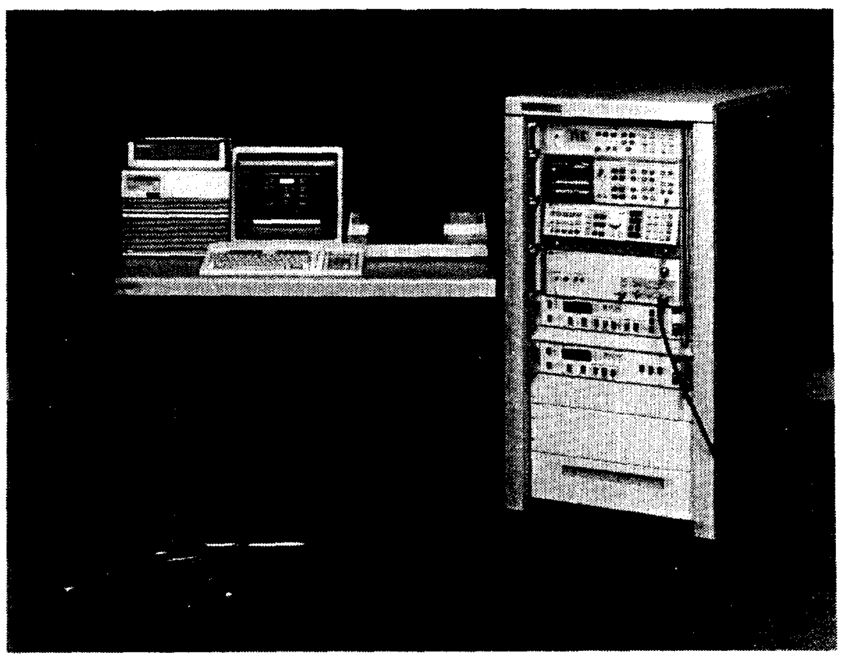
HEWLETT-PACKARD

Test Receiver/CISPR EMI Receiver Installation and Troubleshooting Guide



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HEWLETT PACKARD

Test Receiver/CISPR EMI Receiver Installation and Troubleshooting Guide *

*For use with:
HP 8573A and HP 8574A and other HP EMI Receivers containing
HP 8566B, HP 8567A, and HP 8568B Spectrum Analyzers
HP 85650A Quasi-Peak Adapter
HP 85685A RF Preselector
HP 85864C EMI Measurement Software
HP 85867A EMI Receiver Functions
HP 85870A Open-Site EMI Measurement Software
Peripherals such as:
HP 7470, 7550, 7447A and 7475A Plotters
ThinkJet and QuietJet Printer

1212 VALLEY HOUSE DRIVE, ROHNERT PARK, CALIFORNIA, U.S.A. 94928-4999

Manual Part Number [redacted] / Printed February 1988

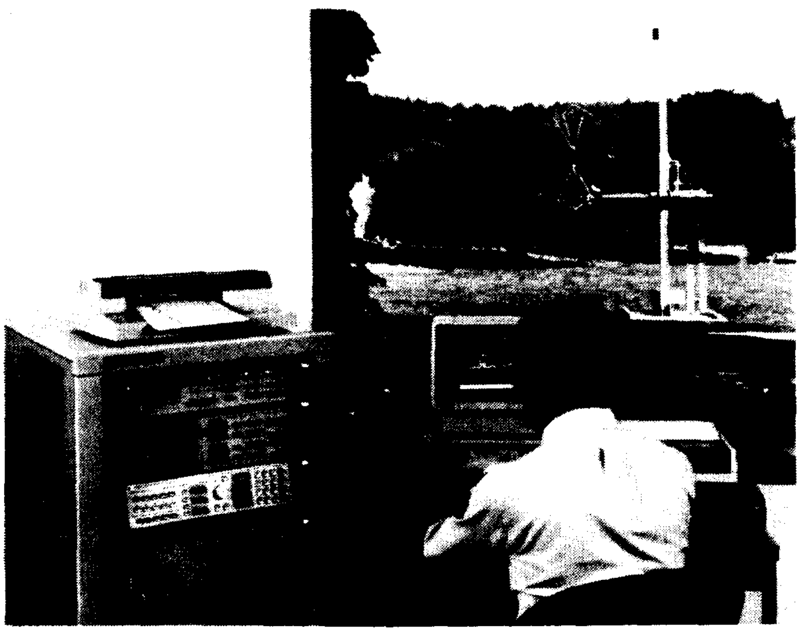

Figure 1. Hewlett-Packard EMI Receiver

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General Information

1. Installation

2. Receiver Calibration

3. Measurement Sensitivity

4. Operating Tips

Introduction

The HP Test Receiver/CISPR EMI Receiver Installation and Troubleshooting Guide tells you how to configure the receiver and includes some operating instructions. Additional information is available in the operating and programming manuals that are shipped with each instrument.

Chapter 1. Installation describes installation for receivers that consist of an HP 8566B, HP 8567A, or an HP 8568B Spectrum Analyzer; an HP 85650A Quasi-Peak Adapter; and an HP 85685A RF Preselecter.

Chapter 2. Receiver Calibration describes receiver calibration and verification.

Chapter 3. Measurement Sensitivity discusses sensitivity for MIL-STD measurements.

Chapter 4. Operating Tips suggests ways of familiarizing yourself with receiver operation.

Chapter 5. When the Unexpected Happens... contains tips for troubleshooting unexpected receiver operation.

Appendix A: Rack-Mount Installation describes rack mounting the instruments.

Appendix B: Guidelines for Using Spectrum Analyzers to Make Interference Measurements.

Appendix C: Sources and Further Reading.

SAFETY CONSIDERATIONS

Before operating this receiver, familiarize yourself with the safety markings on the instruments and the safety instructions in this manual. The receiver has been manufactured and tested in accordance with international safety standards. However, to ensure safe operation of the instruments and personal safety of the user, the cautions and warnings in this manual must be followed. Refer to the summary of safety information located at the end of this section.

SAFETY SYMBOLS

The following safety symbols are used throughout this manual and in the instrument. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

⚠ Instruction manual symbol. The instrument will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the instrument against damage. Location of pertinent information within the manual is indicated by use of this symbol in the table of contents.

Indicates dangerous voltages are present. Be extremely careful.

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

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

GENERAL SAFETY CONSIDERATIONS

WARNING

BEFORE THIS INSTRUMENT IS SWITCHED ON, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact. Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

WARNING

There are voltages at many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.

CAUTION

BEFORE THIS INSTRUMENT IS SWITCHED ON, make sure its primary power circuitry has been adapted to the voltage of the ac power source. Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

Chapter 1

INSTALLATION

Electrical Requirements

POWER REQUIREMENTS

An HP 8566B, HP 8567A, or HP 8568B Spectrum Analyzer requires a power source of 100, 120, 220, or 240 Vac, +5% -10%, 50 - 60 Hz. Power consumption is less than 400 volt-amperes.

An HP 85650A Quasi-Peak Adapter requires a power source of 100, 120, 200, or 240 Vac, +5% -10%, 48 - 66 Hz. Power consumption is less than 22 volt-amperes.

An HP 85685A RF Preselector requires a power source of 100, 120, 200, or 240 Vac, +5% -10%, 50 - 400 Hz. Power consumption is less than 105 volt-amperes.

LINE VOLTAGE AND FUSE SELECTION

WARNING

BEFORE SWITCHING ON ANY INSTRUMENT, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket provided with protective earth contact. Any interruption of the protective (grounding) conductor inside or outside the instrument, or disconnection of the protective earth terminal, can result in injury.

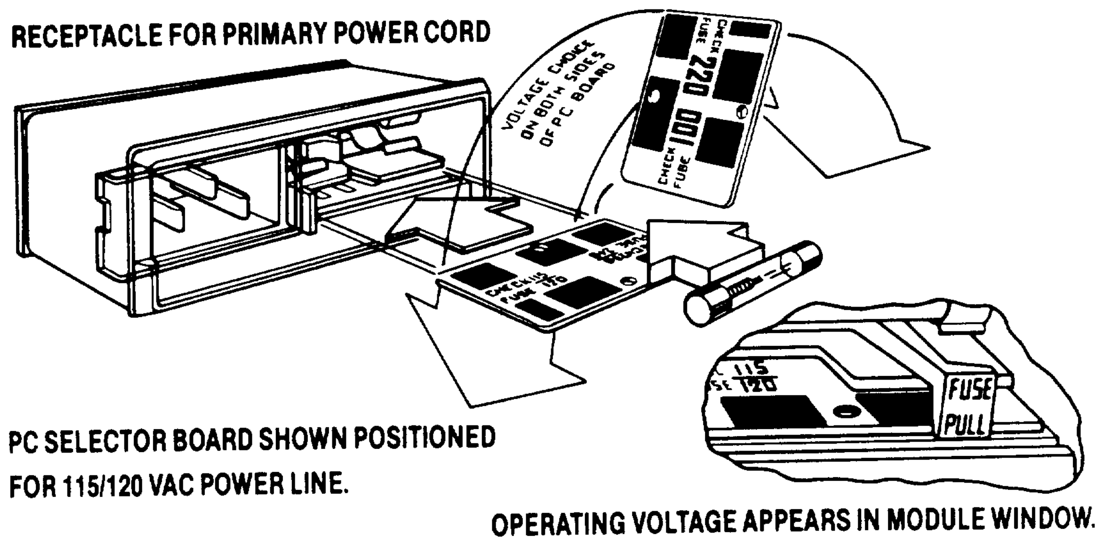
CAUTION

BEFORE SWITCHING ON ANY INSTRUMENT, make sure it is set to the voltage of the ac power source. Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

Select the line voltage and fuses as follows:

Determine the ac line voltage to be used.

1. If you have an HP 8566B, HP8567A, or HP 8568B Spectrum Analyzer, position the power line module PC Selector board (on the rear panel of each instrument section) to the correct line voltage, as shown in Figure 1-1. If the line voltage is not within the instrument requirements, connect a variable-ratio transformer (i.e., autotransformer) between the ac source and the spectrum analyzer. Check that the required fuses are installed in both instrument sections, as indicated in Table 1-1.



SELECTION OF OPERATING VOLTAGE

1. SLIDE OPEN POWER MODULE COVER DOOR AND PUSH FUSE-PULL LEVER TO LEFT TO REMOVE FUSE.
2. PULL OUT VOLTAGE SELECTOR PC BOARD. POSITION PC BOARD SO THAT VOLTAGE NEAREST ACTUAL LINE VOLTAGE LEVEL WILL APPEAR IN MODULE WINDOW. PUSH BOARD BACK INTO ITS SLOT.
3. PUSH FUSE-PULL LEVER INTO ITS NORMAL RIGHT-HAND POSITION.
4. CHECK FUSE TO MAKE SURE IT IS OF CORRECT RATING AND TYPE FOR INPUT AC LINE VOLTAGE. FUSE RATINGS FOR DIFFERENT LINE VOLTAGES ARE INDICATED BELOW POWER MODULE.
5. INSERT CORRECT FUSE IN FUSEHOLDER.

Figure 1-1. Spectrum Analyzer Voltage Selection

Table 1-1 Spectrum Analyzer Line Voltages and Appropriate Fuse Selections

Voltage	IF-Display Section	RF Section
100/120	2 amperes FAST BLO	4 amperes FAST BLO
220/240	1 ampere SLO BLO	2 amperes SLO BLO

WARNING

Power is still applied to the spectrum analyzer with the LINE switch in the STANDBY position. There is no OFF position on the LINE switch. To remove power from the instrument, you must remove the power cable from the rear of each instrument section.

2. If you have an HP 85650A Quasi-Peak Adapter, set the rear-panel, ac power level switches to the line voltage closest to the voltage measured. See Figure 1-2. The line voltage must be within +5% -10% of the voltage setting on the switch. If the line voltage is not within these limits, connect a variable-ratio transformer (i.e., autotransformer) between the ac source and the HP 85650A. Make sure the correct fuse is installed in the fuse holder. The required fuse rating depends on the ac line voltage and is indicated next to the fuse holder and in Table 1-2.

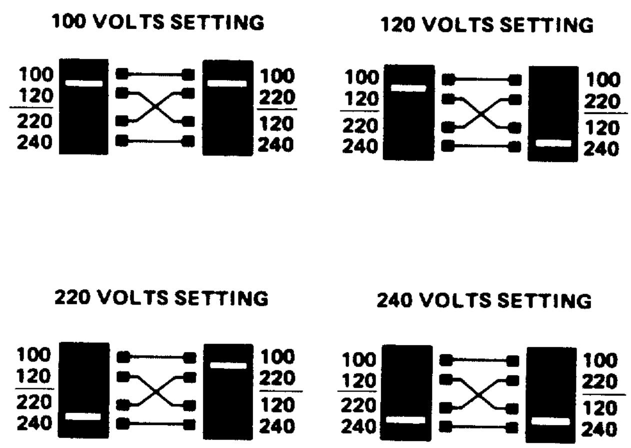


Figure 1-2. Quasi-Peak Detector Voltage Selection

Table 1-2 HP 85650A Line Voltages and Appropriate Fuse Selections

Voltage	Quasi-Peak Adapter
100/120	750 mA FAST BLO
220/240	500 mA FAST BLO

3. If you have an HP 85685A RF Preselector, set the rear-panel voltage selector switch to the correct line voltage. You must remove the voltage tumbler before rotating it to the desired voltage value. Refer to Figure 1-3. The line voltage must be within +5% -10% of the voltage setting. If the line voltage is not within these limits, connect a variable-ratio transformer (i.e., autotransformer) between the ac source and the HP 85685A. Make sure the correct fuse is installed in the fuse holder. The required fuse rating depends on the ac line voltage and is indicated in Table 1-3.

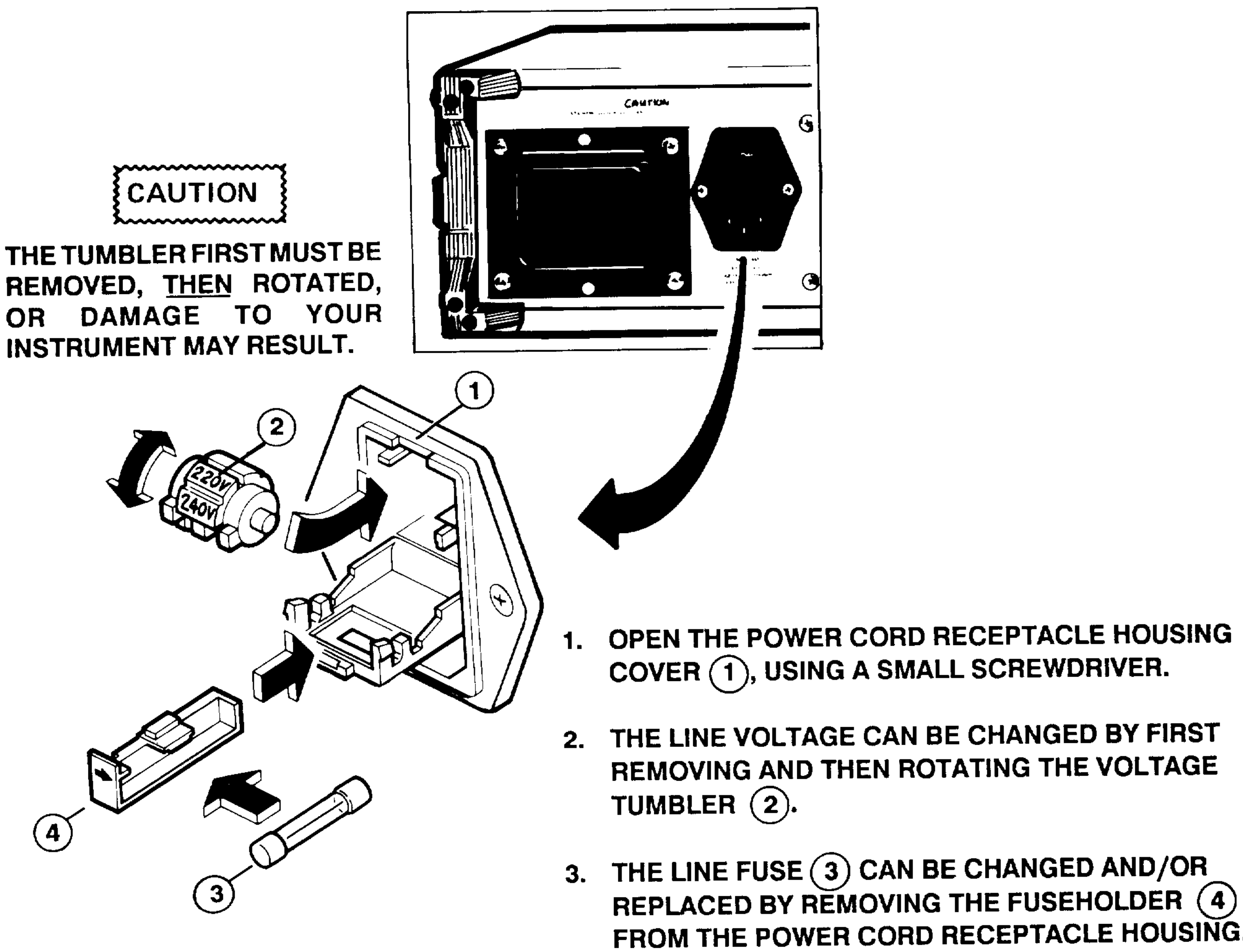


Figure 1-3. RF Preselector Voltage Selection

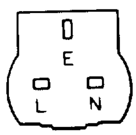
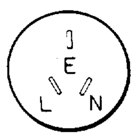
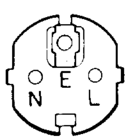
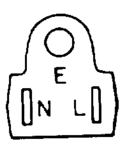
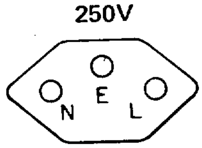
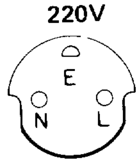
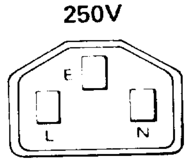
Table 1-3. HP 85685A Line Voltages and Appropriate Fuse Selections

Voltage	RF Preselector	HP Part Number
100/120	1 ampere SLO BLO	2110-0007
220/240	500 mA SLO BLO	2110-0210

POWER CABLES

In accordance with international safety standards, all instruments are equipped with three-wire ac power cables. Table 1-4 shows the types of plugs available on ac power cables supplied with Hewlett-Packard instruments.

Table 1-4. AC Power Cables and Plugs

Plug Type**	Cable HP Part Number	Plug Description	Cable Length cm (inches)	Cable Color	For Use In Country
250V 	8120-1351 8120-1703	Straight*BS1363A 90°	229 (90) 229 (90)	Mint Gray Mint Gray	Great Britain, Cyprus, Nigeria, Rhodesia, Singapore, So. Africa, India
250V 	8120-1369 8120-0696	Straight*NZSS198/ASC112 90°	201 (79) 221 (87)	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	Straight*CEE7-Y11 90°	201 (79) 201 (79)	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, United Arab Republic (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754	Straight*NEMA5-15P 90° Straight*NEMA5-15P	203 (80) 203 (80) 91 (36)	Black Black Black	United States Canada, Japan (100 or 200V), Mexico, Phillipines, Taiwan
	8120-1378 8120-1521 8120-1676	Straight*NEMA5-15P 90° Straight*NEMA5-15P	203 (80) 203 (80) 91 (36)	Jade Gray Jade Gray Jade Gray	
250V 	8120-2104	Straight*SEV1011 1959-24507 Type 12	201 (79)	Gray	Switzerland
220V 	8120-0698	Straight*NEMA6-15P			
250V 	8120-1860	Straight*CEEE22-VI			

* Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable, including plug.

