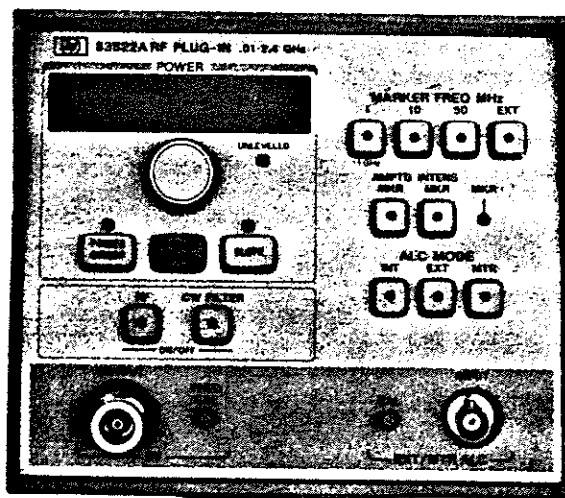


OPERATING AND SERVICE MANUAL

83522A RF PLUG-IN .01 to 2.4 GHz

PROPERTY OF
ELECTRICAL ENGINEERING DEPARTMENT
UNIVERSITY OF WATERLOO

INV NUMBER 124740



CERTIFICATION

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INV NUMBER.....

83522A RF PLUG-IN (Including Options 002 and 004)

SERIAL NUMBERS

This manual applies directly to HP Model 83522A RF Plug-ins having serial number prefix 2040A or 2127A.

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

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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 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.

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.

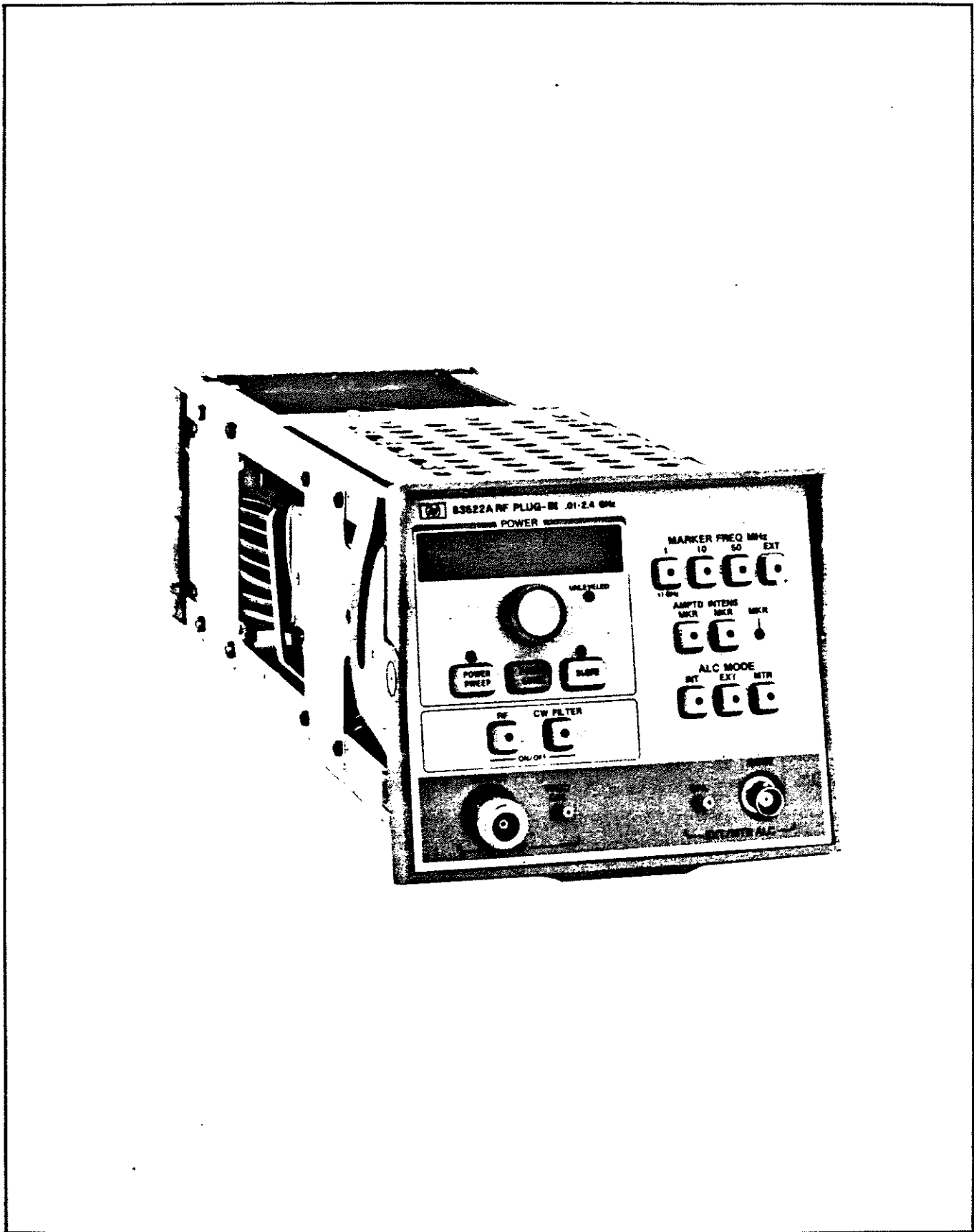


Figure 1-1. Model 83522A RF Plug-in.

SECTION I GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Operating and Service Manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 83522A RF Plug-in. Figure 1-1 shows the Model 83522A.

1-3. 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, specifications, supplemental characteristics, instrument identification, options available, accessories available, and a list of recommended test equipment.
 - b. SECTION II, INSTALLATION, provides information for initial inspection, preparation for use, storage, and shipment.
 - c. SECTION III, OPERATION, explains the resolution characteristics of the RF plug-in in CW and swept frequency modes. Operating instructions include a front panel FREQUENCY CALIBRATION procedure, FM switch parameter settings, and crystal and power meter leveling instructions. A description of front and rear panel features and plug-in error codes is also given.
 - d. SECTION IV, PERFORMANCE TESTS, presents procedures required to verify that performance of the RF Plug-in is in accordance with published specifications.
 - e. SECTION V, ADJUSTMENTS, presents procedures required to properly adjust and align the Model 83522A RF Plug-in after repair.
 - 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 make this manual 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 on a separate Service Sheet which contains a circuit description, schematic diagram, component location diagram, and troubleshooting information to aid in the proper maintenance of the instrument.
- 1-4. Supplied with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of the manual which should be kept with the instrument for use by the instrument operator.
- 1-5. On the front cover of this manual is a "Microfiche" part number. This number may be used to order 10- by 15- centimeter (4- by 6-inch) microfilm transparencies of the manual. Each 4- by 6-inch 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.
- 1-6. Refer any questions regarding this manual, the Manual Changes sheet, 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 inside rear cover of this manual for a worldwide listing of HP Sales/Service Offices.

1-7. SPECIFICATIONS

1-8. Listed in Table 1-1 are the specifications for the Model 83522A RF Plug-in. These specifications are the performance standards, or limits, against which the instrument may be

tested. Table 1-2 lists the RF Plug-in supplemental performance characteristics. Supplemental performance characteristics are not specifications but are typical characteristics included as additional information for the user.

1-9. SAFETY CONSIDERATIONS

1-10. This product has been manufactured and tested in accordance with international safety standards. Before operation, this product and related documentation must be reviewed for familiarization with safety markings and instructions. A complete listing of Safety Considerations precedes Section I of this manual.

1-11. INSTRUMENTS COVERED BY MANUAL

1-12. 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.

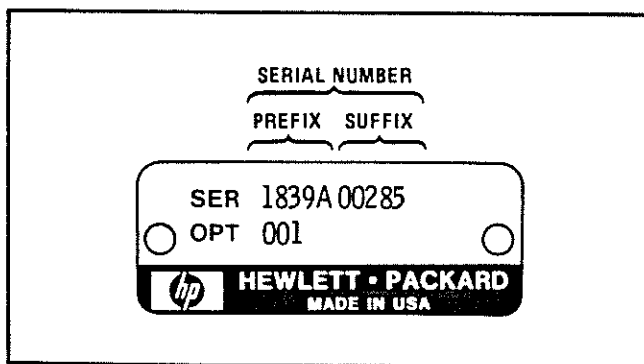


Figure 1-2. Typical Serial Number Plate

1-13. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. An unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for the instrument is then supplied with a Manual Changes supplement that contains information which documents the differences.

1-14. 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. Complimentary copies of the Manual Changes supplement are available on request from Hewlett-Packard.

1-15. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes Supplement, contact your nearest Hewlett-Packard Sales/Service Office.

1-16. DESCRIPTION

1-17. The Model 83522A is an RF plug-in which has been designed for use with the Model 8350A Sweep Oscillator. The Model 83522A covers the frequency range of 0.01 to 2.4 GHz. A YIG oscillator is used as the tunable RF frequency source and a fixed 3.8 GHz oscillator is mixed with the YIG oscillator to generate a 0.01 to 2.4 GHz RF output.

1-18. Model 83522A front panel functional controls, pushbuttons, and the Rotary Pulse Generator (RPG), are monitored by the Model 8350A via the RF plug-in interface circuits. The Model 8350A generates a tuning voltage ramp according to the mode of operation (CW, START/STOP, CF/ Δ F). This voltage ramp is scaled and offset by the Model 83522A to provide a voltage ramp which is proportional to the YIG oscillator frequency in the Model 83522A. The Model 83522A then converts the tuning ramp voltage to a current which drives the YIG oscillator tuning coil.

