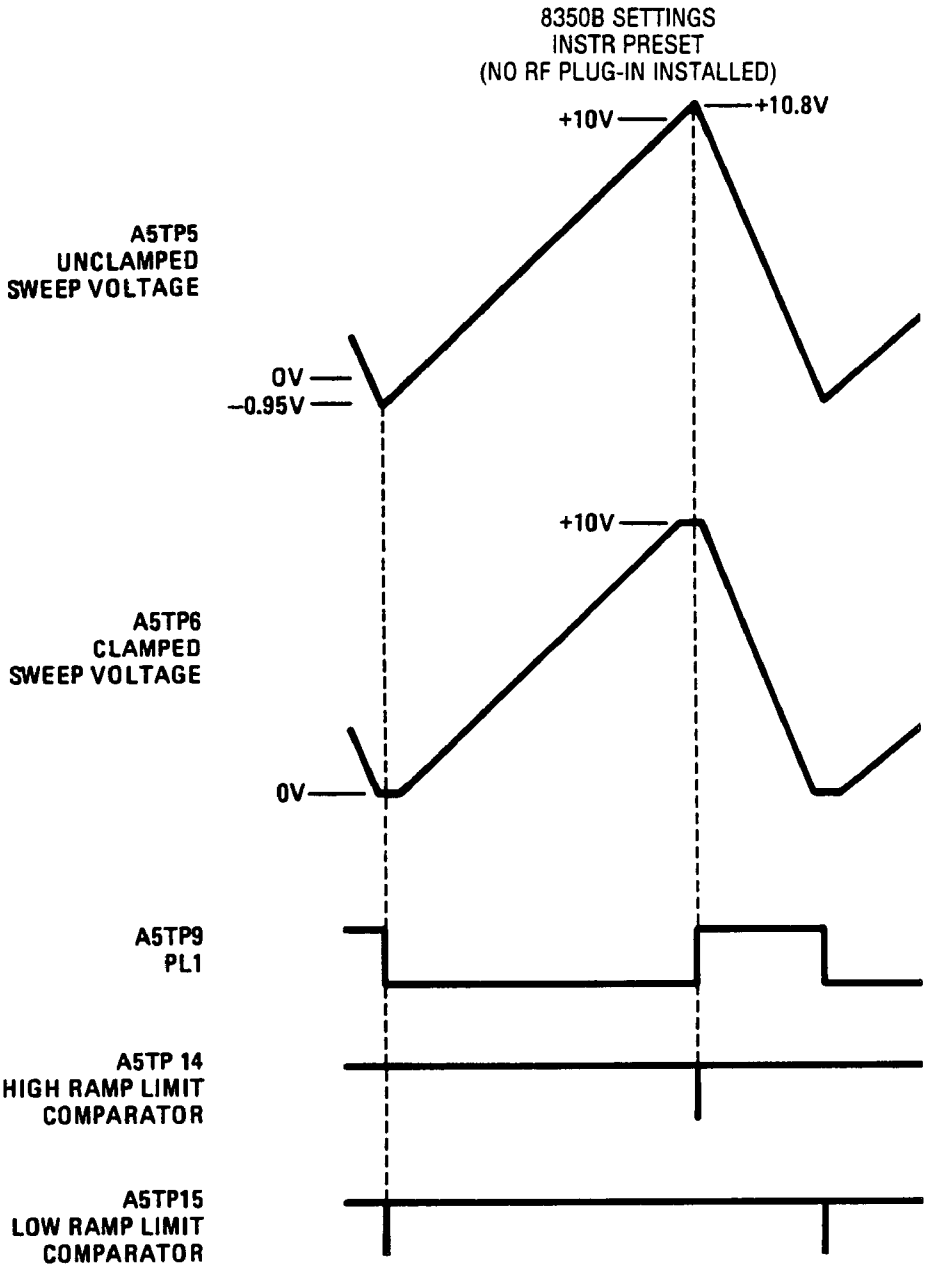


Figure 8-33. Sweep Trigger Timing Diagram

Table 8-21. Sweep Trigger Mode Select

TM1	TM2	Sweep Trigger Mode
0	0	INTERNAL
1	0	LINE
0	1	EXTERNAL
1	1	SINGLE/REMOTE

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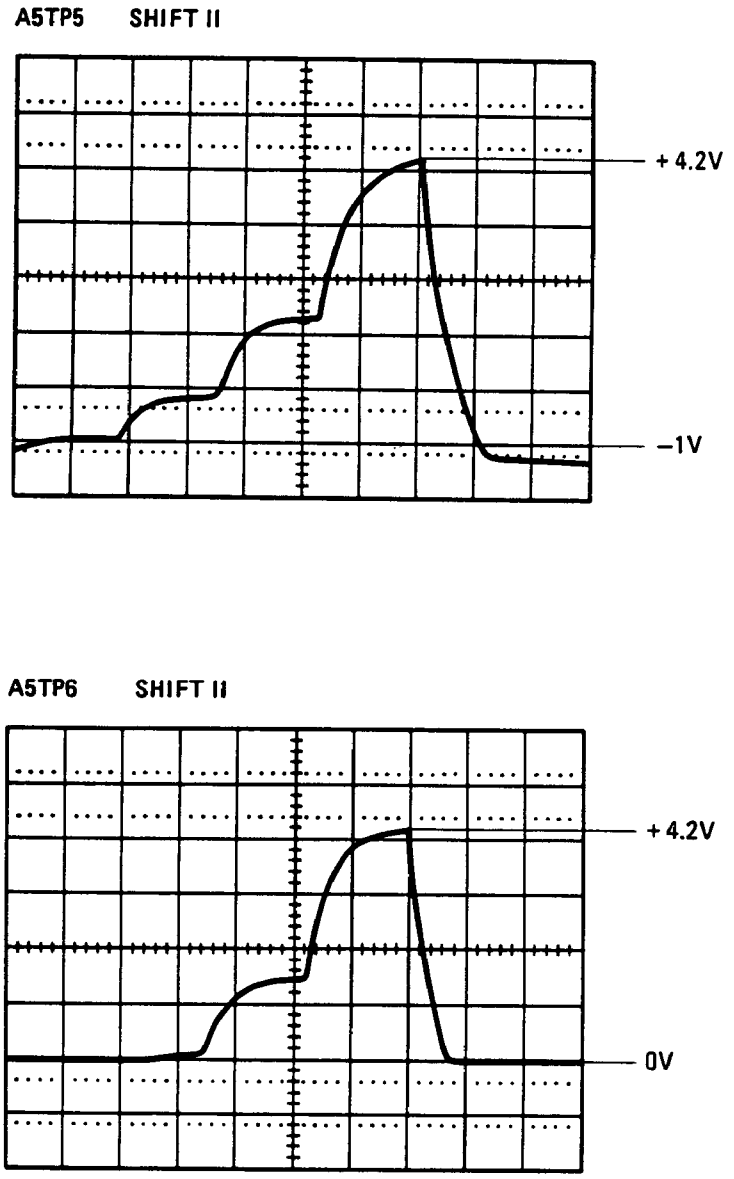


Figure 8-34. Sweep Voltage Waveforms for Sweep versus Marker Self Test

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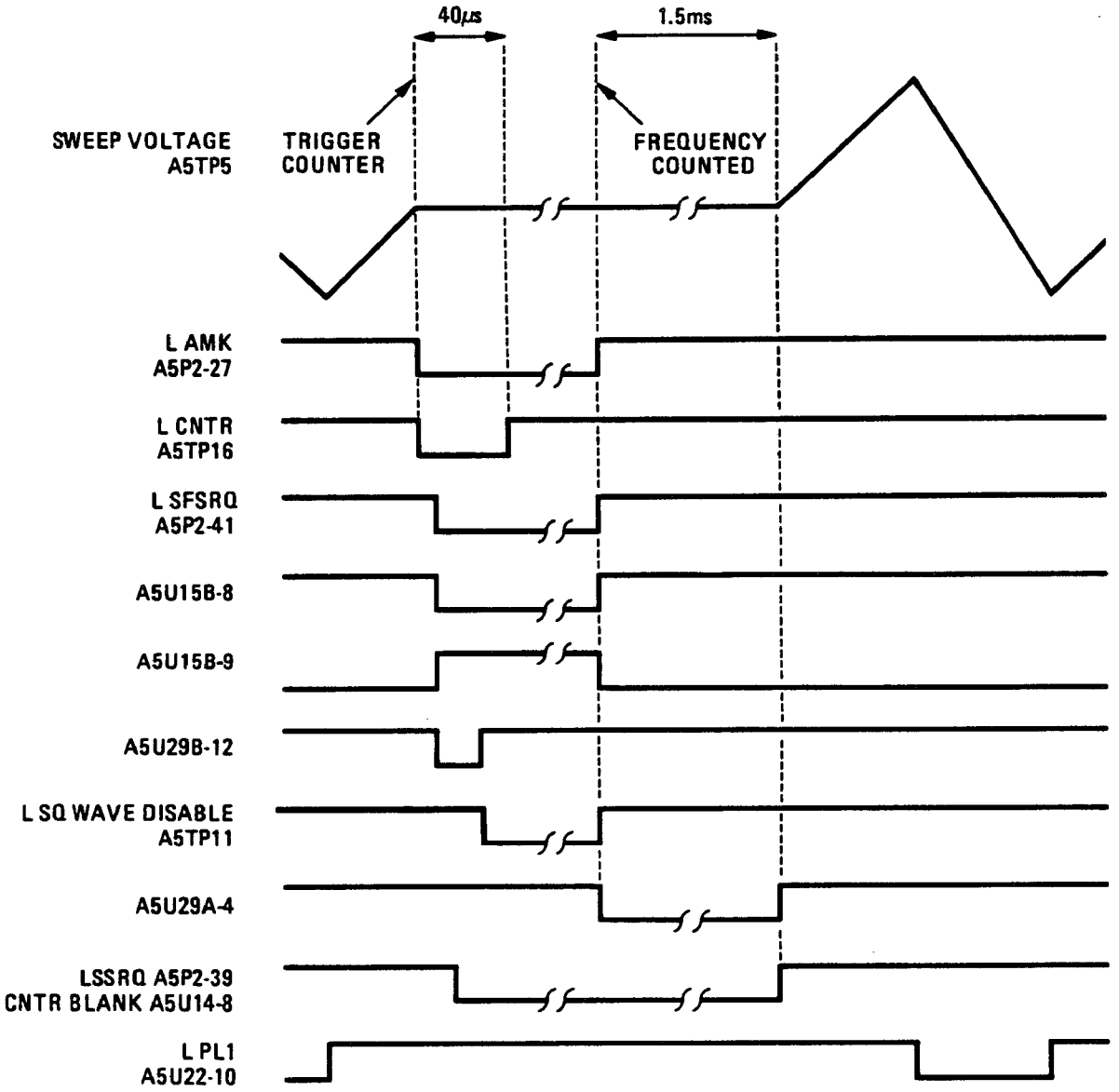


Figure 8-35. Counter Interface Timing Diagram

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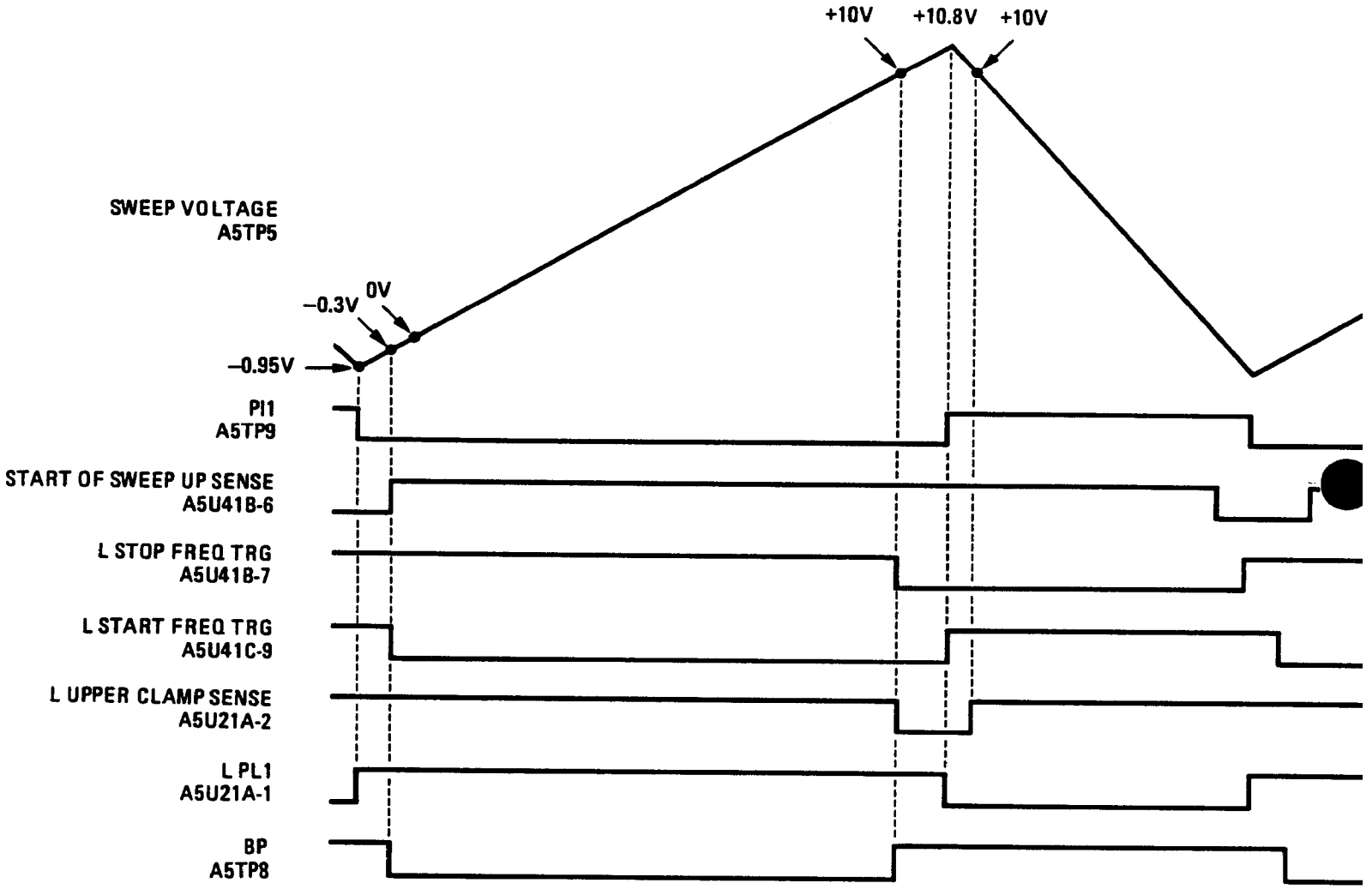


Figure 8-36. Sweep Ramp Status Timing Diagram

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A5P2

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	GND ANLG			M
23	GND ANLG			M
2	VSW2	I/O	J1, J8	G
24	VSW	OUT	J2-64	G
3	N.C.			
25	L REMTRG	IN	A8P1-3	E
4	−15V	IN	A7P1-14, 36	M
26	−15V	IN	A7P1-14, 36	M
5	SYNC TRG	OUT	J13-24	K
27	L AMK	IN	A4P2-27	I
6	L MK	IN	A4P2-6	K
28	L SW	OUT	A2P1-44	K
7	+10V REF	IN	A4P2-7, 29	M
29	+10V REF	IN	A4P2-7, 29	M
8	+15V	IN	A7P1-8, 30	M
30	+15V	IN	A7P1-8, 30	M
9	GND DIG			M
31	GND DIG			M
10	GND DIG			M
32	GND DIG			M
11	L BP2	OUT	A4P2-33, J2-53	K
33	L ZMRQ	IN	J2-23	K
12	NZAB	OUT	J6	L
34	PZAB	OUT	J5	L
13	L MUTE	OUT	J13-11	K
35	L PL	OUT	A6P1-25	K
14	L MP	OUT	J13-2	K
36	L BP1	OUT	J13-14	K
15	L LINETRG	IN	A6P1-24	E
37	SQ MOD	OUT	J2-26	I
16	L PLRQ	IN	J13-3	K
38	L MKRQ	IN	J13-15	K
17	L RFBRQ	IN	J2-54, J13-8	K
39	L SSRQ	IN	J2-32, J13-18	D
18	L RTS	OUT	A2P1-42, J2, J13, J14	K
40	L BPRQ	IN	J2-55, J13-20	K
19	L RTS	OUT	A2P1-42, J2, J13, J14	K
41	L SFSRQ	IN	J13-5, J10	D, I
20	L RFM	OUT	J2-24	K
42	L RFB	OUT	J2-56, J13-7	K
21	GND DIG			M
43	GND DIG			M
22	GND ANLG			M
44	GND ANLG			M

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A5P1

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	GND DIG			M
23	GND DIG			M
2	GND ANLG			M
24	GND ANLG			M
3	+5VA	IN	A7P1-2, 24	M
25	+5VA	IN	A7P1-2, 24	M
4	+5VA	IN	A7P1-2, 24	M
26	+5VA	IN	A7P1-2, 24	M
5	GND DIG			M
27	GND DIG			M
6	ID0	IN	A3P1-28	B
28	ID1	IN	A3P1-29	B
7	ID2	IN	A3P1-30	B
29	ID3	IN	A3P1-31	B
8	ID4	IN	A3P1-32	B
30	ID5	IN	A3P1-33	B
9	ID6	IN	A3P1-34	B
31	ID7	IN	A3P1-35	B
10	GND DIG			M
32	GND DIG			M
11	GND ANLG			M
33	L ALTE	OUT	J13-17, J14-2	C
12	GND ANLG			M
34	ALT1	OUT	J13-4, J14-1	C
13	L I/OSTB	IN	A3P1-37	A
35	GND DIG			M
14	I/OE2	IN	A3P1-16	NOT USED
36	GND DIG			M
15	I/OE1	IN	A3P1-17	A
37	L IRD	IN	A3P1-39	NOT USED
16	L IA0	IN	A3P1-18	A
38	GND DIG			M
17	L IA2	IN	A3P1-19	A
39	L IA1	IN	A3P1-41	A
18	L IA4	IN	A3P1-20	A
40	L IA3	IN	A3P1-42	A
19	EXT TRG	IN	J13-9	E
41	GND DIG			M
20	VRAMP	OUT	A4P1-20	G
42	L CNTR	OUT	J2-22, J9	I
21	VSW1	OUT	A4P1-20	G
43	N.C.			
22	GND ANLG			M
44	GND DIG			M

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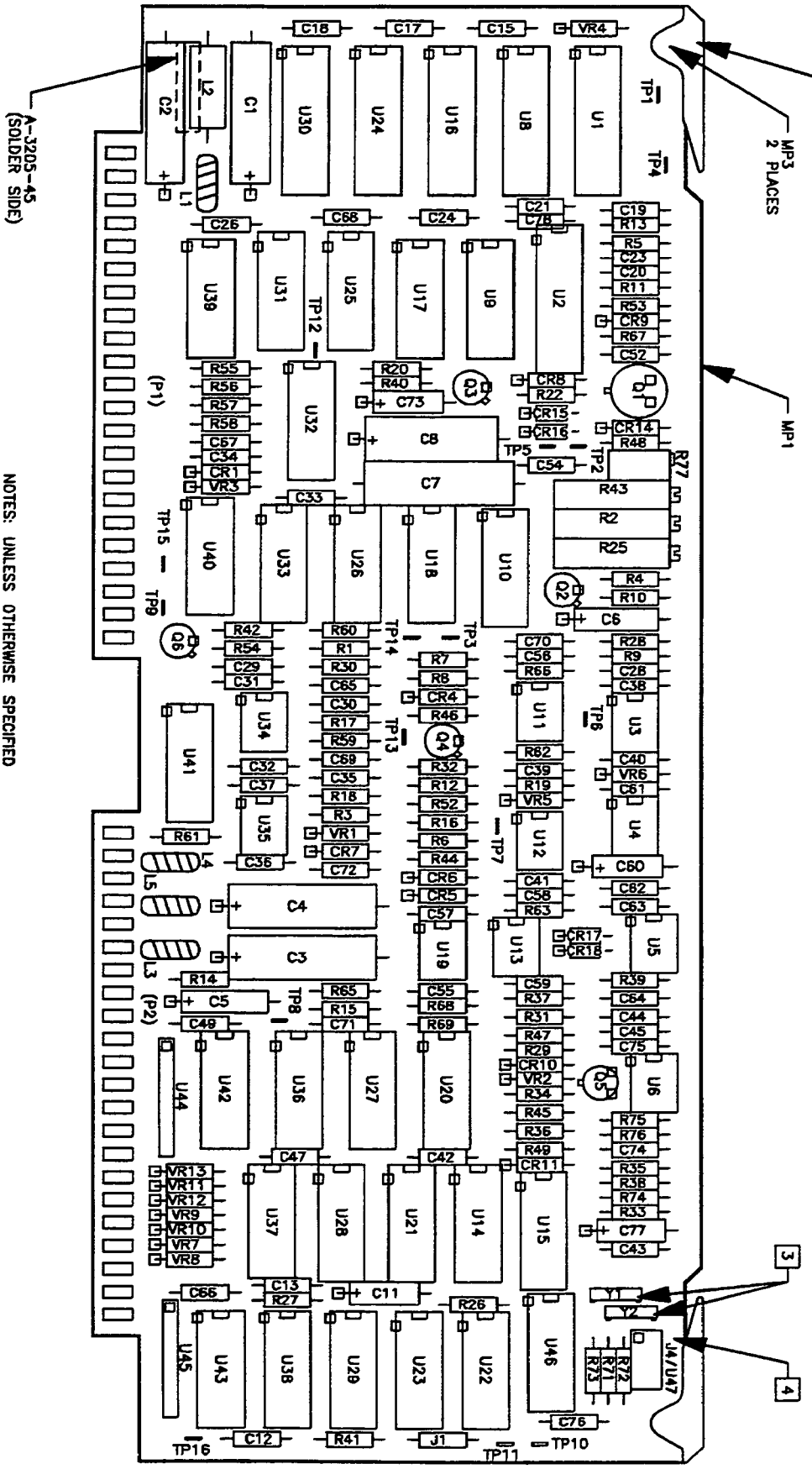
NOTES

1. The following key entries provide front panel access for a data write/read operation to/from the addressed location:

Function	Key Entry
*Hex Address Entry	**[SHIFT] [0] [0]** (enter hex address)
Hex Data WRITE	**[M2]** (enter data: two hex digits)
Hex Data READ	**[M3]**
Hex Data Rotation Write	**[M4]**
Hex Addressed Fast Read	**[M5]**

*To address a different location, press **[M1]** and enter the new address, or use the increment keys **[▲] [▼]** to step to the new address.