** E = Earth Ground; L = Line; N = Neutral.

Firmware Requirements

If your Hewlett-Packard EMI Receiver instruments have just been purchased, you have the latest firmware revision for your instruments and will meet all firmware requirements. In this case, proceed to SYSTEM INTERCONNECTIONS. If your spectrum analyzer has been in use for some time, check its firmware revision date before assembling the receiver. The following describes how to identify the firmware revision dates of each spectrum analyzer model and gives each model's firmware requirements.

To identify the spectrum analyzer firmware revision date, switch the LINE switch from STANDBY to ON. The firmware revision date appears on the left side of the display, as in Figure 1-4. Firmware revisions for the HP 8566B, HP 8567A, and HP 8568B must have date codes of, or later than 29.9.86, 9.9.86, and 9.9.86 respectively. (NOTE: If you intend to use HP 85864C EMI Measurement Software and no HP 85685A RF Preselector in your system, firmware revisions may be 8.3.81, 4.6.85, and 8.7.79, respectively, or later.) For optimum manual performance, spectrum analyzer firmware may be updated to the latest version:

HP 8566B firmware, HP part number 85660-60270
HP 8567A firmware, HP part number 85670-60009
HP 8568B firmware, HP part number 85680-60197

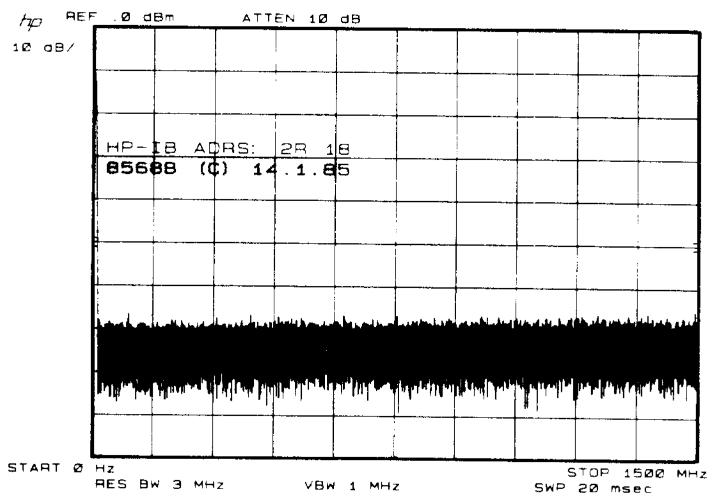


Figure 1-4. Spectrum Analyzer Firmware Revision Date

System Interconnections

WARNING

Most of the instruments that make up the EMI receiver are very heavy, especially the spectrum analyzer. To avoid injury to yourself or damage to the instruments, be careful when lifting or moving these instruments.

NOTE

The IF input/output and VIDEO input/output cables on the display section of the spectrum analyzer are only removed for connection of the IF and VIDEO ports to the HP 85650A Quasi-Peak Adapter. If the spectrum analyzer is used without the quasi-peak adapter, these cables must remain connected for the analyzer to operate. These connections are illustrated in Figure 1-12.

NOTE

The RF Preselector can be configured in several ways. The most common configuration is described here. A preselector configuration guide appears at the end of the Remote Operation section of the preselector Operating and Programming Manual.

IF YOU HAVE AN HP 85685A RF PRESELECTOR:

1. Fasten the lock links provided with the preselector to the top of the preselector, as in Figure 1-5.

CAUTION

When attaching the lock links, using screws other than the ones provided may cause damage to the preselector, resulting in costly repair. If replacement of these screws is necessary, be sure the replacements do not exceed the specified length.

NOTE

Failure to interlock the preselector and RF section of the spectrum analyzer can cause increased susceptibility to incident fields and higher line-related residuals.

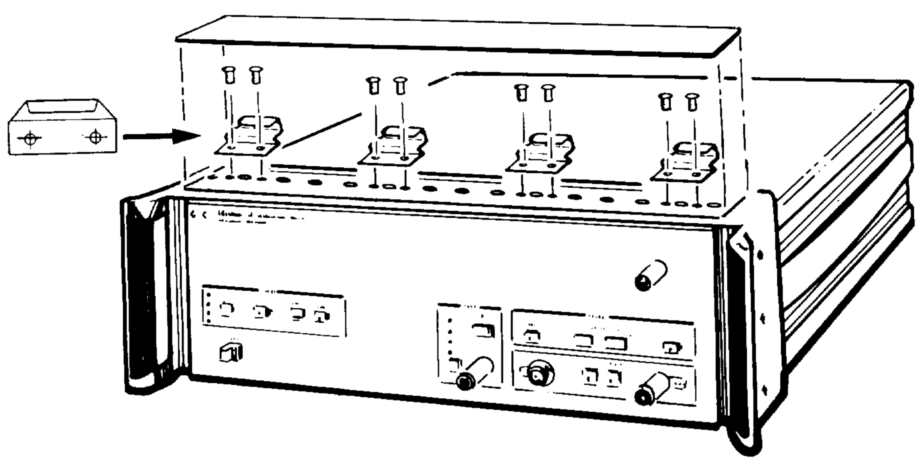


Figure 1-5. Lock Link Installation

2. Remove any HP-IB cables, line cords, and interconnect cables from the spectrum analyzer. Be sure that the preselector and spectrum analyzer power switches are OFF or in the STANDBY position.

3. Remove the spectrum-analyzer bottom feet and information card tray; the tray can no longer remain on the bottom of the spectrum analyzer. The card tray may be installed on the bottom of the preselector: remove the preselector front bottom feet, insert the information tray in the preselector rear bottom feet, then reattach the front feet.

4. Exchange the preselector's bottom rear lock feet with the spectrum analyzer's bottom rear feet, as in Figure 1-6.

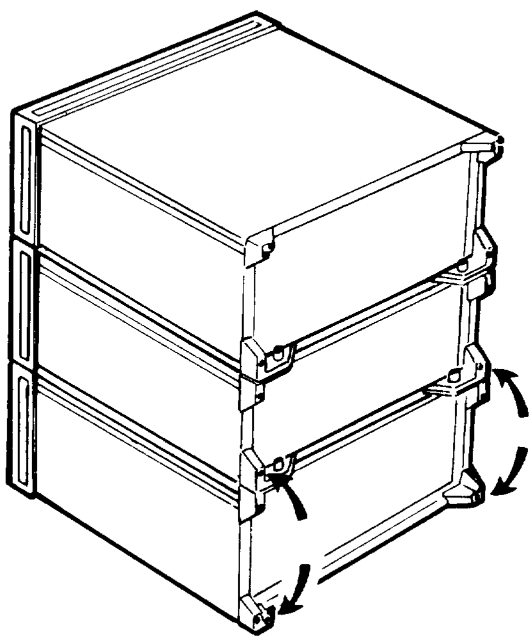


Figure 1-6. Lock Feet Installation

5. Install the preselector underneath the spectrum analyzer, using the lock links to secure the instruments.

6. Using the thumbscrews, secure the spectrum analyzer's new bottom rear lock feet to the preselector's top rear lock feet, as in Figure 1-7.

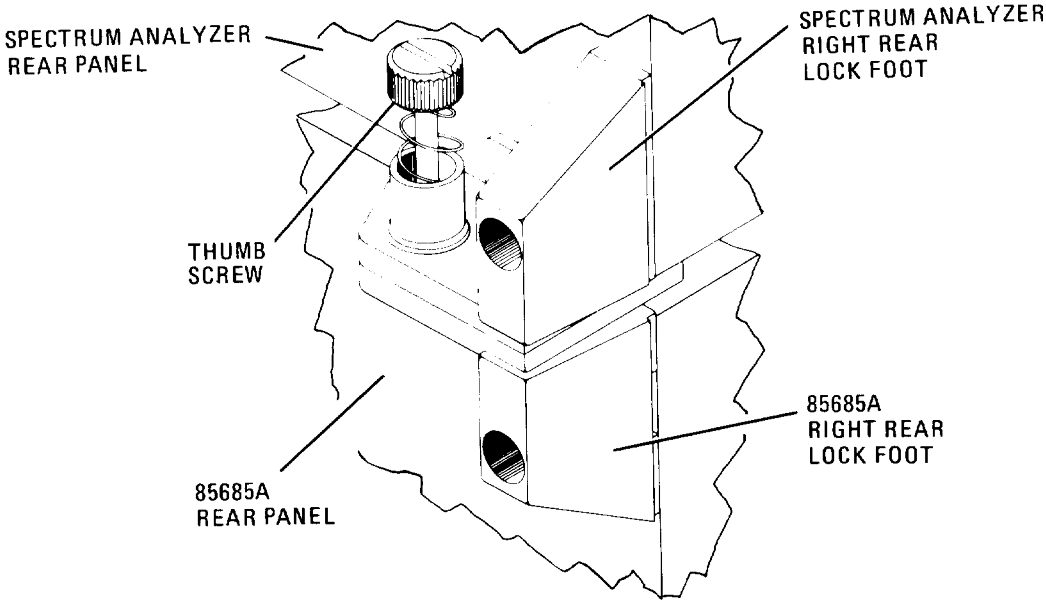


Figure 1-7. Securing the Lock Feet

7. Set the address switch on the preselector rear panel to 18, as in Figure 1-8.

NOTE

The private control bus, necessary for automatic spectrum analyzer/ preselector tracking, is active only when the preselector rear panel address switch is set to an EVEN number. We recommend address 18. Odd values deactivate the private bus. In that case, the preselector will not track the spectrum analyzer.

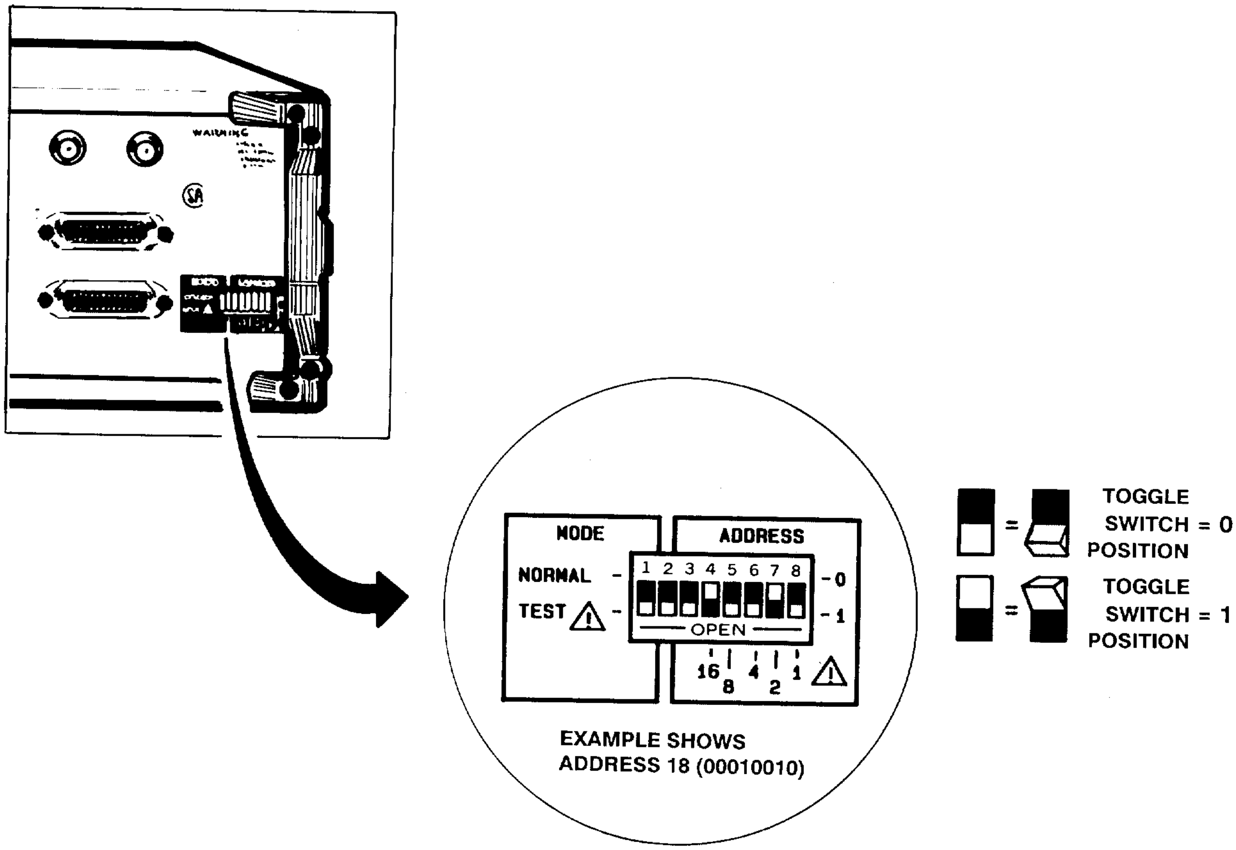


Figure 1-8. Preselector Address Selection

8. Attach the connector converter supplied with the preselector (HP part number 85685-80009) to the 50-pin jack on the spectrum analyzer.

9. Connect the 50-pin interconnect cable and the IF cable supplied with the spectrum analyzer to the RF and IF sections of the spectrum analyzer.

IF YOU HAVE AN HP 85650A QUASI-PEAK ADAPTER:

1. Remove the front-frame top trim from the spectrum analyzer (see Figure 1-9).

2. Fasten the lock links supplied with the quasi-peak adapter to the top of the spectrum analyzer frame, as in Figure 1-9.

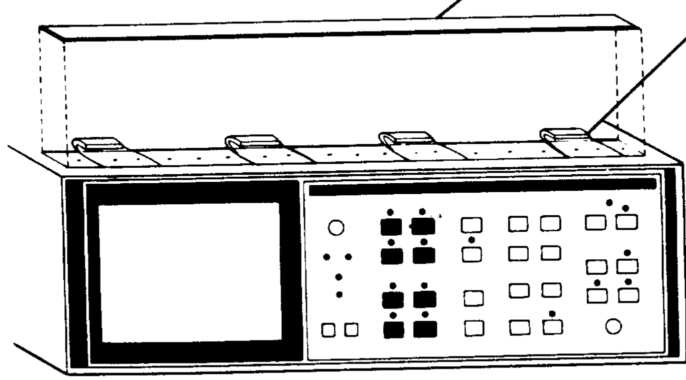


Figure 1-9. Installation of Lock Links on the Spectrum Analyzer

3. Interchange the two top rear lock feet on the quasi-peak adapter with the two top rear feet of the spectrum analyzer, as in Figure 1-10.

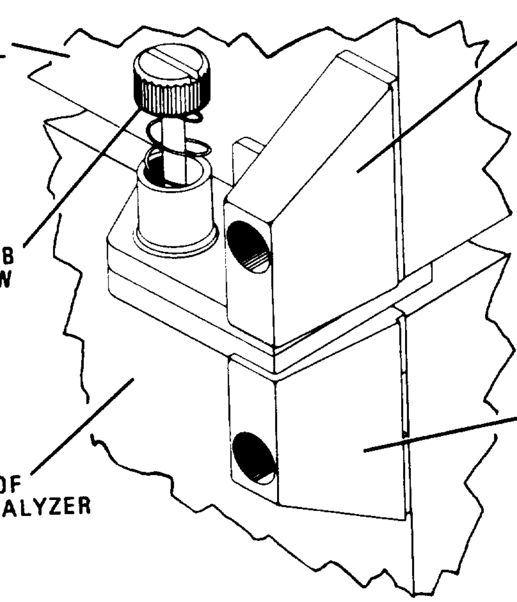
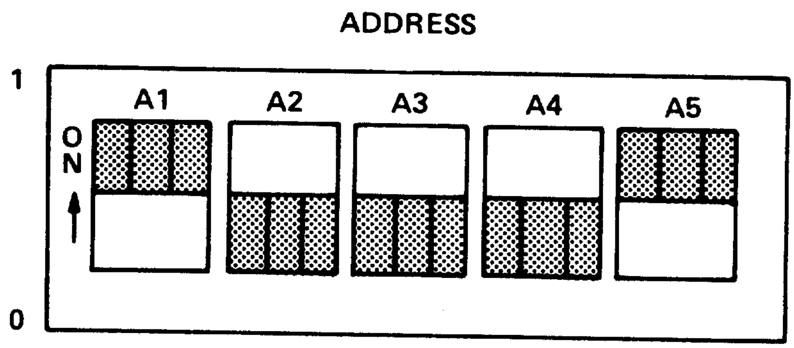


Figure 1-10. Installation of the Lock Feet

4. Install the quasi-peak adapter on top of the spectrum analyzer, using the lock links to secure the instruments.

5. Using the thumbscrews, secure the rear lock feet of the quasi-peak adapter to the rear lock feet of the spectrum analyzer.

6. Set the quasi-peak address to 17, as shown in Figure 1-11.



$A1 = 2^0 = 1$
$A2 = 2^1 = 2$
$A3 = 2^2 = 4$
$A4 = 2^3 = 8$
$A5 = 2^4 = 16$

FACTORY PRESET ADDRESS
$17_{10} = 10001_2$

Figure 1-11. Quasi-Peak Address Selection

For all instruments, refer to Figure 1-12 to complete the EMI receiver configuration, as described below:

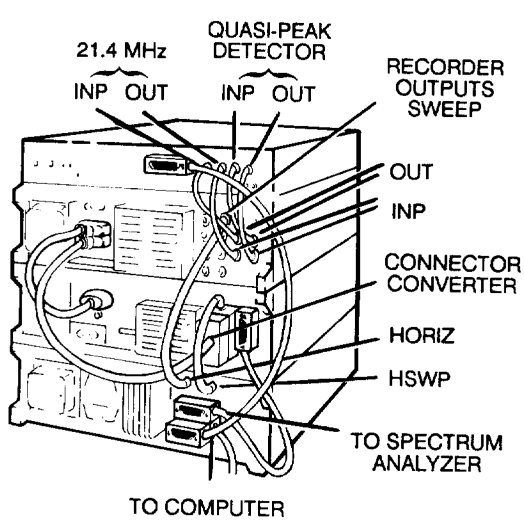


Figure 1-12 Receiver Cable Connections

If you have an HP 85685A RF Preselector, the following interconnect pieces are included with the preselector:

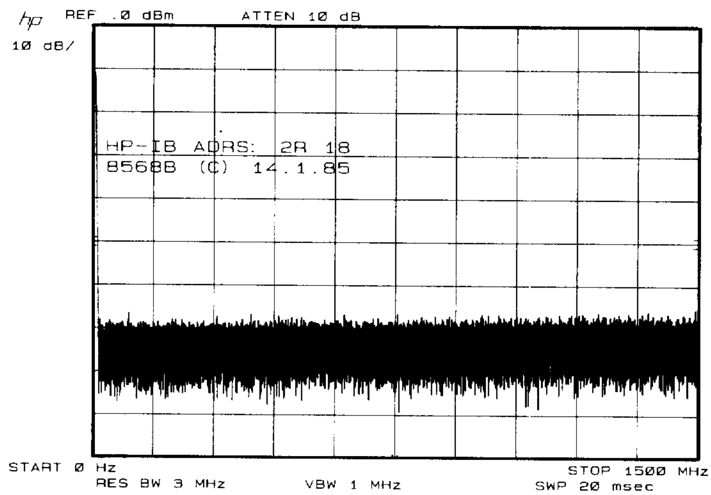
1 - cable assembly converter, HP part number 85685-60068
1 - 24" BNC-BNC coax cable, HP part number 8120-1839
1 - HP-IB cable (0.5 M), HP part number 10833D
2 - type N semi-rigid cables, HP part numbers 85685-20055 and 85685-20062

Connect the cable assembly converter provided with the preselector from the SMA connector on the connector converter to the preselector connector marked HSWP. Connect the BNC-BNC coax cable from the IF display RECORDER OUTPUT SWEEP connector to the preselector connector marked HORIZ. Connect the HP-IB cable from the spectrum analyzer HP-IB to the preselector private control bus marked "PRIVATE BUS (TO SPECTRUM ANALYZER)".