1-19. The Model 83522A offers a maximum leveled RF output power of +13 dBm. Internal (INT), External (EXT), and Power Meter (MTR) leveling is available as selected by the front panel pushbuttons. A front panel EXT/MTR ALC input connector and gain control (CAL) are provided to use with an external leveling loop. A front panel LED indicates when the RF output becomes unleveled. The RF output level is controlled by the Model 83522A RPG, the Model 8350A data entry controls (keypad and step keys), or through HP-IB control via the Model 8350A.

Table 1-1. Specifications for Model 83522A Installed in Model 8350A (1 of 2)

FREQUENCY ¹		Power Variation (at specified Maximum Leveled Power or below)	
Range	0.01 to 2.4 GHz	Internally Leveled:	±0.25 dB ✓
Accuracy ² (25°C ± 5°C) CW Mode	±5 MHz	Externally Leveled:	
All Sweep Modes (Sweep time >100 ms)	±15 MHz	Negative Crystal Detector: ⁴	±0.1 dB
Frequency Markers (Sweep time >100 ms)	±15 MHz ±0.5% of sweep width	Power Meter: ⁵	±0.1 dB

		0.01 to 2.1 GHz	2.1 to 2.4 GHz
Stability	With 10% Line Voltage Change	±20 kHz	
	With 10 dB Power Level Change	±100 kHz	
	With 3 : 1 Load SWR	±10 kHz	
	With Time (In a 10 minute period after one hour warmup)	±100 kHz	
	Residual FM, Peak (10 Hz to 10 kHz Bandwidth)	<5 kHz	
	Residual AM in 100 kHz Bandwidth (in dB below carrier and at specified maximum leveled power)	≥50 dB	≥50 dB
	Spurious Signals (at specified maximum leveled power)		
	Harmonics (in dB below carrier)	≥25 dB	≥25 dB
	Non-Harmonics (in dB below carrier)	≥30 dB	≥25 dB
	Output VSWR (internally leveled)	<1.5	<1.5

POWER OUTPUT ¹		Power Sweep ⁸	
Maximum Leveled Output Power: ³ (25°C ± 5°C)	+13 dBm	Calibrated Range: ⁷	≥15 dB
With Option 002:	+13 dBm		
Power Level Accuracy: ⁹ (Internally Leveled)	±1.0 dB		
With Option 002: ⁶ (at 0 dB attenuator step)	±1.2 dB		
Calibrated Range:	15 dB		
With Option 002:	85 dB		

Attenuator Accuracy (±dB referenced from the 0 dB setting):							
	Attenuator Setting (dB)						
	10	20	30	40	50	60	70
Attenuator Accuracy	0.5	0.7	0.9	1.2	1.5	1.8	2.1

MODULATION ¹	
External AM	
Maximum Input: 15V	
Internal AM	
Selectable (by internal jumper in 8350A) to 1 kHz or 27.8 kHz square wave modulation. The 27.8 kHz modulation allows operation with HP Model 8755A/B/C Swept Amplitude Analyzer.	
On/Off Ratio: ≥30 dB below specified maximum leveled power	
Symmetry: 40/60	

Table 1-1. Specifications for Model 83522A Installed in Model 8350A (2 of 2)

External FM		CRYSTAL MARKER CAPABILITY ¹	
Maximum Deviations for Modulation Frequencies:		Internal Crystal Markers (+3 to +13 dBm power level and ≤10 markers/sweep): Harmonic Markers of 10 MHz and 50 MHz are available up to 2.4 GHz; 1 MHz harmonic markers are available below 1 GHz. Markers are output as intensity spots through the POS Z BLANK connector on the 8350A or as amplitude dips on the RF output.	
		Cross Over Coupled	Direct Coupled
DC to 100 Hz:	±75 MHz	±12 MHz	
100 Hz to 1 MHz:	±7 MHz	±7 MHz	
1 MHz to 2 MHz:	±5 MHz	±5 MHz	
2 MHz to 10 MHz:	±1 MHz	±1 MHz	
Frequency Response (DC to 2 MHz): ±3 dB		Marker Indicator Light: LED lights when coincident with crystal or external marker for accurate CW calibration.	
		GENERAL SPECIFICATIONS ¹	
		Minimum Sweep Time (over full band): 10 ms	
		RF Output Connector: Type N Female	
FOOTNOTES			
1 Unless otherwise noted, all specifications are at the RF OUTPUT connector and at 0° to 55°C.			
2 Accuracy when calibrated using internal crystal markers and FREQ. CAL. adjustment.			
3 For temperatures greater than 30°C, maximum leveled output power typically degrades 0.1 dB/degree C.			
4 Excludes coupler and detector variation. Crystal detector output should be between -10 mV and -200 mV at specified maximum leveled power.			
5 Use HP Model 432A/B/C Power Meter. Sweep duration ≥50 seconds.			
6 Attenuator switch points are every 10 dB starting at -2 dBm indicated power.			
7 With Option 002, in power sweep or slope functions, power can exceed attenuator step by 5 dB.			
8 Power Sweep and Slope Compensation total must not exceed 15 dB.			
9 Includes internally leveled power variations.			

Table 1-2. Supplemental Performance Characteristics for Model 83522A Installed in Model 8350A (1 of 2)

NOTE	
Values in this table are not specifications, but are typical characteristics included for user information.	
FREQUENCY CHARACTERISTICS¹	
Accuracy ² (25°C ± 5°C)	Stability with Temperature: ±200 kHz/°C
CW Mode, typically: 0.01 to 2.4 GHz: ±1.5 MHz	OUTPUT CHARACTERISTICS¹
Manual Sweep 0.01 to 2.4 GHz: ±40 MHz	Power Output
All Sweep Modes (Sweep time 10 ms to 100 ms): ±25 MHz	Resolution (displayed): 0.1 dB
Sweep Mode Linearity ³ 0.01 to 2.4 GHz: ±1 MHz	Remote Programming (settable): Typically ±0.01 dB
	Stability with Temperature (at maximum specified leveled power): ±0.02 dB/°C

Table 1-2. Supplemental Performance Characteristics for Model 83522A Installed in Model 8350A (2 of 2)

<p>Spurious Signals (in dB below carrier)</p> <p>Harmonics: 0.01 to 2.4 GHz</p> <p>At specified maximum leveled power, typically: ≥ 25 dB</p> <p>At power level of +10 dBm, typically: ≥ 30 dB</p> <p>Non-Harmonics at specified maximum leveled power, typically: ≥ 30 dB</p>	<p>Pulse In</p> <p>TTL compatible; Logic HIGH=RF ON Logic LOW=RF OFF</p> <p>Square Wave modulation up to 30 kHz is allowable.</p> <p>External FM</p> <p>Sensitivity (switch selectable)</p> <p>FM Mode: Typically -20 MHz/V</p> <p>Phase-Lock Mode: Typically -6 MHz/V</p> <p>Input Impedance: 2000 Ohms nominal</p>
<p>Impedance: 50 Ohms</p> <p>Power Sweep⁵</p> <p>Accuracy (including linearity): Typically ± 1.0 dB</p> <p>Resolution (displayed): 0.1 dB</p> <p>Slope Compensation⁵</p> <p>Linearity: Typically < 0.2 dB</p> <p>Calibrated Range:⁴ Up to 5 dB/GHz; Up to 15 dB for full sweep range</p> <p>Resolution (displayed): 0.01 dB/GHz</p>	<p>CRYSTAL MARKER¹ (Operation when RF power set between +3 to +13 dBm and ≤ 10 markers per sweep)</p> <p>Accuracy of Center Frequencies (at 25°C): $\pm 5 \times 10^{-6}$</p> <p>Typical Marker Width Around Center Frequency</p> <p>1 MHz Markers: ± 100 kHz</p> <p>10 MHz Markers: ± 200 kHz</p> <p>50 MHz Markers: ± 300 kHz</p> <p>External Markers: ± 300 kHz</p> <p>Temperature Stability: Typically $\pm 2 \times 10^{-6}/^{\circ}\text{C}$</p>
<p>MODULATION CHARACTERISTICS¹</p> <p>External AM</p> <p>Frequency Response: Typically 100 kHz</p> <p>Input Impedance: Approximately 10K Ohm</p> <p>Range of Amplitude Control: Typically 15 dB</p> <p>Sensitivity: Typically 1 dB/V</p>	<p>GENERAL CHARACTERISTICS¹</p> <p>External Marker Input: Generates amplitude or Z-axis marker when sweep frequency equals external input frequency.</p> <p>Frequency Range: 0.01 to 2.4 GHz</p> <p>Frequency Reference Output: 1V/GHz ± 25 mV (over full sweep range) rear panel BNC output.</p> <p>Weight: Net 4.5 kg (10 lb.), Shipping 7.7 kg (17 lb.)</p>
<p>FOOTNOTES</p>	
<p>¹ Unless otherwise noted, all characteristics are at the RF OUTPUT connector and at 0° to 55°C.</p> <p>² Accuracy when calibrated using internal crystal markers and FREQ CAL adjustment.</p> <p>³ With respect to the SWEEP OUT voltage.</p> <p>⁴ With Option 002, in power sweep or slope functions, power can exceed attenuator step by 5 dB.</p> <p>⁵ Power Sweep and Slope Compensation must not exceed 15 dB.</p> <p>⁶ External marker input power typically between -10 dBm and +10 dBm (over limited power range).</p>	

1-20. Internal crystal referenced frequency markers are available to provide Z-axis intensity markers from the Model 8350A rear panel POZ Z BLANK BNC output or 1 dB amplitude marker dips on the RF output. Harmonic markers of 10 and 50 MHz are available up to 2.4 GHz and 1 MHz markers are available up to 1 GHz. A rear panel BNC connector accepts an external marker reference frequency. Marker operation is selected by the front panel controls or through HP-IB control via the Model 8350A.