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NOTES: UNLESS OTHERWISE SPECIFIED

1. WORKMANSHIP ACCEPTABILITY: ASSEMBLY PER A-5951-1582-1 (741.070C)
   SOLDERING PER A-5951-1585-1 (741.070F)
   REWORK PER A-5951-1586-1 (741.070G)
2. USE RAW BOARD PART NUMBER 08350-20135.

[3] LOAD CRYSTAL WINDOWS ON LEFT HAND SIDE (Y1,Y2).

[4] DOT ON JUMPER (U47) ALIGNED WITH DOT ON BOARD GIVES 27.8KHz SQ. MOD. (FACTORY SETTING). DOTS NOT ALIGNED GIVES 1KHz SQ. MOD.

Figure 8–37. A5 Sweep Generator Component Location Diagram

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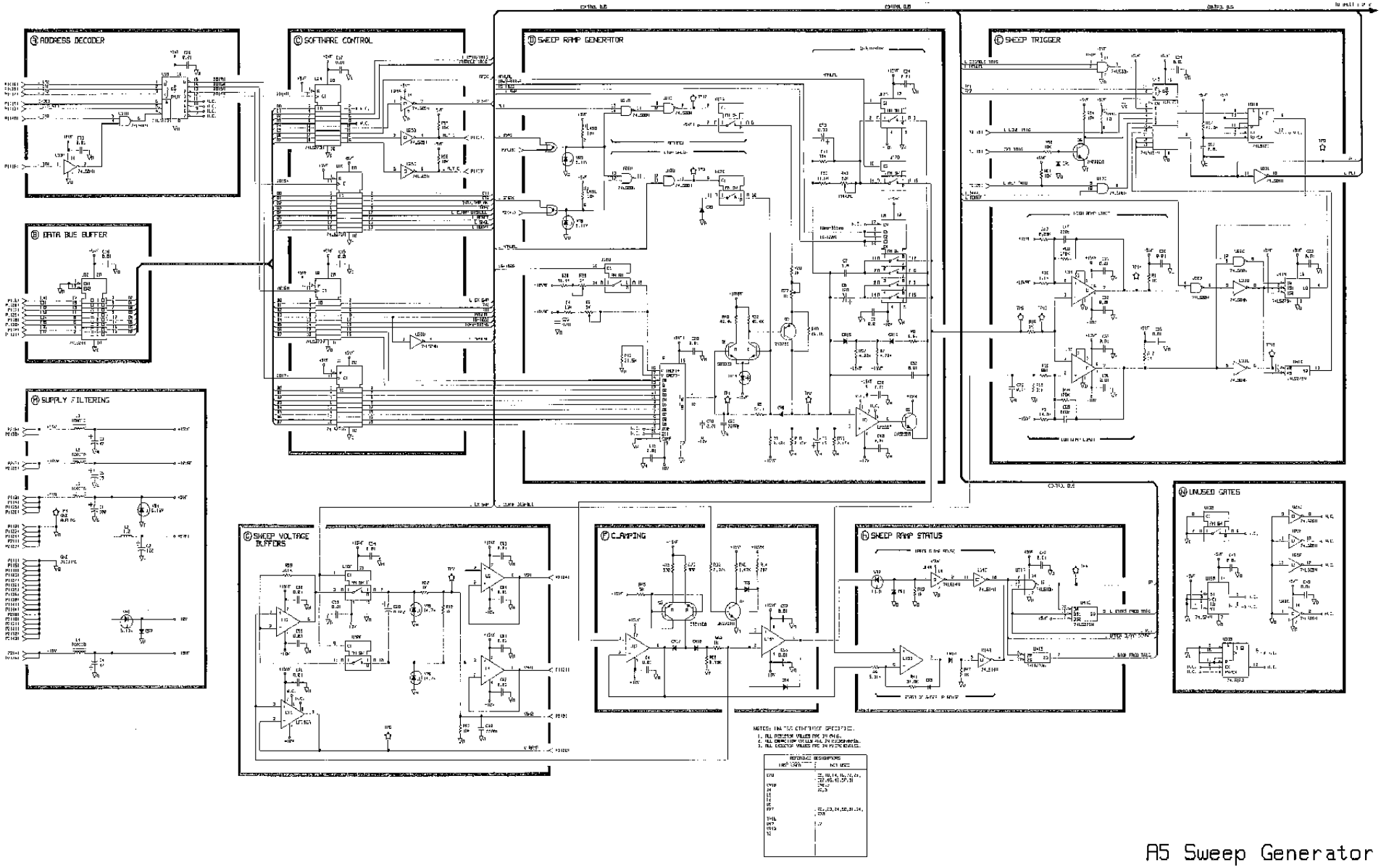
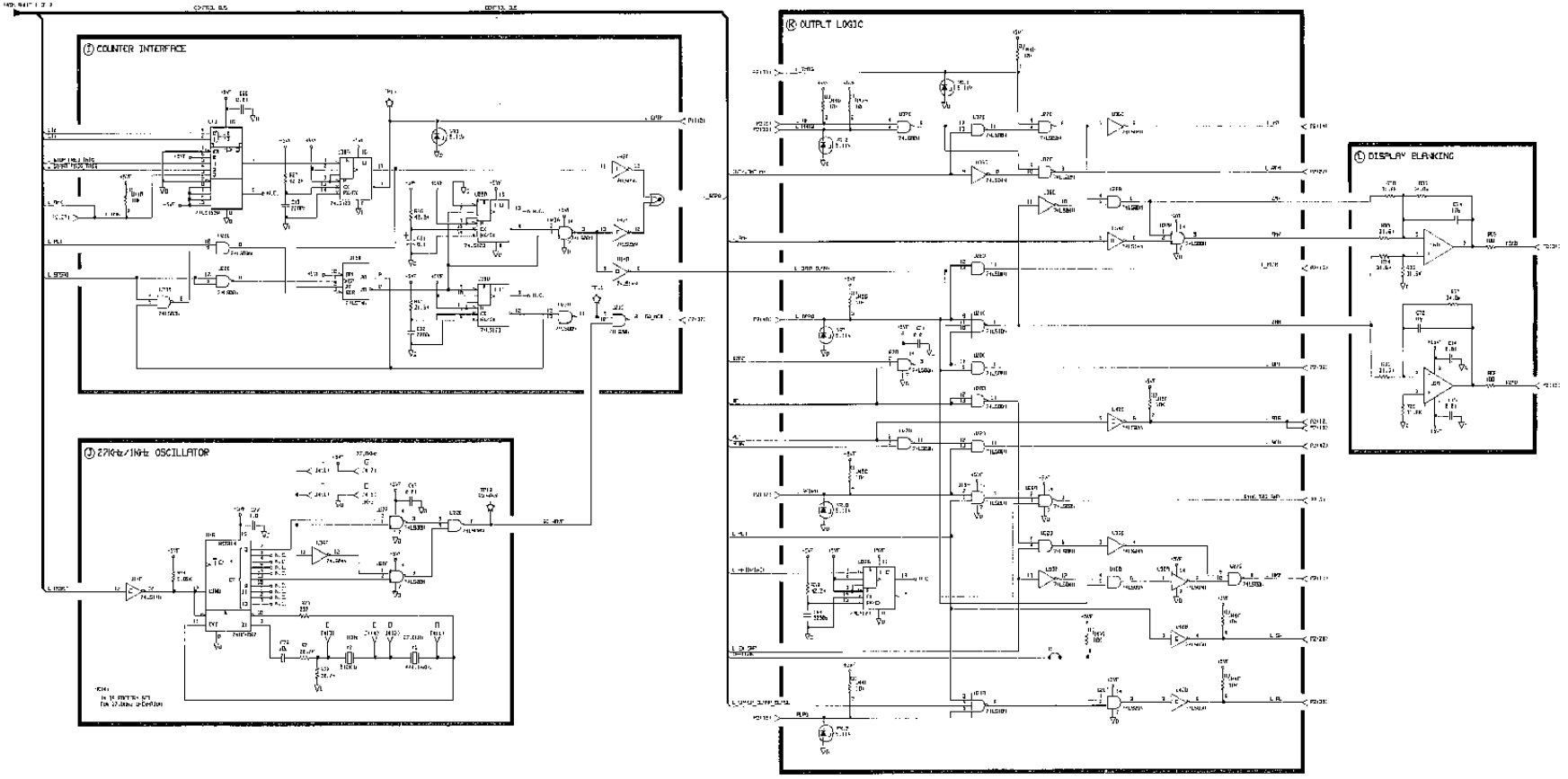


Figure 8-38. A5 Sweep Generator, Schematic Diagram (1 of 2)

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A5 Sweep Generator
08350-60135
(SHEET 2 of 2)

Figure 8-3E. A5 Sweep Generator, Schematic Diagram (2 of 2)

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A6 Rectifier
A7 Regulator

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A6 Rectifier and A7 Regulator Circuit Description

INTRODUCTION

The main function of the A6 rectifier and A7 regulator assemblies is to provide regulated power supply voltages for the HP 8350B and RF plug-in installed. Table 8-22 lists the regulated power supply outputs and describes where they are used. Overvoltage protection and "power on" LED indicators for all regulated supplies are on the A7 regulator.

The +20V, −10V, and −40V power supplies are used only in the RF plug-in. They provide power for the RF microcircuits, and are also used for reference voltages to control frequency and power. Therefore, these supplies must be very well regulated. To ensure high stability (independent of voltage drops through the various connectors, motherboard traces, and cables) post regulation is used. For these supplies, their respective voltages and returns are sensed in the RF plug-in, and regulated at that point.(See simplified diagram in Figure 8-39.)

Additional functions provided are as follows:

- Penlift Driver
- Power-up — Resets microprocessor when power is turned on.
- Line Trigger
- Power Supply Failure Detection
- Air Flow Detection
- Line Surge Protection

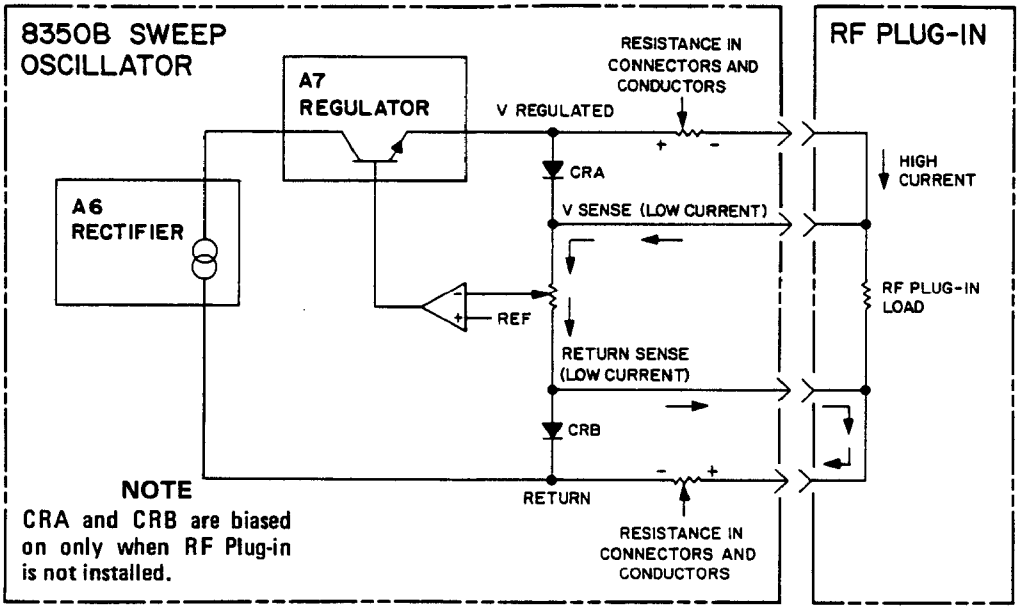


Figure 8-39. Typical Post Regulated Power Supply, Simplified Schematic

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Primary Power

Primary power is supplied to the primary of T1 through power line module FL1, which includes a line voltage selector PC board. The voltage selector board is positioned to provide correct power connections to T1 for operation with line voltages of 100 VAC, 120 VAC, 220 VAC, or 240 VAC. (See Figure 2-1 for correct installation of the line voltage selection PC board.)

Thermal switch S2 senses the internal temperature and opens to turn off primary power if the temperature exceeds 71°C. Suppression of radio frequency interference (RFI) is provided by the LC filter in FL1. The front panel LINE switch, S1, turns the line power on or off.

Transformer T1 supplies 120 VAC through the power line module to fan B1.

The A6 rectifier assembly contains an over-voltage protection circuit that fires if the −40V UNREG output exceeds approximately 83 volts. The excessive current through Q5 blows the main line fuse. This circuit is designed to protect the HP 8350B from damage caused by supplying the instrument with an excessive line voltage (i.e. line voltage PC board positioned for 100 VAC and 240 VAC line voltage is applied).

NOTE: All power supply circuit descriptions include the unregulated (A6 Rectifier) and regulated (A7 Regulator) sections of the supply.

Table 8-22. Power Supply Distribution

Power Supply	Distribution
+20V	RF Plug-in
+15V	A4, A5, RF Plug-in
+10V	RF Plug-in
+15VA	A2, A3, A4, A5, A6, A8, J13
+5VAFP	A1
+5VB	RF Plug-in
−10V	RF Plug-in
−15V	A4, A5, RF Plug-in
−40V	RF Plug-in

+20V Power Supply

+20V Unregulated. The approximately 26 VAC T1 output is rectified by full-wave bridge rectifer A6CR1-4. A6C1 and A6C12 filter switching transients, and A9C6 filters AC line ripple.

+20V Regulator. Regulation is provided by three-terminal regulator A7U7. Error amplifier A7U8 improves regulation by controlling the reference voltage to the regulator A7U7 pin 1. Under normal operating conditions, the voltage difference between the regulator output and its reference input is about 1.25V. Zener diode VR2 provides a stable reference voltage to the noninverting input of A7U8. The +20V output is scaled by the voltage divider consisting of A7R9, A7R10 (+20V ADJ potentiometer), and A7R11, and applied to the inverting input of U8. Since error amplifier U8 drives the regulator to balance its inputs, the power supply stability is a direct function of the reference voltage

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stability. When an RF plug-in is installed, the voltage divider is connected across the +20V SENSE and +20V RET SENSE (+20V return sense) inputs from the RF plug-in. Any change in the +20V regulated supply or current return in the RF plug-in is sensed by A7U8, which generates an error signal to A7U7 to maintain the voltage constant. When the RF plug-in is not installed, diodes A7CR9 and A7CR10 conduct to connect the +20V REG and +20V RET lines across the voltage divider. This results in two diode-drops being added to the voltage divider, with a corresponding increase in the power supply output voltage. If the +20V supply turns off, then +10V, −10V, and −40V supplies are automatically turned off.

Voltage regulator A7U7 has overcurrent protection. If the supply is shorted to ground, A7U7 will go into a current limit foldback condition, limiting the current. Fuse A7F5 protects the +20V loads in case the +20V regulator fails. Diode A7CR3 protects the regulator if the +20V UNREG input is shorted to ground. Overvoltage protection is provided by crowbar circuit A7Q11. If the power supply output exceeds approximately +24V, zener diode VR8 turns on and switches SCR Q11 on. This shorts the +20V supply to ground, causing it to current limit. If regulator is defective, fuse A7F5 provides overcurrent protection. A7CR1,A7VR1, and A7R6 protect regulator A7U7 from positive transients on the +20V output. LED A7DS2 provides a power on indication when the output voltage exceeds approximately +18V. Diode A7CR18 provides reverse voltage protection.

±15V Power Supplies

+15V Unregulated. The two AC outputs of the T1 center-tapped secondary (approximately 20VAC) are applied to full-wave bridge rectifier A6CR5-8. The rectifier provides both a +15V and −15V output that is referenced to the T1 center-tap (system ground). Fuses A6F1 and A6F2 provide overcurrent protection. A6C2 and A6C3 filter switching transients, and A9C2 and A9C3 filter AC line ripple.

+15V Regulator. Three terminal regulator A7U13 provides regulation and current limiting. The actual voltage output is determined by the voltage across A7R81 and current through A7R82. Overvoltage protection is provided by crowbar circuit A7Q12. If the power supply output exceeds approximately +18V, zener diode VR9 turns on and switches SCR Q12 on. This shorts the −15V supply to ground, causing it to current limit. LED A7DS6 provides a power on indication when the output voltage exceeds approximately +12V. Diode A7CR23 provides reverse voltage protection.

−15V Regulator. Regulation is provided by three-terminal regulator A7U15. The regulator output voltage is determined by the voltage across A7R85 and current through A7R86. Diode A7CR26 protects the regulator if the −15V UNREG input is shorted to ground. Overvoltage protection is provided by crowbar circuit A7Q15. If the power supply output exceeds approximately −18V, zener diode VR14 turns on and switches SCR Q15 on. This shorts the −15V supply to ground, causing it to current limit. LED A7DS7 provides a power on indication when the power supply exceeds approximately −12V. Diode A7CR17 provides reverse voltage protection.

±10V Power Supplies

±10V Unregulated. The two AC outputs of the T1 center-tapped secondary (approximately 16 VAC) are applied to full-wave bridge rectifier A6CR9-12. The rectifier provides both a +10V and −10V unregulated output that is referenced to the T1 center-tap (which is isolated from system ground by A6R11). A6C4 and A6C5 filter switching transients, and A9C1 and A9C4 filter AC line ripple.

+10V Regulator. Regulation is provided by three terminal regulator A7U5. The regulator output voltage is determined by the voltage drop across A7R45 and current through A7R46. Diode A7CR6 protects the A7U5 regulator if the +10V UNREG input is shorted to ground. Overvoltage protection is provided by crowbar circuit A7Q13. If the power supply output exceeds approximately +13V, zener diode VR10 turns on and switches SCR Q13 on. This shorts the +10V supply to ground, causing it to current limit. LED A7DS5 provides a power on indication when the power supply exceeds approximately +8V. Diode A7CR20 provides reverse voltage protection. If the +20V power supply is off, A7CR7 biases on to turn off the +10V supply.