If you have an HP 85650A Quasi-Peak Adapter, connect the 21.4 MHz IF INP/OUT on the rear panel of the quasi-peak adapter to the IF OUT/INP on the rear panel of the spectrum analyzer. Connect the QUASI-PEAK DETECTOR INP/OUT on the rear panel of the Quasi-Peak Adapter to the VIDEO OUT/INP on the rear panel of the spectrum analyzer. For further discussion of adjustments which may be necessary to ensure proper operation of the quasi-peak adapter and spectrum analyzer, refer to HP Service Note 85650A-2. This service note is issued with the HP85650A Quasi-Peak Adapter Operation and Service Manual and should be followed to ensure that your EMI measurement system functions properly.

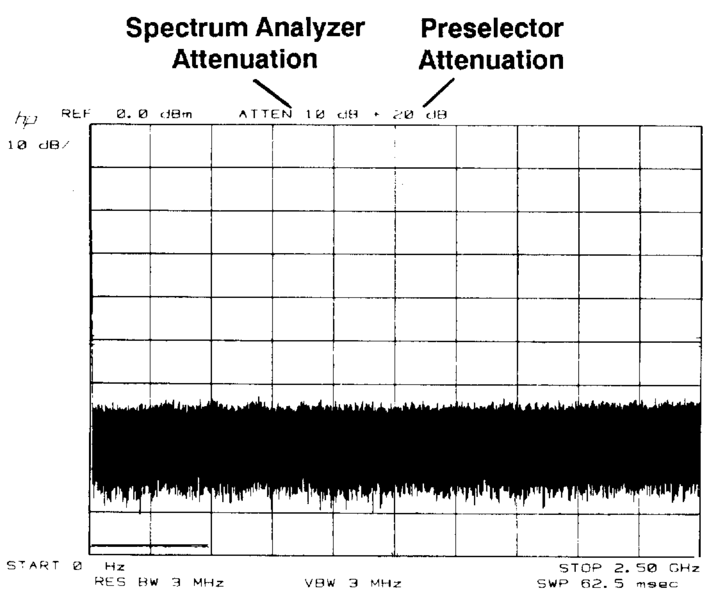
Connect an HP-IB cable from the rear panel of the quasi-peak adapter to the spectrum analyzer only if you are using HP 85867A EMI Receiver Functions (for manual operation).

For all instruments, install the line cords. Power up the spectrum analyzer. Note the address in the left portion of the display. If you are using an HP 85685A RF Preselector in your system, make sure the spectrum analyzer address is set to an address other than 21. If it is set to 21, to change the address press (SHIFT) P (ZOOM), enter the numeric value, and press (Hz). Continue to power up the HP 85650A Quasi-Peak Adapter and the HP 85685A RF Preselector. The spectrum analyzer display should resemble Figure 1-13(a) with no HP 85685A preselector in the system and Figure 1-13(b) with the preselector in the system. At this point, if you have only a spectrum analyzer and quasi-peak adapter and the spectrum analyzer display looks like Figure 1-13(a), continue to REMOTE/SOFTWARE CONFIGURATION or to the chapters in this manual on receiver calibration or operating tips. If Figure 1-13(a) and the display on the spectrum analyzer/ quasi-peak adapter receiver do not agree, check your rear-panel cable connections. Continue for more preselector information.



(a) without the HP 85685A

and



(b) with the HP 85685A.

Figure 1-13. Initial Receiver Display

If you have a preselector, note that the top of the display shows both the spectrum analyzer input attenuation and the preselector input attenuation, as in Figure 1-13(b). A line appears in the two divisions of the lower-left graticule on the screen. The line is associated with the preselector. This line indicates a frequency span over which the input is not preselected; reducing the span gives a completely preselected display. Both the displayed preselector attenuation and the line indicate that the preselector and spectrum analyzer are communicating.

NOTE

To preset the receiver, always press (INSTR PRESET) on the preselector and not on the spectrum analyzer. This ensures that the preselector is tracking the spectrum analyzer and that the display annotation is correct. Pressing (INSTR PRESET) on the spectrum analyzer uncouples the system and does not allow it to track properly.

As an additional check, press (⇧) three times to set the comb generator repetition rate to 1 MHz. On the spectrum analyzer, press (CENTER FREQUENCY) (2) (0) (0) (MHz) and (SPAN) (2) (0) (MHz). You will see an SRQ flash briefly on the spectrum analyzer display. Connect the comb generator output directly to the spectrum analyzer input. Verify that the comb teeth are relatively flat. Disconnect the comb generator output from the spectrum analyzer input. If you have an HP 8567A or HP 8568B, connect the type N semi-rigid cable (HP part number 85685-20055) from the preselector RF output to spectrum analyzer type N input. If you have an HP 8566B, use the semi-rigid cable, HP part number 85685-20062, instead. The resulting display should resemble Figure 1-14. If the SRQ remains or if the signals on the spectrum analyzer screen vary in amplitude, go to the section "What Is Wrong When the Display Looks Like. . .?" If the display agrees with Figure 1-14, continue to the section "SRQ 102."

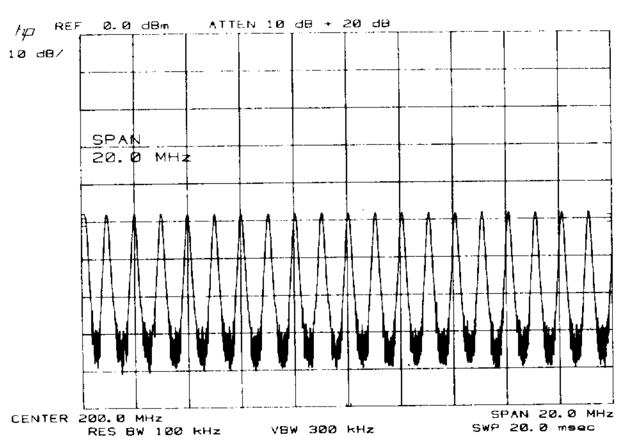


Figure 1-14. Preselector Comb Generator Display

What Is Wrong When the Display Looks Like. . .?

Set the receiver to the settings described in the previous paragraph. Refer to the following figures and suggestions for troubleshooting your receiver.

If "SRQ 102" remains on the screen as in Figure 1-15, press (NORMAL) on the preselector. Next, check the rear panel connections. If the problem persists, press (INSTR PRESET) on the preselector.

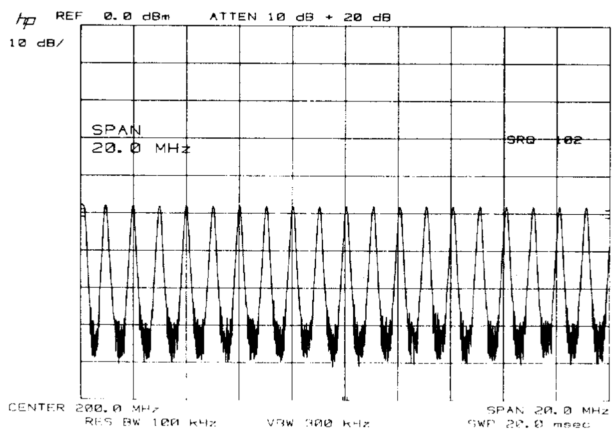


Figure 1-15. "SRQ 102" Remains on the Screen

If the comb generator signals roll off with increasing frequency, as in Figure 1-16, make sure that the BNC cable is connected from the preselector rear-panel connector marked "HORIZ" to the spectrum analyzer rear-panel connector marked "SWEEP RECORDER OUTPUT". If connected, make sure it is not shorted to ground. Finally, check that (LOWER LEFT) on the spectrum analyzer has not been pressed. (The lower-left function can disrupt tracking.)

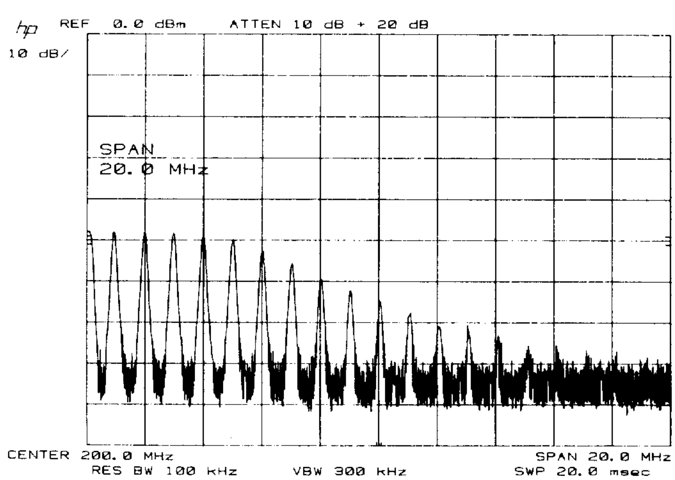


Figure 1-16. Comb Generator Decreasing in Amplitude

If the comb generator signals roll off less linearly with frequency than shown in Figure 1-17, check the HSWP rear panel cable connection.

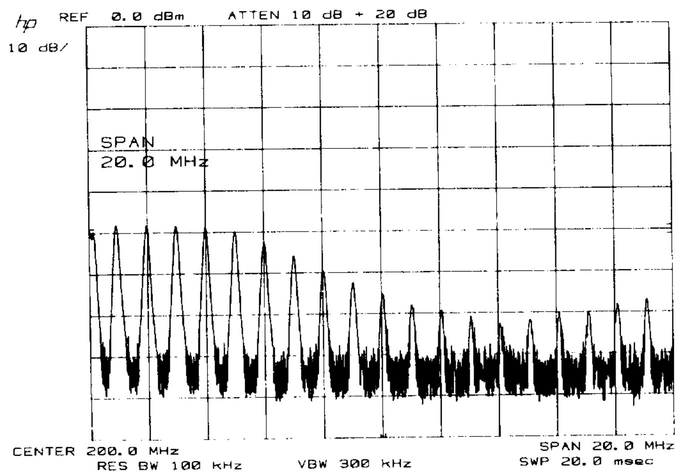


Figure 1-17. Comb Generator Decreasing in Amplitude Less Linearly

If the comb generator signals are low at the beginning of the sweep, as in Figure 1-18, check that (UPPER RIGHT) on the spectrum analyzer has not been pressed.

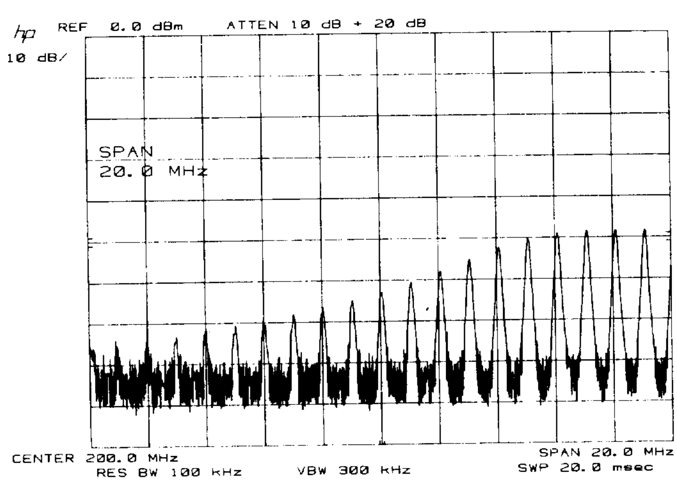


Figure 1-18. Comb Generator Increasing in Amplitude

If the comb generator signals rise and then fall in amplitude, as in Figure 1-19, or are simply not equal in amplitude, you may have pressed (INSTR PRESET) on the spectrum analyzer. Press (NORMAL) on the preselector to initiate tracking . Presetting the receiver also initiates tracking. We recommend that you use only the preselector's instrument preset function to preset the receiver; the spectrum analyzer's instrument preset function disables tracking.

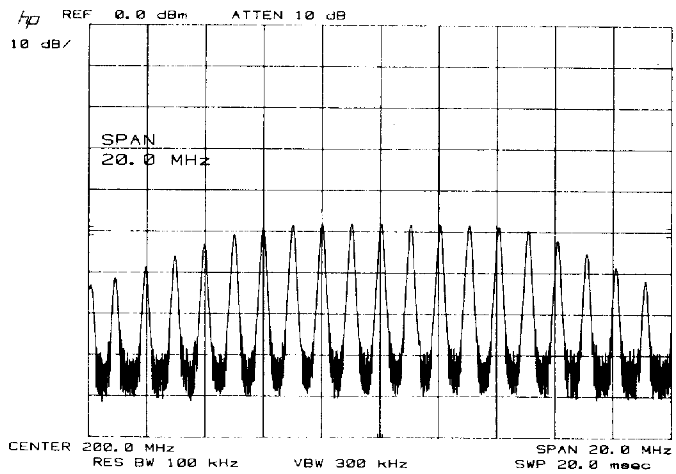


Figure 1-19. Comb Generator Rising and Falling in Amplitude

ADDITIONAL CHECKS

Be sure that the preselector address switch is set to 18 or to some even address.

Be sure that an HP-IB cable is connected from the spectrum analyzer HP-IB port to the preselector port marked "PRIVATE BUS (TO SPECTRUM ANALYZER)". If you suspect that the preselector comb generator is broken, connect it directly to the spectrum analyzer input for verification.

If no LEDs light in the front panel of the preselector, check the HP-IB connection between the preselector and the spectrum analyzer. If the preselector's front-panel LEDs flash three times, you may be in diagnostic mode. Make sure that the most significant bit on the address switch (i.e., the left-most toggle switch on the address switch) is set to zero.

SRQ 102

Whenever the spectrum analyzer changes frequency or span, "SRQ 102" flashes on the spectrum analyzer display. This is normal operation. The preselector must momentarily interrupt spectrum analyzer operation in order to read the new frequency or span settings. Once the preselector has the new data, the preselector adjusts its own settings to continue tracking the spectrum analyzer. Receiver operation then resumes. The interruption lasts approximately 0.2 - 0.8 seconds.

Preselector Private Control Bus

The preselector and spectrum analyzer communicate via the private control bus. The private control bus, connected from the spectrum analyzer HP-IB port to the preselector port marked "PRIVATE BUS (TO SPECTRUM ANALYZER)," provides access to the spectrum analyzer and allows the preselector to continually monitor the spectrum analyzer frequency settings. The preselector can then automatically track the spectrum analyzer. Do NOT connect computers and other devices to the private control bus or to the spectrum analyzer HP-IB (unless using HP 85867A EMI Receiver Functions, other downloadable programs, or a plotter for direct-plotter output. Instead, connect these devices to the preselector HP-IB port marked "TO COMPUTER." Note, too, that the preselector private control bus has an internal address of 21, which cannot be changed. Do not set the spectrum analyzer to this address.

NOTE

The private control bus is active only when the preselector rear panel address switch is set to an EVEN number. Odd values deactivate the private control bus.

If you wish to operate the receiver remotely, continue to "Remote/Software Configuration". The following chapters give information on calibration and operating tips.

Remote/Software Configuration

To operate the EMI receiver remotely using your own programs, connect a controller to the HP-IB marked "TO COMPUTER," located on the rear panel of the HP 85685A RF Preselector. If you do not have this preselector, connect the controller via HP-IB to the spectrum analyzer. If you have an HP 85650A Quasi-Peak Adaptor, connect the HP 85650A via HP-IB to the same port where you attached the controller. Refer to Figure 1-20. If desired, the preselector address may be changed to an odd value for remote operation; however, the preselector will have no means of tracking the spectrum analyzer. You must keep track of the frequency yourself. You also connect both the preselector and spectrum analyzer to the computer via HP-IB. This is discussed further in the Remote Operation section of the preselector operating and programming manual.

For information on programming the receiver, refer to the following manuals:

* HP 8566B Spectrum Analyzer Operating and Programming Manual, HP part number 08566-90001
* HP 8567A Spectrum Analyzer Operating and Programming Manual, HP part number 08567-90001
* HP 8568B Spectrum Analyzer Operating and Programming Manual, HP part number 08568-90001
* HP 85685A RF Preselector Operating and Programming Manual, HP part number 85865-90001
* HP 85650A Quasi-Peak Adapter Operation and Service Manual, HP part number 85650-90001

NOTE

The following discusses peripheral configuration when HP 85867A, HP 85864C, or HP 85870A Software is used. You may find this information useful for other remote operation.

SOFTWARE CONFIGURATION

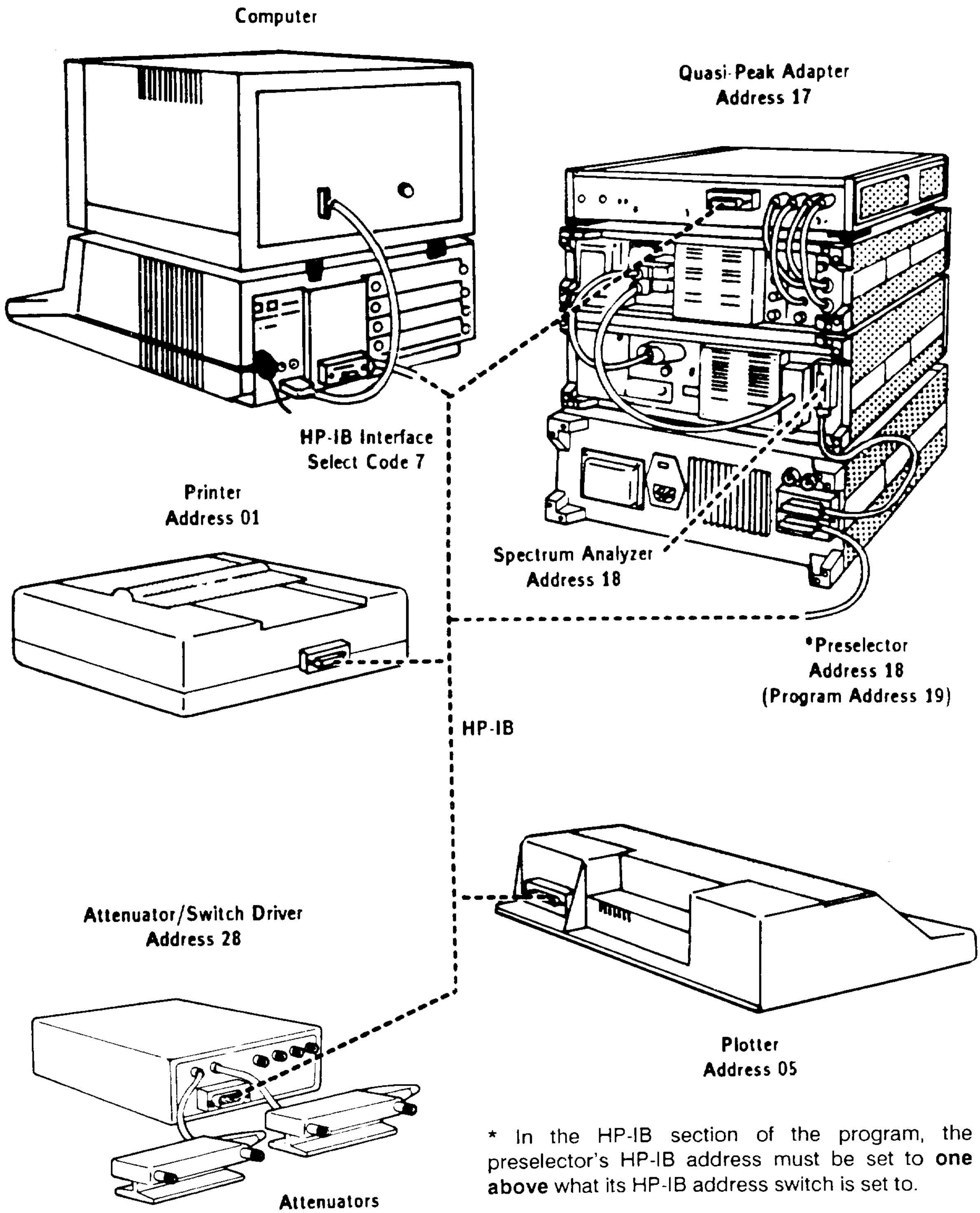
Figure 1-20 shows a typical system configuration for use with the HP 85864C EMI Measurement Software. Figure 1-21 shows a typical configuration for use with HP 85867A EMI Receiver Functions and other downloadable programs. (After installing the HP 85867A software, be sure to remove the computer or set the computer HP-IB state to local. Any transmissions on the computer port of the HP 85685A may disable software operation.) Figure 1-22 shows a typical configuration for use with HP 85870A Open-Site EMI System Measurement Software. For detailed lists of compatible computers and peripherals, consult the Operation Manual for your software.