1-21. A power sweep function allows the RF output power to be swept at least 15 dB during CW mode or swept frequency modes. Power sweep is selected by the front panel POWER SWEEP pushbutton. Slope compensation control is also available by selecting the SLOPE pushbutton and rotating the Model 83522A RPG or manipulating the Model 8350A data entry controls. The power sweep function and slope compensation may both be selected and modified through HP-IB control via the Model 8350A.

1-22. The RF output may be internally or externally amplitude modulated, or externally frequency modulated. Internal square wave amplitude modulation frequency is selectable by a Model 8350A internal jumper to be 1 kHz or 27.8 kHz (for use with the Model 8755 Swept Amplitude Analyzer). Rear panel BNC connectors accept an external AM or FM frequency. FM coupling (direct coupled or cross-over) and sensitivity is selected by an internal configuration switch in the Model 83522A. Refer to Section III, Operation, of this manual for detailed information on the configuration switch.

1-23. A rear panel 1V/GHz signal corresponds to the RF output frequency. This output voltage may be used as a reference for pretuning external equipment in phase locking applications. (The Model 8410B/8411A Network Analyzer utilizes this output in such a configuration).

1-24. The RF output may be turned off by the RF ON/OFF pushbutton. RF power on is indicated by the LED in the center of the pushbutton. Additionally, in CW mode, the CW FILTER, when selected, places a capacitor across the YIG oscillator tuning coil to filter

high frequency noise which would appear at the RF output. All front panel functions, with the exception of the FREQ CAL and CAL adjustments, may be set or altered by computer control via the HP-IB bus connection on the Model 8350A.

1-25. OPTIONS

1-26. Option 002, 70 dB Attenuator

1-27. Option 002 instruments contain a digitally controlled attenuator just before the RF output. Up to 70 dB of attenuation in 10 dB steps is automatically selected as required to attenuate the RF output power to the indicated level. The continuously variable power level function operates as in a standard instrument with the data entry controls.

1-28. Option 004, Rear Panel RF Output

1-29. Option 004 instruments have the Type N RF output connector and the BNC EXT/MTR ALC input connector on the rear panel instead of the front panel.

1-30. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-31. To have a complete operating sweep oscillator unit, the Model 83522A RF plug-in must be installed in a Model 8350A Sweep Oscillator. Refer to Section II Installation in this manual for a detailed description of RF plug-in installation.

1-32. EQUIPMENT AVAILABLE

1-33. Service Accessories

1-34. A Service Accessory Kit (HP Part No. 08350-60020) is available for servicing the Model 83522A RF Plug-in and the Model 8350A Sweep Oscillator. HP Part Numbers for the individual parts of the kit are provided in Table 1-3.

1-35. The Service Accessory Kit includes:

- Two 44-pin printed circuit board extenders. These boards have keyed slots which allow them to be used in each of the keyed pc board connectors in the Model 83522A and in the Model 8350A as well.

- An RF Plug-in extender cable set that provides all electrical connections to the RF plug-in when it is removed from the sweep oscillator. The RF Plug-in Interface connector (P2) and the Power Supply Interface connector (P1) are extended by separate cables.
- One Hex Balldriver for use in Model 8350A repairs.
- One 16-pin and one 20-pin integrated circuit test clip.

1-36. A listing of service accessories available including service cables, wrenches, adapters, and extender boards is given in Table 1-3.

1-37. Model 8410B/8411A Network Analyzer

1-38. The Model 8350A Sweep Oscillator, with the Model 83522A RF Plug-in installed, is compatible with the HP Model 8410B Network Analyzer system. The combination of the Model 8410B Network Analyzer, the Model 8411A Frequency Converter, and an appropriate display plug-in forms a phasemeter and a ratiometer for direct phase and amplitude ratio measurement on RF voltages. These measurements can be made on single frequencies and on swept frequencies from 110 MHz to 18 GHz. The Model 8350A/83522A combination is capable of operation from 110 MHz to 2.4 GHz within this range. The Model 8410B has an Auto-Frequency

Table 1-3. Service Accessories Available

NAME	HP PART NUMBER	DESCRIPTION
44-pin printed circuit board extender	08350-60031*	Extends printed circuit boards
RF Plug-in Extender Cables	08350-60034* 08350-60035*	Extends RF Plug-in Interface connector (P2) Extends RF Plug-in Power Supply Interface connector (P1)
Adjustment Tool	8830-0024	Fits miniature adjustment slot on potentiometers
Wrenches	08555-20097 8710-0946	5/16" slotted box/open end 15/64" open end
Service Cables	8120-1578 83525-60019	18" coax with SMA (m) connector on each end 10" coax with SMB snap on (f) and SMA (m)
Adapters	1250-0777 1250-0082 1250-1404 1250-1158 1250-0674 1250-0675 1250-0069	Type N (f) to BNC (m) Type N (m) to BNC (m) Type N (f) to SMA (f) SMA (f) to SMA (f) SMA (f) to SMB (m) SMA (f) to SMC (m) SMB snap on (m) to SMB snap on (m)
Hex Balldriver	8710-0523*	Removes front panel hold down plate hex screws in 8350A
IC Test Clip	1400-0734* 1400-0979*	16-pin IC test clip 20-pin IC test clip

*These items are included in a Service Accessories Kit HP Part No. 08350-60020 (2 board extenders are included in this kit).

range mode which gives it the capability of automatically tracking the Model 8350A Sweep Oscillator over octave and multi-octave frequency bands. Two interconnections to the Model 8350A are necessary to ensure that the Model 8410B will phase lock properly. The Model 8410B Source Control Cable (HP 08410-60146) connects the Model 8410B rear panel SOURCE CONTROL connector to the Model 8350A rear panel PROGRAMMING CONNECTOR. Additionally, the Model 83522A RF Plug-in rear panel 1V/GHz output connects to the Model 8410B rear panel FREQ REF INPUT. The Model 8410B Source Control Cable connector pins and signals are illustrated in the Model 8350A Sweep Oscillator Operating and Service Manual.

1-39. Model 8755 Frequency Response Test Set

1-40. The Model 8350A Sweep Oscillator with the Model 83522A RF Plug-in installed is compatible with the Model 8755 Frequency Response Test Set for broadband swept scalar measurements. The Model 8350A provides internal 27.8 kHz square wave AM modulation of the RF output eliminating unnecessary cable connections to the Model 8755 or the use of an external modulator. The Model 8350A can also produce alternate sweeps through use of the ALT n function which works in conjunction with the channel switching circuits in the Model

8755C. This permits Channel 1 on the Model 8755C to respond only to the Model 8350A current state and Channel 2 to the alternate state. A single cable (HP Part Number 8120-3174) connects between the Model 8350A rear panel ALT SWP INTERFACE connector and the Model 8755C front panel ALT SWP INTERFACE connector.

1-41. Power Meters and Crystal Detectors

1-42. The RF output can be externally leveled using the HP Model 432 Power Meter or negative polarity output crystal detectors. Refer to Section III Operation of this manual for detailed information on leveling techniques that may be used with the Model 8350A/RF Plug-in combination.

NOTE

The Model 435A and 436A Power Meters should not be used in Model 8350A/Model 83522A external leveling systems.

1-43. RECOMMENDED TEST EQUIPMENT

1-44. Equipment required for testing and adjusting 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.

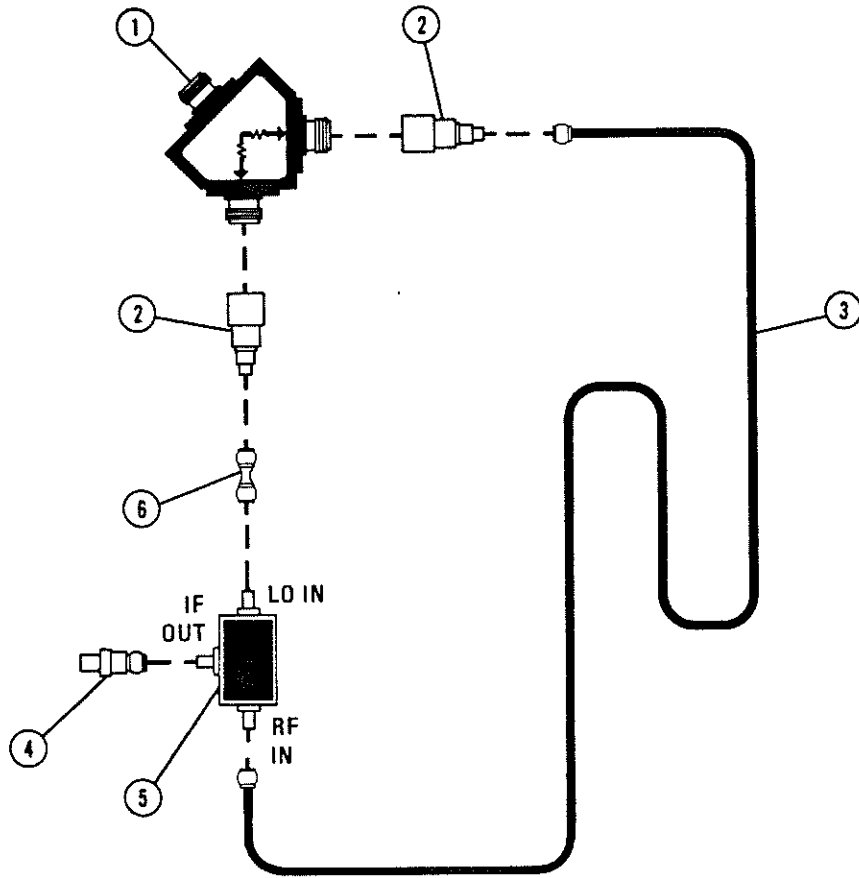
Table 1-4. Recommended Test Equipment (1 of 2)

