About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual is the best copy we could find; it may be incomplete or contain dated information. If we find a more recent copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available. You will find any other available product information on the Agilent Test & Measurement website, www.tm.agilent.com.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. In other documentation, to reduce potential confusion, the only change to product numbers and names has been in the company name prefix: where a product number/name was HP XXXX the current name/number is now Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

HP 84125A/B

User's Guide

Microwave EMI Measurement Test System

HP Part No. 84125-90011
Printed in USA February 1999

Notice

The information contained in this document is subject to change without notice.

Hewlett-Packard makes no warranty of any kind with regard to this material, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Hewlett-Packard shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Restricted Rights Legend

Use, duplication, or disclosure by the U.S. Government is subject to restrictions as set forth in subparagraph (c) (1) (ii) of the Rights of Technical Data and Computer Software clause at DFARS 252.227-7013 for DOD agencies, and subparagraphs (c) (1) and (c) (2) of the Commercial Computer Software Restricted Rights clause at FAR 52.227-19 for other agencies.

1400 Fountain Grove Parkway, Santa Rosa CA, 95403-1799, USA

Certification

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

Regulatory Information

Regulatory information is located in Chapter 2.

Warranty

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

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

Hewlett-Packard warrants that its software and firmware designated by Hewlett-Packard for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error-free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HEWLETT-PACKARD SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Exclusive Remedies

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Assistance

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products. For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

Compliance

This instrument has been designed and tested in accordance with IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

Safety Notes

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

WARNING

Warning 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 note until the indicated conditions are fully understood and met.

CAUTION

Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, would 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.

General Safety Considerations

WARNING

- **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.**
- **If this instrument is not used as specified, the protection provided by the equipment may be impaired. This instrument must be used in a normal condition (in which all means for protection are intact) only.**
- **For continued protection against fire hazard, replace line fuse only with same type and rating ([F 5A/250V]). The use of other fuses or material is prohibited.**

CAUTION

- Before switching on this instrument, make sure that the line voltage selector switch is set to the voltage of the power supply and the correct fuse is installed.
- Always use the three-prong ac power cord supplied with this instrument. Failure to ensure adequate earth grounding by not using this cord may cause instrument damage.
- Only clean the instrument cabinet using a damp cloth.

	The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.
CE	The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)
ISM1-A	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.
CSA	The CSA mark is a registered trademark of the Canadian Standards Association.

Manual Conventions

(Front-Panel Key)	This represents a key physically located on the instrument.
`Softkey`	This indicates a "softkey," a key whose label is determined by the firmware of the instrument.
`Screen Text`	This indicates text displayed on the instrument's screen.

Contents

Figures

Tables

1

Product Description

The HP 84125A/B microwave EMI measurement test system is designed to measure the radiated energy from an unintentional or intentional radiator such as a transmitter or transceiver. It provides a system level solution to make measurements above 1 GHz. The HP 84125A/B system is designed to test products for EMI compliance to current FCC regulations governing emissions and has the performance necessary for measuring to current ETSI and CISPR regulations in the same frequency band.

The system is integrated into a portable instrument cart for easy transport to and from the test location. There are two major components of the system: a hand-held, tripod-mountable or antenna mast-mountable test set and the EMC analyzer mounted on an instrument cart. The test set contains two low noise amplifiers, high-pass filters, antenna, and interconnecting cables. A three-meter RF cable assembly connects the test set to the EMC analyzer and allows the test set to be moved around without moving the instrument cart. The RF cable assembly contains a rugged, low loss, high frequency cable and two DC power cables for the amplifiers.

The calibration data is stored on a RAM card during factory calibration of the HP 84125A/B microwave EMI measurement test system and is shipped with each HP 84125A/B system. The calibration data is specific to that system. The RAM card contains amplitude correction factors for the test set and the antenna.

To combine the functionality of the HP 8593EM EMC analyzer and the test set, a downloadable program (DLP) has been provided. The DLP provides the system softkeys that set the parameters for making an EMI measurement. Frequency ranges can be selected enabling you to test the harmonic frequencies of your equipment under test (EUT) while filtering out the fundamental frequencies. Correction data is used to sum out losses due to the antenna, cables, amplifiers, and filters. The values displayed by the HP 84125A/B system are the actual field strength of the emission (in dBμV/m), corrected for all system gains and losses including the antenna transducer factors. A limit line is provided to assist you in identifying problem emissions. The EMC analyzer is automatically setup for optimum signal identification.

Each system is calibrated by Hewlett-Packard before shipment. The calibration data consists of amplifier gain, cable loss, filter response, and antenna factors. The data is then stored into data correction tables which are loaded into the HP 8593EM EMC analyzer's RAM card for easy recall during each measurement band.

Measurement Overview

The HP 84125A/B microwave EMI measurement test system may be used for a variety of measurements. To assure the best, most accurate measurements of your product, you should read and review the required product regulations. The following is a brief description of how to use the system to test a product to the FCC Part 15 regulation. A detailed measurement example for measuring an intentional radiator has been provided in Chapter 6.

Current FCC regulations specify that harmonic emissions measured above 1 GHz on wireless transmitters should be below 54 dBμV/m using average detection at a distance of 3 meters. At higher frequencies, cable loss and antenna factors bring the inherent system noise level close to the regulatory limit. To improve the signal-to-noise ratio, the FCC allows positioning the measuring antenna at a distance closer than 3 meters. The correction to be applied is described in FCC, Part 15.31 (f)(1) which states:

> "At frequencies equal to or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field; and, it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measuring equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than what is specified, the results shall be extrapolated to the specified distance using an inverse linear distance extrapolation factor (20 dB/decade)."

This would translate to measuring to a limit of approximately 64 dBμV/m at a distance of 1 meter. Therefore, we recommend that you first make a measurement at a distance of 1 meter to the 64 dBμV/m limit line with peak detection. Using a 1 meter measurement will improve the signal-to-noise ratio making it easier to detect emissions. Signals with a peak value above the 64 dBμV/m limit line will need to be remeasured using average detection.

2

Specifications and Characteristics

This chapter contains specifications, characteristics, and typical performance for the HP 84125A/B system.

Definition of Terms

Specifications describe warranted performance which is traceable to the National Bureau of Standards (NIST).

Characteristics describe non-warranted performance derived during the design phase of the system and is not verified on a continuing basis.

Typical Performance is non-warranted, but indicates performance which most units will exhibit.

Frequency Range	
HP 84125A	1 to 18 GHz
HP 84125B	1 to 26.5 GHz

HP 8593EM EMC Analyzer

Additional instrument specifications are described in *HP 8590 EM Series EMC Analyzer Calibration Guide.*

EMC Analyzer Display Average Noise Level (Measured at test-set input with 1 MHz RBW)[1]	**Specification**	**Typical**
1 to 18 GHz	8 dBμV	–1 dBμV
18 to 26.5 GHz[2]	15 dbμV	5 dbμV

1 For use with the through cable or the correct high-pass filter for the selected frequency range

2 For an HP 84125B only.

Limit to Noise Ratio / Sensitivity (Characteristic)

>6 dB (at 64 dBμV/m)

Test Set (Includes amplifiers, filter, and RF cable assembly.)	
Calibration Data Uncertainty	±0.9 dB
Flatness Uncertainty (Characteristic)	±1.7 dB
Test-Set Repeatability (Characteristic)[1]	±0.7 dB
Maximum Temperature Drift (Characteristic)[2]	±1.5 dB
Input VSWR (Characteristic)	
1 to 18 GHz	3.2 to 1.0
18 to 26.5 GHz[3]	2.3 to 1.0

1 Includes cable flexure, amplifier aging, and connection repeatability.

2 The system is specified between 20°C and 30°C.

3 For an HP 84125B only.

Test-Set Filter Rejection (characteristic)		
Frequency Range	**Passband**	**60 dB Rejection**
1 to 18 GHz	1.5 to 18 GHz	≤0.95 GHz
1 to 18 GHz	3.5 to 18 GHz	≤2.5 GHz
1 to 18 GHz	8.25 to 18 GHz	≤ 5.9 GHz

Antenna Specifications and Characteristics

Antenna Factor Accuracy		
1 to 18 GHz	HP 11966E	± 2 dB
18 to 26.5 GHz[1]	HP part number 84125-80008	± 0.5 dB

1 For an HP 84125B only.

VSWR (characteristic)	
1 to 18 GHz (HP 11966E)	2.8 to 1.0
18 to 26.5 GHz (p/n 84125-80008)[1]	1.4 to 1.0

1 For an HP 84125B only.

Third Order Intercept (characteristic)
>45 dBμV

Weight		
Test Set[1]	10.75 lb.[2]	23.7 kg
HP 84125A/B System[3]	150 lb.	330.8 kg

1 The weight includes the 1 to 18 GHz antenna horn.

2 For an HP 84125B, with the 18 to 26.5 GHz antenna horn installed, the test-set weight is 7.5 lb or 16.5 kg.

3 Includes EMC analyzer, instrument cart, and test set.

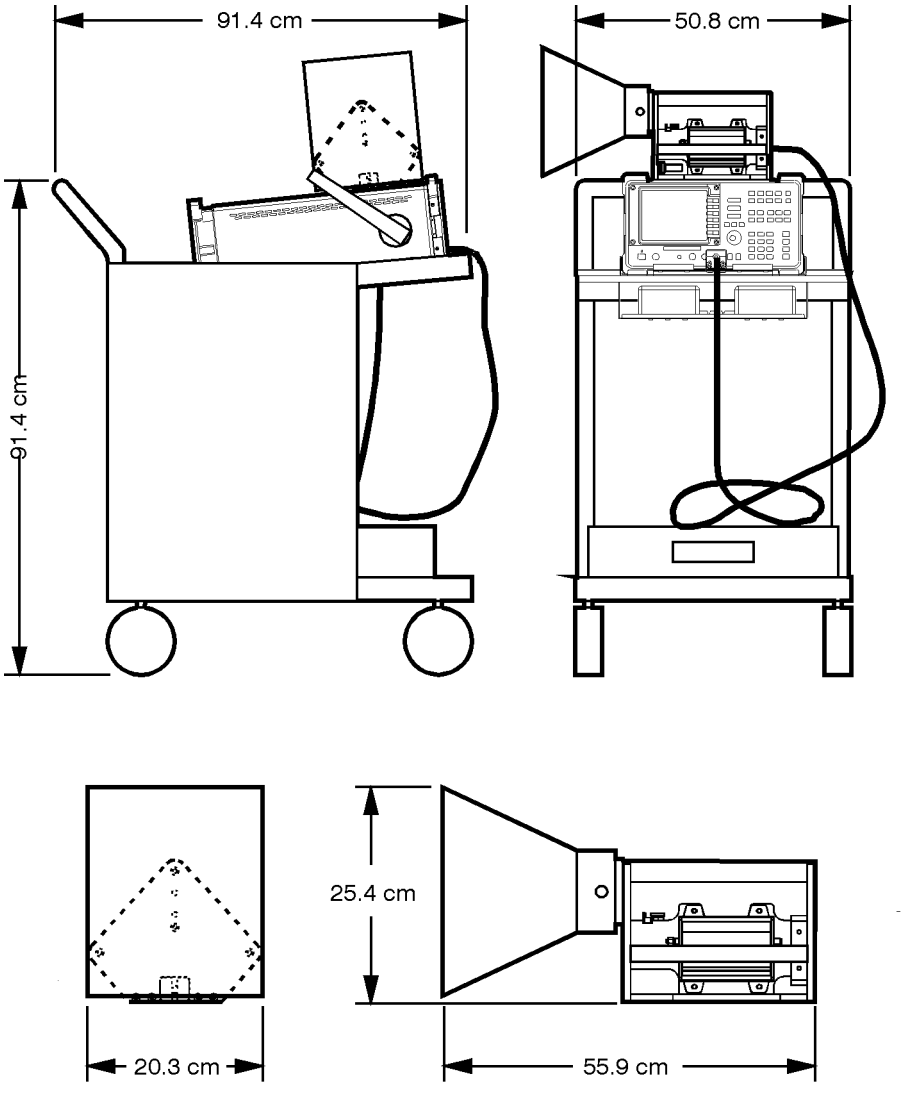


Figure 2-1. HP 84125A/B System Dimensions

Typical Sensitivity for an HP 84125A/B System

Note The values displayed by the HP 84125A/B system are the actual field strength of the emission (in dBμV/m), corrected for all system gains and losses including the antenna transducer factors.