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−10V Regulator. The operation of the −10V regulator is similar to the +20V regulator. R19 and VR15 provide a reference voltage to the non-inverting input of U2. R18 and C9 form a low pass filter for the reference voltage. R20, 21, and 22 form a voltage divider between −10V SENSE and −10V RET SENSE which provides an error voltage to the inverting input of U2. Error amplifier U2 controls the series pass base drive through A7 Q16 to maintain a regulated −10V supply. R13 senses the output current of the supply. If the output current exceeds approximately 2.5A, Q17 is biased on limiting the base current to U16 and therefore the output current. Q1 acts as a switch. If the −20V regulator fails Q1 is biased on, shorting the base of Q16 to ground and shutting off the −10V supply. Overvoltage protection is provided by a crowbar circuit (A7 Q14, A7 VR13, and A7 R102). If the power supply output exceeds aproximately −13V, zener diode VR13 turns on and switches SCR Q14 on, shorting the −10V supply to ground, and causing the −10V supply to current limit. Diode A7 CR19 provides reverse voltage protection. If the RF plug-in is not installed, diodes A7CR13 and A7CR14 conduct to connect the −10V reg and −10V RETURN lines across the voltage divider.

−40V Power Supply

−40V Unregulated. The approximately 47 VAC T1 output is rectified by full-wave bridge rectifier A6CR15-18. A6C8 and A6C14 filter switching transients, and A9C7 filters AC line ripple.

−40V Regulator. The −40V regulator operation is similar to the +20V regulator except that the regulator consists of discrete components (A7Q6-8) and, for improved reliability, the return side of the unregulated supply is regulated. The −40V output is common with −40V output of the unregulated supply.

A7Q6 is a series pass regulator with A7R29 functioning as the current sense resistor for foldback current limit transistor A7Q7. Error amplifier U19 controls the series pass base drive through A7Q8 to maintain a regulated −40V. The positive error amplifier input is scaled by the voltage divider consisting of A7R37-40. A7R39 is adjusted for −40V in the RF plug-in. The voltage divider is normally connected across the +20V SENSE and −40V SENSE inputs from the RF plug-in. However, if the RF plug-in is not installed, diodes A7CR11 and A7CR12 conduct to connect the voltage divider across the −40V regulator output and −40V RET line. Overvoltage protection is provided by a crowbar circuit (A7Q5, A7VR5). If the power supply output exceed approximately −51V, zener diode VR5 turns on and switches SCR Q5 on, shorting the −40V supply to ground, and causing the −40V supply to current limit. Diode A7CR8 provides reverse voltage protection.

+5V Power Supply

+5V Unregulated. The two AC outputs of the T1 center-tapped secondary are half-wave rectified by diodes A6CR13 and A6CR14. A6C6 and A6C7 filter switching transients, and A9C5 filters AC line ripple.

+5V Regulators. The +5V UNREG from the A6 rectifier is applied to two regulators. The A7U16 regulator output at A7TP1 is used only in the HP 8350B. The A7U10 regulator output at A7TP2 is used only by the RF plug-in. Each power supply output is provided overvoltage protection by crowbar circuits A7Q9 and A7Q10. Diodes A7CR21 and A7CR22 provide reverse voltage protection. Power on indication for each supply is provided by A7DS1 and A7DS8.

Three terminal regulator A7U16 provides regulation and current limiting for the +5VA and +5VAFP supply outputs. Regulation for the +5VB output is provided by three terminal regulator A7U10. The +5VB regulator output voltage is determined by the voltage drop across A7R2 and current through resistors A7R76, A7R106, and A7R1. A7R106 is adjusted for a +5.3V output at A7TP2. The extra 0.3V ensures sufficient voltage level at the RF plug-in. A7CR24 provides noise isolation between +5VB GND REF and GND DIG. The +5VA regulator output voltage is determined by the voltage drop across A7R89, A7R83, A7R105, and A7R84. A7R105 is adjusted for a +5.1V output at A7 TP1.

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Penlift A6 F

The penlift circuit controls the penlift solenoid in the X-Y recorder to raise or lower the pen. When L PL (Low = Penlift) from the A5 sweep generator goes active low, A6Q1 and A6Q2 turn off, deactiviting the penlift solenoid in the plotter or recorder. When L PL goes high, A6Q1 and A6Q2 are turned on, grounding the penlift solenoid, and causing the pen to set down. The Q2 collector voltage of about +40V is supplied through the penlift solenoid by the plotter or recorder. For TTL compatibility, +5V is also supplied to the Q2 collector through R15 and CR25. A6VR2 provides overvoltage protection.

Power-up Circuit A6 G

The power-up circuit provides the PWON output (Power On) that goes high after the +5VA supply reaches +5V at initial power on. PWON goes low when power is removed, but before the +5VA supply begins to drop. When low, the PWON output resets the microprocessor and initializes the HP 8350B. Diodes CR19 through CR24 rectify the T1 secondary output. At initial power on, A6Q4 is biased on by A6R4 and A6R5. A6C10 charges to about +8V and biases A6CR21 and A6CR24 off. The voltage at the noninverting input of comparator A6U1 rises immediately to about +2.4V. The voltage rise at the inverting input of comparator U1 is much slower, since A6C11 must charge through A6R1, A6R2, and CR23. Therefore, the U1 output is initially high which keeps A6Q4 biased on. After the +5VA supply reaches +5V, and A6C11 is fully charged, the voltage level at the A6U1 inverting input is about +2.6V. The U1 output goes low and turns off A6Q4 to switch the PWON output high.

When power is removed, A6C10 discharges quickly through A6R12. A6CR21 turns on and the voltage level at the U1 inverting input decreases. This results in a high A6U1 output that turns on A6Q4 and switches the PWON output low before the +5VA supply starts to decrease. This disables all actvity on the A3 microprocessor before the +5VA supply is able to turn off. This ensures that none of the data stored in RAM is altered or lost when power is turned off.

When power is turned off, A6CR24 provides a discharge path for A6C11. A6R6 provides some hysteresis when the comparator output changes states.

Line Trigger A6 H

The Q3 base is connected through R8 to the 5V secondary winding of T1. CR22 clips the negative half of the 60 Hz sine wave, and Q3 amplifies and inverts the clipped sine wave to provide a square-wave output to the A5 sweep generator. The Q3 collector is connected to +5V through a resistor on the A5 sweep generator.

Power Supply Failure Detection A7 A

The power supply failure detection circuit provides an active low L PSF (Low = Power Supply Failure) output if any of the regulated power supplies fail (except +5VA). The positive regulated power supply outputs are connected through a voltage divider to the noninverting input of comparator A7U17. The negative regulated supplies are connected through a voltage divider with the +5VA requlated supply to the inverting input of A7U17. Under normal operating conditions, the noninverting comparator input is more positive. If a power supply fails, the inverting comparator input goes more positive, and the comparator output, L PSF (Low = Power Supply Fail) goes active low.

Air Flow Detection A7 B

The air flow detection circuit senses the internal air flow generated by fan B1, and flags the A3 microprocessor if the air flow is restricted. This results in error message E016 being displayed on the front panel FREQUENCY display, but does not disable the instrument.

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AIR FLOW BAL potentiometer A7R58 is adjusted to balance the voltage levels of the two A7U11 comparator inputs under conditions of normal airflow. Transistor A7Q4 is always biased on, and, through a heatsink, acts as a heater for A7Q3. The efficiency of Q4 as a heater is directly dependent on airflow across the heatsink. If the airflow is restricted, A7Q3 is heated by A7Q4, and the A7Q3 base-emitter voltage drop decreases. This unbalances the bridge network, and the inputs to A7U11 are unbalanced, causing the A7U11 output (L PST) to go active low and flag the A3 microprocessor. Since the microprocessor reads the flag only once every 10 minutes, the air flow error code (E016) is not immediately displayed.

A7C35 prevents the comparator from triggering for transients. Resistor A7R28 provides some hysteresis once the comparator is triggered.

TROUBLESHOOTING

Power Supply Circuits

The regulators for the +20V, +10V, +5VA, +5VB, +15V and −15V power supplies are operating properly if the voltage difference between the regulated output and error voltage input pins is about 1.25 VDC. If the output voltage is low, and the above voltage difference exists, the problem is either the crowbar circuit or the load, which is causing the regulator to current limit.

Table 8-23 lists each regulated supply with its voltage limits. Test points for the voltage and return connections are provided for either an HP 83500 series RF plug-in or an HP 11869A Adapter/86200 series RF plug-in installed. The +20V, −10V, −40V, +5VA and +5VB supplies are adjustable. If these supplies are not within the limits, refer to Section V, before further troubleshooting. Tolerances and test instructions may be found in the beginning of Section VIII for +20, −40, and −10 supplies.

Airflow Circuit

The logic state of the airflow detection circuit output (L PST) is monitored by the A3 microprocessor, assembly and stored in the status buffer at hexadecimal address location 1000. The status buffer data is displayed on the front panel FREQUENCY/TIME display when the following key sequence is entered.

[SHIFT] [0] [0] [M1] [1][0][0][0] [M3]

The FREQUENCY/TIME display should indicate 02 if L PST is active low, and 00 if L PST is high. Jumper A7TP6 to A7TP7; the FREQUENCY/TIME display should cycle between 00 and 02. If the display does not cycle, refer to the airflow adjustment procedure in Section V.

Error Code 15 A6

Perform the following tests with an RF plug-in installed. Set 1740A (or equivalent) oscilloscope up as shown:

Display: Channel A: 2 volts/Div.
Channel B: 2 volts/Div.
Trigger on Channel B

Trigger: Normal
Level Positive
Edge Positive
D.C. coupled

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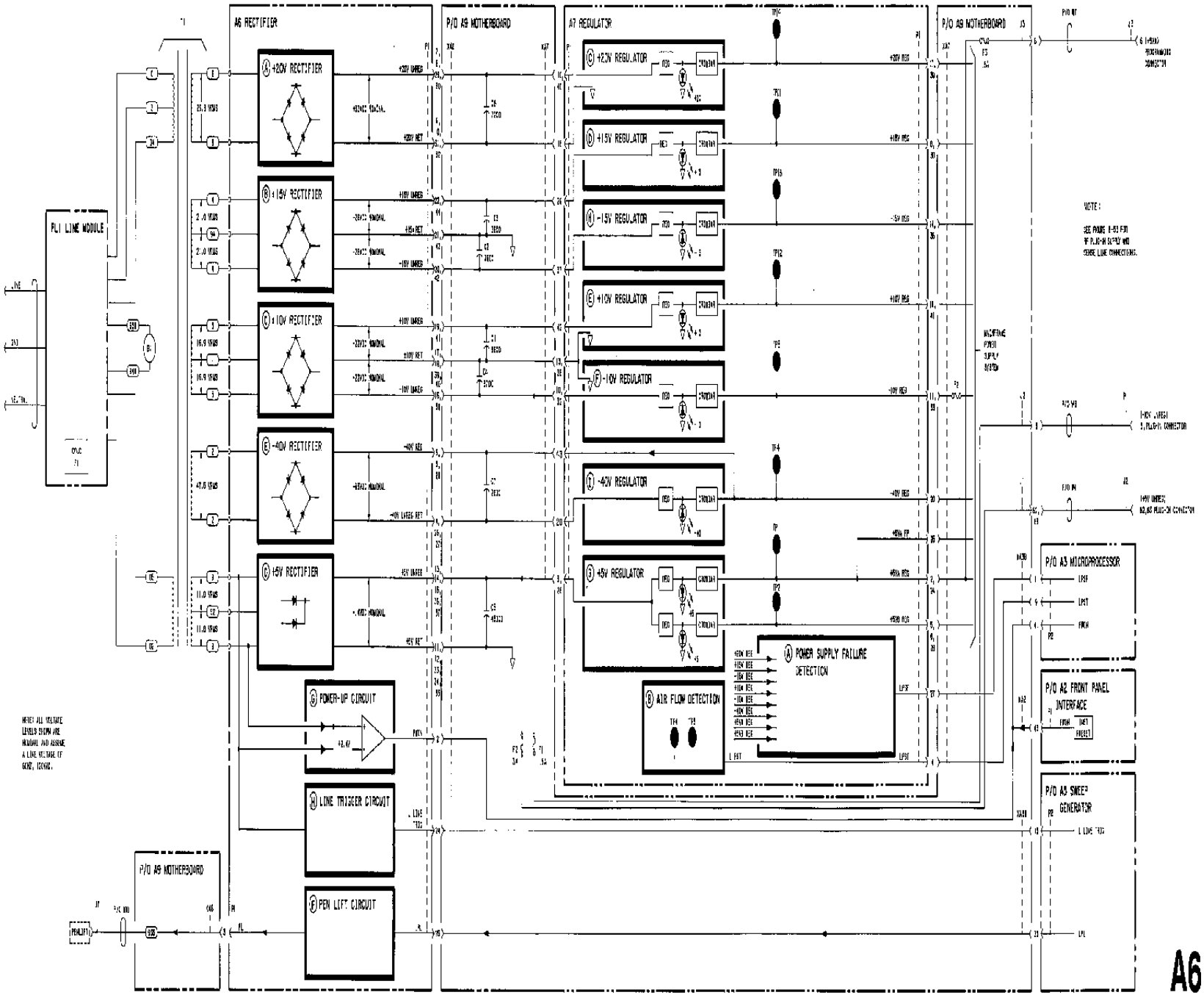
Scope Probes: Connect Channel A probe to A6 P1-2 (probe) and A6 P1-1 (Ground).

Connect Channel B probe to A6 P1-23 (probe) and A6 P1-1 (Ground)

Power On Test. Turn the HP 8350B power on. Make sure that PWON (Channel A) stays low (<.4V) for at least 5 ms after +5VA (Channel B) reaches +5V. Repeat as necessary to verify.

Power Off Test. Set scope to trigger on Channel A, edge negative. Turn the HP 8350B power off. +5VA (Channel B) must be at +5V for at least 5 ms after PWON (Channel A) goes low. Repeat as necessary to verify.

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A6, A7

Figure 8-40. A6 Rectifier/A7 Regulator, Block Diagram

8-141/8-142

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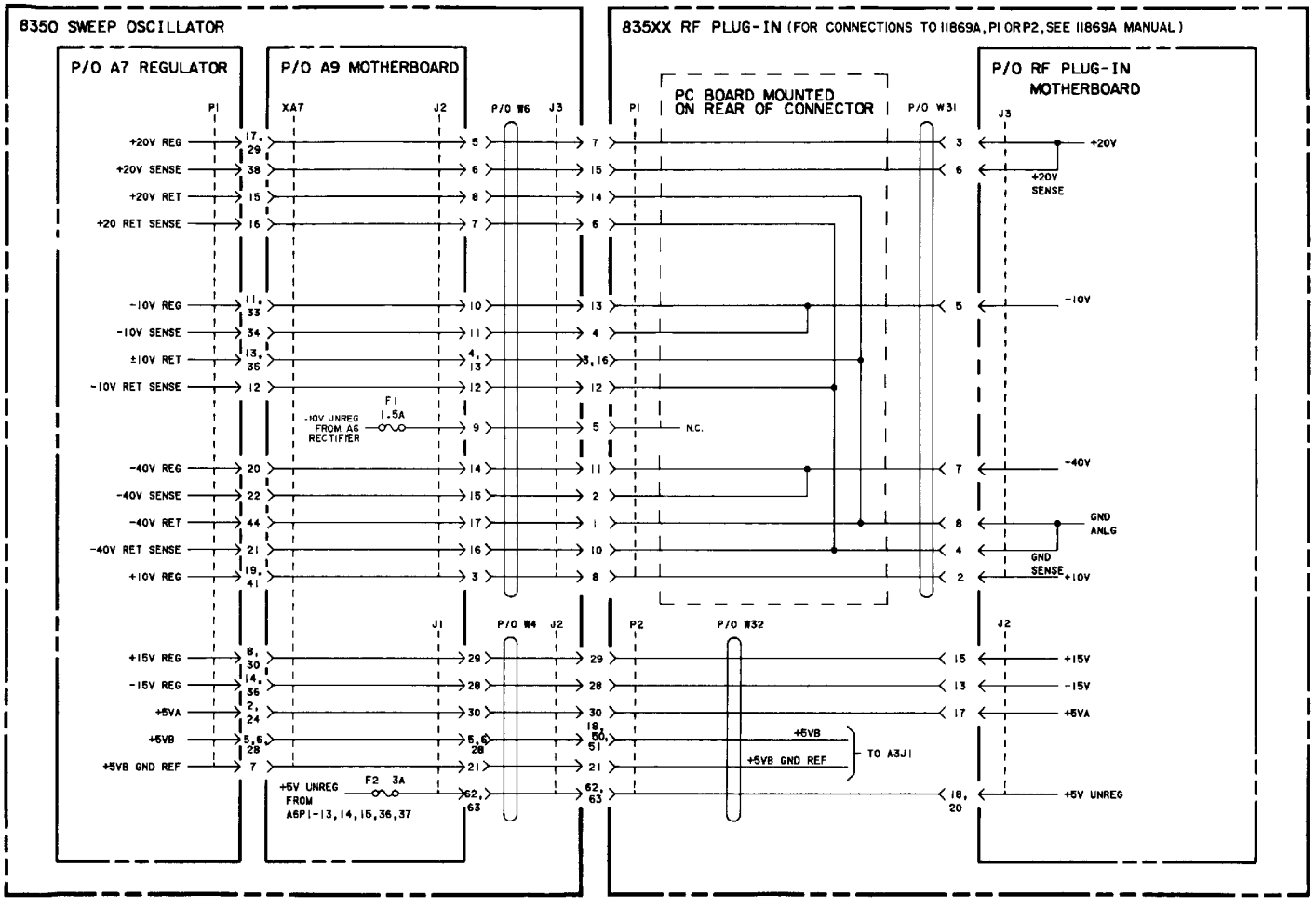


Figure 8-41. HP 8350B/RF Plug-in Power Supply Interface Schematic Diagram

Table 8-23. Regulated Supply Limits

Supply	With 83500-Series or 11869 Adapter		Limits
	DVM Probe	Ground	
+20V	A7TP15	A7TP16	19.900V to 20.010V
−10V	A7TP8	A7TP9	−10.005V to −9.995V
−40V	A7TP17	A7TP18	−40.02V to −39.980V
+5VA	A7TP1	A7TP10	4.750V to 5.250V
+5VB	A7TP2	A7TP10	5.000V to 5.450V
+10V	A7TP12	A7TP10	9.50V to 10.50V
+15V	A7TP11	A7TP10	15.0 to 16.40V
−15V	A7TP13	A7TP10	−14.50V to 15.90V

* Voltage limits given are for 11869A Adapter without the 86200-series RF Plug-in connected.