Along with making the appropriate HP-IB connections, be sure to select the correct addresses for each component. A check list of addresses follows:

Computer:	Select code 7
Spectrum Analyzer:	18
Quasi-Peak Adapter:	17
Preselector:	18 (programming address: 19)
Plotter:	05
Printer:	01
Attenuator/Switch Driver:	28
Antenna Tower Control Unit:	08
Turntable Control Unit:	09

Note that the antenna tower and turntable are connected to their respective control units and it is these control units that are connected to the receiver system via HP-IB.

You now are ready to install your software; refer to the software operation manual.



* In the HP-IB section of the program, the preselector's HP-IB address must be set to **one above** what its HP-IB address switch is set to.

Figure 1-20. EMI Measurement Software Configuration

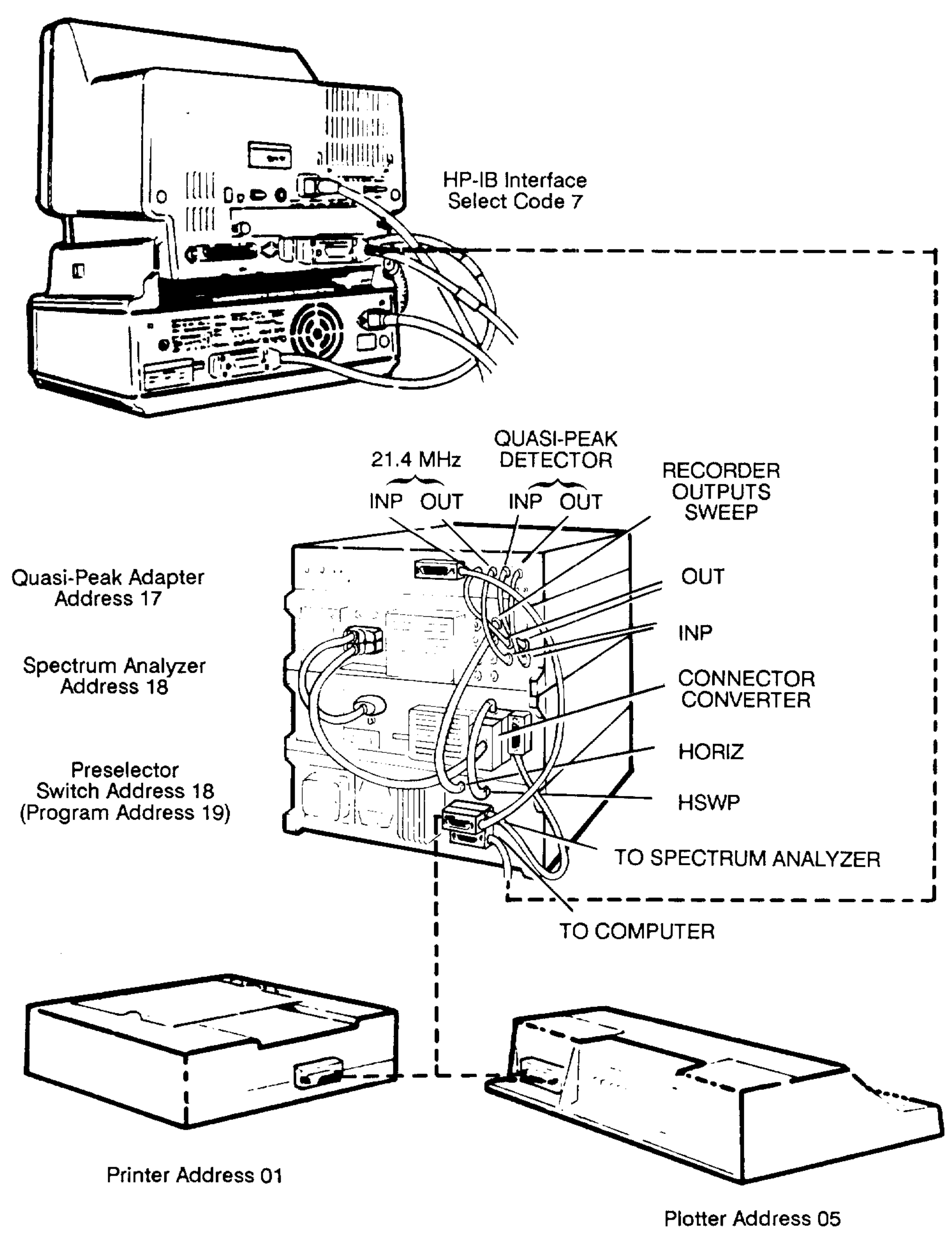


Figure 1-21. EMI Receiver Functions Configuration

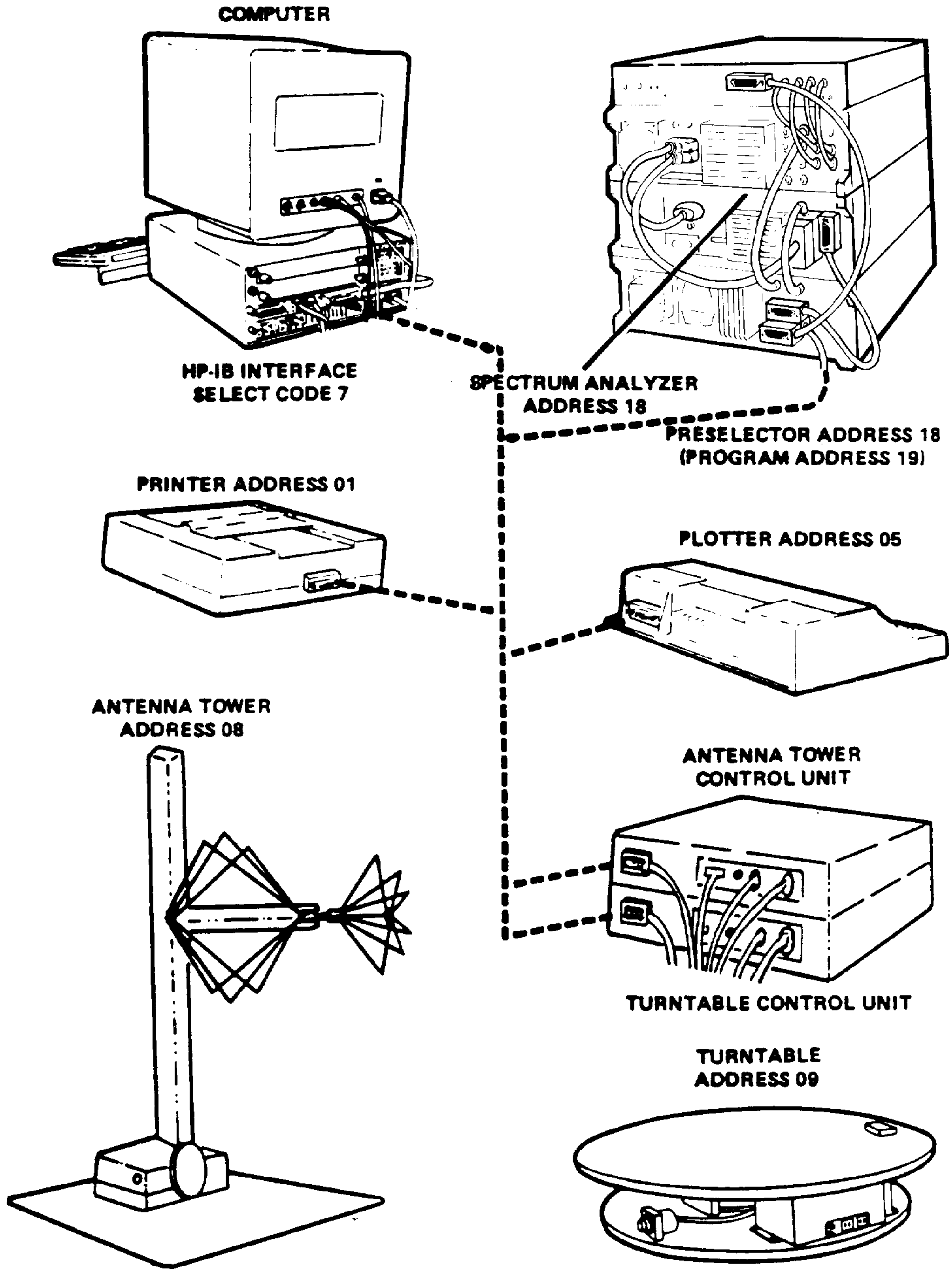


Figure 1-22. Open-Site EMI Software Configuration

Chapter 2

RECEIVER CALIBRATION

This chapter describes how to calibrate the receiver and how to verify that the calibration meets CISPR requirements. It also includes tips on maintaining calibration.

Calibrate the Receiver

A test receiver consisting of an HP 8566B, HP 8567A, or HP 8568B Spectrum Analyzer; an HP 85650A Quasi-Peak Adapter; and an HP 85685A RF Preselector meets the EMI receiver recommendations of CISPR Publication 16.[1] Proper calibration of this test receiver ensures amplitude accuracy over the frequency range of 9 kHz to 1 GHz. The procedures below describe how to calibrate absolute amplitude and flatness and verify this calibration. Extensive amplitude accuracy verification procedures are available in the preselector Performance Verification Manual, HP part number 85685-90036.

For the amplitude calibration procedure below, if you do not have an HP 85650A Quasi-Peak Adapter, omit the instructions that pertain to the quasi-peak adapter.

Amplitude calibration consists of two parts: (1) calibrating the spectrum analyzer absolute amplitude and (2) calibrating the flatness vs. frequency of the entire receiver. The spectrum analyzer amplitude calibration adjusts any gain error introduced by the preselector.

The second part of calibration uses the preselector comb generator and calibrates flatness for the entire receiver to 1 GHz. Run this routine to achieve amplitude accuracy.

NOTE

Whenever possible, select a cable for calibrating that you can also use for making measurements. The system is calibrated with respect to the end of the cable that was connected to the output port of the comb calibrator. The use of other cables may introduce an amplitude error.

SPECTRUM ANALYZER AMPLITUDE CALIBRATION

To calibrate the spectrum analyzer amplitude refer to steps 1 - 4:

1. Connect the spectrum analyzer CAL OUTPUT to the preselector input 2. Press (ENABLE) (BYPASS) on the preselector. Press (BYPASS) on the quasi-peak adapter.

2. Connect the preselector output to the spectrum analyzer input corresponding to the frequency of the calibrator. If you use the low-frequency input on the HP 8568B, use a BNC type cable in place of the N type hard cable supplied with the preselector.

[1] CISPR Publication 16 is the *Comite International Special des Perturbations Radioelectrique* specification for radio interference measuring apparatus and measurement methods.

3. Press (RECALL) (8) on the spectrum analyzer. Adjust AMPTD ADJ on the front panel for a -10.00 dBm ±0.02 dB marker amplitude reading.

4. Press (RECALL) (9) on the spectrum analyzer. Adjust FREQ ZERO (except on the HP 8567A) on the front panel for maximum signal amplitude.

RECEIVER FLATNESS CALIBRATION

This procedure calibrates flatness for the entire receiver to 1 GHz. It improves amplitude accuracy across a given frequency range. It is important that steps 1 - 4 above be completed first.

To calibrate the receiver, complete steps 1 and 2 below:

1) Press (NORMAL) on both the quasi-peak adapter and the preselector.

2) Remove CAL OUT from the preselector input. Select the desired CISPR band and appropriate instrument settings from Table 2.1, then set the spectrum analyzer, quasi-peak adapter, and preselector to these settings. Press the spectrum analyzer (LIN) key. Connect the comb generator OUTPUT to the preselector input that corresponds to the chosen frequency range. Press the preselector CAL SEQ (START). The preselector calibration is complete when the spectrum analyzer has been set to the initial frequency settings.

The above procedure also applies to flatness calibration for MIL-STD measurements. However, instead of using settings from Table 2-1, select the resolution bandwidth and log display to be used for a measurement, then start the preselector calibration sequence.

Table 2-1. Calibration Settings for CISPR-based Emission Measurement

Instrument Settings	CISPR BAND[1]		
	B	C	D
Frequency Range[2]	0.15 - 30 MHz	30 - 300	0.3 - 1 GHz
Quasi-Peak Bandwidth[3]	9 kHz	120 kHz	120 kHz
Quasi-Peak Detector	OFF	OFF	OFF
S.A. Bandwidth	100 kHz	1 MHz	1 MHz
S.A. Video Bandwidth	1 kHz	3 kHz	3 kHz
S.A. Input Attenuator	10 dB	0 dB	0 dB
Preselector	20 dB	10 Db	10 dB
Preselector Input	INPUT 1	INPUT 2	INPUT 2

[1] For CISPR band A (10-150 kHz) spectrum analyzer calibration is adequate to ensure ±2dB amplitude accuracy.

Verify Calibration

You can verify that calibration meets CISPR Publication 16 requirements using absolute and relative pulse-response measurements. The following discusses independent-source methods for verifying calibration.

QUICK ABSOLUTE MEASUREMENT VERIFICATION OF CW SIGNALS

This method of absolute measurement involves connecting a continuous-wave (cw) signal source with a known signal amplitude to the receiver input (i.e., preselector input 1 or 2). The difference between the source amplitude and the amplitude measured on the receiver display is the amplitude error. This method is simple, but it is only as accurate as the amplitude of the source. Since cw sources often vary by as much as ± 1 dB from the selected amplitude, verify the amplitude of the power source before verifying receiver calibration. For example, first check the source with a power meter; or, use a power splitter to connect both the receiver and the power meter to the source, then measure the amplitude error over a range of frequencies. Using the power splitter may require power levels between -20 dBm and 0 dBm to the power meter (lower power levels may be used if the power meter is accurate in low-amplitude ranges). The balance of the splitter must also be taken into account.

ABSOLUTE AMPLITUDE AND RELATIVE PULSE-RESPONSE MEASUREMENT VERIFICATION

This method uses either a pulsed RF generator or a CISPR pulse generator. If you use a pulsed RF generator, follow the pulse tests provided in the Performance Tests section of the HP 85650A Quasi-Peak Adapter Operation and Service Manual. A CISPR pulse generator uses very large amplitude pulses. To protect the front-end of the spectrum analyzer, input CISPR pulses into the HP 85685A RF Preselector only. You must verify that the receiver is operating in its linear range (i.e., not in overload). Use a minimum of 30 dB preselector attenuation and either 0 dB or 10 dB attenuation in the spectrum analyzer; use the 3 dB linearity check to verify constant amplitude for the selected attenuation. Further information follows on the receivers normal response to pulses.

Normal Response of the Receiver to Pulses

ABSOLUTE AMPLITUDE RELATIONSHIP

Table 2-2 shows the values used in observing receiver response to pulses. The response of the receiver to pulses of *a* μVs (microvolt second) having a uniform spectrum up to at least *b* MHz, repeated at a frequency of *c* Hz shall, for all frequencies of tuning, be equal to the response to an unmodulated sine-wave signal at the tuned frequency having an e.m.f of r.m.s value 2 mV (66 dB(μV)) from a signal generator having the same source impedance as the pulse generator.

It follows that if this source impedance is equal to the input impedance of the receiver, the r.m.s. value of the signals at the input to the measuring apparatus will be 1 mV (60 dB $\pm$1.5 dB (μV)).

Table 2-2. Frequency and Amplitude Constants for CISPR Bands

Band	a(μVs)	b(MHz)	c(MHz)	Notes
A	13.5 ±1.5	0.15	25	1 and 2
B	0.316	30	100	2
C	0.044	300	100	2
D	0.044	1000	100	2

[1] The value 13.5 μVs is an experimental value with a tolerance of ±1.5 dB.
[2] A tolerance of ±1.5 dB is allowed on the sine-wave voltage levels prescribed above.

VARIATION WITH REPETITION FREQUENCY (RELATIVE PULSE RESPONSE)

The response curve for a particular receiver shall lie between the limits defined in Table 2-3.

Table 2-3. Pulse Amplitudes of Varying Repetition Rates for CISPR Bands

Repetition Frequency (Hz)	Relative Equivalent Level of Pulse Using Peak and Quasi-Peak Detection		
	Band A[1] Quasi-Peak (Peak)	**Band B** Quasi-Peak (Peak)	**Bands C and D** Quasi-Peak (peak)
1000	--	+4.5 ±1.0 (+2.0)	+8.0 ±1.0 (+3.9)
100	+4.0 ±1.0 (+2.1)	0 (reference)(+6.5)	0(reference)(+11.9)
60	+3.0 ±1.0 (+3.1)	--	--
25	0 (reference)(+6.1)	--	--
20	--	-6.5 ±1.0 (+13.0)	-9.0 ±1.0 (+20.9)
10	-4.0 ±1.0 (+10.1)	-10.0 ±1.5 (+16.5)	-14.0 ±1.5 (+25.9)
5	-7.5 ±1.5 (+13.6)	--	--
2	-13.0 ±2.0 (+19.1)	-20.5 ±2.0 (+27.0)	-26.0 ±2.0 (+37.9)
1	-17.0 ±2.0 (+23.1)	-22.5 ±2.0 (+29.0)	-28.5 ±2.0 (+40.4)
Isolated Pulse	-19.0 ±2.0 (+25.1)	-23.5 ±2.0 (+30.0)	-31.5 ±2.0 (+43.4)

[1] It is not possible to specify a definite response above 100 Hz in Band A because of the overlapping of the pulses in the intermediate frequency amplifier.