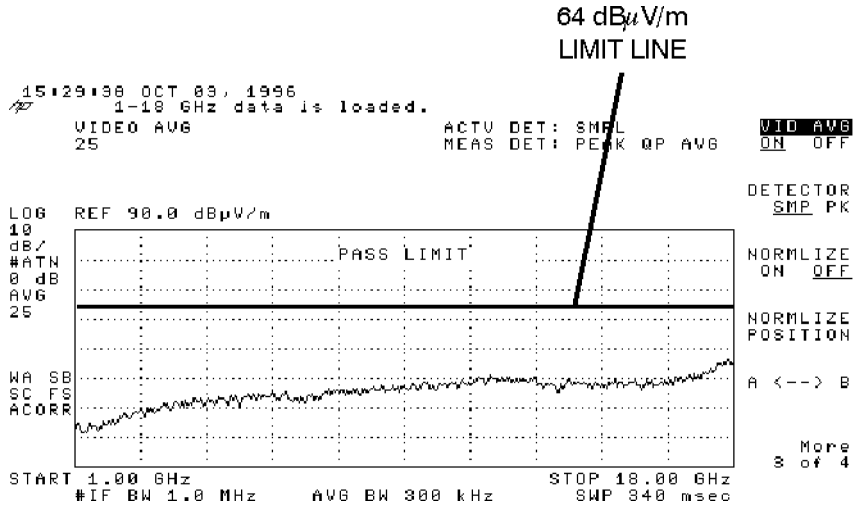


Figure 2-2. Typical Sensitivity from 1 to 18 GHz

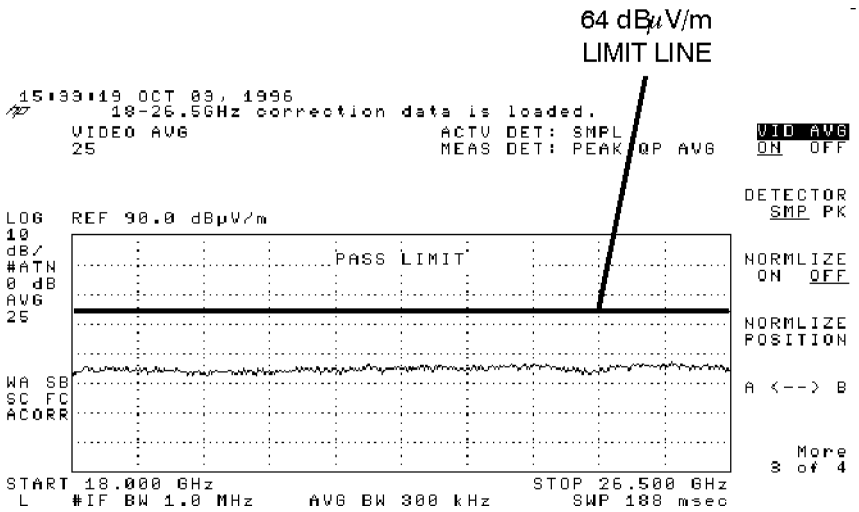


Figure 2-3. Typical Sensitivity from 18 to 26.5 GHz

Amplitude Accuracy

The table below shows the typical amplitude uncertainty for the HP 84125A/B system. The following conditions must be met to assure the amplitude accuracy of your system.

1. The HP 84125A/B system has been warmed up for 30 minutes or more at a stable temperature between 20 °C and 30 °C.
2. The EMC analyzer has successfully completed a full self calibration.
3. The HP 84125A/B system has valid calibration data.
4. The HP 84125A/B system has the correct correction data loaded for the selected antenna and frequency range.
5. The measurement is made with the EMC analyzer in Linear Scale mode with a resolution bandwidth (RBW) of 1 MHz.
6. While the measurement is made, the EMC analyzer reference level is kept at >56 dBμV/m when using the 1 to 18 GHz antenna, or >48 dBμV/m when using the 18 to 26.5 GHz antenna.
7. While the measurement is made, the measured signal is kept within the top four divisions (that is, the top half) of the display.

These conditions should work in most measurement situations. However, if conditions 5, 6, or 7 cannot be met, the measurement uncertainty should be calculated using the method detailed in Appendix A.

Amplitude Accuracy (typical)	
1.0 to 2.9 GHz	6.10 dB
2.75 to 6.5 GHz	6.18 dB
6.0 to12.8 GHz	6.29 dB
12.4 18.0 GHz	6.43 dB
18.0 to 22.0 GHz	4.28 dB
22.0 to 26.5 GHz	5.36 dB

Declaration of Conformity

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	Hewlett-Packard Co.
Manufacturer's Address:	Santa Rosa Systems Division 1400 Fountaingrove Parkway Santa Rosa, CA 95403-1799 USA

declares that the product

Product Name:	Microwave EMI Measurement System
Model Number:	HP 84125A, HP 84125B
Product Options:	This declaration covers all options of the above products.

conforms to the following Product specifications:

Safety: EN 61010-1:1993
CAN/CSA-C22.2 No. 231 (Series M-89)

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV Sig. Lines, 1 kV Power Lines

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and is marked accordingly.

Santa Rosa, California, USA 30 Oct. 1996

John Hiatt/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department HQ-TRE, Herrenberger Strasse 130, D-71034 Böblingen, Germany (FAX +49-7031-14-3143)

Figure 2-4. Declaration of Conformity

3

System Setup and Functional Tests

System Setup

The following procedure will assist you in setting up your HP 84125A/B system.

Initial Inspection

Your HP 84125A/B system is sent to you in three shipping containers. Inspect the shipping containers for damage. Use Table 3-1 to verify that the contents are complete. It is important that you retain the shipping containers for returning the system in one year for recalibration. See "Returning the HP 84125A/B System for Calibration or Service " in Chapter 7 for more information.

Test-Set Components

Table 3-1. HP 84125A/B System Accessories

Description	HP Part Number	Comments
System Rack Box (largest carton)		
Testmobile Instrument Cart	HP 1182A	Shipped assembled except for the handle and casters. The handle and hardware are contained in a carton within the system rack carton. The casters and hardware are attached to the bottom of the cart.
Accessory carton includes:		
#10 torx driver	8710-1623	
#15 torx driver	8710-1622	
8-in lb, 5/16 inch torque wrench	8710-1765	
High-Pass Filter, 1.5 GHz	84300-80037	
High-Pass Filter, 3.5 GHz	84300-80038	
High-Pass Filter, 8.25 GHz	84300-80039	
Std. Gain Horn Antenna, 18 to 26.5 GHz	84125-80008	Shipped with an HP 84125B only
Power Module	HP 92199E	Includes EMCO 3160-09 manual
Cable, Type N (m) to SMA (f)	84125-20043	
Cable, 2.4 mm (m) to 2.92 mm (m)	84125-20044	Shipped with an HP 84125B only
Adapter, SMA (m) to SMA (m)	1250-1159	Adapter is attached to W3 (84125-20043) and should remain in this configuration.
Double-Ridged Horn Antenna, 1 to 18 GHz	HP 11966E	Includes EMCO 3115 (HP 11966E) manual
Power Supplies	HP 87421A	Two, $\pm 12V_{DC}$, 25W
Power Cords	8120-1396	Four, 30-inch power cords; located in the cart drawer
Power Cord (system)		The part number varies in accordance with plug type used in your country.
Read Me First Document	84125-90002	Attached to the top of the accessories carton
HP 84125A/B User's Guide	84125-90011	
HP 1182A Operating Instructions	N/A	Taped to the bottom of the cart with the casters
EMCO 3160-09 (p/n 84125-80008) manual	N/A	Shipped with an HP 84125B only
Hardware packet for installing the EMC analyzer	N/A	Packet is taped to the top of the rack tray.

Table 3-1. HP 84125A/B System Accessories (continued)

Description	HP Part Number	Comments
EMC Analyzer Box (medium-sized carton)		
Memory Card (RAM)	08591-10008	Blank RAM memory card
Memory Card (ROM)	08590-10027	ROM memory card with EMC setups, limit lines, and correction factors
Memory Card Holder	9222-1545	Two holders included
User's Guide	5963-2930	
Quick Reference Guide	5963-2929	
Calibration Guide	5962-0467	
Adapter BNC (m) to SMA (f)	1250-1700	
Connector, APC-3.5 mm (f) to (f)	5061-5311	
Reference Connector	1250-1499	Shipped connected between the 10 MHz REF OUT and the EXT REF IN on the rear panel of the EMC analyzer.
Cable, SMA (m) to SMA (m)	08592-60061	
Keyboard overlay	5182-1204	Overlay for external keyboard
Power cable		Not used, appropriate cable is supplied with the system.
Test Set Box (smallest carton)		
Test Set		Includes amplifiers and appropriate cabling
Through Line	84125-20019	
Cable, 2.92,(k) (m) to 2.4 (m)	84125-20042	
HP 84125A/B RAM Card	N/A	Contains the DLP and system correction factors.

Installing the HP 84125A/B System

The following procedure will assist you with installing your HP 84125A/B system.

Assembling the Test Mobile Instrument Cart

1. From the largest carton, carefully remove the cart from its shipping container and the items contained in the space between the drawer and the upper shelf of the cart.

Note The instrument strap will not be used for this installation.

2. Assemble the casters (that is,wheels) and the cart handle to the cart as shown in the *HP 1182A Testmobile Instrument Cart and Accessories Operating Guide*.

Installing the EMC Analyzer

Refer to Figure 3-1 to assist you with the following procedure.

1. Remove the EMC analyzer from the medium-sized carton.
2. Remove the packet of hardware from the top shelf of the cart. The hardware will be used to assemble the system.
3. To attach the EMC analyzer onto the metal bracket on top of the shelf:
   a. Center the analyzer over the bracket with the front end of the analyzer tilted upwards.

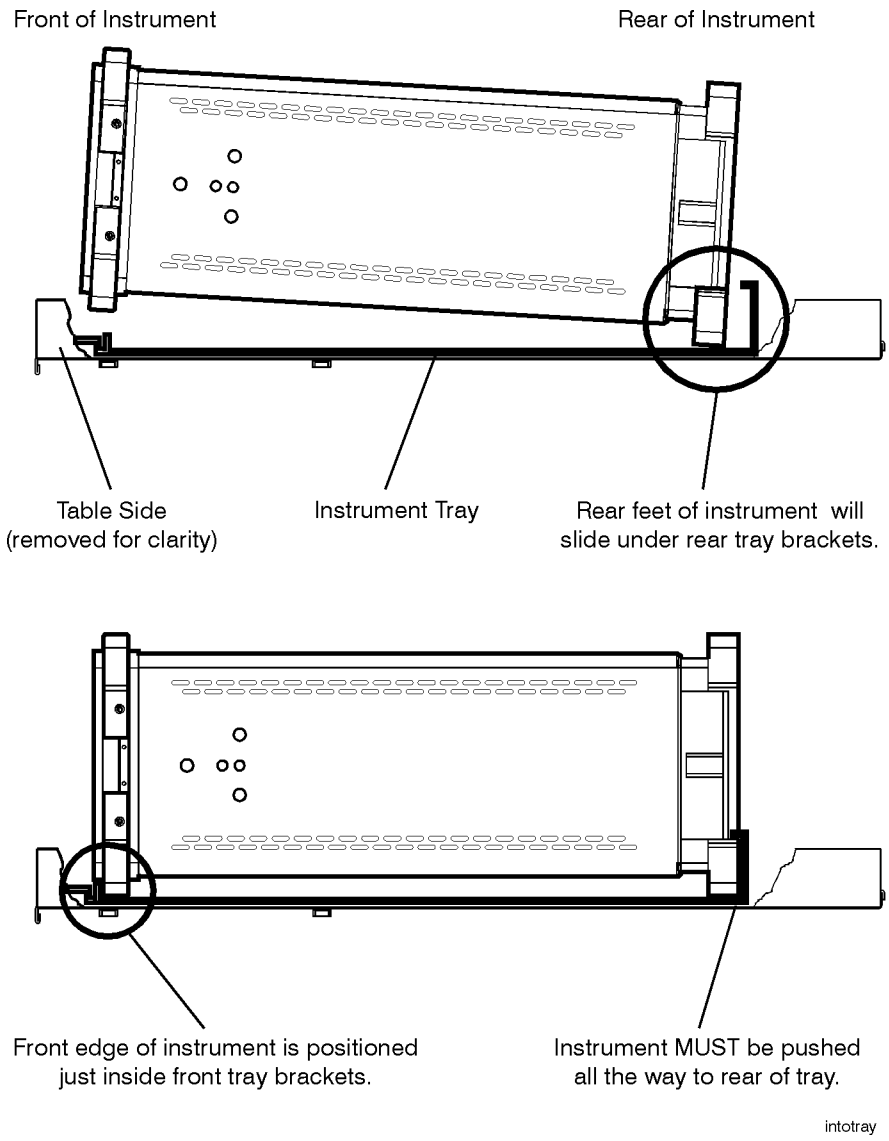


Figure 3-1. EMC Analyzer Installation

b. Slide the rubberized bumpers on the back of the analyzer under the folded tabs on the back of the bracket.

c. Lower the front of the analyzer into the bracket so that the front lower bumpers fit behind the front tabs of the bracket.