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A6P1

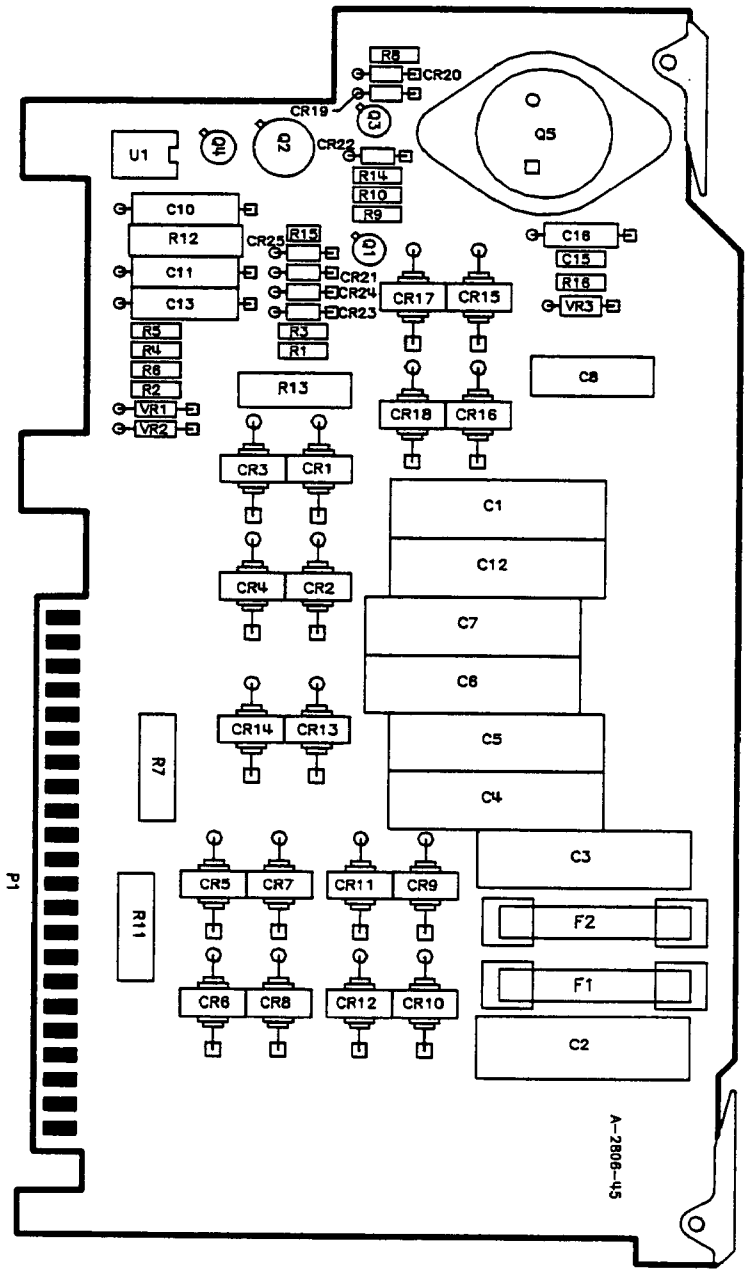
PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	GND DIG			I
23	+5VA	IN	A7P1-2, 24	I
2	PWON	OUT	DIST.	G
24	L LINETRG	OUT	A5P2-15	H
3	PL	OUT	J7, J13-10	F
25	L PL	IN	A5P2-35	F
4	−40V	OUT	A7P1-20	E
26	−40V	OUT	A7P1-20	E
5	−40V UNREG RET		A7P1-43	E
27	−40V	OUT	A7P1-20	E
6	−40V UNREG RET		A7P1-43	E
28	−40V UNREG RET		A7P1-43	E
7	+20V UNREG	OUT	A7P1-18, 40	A
29	+20V UNREG	OUT	A7P1-18, 40	A
8	+20V UNREG	OUT	A7P1-18, 40	A
30	+20V UNREG	OUT	A7P1-18, 40	A
9	+20V RET		A7P1-15	A
31	+20V RET		A7P1-15	A
10	+20V RET		A7P1-15	A
32	+20V RET		A7P1-15	A
11	+5V RET			D
33	+5V RET			D
12	+5V RET			D
34	+5V RET			D
13	+5V UNREG	OUT	A7P1-3, 26	D
35	+5V RET			D
14	+5V UNREG	OUT	A7P1-3, 26	D
36	+5V UNREG	OUT	A7P1-3, 26	D
15	+5V UNREG	OUT	A7P1-3, 26	D
37	+5V UNREG	OUT	A7P1-3, 26	D
16	−10V UNREG	OUT	A7P1-42	C
38	−10V UNREG	OUT	A7P1-10, 32	C
17	±10V RET		A7P1-13, 35	C
39	±10V RET		A7P1-13, 35	C
18	±10V RET		A7P1-13, 35	C
40	±10V RET		A7P1-13, 35	C
19	+10V UNREG	OUT	A7P1-42	C
41	+10V UNREG	OUT	A7P1-42	C
20	−15V UNREG	OUT	A7P1-37	B
42	−15V UNREG	OUT	A7P1-37	B
21	±15V RET			B
43	±15V RET			B
22	+15V UNREG	OUT	A7P1-29	B
44	+15V UNREG	OUT	A7P1-29	B

NOTES

1. Switch connections shown are actually connections that are determined by line voltage selector PC board positioning. Board position shown is for 120 VAC line voltage. Instructions for line voltage selection are provided in Section II, Installation.

2. See A7 Regulator service information next to the A6/A7 block diagram.

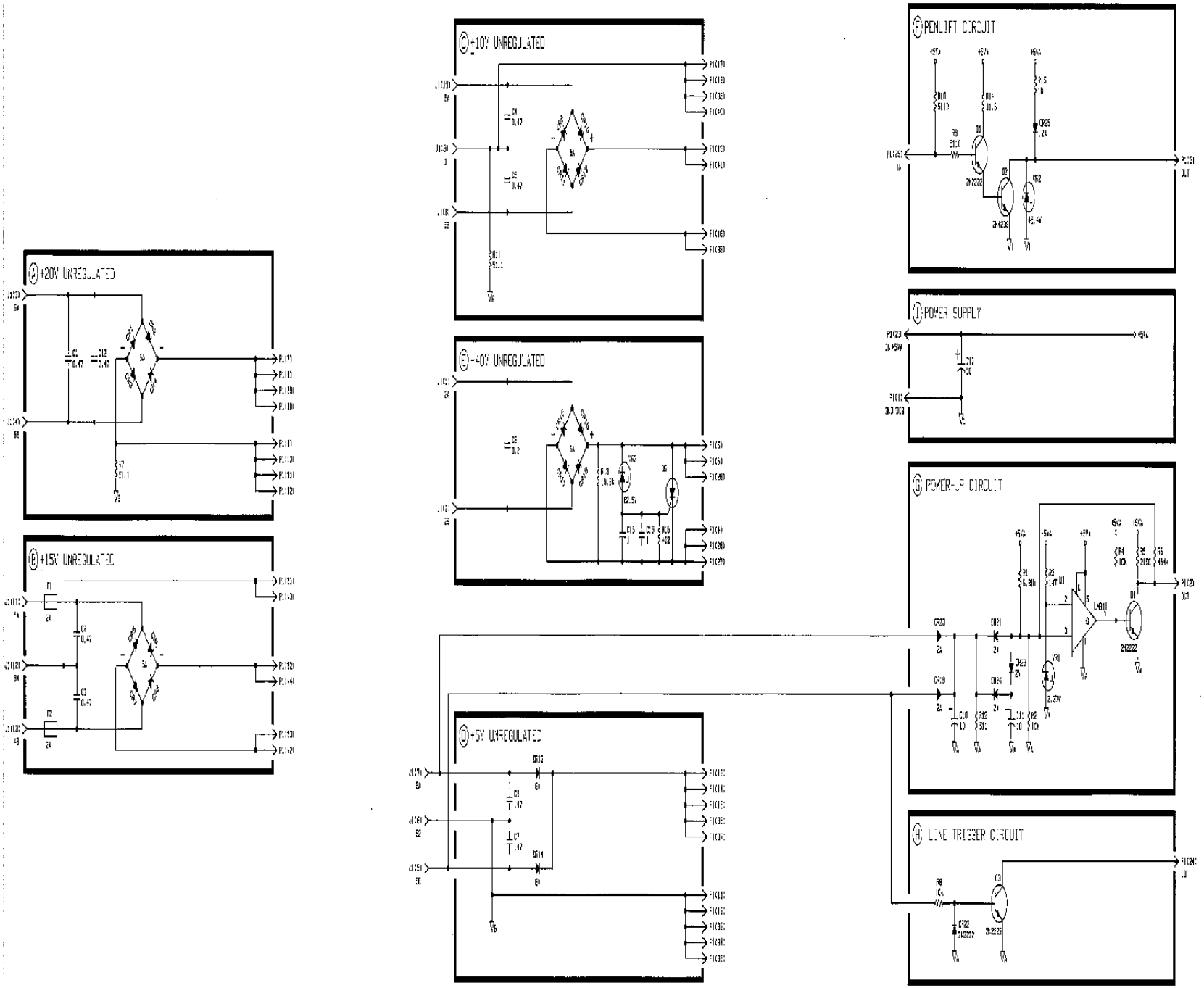
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Figure 8-42. A6 Rectifier Component Location Diagram

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A6 RECTIFIER

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Figure 8-43. A6 Rectifier, Schematic Diagram

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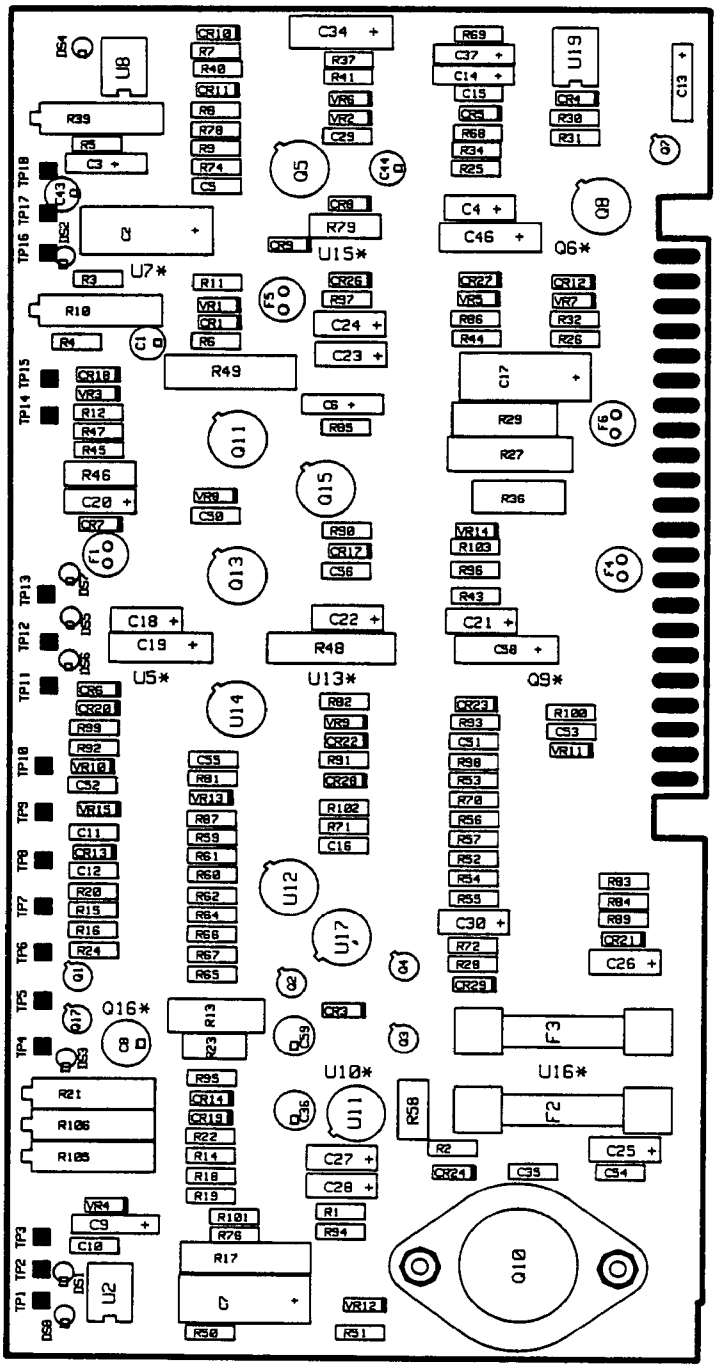
NOTES

1. See block diagram for fuses mounted on Motherboard.
2. The state of power supply failure and airflow flags L PSF and L PST are read by the A3 Microprocessor and stored with the status byte at hex address 1000. Performing a hex data read from the front panel will give 01 if L PSF is true (low), 02 if LPST is true (low), and 03 if both are true.
3. The return for each supply is shown in the function blocks.
4. These components are not visible on the component side of the printed circuit assembly but the connections to these components are shown on the lower component location figure.

A7P1

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1 23	GND DIG GND DIG			J J
2 24	+5VA +5VA	OUT OUT	DIST. DIST.	G G
3 25	+5V UNREG +5VAFP	IN OUT	A6P1-13, 14 A9E8	G G
4 26	L PST +5V UNREG	OUT IN	A3P2-9 A6P1-13, 14	B G
5 27	+5VB L PSF	OUT OUT	J2-18, 50 A3P2-11	G A
6 28	+5VB +5VB	OUT OUT	J2-18, 50 J2-18, 50	G G
7 29	+5VB GNDREF +15V UNREG	 IN	J2-21 A6P1-22, 44	G D
8 30	+15V +15V	OUT OUT	DIST. DIST.	D D
9 31	GND ANLG GND ANLG			J J
10 32	−10V UNREG −10V UNREG	IN IN	A6P1-16, 38 A6P1-16, 38	F F
11 33	−10V −10V	OUT OUT	J3-13 J3-13	F F
12 34	−10V RET SENSE −10V SENSE		J3-12 J3-4	F F
13 35	±10V RET ±10V RET		A6P1-17, 18 A6P1-17. 18	E, F E, F
14 36	−15V −15V	OUT OUT	DIST. DIST.	H H
15 37	+20V RET −15V UNREG	 IN	A6P1-9, 10 A6P1-20, 42	C H
16 38	+20V RET SENSE +20V SENSE		J3-6 J3-15	C C
17 39	+20V +20V	OUT OUT	J3-7 J3-7	C C
18 40	+20V UNREG +20V UNREG	IN IN	A6P1-7, 8 A6P1-7, 8	C C
19 41	+10V +10V	OUT OUT	J3-8 J3-8	E E
20 42	−40V +10V UNREG	OUT IN	J3-11 A6P1-19, 41	I E
21 43	−40V RET SENSE −40V UNREG RET		J3-10 A6P1-5, 6	I I
22 44	−40V SENSE −40V RET		J3-2 J3-1	I I

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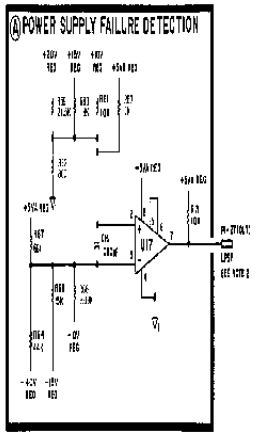


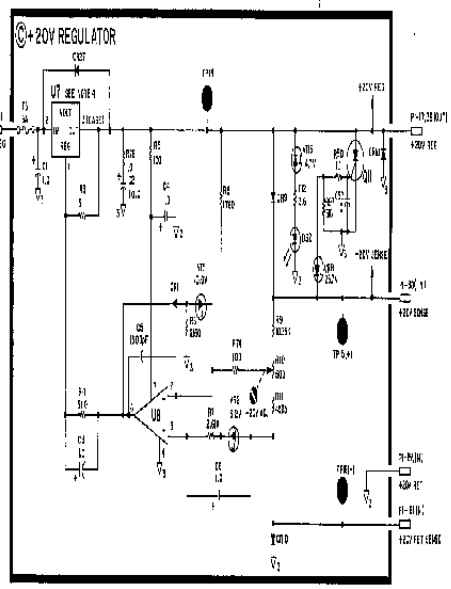
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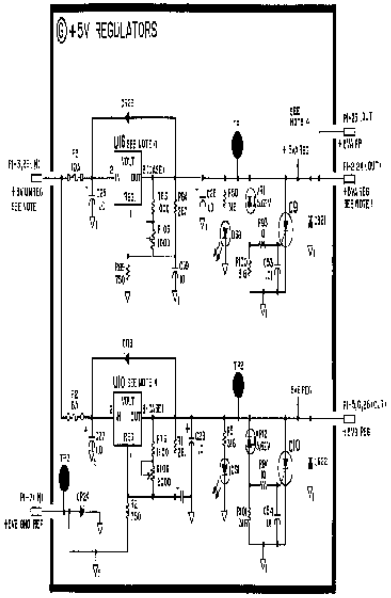
Figure 8-44. A7 Regulator Component Location Diagram

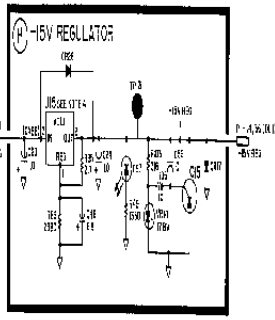
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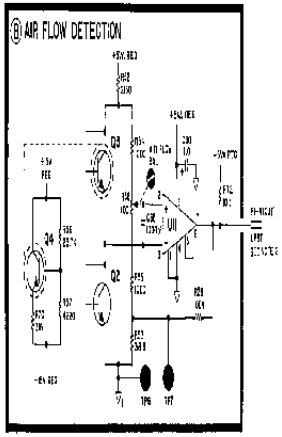
A7 REGULATOR
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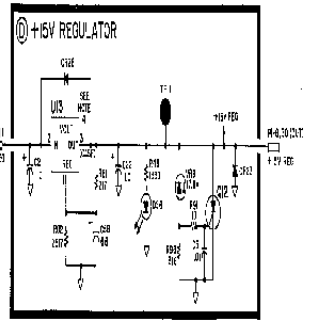


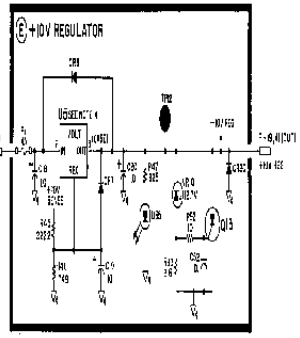


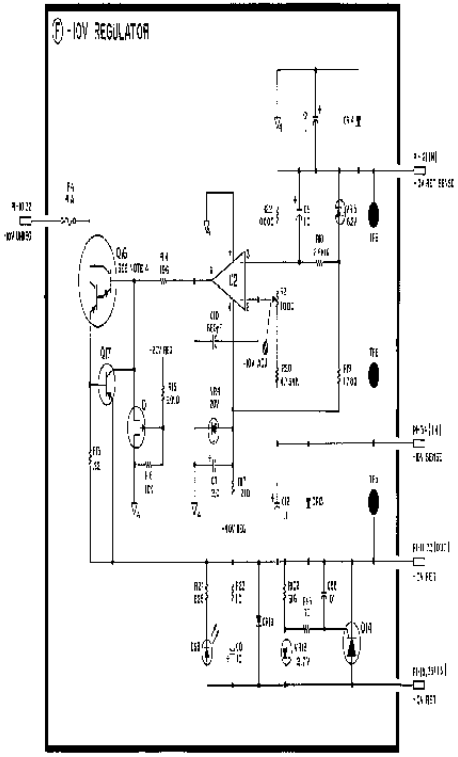


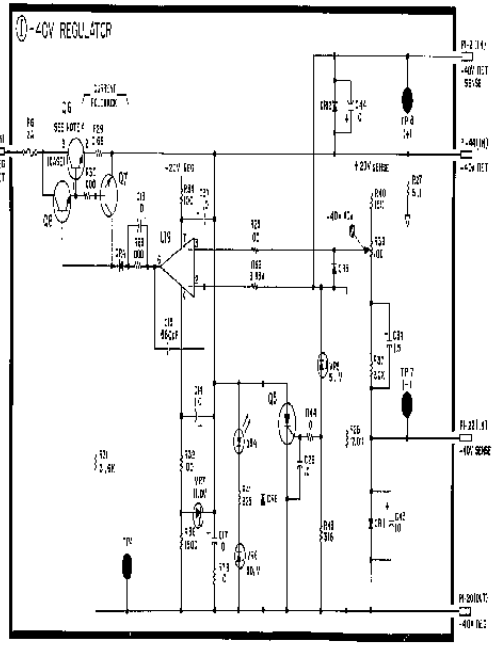


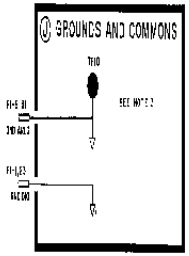












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Figure 6-45. A7 Regulator, Schematic Diagram

A8 HP-IB Interface

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A8 HP-IB Interface Circuit Description

INTRODUCTION

The A8 HP-IB interface functions as a talker/listener for interfacing the HP 8350B to the Hewlett Packard Interface Bus (HP-IB). For an explanation of bus operation, refer to "Condensed Description of the Hewlett Packard Interface Bus" (HP Part No. 59401-90030). The A8 HP-IB interface assembly interfaces with the external HP-IB through rear panel connector J4. The sixteen bus lines are buffered by the HP-IB Bus Driver **F**, and connect to the HP-IB Interface circuit **E**. Communication with the A3 microprocessor is through the instrument bus (data, address, and control).

The Address Decoder **A** decodes the instrument address bus lines L A0 through L A4 and I/OE1 to generate chip select signals for specific components on the A8 HP-IB assembly.

The HP-IB address is stored in RAM on the A3 microprocessor and in an internal register of the HP-IB interface circuit. The A3 microprocessor does not read the address switch unless power to non-volatile memory has been interrupted. New addresses must be entered from the front panel.