Maintaining Calibration

Measurement accuracy of the EMI receiver is very stable in laboratory environments. When the temperature varies, recalibrate using the internal comb generator. Performing this calibration weekly is adequate. Be aware that calibration data is lost when power is shut off. (A method below describes how to store and reload calibration data.) If calibration data is in the preselector, recalibration runs very quickly, provided there has been no significant change in the system. Because of its brevity, this routine can be handy as a system self-test. If the EMI receiver has just been powered up, allow the receiver to warm up for about one hour before performing calibration.

Calibrating the entire CISPR radiated band (30 MHz - 1000 MHz) using the automatic calibration sequence takes about 5 minutes for the first calibration. If you want to make measurements in only a portion of a CISPR band, you may calibrate only that portion. Simply select the desired frequency range before activating the preselector calibration sequence. Using this method, you can calibrate a portion or several portions of a single CISPR band without running calibration for the entire band. In addition, you can "spot check" a frequency or smaller area within a range. Note, however, that at the endpoints of the smaller area an amplitude discontinuity in calibration may occur within the larger range. To prevent this, calibrate using the same cable and limit changes in resolution bandwidth, spectrum analyzer input attenuation, and log amplitude settings.

You may want to store and reload calibration data; the method below shows how. Using this method, multiple sets of calibration data can be stored, one for each range of temperatures. You may want to try this to discover the calibration data offset at your site.

Two following routines illustrate how to query the preselector for calibration data and send the data as a string to the computer. The data then can be stored on a disc. A third routine illustrates sending data from the computer to the preselector. Although you may want to recalibrate the receiver, placing previous data in the preselector reduces by several minutes the time required to run the calibration sequence. For more information on data transfer commands, refer to the commands CALDATA and CALDATAB in the preselector's operating and programming manual.

Example 1:
This example transfers data in standard ASCII format.

```
10    ASSIGN @Rfps TO 719
20    INTEGER Caldata(1:226)
30    OUTPUT @Rfps; "CALDATA?;"
40    ENTER @Rfps;Caldata(*)
50    END
```

Example 2:
This example transfers each calibration point as two data bytes.

```
10    ASSIGN @Rfps TO 719
20    ASSIGN @Rfps_bin TO 719; FORMAT OFF
30    INTEGER Caldata(1:226)
40    OUTPUT @Rfps;"CALDATAB?;"
50    ENTER @Rfps_bin;Caldata(*)
60    END
```

Example 3:
This example sends the data from a computer array to the preselector. The example uses the command "CALDATA," but CALDATAB works as well, provided you insert line 20 from Example 2 into the program. Note, too, that lines 30 and 40 are used here only to supply the array "Caldata" with values to send to the preselector. Be sure to omit these lines and insert a procedure that retrieves stored calibration data.

```
10    ASSIGN @Rfps TO 719
20    INTEGER Caldata(1:226)
30    OUTPUT @Rfps;"CALDATA?;"
40    ENTER @Rfps;CALDATA(*)
50    OUTPUT @Rfps;"CALDATA;"
60    OUTPUT @Rfps;Caldata(*)
70    END
```

Chapter 3

MEASUREMENT SENSITIVITY

This chapter discusses elements that affect measurement-system sensitivity. It also describes how to establish the sensitivity required to successfully measure to MIL-STD emmission levels and how to compute impulse bandwidth correction factors using HP 85864C EMI measurement software. Unlike commercial regulations, which require that specific bandwidths be used in the frequency ranges of interest, most of the tests in MIL-STDs 461A/B/C and 462 make no mention of required bandwidths. The process of determining which instrument settings will result in optimum sensitivity is therefore more involved for MIL-STD measurements than for commercial measurements. Because MIL-STD procedures require that the measurement-system noise floor be a minimum of 6 dB below the test limit, it is strongly recommended that you make certain the instrument settings you choose will result in sufficient sensitivity before performing a measurement.

What Affects System Sensitivity?

Several elements affect measurement sensitivity: the transducer characteristics, preamplifier gain and noise figure, spectrum anlayzer attenuation, preselector attenuation, and resolution bandwidth. Each of these is described below.

TRANSDUCER FACTORS

Various types of antennas, current probes, and other devices are used as transducers in EMI testing. They generate a voltage at their output which is proportional to the input we are trying to measure, such as radiated field strength (generally measured in dB μA). The relationship between the transducer's input and output voltage is called the transducer factor. This transducer factor must be added to the voltage measured on the EMI receiver to obtain the equivalent field strength or current reading for comparison to the applicable test limit. In Figure 3-1, we can see the effect of the transducer factor on system sensitivity. The top trace shows the noise floor with transducer factors entered in. The lower trace shows the noise floor without transducer factors.

PREAMPLIFICATION

Overall system sensitivity can be improved by adding a high-gain, low-noise preamplifier in front of the spectrum analyzer input. If the HP 85685A RF Preselector is used in your system, no additional preamplification is necessary, because the preselector has a built-in 20 dB preamplifier. In general, most commercial and military test limits are low enough that either the HP 85685A RF Preselector or a preamp, such as the HP 8447D, must be included in the receiver system to obtain the necessary sensitivity.

ATTENUATION

Every 10 dB increase in spectrum analyzer or preselector attenuation decreases the receiver's sensitivity by 10 dB. Therefore, to achieve the best sensitivity, use the minimum amount of attenuation necessary to prevent receiver overload or gain compression (see Chapter 4 and Appendix B). If an HP 85685A RF Preselector is used in your system, be sure to limit spectrum analyzer attenuation to 0 or 10 dB. To adjust receiver input attenuation, use the preselector attenuator instead. To adjust the spectrum analyzer input

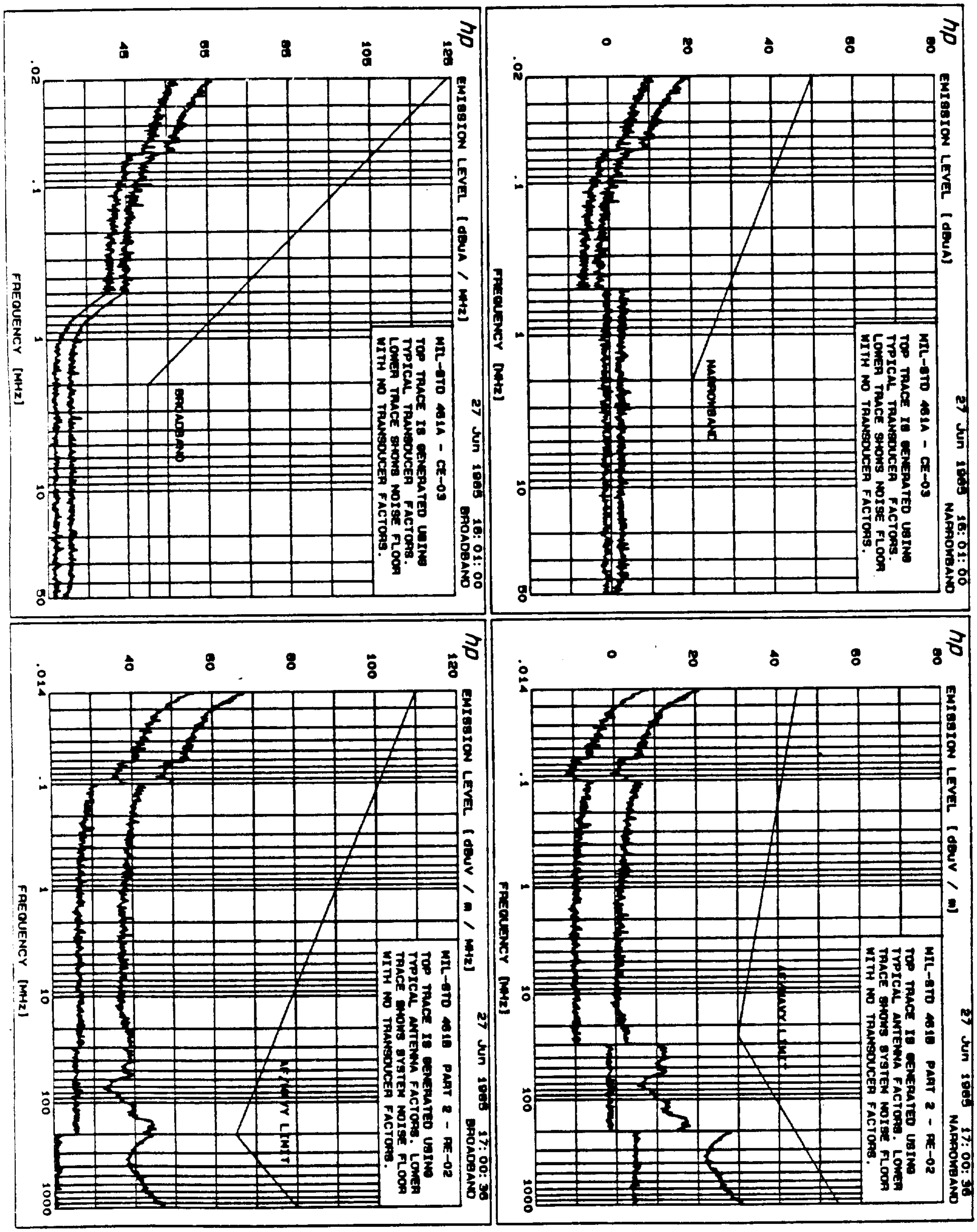


Figure 3-1. Transducer effect on system sensitivity

attenuation to 0 dB, press (ATTENUATION) (0) (dB). Pressing the (↓) key will decrease spectrum analyzer attenuation only down to 10 dB.

CABLE LOSSES

Cables of appreciable length placed ahead of the receiver input, such as a cable between the antenna and the preselector, can introduce several dB of loss. This loss should be accounted for, as it is equivalent to adding attenuation in front of the receiver. Cable insertion loss can be measured with a spectrum analyzer using a tracking generator or a signal generator as a source.

RESOLUTION BANDWIDTH

The system sensitivity is also a function of the resolution bandwidth of the receiver. A 10X increase in resolution bandwidth will cause the noise floor of the receiver to increase by a factor of 10 dB. Stated mathematically,

$$\Delta \text{ noise floor (dB)} = 10\log(BW2/BW1),$$

where BW1 and BW2 are the two different noise-power bandwidths chosen. This relationship holds true for broadband, uncorrelated noise. Thus, when narrowband signals are viewed on the display, reducing the resolution bandwidth will cause the noise floor to drop, thereby improving the signal-to-noise ratio. However, resolution bandwidth also affects the receiver's sweep time. The HP 8573A and 8574A EMI Receivers use synchronously-tuned filters which have the characteristic that the sweeptime is inversely proportional to the square of the bandwidth, as shown in this equation:

$$\text{sweep time} = K * SPAN/BW^2,$$

where K is a constant of proportionality. Therefore, a 10X decrease in bandwidth causes the EMI receiver to sweep 100 times slower. Because of this trade-off between sensitivity and sweep time, when narrowband signals are measured, it is desireable to use the widest bandwidth possible that will still give sufficient sensitivity. "Sufficient" sensitivity generally means that the noise floor must be at least 6 dB and preferably 10 dB or more below the test limit.

One additional fact that must be considered when you decide on the proper bandwidth to use for MIL-STD measurements is that at low frequencies, the local oscillator (LO) feedthrough may make it necessary to use a narrower resolution bandwidth than would otherwise be needed. For example, in an RE-02 test which starts at 14 kHz, you cannot use a 30 kHz filter at the start frequency even though the receiver noise level for this filter is well below the limit. It is necessary to use a 3 kHz filter up to 100 kHz before switching to a wider resolution bandwidth in order to prevent the LO feedthrough from masking emissions present near the start frequency.

For broadband signal measurements, the situation is somewhat different. Coherent broadband signals have spectral components spread out over a wide section of the spectrum. Therefore, increasing the receiver's resolution bandwidth lets more of the signal's spectral energy fall within the passband of the bandwidth filter. As the voltage phasors that make up the signal add in phase, the displayed signal level increases according to the following relationship:

$$\Delta \text{ signal level (dB)} = 20\log(BW_i2/BW_i1),$$

where BWi1 and BWi2 are the two bandwidths selected. Therefore, a 10X increase in resolution bandwidth causes the broadband signal level to rise by 20 dB and the broadband noise level to rise by only 10 dB, resulting in a 10 dB improvement in signal-to-noise ratio. This contrasts with the case of the narrowband signal, in which a 10X increase in bandwidth has the oppposite effect on signal-to-noise ratio. However, the general rule of using the widest bandwidth possible to achieve fast sweep times and at least 10 dB test limit-to-noise margin still applies to broadband signal measurements.

Broadband Measurement Corrections

Because broadband signals have a large bandwidth in comparison to the bandwidth of the measuring receiver, they are typically measured in terms of dB μV/m/MHz (radiated measurements) or dB μA/MHz (conducted measurements). Therefore, test data must be normalized to a 1-MHz-reference impulse bandwidth. The correction factor is computed with the following equation:

$$\text{correction factor (dB)} = -20\log(\text{BWimeas}/\text{BWiref})\ \text{dB},$$

where BWimeas is the impulse bandwidth of the receiver (which is determined by the resolution bandwidth filter, the detector, and post-detection video filters) used to perform the measurement and BWiref is the reference impulse bandwidth, normally 1 MHz. This correction factor, in dB, is added to the spectrum analyzer reading to achieve a normalized broadband reading.

The HP 85864C EMI software has a utility routine that automatically computes the impulse bandwidth and associated correction factor for each resolution bandwidth filter in the spectrum analyzer (assuming video bandwidth > 10X resolution bandwidth). HP spectrum analyzers with option 462 make it very easy to compute the proper correction factor. Since analyzers with this option already have bandwidths specified and calibrated in terms of their impulse bandwidth, the correction factor can be readily computed using the equation above. For example, if the measurement is made with a 10 kHz impulse resolution bandwidth filter, the correction factor is simply

$$\text{correction factor (dB)} = -20\log(1E+4/1E+6) = 40\ \text{dB}.$$

The correction factors are added in automatically by the HP 85864C software when broadband measurements are performed.

If you do not have HP 85864C EMI software, the procedure below describes how to determine impulse bandwidth manually, which you can then use to determine the correction factor for normalizing test data. This procedure requires only a pulse generator. The pulse generator must have an accurate repetition frequency that can be set, and the pulse shape must remain constant when the repetition frequency is changed.

Several things must be considered when the impulse bandwidth is measured:

1. The spectrum analzyer must be in linear mode display mode (log mode distorts the filter's response).
2. The analyzer must have enough input attenuation to prevent overloading by the pulse generator. This can be tested by changing the input attenuation level and making sure that the displayed signal level changes an equal amount.
3. The video bandwidth must be at least ten times as wide as the resolution bandwidth to prevent averaging.

The procedure for measuring the impulse bandwidth of a filter has two parts:

1. Set the pulse generator to a pulse repetition rate (PRF1) much higher than the spectrum analzyer's resolution bandwidth; only one spectral line is contained by the resolution bandwidth filter. Tune the center frequency of the spectrum analyzer to the value of the pulse repetition frequency or to a multiple thereof. Measure the amplitude of the signal. This amplitude, V1, is equal to 2 * A * PRF1 where A is the area of the pulse (this equation is derived from the Fourier analysis of a pulse).

2. Change the pulse repetition rate to a rate much less than the spectrum analyzer's resolution bandwidth. The pulse shape must remain constant. Because the pulse rate is much less than the resolution bandwidth, several spectral lines are contained by the filter. Keeping the center frequency tuned to the same value as in the first part of this procedure, measure the signal amplitude. This amplitude, V2, is equal to 2 * A * BW_i, where A is the area of the pulse and BW_i is impulse bandwidth. By combining the equations for V1 and V2, the variable A drops out; the resulting equation is BW_i = PRF1 * V2/V1 (see Figure 3-2).

The pulse width set in the second step of the procedure must be set narrow enough to give a flat frequency spectrum within the resolution bandwidth filter. The pulse width must also be wide enough so that the signal will be sufficiently above the noise floor. If the spectrum analyzer or receiver cannot tune low enough in frequency to make the measurement directly, then a mixer can be used to move the pulse spectrum up to a more convenient center frequency.

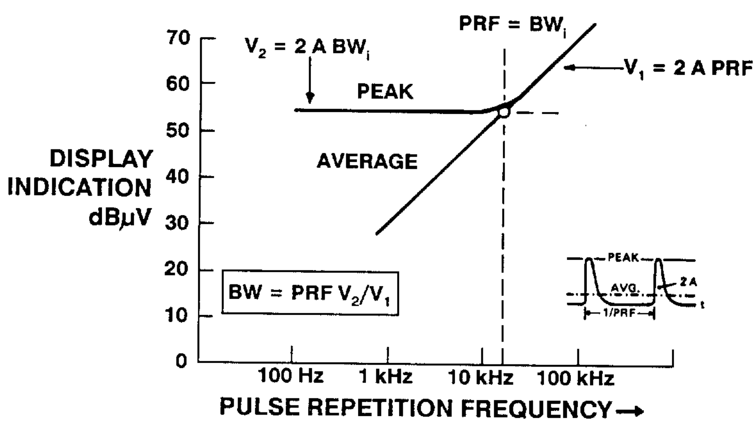


Figure 3-2

Chapter 4

OPERATING TIPS

This chapter contains several operating tips that help you become acquainted with receiver operation.

Know When Your Preselector Is Tracking

A quick way to make sure that the preselector and spectrum analyzer are tracking is to compare two swept traces. Set both Trace A and Trace B of the spectrum analyzer to clear-write mode. Set the spectrum analyzer start and stop frequency so that the entire span is preselected (e.g., from 30 MHz to 300 MHz). Set the sweep time to 200 msec or slower. Set the preselector comb generator repetition rate to 5 MHz and connect the comb to the preselector input corresponding to the selected spectrum analyzer frequency range. Place the preselector in bypass mode ((ENABLE) (BYPASS)), see that the analyzer takes at least one full sweep, then set Trace B on the spectrum analyzer to view mode. Press (NORMAL) on the preselector and compare Trace A to Trace B. There should be less than 1 dB difference between the two traces when the two instruments are tracking. If the spectrum analyzer and preselector are not tracking, you will see discontinuities in amplitude between the two traces.

You may want to bypass the preselector or discontinue tracking. To do this, press (ENABLE) (BYPASS) on the preselector. Note that the second attenuation value is no longer displayed. Reactivate tracking by pressing (NORMAL) on the preselector.

Even though the preselector is tracking the spectrum analyzer, sometimes it does not preselect the entire display. In this case, a line appears across the bottom-left graticules of the display in the area that is not preselected. The line will change in length or disappear completely (to give a fully preselected span) depending on the frequency span. The preselector is fully tracking when the frequency ranges for CISPR Bands A, B, C, and D are selected.

Get the Best Receiver Sensitivity Without Overload

For best receiver sensitivity, limit spectrum analyzer attenuation to 0 dB or 10 dB. To adjust receiver input attenuation, use the preselector attenuator instead. To set the spectrum analyzer attenuation to 0 dB, press (ATTEN) (0) (dB). Using the (⬇) key decreases attenuation to 10 dB only.