4. Position the analyzer clamps as shown in Figure 3-2 and loosely attach with four 4.0 mm X 16 mm screws.

5. Align the front edge of the clamp with the front edge of the bracket then tighten the hold-down screws.

Attaching the Power Module and Power Cords

1. Attach the power cord module (found in the accessories carton) to the rear-upper cart support. Use the metal posts located on the far right-hand side of the cart when viewed from the rear of the cart. The power cord module is grooved to slip over the metal posts.
2. Plug the power cord into the power module for the two amplifier power supplies (located on the bottom of the tiltable shelf).
3. Plug in the EMC analyzer using one of the 30-inch power cords.
4. Attach the 8-foot long power cord supplied with the system to the power cord module.

CAUTION

Notice that the input end of this cable is specific to the country receiving the system. Before connecting the system to a power source, make sure that the EMC analyzer line module is configured for the proper voltage requirements. Refer to Chapter 1 of the *HP 8590 EM Series EMC Analyzer User's Guide* for complete instructions.

Installing the Accessories and Test Set in the System

1. Open the drawer of the cart and remove all of the contents except the foam filler. Position the foam filler at the back of the drawer.
2. Remove the shipping foam with the accessories from the accessory carton and place it in the front of the drawer. This is a convenient place to store the system hardware.
3. Remove the test set with its attached three-meter RF cable assembly from the smallest carton and place it on top of the EMC analyzer. Position the analyzer handle so that it rests against the back of the analyzer.
4. The test-set carton also contains the HP 84125A/B RAM card for the EMC analyzer. Install the RAM card into the memory card slot located underneath the analyzer display. To install the RAM card:
   a. Position the card with the label facing upwards.
   b. Press the card into the slot. When correctly inserted, about 19mm (0.75 in) of the card is exposed from the slot.

Performing an EMC Analyzer Calibration

Data from the self-calibration routine is necessary for proper operation of the EMC analyzer. Executing the self-calibration routine ensures that the EMC analyzer is using current calibration data that improves the EMC analyzer frequency and amplitude accuracy. The EMC analyzer should be turned on and allowed to warm up for at least 30 minutes before performing the self-calibration routine or attempting to make any measurements. The addition of the correction factors is required to meet frequency and amplitude specifications. This is a convenient point in the system installation to perform an EMC analyzer calibration, since the RF cable assembly is not yet connected to the INPUT 50Ω of the analyzer.

Refer to "Calibrating the HP 8593EM EMC Analyzer" in Chapter 6 to perform a frequency and amplitude calibration.

Note

Since the system functional tests also require the RF cable assembly to be removed from the INPUT 50Ω of the analyzer, you may elect to perform the system functional tests at this time. Additional equipment and accessories will be required to perform these tests. Refer to "System Functional Tests" later in this chapter.

Connecting the RF Cable Assembly to the EMC Analyzer

Refer to Figure 3-2 for the following procedure.

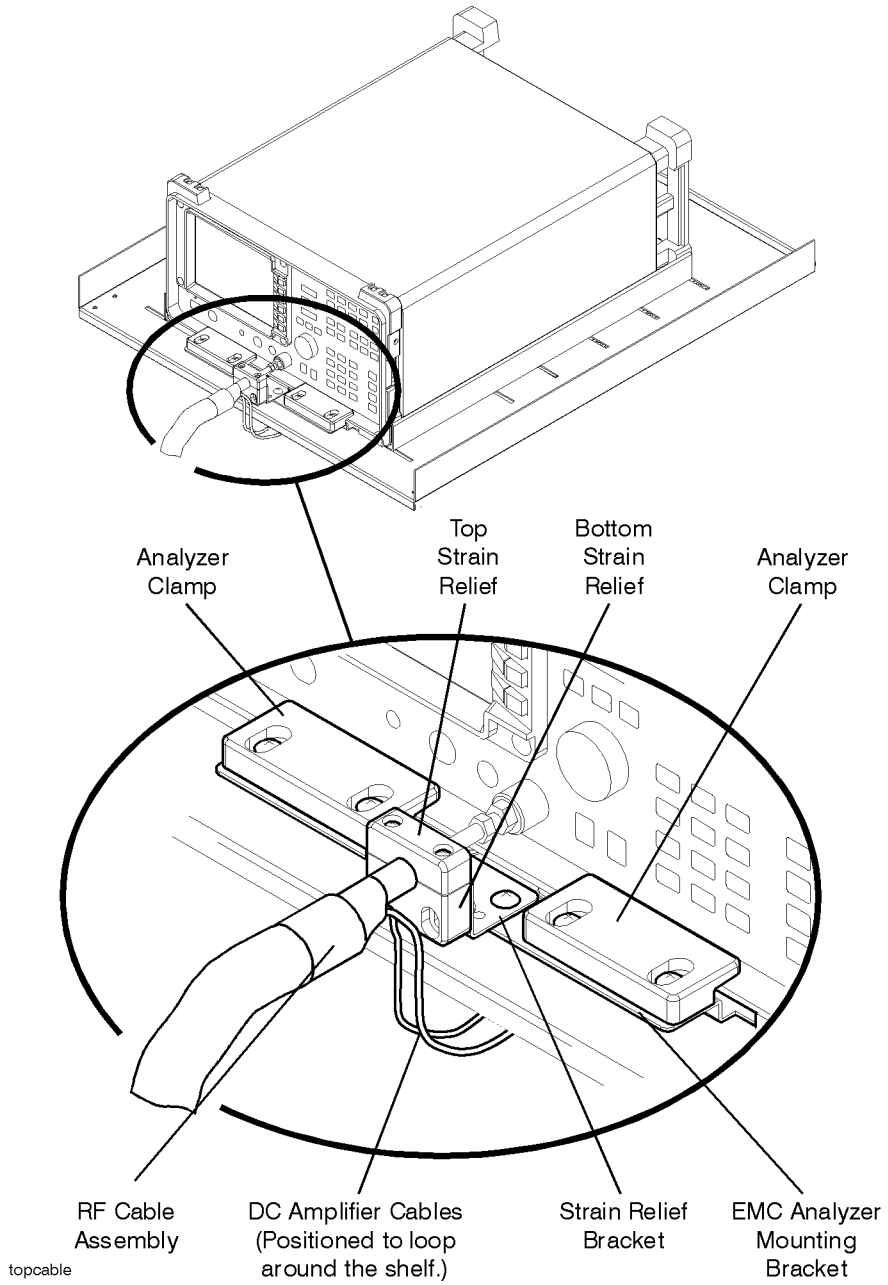


Figure 3-2. Front view of the EMC Analyzer

1. Use a #15 torx driver and two 4.0 mm X 12.0 mm torx screws to attach the strain-relief support bracket to the EMC analyzer mounting bracket. Notice that the strain-relief bracket has four holes in the bottom surface. Use the two holes furthest from the strain relief.

Note

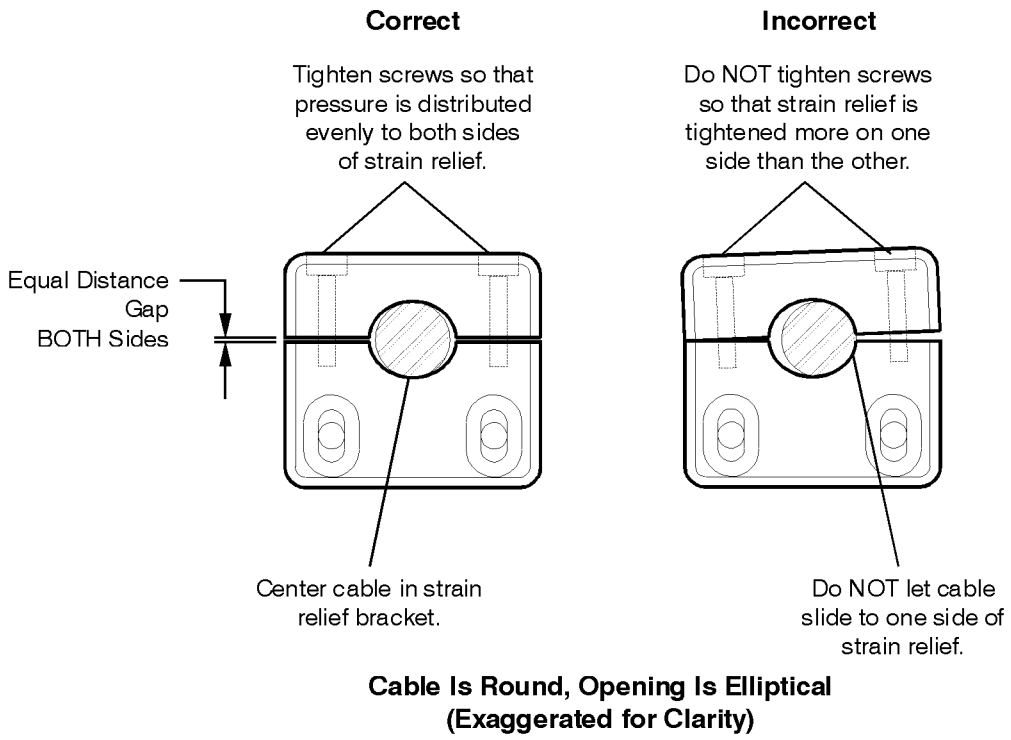
Be sure to use the correct adapter when connecting the RF cable assembly to the EMC analyzer.

2. Connect the RF cable assembly from the test set to the EMC analyzer INPUT 50Ω using the 3.5 mm (f) to (f) RF adapter (part number 5061-5311) supplied with the EMC analyzer. Before torquing the connector, make sure the two DC power cables are facing toward the bottom of the cart. Use the torque wrench to torque the connector to 8-inch pounds.
3. The RF cable strain relief has a top and bottom section. The bottom section has two slotted holes in one surface. Use a #10 torx driver and two 3.5 mm X 16.0 mm screws to attach the bottom section to the strain-relief bracket. Tighten the screws just enough to hold the bottom strain relief against the bracket surface.
4. Use a #10 torx driver and two 3.0 mm X 14.0 mm screws to attach the top section of the strain relief to the bottom section of the strain relief. Tighten the screws to properly secure the RF cable.

CAUTION

Be sure to leave an equidistant gap (that is, spacing) between the top and bottom portion of the strain relief. This will ensure that the maximum amount of strain relief is supplied to the RF cable assembly. Refer to Figure 3-3 for proper strain-relief installation.