The HP-IB Interface circuit **E** handles the data transfer, handshake timing, device clearing and triggering, service requests, and serial and parallel polling. When a remote command is received, the HP-IB Interface circuit **E** transmits a L IBIRQ (low HP-IB interrupt request) to the A3 microprocessor. The microprocessor responds by polling the HP-IB interface circuit to determine the status of the interrupt. When addressed to listen, the HP-IB interface circuit outputs the received instruction onto the instrument bus data lines. The data is buffered through bi-directional data buffer U19 and sent to the A3 microprocessor. The microprocessor decodes the HP-IB information and implements the remote instruction.

Since the HP 8350B is both a talker and a listener, data transfer is bi-directional between the HP 8350B and the HP-IB bus. Instrument bus control line L IRD (Low=Instrument Bus Read) controls the direction of data flow through the Bi-directional Data Buffer **B**. L IRD is inverted to L WRITE and controls the data flow direction into and out of the HP-IB Interface circuit **E**. The direction of data flow through HP-IB Bus Driver **F** is determined by T/LR (Talk/Low Receive) and L ATN (Low=Attention) signals from the HP-IB Interface circuit **E**.

The A3 microprocessor communicates with the Self Test circuit **D** to verify operation of the instrument bus. This instrument bus self test is part of the series of self tests performed at initial "power on" or when front panel **[INSTR PRESET]** key is pressed. The Instrument Bus self test is also initiated by pressing front panel keys **[SHIFT] [0] [9]**. This self test checks only operation of the instrument bus, and does not check the HP-IB interface circuit. To check the instrument data bus, the A3 microprocessor writes a specific bit pattern to the HP-IB Status Indicator **G**, where the data is latched. This data is then read by the microprocessor and compared to the original bit pattern. If the data received does not equal the data sent, error code E005 is displayed on the front panel.

If data bus operation is verified, the microprocessor then places a specific bit pattern on the instrument address bus. This bit pattern is repeated fifteen times. The address lines are decoded and used to increment a counter. The counter output is applied to the data bus and this information is then read by the microprocessor. The microprocessor reads the counter output when the counter is cleared and when it has counted to its maximum state. If the data received is not correct, error code E005 is displayed on the front panel.

NOTE: All address locations are given in hexadecimal.

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Address Decoder A

The HP-IB interface assembly uses address locations 2000 to 200F. When the instrument address bus contains a valid address, the address decoder decodes the address to determine which device on the A8 HP-IB interface assembly is addressed by the A3 microprocessor. The address decoding for the HP-IB interface circuitry is provided by NAND gate U11B and its associated circuitry. Three-to-eight decoder U15 provides the decoding for the remaining circuits. Table 8-24 shows the address decoding for each device.

Address lines L IA0-L IA2 are inverted and buffered through U24A, U24F and U24B. These three lines are multiplexed into eight lines by U15. Address lines LA3, LA4, control signals I/OE1 (Input/Output Enable 1) and L I/OSTB (Low Input/Output Strobe) are used to enable U15. The outputs of U15 are active low and are used as chip select signals for U5, U9, U10 and U14.

The address lines LA0-LA4 are inverted and buffered by U24A-F and are sent to the Self Test **D** and HP-IB interface circuits. The output from U11B, LCS (Low=Chip Select), is the enable signal for the HP-IB interface circuit U6.

Bi-directional Data Buffer B

Transceiver U19 buffers the data on the instrument data bus and the data on the HP-IB interface. U19 is enabled for address locations 2000 to 200F. Control line L IRD determines the direction of flow of the data through U19. When L IRD is low, the data transfers from the A8 HP-IB interface assembly to the instrument data bus. When L IRD is high, the data transfers from the instrument data bus to the A8 HP-IB interface assembly. Resistor array U23 provides series resistors for each data line to reduce ringing and crosstalk.

HP-IB Address C

Switch S1 is used to set the HP-IB address for the HP 8350B. When buffer U14 is enabled (LEN7 is low), the SI switch settings are read by A3 microprocessor where they are compared to the address being sent on the HP-IB. U18 provides pull up resistors for the S1 switch lines. The HP-IB address is not read at power on, and any changes must be entered from the front panel (SHIFT LCL nn GHz, where nn is between 0 and 30. The value 21 is typically reserved for the controller and should be avoided.)

HP-IB Interface E

Integrated circuit U6 is an HP-IB talker/listener device that provides the communications between the HP 8350B and the HP-IB. U6 handles the data transfer, handshake timing, device clearing and triggering, service requests, and serial and parallel polling. Figure 8-46 is a flow diagram showing the logic involved upon receipt of a command from the HP-IB.

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Table 8-24. HP-IB Interface Address Decoding

Address	Address Decoder Components	Components Addressed	Read or Write	Description
2000	U11A, U15, U24, U25	U5	Write	Write HP-IB Status
2001	"	U10	Read	Read Self Test
2002	"	U9	Read	Read HP-IB Status
2003	"	Not Used		
2004	"	Not Used		
2005	"	Not Used		
2006	"	U14	Read	Read HP-IB Address switch
2007	"	Not Used		
2008	U11B, U24, U25A, F	U6	Read Write	Read Data in Write Data out
2009	"	"	Read Write	Interrupt Status 1 Interrupt Mask 1
200A	"	"	Read	Interrupt Status 2 Interrupt Mask 2
200B	"	"	Read Write	Serial Poll Status Serial Poll Mode
200C	"	"	Read Write	Address Status Address Mode
200D	"	"	Read Write	Command Pass Through Aux Mode
200E	"	"	Read Write	Address 0 Address 0/1
200F	"	"	Read Write	Address 1 EOS

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When the HP 8350B is addressed by the HP-IB to implement a remote command, U6 interrupts the A3 microprocessor by sending an interrupt request (L IBIRQ). The microprocessor responds to the interrupt request and polls U6 to determine the status of the interrupt. Communication then continues through the instrument data bus between U6 and the microprocessor. The microprocessor determines what remote command to implement and performs the instruction.

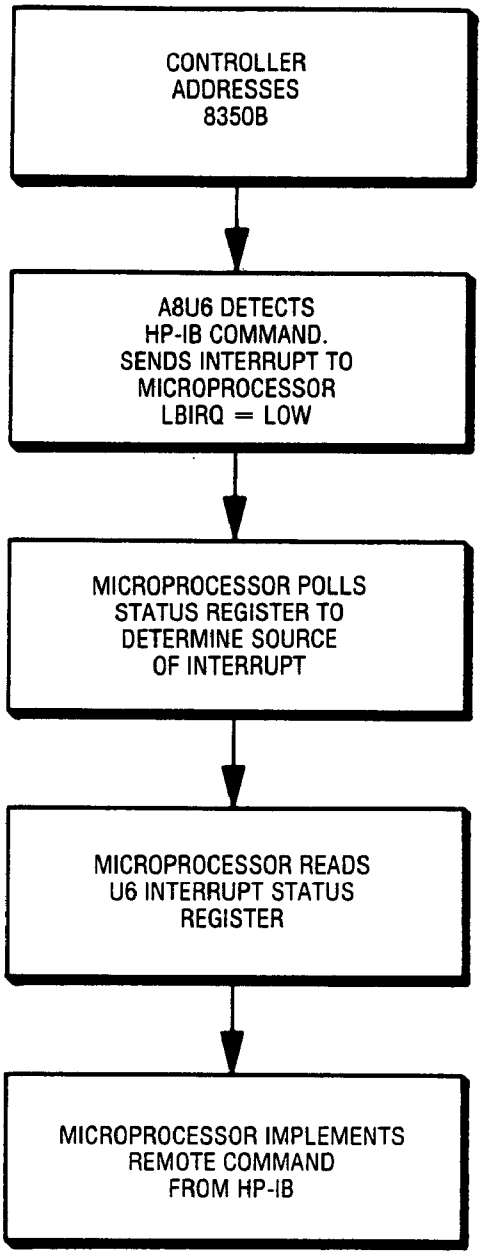


Figure 8-46. HP-IB Interrupt Flow Diagram

NOTE: HP-IB signals L REN, and L IFC are always inputs to the HP 8350B. Signal L SRQ is always an output to the HP-IB.

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Table 8-25. A8U8 Directional Control

Controls		Direction of Data			
T/LR	L ATN	L EOI	L NRFD	L NDAC	L DAV
H	H	OUT	IN	IN	OUT
H	L	IN	IN	IN	OUT
L	X	IN	OUT	OUT	IN

HP-IB Driver F

The HP-IB Driver provides a link between the HP-IB interface and the HP-IB. The sixteen signal lines are interfaced through transceivers U8 and U16. U8 handles the data transfer and bus management signals and U13 handles the eight line data bus. For U8, the direction of signal flow is determined by T/LR (Talk/Low Receive), and L ATN (Low=Attention) inputs. Directional control for U8 is shown in Table 8-25.

The direction of signal flow for transceiver U13 is also determined by T/LR. When T/LR is high, data is transferred from U6 to the HP-IB. When T/LR is low, data transfers from the HP-IB to U6. The sixteen signal lines travel from U8 and U13 through J1 and ribbon cable W5 to the rear panel HP INTERFACE BUS connector J4.

HP-IB Status Indicator G

Latch U5 has two functions. It is utilized for the self-test routines as well as for HP-IB status indication. Refer to the self test circuit description for operation in the self-test routine.

U5 latches in the data from the instrument data bus which turns on LEDs DS1-DS3 to indicate the HP-IB status of the HP 8350B. U5 is clocked by LEN1 from the address decoder. L SRQ (Low Service Request) is taken directly from the output of U6 and inverted twice through U2B and U2F. The HP-IB state for this signal is indicated by LED DS4. LEDs DS1-DS4 indicate an active state when illuminated (i.e., when the HP 8350B is in the talk mode DS3 and DS2 are on).

Self Test D

The A3 microprocessor writes a data pattern into latch U5, then reads U9 and compares this data with the original data written into U5. Since U9 is the three-state buffer used to read the latched U5 output, the two data patterns should be identical. The data pattern written is a single high data bit (all other bits are low). This data bit is rotated from the least significant to the most significant bit over a sequence of eight write/read/compare cycles.

The instrument bus address lines are then checked. The A3 microprocessor outputs a series of addresses that are decoded by the self test circuit, and used to control counter U7. The counter is reset at the beginning of the test by an address bit pattern that results in all highs at the input of 13-input NAND gate U17. This results in a counter reset pulse that is gated with L I/O STB in NOR gate U3D. The A3 microprocessor then complements the address bit pattern, which results in all highs on the input to 13-input NAND gate U16 The U16 output is gated with I/O STB by U11C, and is used to increment counter U7. This address bit pattern is repeated 15 times to increment the counter so all its outputs are high (a count of 15). The A3 microprocessor then reads the tri-state buffer U10 to determine the counter output. If the counter outputs are all high, the instrument bus address lines are operational.

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TROUBLESHOOTING

Component failures on the A8 HP-IB interface may be classified as either an instrument bus self-test failure or HP-IB interface failure. Instrument bus operation should be verified before troubleshooting a HP-IB interface failure.

Instrument Bus Failure. Correct instrument bus operation is checked during the instrument preset self-tests. If the front panel **[INSTR PRESET]** key is pressed and error code E004 or lower occurs, instrument bus operation is verified. If E005 occurs, perform an instrument preset self-test with A4 scaling and marker, A5 sweep generator and the RF plug-in removed. (This removes the possibility of these assemblies causing an instrument bus error code.) If E005 still occurs, set the HP 8350B into the repetitive instrument bus self-test by pressing **[SHIFT] [0] [9]**, and checking waveforms shown in Figure 8-48.

If Instrument Bus Test passed the following circuits have been verified:

- All address decoder circuitry except L CS (U11B pin 6) and LEN 7 (U15 pin 9).
- All self-test circuitry.
- All HP-IB status indicator circuitry except L SRQ (U2B pin 3).
- All bi-directional data buffer circuitry.

An E005 indicates that one of the above circuits is faulty.

HP-IB Interface Failure. Provided the instrument bus is operational (no error code), an HP-IB failure is limited to one of the following circuits:

- HP-IB Address C
- HP-IB Interface E
- HP-IB Driver F
- Address Decoder U11B pin 6, L CS or U15 pin 9, LEN 7
- HP-IB Status Indicator, A8 U2B is internally shorted and is pulling L SRQ to an incorrect logic level.

Basic remote programming operation is verified by performing the Remote Operator's Check in Section III. Depending on the outcome of the Remote Operator's Check, troubleshoot the HP-IB interface as follows:

Not Able To Complete Remote Operator's Check

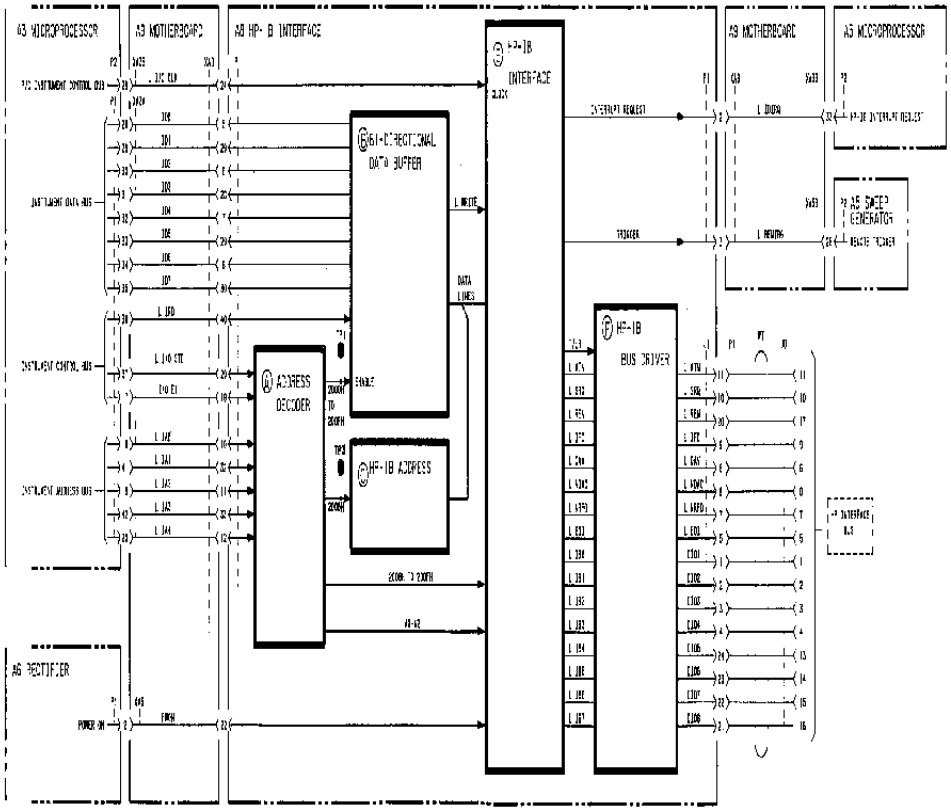
1. Check address switch for correct HP-IB address. Press **[SHIFT] [LCL]** to read the HP-IB address and compare it with the desired switch setting.
2. Check interrupt operation. Run Remote Check program in Table 8-26 Check that U6 generates an active low L IBIRQ signal and that U6 receives an active low L CS input. Generation of the interrupt request indicates that U6 has received an HP-IB command. An active L CS pulse indicates that the A3 microprocessor responds to the interrupt request.
3. Run Remote Check program in Table 8-26. Check for activity on handshake lines L ATN, L NDAC, L NRFD, L DAV, and also the L REN bus management line.
4. Run Talk/Listen program in Table 8-26. Check HP-IB status indicators switch between TALK and LISTEN indications.

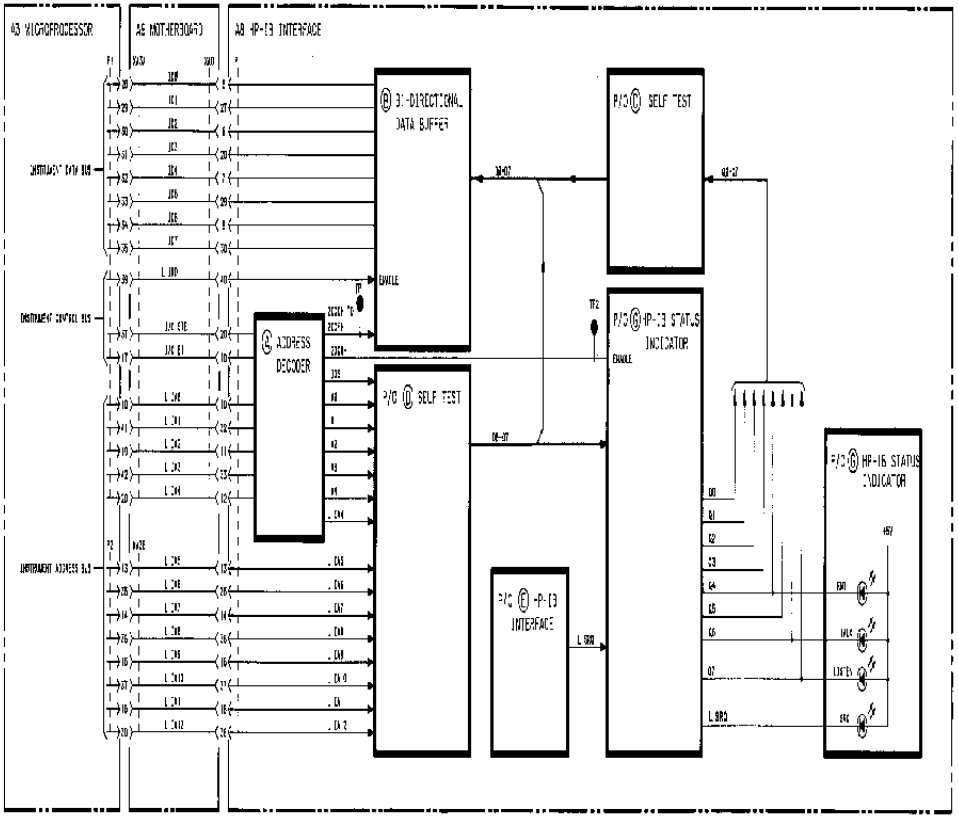
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Remote Operator's Check is Verified

1. Check operation of bus management lines L SRQ, L IFC, and L EOI. Run programs listed in Table 8-26 to exercise each bus management line and check for activity on that line.
2. Run L REMTRG Check program in Table 8-26, and check L REMTRG line for activity.
3. Problem may be software related. Check that software conforms to guidelines in Section III.