Instrument	Critical Specifications	Recommended Model	Use ¹
Sweep Oscillator	No substitute	HP 8350A	P,A,T
Digital Voltmeter (DVM)	Range: -50V to +50V Accuracy: $\pm 0.01\%$ Input Impedance: $\geq 10M$ Ohms	HP 3455A	P,A,T
Oscilloscope	Dual Channel Bandwidth: dc to 100 MHz Vertical Sensitivity: ≤ 5 mV/Div Horizontal Sweep Rate: $\leq 0.1 \mu$ S/Div X vs. Y Display Mode	HP 1740A	P,A,T
Frequency Counter	Frequency Range: 0.01 to 2.4 GHz	HP 5343A	P,A
Spectrum Analyzer	Frequency Range: 0.01 to 18 GHz Residual FM: ≤ 100 Hz Must have auxiliary IF output when used with the HP 8901A Modulation Analyzer	HP 8565A or HP 8566A	P,T
Modulation Analyzer	(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 8901A	P,T
Swept Amplitude Analyzer	Capable of Transmission and Reflection measurements. Power Resolution: ≤ 0.25 dB/Div	HP 8755C	P,A
Display Mainframe	Compatible with HP 8755C Swept Amplitude Analyzer and HP 8750A Storage-Normalizer	HP 182T/TR	P,A
Detector	Compatible with Swept Amplitude Analyzer Frequency Range: 0.01 to 2.4 GHz Power Range: -20 to +10 dBm	HP 11664A	P,A
Storage-Normalizer	Compatible with Display Mainframe and Swept Amplitude Analyzer	HP 8750A	P
RF Marker Source	CW Frequency: 1.2 GHz Output Power Level: ≥ -10 dBm	HP 8350A/83522A	A
Frequency Meter	Frequency Accuracy: $\leq 0.17\%$ Calibration Increments: ≤ 2 MHz Frequency Range: 0.96 to 4.0 GHz	HP 536A	P

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

Instrument	Critical Specifications	Recommended Model	Use ¹
Function Generator	Frequency Range: 0.1 Hz to 10 MHz Sine wave and square wave output Output Level: 10 V p-p into 50 Ohms Output Level Flatness: $\leq \pm 3\%$ from 10 Hz to 100 kHz $\leq \pm 10\%$ from 100 kHz to 10 MHz	HP 3312A	P,A,T
Power Meter	Power Range: -20 to +10 dBm (No substitute when used for external power meter leveling).	HP 432A	P,A
Thermistor Sensor (Used with HP 432A)	Frequency Range: 0.01 to 2.4 GHz Maximum SWR: ≤ 1.75	HP 478A	P,A
Power Meter	Power Range: 1 μ W to 100 mW	HP 436A	P,A
Power Sensor (Used with HP 436A)	Frequency Range: 0.01 to 2.4 GHz	HP 8481A	P,A
Crystal Detector	Frequency Response: 0.01 to 2.4 GHz Maximum Input Power: 100 mW	HP 423B	P
Attenuator	Attenuation: 10 ± 0.5 dB Frequency Range: 0.01 to 2.4 GHz Maximum Input Power: $\geq +20$ dBm Type-N Connector	HP 8491A Option 010	P,A
Power Splitter	Frequency Range: 0.01 to 2.4 GHz Output Port Tracking: ≤ 0.25 dB Maximum Input Power: +20 dBm	HP 11667A	P,A
1:1 Probe	General Purpose Probe	HP 10007B	A
DC Power Supply	DC Output: 0 to 6.5 Vdc ± 0.05 Vdc	HP 6213A	A
50 Ohm Termination	Type N, 50 Ohms ± 0.5 Ohms	HP 909A	P,A
Delay Line Discriminator	Refer to Figure 1-3.		A

¹ P = Performance Test; A = Adjustments; T = Troubleshooting



Item	Description	HP Part Number
1	Power Splitter	HP 11667A
2	Adapter: Type N Male to SMA Female (2 required)	1250-1250
3	Delay Line: >1 meter (3 feet) in length, SMA male connectors	08503-20038
4	Adapter: BNC Female to Male SMA	1250-1200
5	Mixer: Double Balanced 1 to 12 GHz: RHG Electronics Part No. DM 1-12 1 to 18 GHz: RHG Electronics Part No. DM 1-18 RHG Electronics Laboratories, Inc. Deer Park, NY 11729	0960-0451 0960-0543
6	Adapter: SMA Male to SMA Male	1250-1159

Figure 1-3. Delay Line Discriminator



SECTION II INSTALLATION

2-1. INTRODUCTION

2-2. This section provides installation instructions for the Model 83522A RF Plug-in. This section also includes information about initial inspection, damage claims, preparation for use, packaging, storage, and shipment.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. 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, in the Model 8350A Operating and Service Manual. Performance Test limits are given in Section IV of this manual. If the instrument combination does not pass the electrical Performance Tests, refer to Section V, Adjustments, of this manual. If, after the adjustments have been made, the instrument combination still fails to meet specifications, and a circuit malfunction is suspected, refer to troubleshooting procedures in Section VIII, Service, in this 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. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. When the Model 83522A RF Plug-in is properly installed, it obtains all power through the rear panel interface connector from the Model 8350A Sweep Oscillator.

2-8. RF Plug-in Configuration Switch

2-9. The Model 83522A RF Plug-in has a configuration switch (A3S1) located on the A3 Digital Interface Board. This switch must be preset prior to RF Plug-in operation in the Model 8350A. The configuration switch is an 8-section multiple switch. Each of the separate switches corresponds to a separate RF plug-in function such as FM sensitivity selection, FM modulation input coupling selection (direct coupled or cross-over), RF power level at power on (minimum or maximum), and Option 002 Step Attenuator operation. Refer to Section III, Operation, in this manual for a complete description of the configuration switch and instructions on how to set the switches.

2-10. Interconnections

2-11. There are two rear panel interconnections on the Model 83522A RF Plug-in to the Model 8350A Sweep Oscillator. These are the RF Plug-in Interface connector (P2) and the Power Supply Interface Connector (P1). A complete listing of pins and associated signals and voltages for these connectors are listed on the Wiring List in Section VIII, Service, of this manual. Figures 2-1 and 2-2 provide the connector configuration and associated signal mnemonics.

2-12. Mating Connectors

2-13. All of the externally mounted connectors on the Model 83522A are listed in Table 2-1. Opposite each 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.

2-14. Operating Environment

2-15. **Temperature.** The instrument may be operated in temperatures from 0°C to +55°C.

2-16. **Humidity.** The instrument may be operated in environments with humidity from 5% to 80% relative at +25°C to +40°C. However,