5. Tighten the bottom strain relief screws.



strain

Figure 3-3. Strain Relief Installation

Connecting the DC Amplifiers to the RF Cable Assembly

Refer to Figure 3-4 for the following procedure.

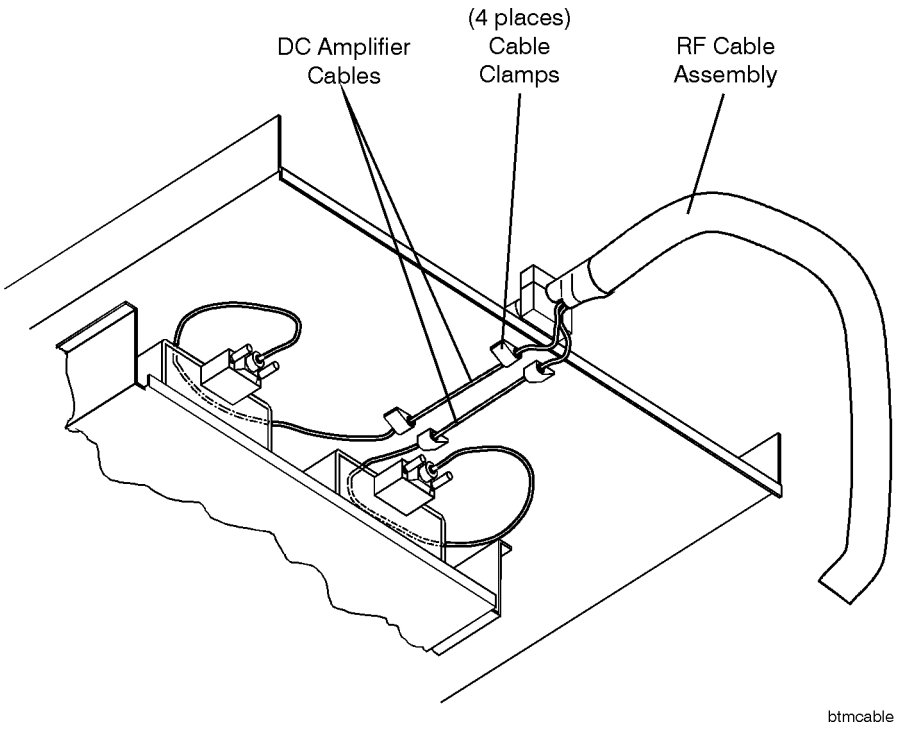


Figure 3-4. DC Amplifiers Cable Routing

1. Locate the two DC amplifier cables where they separate from the RF cable assembly. Position the DC amplifier cables so that they loop around the edge of the shelf. Clamp the cables to the bottom of the shelf using four 4.0 mm screws and four cable clamps.

   The loop should be large enough that normal cable flexure will not cause the DC cables to rub the shelf edge. Any excess cable length should be routed above the two amplifier power supplies mounted on the bottom of the shelf.

2. Connect the two DC amplifier cables to the two power supplies.

3. Configure the test set with the required filters, antenna, and cables for your testing needs. Refer to Chapter 4 for more information on test set configurations.

System Functional Tests

The purpose of the system functional tests are to verify that the HP 84125A/B microwave EMI measurement test system is operating correctly. The test consists of two sections:

- Test Set Verification
- Displayed Average Noise Level

Test Set Verification Description

This test procedure instructs you to perform specific tests that will verify the functionality and performance of the system. Completion of these tests will verify that the:

- EMC analyzer calibration passes
- Downloadable program (DLP) is loaded and operational
- Amplifiers, cables, and filters are operating properly (that is, measures the gain of the test set)
- Proper correction factors are loaded into the EMC analyzer

The DLP is used to set up the initial EMC analyzer settings and also loads the correction factors for the test set, which includes correction factors for the antenna, amplifiers, cables, and filters, into the EMC analyzer.

The synthesized sweeper provides a stable continuous wave (CW) signal which is fed through a 10 dB attenuator directly into the input of the EMC analyzer. See Figure 3-5. A frequency of 10 GHz is used as the reference point for the gain calculation as it is common to all frequency bands except for the 18 to 26.5 GHz range (that is, HP 84125B only). In this range, a 20 GHz reference point is used.

The beginning of this procedure requires the EMC analyzer portion of the system (that is, the test set) is bypassed. Therefore, the correction factors for the test set must be deactivated to ensure correct power level readings on the EMC analyzer. The synthesized sweeper output power level is adjusted for a −45 dBm signal on the EMC analyzer display and the power level is recorded in Table 3-4.

The test set output cable is connected to the input of the EMC analyzer replacing the 10 dB attenuator and cable from the synthesizer. The correction factors for the test set (`OTHER FACTORS`) are activated in the analyzer. The "Other Factors" contains the calibration factors for the entire test set, excluding the antenna factors. Once the "Other Factors" are activated, the output of the synthesized sweeper is fed through the same 10 dB attenuator directly into the input of the test set. See Figure 3-6. If the system is functioning properly, the EMC analyzer display should indicate a level of approximately −45 dBm. The Marker Delta function of the EMC analyzer is activated to determine the error difference between the −45 dBm calibration signal and the displayed level on the EMC analyzer. The Marker Delta amplitude is recorded in Table 3-4.

A data table (Table 3-4) is provided to record measurement results. The same test method can be performed to measure additional or specific frequency points, if necessary (*ensure that the appropriate hardware is correct for the configuration selection*).

Note

These tests are intended for basic system verification purposes only. The test methods being used result in a higher level of measurement uncertainty. Therefore, the measurement uncertainty factor has been increased.

Table 3-2.
Recommended Test Equipment and Accessories

Equipment and Accessories	Critical Specifications for Equipment Substitution	Recommended Model
Synthesized Sweeper[1]	Frequency Range: 1 to 20 GHz	HP 83711B Option 1E1
Synthesized Sweeper[2]	Frequency Range: 1 to 26.5 GHz Internal Step Attenuator	HP 83630A Option 001
10 dB Attenuator[1]	Type N (m to f) Frequency Range: 18 GHz	HP 8491B Option 010
10 dB Attenuator 3.5 mm[2]	3.5 mm (m to f) Frequency Range: 26.5 GHz	HP 8493C Option 010
Adapter	APC 3.5 (f) to APC 3.5 (f)	5061-5311
Adapter	Type N (f) to APC 3.5 (f)	1250-1745
Adapter	Type N (m) to APC 3.5 (f)	1250-1744
Cable	Connectors: APC 3.5 (m) (both ends) Frequency Range: 1 to 26.5 GHz 24 inches long	8120-4921
Termination, 50 Ω	Connector: APC 3.5 (m) Frequency Range: 1 to 26.5 GHz	HP 909D Option 12

1 For use with an HP 84125A only.

2 For use with either an HP 84125A or HP 84125B.

Procedure

1. Connect the equipment as shown in Figure 3-5.

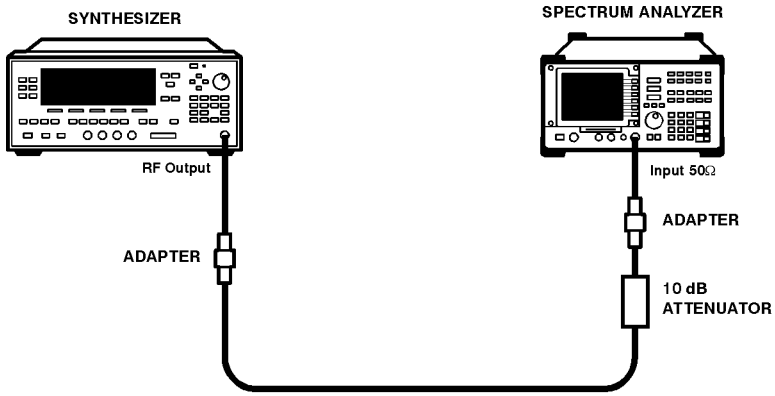


Figure 3-5. Reference Point Setup

2. Press (PRESET) on the EMC analyzer.
3. If the analyzer has not been calibrated recently, refer to "Calibrating the HP 8593EM EMC Analyzer" in Chapter 6 and perform the frequency and amplitude calibration. When completed, *DO NOT* reconnect the test set output to the EMC analyzer INPUT 50Ω.

   Verify that the HP 8593EM EMC analyzer is in EMC analyzer mode.
4. Press, (MODE)

   Verify that `EMC ANALYZER` is underlined. If not, press `EMC ANALYZER`.
5. Press `84125A/B PRESET`, `CONT`, `SELECT CONFIG`.

   If the `HP 84125A/B PRESET` softkey is not present, the DLP is not loaded into the EMC analyzer. Refer to "Reloading the Downloadable Program (DLP) into the EMC Analyzer" in Chapter 7.
6. Select one of the available configurations. The correction factors including the corresponding test set amplitude correction data (that is, amplifiers, filter, and cables summed together), antenna correction data, limit lines, and appropriate EMC analyzer settings for performing an EMI measurement are loaded for the band selected.

   Ensure that the test set hardware is correct for the configuration selected. There are different correction factors for each hardware configuration. Refer to Chapter 4 for test set configuration information.

Note

When either the 1GHZ to 18GHZ or 1.5GHZ to 18GHZ softkeys are selected, the EMC analyzer start and stop frequencies will default to 2.68 to 18 GHz. This is normal operation of the EMC analyzer and is due to the internal RF switching paths of the EMC analyzer. Therefore, if the signal of interest is below 2.68 GHz, you must change the start frequency of the analyzer to the desired frequency below 2.68 GHz; press (FREQUENCY), START FREQ "x" (GHz). The stop frequency will automatically change to 2.9 GHz.

7. Press (PRESET) on the synthesizer/level generator, then set the controls as follows:

   (CW) 10 (GHz) (20 GHz for the 18 to 26.5 GHz range)

   (POWER LEVEL) − 35 (dBm)

8. Connect the synthesizer to the input of the EMC analyzer through the 10 dB pad.

9. Set up the EMC analyzer by pressing the following keys:

   (SETUP), More 1 of 4, Correctn Factors,
   Antenna Factors, ANTENNA ON OFF with OFF underlined

   Previous Menu, Other Factors, OTHER ON OFF with OFF underlined

   Previous Menu, Previous Menu, Limit Lines, Limit 1,
   LIMIT 1 ON OFF with OFF underlined

   (AMPLITUDE), More 1 of 3, Amptd Units, dBm

   (AMPLITUDE), REF LVL, 40 −dBm, ATTEN AUTO MAN, 10 (dB)

   (FREQUENCY), CENTER FREQ, 10(GHz)

   (20 GHz for the 18 to 26.5 GHz range)

   (SPAN), 5 (MHz)

   (BW), (AVG BW), 100 (Hz)

   (AMPLITUDE), More 1 of 3, PRESEL PEAK

   Wait for the "peaking" message to disappear, then press:

   (MKR →), MARKER → HIGH, MARKER → CF

10. Adjust the synthesizer/level generator amplitude until the EMC analyzer display indicates a level of −45 dBm.

11. Record the synthesizer/level generator output level in Table 3-4.

12. Press, (MKR →), MARKER Δ.

13. Disconnect the synthesizer/level generator cable from the EMC analyzer INPUT 50Ω leaving the 10 dB attenuator on the end of the cable.

14. Connect the RF cable assembly from the test set to the EMC analyzer INPUT 50Ω using the 3.5 mm (f) to (f) RF adapter supplied with the EMC analyzer. Refer to Figure 3-6. Torque the connector to 8 inch lbs.

15. Activate the test set correction factors, excluding antenna factors, in the EMC analyzer as follows:

    (SETUP), More 1 of 4, Correctn Factors, Other Factors, OTHER ON

16. Connect the synthesizer/level generator cable with a 10 dB attenuator to the input of the test set. Refer to Figure 3-6.