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A8

Figure 8-17. A8 HP-IB Interface Self Test, Block Diagram

8-163/8-162

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Table 8-26. HP-IB Interface Checks

Remote Check

BASIC

```
10  RESET 7
20  REMOTE 719
30  LOCAL 719
40  GOTO 10
```

HPL

```
0 :  rem719
1 :  lcl 719
2 :  gto −2
```

Talk/Listen Check

BASIC

```
10  OUTPUT 719; "ST1SC"
20  WAIT 1000
30  OUTPUT 719; "OPST"
40  ENTER 719;A
50  DISP A
60  GOT0 10
```

HPL

```
0 :  wrt 719, "ST1SC"
1 :  wait 1000
2 :  wrt 719, "OPST"
3 :  red 719, A
4 :  wait 1000
5 :  dsp A
6 :  gto −6
```

SRQ and LIFC Check

BASIC

```
10  OUTPUT 719; "RM" 7 CHR$(96)
20  ABORTIO 7
30  CLEAR 719
40  ON INTR 7 GOSUB 90
50  ENABLE INTR 7;8
60  OUTPUT 719 "OF"
70  WAIT 100
80  GOTO 10
90  STATUS 7,1;X
100 A=SPOLL(719)
110 CLEAR 719
120 RETURN
```

HPL

```
0 :  wrt 719, "RM" & char (96)
1 :  cli 7
2 :  cir 719
3 :  oni 7, "SRQ"
4 :  eir 7,8
5 :  wrt 719, "OF"
6 :  wait 100
7 :  gto −6
8 :  "SRQ":rds(719)→A
9 :  cir 719
10:  eir 7,8
11:  iret
```

LEOI Check

BASIC

```
10  X=PPOLL (7)
20  GOTO 10
```

HPL

```
0 :  pol(7)→B
1 :  gto −1
```

L REMTRG Check

BASIC

```
10  TRIGGER 719
20  GOTO 10
```

HPL

```
0 :  trg 719
1 :  gto −1
```


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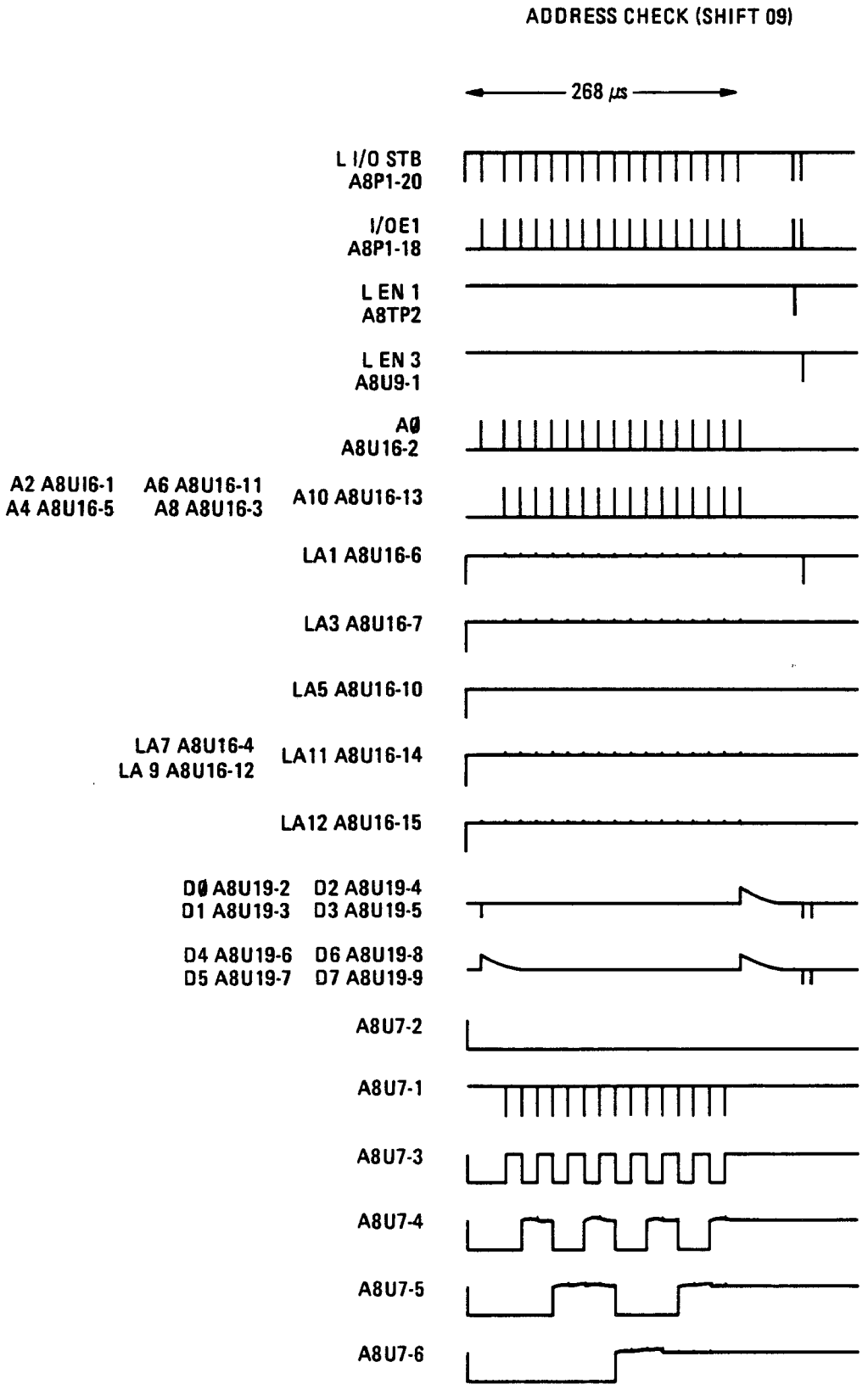


Figure 8-48. Instrument Bus Self Test, Timing Diagram (1 of 2)

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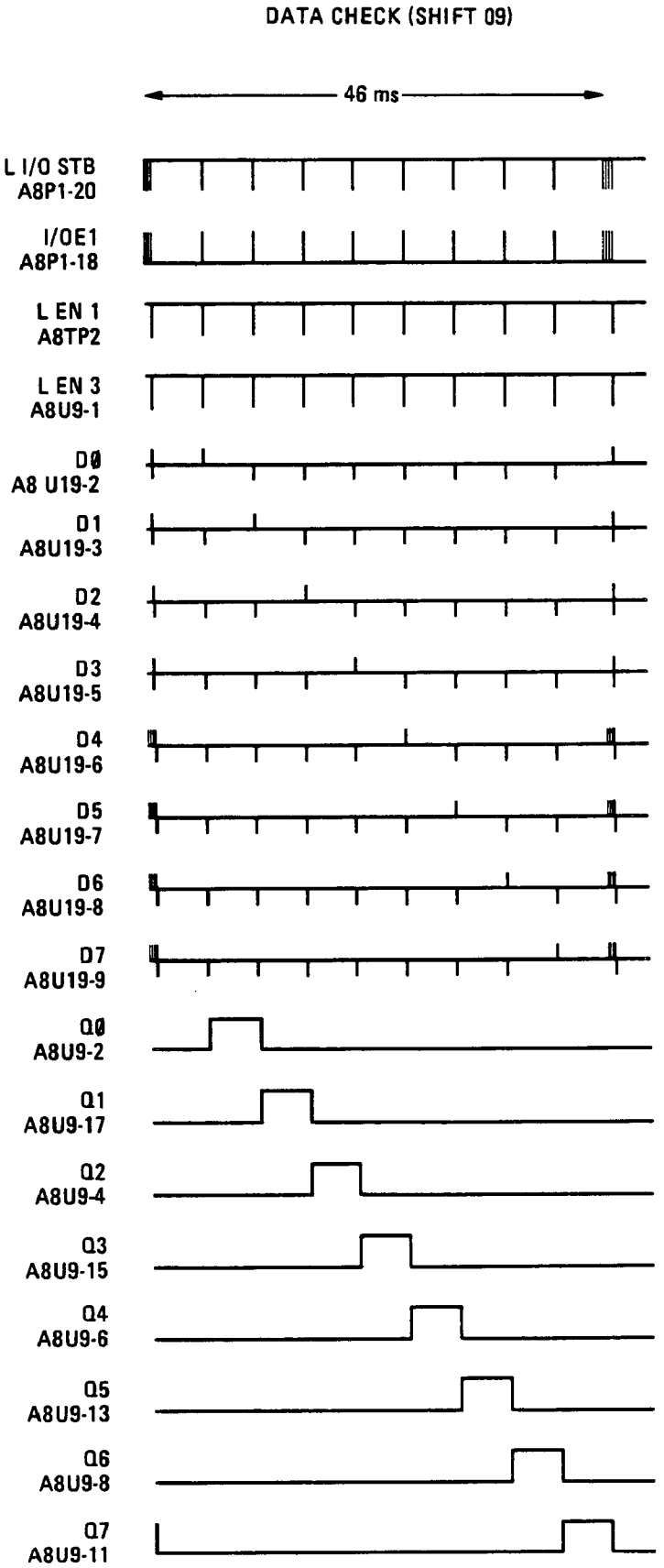


Figure 8-48. Instrument Bus Self Test, Timing Diagram (2 of 2)

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A8J1

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	DIO1	I/O	J4-1	F
2	DIO2	I/O	J4-2	F
3	DIO3	I/O	J4-3	F
4	DIO4	I/O	J4-4	F
5	L EO1	I/O	J4-5	F
6	L DAV	I/O	J4-6	F
7	L NRFD	I/O	J4-7	F
8	L NDAC	I/O	J4-8	F
9	L IFC	IN	J4-9	F
10	L SRQ	OUT	J4-10	F
11	L ATN	I/O	J4-11	F
12	N.C.			
13	GND HP-IB		J4-24	F
14	GND HP-IB		J4-23	F
15	GND HP-IB		J4-22	F
16	GND HP-IB		J4-21	F
17	GND HP-IB		J4-20	F
18	GND HP-IB		J4-19	F
19	GND HP-IB		J4-18	F
20	L REN	IN	J4-17	F
21	DIO8	I/O	J4-16	F
22	DIO7	I/O	J4-15	F
23	DIO6	I/O	J4-14	F
24	DIO5	I/O	J4-13	F

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A8P1

PIN	SIGNAL	I/O	TO/FROM	FUNCTION
1	N.C.			
23	GND DIG			H
2	L IBIRQ	OUT	A3P2-33	E
24	L I/OCLK	IN	A3P2-29	E
3	L REMTRG	OUT	A5P2-25	E
25	GND DIG			H
4	GND DIG			H
26	GND DIG			H
5	ID0	I/O	A3P1-28	B
27	ID1	I/O	A3P1-29	B
6	ID2	I/O	A3P1-30	B
28	ID3	I/O	A3P1-31	B
7	ID4	I/O	A3P1-32	B
29	ID5	I/O	A3P1-33	B
8	ID6	I/O	A3P1-34	B
30	ID7	I/O	A3P1-35	B
9	GND DIG			H
31	GND DIG			H
10	L IA0	IN	A3P1-18	A
32	L IA1	IN	A3P1-41	A
11	L IA2	IN	A3P1-19	A
33	L IA3	IN	A3P1-42	A
12	L IA4	IN	A3P1-20	A
34	GND DIG			H
13	L IA5	IN	A3P2-13	D
35	L IA6	IN	A3P2-35	D
14	L IA7	IN	A3P2-14	D
36	L IA8	IN	A3P2-36	D
15	L IA9	IN	A3P2-15	D
37	L IA10	IN	A3P2-37	D
16	L IA11	IN	A3P2-16	D
38	L IA12	IN	A3P2-38	D
17	GND DIG			H
39	GND DIG			H
18	I/OE1	IN	A3P1-17	A
40	L IRD	IN	A3P1-39	B
19	I/OE2	IN	A3P1-16	NOT USED
41	GND DIG			H
20	L I/OSTB	IN	A3P1-37	A
42	GND DIG			H
21	N.C.			
43	N.C.			
22	PWON	IN	A6P1-2	E
44	+5VA	IN	A7P1-2, 24	H

NOTES

1. The following key entries provide front panel access for a data write/read operation to/from the addressed location:

Function	Key Entry
*Hex Address Entry	**[SHIFT] [0] [0]** (enter hex address)
Hex Data WRITE	**[M2]** (enter data: two hex digits)
Hex Data READ	**[M3]**
Hex Data Rotation Write	**[M4]**
Hex Addressed Fast Read	**[M5]**

*To address a different location, press **[M1]** and enter the new address, or use the increment keys **[▲] [▼]** to step to the new address.

2. On the rear panel HP interface bus connector, pin 12 is connected to chassis ground.
3. See A8 circuit for table showing directional flow through A8U8.

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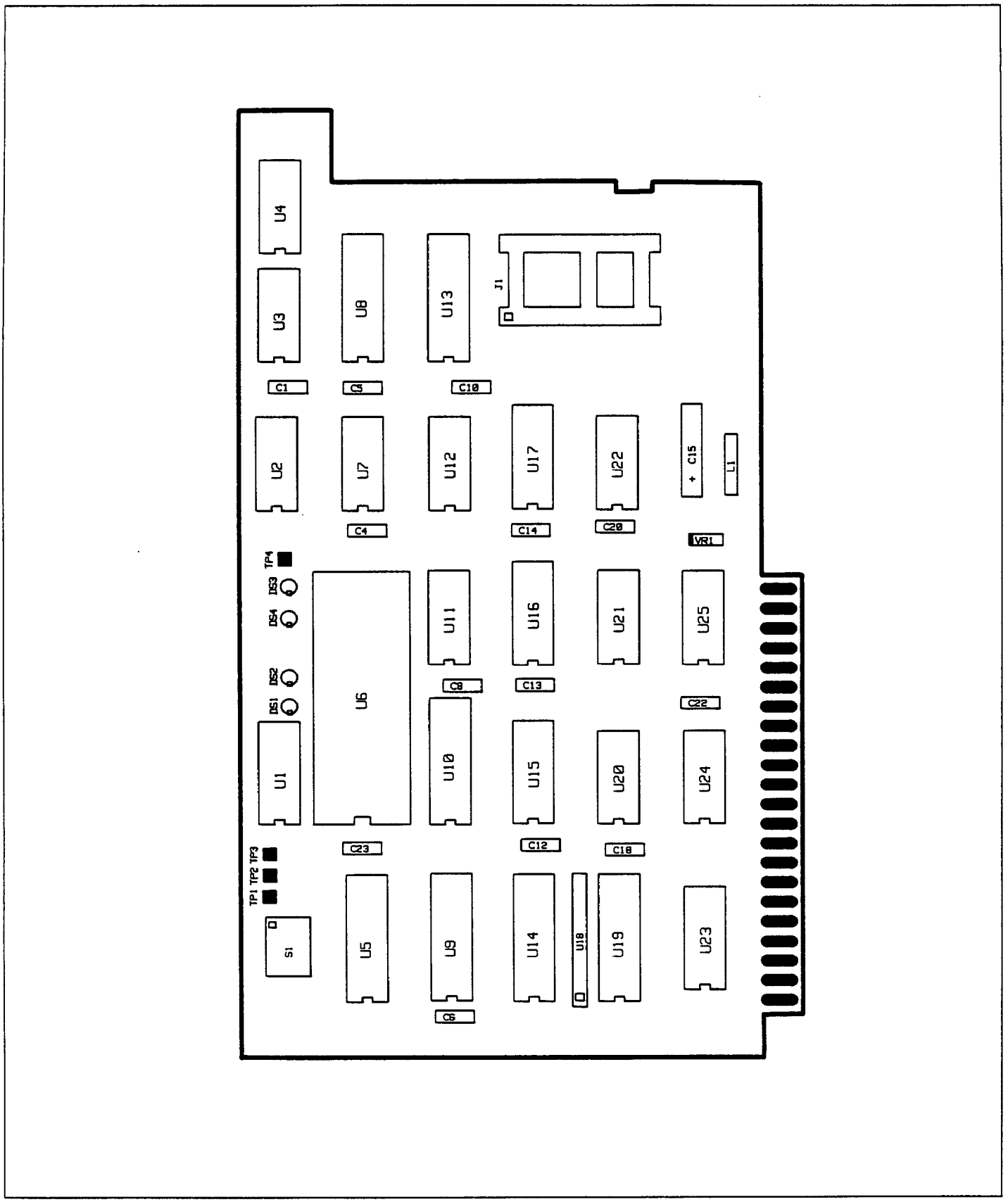


Figure 8-49. A8 HP-IB Interface Component Location Diagram

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A8 HP-IB INTERFACE
08350-60086

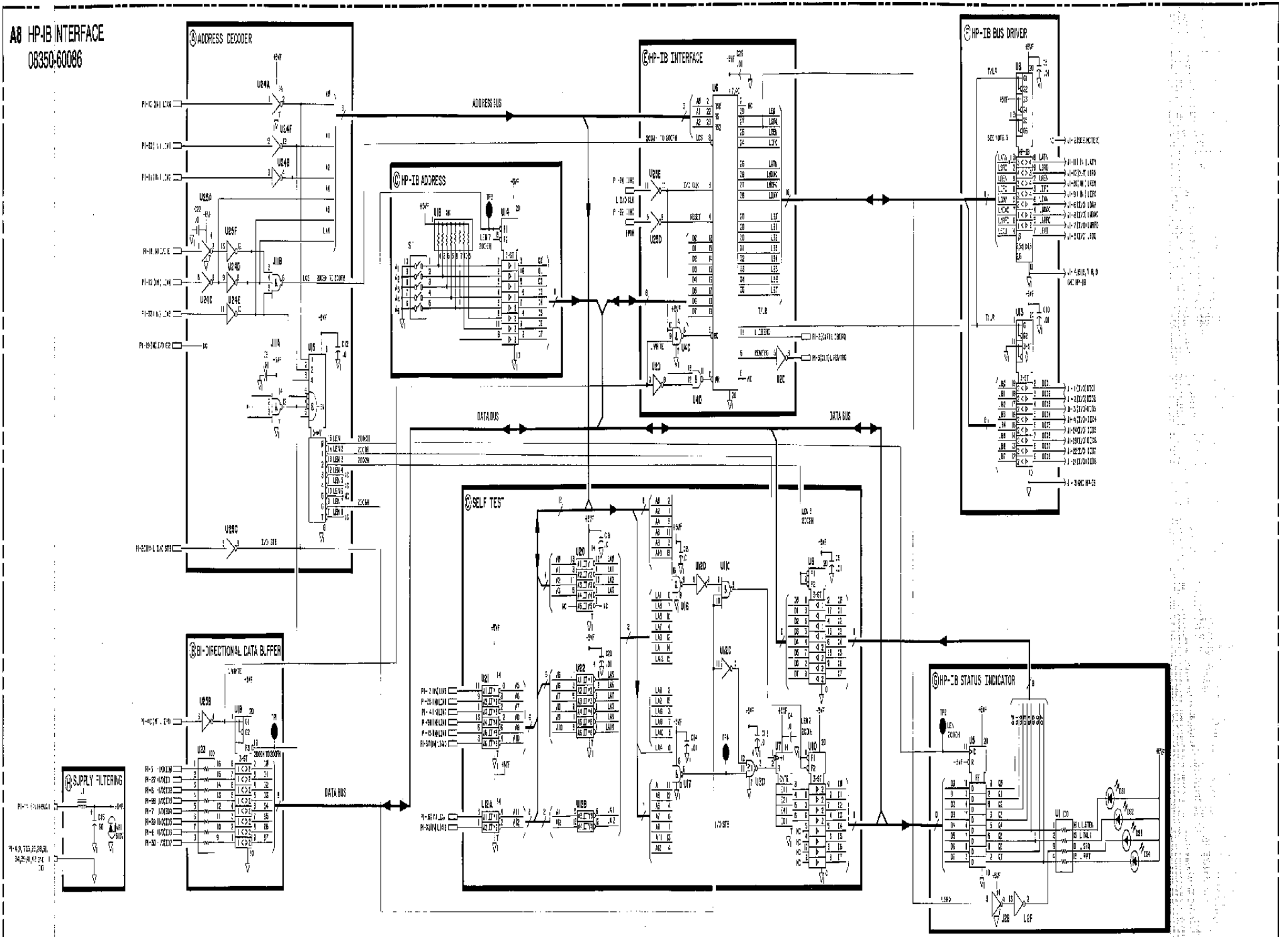


Figure 8-50. A8 HP-IB Interface Schematic Diagram

A9 Motherboard and Wiring List

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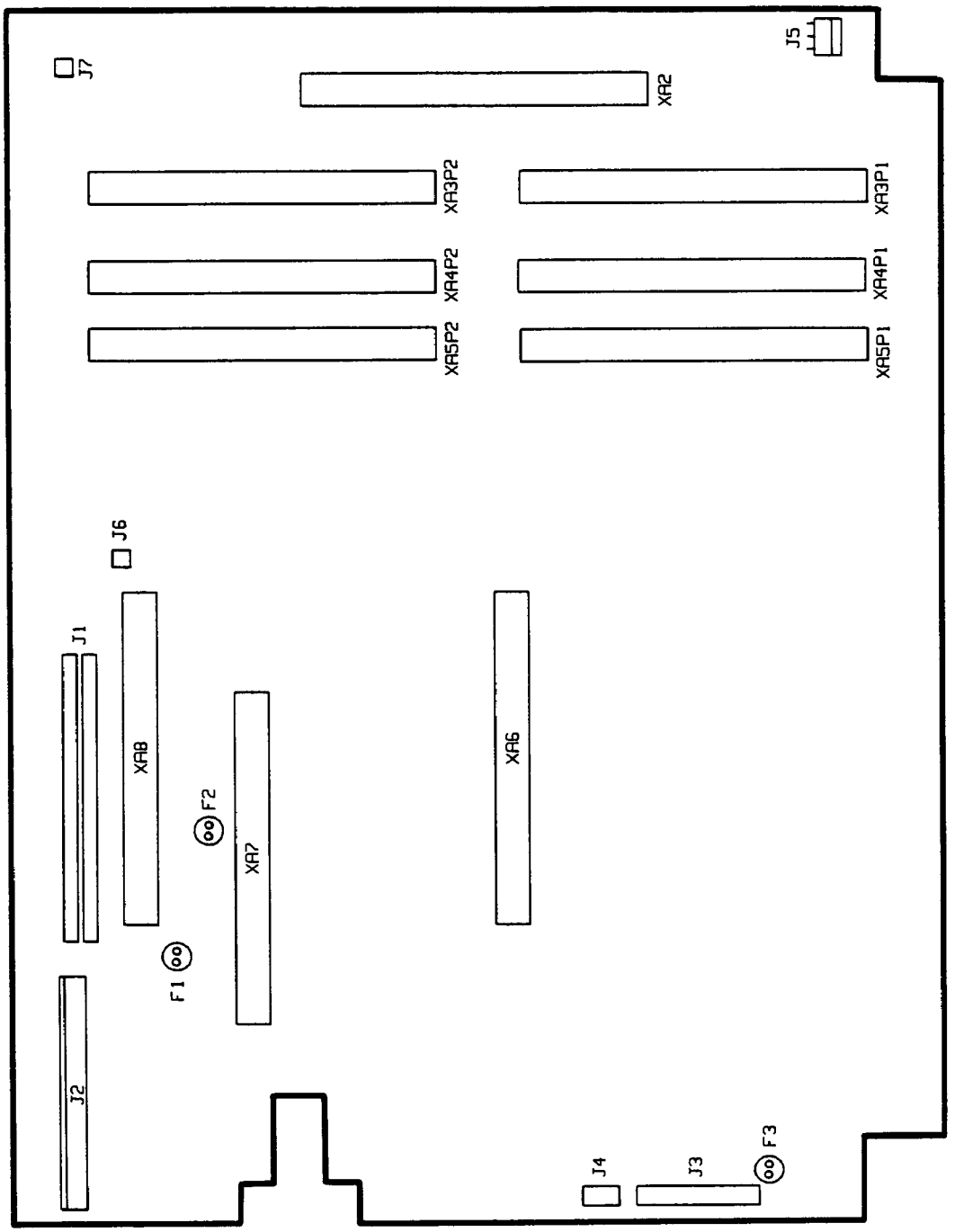