While a minimum of attenuation may be desirable, too little attenuation may allow input signals to cause gain compression. The preselector 3 dB LIN function enables you to quickly check for any overload condition. With the signal(s) of interest displayed, press the 3 dB key and observe the amplitude level of the signals on the spectrum analyzer display. With the signals of interest at least 10 dB above the noise floor, there should be less than 1 dB of amplitude change in the signals. (To view this change easily, blank Trace A; place Trace B in clear/write mode, then in view mode. Reactivate Trace A to clear/write mode, then activate the 3 dB LIN function.) If the change in amplitude is greater than 1 dB, increase the preselector input attenuation by 10 dB and repeat the test. Continue to add attenuation until the signals behave linearly. Use the least amount of attenuation necessary to produce linear signal-amplitude change.

Generally, when making measurements, cw signals should be at least 20 dB above the noise floor. Quasi-peak readings are accurate down to the displayed peak-noise level; the HP 85867A EMI Receiver Functions makes accurate readings at this level.

Keep Sweeptimes Short, But Not Too Short

Be sure that the selected spectrum analyzer sweep time gives a calibrated response. To test this, simply increase the sweep time. You should see no change in peak signal amplitude. If a change occurs, continue to increase the sweep time until the change in sweep time no longer causes a change in the peak amplitude of the displayed signals. Generally, use the equation below to determine sweep time:

$$ST \geq \frac{K*SPAN}{RB^2}$$

where:

ST = Sweep time
RB = Resolution Bandwidth
K = Constant of Proportionality

This equation gives the same sweep time as when the sweep time (AUTO) key is pressed. Note that when the HP 85650A Quasi-Peak Adapter is used, pressing (AUTO) still may give a sweep time that is too fast. Refer to Table 4-1 to determine an appropriate sweep time for quasi-peak measurements. For example, if the desired frequency range is within 9 - 150 kHz and the desired span is 10 kHz, set the sweep time to 100 sec.

Table 4-1. Sweep time per Span for Various Frequency Ranges

Frequency Band	Sweep/Span (QPA ON)
9 - 150 kHz	10 sec/kHz
0.15 - 30 MHz	200 sec/MHz
0.03 - 1 GHz	20 sec/MHz

How Video Filtering Affects Average Detection

Three detection methods are available in this receiver: peak, quasi-peak, and average. The following briefly describes these methods and the effect of video filtering on average detection.

Peak measurement values are obtained when the spectrum analyzer post-detection filter (i.e., video filter) setting is wider than the resolution bandwidth filter setting. The peak measurement is defined as the measured peak voltage indicated by the RMS value of an equivalent peak-amplitude, sinusoidal calibration signal. Peak detection is the spectrum analyzer's normal detection mode and is the most common detection method used to evaluate electromagnetic emissions. Peak detection is used for MIL-STD measurements and commercial diagnostic testing, and it allows for the shortest measurement time.

For commercial compliance measurements, quasi-peak detection is specified. This requires the use of the HP 85650A Quasi-Peak Adapter. However, peak detection can be used instead because it will always give the worst-case (i.e., highest) emission level compared to the quasi-peak method. *If emission levels meet requirements using peak detection, then a quasi-peak measurement is not necessary.*

Average detection is obtained using video filtering in the linear amplitude display mode and can be used for both military and commercial measurements.

Video (post-detection) filtering provides averaging of the higher frequency components (such as noise) at the output of the envelope detector. When the video filter bandwidth is narrower than the resolution bandwidth filter, averaging occurs. Narrowband (e.g., continuous-wave) signal amplitudes are not affected by video filtering.

For the true average, the video bandwidth must be less than the lowest pulse-repetition frequency (PRF), the sweep must be slow enough to let the filters charge completely, and the spectrum analyzer must be in the linear amplitude display mode.

With the spectrum analyzer in the log amplitude mode, video filtering greatly reduces the amplitude of the impulsive and randomly broadcast signals. The amplitude of narrowband signals is unaffected, as shown in Figure 4-1.

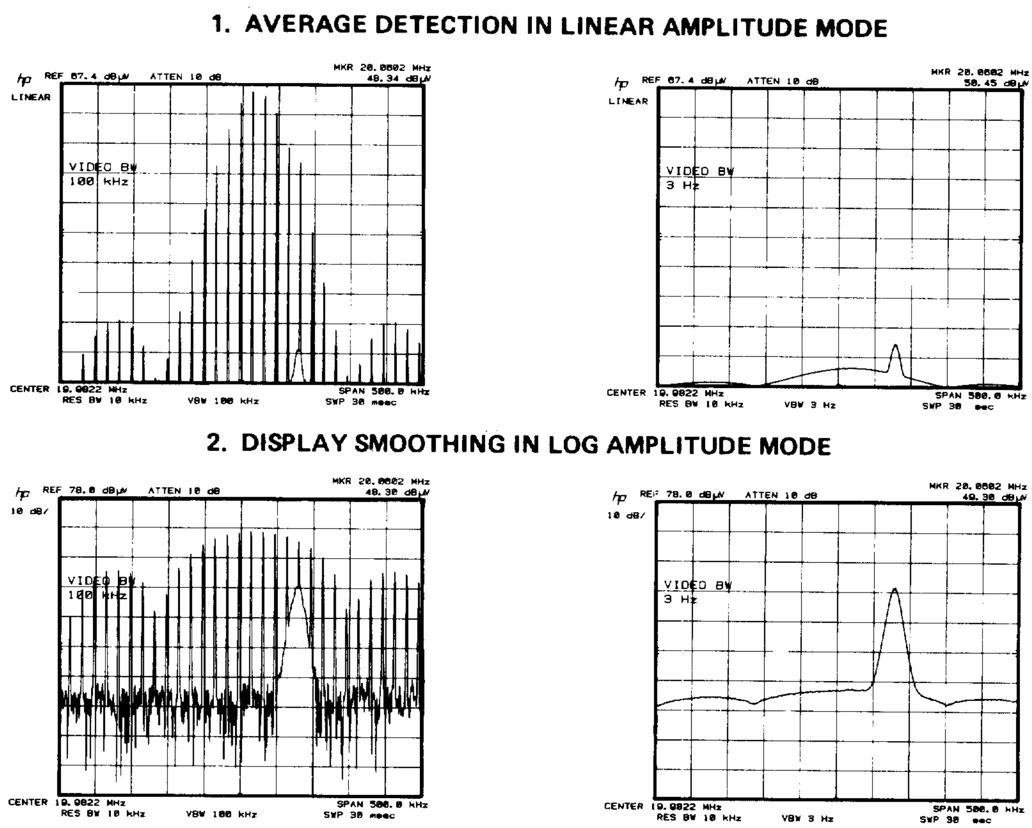


Figure 4-1. Effect of Video Filtering

With the spectrum analyzer in linear mode, video filtering provides the average value of a signal. In the log mode, video filtering smooths the logarithmically-distorted detector output signal.

For broadband signals, the smoothed indication is considerably lower than the average value of the impulses. This smoothing effect allows more accurate measurement of the narrowband component on a mixed narrowband/broadband spectrum. Furthermore, the measurement dynamic range is larger in log mode so that even low-level narrowband signals can be measured in the presence of larger amplitude broadband signals.

The video bandwidth needs to be reduced only to the point at which rapid fluctuations of the signal are smoothed. Further reduction will not change the measured value but will increase the required settling, analysis, and measurement times.

Note that the ratio of peak-to-average voltage for a broadband impulsive signal with a known PRF is the same as the ratio of the receiver impulse bandwidth to the PRF:

$$\text{Vpeak/Vaverage} = BW_i/PRF$$

This allows for easy determination of BW_i for the synchronously-tuned, non-ringing resolution bandwidth filter of the spectrum analyzer (see Figure 4-2).

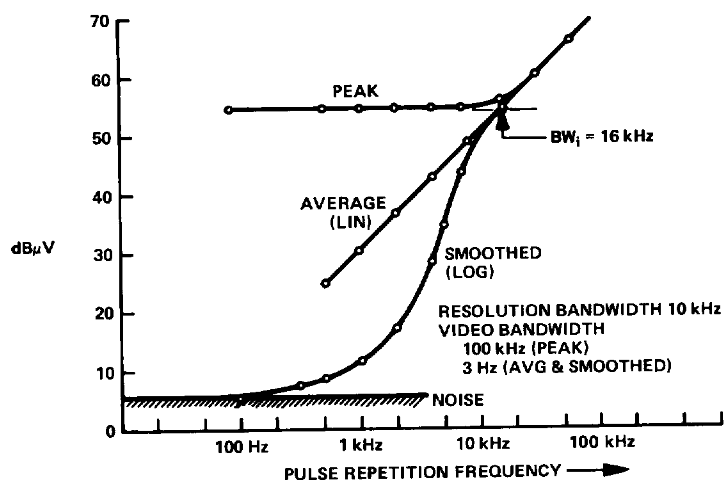


Figure 4-2 Post Detection Video Filtering of Impulsive Signals

Table 4-2 describes how to access peak, quasi-peak, and average detection.

Table 4-2. Accessing Various Detection Modes

Detection Method	How to Access
PEAK	* Use MAX HOLD function * Use Positive-Peak Detector (SHIFT 6)
AVERAGE	* VB < PRF * Sweep allows filters to charge * LINear mode
QUASI-PEAK	* Use HP 85867A functions * Use HP 8565A procedure in operating manual * Use LINear mode * Signal peaks must be at or below reference level

Use Frequency Spans and Markers to Facilitate Measurements

When an RF preselector is used in your system, changing the spectrum analyzer frequency generates an SRQ 102 interrupt. If you change the start, stop, or center frequency often (e.g., scroll the knob), you will generate many interruptions, one for each change in frequency. This can increase measurement time. Consider viewing a range from 20 MHz to 200 MHz. Scrolling through this range is tedious. An efficient method for viewing signals of interest is to select a desired frequency span (5 MHz, for example) and set the center frequency step-size to the same value as the frequency span. Then, after setting the center frequency to 20 MHz, use the spectrum analyzer (⬆) key to step the center frequency in 5 MHz increments until you reach a center frequency of 200 MHz.

Other methods for viewing several signals of interest at once are to select a start and stop frequency that displays these signals simultaneously, or to divide the desired range into portions so that you need scan only a few spans. For example, a frequency range of interest may extend be from 20 MHz to 200 MHz. Set the start frequency to 20 MHz and the stop frequency to 100 MHz. Now, activate a marker (for example, press (PEAK SEARCH) and (NORMAL)) and use the knob to move the marker to the peaks of signals of interest. The marker reads both the frequency and the amplitude of a signal. For a closer look at a signal, place the marker on the signal of interest, then press (SIGNAL TRACK). Press (FREQ SPAN) and then the (⬇) key until you reach the desired span; turn off the signal track function. To view the second portion of the 20 MHz to 200 MHz range, select a start frequency of 100 MHz and a stop frequency of 200 MHz. Again, use markers to read signal frequency and amplitude, and reduce the span for a closer look.

As a rule of thumb, select start and stop frequencies that produce a span no greater than 500 times the resolution bandwidth value used.

When Using IF Correction Data and the Quasi-Peak Adapter

The IF correction routine ((SHIFT) W (FREQUENCY SPAN) or (SHIFT) X (START FREQ)) found in the HP 8566B, or HP 8567A, and HP 8568B spectrum analyzers is not recommended for use with the CISPR EMI Receiver System (HP 8573A or HP 8574A) or EMI Test Receiver (spectrum analyzer and HP 85685A RFP). The IF correction routine is designed to minimize the accumuulation of errors associated with changing settings for a stand-alone spectrum analyzer. However, because the IF correction routine is not compatable with the calibration routine employed by the RF Preselector using the IF correction routine (KSW) with the RF Preselector could actually degrade performance.

The CISPR EMI Receiver System and EMI Test Receiver should be calibrated with (CAL SEQ) in the RF Preselector. This routine is sufficient to provide system accuracy as outlined in the RF Preselector manual.

For configurations consisting of only a spectrum analyzer and quasi-peak adapter refer to the HP 85650A Quasi-Peak Adapter Operation and Service Manual (85650-90001) for the procedure on using the IF correction routine. This procedure must be adhered to if specified accuracy is to be ensured.

When Using a LISN

Large transient voltages may appear at the test port of a LISN due to switching between power lines, cycling the power to the device under test or external transients on the AC line. These transients may be large enough to damage the input circuitry of the measuring receiver or spectrum analyzer connected to the test port of a LISN.

The best method to avoid damaging the receiver is to disconnect the input before switching power lines or cycling power. A limiter and high pass filter, at the input, can also help to protect the receiver.

Identifying the Preselector Firmware Revision Date

To identify the HP 85685A preselector date code, connect a controller to the preselector HP-IB port marked "TO COMPUTER" and run the program below. The firmware revision date code is printed.

```
10    ASSIGN @Rfps TO 719
20    OUTPUT @Rfps;"REV;"
30    ENTER @Rfps;N$
40    PRINT N$
50    END
```

If you do not have access to a controller, you can use the following downloadable procedure. Activate the spectrum analyzer title mode, enter the procedure into the title area, then store it under a softkey. This is done from the spectrum analyzer front panel.

Briefly, the procedure defines a variable "PZZ" and stores it under softkey 201. It queries the preselector for its firmware revision date, enters it into the variable "PZZ," and displays the value. This sequence is stored under softkey 202. Executing softkey 202 displays the revision date (day, month, year) in the center of the spectrum analyzer display. The procedure follows. Note that where an alpha character is displayed, you press the corresponding front-panel key. For example, in "VARDEF," you press (CENTER FREQUENCY) to produce the "V." Note, too, that "|" is produced by pressing the upper right key, and "," is produced by pressing (0 - 1.5 MHz) or (0 - 2.5 GHz).

Before executing the procedure, set the preselector address switch to 19. Remove the spectrum analyzer from the private bus marked "PRIVATE BUS (TO SPECTRUM ANALYZER)" and connect it to the preselector HP-IB port marked "TO COMPUTER".

Execute the following key sequence:

(SHIFT) E (AUTO) VARDEF (SPACE) PZZ,0 (NORMAL)

(SHIFT) (2) (0) (1) (kHz) (This stores the variable definition under softkey 201.)

(SHIFT) (2) (0) (1) (Hz) (This defines the variable and sets it to zero.)

(SHIFT) E (AUTO) OUTPUT (SPACE) 19 (SPACE) KC (SPACE) | (SPACE) REV | , ENTER (SPACE) 19 (SPACE) K (SPACE) PZZ (SPACE) DISPLY (SPACE) PZZ (SPACE) (1) (0) (.) (4) (NORMAL)

(SHIFT) (2) (0) (2) (kHz) (This stores the procedure under softkey 202.)

(SHIFT) (2) (0) (2) (Hz) (This executes the procedure.)

The revision date appears in the center of the spectrum analyzer display.

Plotting the Contents of the Spectrum Analyzer Display Remotely

Plotting the contents of the spectrum analyzer display contents from a controller is a simple procedure; more difficult is devising a method that lets the controller determine when the plot is complete. The controller must be able to determine when a plot is complete because, if the controller were to send commands to the spectrum analyzer during the plot sequence, plotting would be aborted. Therefore, the controller must wait until plotting is complete before sending further commands to the spectrum analyzer.

The procedure below illustrates how to plot the display contents. It also illustrates how to determine when a plot is complete. Briefly, this method makes use of the end-or-identify (EOI) line. The spectrum analyzer sets this line true when it is finished sending its display contents to the plotter. The controller is set as a listener and "eavesdrops" on the data and control lines until EOI is set true. Once the controller senses the EOI, it can again send commands to the spectrum analyzer. Further explanation of this procedure follows.

```
10     OUTPUT 705;"OP;"
20     ENTER 705;P1x,P1y,P2x,P2y
30     OUTPUT 718;"VIEW TRA;"
40     OUTPUT 718;"PLOT ";P1x;",";P1Y;",";P2x;",";P2y;";"
50     SEND 7;UNL MLA LISTEN 5 TALK 18 DATA
60     INTEGER Bite, Done, Aborted
70    Aborted=0
80    REPEAT
90      ENTER 7 USING "#,B";Bite
100       STATUS 7,7;Done
110       Done=BIT(Done,11)
120    UNTIL Done or Aborted
130    END
```

Lines 10 and 20 read the plotter coordinates and enter them into variables (for more plotter information, refer to your plotter manual). Line 30 sets Trace A to view mode. (This procedure assumes that Trace B is blank; if Trace B is displayed, set it to view mode as well.) Lines 40 and 50 plot the display contents. In Line 50, "MLA" configures the controller as a listener and "LISTEN 5" configures the plotter as a listener. "TALK 18" configures the spectrum analyzer as the talker, since it must send the display contents. Lines 70-100 establish when the plot is complete. Because the controller has become a listener, in line 90 it reads the status register of the internal HP-IB; this allows the controller to "eavesdrop" and read the state of the bus data and control lines while the plot is executing. Line 100 masks the bit that corresponds to the EOI line. When the EOI is set true, the REPEAT/UNTIL loop condition is satisfied and the controller again can send commands to the spectrum analyzer.

NOTE

The preselector's passthrough scheme causes the preselector to uncouple from the spectrum analyzer whenever the spectrum analyzer is addressed. As a result, the preselector's input attenuation and the line denoting areas not preselected no longer appear on the display and are not plotted. To remedy this, whenever possible, set the span so that it is fully preselected; then plot the display. Even though the preselector's attenuation has been removed from the display, the reference level and reference level offset do not change; from these values you can calculate the preselector attenuation.

Chapter 5

WHEN THE UNEXPECTED HAPPENS. . .

This chapter contains suggestions to help you troubleshoot an unexpected response of the receiver.

The Preselector Stops Tracking

If known signals are not displayed or if they are uncharacteristically low in amplitude, you may have lost tracking. Check the spectrum analyzer display. It should display two attenuation values, the second one indicating the preselector attenuation. If the second value is not displayed, press (NORMAL) on the preselector.

If you have just completed a plot using the direct plotter output function, press (UPPER RIGHT) on the spectrum analyzer TWICE. (The lower-left and upper-right functions hold the sweep ramp low or high. Pressing upper right twice disables these functions.)

Did you press (INSTR PRESET) on the spectrum analyzer or (ENABLE)(BYPASS) on the preselector? Either function disables automatic tracking. Press (NORMAL) on the preselector to resume tracking. You could also press (INSTR PRESET) on the preselector; this will return the receiver to its preset state.

Finally, you may have rear panel cables configured incorrectly. Refer to "What Is Wrong When the Display Looks Like. . .?" in Chapter 1 of this manual.

For more information on tracking during manual operation, refer to "Know When Your Preselector Is Tracking" in Chapter 4.

If you are programming the receiver and the instruments are not tracking, be sure that you are (1) sending commands to the appropriate instrument addresses and (2) using the preselector COUPLE command or keeping track of the frequency values for each instrument yourself.

For example, if the spectrum analyzer address is set to 18 and if the preselector rear panel address is also set to 18 (or to some EVEN number), you send spectrum analyzer commands to address 18 and you send preselector commands to address 19 (or to a value one greater than that on the address switch). With this address configuration, you must use the preselector COUPLE command whenever you change the spectrum analyzer frequency. See Example 1:

Example 1:

```
10  OUTPUT 718: "FA 20MHZ;"
20  OUTPUT 719: "COUPLE;"
30  END
```

Here, the COUPLE command enables the preselector to change its start frequency to 20 MHz and maintain tracking. If the preselector rear panel address switch is set to an odd value (e.g., 23), the COUPLE command no longer functions. You must keep track of the preselector and spectrum analyzer frequencies in your program. Refer to Example 2.