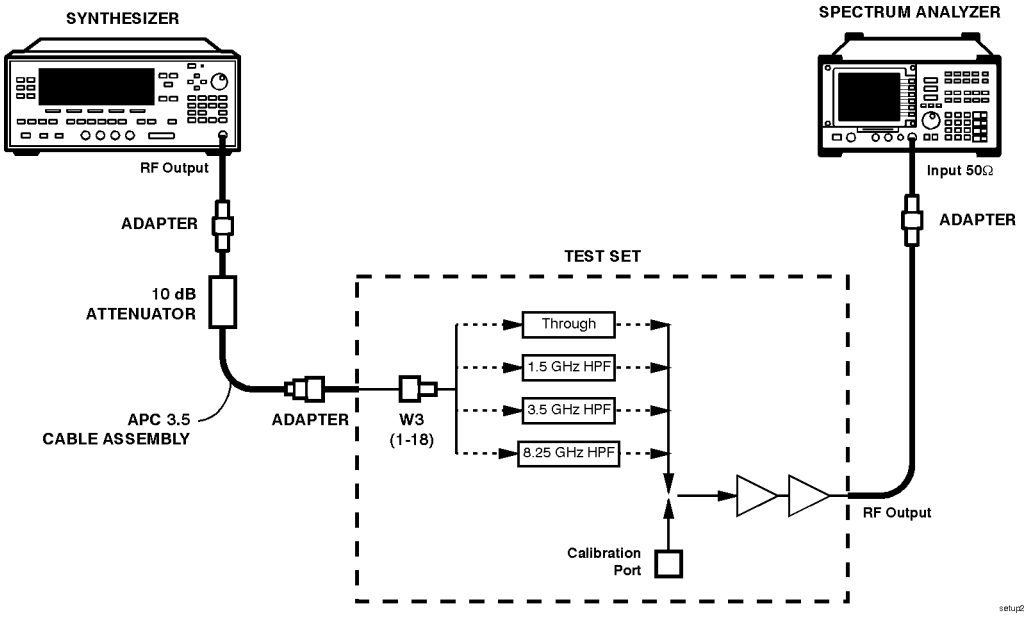


Figure 3-6. System Gain Verification

17. Record the MARKER Δ amplitude in Table 3-4.

18. Repeat steps 5 through 17 for the remaining test frequencies listed in Table 3-4. You can also verify HP 84125A/B system functionality at other frequency points by repeating the above procedure at the frequency point of interest.

Displayed Average Noise Level (DANL) Description

This test measures the displayed average noise level of the HP 84125A/B microwave EMI measurement test system.

The test set is connected to the input of the EMC analyzer. The DLP is used to set up the initial EMC analyzer settings and to load the correction factors for the complete test set. This includes the correction factors for the antenna (that is, Antenna Factors) and correction factors for the amplifiers, cables, and filters which is stored in the "Other Factors" register of the EMC analyzer. The antenna is replaced with a 50 ohm termination and the antenna

correction factors are turned off in the analyzer. Video averaging is activated and the displayed average noise is measured over a selected frequency range.

Equipment Required

Table 3-3.
Recommended Test Equipment and Accessories

Equipment and Accessories	Critical Specifications for Equipment Substitution	Recommended Model
Adapter	APC 3.5 (f) to APC 3.5 (f)	5061-5311
Adapter	Type N (f) to APC 3.5 (f)	1250-1745
Termination, 50 Ω	Connector: APC 3.5 (m) Frequency Range: 1 to 26.5 GHz	HP 909D Option 12

Procedure: Input 1 to 18 GHz (1 to 2.9 GHz, 2.68 to 18 GHz)

1. Connect equipment as shown in Figure 3-7.

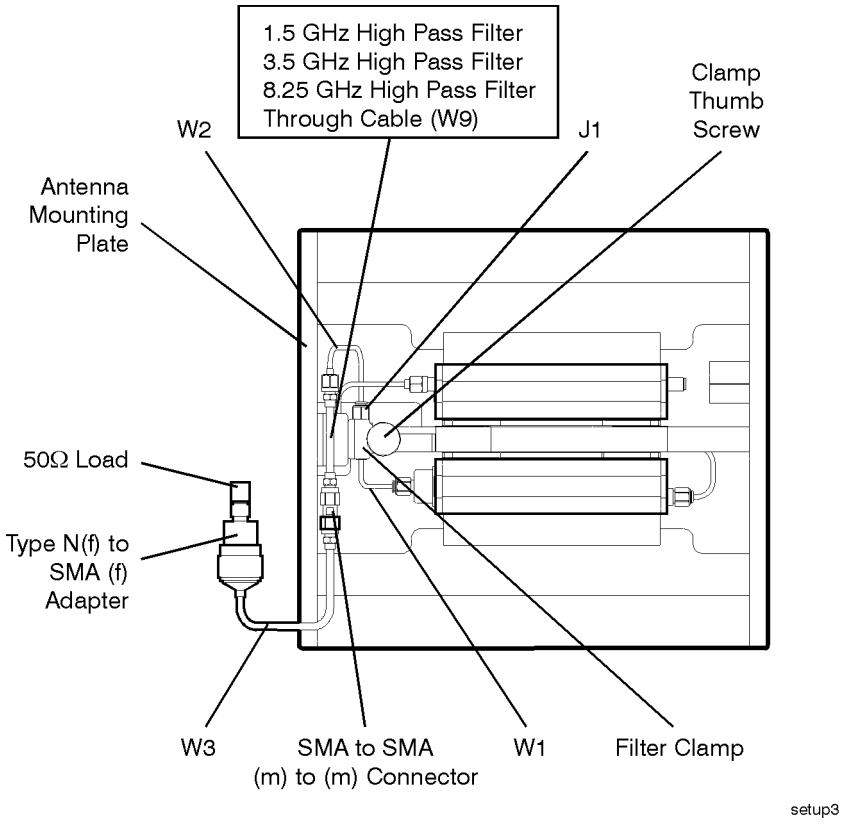


Figure 3-7. DANL Measurement Setup, 1 to 18 GHz

2. Press (MODE) and verify that `EMC ANALYZER` is underlined. If not, press `EMC ANALYZER`.

3. Press 84125A/B PRESET, CONT, SELECT CONFIG.

4. Press 1 GHZ to 18 GHZ to select the 1 to 18 GHz configuration.

   Ensure that the test set hardware is correct for the configuration selected. There are different correction factors for each hardware configuration. Refer to Chapter 4 for proper test set hardware configuration.

Note

When either the 1GHZ to 18GHZ or 1.5GHZ to 18GHZ softkeys are selected, the EMC analyzer start and stop frequencies will default to 2.68 to 18 GHz. This is normal operation of the EMC analyzer and is due to the internal RF switching paths. Therefore, if the signal of interest is below 2.68 GHz, you must change the start frequency of the analyzer to the desired frequency below 2.68 GHz; press (FREQUENCY), START FREQ "x" (GHz). The stop frequency will automatically change to 2.9 GHz.

5. Press (FREQUENCY), START FREQ, 1 (GHz). The analyzer stop frequency will automatically default to 2.9 GHz.
6. Connect the 50 ohm termination to W3. See Figure 3-7.
7. Setup the EMC analyzer settings by pressing the following keys:
   a. (SETUP), More 1 of 4, Correctn Factors, Antenna Factors, ANTENNA ON OFF with OFF underlined.
   b. Previous Menu, Previous Menu, Limit Lines, Limit 1, LIMIT 1 ON OFF with OFF underlined.
   c. (AMPLITUDE), More 1 of 3, Amptd Units, dBμV, (AMPLITUDE), REF LVL, 40 (dBμV).
8. Use the RPG knob on the EMC analyzer to center the noise on the analyzer display.
9. Press the following EMC analyzer keys:
   - (TRACE), More 1 of 4, More 2 of 4, VID AVG ON OFF with ON underlined, 25 (ENTER).

     Wait for the completion of 25 sweeps.
10. Press, (MKR →), MARKER → HIGH and record the marker frequency and amplitude in Table 3-5.
11. To measure the Displayed Average Noise Level from 2.68 to 18 GHz, repeat the above procedure skipping step 5.

Input 18 to 26.5 GHz (For an HP 84125B only)

1. Connect equipment as shown in Figure 3-8.

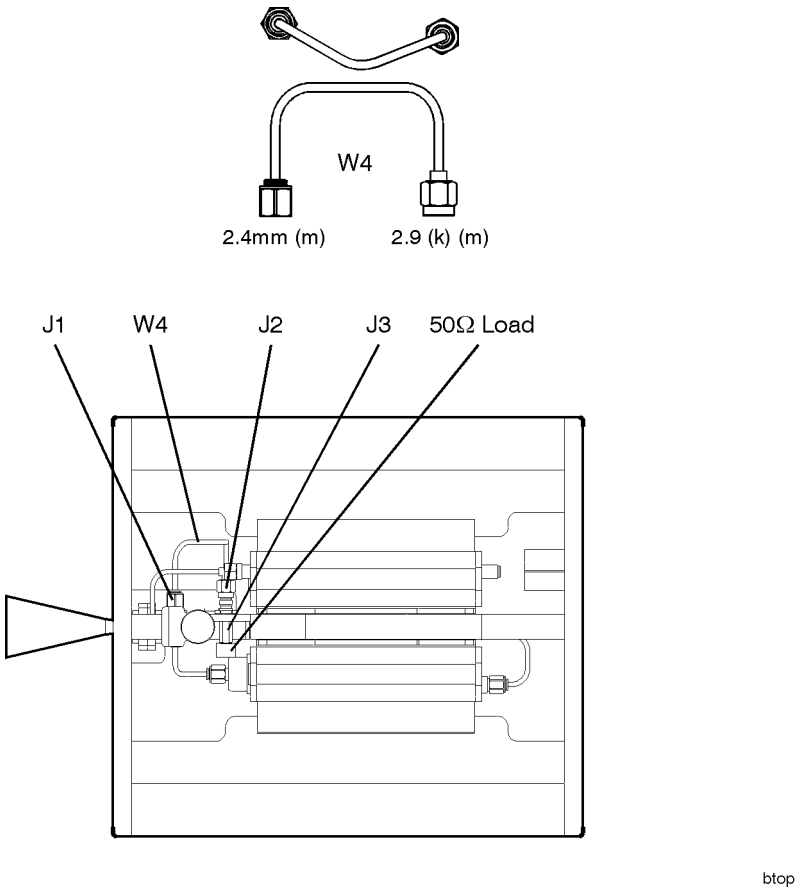


Figure 3-8. DANL Measurement Setup, 18 to 26.5 GHz

2. Press (MODE) and verify that `EMC ANALYZER` is underlined. If not, press `EMC ANALYZER`.
3. Press `84125B PRESET`, `CONT`, `SELECT CONFIG`.
4. Press `18GHZ to 26.5GHZ` to select the 18 to 26.5 GHz configuration.

   Ensure that the test set hardware is correct for the configuration selected. There are different correction factors for each hardware configuration. Refer to Chapter 4 for proper test set hardware configuration.
5. Connect the W4 from J1 to J2. Refer to Figure 3-8.
6. Connect the 50 ohm termination to J3. Refer to Figure 3-8.
7. Change the EMC analyzer settings by pressing the following keys:
   a. (SETUP), `More 1 of 4`, `Correctn Factors`, `Antenna Factors`, `ANTENNA ON OFF` with `OFF` underlined.

b. Previous Menu, Previous Menu, Limit Lines, Limit 1, LIMIT 1 ON OFF with OFF underlined.

c. (AMPLITUDE), More 1 of 3, Amptd Units, dBμV, (AMPLITUDE), REF LVL, 40 (dBμV).

8. Use the RPG knob on the EMC analyzer to center the noise on the analyzer display.

9. Press the following EMC analyzer keys:

   - (TRACE), More 1 of 4, More 2 of 4, VID AVG ON OFF with ON underlined, 25 (ENTER).

     Wait for the completion of 25 sweeps.