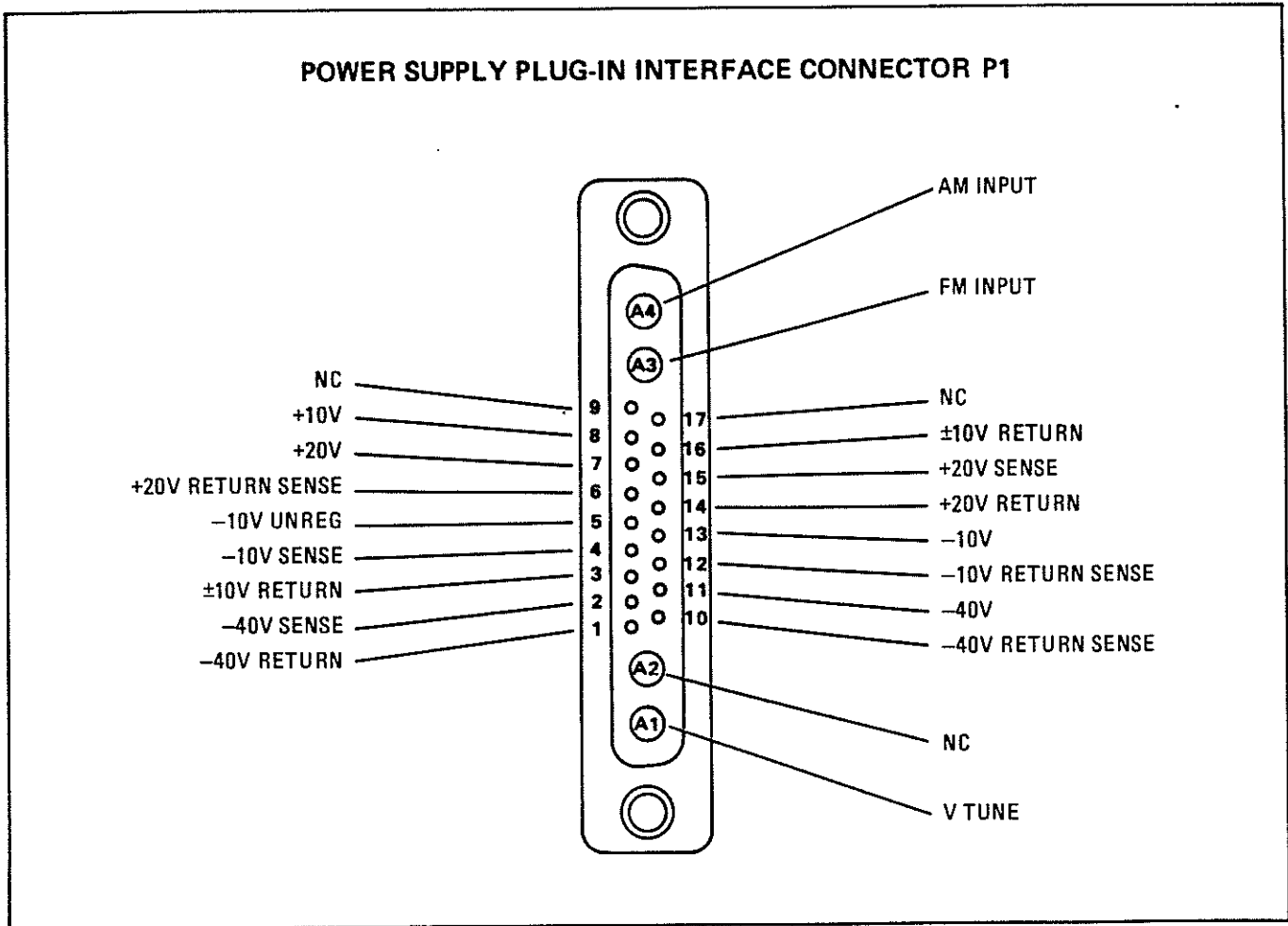


Figure 2-1. Interface Signals on Connector P1

Table 2-1. Mating Connectors

83522A Connector		Mating Connector	
Connector Name	Industry Identification	HP Part No.	Alternate Source
J1 RF INPUT	TYPE N (f)	1250-0882	Specialty Connector 25-P117-2
J2 EXT/MTR ALC INPUT	BNC (f)	1250-0256	Specialty Connector 25-P118-1
J3 EXT MKR	BNC (f)	1250-0256	Specialty Connector 25-P118-1
J4 1V/GHz	BNC (f)	1250-0256	Specialty Connector 25-P118-1
J5 PULSE IN	BNC (f)	1250-0256	Specialty Connector 25-P118-1

PLUG-IN INTERFACE CONNECTOR P2

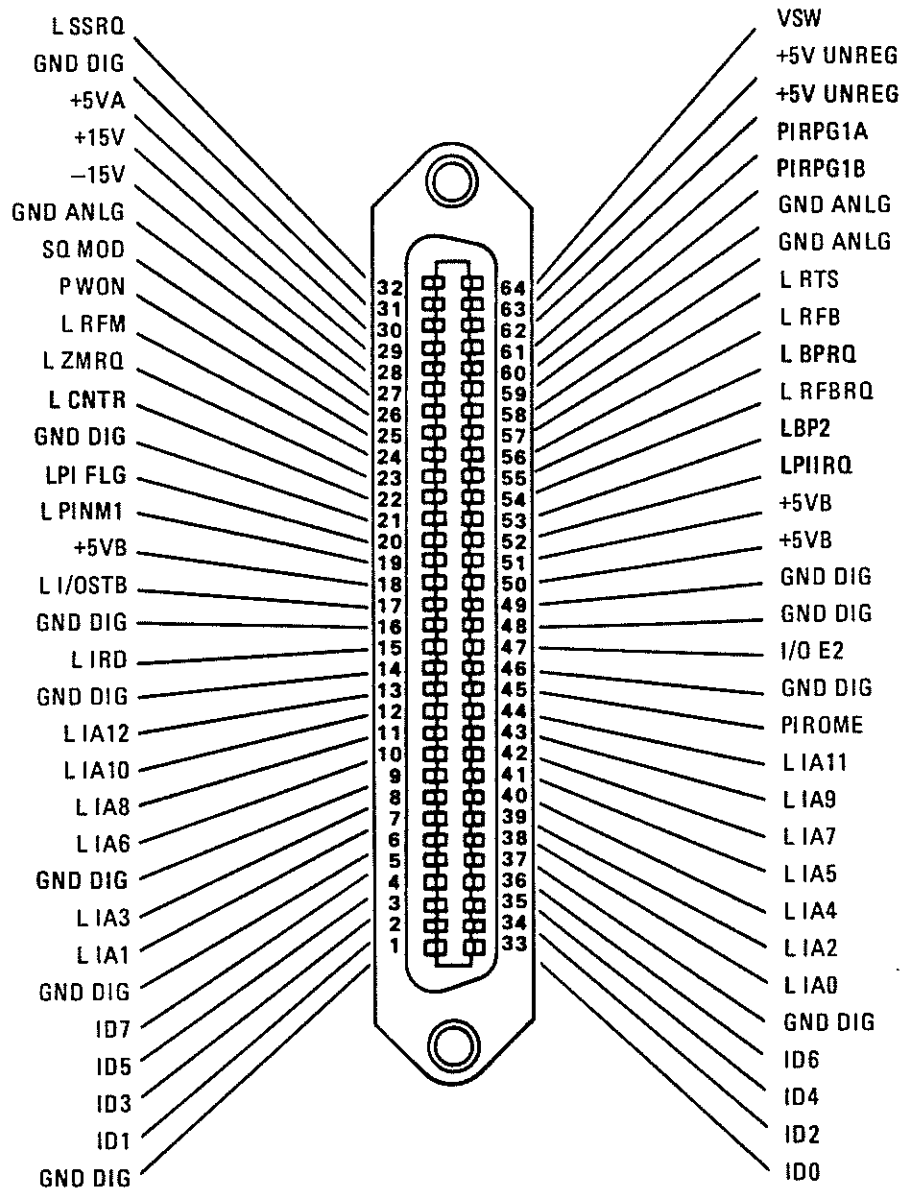


Figure 2-2. Interface Signals on Connector P2

the instrument should also be protected from temperature extremes which cause condensation within the instrument.

2-17. Altitude. The instrument may be operated at altitudes up to 4572 meters (approximately 15,000 feet).

2-18. Cooling. When the Model 83522A RF Plug-in is properly installed in the Model 8350A Sweep Oscillator, it obtains all of its cooling airflow by forced ventilation from the fan in the Model 8350A. A diagram showing the various cooling airflow paths within the sweep oscillator is given in Section II, Installation, of the Model 8350A Sweep Oscillator Operating and Service Manual. Ensure that all airflow passages in the Model 8350A and the Model 83522A are clear before installing the RF Plug-in in the Sweep Oscillator.

2-19. Installation Instructions

2-20. To operate as a completely functional sweep oscillator, the Model 83522A RF Plug-in must be installed in a Model 8350A Sweep Oscillator. To install the Model 83522A RF plug-in in the Model 8350A Sweep Oscillator:

- a. Set the Model 8350A mainframe LINE switch to OFF.
- b. Remove all connectors and accessories from the front and rear panel connectors of the Model 83522A to prevent them from being damaged.
- c. Position the RF plug-in unit latching handle in the fully raised position. The latching handle should spring easily into the raised position and be held by spring tension.
- d. Ensure that the Model 8350A RF plug-in channel is clear, align the RF plug-in 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 in position.
- 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 sweep oscillator front panel.

2-21. STORAGE AND SHIPMENT

2-22. Environment

2-23. 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)

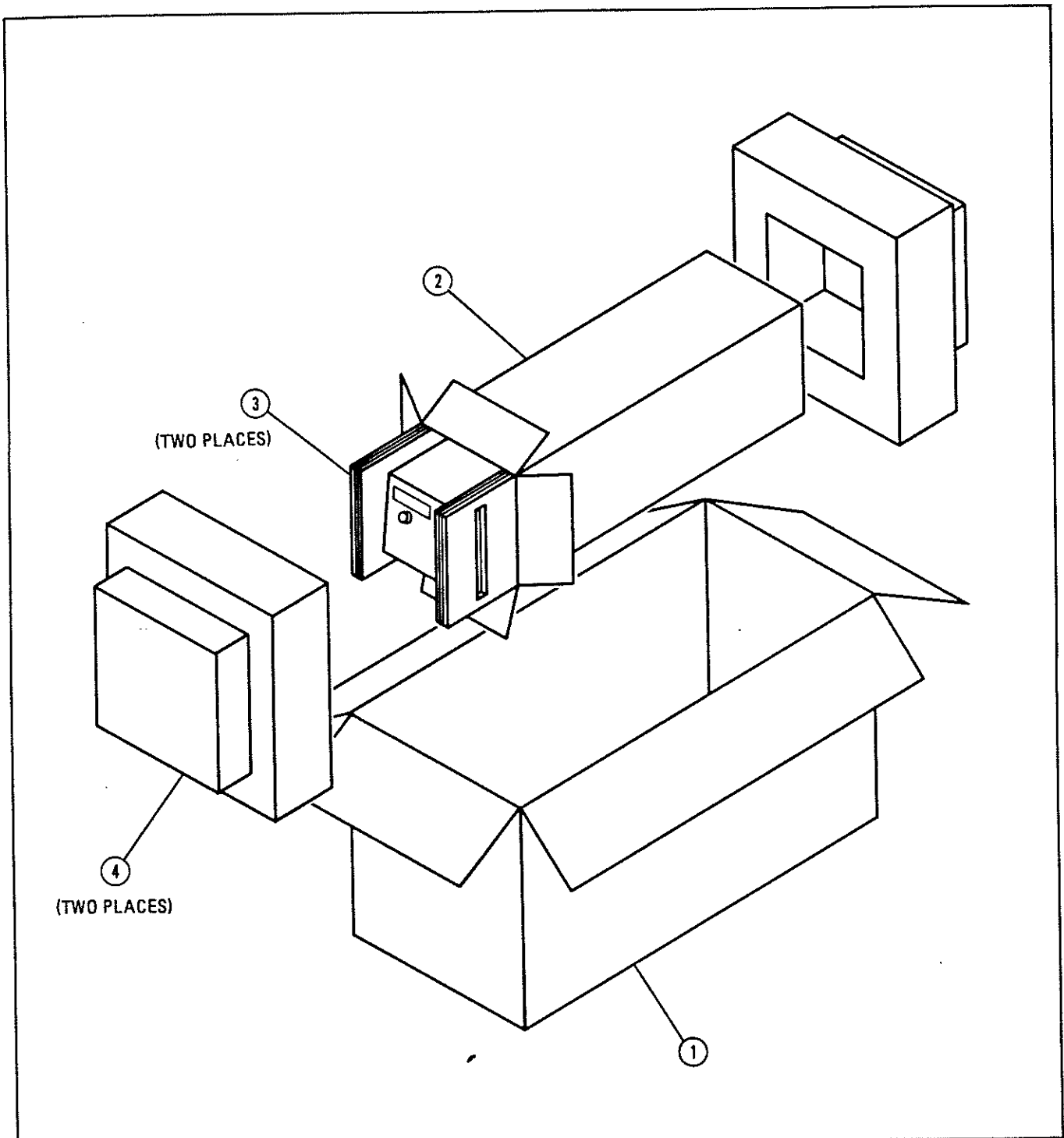
2-24. The instrument should also be protected from temperature extremes which may cause condensation in the instrument.