Figure 8-51. A9 Motherboard Component Location Diagram

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Mnemonic	Source	Description	A1J1 (W1)	A1J2 (W2)	A2J3 (W1)	A2J4 (W2)	A2P1	A3P1	A3P2	A4P1	A4P2	A5P1	A5P2	A6P1	A7P1	A8J1 (W5)	A8P1	A9J1 (W4)	A9J2 (W6)	A9J3 (W7)	A9J4 (W12)	A9J5 (W11)	A9J6 (W10)	A9J7 (W13	MISC.	CHASSIS
ALT1	A5P1-34	Alternate Sweep 1									—	34	—			—				4,13					—	J13-4, J14-1
L ALTE	A5P1-33	Low = Alternate Sweep Enable									—	33	—			—				17,25					—	J13-17, J14-2
AM	J12	Amplitude Modulation Input									—	—	—			—				—					W9	J3-A4, J12
L AMK	A4P2-27	Low = Active Marker									27	—	27			—				—					—	—
L ATN	J4-11	Low = Attention (HP-IB)									—	—	—			11				—					—	J4-11
L BP1	A5P2-36	Low = Blanking Pulse 1		—		—					—		36					—		14						J13-14
L BP2	A5P2-11	Low = Blanking Pulse 2		—		—					33		11					53		—						J2-53
L BPRQ	J2-55,J13-20	Low = Blanking Pulse Request		—		—					—		40					55		20						J2-55,J13-20
C0	A2J4-16	Keyboard Column 0		16		16					—		—					—		—						—
C1	A2J4-11	Keyboard Column 1		11		11					—		—					—		—						—
C2	A2J4-5	Keyboard Column 2		5		5																				
C3	A2J4-30	Keyboard Column 3		30		30																				
C4	A2J4-15	Keyboard Column 4		15		15																				
C5	A2J4-13	Keyboard Column 5		13		13																				
C6	A2J4-9	Keyboard Column 6		9		9																				
C7	A2J4-12	Keyboard Column 7	—	12	—	12																				
Ca	A2J3-5	Digital Display Segment a	5	—	5	—																				
Cb	A2J3-32	Digital Display Segment b	32	—	32	—																				
Cc	A2J3-10	Digital Display Segment c	10	—	10	—																				
Cd	A2J3-7	Digital Display Segment d	7	—	7	—																				
Cdp	A2J3-28	Digital Display Decimal Point	28		28							—						—		—	—				—	—
Ce	A2J3-30	Digital Display Segment e	30		30							—						—		—	—				—	—
Cf	A2J3-8	Digital Display Segment f	8		8							—						—		—	—				—	—
Cg	A2J3-34	Digital Display Segment g	34		34							—						—		—	—				—	—
L CNTR	A5P1-42	Low = Counter Trigger	—		—							42						22		21	2				—	J2-22,J9,J13-21
L DAV	J4-6	Low = Data Valid (HP-IB)	—		—											6										J4-6
DCA0	A2J3-9	Digit Counter Address 0 (LSB)	9		9											—										—
DCA1	A2J3-12	Digit Counter Address 1	12		12											—										—
DCA2	A2J3-16	Digit Counter Address 2	16		16											—										—
DCA3	A2J3-26	Digit Counter Address 3 (MSB)	26		26											—										—
L DCA3	A2J3-13	Low = Digit Counter Address 3 (MSB)	13		13											—										—
L DE	A2J3-14	Low = Display Enable, Front Panel	14		14											—										—
DIO1	J4-1	HP-IB Data Input/Output (LSB)	—		—											1										J4-1
DIO2	J4-2	HP-IB Data Input/Output	—		—											2										J4-2
DIO3	J4-3	HP-IB Data Input/Output	—		—											3										J4-3
DIO4	J4-4	HP-IB Data Input/Output														4										J4-4
DIO5	J4-13	HP-IB Data Input/Output														24										J4-13
DIO6	J4-14	HP-IB Data Input/Output														23										J4-14
DIO7	J4-15	HP-IB Data Input/Output														22										J4-15
DIO8	J4-16	HP-IB Data Input/Output														21										J4-16
L DS1	A2J4-48	Low = Left Frequency GHz Annunciator On		48		48																				
L DS2	A2J4-50	Low = Left Frequency MHz Annunciator On		50		50																				
L DS3	A2J4-46	Low = Right Frequency GHz Annunciator On		46		46																				
L DS4	A2J4-43	Low = Right Frequency MHz Annunciator On		43		43																				
L DS5	A2J4-45	Low = Frequency/Time GHz Annunciator On		45		45																				
L DS6	A2J4-49	Low = Frequency/Time MHz Annunciator On	—	49	—	49																				
L DS7	A2J4-47	Low = Frequency/Time Sec Annunciator On	—	47	—	47																				
L DS8	A2J4-7	Low = ALTn Annunciator On	—	7	—	7																				
L DS9	A2J4-41	Low = Vernier Annunciator On	—	41	—	41																				
L DS10	A2J3-15	Low = ≠ 0 Annunciator On	15	—	15	—																				

Figure 8-52. Motherboard Wiring List (1 of 5)

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Mnemonic	Source	Description	A1J1 (W1)	A1J2 (W2)	A2J3 (W1)	A2J4 (W2)	A2P1	A3P1	A3P2	A4P1	A4P2	A5P1	A5P2	A6P1	A7P1	A8J1 (W5)	A8P1	A9J1 (W4)	A9J2 (W6)	A9J3 (W7)	A9J4 (W12)	A9J5 (W11)	A9J6 (W10)	A9J7 (W13)	MISC.	CHASSIS
L DS11	A2J4-38	Low = MKRΔ Annunciator On		38		38																				
L DS12	A2J4-20	Low = Start Annunciator On		20		20																				
L DS13	A2J4-22	Low = CW Annunciator On		22		22																				
L DS14	A2J4-18	Low = CF Annunciator On		18		18																				
L DS15	A2J4-24	Low = ΔF Annunciator On		24		24																				
L DS16	A2J4-26	Low = Stop Annunciator On		26		26																				
L DS17	A2J4-37	Low = M1 Annunciator On		37		37																				
L DS18	A2J4-44	Low = M2 Annunciator On		44		44																				
L DS19	A2J4-42	Low = M3 Annunciator On		42		42																				
L DS20	A2J4-36	Low = REM Annunciator On		36		36																				
L DS21	A2J4-17	Low = ADRS'D Annunciator On	—	17	—	17																				
L DS22	A2J3-20	Low = Marker Sweep Annunciator On	20	—	20	—																				
L DS23	A2J4-32	Low = M4 Annunciator	—	32	—	32																				
L DS24	A2J4-34	Low = M5 Annunciator On	—	34	—	34																				
L DS25	A2J4-19	Low = Shift Annunciator On (Blue Key)	—	19	—	19																				
L DS26	A2J4-21	Low = Swp Annunciator On		21		21																				
L DS27	A2J4-23	Low = Int Annunciator On		23		23																				
L DS28	A2J4-25	Low = Line Annunciator On		25		25																				
L DS29	A2J4-27	Low = Ext Trig Annunciator On		27		27																				
L DS30	A2J4-29	Low = Single Annunciator On		29		29																				
L DS31	A2J4-31	Low = Ext Swp Annunciator On		31		31																				
L DS32	A2J4-33	Low = Man Annunciator On		33		33																				
L DS33	A2J4-35	Low = Time Annunciator On		35		35																				
L DS34	A2J4-2	Low = Amptd Mkr Annunciator On		2		2																				
L DS35	A2J4-10	Low = Displ Blank Annunciator On		10		10																				
L DS36	A2J4-8	Low = RF Blank Annunciator On		8		8						—				—				—					—	—
L DS37	A2J4-6	Low = ⌊⌐MOD Annunciator On		6		6						—				—				—					—	—
L E01	J4-5	Low = End or Identify (HP-IB)		—		—						—				5				—					—	J4-5
EXT TRG	J13-19	High = External Trigger Sweep		—		—						19				—				9					—	J13-9
FM INPUT	J11	Frequency Modulation Input		—		—						—				—				—					W8	J3-A3,J11
L FPA0	A3P2-4	Low = Front Panel Address Line 0 (LSB)					16		4																	
L FPA1	A3P2-26	Low = Front Panel Address Line 1					38		26																	
L FPA2	A3P2-5	Low = Front Panel Address Line 2					17		5																	
L FPA3	A3P2-27	Low = Front Panel Address Line 3 (Not Used)					39*		27*																	
L FPA4	A3P2-6	Low = Front Panel Address Line 4 (MSB) (Not Used)					18*		6*																	
FPD0	A3P1-6	Front Panel Data Line 0 (LSB)					6	6																		
FPD1	A3P1-7	Front Panel Data Line 1					28	7																		
FPD2	A3P1-8	Front Panel Data Line 2					7	8																		
FPD3	A3P1-9	Front Panel Data Line 3					29	9																		
FPD4	A3P1-10	Front Panel Data Line 4					8	10																		
FPD5	A3P1-11	Front Panel Data Line 5					30	11	—																	
FPD6	A3P1-12	Front Panel Data Line 6					9	12	—																	
FPD7	A3P1-13	Front Panel Data Line 7 (MSB)					31	13	—																	
FPE	A3P2-3	Front Panel Enable					15	—	3																	
L FPIRQ	A2P1-23	Low = Front Panel Interrupt Request					23	1	—																	
L FPRD	A3P2-25	Low = Front Panel Read (High = Write)					37	—	25	—		—					—	—								—
L FPSTB	A3P2-1	Low = Front Panel Strobe					13	—	1	—		—					—	—								—
L IA0	A3P1-18	Low = Instrument Address Line 0 (LSB)					—	18	—	16		16					10	38								J2-38
L IA1	A3P1-41	Low = Instrument Address Line 1					—	41	—	39		39					32	7								J2-7
L IA2	A3P1-19	Low = Instrument Address Line 2					—	19	—	17		17					11	39								J2-39

*Not used on this assembly.

Figure 8-52. Motherboard Wiring List (2 of 5)

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Mnemonic	Source	Description	A1J1 (W1)	A1J2 (W2)	A2J3 (W1)	A2J4 (W2)	A2P1	A3P1	A3P2	A4P1	A4P2	A5P1	A5P2	A6P1	A7P1	A8J1 (W5)	A8P1	A9J1 (W4)	A9J2 (W6)	A9J3 (W7)	A9J4 (W12)	A9J5 (W11)	A9J6 (W10)	A9J7 (W13)	MISC.	CHASSIS
L IA3	A3P1-42	Low = Instrument Address Line 3						42	—	40		40					33	8								J2-8
L IA4	A3P1-20	Low = Instrument Address Line 4						20	—	18		18					12	40								J2-40
L IA5	A3P2-13	Low = Instrument Address Line 5						—	13	—		—					13	41								J2-41
L IA6	A3P2-35	Low = Instrument Address Line 6						—	35	—		—					35	10								J2-10
L IA7	A3P2-14	Low = Instrument Address Line 7						—	14	—		—					14	42								J2-42
L IA8	A3P2-36	Low = Instrument Address Line 8							36								36	11								J2-11
L IA9	A3P2-15	Low = Instrument Address Line 9							15								15	43								J2-43
L IA10	A3P2-37	Low = Instrument Address Line 10							37								37	12								J2-12
L IA11	A3P2-16	Low = Instrument Address Line 11							16								16	44								J2-44
L IA12	A3P2-38	Low = Instrument Address Line 12 (MSB)							38								38	13								J2-13
L IBIRQ	A8P1-2	Low = HP-IB Interrupt Request						—	33	—		—					2	—								—
ID0	A3P1-28	Instrument Data Line 0 (LSB)						28	—	6		6					5	33								J2-33
ID1	A3P1-29	Instrument Data Line 1						29	—	28		28					27	2								J2-2
ID2	A3P1-30	Instrument Data Line 2						30	—	7		7					6	34								J2-34
ID3	A3P1-31	Instrument Data Line 3						31	—	29		29					28	3								J2-3
ID4	A3P1-32	Instrument Data Line 4						32		8		8				—	7	35								J2-35
ID5	A3P1-33	Instrument Data Line 5						33		30		30				—	29	4								J2-4
ID6	A3P1-34	Instrument Data Line 6						34		9		9				—	8	36								J2-36
ID7	A3P1-35	Instrument Data Line 7(MSB)						35		31		31				—	30	5								J2-5
L IFC	J4-9	Low = Interface Clear (HP-IB)						—		—		—				9	—	—								J4-9
L I/O CLK	A3P2-29	Low = Input/Output Clock						—	29	—	9*	—					24	—								—
I/OE1	A3P1-17	High = I/O Enable for Sweep Gen. and HP-IB Interface						17	—	15*	—	15					18	—								—
I/OE2	A3P1-16	High = I/O Enable for RF Plug-in						16	—	14*	—	14*					19	47								J2-47
I/OE3	A3P2-24	High = I/O Enable for Scaling and Marker						—	24	—	3	—					—	—								—
L I/OSTB	A3P1-37	Low = Input/Output Strobe						37	—	13	—	13					20	17								J2-17
L IRD	A3P1-39	Low = Instrument Bus Read (High = Write)	—		—			39		37		37	—	—			40	15								J2-15
IS1	A2J3-3	Annunciator Current Source (Left Freq Display)	3		3			—		—		—	—	—			—	—								—
IS2	A2J3-1	Annunciator Current Source (Right Freq Display)	1		1			—		—		—	—	—			—	—								—
IS3	A2J3-2	Annunciator Current Source (Freq/Time Display)	2		2			—		—		—	—	—			—	—								—
L LINETRG	A6P1-24	Low = Line Trigger	—		—			—		—		—	15	24			—	—								—
L MFLG	A4P2-11	Low = Marker Flag							31		11		—							—						—
L MK	A4P2-6	Low = Marker							—		6		6							—						—
L MKRQ	J13-15	Low = Marker Request							—		—		38							15						J13-15
L MP	A5P2-14	Low = Marker Pulse							—		—		14							2						J13-2
L MUTE	A5P2-13	Low = Pen Mute for X-Y Recorder							—		—		13							11						J13-11
L NDAC	J4-8	Low = Not Data Accepted (HP-IB)							—				—			8		—			—				—	J4-8
L NRFD	J4-7	Low = Not Data Accepted (HP-IB)							—				—			7		—			—				—	J4-7
NZAB	A5P2-12	Negative Z Axis Blanking							—				12			—		—			4				—	J6
L PIFLG	J2-20	Low = Plug-in Flag							19				—			—		20			—				—	J2-20
L PIIRQ	J2-52	Low = Plug-in Interrupt Request							20				—			—		52			—				—	J2-52
L PINMI	J2-19	Low = Plug-in Nonmaskable Interrupt					—		40					—				19		—	—				—	J2-19
PIROME	A3P2-17	Plug-in ROM Enable					—		17					—				45		—	—				—	J2-45
PIRPG1A	J2-60	Plug-in RPG Output					41		—					—				60		—	—				—	J2-60
PIRPG1B	J2-61	Plug-in RPG Output					20		—					—				61		—	—				—	J2-61
PL	A6P1-3	High = Penlift					—		—					3				—		10	1				—	J7,J13-10
L PL	A5P2-35	Low = Penlift	—		—				—				35	25	—					23						J13-23
L PLRQ	J13-3	Low = Penlift Request	—		—				—				16	—	—					3						J13-3
L PRESET	A1J1-25	Low = Instrument Preset	25		25				—				—	—	—					—						—
L PRESETE	A2J3-27	Low = Instrument Preset Enable	27		27				—				—	—	—					—						—
L PSF	A7P1-27	Low = Power Supply Failure	—		—				11				—	—	27					—						—

*Not used on this assembly.