10. Press, (MKR →), MARKER → HIGH and record the marker frequency and amplitude in Table 3-5.

Table 3-4. Test Set Verification

Configuration Band (GHz)	Test Frequency (GHz)	Synthesizer Output Level (dBm)	Deviation Marker Δ (dB)	Limits (dB)
1 to 18	10			±3.5
1.5 to 18	10			±3.5
3.5 to 18	10			±3.5
8.25 to 18	10			±3.5
18 to 26.5[1]	20			±3.5

1 For an HP 84125B only.

Table 3-5. Displayed Average Noise Level

Frequency Range (GHz)	Marker Frequency (GHz)	Marker Amplitude (dBμV)	Limit (dBμV)
1 to 2.9 GHz			8
2.68 to 18 GHz			8
18 to 26.5 GHz			15

4

Test Set Hardware Configurations

This chapter describes how to set up and configure your test set with the appropriate antenna and filters needed to make measurements over the entire frequency range of the HP 84125A/B system. When making measurements from 1 to 18 GHz, a high-pass filter can be installed. If testing an intentional radiator product, this helps to avoid an RF overload condition by filtering out the fundamental frequency. There are three filters supplied with the system: 1.5 GHz, 3.5 GHz, and 8.25 GHz. These filters provide 60 dB of rejection at the fundamental frequency. Measurement of harmonics above 18 GHz do not require the use of a high-pass filter; the 18 to 26.5 GHz waveguide horn antenna serves as a high-pass filter.

Figure 4-1 shows the possible antenna and filter configurations available.

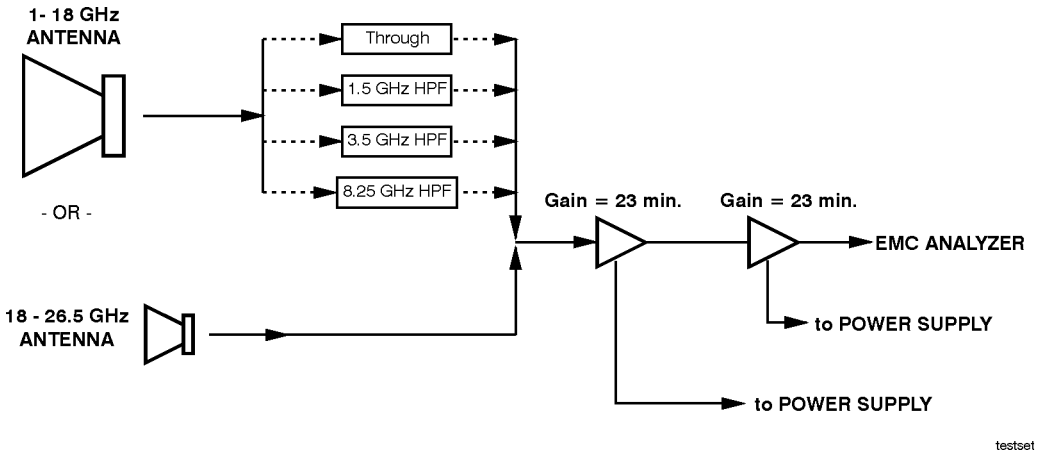


Figure 4-1. Test Set Diagram

1 to 18 GHz Configuration

Note

- If an antenna is already installed, you may need to remove the antenna and any associated cables or filters before installing another antenna.
- When performing the following antenna installation, only finger tighten connectors keeping all connections loose until the last step.
- To ensure good cable connections, refer to "Cable and Connector Care" found later in this chapter.

1. Attach the antenna (HP 11966E) to the front plate. Position the antenna so that the Type N connector on the test set is pointing to the right of the test set as viewed from the front. Use the 1/4 inch flat washer, the split lock washer, and the 1/4-20 hex nut supplied in the accessories box, to attach the antenna. See Figure 4-2 below.

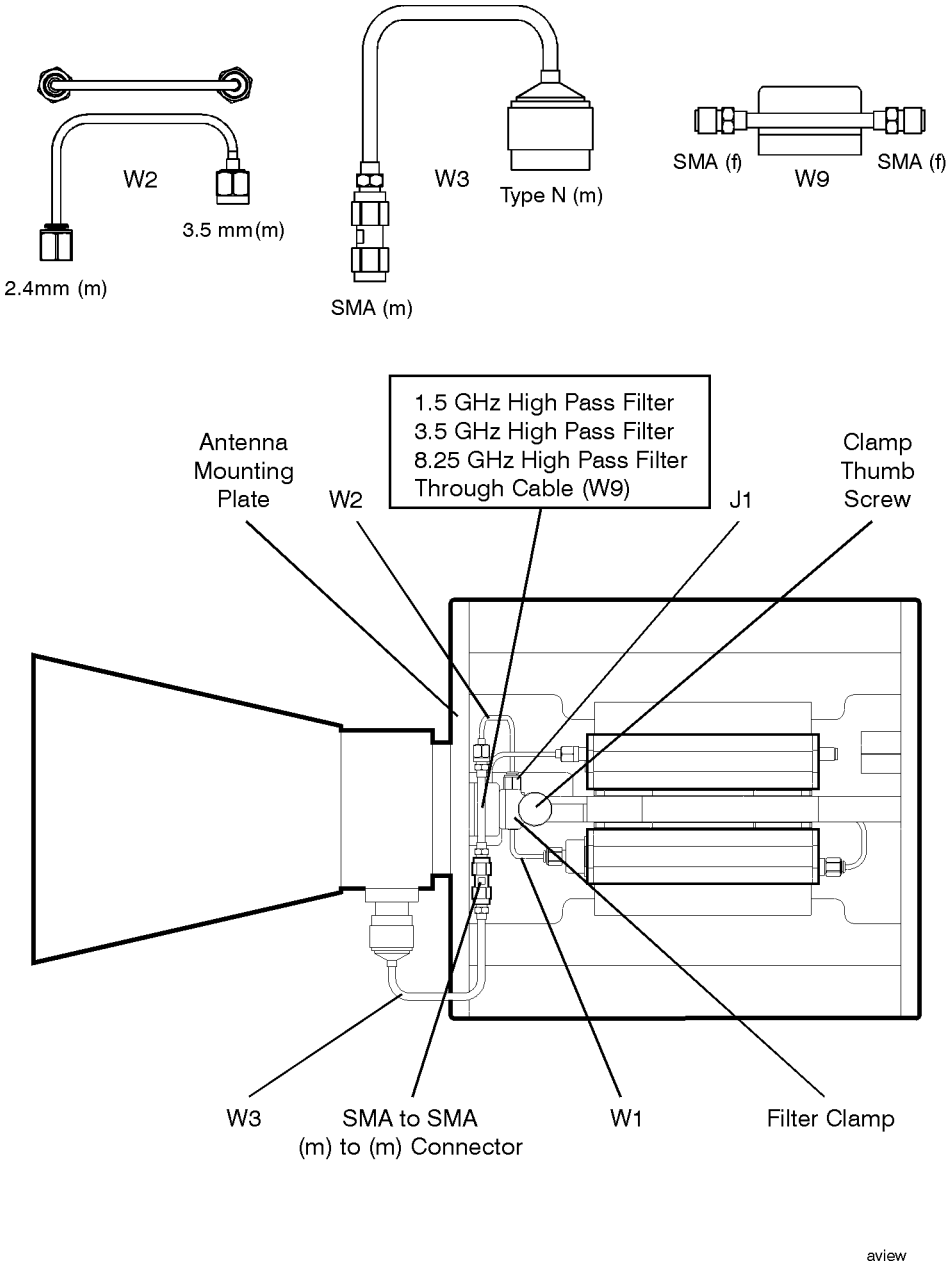


Figure 4-2. 1 to 18 GHz Test-Set Configuration (top view)

2. Install the Type N connection of the W3 semirigid cable to the antenna. The cable will have an SMA (m) to (m) adapter installed on one end.
3. Select one of the three filters or the through cable and attach it to the SMA (m) to (m) adapter on the end of the W3 semirigid cable.

Position the filter or through cable in the space provided in front of the filter clamp. Push the filter clamp toward the filter while keeping the filter within the recessed area of the antenna mounting plate. When the filter is properly positioned, tighten the thumb clamp screw to secure the filter.

Description	Part Number
1.5 GHz High Pass Filter	84300-80037
3.5 GHz High Pass Filter	84300-80038
8.25 GHz High Pass Filter	84300-80039
Through Cable	84125-20019

4. Using the W2 semirigid cable, connect the filter or through cable to J1.
5. Be sure to torque all connectors to 8 inch-pounds using the 5/16 inch torque wrench provided (8710-1765).

18 to 26.5 GHz Configuration (For the HP 84125B only)

Note

- If an antenna is already installed, you may need to remove the antenna and any associated cables or filters before installing another antenna.
- When performing the following antenna installation, only finger tighten connectors keeping all connections loose until the last step.

1. Remove the antenna clamp from the front of the antenna mounting plate using the Torx #10 screwdriver supplied. See Figure 4-3 below.

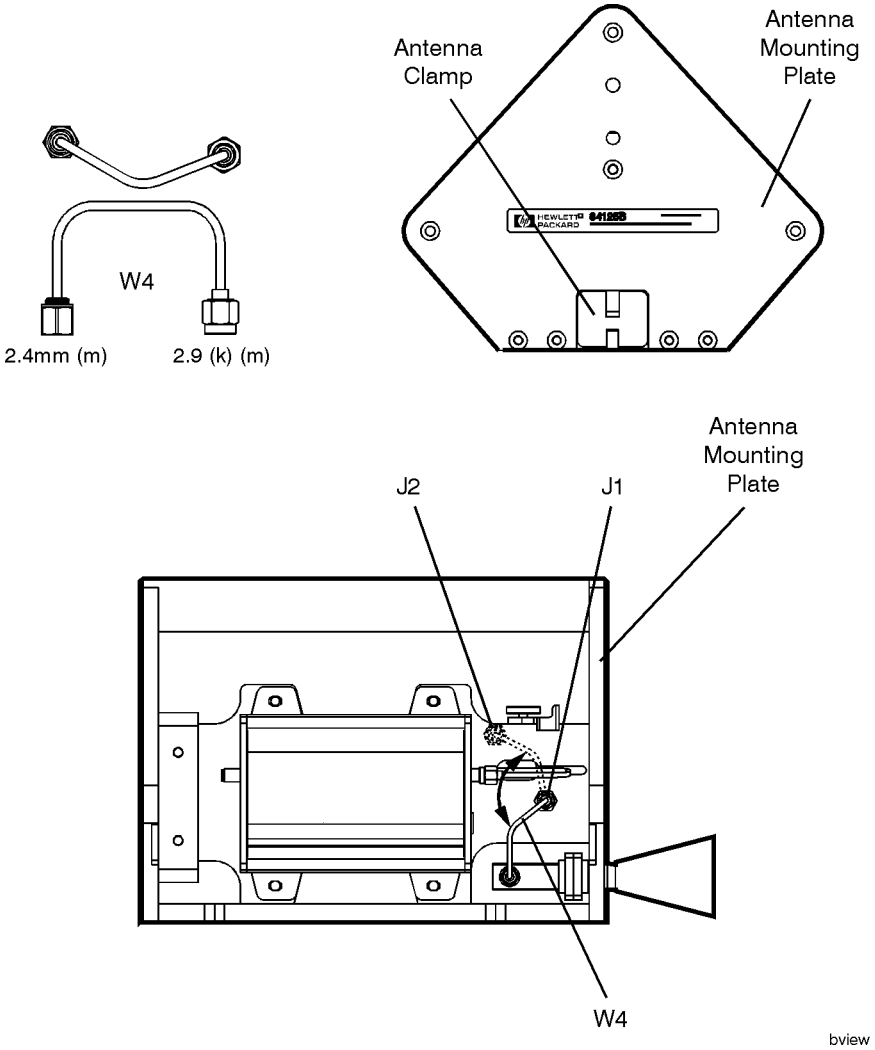


Figure 4-3. 18 to 26.5 GHz Test-Set Configuration (side view)

2. Position the antenna in the larger of the two slots of the antenna clamp, placing the antenna clamp between the antenna horn and the waveguide flange.

3. Reinstall the clamp containing the antenna to the front plate and finger tighten the clamp screws. See Figure 4-3. Make sure that the antenna connector is pointed toward the left of the test set when viewed from the front of the test set.
4. Select the W4 semirigid cable and install it on the antenna. Verify that the 2.92 mm (K) connector is attached to the antenna and the 2.4 mm connector (the 2.4 mm end has a loose nut) is attached to J1.
5. Be sure to torque all connectors to 8 inch-pounds using the 5/16 inch torque wrench provided (8710-1765).
6. Tighten the antenna clamp screws using the Torx #10 screwdriver.