2-25. Packaging

2-26. 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 Model 83522A is shown in Figure 2-3. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number (located on rear panel serial plate). Mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-27. 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 tag 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.



Item	Quantity	HP Part Number	C D	Description
1	1	9211-3515	6	Outer Carton
2	1	9211-3514	5	Inner Carton
3	2	9220-3409	6	Side Pads – Corrugated Cardboard
4	2	9220-3406	3	Foam Pads
Not Shown	1	9222-0352	6	Poly Bag – to cover instrument

Figure 2-3. Packaging for Shipment Using Factory Packaging Materials



SECTION III OPERATION

3-1. INTRODUCTION

3-2. This section is divided into four major sections. Operating Characteristics explains the frequency resolution characteristics in CW and swept modes. Front and rear Panel Features are shown with illustrated descriptions. Operating Instructions provide a front panel frequency calibration procedure, configuration switch setting instructions, and crystal detector and power meter leveling instructions. Operator's Maintenance includes information on the plug-in error codes, fuses, and service tags.

3-3. OPERATING CHARACTERISTICS

3-4. Frequency Resolution

3-5. Two areas relating to frequency resolution must be considered; input resolution and displayed resolution. Input resolution refers to the number of bits (8 bits = 256 points) internally used in the digital to analog converters (DACs) used to generate the tuning voltage for a particular mode of operation. Table 3-1 cross references input resolution with each DAC used. Displayed frequency resolution refers to the number of digits shown on the 8350A FREQUENCY displays.

Table 3-1. Input Resolution

DAC Used	Voltage Resolution	Frequency Resolution
CF	2.5 mV	0.606 MHz
Vernier	40 μ V	9.45 kHz
ΔF 1 - 1/8 of band	10 mV	2.43 MHz
ΔF 1/8 - 1/64 of band	1.25 mV	0.303 MHz
$\Delta F \leq 1/64$ of band	0.156 mV	38.0 kHz

3-6. Figure 3-1 is a simplified block diagram of the frequency tuning circuits. The net tuning voltage results from the summation of the three

DAC outputs. With this DAC configuration the START/STOP sweep mode is computed by the microprocessor into a center frequency and a ΔF sweep width. Therefore the operation of all sweeps are set with a center frequency and sweep width. The center frequency is specified by the center frequency (CF) DAC and the Vernier DAC, and the sweep width is determined by the ΔF DAC.

3-7. The CF DAC has 12 bits, hence 4096 points across the plug-in frequency band (including overrange). The analog output ranges from zero to ten volts, which is used to coarsely specify the center frequency output of the plug-in. These parameters give the CF DAC a resolution of 0.024% (2.5mV) over the full band (including overrange).

3-8. Resolution of Center Frequency is enhanced with a summed voltage input generated by an 8-bit (256 points) Vernier DAC. Vernier range is set to $\pm 0.05\%$ of RF plug-in bandwidth (including overrange). In multiband plug-ins, total range of the vernier will vary with each band sweep. Vernier resolution is determined by dividing $\pm 0.05\%$ bandwidth by 256 points (128 points either side of CF). The voltage range of the total 256 points on the Vernier DAC is equal to four points on the 12-bit CF DAC (two points on either side of CF). This increases CF resolution from 0.024% (2.5mV) to 0.00038% (.04mV), and improves the relative accuracy of the CF by a similar factor.

NOTE

When adjusting the vernier through its zero-point, the CF DAC is incremented or decremented by the total value of the vernier (2 points on the CF DAC). At this time the accuracy of the Center Frequency is again entirely dependent on the CF DAC $\pm 0.005\%$ of bandwidth.

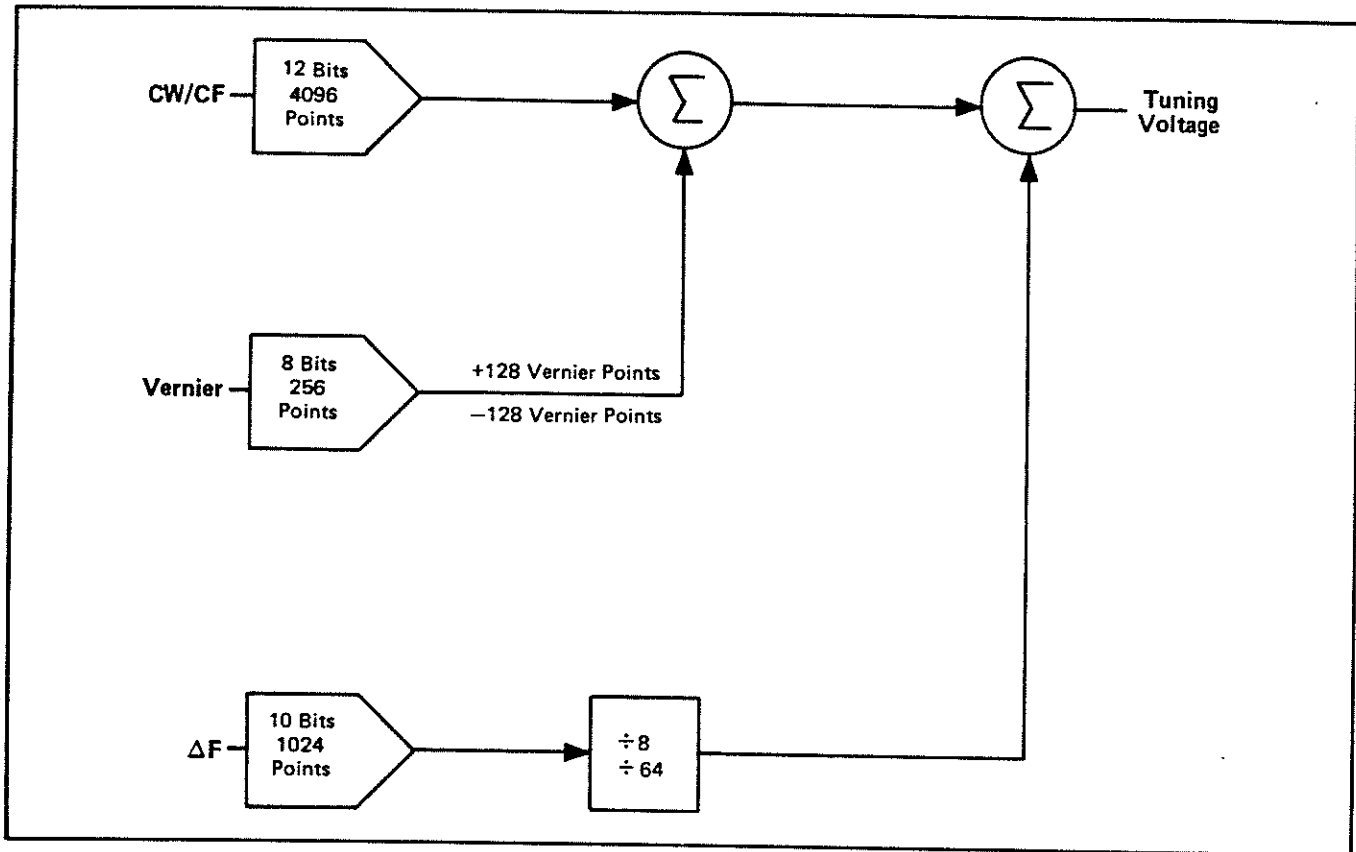


Figure 3-1. Simplified Tuning Voltage Block Diagram

3-9. The ΔF DAC has 10 bits (1024 points). The analog output from this DAC ranges from -5 to $+5$ volts to produce an even sweep on either side of the center frequency. The ΔF resolution improves with narrower sweep widths. For broad sweeps, the resolution is 0.1% of the full band. For sweep widths less than $1/8$, but greater than $1/64$ of the full band range, the resolution is improved to 0.012% of the full band. For sweep widths less than $1/64$ of the full band range, the resolution is improved to 0.0015% of the full band.