Example 2:

```
10  OUTPUT 718: "Fa?:"
20  ENTER 718: Fa
30  OUTPUT 723: "FA"; Fa:":"
40  END
```

Here, after finding the spectrum analyzer start frequency, you set the preselector to the same value. Note that the maximum frequency of the RF preselector is 2 GHz. For more information, refer to the "Remote Operation" section of the preselector operating and programming manual.

Optimizing Receiver Sensitivity

Check the spectrum analyzer attenuation; it should be no greater than 10 dB. Check linearity. A procedure for this appears under "Get the Best Receiver Sensitivity Without Overload" in Chapter 4 of this manual.

The Reference Level Changes With Attenuation Adjustments

This is normal operation when a preselector is used in the receiver system. In this configuration, the reference level annotation on the spectrum analyzer display indicates the reference level at the input of the preselector, not at the input of the spectrum analyzer. The preselector has a gain of 20 dB along with 0 dB to 53 dB of input attenuation. The gain and selected input attenuation are incorporated into one term, which equals the reference level offset. When the offset changes, the reference level changes as well. The offset value appears on the left side of the spectrum analyzer display. For example, consider using 0 dB of preselector attenuation. This, combined with 20 dB of gain, produces a -20 dB reference level offset. Adding 20 dB of attenuation combines with 20 dB of gain to produce a 0 dB reference level offset.

"SRQ 102" Flashes on the Screen

In general, consider this normal operation. Whenever the spectrum analyzer changes frequency, the preselector must also change frequency to continue tracking the spectrum analyzer. To accomplish this, the preselector must interrupt spectrum analyzer operation momentarily in order to read the new frequency or span settings. Once the preselector has the new data, it adjusts its own settings. Receiver operation then resumes, with both instruments in synchronization. Operation is interrupted for about 0.2 - 0.8 seconds.

Note that if you are changing the frequency often (for example, scrolling the knob to change frequency), you will see "SRQ 102" appear almost continuously. A better method for observing signals is to choose a frequency span, set the center-frequency step-size to the same value, set the center frequency to the lowest frequency signal of interest and use the ⇧ key on the spectrum analyzer to view signals to the highest-frequency signal of interest. For more information on this procedure, refer to "Use Frequency Spans and Markers to Facilitate Measurements" in Chapter 4.

If no changes in the instrument state occur and the SRQ 102 remains on the screen, try pressing (NORMAL) on the preselector, check the HP-IB cable between the spectrum analyzer and the preselector, or press (INSTR PRESET) on the preselector.

The HP-IB Locks Up Under Program Control

Check to make sure both the printer and the plotter have paper. If either is out of paper, refill it and cycle power on that device. Under rare conditions, an HP 2225A Thinkjet Printer may lock up the bus after it has generated a service request. Cycle power on this peripheral. HP 8566B firmware versions dated 29.9.86 or earlier may also cause occasional lockups. In this case, we suggest you upgrade the spectrum analyzer firmware.

The Plotter Is Not Recognized in the EMI Software System

If the plotter worked at one time, be sure that paper is in the plotter and cycle power. Check that the address is at 05 and check the HP-IB cable.

Direct Plot Does Not Work

First, be sure that the plotter address is set to 05 and that the plotter is connected to the spectrum analyzer as indicated below. Refer to the section below that applies to your receiver configuration. For an HP 7475A plotter, you may need to modify your plotter. Refer to Service Note 7475A-2.

IF YOUR RECEIVER INCLUDES AN RF PRESELECTOR

If your receiver also includes a controller, first pause or stop any running programs, then set the controller HP-IB state to local. Connect the plotter to the spectrum analyzer via HP-IB, cycle power on the plotter, add paper, then press (LOWER LEFT) on the spectrum analyzer. When the plot is complete, press (UPPER RIGHT) twice, then reconnect the controller.

IF YOUR RECEIVER DOES NOT INCLUDE A PRESELECTOR

If it includes a controller, disconnect this device. Connect the plotter to the spectrum analyzer via HP-IB, cycle power on the plotter, add paper, then press (LOWER LEFT) on the spectrum analyzer.

Screen Titles Are Overwritten

With a system consisting of an HP 8566B and HP 85685A, screen titles may be overwritten. To prevent this, place the display in single-sweep or view mode before writing the title.

Appendix A

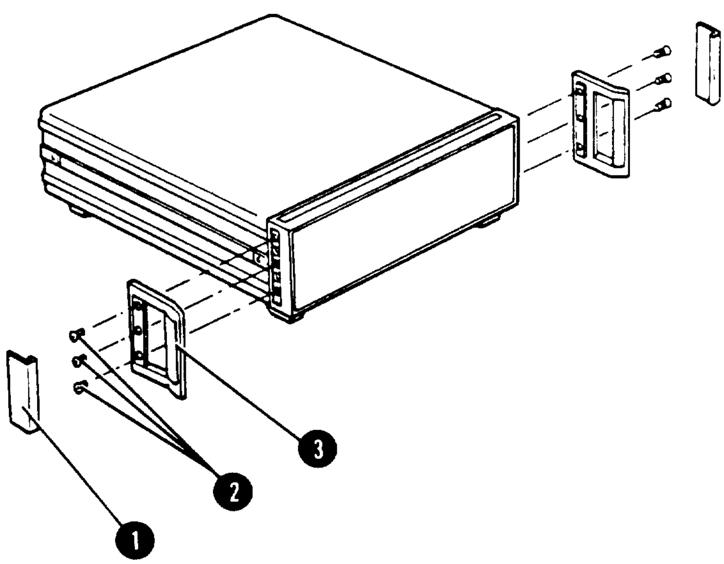
RACK-MOUNT INSTALLATION

This appendix describes how to rack-mount an HP 8566B, 8567A, and 8568B Spectrum Analyzer with the HP 85650A Quasi-Peak Adapter and the HP 85685A RF Preselector.

For an HP 8566B, 8567A, or 8568B Spectrum Analyzer

FRONT HANDLE REMOVAL

To install some instrument options, the front handles need to be removed. See Figure A-1 for instructions. When installing an option or replacing the handles, be sure the correct screw size (as indicated in the instructions) is used to prevent damage to the instrument.

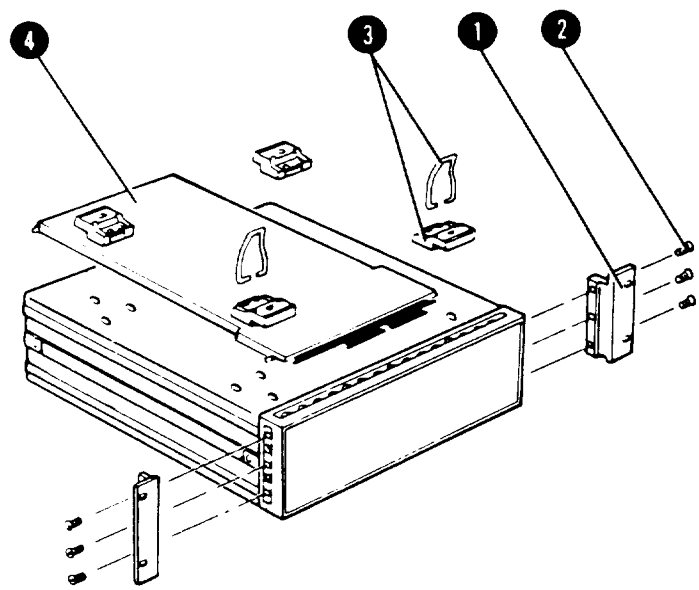


1. REMOVE FRONT HANDLE TRIM 1
2. REMOVE THREE 8-32X3/8 SCREWS 2 AND DETACH HANDLE 3

Figure A-1. Removing Front Handles

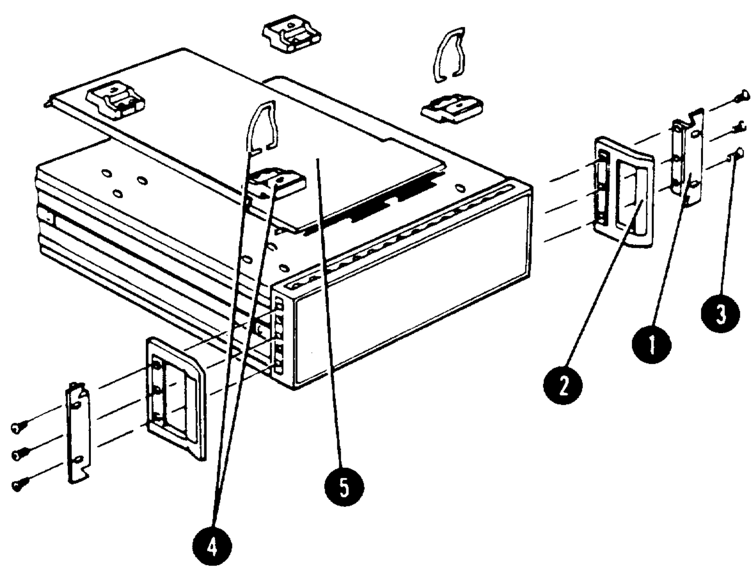
RACK-MOUNTING (OPTIONS 908 AND 913)

Instrument options 908 and 913 contain the necessary hardware to mount the spectrum analyzer in a rack of 482.6 mm (19 inches) spacing. Option 908 is for mounting without handles (see Figure A-2) and option 913 is for mounting with handles (see Figure A-3).



1. REMOVE FRONT HANDLES (SEE FIGURE 4).
2. ATTACH RACK MOUNT FLANGE 1 AND FRONT HANDLE ASSEMBLY WITH THREE 8-32X3/8 SCREWS 2 .
3. REMOVE FEET AND TILT STANDS 3 BEFORE RACK MOUNTING. THIS ALSO REMOVES INFORMATION CARD TRAY 4 . TO RETAIN USE OF INFORMATION CARDS, DO NOT REMOVE FEET, AND WHEN RACK MOUNTING, ALLOW APPROXIMATELY 2 CM (3/4 INCH) BELOW INSTRUMENT TO ACCOMODATE THE TRAY. (NO FILLER STRIP IS PROVIDED.)

Figure A-2. Option 908: Attaching Rack-Mount Flanges Without Handles



1. REMOVE FRONT HANDLES (SEE FIGURE 4).

2. ATTACH RACK MOUNT FLANGE 1 AND FRONT HANDLE ASSEMBLY 2 WITH THREE 8-32X5/8 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 2 CM (3/4 INCH) BELOW INSTRUMENT TO ACCOMODATE THE TRAY. (NO FILLER STRIP IS PROVIDED.)

Figure A-3. Option 913: Attaching Rack-Mount Flanges With Handles

RACK-MOUNTING WITH SLIDES (OPTION 010)

Instrument Option 010 contains the necessary hardware to mount the spectrum analyzer with slides in a rack of 482.6 mm (19 inches) spacing. The kit also contains adapters for mounting non-HP racks. The slides provide extra support at the sides of the instrument in the rack and, because of the weight of the instrument, are recommended. Refer to Figure A-4 and the following instructions to install the slides.

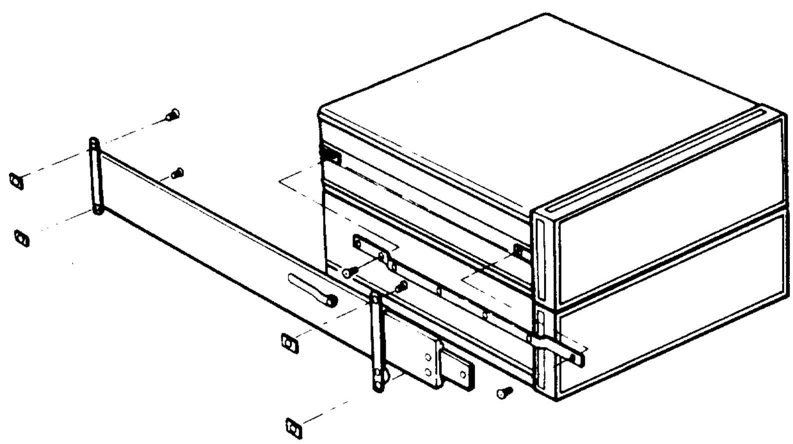


Figure A-4. Option 010: Attaching Rack-Mount Slides

1. To gain access to the slide-mount holes (in the IF Display Section), first remove the strap handle on the right side panel. Next, remove the left rear lock foot and slide the left side cover off the rear. Replace it with the panel included in the kit. (If the instrument sections are combined, move the lock foot enough for the side cover to clear but still support the IF Display Section.)

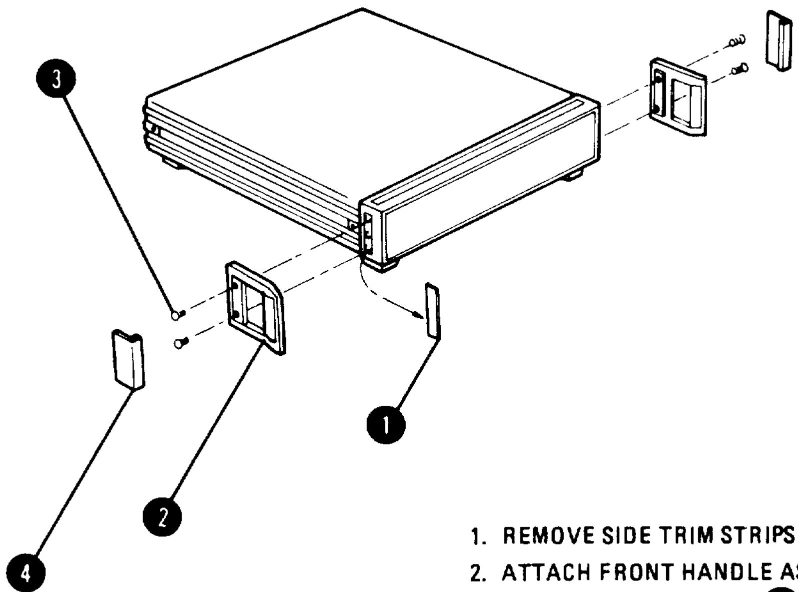
2. Remove the front handles on both instrument sections and replace them with the 10 1/2 inch handles and or the 10 1/2 inch rack-mount brackets supplied with the kit (refer to Figures A-1, A-2, and A-3).

3. Attach one slide inner member bracket to each side of the instrument using two 10-32 3/8 inch pan head screws per side. Attach the brackets to the inner members of the slides with four 10-32 3/8 inch flat head screws per side.

4. Insert two Unistrut nuts into each of the four vertical columns of the enclosure and attach the slide outer members with four 10-32 7/16 inch pan head screws per slide. Install the instrument by aligning the inner members (attached to the instrument) with the outer members (attached to the enclosure). If there is any binding, adjust the slides by supporting the instrument and loosening the screw to the Unistrut nuts at each side of the enclosure. Adjust the slides slightly until they operate freely.

For an HP 85650A Quasi-peak Adapter

Instruments are shipped with a Front Handle Kit that supplies the necessary hardware and installation instructions for mounting front handles on the instrument. Installation instructions are also given in Figure A-5.

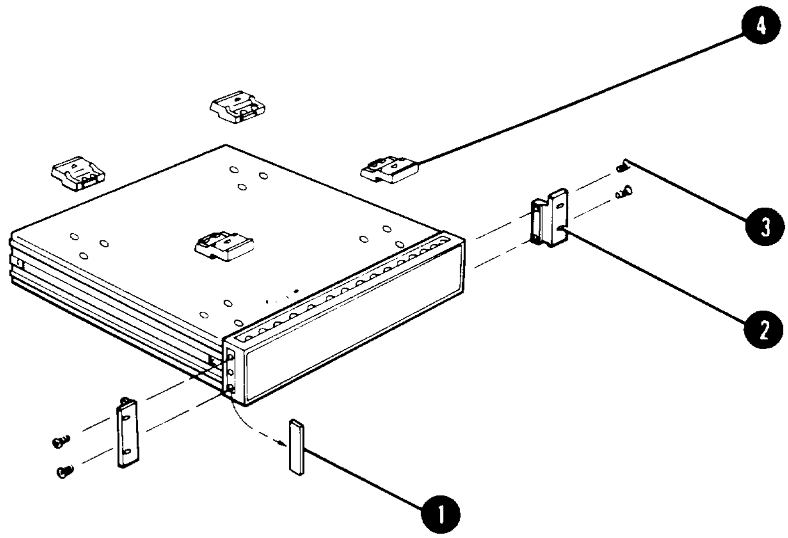


1. REMOVE SIDE TRIM STRIPS 1
2. ATTACH FRONT HANDLE ASSEMBLY 2 WITH TWO 8-32 x 3/8 SCREWS 3 PER SIDE.
3. PRESS FRONT HANDLE TRIM 4 IN PLACE.

Figure A-5. Installation of Front Handles

RACK-MOUNTING (OPTIONS 908 AND 913)

Instruments with Option 908 are shipped with a Rack Flange Kit which supplies the necessary hardware and installation instructions for mounting the instrument on a rack with a spacing of 482.6 mm (19 inches). Installation instructions also are given in Figure A-6. Refer to Table A-1 for HP part numbers.



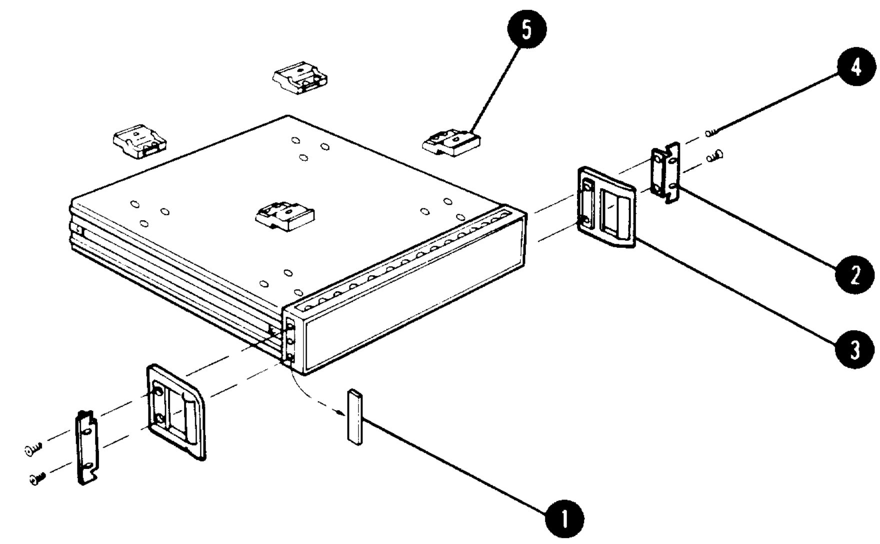
1. REMOVE SIDE TRIM STRIPS 1
2. ATTACH RACK MOUNT FLANGE 2 WITH TWO 8-32 x 3/8 SCREWS 3 PER SIDE.
3. REMOVE FEET 4 BEFORE RACK MOUNTING.

Figure A-6. Installation of Rack-Mounting Without Front Handles

Table A-1. Rack-Mount Kits for the HP 85650A

Description	CD	HP Part Number	Quantity
OPTION 908			
Rack-Mount Flange	4	5020-8934	2
Machine Screw, Pan Head, 8-32 x 0.375 inch	7	2510-0193	4
OPTION 913			
Rack-Mount Flange	5	5020-8935	2
Machine Screw, Pan Head, 8-32 x 0.625 inch	8	2510-0194	4

Instruments with Option 913 are shipped with a Rack Flange and Front Handle Kit that supplies the necessary hardware and installation instructions to add front handles and to mount the instrument on a rack with a spacing of 482.6 mm (19 inches). Installation instructions also are given in Figure A-7. Refer to Table A-1 for HP part numbers.