Cable and Connector Care

Instrument sensitivity and coaxial connector mechanical tolerances are such that slight errors in operator technique can have a significant effect on measurements and measurement uncertainties. *The most common cause of measurement error is poor connections.*

Note

The term "connector" will be used in the following procedures to describe the connection ends of the semirigid cables, filters, and adapters supplied with this system

Follow these recommendations for optimum connection technique:

- Clean and inspect (visually and mechanically) all connectors, cables, and filters.
- Align connectors carefully. Look for flat physical contact at all points on the mating plane surfaces.
- Make a gentle, preliminary connection.
- When you make a connection, turn *only* the connector nut. Do not rotate a device when you make a connection and do not apply lateral or horizontal (bending) force.

Connection Procedure

1. Visually inspect the connectors.
2. If necessary, clean the connectors. Use a 99.5% Isopropyl Alcohol solution (HP part number 8500-5344).
3. Carefully align the connectors.

   The male connector center pin must slip concentrically into the contact fingers of the female connector.
4. Push the connectors straight together. Do *not* twist or screw them together. As the center conductors mate, there is usually a slight resistance.
5. The preliminary connection is tight enough when the mating plane surfaces make uniform, light contact. Do not overtighten this connection.

At this point all you want is a connection in which the outer conductors make gentle contact at all points on both mating surfaces. Very light finger pressure (no more than 2 inch–pounds of torque) is enough.

6. Torque final connections to 8-inch lbs.

Disconnection Procedure

1. Use a wrench to loosen the connector nut.
2. Complete the disconnection by hand, turning only the connector nut.
3. Pull the connectors straight apart without twisting or bending.

Handling and Storage

- Store the semirigid cables and filters in the foam–lined storage tray.
- Never store the cables or filters loose in a box, in a desk, or in a bench drawer. This is the most common cause of connector damage during storage.
- Keep connectors clean.
- Do not touch mating plane surfaces. Natural skin oils and microscopic particles of dirt are easily transferred to a connector interface and are very difficult to remove.
- Do not set connectors contact–end down on a hard surface. The plating and the mating plane surfaces can be damaged if the interface comes in contact with any hard surface.
- When you are not using a connector, use plastic end caps over the mating plane surfaces to keep them clean and protected.

5

System Interface

To combine the functionality of the HP 8593EM EMC analyzer and the test set, a downloadable program (DLP) has been provided. The DLP provides the system softkeys that set the parameters for making an EMI measurement. Frequency ranges can be selected enabling you to test the harmonic frequencies of your equipment under test (EUT) while filtering out the fundamental frequencies. Correction data is used to sum out losses due to the antenna, cables, amplifiers, and filters. The values displayed by the HP 84125A/B system are the actual field strength of the emission (in dBμV/m), corrected for all system gains and losses including the antenna transducers factors. A limit line is provided to assist you in identifying problem emissions. The EMC analyzer is automatically set up for optimum signal identification.

HP 84125A/B System Softkey Reference

The softkey reference describes the function of each of HP 84125A/B system softkeys. Refer to the *HP 8590 EM-Series EMC Analyzer User's Guide* for a complete description of the EMC analyzer front-panel keys and softkeys. Access the HP 84125A/B system softkeys by pressing the MODE key.

There are two ways to access the HP 84125A/B system main menu:

`HP4125A/B MAIN MENU` accesses the HP 84125A/B system main menu softkeys and maintains the current settings of both the EMC analyzer and HP 84125A/B system.

`HP84125A/B PRESET` accesses the HP 84125A/B system main menu softkeys and returns both the HP 84125A/B system settings and EMC analyzer settings to their preset value.

Note

For your convenience, the top softkey placeholder (that is, top right-hand corner of the screen) includes the frequency range of the correction factors currently loaded into the EMC analyzer. The label, in this case, does not serve as a softkey function.

`SELECT CONFIG` accesses a menu to specify the frequency range of the test-set configuration. When a frequency range is selected, the corresponding test-set amplitude-correction data (which includes filter, amplifiers, and cables), antenna-correction data, limit lines, and appropriate EMC analyzer settings are automatically loaded. The functionality of the HP 84125A/B system softkeys is described below.

Note

When correction data is loaded and turned on, the letter "A" and the word "CORR" appear in the lower left-hand side of the EMC analyzer screen. The appropriate correction data must be loaded when using the HP 84125A/B system for valid measurements.

`Hold Peaks` maintains the maximum level for each trace and updates the trace if a new maximum level is detected in successive sweeps.

`View Peaks` holds and displays the trace data. The data will not be updated if the instrument sweeps.

`Clear Peaks` erases any screen data previously stored using the `Hold Peaks` or `View Peaks` functions and continuously displays any signals during the sweep of the instrument.

The following softkeys are accessed via the `SELECT CONFIG` softkey.

Note

- When either the `1GHZ to 18GHZ` or `1.5GHZ to 18GHZ` softkeys are selected, the EMC analyzer start and stop frequencies will default to 2.68 to 18 GHz. This is normal operation of the EMC analyzer and is due to the internal RF switching paths. Therefore, if the signal of interest is below 2.68 GHz, you must change the start frequency of the analyzer to the desired frequency below 2.68 GHz; press (FREQUENCY), `START FREQ` "x" (GHz). The stop frequency will automatically change to 2.9 GHz.
- The following softkey selections depend on the test-set hardware being properly configured. That is, for frequencies below 18 GHz, the test set must be configured in the 1 to 18 GHz configuration with the through cable or filter that corresponds to the softkey selection. For frequencies above 18 GHz, the test set must be configured in the 18 to 26.5 GHz configuration. Refer to Chapter 4 for test-set configuration information.

`1GHZ to 18GHZ` loads the correction data and parameters for the 1 to 18 GHz test set configuration. This includes the corresponding test-set amplitude-correction data (that is, the amplifiers and cables are summed together), antenna correction data, limit lines, and appropriate EMC analyzer settings for making an EMI measurement.

`1.5GHZ to 18GHZ` loads the correction data and parameters for the 1.5 to 18 GHz test-set configuration. This includes the

corresponding test-set amplitude-correction data (that is, the 1.5 GHz high-pass filter, amplifiers, and cables are summed together), antenna correction data, limit lines, and appropriate EMC analyzer settings for making an EMI measurement.

`3.5GHZ to 18GHZ` loads the correction data and parameters for the 3.5 to 18 GHz test-set configuration. This includes the corresponding test-set amplitude-correction data (that is, the 3.5 GHz high-pass filter, amplifiers, and cables are summed together), antenna correction data, limit lines, and appropriate EMC analyzer settings for making an EMI measurement.

`8.25GHZ to 18GHZ` loads the correction data and parameters for the 8.25 to 18 GHz test-set configuration. This includes the corresponding test-set amplitude-correction data (that is, the 8.25 GHz high-pass filter, amplifiers, and cables are summed together), antenna correction data, limit lines, and appropriate EMC analyzer settings for making an EMI measurement.

For an HP 84125B only

Note

The 18 to 26.5 GHz waveguide horn antenna serves as a high-pass filter providing high rejection to fundamental frequencies below 18 GHz.

`18GHZ to 26.5GHZ` loads the correction data and parameters for the 18 to 26.5 GHz test-set configuration. This includes the corresponding test-set amplitude-correction data (that is, amplifiers and cables are summed together), antenna correction data, limit lines, and appropriate EMC analyzer settings for making an EMI measurement.

6

Making Measurements

The HP 84125A/B microwave EMI measurement test system may be used for a variety of measurements. To assure the best, most accurate measurements of your product, you should read and review the required product regulations. The following example describes one method for measuring the intentional radiation of a cellular telephone in accordance with the current FCC, Part 15 regulation. However, there are other methods that you can use that may work better for your testing environment.

Current FCC regulations specify that harmonic emissions measured above 1 GHz on wireless transmitters should be below 54 dBμV/m using average detection at a distance of 3 meters. At higher frequencies, cable loss and antenna factors bring the inherent system noise level close to the regulatory limit. To improve the signal-to-noise ratio, the FCC allows positioning the measuring antenna at a distance closer than 3 meters. The correction to be applied is described in FCC, Part 15.31 (f)(1) which states:

> "At frequencies equal to or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field; and, it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measuring equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than what is specified, the results shall be extrapolated to the specified distance using an inverse linear distance extrapolation factor (20 dB/decade)."

This would translate to measuring to a limit of approximately 64 dBμV/m at a distance of 1 meter. Therefore, we recommend that you first make a measurement at a distance of 1 meter to the 64 dBμV/m limit line with peak detection. Using a 1 meter measurement will improve the signal-to-noise ratio making it easier to detect emissions. Signals with a peak value above the 64 dBμV/m limit line will need to be remeasured using average detection.

Note

- This procedure describes the FCC requirement. Measurements to other regulatory standards would be similar but should use the limits, measuring distances, and procedures described in those regulations.
- Even though the measurement is done specifically for harmonic emissions, any spurious emission from the test device that exceeds the limit also fail the specification.

- If measured results using peak detection are significantly below the limit line (approximately 6 dB), further measurements are not required.

Configuring the Test Set

CAUTION

The HP 84125A/B microwave EMI measurement test system has two high-gain amplifiers to achieve the needed sensitivity. There is a possibility of overloading the second amplifier if the signal into the first amplifier is too large. The signal level out of the second amplifier should be less than +10 dBm or 117 dBμV, as displayed on the EMC analyzer. Special care should be taken to avoid overloading the system with signals greater than +10 dBm or 117 dBμV; this may result in making invalid measurements.

1. Determine the fundamental frequency of the equipment under test (EUT). For this example, a fundamental frequency of 830 MHz will be used for the cellular telephone.
2. Make a list of the harmonic frequencies that you will need to test. For 830 MHz, the ten harmonic frequencies to be tested are:

   1.66 GHz
   2.49 GHz
   3.32 GHz
   4.15 GHz
   4.98 GHz
   5.81 GHz
   6.64 GHz
   7.47 GHz
   8.30 GHz

3. The fundamental signal is usually 40 dB above the harmonics. In order to avoid overloading the EMC analyzer first converter, a high-pass filter must be added. To filter out the fundamental frequency of 830 MHz, install the 1.5 GHz filter in the test set. Refer to Figure 4-2 to assist you with this procedure.

Note

For an HP 84125B system, make sure that the 1 to 18 GHz antenna (HP 11966E) is installed in the test set. Refer to Chapter 4 to assist you with this procedure.

4. On the EMC analyzer, press the following key sequences:
   a. (PRESET), (MODE).

      Verify that `EMC ANALYZER` is underlined. If not, press `EMC ANALYZER`. This ensures full range of analyzer functionality.
   b. `HP84125A/B PRESET`, `CONT`, `SELECT CONFIG`, `1.5GHZ to 18GHZ`.

Note

When either the 1GHZ to 18GHZ or 1.5GHZ to 18GHZ softkeys are selected, the EMC analyzer start and stop frequencies will default to 2.68 to 18 GHz. This is normal operation of the EMC analyzer and is due to the internal RF switching paths. Therefore, if the signal of interest is below 2.68 GHz, you must change the start frequency of the analyzer to the desired frequency below 2.68 GHz; press (FREQUENCY), START FREQ "x" (GHz). The stop frequency will automatically change to 2.9 GHz.

This selects the amplitude correction factors for the 1.5 to 18 GHz filter signal path and the 1 to 18 GHz horn (from 1.5 to 18 GHz). The IF bandwidth is also set to 1 MHz and the average bandwidth to 300 kHz. For your convenience, a limit line is displayed at 64 dBμV/m for making a 1 meter measurement.