3-10. Center Frequency is always displayed with 1 MHz resolution. Likewise, Vernier values are always displayed at 10 kHz resolution. Display resolutions for ΔF values vary with sweep width. Figure 3-2. illustrates the ΔF mode displayed resolution values versus displayed ΔF frequency sweep widths.

3-11. PANEL FEATURES

3-12. Front and rear panel features are described in Figure 3-3 and 3-4, respectively. Description numbers match the numbers on the illustration.

3-13. OPERATOR'S CHECKS

3-14. The Operator's Checks (local and remote) in the 8350A Sweep Oscillator manual provide a quick evaluation of 8350A and 83522A main functions. Error codes 50 to 99 indicate plug-in related problems. The 8350A Local Check covers the sweep oscillator and RF plug-in, therefore, if the correct indications are not obtained, trouble may be in either of the units. If the RF plug-in is suspected, follow the troubleshooting information in Section VIII, Service, in this manual to isolate the problem.

3-15. OPERATING INSTRUCTIONS

3-16. Front Panel FREQ CAL

NOTE

The 83522A RF Plug-in may not meet the frequency accuracy specifications unless the front panel FREQ CAL (frequency calibration) procedure is performed.

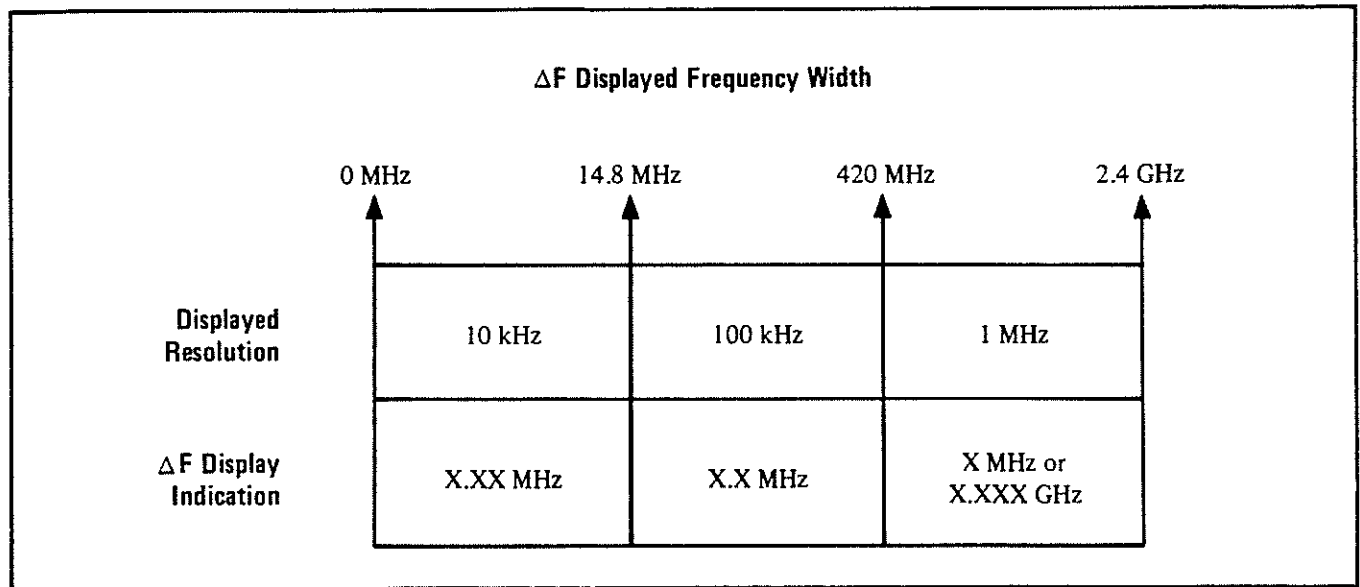


Figure 3-2. Model 83522A ΔF Sweep Mode Displayed Resolution

3-17. The front panel **FREQ CAL** procedure, shown in Figure 3-5, should be performed after the instrument has warmed up for at least one hour. Performing this procedure adjusts the RF Output frequency to the crystal marker frequency.

3-18. Internal Leveling

3-19. The most convenient method of RF output leveling is internal leveling. A portion of the RF output is coupled out of an internal directional detector, producing a dc voltage proportional to the RF output signal. This detected dc voltage is applied to the automatic leveling control circuit (ALC).

3-20. External Crystal Detector Leveling

3-21. RF Output power may also be leveled externally using a power splitter (or external directional coupler) and a crystal detector. This leveling system uses a power splitter to sample a portion of the RF Output signal with a crystal detector to produce a dc voltage proportional to the RF signal level. The detector output voltage is compared with an internal reference voltage, and the difference voltage changes the output power level to keep it constant at the output. A directional coupler may be used instead of a power splitter to sample the RF signal for the leveling loop. Directional couplers are usually narrow band, whereas the power splitter is flat over a wide frequency range. The advantage of a directional coupler is that it does not have the

6 dB loss like the power splitter, therefore, a higher maximum leveled power output may be obtained. Figure 3-6 illustrates a typical crystal detector leveling setup.

3-22. External Power Meter Leveling

3-23. RF Output power may also be leveled with a power meter and power splitter (or directional coupler) as shown in Figure 3-7. The sweep time is limited to greater than 50 seconds when this leveling method is used. A sample of the RF output signal is routed to a power meter which produces a dc output voltage proportional to the RF signal level. This dc voltage is applied to the 83522A ALC circuits and compared with an internal reference voltage. A difference voltage is produced and amplified by the ALC amplifier before being applied, as modulator drive, to a PIN Modulator. Figure 3-7 illustrates a typical power meter leveling setup.

3-24. External Frequency Modulation

3-25. The 83522A RF output signal can be frequency modulated using an external modulating signal applied to the 8350A rear panel **FM INPUT** connector. The external FM function provides a means of obtaining an output frequency that varies under the control of an external modulating signal. A positive going voltage at the **FM INPUT** causes output frequency to decrease while a negative going voltage causes output frequency to increase. The

sensitivity and coupling of the modulating signal may be set via configuration switch (A3S1). Figure 3-8 lists the available configuration switch settings. The configuration switch settings override 8350A Sweep Oscillator non-volatile memory settings at Instrument Preset.

3-26. External Amplitude Modulation

3-27. Pulse Modulation (PULSE IN Connector on Plug-in). The PULSE IN connector provides pulsed or square wave modulation, where the RF output is switched on and off. This input provides an on/off power ratio of greater than 30 dB below specified maximum leveled power. The PULSE IN input is normally at a TTL HIGH (approximately +3 Volts dc). When a TTL LOW signal (approximately 0 Volts dc) is applied, the RF output is turned off. RF power may be square wave modulated at repetition rates up to 30 kHz at any power setting. The input impedance for TTL level signals is approximately 500 Ohms. If the PULSE IN circuit is driven beyond TTL levels, the input impedance is reduced to approximately 200 Ohms due to diode clamping action. See the specifications and supplemental characteristics in Section I for more details on the modulation characteristics when using this input.

3-28. Amplitude Modulation (AM INPUT Connector on 8350A). The AM INPUT connector provides linear amplitude changes (up to approximately 15 dB) proportional to the modulating input voltage. It is limited to a frequency response of about 100 kHz. For maximum depth of modulation (i.e., maximum modulation index), the RF power level should be set to the middle of the control range (e.g., +5.5 dBm for a plug-in with calibrated power control from -2 to +13 dBm). For plug-ins equipped with Option 002 (70 dB Step Attenuator), the middle of the attenuator range should be selected. The center of the power control range may be selected with the front panel power control knob or by applying a dc bias voltage on the external modulating signal. A positive (+) dc voltage into the AM INPUT causes a decrease in RF output power; a negative (-) dc voltage causes an increase in RF output power.

3-29. RF Power Control

3-30. The RF power selected at power-up (Instrument Preset) may be either maximum

power (+13 dBm) or power OFF as chosen on the configuration switch (A3S1); refer to Figure 3-8 for this setting. The configuration switch also has switch settings for the model plug-in and use of Option 002 Step Attenuator. The configuration switch settings override Sweep Oscillator non-volatile memory settings at Instrument Preset. Switch numbers 1, 2, 3, and 7 are set at the factory and should not be changed.

3-31. Option 002 Step Attenuator

3-32. With Option 002 installed, when the selected POWER setting goes below -2 dBm, the step attenuator increments as required in 10 dB steps to a maximum attenuation of 70 dB (which sets minimum power to -72 dBm). Within the individual 10 dB steps of the attenuator, the ALC loop adjusts the power output to the power level programmed by the front panel POWER control.

3-33. Alternate Sweep Mode With Option 002

3-34. If Option 002 attenuator is installed, and alternate sweep mode is selected, a slow sweep default condition of 1 second/sweep may occur. This default condition only occurs when the POWER settings of the two alternate sweeps require the attenuator to switch after each sweep. The program prevents the attenuator from switching faster than 1 second per attenuator change to prevent damage to the attenuator coils due to overheating.