Figure 8-52. Motherboard Wiring List (3 of 5)

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Mnemonic	Source	Description	A1J1 (W1)	A1J2 (W2)	A2J3 (W1)	A2J4 (W2)	A2P1	A3P1	A3P2	A4P1	A4P2	A5P1	A5P2	A6P1	A7P1	A8J1 (W5)	A8P1	A9J1 (W4)	A9J2 (W6)	A9J3 (W7)	A9J4 (W12)	A9J5 (W11)	A9J6 (W10)	A9J7 (W13)	MISC.	CHASSIS
L PST	A7P1-4	Low = Power Supply Overtemp. (Airflow)		—		—	—		9				—	—	4		—	—			—				—	—
PWON	A6P1-2	High = Power On		—		—	43		41				—	2	—		22	25			—				—	J2-55
PZAB	A5P2-34	Positive Z Axis Blanking		—		—	—		—				34	—	—		—	—			8				—	J5
R0	A1J2-39	Keyboard Row 0 Sense		39		39	—		—				—	—	—		—	—			—				—	—
R1	A1J2-4	Keyboard Row 1 Sense		4		4	—		—				—	—	—		—	—			—				—	—
R2	A1J2-40	Keyboard Row 2 Sense		40		40																				
R3	A1J2-14	Keyboard Row 3 Sense		14		14																				
R4	A1J2-1	Keyboard Row 4 Sense		1		1																				
R5	A1J2-3	Keyboard Row 5 Sense		3		3																				
R6	A1J2-28	Keyboard Row 6 Sense		28		28																				
L REM TRG	A8P1-3	Low = Remote Trigger (Group Execute)											25			—	3	—		—						—
L REN	J4-17	Low = Remote Enable (HP-IB)											—			20	—	—		—						J4-17
L RFB	A5P2-42	Low = RF Blank											42			—	—	56		7						J13-7,J2-56
L RFBRQ	J2-54,J13-8	Low = RF Blank Request											17			—	—	54		8						J13-8,J2-54
L RFM	A5P2-20	Low = RF Marker (Amplitude)											20			—	—	24		—						J13-8,J2-24
RPG1A	A1J1-31	Left Frequency RPG Output	31		31																					
RPG1B	A1J1-29	Left Frequency RPG Output	29		29																					
RPG2A	A1J1-21	Right Frequency RPG Output	21		21																					
RPG2B	A1J1-19	Right Frequency RPG Output	19		19																					
RPG3A	A1J1-4	Frequency/Time RPG Output	4		4																					
RPG3B	A1J1-6	Frequency/Time RPG Output	6		6		—		—				—					—		—	—				—	—
L RTCIRQ	A2P1-21	Low = Retrace Interrupt Request	—		—		21		8				—					—		—	—				—	—
L RTS	A5P2-18,19	Low = Retrace Strobe	—		—		42		—				18,19					57		16,26	—				—	J2-57,J13-16,J14-3
L SFSRQ	J13-5,J10	Low = Stop Forward Sweep Request	—		—		—		—				41					—		5	3				—	J13-5, J10
SQ MOD	A5P2-37	Squarewave Modulation (1 kHz or 27.8 kHz)	—		—		—		—				37					26		—	—				—	J2-26
L SRQ	A8J1-10	Low = Service Request (HP-IB)					—						—			10		—		—						J4-10
L SSRQ	J2-32,J13-18	Low = Stop Sweep Request					—						39			—		32		18						J13-18, J2-32
L STPADV	J13-22	Low = Step Advance					33						—			—		—		22						J13-22
L SW	A5P2-28	Low = Forward Sweep					44						28			—		—		—						—
SYNC TRG	A5P2-5	High = Synchronizing Trigger					—						5			—		—		24						J13-24
VRAMP	A5P1-20	Voltage Ramp								20	—	20	—					—			—			—	—	—
VSW	A5P2-24	Sweep Voltage to Plug-in								—	—	—	24					64			—			—	—	J2-64
VSW1	A5P1-21	Sweep Voltage to A4 Scaling and Marker								21	—	21	—					—			—			—	—	—
VSW2	A5P2-2	Sweep Voltage to/from Sweep Out/In Connectors								—	—	—	2					—			6			RED	—	J1, J8
VTUNE	A4J1	Voltage Tuning								—	—	—	—					—			—			—	A4J1, W3	J3-A1
L ZMRQ	J2-23	Low = Intensity Marker Request									—		33					23								J2-23
+10V REF	A4P2-7,29	+10V Reference									7,29		7,29					—								—

Figure 8-52. Motherboard Wiring List (4 of 5)

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Mnemonic	Source	Description	A1J1 (W1)	A1J2 (W2)	A2J3 (W1)	A2J4 (W2)	A2P1	A3P1	A3P2	A4P1	A4P2	A5P1	A5P2	A6P1	A7P1	A8J1 (W5)	A8P1	A9J1 (W4)	A9J2 (W6)	A9J3 (W7)	A9J4 (W12)	A9J5 (W11)	A9J6 (W10)	A9J7 (W13)	MISC.	CHASSIS
+20V	A7P1-17,39	+20V Regulated Power Supply												—	17,39				5						—	J3-7
+20V RET	A6P1-9,10,31,32	+20V Return												9,10, 31,32	15				8						A9C6(−)	J3-14
+20V RET SENSE	J3-6	+20V Return Sense												—	16				7						—	J3-6
+20V SENSE	J3-15	+20V Sense												—	38				6						—	J3-15
+20V UNREG	A6P1-7,8,29,30	+20V Unregulated												7,8, 29,30	18,40										A9C6(+)	—
+15V	A7P1-8,30	+15V Regulated									8,30		8,30	—	8,30			29							—	J2-29
+15V UNREG	A6P1-22,44	+15V Unregulated									—		—	22,44	29			—							A9C3(+)	—
+15V RET	A6P1-21,43	+15V Return									—		—	21,43	—			—							A9C2(+), A9C3(−)	—
+10V	A7P1-19,41	+10V Regulated												—	19,41				3						—	J3-8
+10V UNREG	A6P1-19,41	+10V Unregulated												19,41	42				—						A9C1(+)	—
+10V RET	A6P1-17,18,39,40	+10V Return												17,18, 39,40	13,35				4,13						A9C1(−), A9C4(+)	J3-3,16
+5VA	A7P1-2,24	+5V Regulated for 8350B	—	—	—		3,4, 25,26	3,4, 25,26		3,4, 25,26		3,4 25,26		23	2,24		44	30		6		—	—		A9F3	J2-30,J13-6
+5VAFP	A7P1-25	+5V Regulated for Front Panel	—	—	—		—	—		—		—		—	25		—	—		—		RED	—		A1	—
+5VB	A7P1-5,6,28	+5V Regulated for RF Plug-in	—	—	—		—	—		—		—		—	5,6, 28		—	18,50, 51		—		—	—		—	J2-18,50,51
+5V BAT	BT1	+5V Battery	—	—	—		—	21		—		—		—	—		—	—		—		—	RED		—	BT1
+5VB GND REF	A7P1-7	+5VB Ground Reference	—	—	—		—	—		—		—		—	7		—	21		—		—	—		—	J2-21
+5VF SENSE	A2J3-33	+5VAFP Sense	33	—	33		—	—		—		—		—	—		—	—		—		—	—		—	—
+5VR	A2J3-17,18	+5V Rotary Pulse Generator	17,18	—	17,18		—	—		—		—		—	—		—	—		—		—	—		—	—
+5V RET	A6P1-11,12,33,34 35	+5V Return	—		—		—	—		—		—		11,12, 33,34, 35	—		—	—		—		—	—		A9C5(−)	—
+5V UNREG	A6P1-13,14,15, 36,37	+5V Unregulated	—	—	—		—	—		—		—		13,14, 15,36, 37	3,26		—	62,63		—		—	—		A9F2, A9C5(+)	J2-62,63
−10V	A7P1-11,33	−10V Regulated												—	11,33				10						A9F1	J3-13
−10V RET SENSE	J3-12	−10V Return Sense												—	12				12						—	J3-12
−10V SENSE	J3-4	−10V Sense												—	34				11						—	J3-4
−10V UNREG	A6P1-16,38	−10V Unregulated												16,38	10,32				9						A9C4(−)	J3-5
−15V	A7P1-14,36	−15V Regulated									4,26		4,26	—	14,36			28							—	J2-28
−15V UNREG	A6P1-20,42	−15V Unregulated									—		—	20,42	37			—							A9C2(−)	—
−40V	A6P1-4,26,27	−40V Regulated												4,26, 27	20				14						A9C7(−)	J3-11
−40V RET	A7P1-44	−40V Return												—	44				17						—	J3-1
−40V RET SENSE	J3-10	−40V Return Sense												—	21				16						—	J3-10
−40V SENSE	J3-2	−40V Sense												—	22				15						—	J3-2
−40V UNREG RET	A6P1-5,6,28	−40V Unregulated Return												5,6, 28	43				—						A9C7(+)	—
GND ANLG	SYSTEM GROUND	Ground Analog								2,11, 12,22, 24,33 34	1,22, 23,24	2,11, 12,22, 24	1,22 23,44		9,31			27,58 59			5			BLACK	—	J2-27,58,59, J1,J8
GND DIG	SYSTEM GROUND	Ground Digital					1,2,5, 10,12, 14,19, 22,24, 27,32, 35,36, 40	2,5,14, 15,22, 23,24, 27,36, 38,40, 43,44,	2,7,10, 12,18, 21,22, 23,28, 30,32, 34,39 43,44	1,5,10, 23,27, 32,35, 36,38, 41,44	10,12 21,25, 31,32, 43	1,5,10, 23,27, 32,35, 36,38, 41,44	9,10, 21,31, 32,43	1	1,23		4,9,17, 23,25, 26,31, 34,39 41,42	1,6,9, 14,16, 31,37, 46,48, 49		19		BLACK	BLACK		A1	J2-1,6,9, 14,16,31, 37,46,48, 49,J13-19, BT1
GND HP-IB	J4-18 to 23	HP-IB Ground Returns	—		—								13-19												—	J4-18-23
GND R	A2J3-22, 23,24	Ground Rotary Pulse Gen.	22,23, 24		22,23, 24																				—	—
SHIELD HP-IB	J4-12	HP-IB Cable Shield	—		—								—												CHASSIS	J4-12

Figure 8-52. Motherboard Wiring List (5 of 5)

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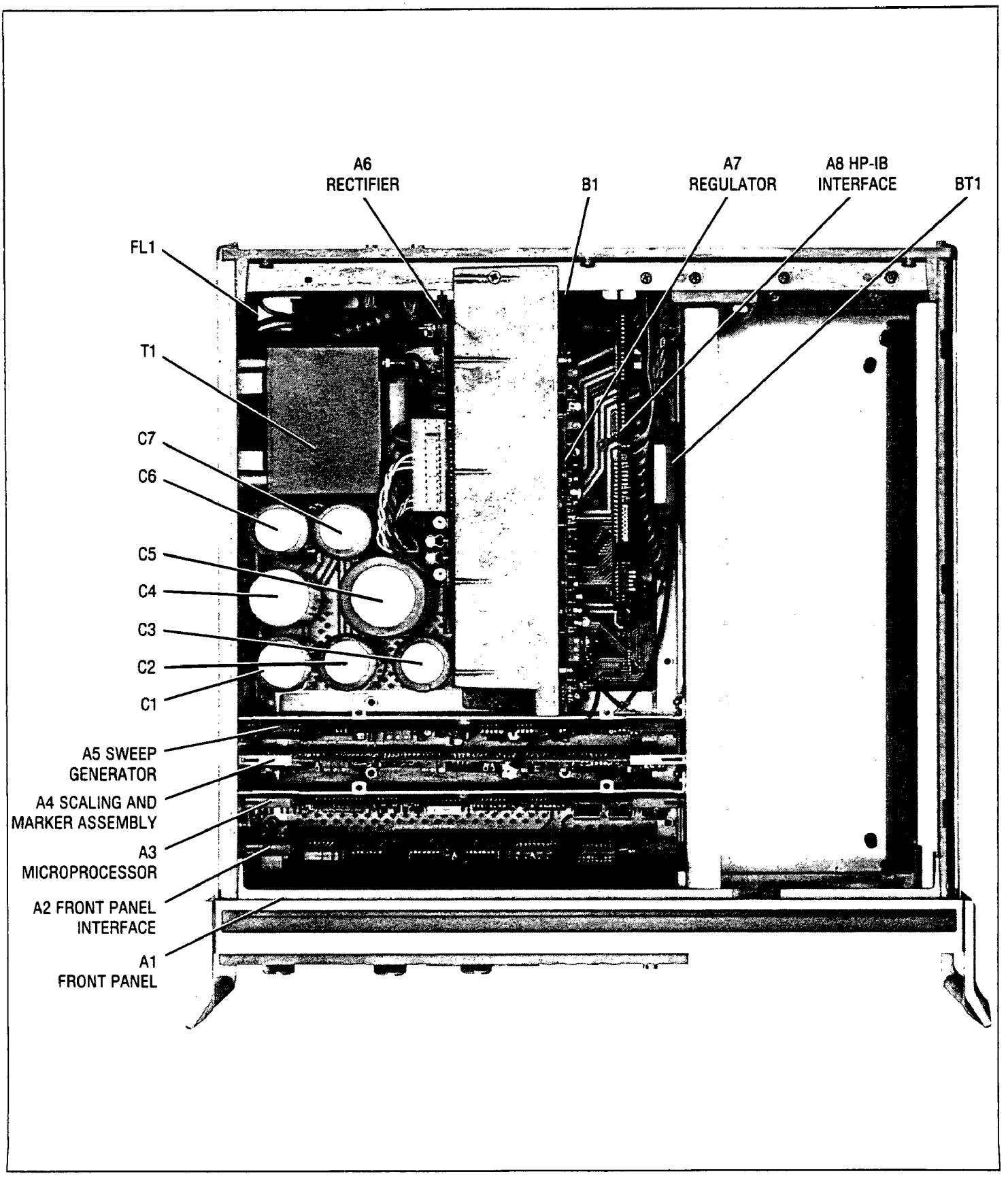


Figure 8-53. Major Assemblies Locations

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Table 8-27. 8350B Cable List

Cable	Description	Connections
W1	Cable Assembly, Ribbon 34C, A1/A2 Interconnect	A2J3 - Front Panel Interface A1J1 - Front Panel
W2	Cable Assembly, Ribbon 50C, A1/A2 Interconnect	A2J4 - Front Panel Interface A1J2 - Front Panel
W3	Cable Assembly, Coax, Brown, VTUNE	A4J1 - Scaling and Marker Assembly J3 - Plug-in Pwr Supply Interface
W4	Cable Assembly, Ribbon 64C, Plug-in Interface	A9J1 - Motherboard J2 - Plug-in Interface
W5	Cable Assembly, Ribbon 26C, HP-IB	A8J1 - HP-IB Interface Assembly J4 - HP-IB Interface (rear panel)
W6	Cable Assembly, 17 pin, Plug-in Pwr Supply Interface	A9J2 - Motherboard J3 - Plug-in Pwr Supply Interface
W7	Cable Assembly, Ribbon 25C, Programming/ALT SWP Interface	A9J3 - Motherboard J13 - PROGRAMMING CONNECTOR (rear panel) J14 - ALT SWP INTERFACE (rear panel)
W8	Cable Assembly, Coax-Orange, FM	J11 - FM INPUT (rear panel) J3 - Plug-in Pwr Supply Interface
W9	Cable Assembly, Coax-Yellow, AM	J12 - AM INPUT (rear panel)
W10	Jack/Battery Cable Assembly	J3 - Plug-in Pwr Supply Interface A9J6/Battery BTI
W11	Cable Assembly, Front Panel	+5V Front Panel/A9J5
W12	Cable Assembly, Rear Panel	J7 - PEN LIFT (rear panel)/ A9J4-1 Motherboard J8-SWEEP OUT/IN (rear panel)/ A9J4-2 Motherboard J10 - STOP SWEEP (rear panel)/ A9J4-3 Motherboard J6 - NEG Z BLANK (rear panel)/ A9J4-4 Motherboard Chassis ground/A9J4-5 Motherboard J5 - POS Z BLANK (rear panel)/ A9J4-6 Motherboard J9 - CNTR TRIG (rear panel)/ A9J4-8 Motherboard
W13	Jack/Battery Cable Assembly	J1 - Sweep OUT/IN Front Panel/A9J7

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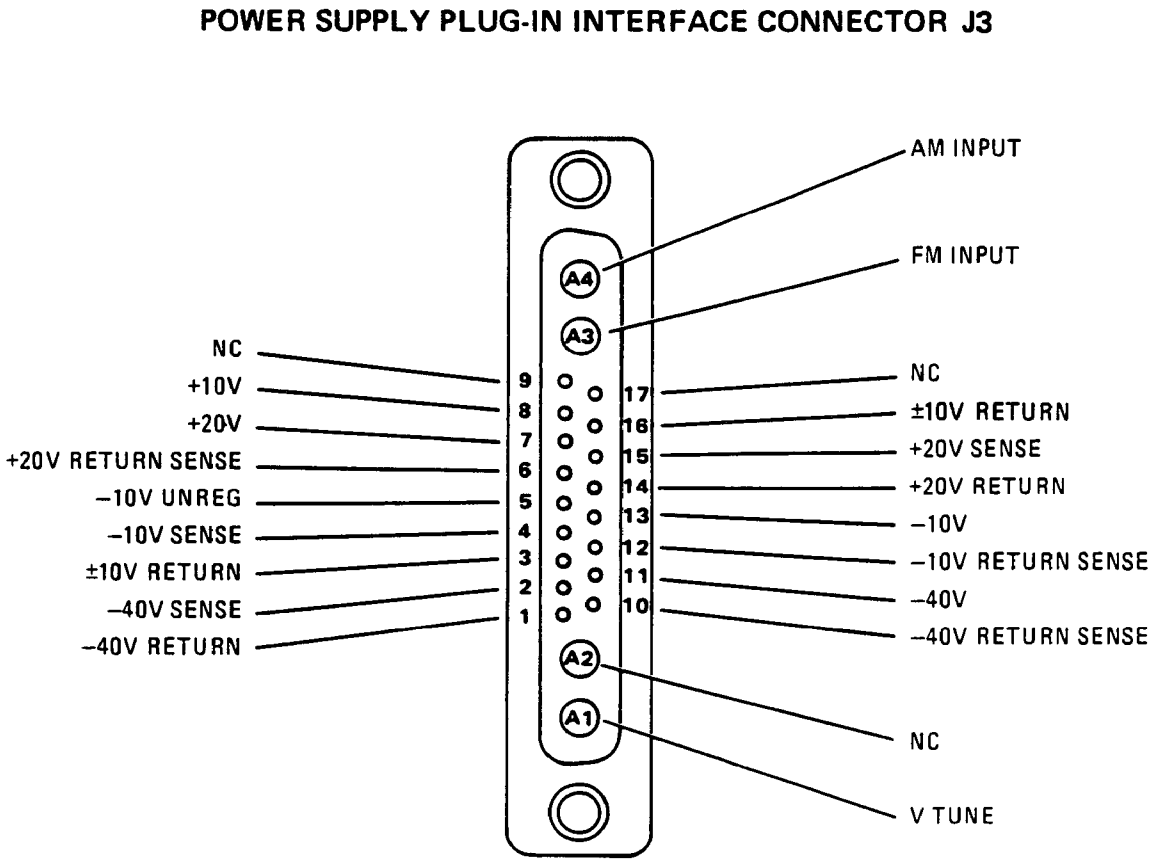


Figure 8-54. Interface Signals on Connector J3

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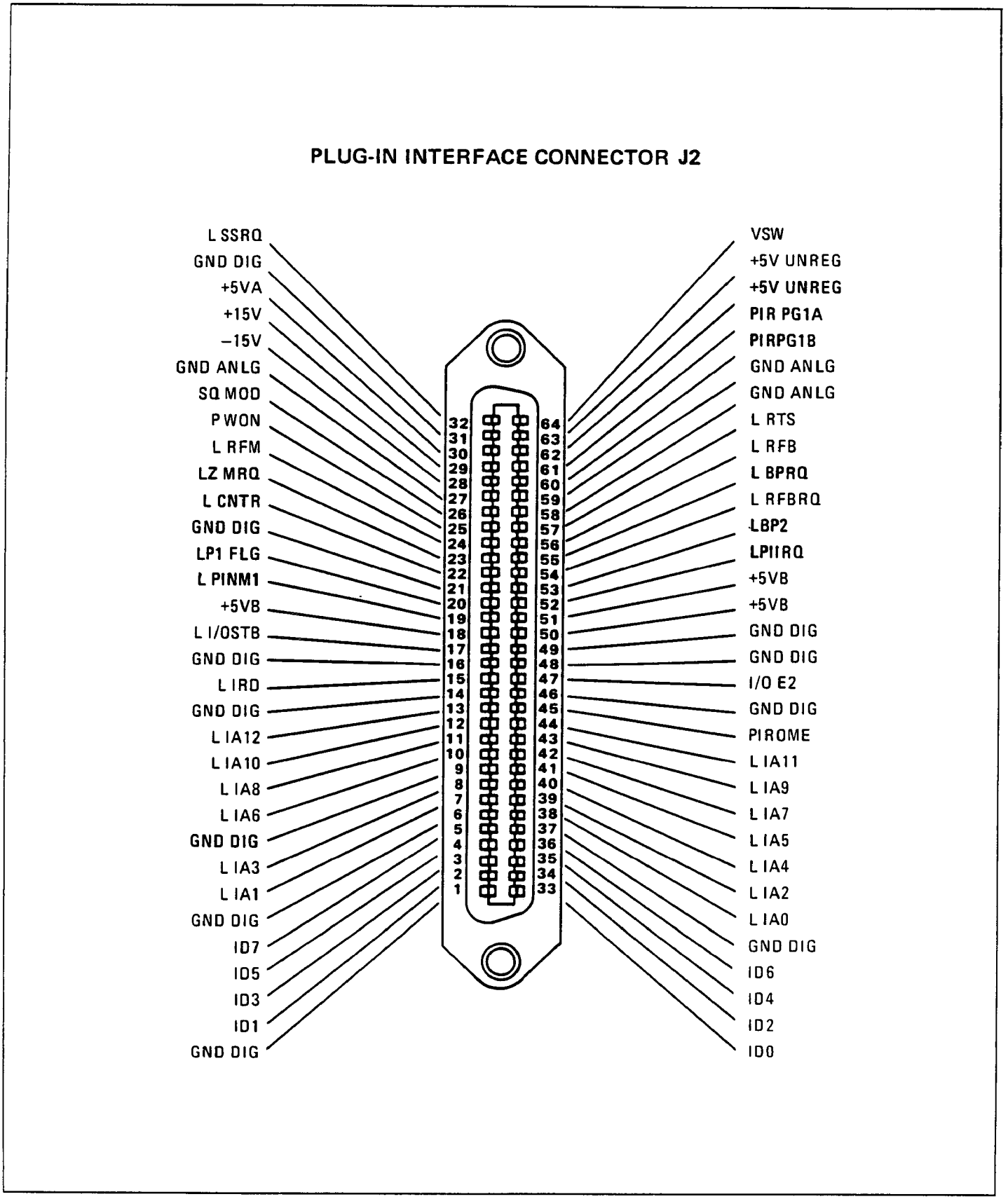


Figure 8-55. Interface Signals on Connector J2

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