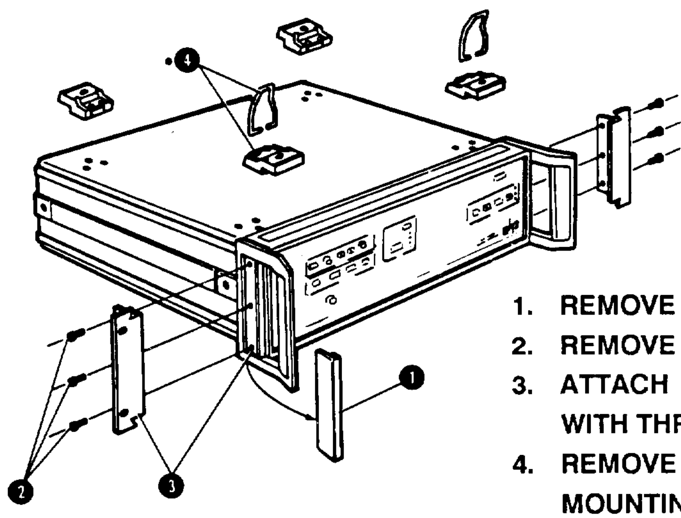
1. REMOVE SIDE TRIM STRIPS 1
2. ATTACH RACK MOUNT FLANGE 2 AND FRONT HANDLE ASSEMBLY 3 WITH TWO 8-32 x 5/8 SCREWS 4 PER SIDE.
3. REMOVE FEET 5 BEFORE RACK MOUNTING.

Figure A-7. Installation of Rack-Mounting Hardware with Front Handles

For an HP 85685A RF Preselector

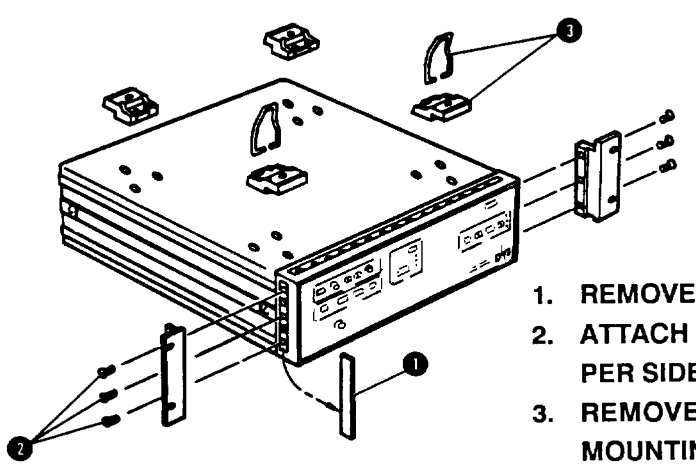
RACK-MOUNTING (OPTIONS 908 AND 913)

Instrument options 908 and 913 contain the hardware necessary to mount the preselector in a rack of 482.6 mm (19 inches) spacing. Option 908 is for mounting without handles (see Figure A-8) and option 913 is for mounting with handles (see Figure A-9).



1. **REMOVE SIDE TRIM STRIPS.**
2. **REMOVE THREE SCREWS PER SIDE.**
3. **ATTACH RACK MOUNT FLANGE AND FRONT HANDLE WITH THREE NEW LONGER SCREWS PER SIDE.**
4. **REMOVE FEET AND TILT STANDS BEFORE RACK MOUNTING.**

Figure A-8. Attaching Rack-Mount Flanges without Handles



1. **REMOVE SIDE TRIM STRIPS.**
2. **ATTACH RACK MOUNT FLANGE WITH THREE SCREWS PER SIDE.**
3. **REMOVE FEET AND TILT STANDS BEORE RACK MOUNTING.**

Figure A-9. Attaching Rack-Mount Flanges with Handles

RACK-MOUNTING WITH SLIDES (OPTION 010)

Instrument Option 010 contains the hardware necessary to mount the spectrum analyzer with slides in a rack of 482.6 mm (19 inches) spacing. The kit also contains adapters for mounting non-HP racks. The slides provide extra support at the sides of the instrument in the rack and are recommended because of the weight of the instrument. Refer to Figure A-11 and the following instructions to install the slides.

1. Remove front handles (see Figure A-10) and side strap handles.

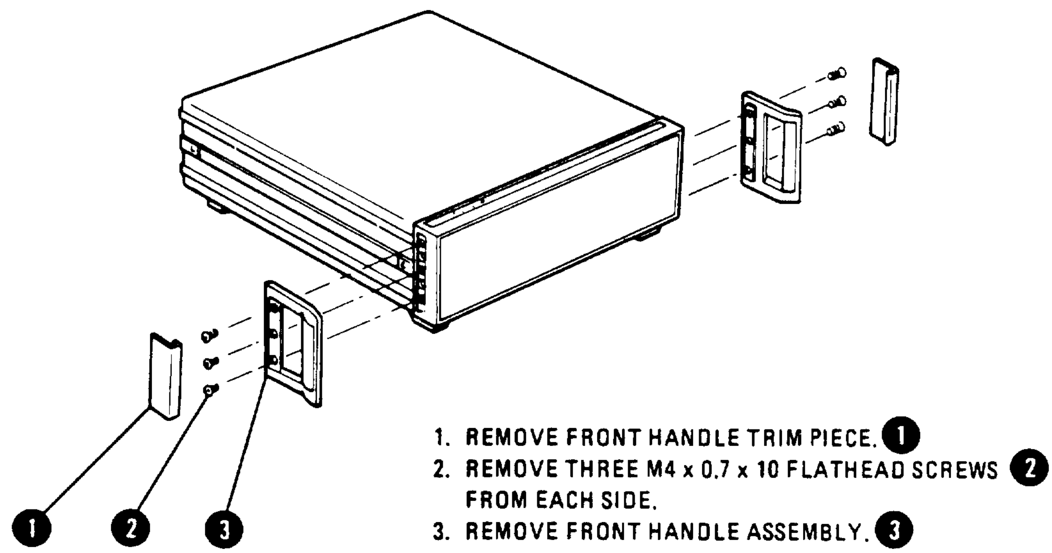


Figure A-10. Front Handle Removal

2. Attach one slide inner member bracket to each side of the instrument, using two M5x0.8x10 pan head screws per side (see Figure A-11).

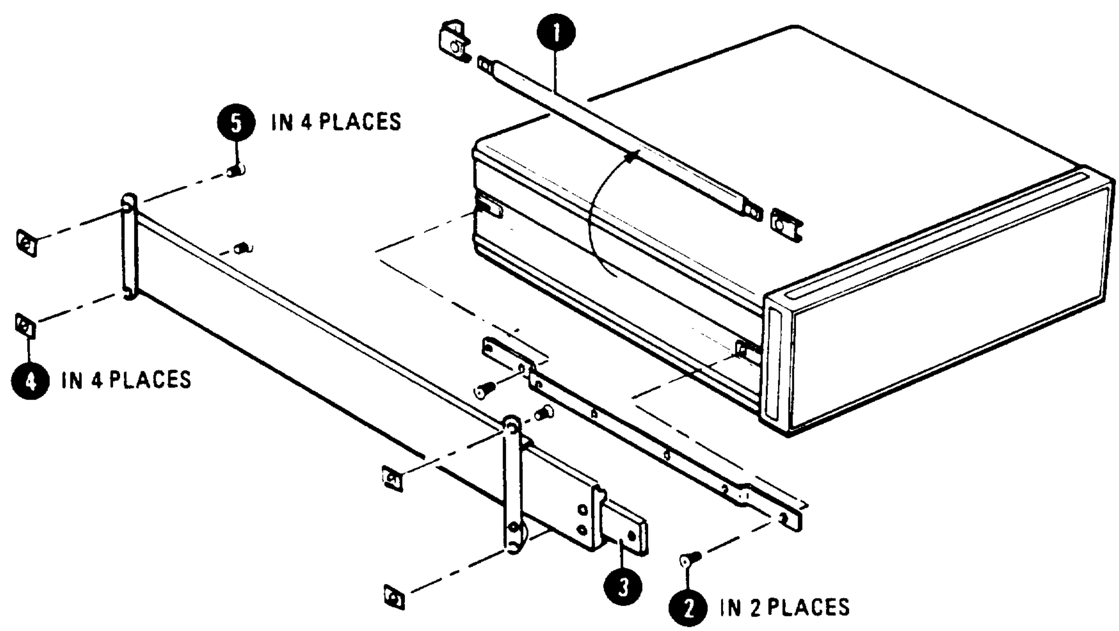


Figure A-11. Option 010: Attaching Rack Mount Slides

3. Remove the inner slide from each slide mount. Mount these slide brackets to each slide inner member bracket, using four M5x.08x12 flat head screws per side.

NOTE

When using non-HP system cabinets, skip steps 4 - 6 and proceed to step 7.

4. Insert two Unistrut nuts into each of the four vertical columns of the system cabinet (using four nuts in each side).

5. Bolt the outer slide mount to the Unistrut nuts on each side of the system cabinet, using four M5x0.8x12 pan head screws per side.

6. Mount the instrument into the system cabinet by lining up on each side the inner slides on the instrument and on the outer slide mount of the system cabinet.

NOTE

If any binding occurs in the slides, remove the instrument and loosen the screws to the Unistrut nuts on each side (adapter end brackets for non-HP cabinets). Adjust the slides until they operate freely and retighten the screws.

7. Attach end brackets for non-HP cabinets using hole pattern "B". Mount end brackets to the front of each outer slide mount using two M5x0.8x12 flat head screws and two nuts with washers per side. See Figure A-12.

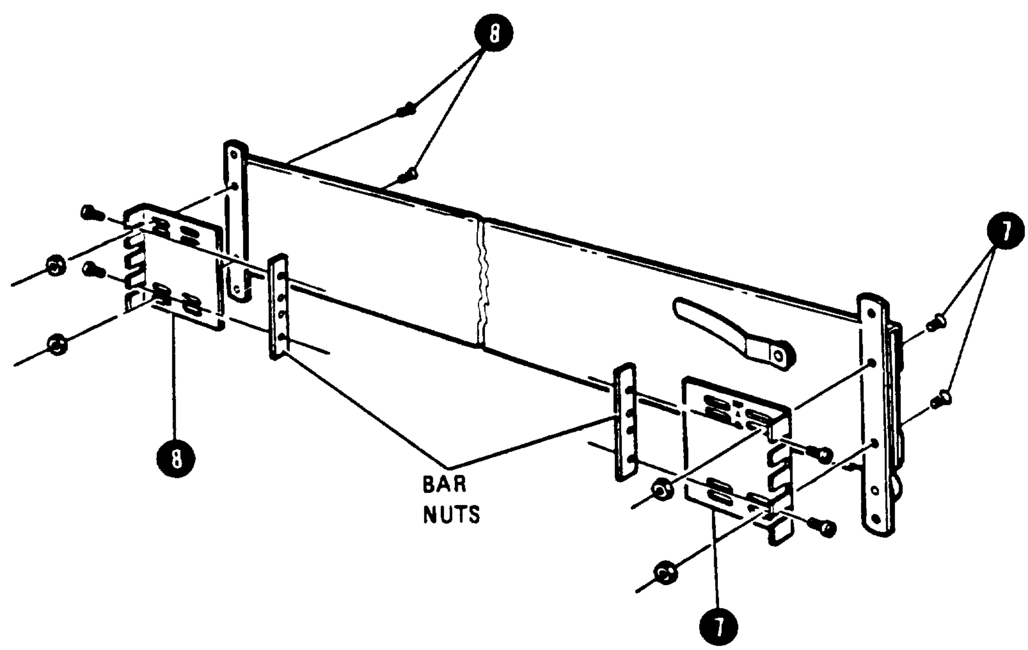


Figure A-12. Installing End Brackets for Non-HP Cabinets

8. Mount end brackets to the rear of each outer slide mount using two M5x0.8x12 pan head screws and two nuts with washers per side. See Figure A-12.

9. Bolt the outer slide mount to each side of the system cabinet using M5x0.8x12 pan head screws. Use the bar nuts if the rack-mounting strips have through-holes.

10. Perform step 6.

Appendix B

GUIDELINES FOR THE USE OF SPECTRUM ANALYZERS AND SCANNING RECEIVERS

Spectrum Analyzers and scanning receivers are particularly useful for interference measurements. Special consideration must be given to certain characteristics of these instruments.

Overload

Most spectrum analyzers have no RF preselection in the frequency range up to 2000 MHz; that is, the input signal is fed directly into a broadband mixer.

To avoid overload and to operate a spectrum analyzer linearly, the signal amplitude at the mixer typically should be less than 150 mV peak. RF attenuation or additional RF preselection may be required to reduce the input signal to this level.

Linearity Test

Prior to this test the input signal level used should be close to the receiver noise.

Linearity is tested by changing the input signal level by A1 dB and observing the A2 dB change of the spectrum analyzer or scanning receiver display indication of the specific signal under investigation. A difference, A1 - A2 = E dB, is the error due to non-linearity and must be added to the measurement uncertainties. Such error should be less than 0.5 dB.

If pre-amplification is inserted ahead of a spectrum analyzer the signal level at the pre-amplifier input should be changed by A1 dB to evaluate the overall system linearity.

Care must be used during this test not to exceed the safe input signal levels for the equipment.

Selectivity

Spectrum analyzers and scanning receivers must have the bandwidths required in Section 1-1 and 3-1 of CISPR Publication 16 to measure broadband and impulsive signals correctly.

Normal Response to Pulses

The response of spectrum analyzers with quasi-peak detection can be verified with the calibration test pulses according to Section 1-2 of CISPR Publication 16. The large peak voltage of the calibration test pulses typically requires RF attenuation of 40 dB and above to satisfy the linearity requirements. This decreases sensitivity and makes impossible the measurement of low repetition frequency and isolated calibration test pulses for bands B, C, and D. If a preselecting filter is used ahead of the spectrum analyzer, then the RF attenuation can be decreased. The filter limits the spectrum width of the calibration test pulse seen by the mixer. Conversely, a pulse-modulated carrier with the same spectral intensity and repetition frequency as the calibration test pulses of Section 1-2 of CISPR Publication 16 could be used to verify the relative detector response as such. The main lobe of the pulsed RF spectrum should exceed 100 times the 6dB bandwidth and the analyzer should be tuned to the uniform portion of the spectrum.

Peak Detection

The normal (peak) detection mode of spectrum analyzers provides a display indication that is never less than the quasi-peak indication. It is convenient to measure emissions using peak detection because it allows faster frequency scans than quasi-peak detection. Those signals which are close to the emission limits then need to be remeasured using quasi-peak detection.

Frequency Scan Rate

The scan rate of a spectrum analyzer or a scanning receiver should be adjusted for the CISPR frequency band and the detection mode used. The minimum sweeptime/frequency or the fastest scan rate is listed in Table B-1.

Table B-1: Minimum Sweeptime/Frequency and Fastest Scan Rate for CISPR Bands

Band	Peak Detection	Quasi-Peak Detection
A	100 ms/kHz	10 s/kHz
B	100 ms/MHz	200 s/MHz
C, D	1 ms/MHz	20 s/MHz

For a fixed-tuned, non-scanning spectrum analyzer the display sweep time may be adjusted independently of the detection mode and according to the needs for observing the time behavior of the emission.

Signal Interception

The spectrum of intermittent emissions may be captured with peak detection and digital display storage if provided. Multiple, fast frequency scans reduce the time required to intercept an emission compared to a single, slow frequency scan. The starting time of the scans should be varied to avoid involuntary synchronism with the emission, thereby hiding it. The total observation time for a given frequency range must be longer than the time between the emissions.

If the frequency of the emission maximum has been found using peak detection, then a quasi-peak measurement need only be performed at this frequency with the spectrum analyzer in zero frequency scan. The quasi-peak measurement time must be long enough to capture the emission.

Average Detection

Average detection with a spectrum analyzer is obtained by reducing the video bandwidth to less than the resolution bandwidth until no further smoothing of the displayed signal is observed. The sweeptime must be increased with a reduction in video bandwidth to maintain amplitude calibration. The amplitude display must be in linear mode.

If a logarithmic amplitude display mode is used, then the displayed value is the average of the logarithmically distorted IF signal envelope. Using this mode results in a larger attenuation of broadband signals than the average detection mode without affecting the display of narrow band signals. Therefore, video filtering in log-mode is especially useful for estimating the narrowband component in a spectrum containing both.

Sensitivity

Sensitivity can be increased with low-noise RF pre-amplification ahead of the spectrum analyzer. The input signal level to the amplifier should be adjusted with an attenuator to test the linearity of the overall system for the signal under examination.

The sensitivity to extremely broadband emissions that require large RF attenuation for system linearity is increased with RF preselecting filters ahead of the spectrum analyzer. The filters reduce the peak amplitude of the broadband emissions and less RF attenuation can be used. Such filters may also be necessary to reject or attenuate strong out-of-band signals and the intermodulation products they cause.

Amplitude Accuracy

The amplitude accuracy of a spectrum analyzer or a scanning receiver may be verified using a signal generator, power meter and precision attenuator. The characteristics of these instrument, cable and mismatch losses have to be analyzed to estimate the errors in the verification test.

Appendix C

SOURCES AND FURTHER READING

Sources:

Comite International Special des Perturbations Radioelectrique. *Publication 16.* Comite International Special des Perturbations Radioelectrique, 1977.

HP 8566B Spectrum Analyzer Operating and Programming Manual. HP part number 08566-90040.

HP 8566B Spectrum Analyzer Operator's Handbook. HP part number 08566-90045.

HP 8567A Spectrum Analyzer Operations, Tests, and Adjustments Manual. Volume 1. HP part number 09567-090001.

HP 8568B Spectrum Analyzer Operating and Programming Manual. HP part number 08568-90001.

HP 8568B Spectrum Analyzer Operator's Handbook. HP part number 08568-90045.

HP 85650A Quasi-Peak Adapter Operation and Service Manual. HP part number 85650-90001.

HP 85685A RF Preselector Operating and Programming Manual. HP part number 85685-90001.

HP 85685A RF Preselector Operations, Tests, and Adjustments Manual. HP part number 85685-90003.

HP 85864C EMI Measurement Software Operation Manual. HP part number 85864-90008.

HP 85867A EMI Receiver Functions Manual.. HP part number 85867-90001.

HP 85870A Open-Site EMI Measurement System Software Operation Manual. HP part number 85870-90001.

Linkwitz, Siegfried and Al Wilcox. *"Techniques for Measuring Narrowband and Broadband EMI Signals Using Spectrum Analyzers".* June, 1984.

For Further Reading See:

Application Note 150-10. *"Spectrum Analysis...Field Strength Measurement".* HP literature number 5952-9234

Application Note 330-1. *"Automatic MIL-STD EMI Testing Using the HP 85864A/B EMI Measurement Software".* HP literature number 5954-2705.

Application Note 331-1. *"Automatic CISPR EMI Testing for Conducted Emissions Using the HP 85864C EMI Measurement Software".* HP literature number 5952-2724.

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Bold type refers to chapter/section headings.

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