3-35. Phase-Lock Operation

3-36. The 83522A RF plug-in RF Output (CW) signal may be phase-locked using an external phase-lock signal applied to the 8350A Sweep Oscillator FM INPUT connector (rear panel). The phase-lock function provides a means of obtaining a very stable CW frequency by transferring the frequency stability of the reference oscillator to the source. If the CW frequency starts to drift, the phase difference between the CW frequency and the reference frequency (reference oscillator) is detected, producing a dc voltage. The dc voltage is a correction signal which restores the CW frequency to its previous point. Stability of the RF Output CW frequency is determined by the stability of the reference oscillator. The CW filter should be turned off in phase lock operation.

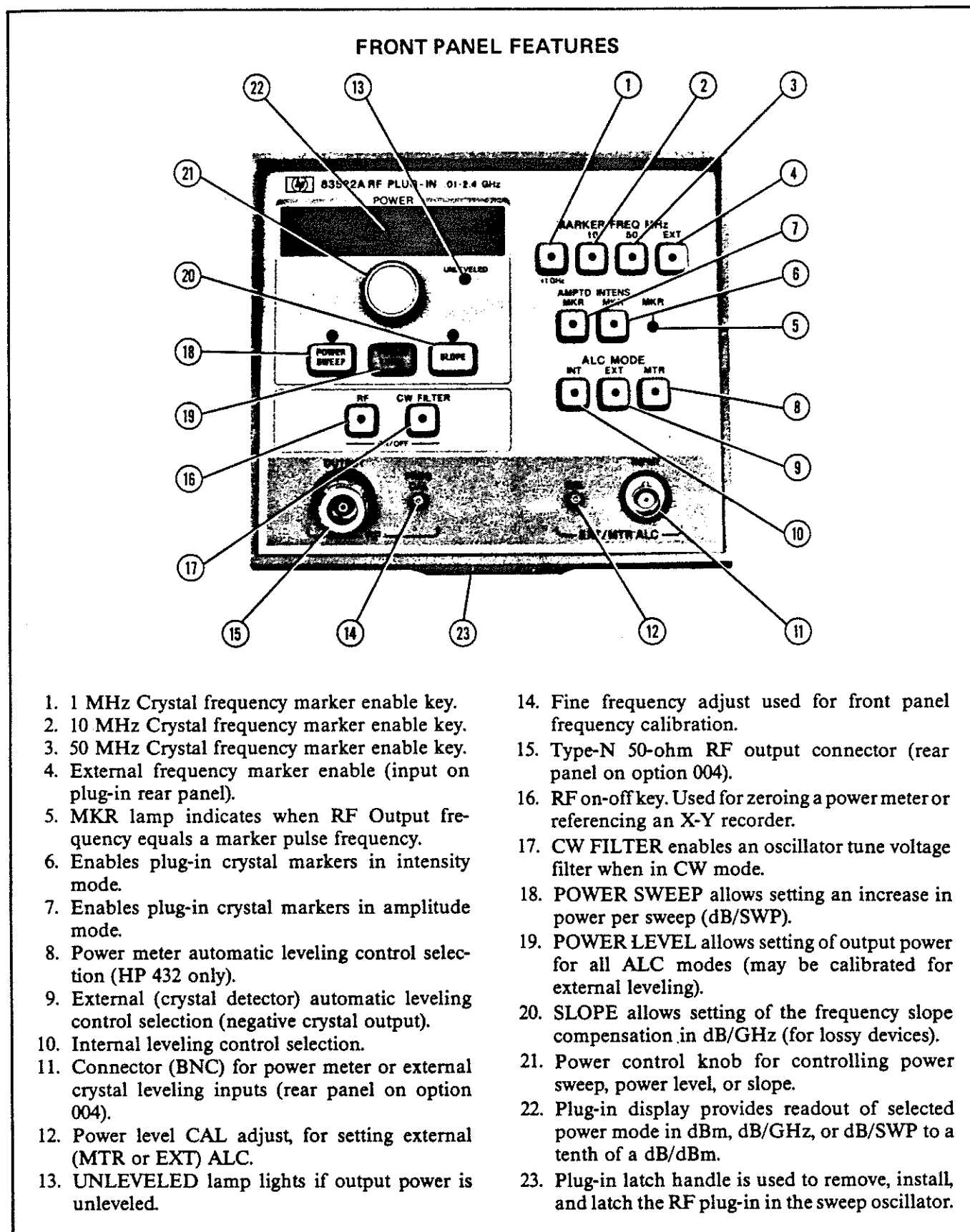
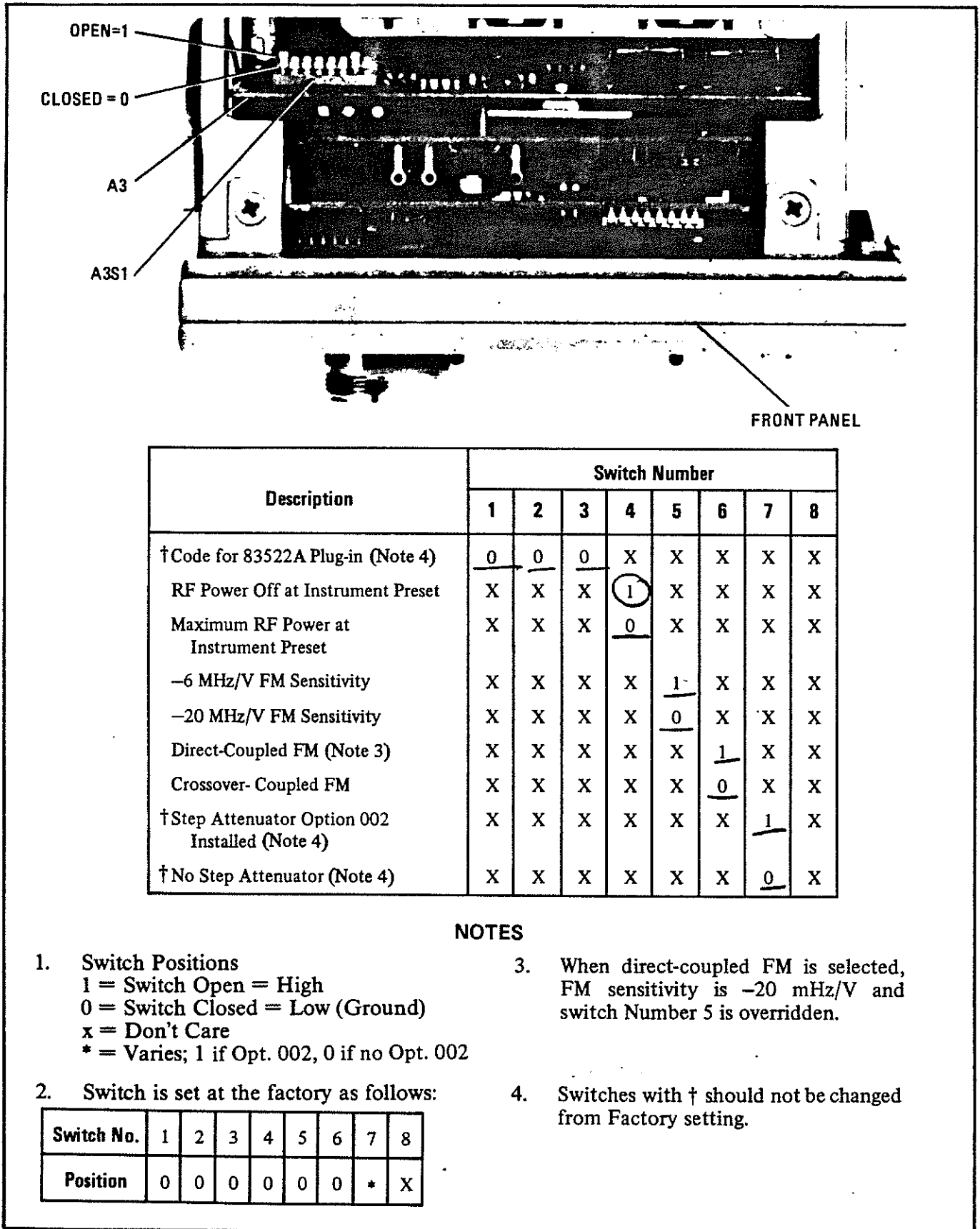


Figure 3-3. Front Panel Features



Description	Switch Number							
	1	2	3	4	5	6	7	8
† Code for 83522A Plug-in (Note 4)	0	0	0	X	X	X	X	X
RF Power Off at Instrument Preset	X	X	X	1	X	X	X	X
Maximum RF Power at Instrument Preset	X	X	X	0	X	X	X	X
-6 MHz/V FM Sensitivity	X	X	X	X	1	X	X	X
-20 MHz/V FM Sensitivity	X	X	X	X	0	X	X	X
Direct-Coupled FM (Note 3)	X	X	X	X	X	1	X	X
Crossover-Coupled FM	X	X	X	X	X	0	X	X
† Step Attenuator Option 002 Installed (Note 4)	X	X	X	X	X	X	1	X
† No Step Attenuator (Note 4)	X	X	X	X	X	X	0	X

NOTES

- Switch Positions
 1 = Switch Open = High
 0 = Switch Closed = Low (Ground)
 x = Don't Care
 * = Varies; 1 if Opt. 002, 0 if no Opt. 002
- Switch is set at the factory as follows:
- When direct-coupled FM is selected, FM sensitivity is -20 mHz/V and switch Number 5 is overridden.
- Switches with † should not be changed from Factory setting.

Switch No.	1	2	3	4	5	6	7	8
Position	0	0	0	0	0	0	*	X

Figure 3-8. Configuration Switch