Setting Up the HP 8593EM EMC Analyzer

To set up the EMC analyzer to measure harmonic emissions, press the following key sequences:

1. (FREQUENCY), CENTER FREQ 1.66 (GHz) to set the center frequency to the first harmonic.
2. CF STEP AUTO MAN, 830 (MHz) to set the center frequency step size of 830 MHz.
3. (SPAN), 500 (MHz), or to a value that allows you to clearly discern the signals.

Making the Measurement

1. Place the EUT (in this case, the cellular telephone) on a nonconductive surface and position the antenna 1 meter away from cellular telephone at the height specified by the regulation. Make sure that the cellular telephone is on.

Tip

To streamline your measurement process, place the EUT on a nonconductive turntable and position the test set on an HP 11968C tripod. Rotate the EUT instead of the test set to find the worst case emissions.

2. Move the antenna 360° around the EUT to find the direction of maximum radiation for the first harmonic (that is, 1.66 GHz). The test set has been designed with three handles to make it easy to use in both vertical and horizontal polarizations.
3. If the noise level at the frequency of the emission is greater than 10 dB below the limit, move the antenna to 3 meters away from the EUT and repeat the above procedure. For emissions that fall close to the 64 dBμV/m limit line, a display line can be set to 54 dBμV/m. To set the display line:
   a. Press (DISPLAY), DSP LINE ON OFF until ON is underlined.
   b. Enter 54 (dBμV).

If the amplitude of the signals fall significantly below either the 54 dBμV/m display line (approximately 6 dB) at a distance of 3 meters or 64 dBμV/m limit line at 1 meter or less, then the harmonic amplitude passes the requirement.

Tip

To streamline the measurement process, make a list of the signals that fail this guideline, then repeat the procedure using average detection after all of the harmonics have been tested using peak detection.

4. Press (FREQUENCY), CENTER FREQ, ↑ to set the center frequency to the next harmonic frequency.
5. Repeat the above procedure for each harmonic frequency.

Note

For your convenience, we have provided a maximum hold feature that may be useful when the signal appears to be unstable or when printing out a copy of the graphics for a report. To access this functionality, press (MODE) then HP84125A/B MAIN MEN. Use the Hold Peaks softkey to capture the maximum peak amplitude of the signal. If a copy of the display is required, press View Peaks to hold and display the trace data. Use (COPY), COPY SCREEN keys to produce your output. Ensure that the appropriate printer or plotter is connected and configured. For more information, refer to the *HP 8590 EM-Series EMC Analyzer User's Guide*.

Making a Measurement Using Average Detection

1. To make a measurement using average detection, the frequency span must be reduced around the signal to be measured. To reduce the span, press the following key sequences:
   a. (MKR →) MARKER → HIGH MARKER → CF to place the emission at the center of the screen.
   b. (MKR), More 1 of 3, MK TRACK ON OFF until ON is underlined. This will keep the signal at the center of the screen while the frequency span is reduced in the next step.
   c. (SPAN), 5 (MHz) or a frequency span that will result in making a calibrated measurement.
   d. (MKR), MORE 1 OF 3, MK TRACK ON OFF until "OFF" is underlined.
2. To select average detection, press (DET), AVG ON OFF until ON is underlined.
3. For a faster measurement, ensure that the marker is at the signal's peak, press (TEST) then MEASURE AT MKR. Once the measurement process is finished, the average value will appear on the EMC analyzer display.

Note

For signals that are close to the noise floor or modulate in frequency, it is best to make the measurement as described in the previous step without using the Measure at Marker feature.

a. Repeat Step 1 above.

b. If the signal of interest is greater than 2.9 GHz, perform a preselector peak by pressing, (AMPLITUDE), More 1 of 3, PRESEL PEAK.

c. Activate the average detector by pressing, (DET), AVG ON OFF until ON is underlined.

Calibrating the HP 8593EM EMC Analyzer

This section describes procedures for calibrating the HP 8593EM EMC analyzer.

Improving Accuracy with Self-Calibration Routines

Data from the self-calibration routine is necessary for EMC analyzer operation. Executing the self-calibration routine regularly ensures that the EMC analyzer is using current calibration data that improves the EMC analyzer frequency and amplitude accuracy. Press the (CAL) key to view the self-calibration routine menus. The last softkey on this menu, labeled More 1 of 4, provides access to additional self-calibration functions.

The self-calibration routines add correction factors to internal circuitry. The addition of the correction factors is required to meet frequency and amplitude specifications.

When the correction factors are added to internal circuitry, CORR (corrected) appears on the left side of the screen.

Warm-up time

In order for the HP 8593EM EMC analyzer to meet its specifications, allow the EMC analyzer to warm up for 30 minutes after being turned on, before attempting to make any calibrated measurements. Be sure to calibrate the EMC analyzer only *after* it has met operating temperature conditions.

The EMC analyzer frequency and amplitude self-calibration routines are initiated by the CAL FREQ & AMPTD softkey in the menu located under the (CAL) key.

Preparing the HP 8593EM EMC Analyzer for Calibration

To prepare the EMC analyzer for calibration, the bracket assembly that secures the harness cable assembly to the EMC analyzer must first be removed.

To remove the harness cable assembly from the EMC analyzer:

1. Using a #10 torx driver, remove the two screws from the top portion of the strain relief.
2. Using a 5/16 inch wrench, disconnect the system cable harness from the EMC analyzer INPUT 50Ω.
3. Using a #10 torx driver, remove the two screws from the bottom portion of the strain relief.
4. Using a #15 torx driver, remove the two screws from the strain-relief bracket that secures the EMC analyzer to the cart bracket.

   Once the calibration is done, use the following procedure to reinstall the cable harness assembly to the EMC analyzer.

To reinstall the cable harness assembly to the EMC analyzer, refer to "Connecting the RF Cable Assembly to the EMC Analyzer" in Chapter 3.

Performing a Frequency and Amplitude Calibration

1. Connect the EMC analyzer CAL OUT to the INPUT 50Ω connector with a 6 inch SMA cable and a BNC to SMA adapter.

Note

A low-loss cable should be used for accurate calibration. Use the 50Ω cable shipped with the EMC analyzer.

2. On the EMC analyzer, press:

   (CAL)
   `CAL FREQ & AMPTD`

   `Cal signal not found` will be displayed if the CAL OUT is not connected to the EMC analyzer input. The frequency and amplitude self-calibration routine take approximately 10 minutes to finish, at which time the internal adjustment data is in working RAM.

3. To save this data in the area of EMC analyzer memory that is saved when the EMC analyzer is turned off, press:

   `CAL STORE`

   To reinstall the cable harness assembly to the EMC analyzer, refer to "Connecting the RF Cable Assembly to the EMC Analyzer" in Chapter 3.

Note

To interrupt the calibration routines started by CAL FREQ, CAL AMPTD, or CAL FREQ & AMPTD, press (PRESET), (CAL), More 1 of 4, and CAL FETCH. CAL FETCH retrieves the previous correction factors. Improperly interrupting the self-calibration routines may result in corrupt correction factors. If this occurs, press CAL FREQ & AMPTD to rerun the frequency and amplitude self-calibration routines.

The frequency and amplitude self-calibration functions can be done separately by using the CAL FREQ or CAL AMPTD softkeys instead of CAL FREQ & AMPTD.

Note

If the frequency calibration CAL FREQ and the amplitude calibration CAL AMPTD self-calibration routines are used, the frequency calibration should be performed before the amplitude calibration, unless the frequency data is known to be accurate.

The CAL FREQ softkey starts the frequency self-calibration routine. This routine adjusts the frequency, sweep time, and span accuracy in approximately 2 minutes.

The CAL AMPTD softkey starts the amplitude calibration routine. This routine takes approximately 3 minutes to adjust the bandwidths, log and linear switching, IF gains, IF frequency centering, RF attenuation, and log amplifier. When the amplitude calibration routine has finished, the preset display returns and the message CAL DONE is displayed.

Although the EMC analyzer stores the correction factors in battery-backed-up RAM, the data will not be saved when the EMC analyzer power is turned off unless the data has been stored with CAL STORE. Using CAL STORE stores the correction factors in an area of EMC analyzer memory that is accessed when the EMC analyzer is turned on. After the frequency and amplitude self-calibration routines are complete, CORR (corrected) now appears on the left side of the screen, indicating that the EMC analyzer is using its frequency and amplitude correction factors. Correction factors can be turned off by pressing CORRECT ON OFF. When OFF is underlined, most amplitude correction factors and some frequency correction factors are not used.

Performing the YTF self-calibration routine

The YTF self-calibration routine should be performed periodically. Refer to "When Is Self-Calibration Needed?" in the following section for some helpful guidelines on how often the self-calibration routines should be performed.

1. Connect a low-loss cable (such as HP part number 8120-5148) from 100 MHz COMB OUT to the EMC analyzer input.
2. To calibrate, press:

   (CAL)
   `More 1 of 4`
   `More 2 of 4`
   `More 3 of 4`
   `CAL YTF`

   The YTF self-calibration routine completes in approximately 7 minutes.
3. To save the calibration factors in memory, press:

   (CAL)
   `CAL STORE`
4. To return to normal operation, press:

   (PRESET)
5. To reinstall the cable harness assembly to the EMC analyzer, refer to "Connecting the RF Cable Assembly to the EMC Analyzer" in Chapter 3.

When is self-calibration needed?

While it is difficult to provide general advice for your specific measurement needs, the following suggestions may help you decide when to use the self-calibration features:

1. Perform the frequency and amplitude self-calibration routines whenever the instrument experiences significant environmental changes such as temperature (±5 °C), humidity, shock, or vibration (such as may occur during shipping or transport). This is especially important if the frequency and amplitude self-calibration routines were performed the last time in a different environment.
2. If the environment is relatively stable (for example, a lab environment), use `CAL FREQ & AMPTD` monthly. After being turned off overnight, the EMC analyzer will need to warm up, but should not require self-calibration.

3. To achieve optimal amplitude accuracy for relative measurements:
   a. Keep the EMC analyzer in a stable environment.
   b. Use CAL FREQ & AMPTD before beginning the first measurement.
   c. Keep the EMC analyzer turned on between measurements.
   d. Do not use CAL FREQ & AMPTD before subsequent measurements since the amplitude drift is normally smaller than the self-calibration uncertainty.
4. If you change the input signal for EXT REF IN, run the frequency and amplitude self-calibration routines using CAL OUT. Amplitude calibration is required to improve IF centering.
5. If preselector peaking (PRESEL PEAK) has more than a 2 dB effect on the signal amplitude when in BAND 1 or above and in a single band sweep, then perform the YTF self-calibration routine and store the data with CAL STORE. The YTF self-calibration routine improves the preselector default values.
6. If accurate self-calibration is needed temporarily in a different environment, use CAL FREQ & AMPTD, but do not press CAL STORE. The temporary correction factors will be used until the EMC analyzer is turned off or until CAL FETCH is pressed.

7

Customer Support

Your HP 84125A/B system is built to provide dependable service. Hewlett-Packard's worldwide sales and service organization is ready to provide the support you need. The following support-related information is provided in this chapter.

- If You Have a Problem
- Calibration Information
- Reloading the Downloadable Program into the EMC Analyzer
- Changing the Memory Card Battery
- Replaceable Parts
- HP Sales and Service Offices
  - Returning the HP 84125A/B System for Calibration or Service
  - Packaging the HP 84125A/B System for Shipment
  - Factory Return Service Sheet

If You Have a Problem

If you have a problem, refer to the following for possible help:

- HP 84125A/B System User's Guide
  - Refer to "System Functional Tests" in Chapter 3.
- Return the FAX Cover Sheet

  A FAX sheet is provided at the end of this chapter as a method in which to directly contact the HP EMC support team in the event of a problem. The FAX cover sheet provides the EMC support team with information about your company, the product, and a detailed description about the problem.

  Simply copy the FAX cover sheet, fill out the requested information, include any additional information sheets, and FAX the sheet(s) to HP EMC Support at (707) 577-4200. Depending on the complexity of the problem, you should receive a response back within a few days.

Calibration Information

Hewlett-Packard recommends that the HP 84125A/B system be calibrated in 1-year intervals. Return the system to the nearest HP Sales and Service office listed in Table 7-2.

A system calibration should be performed when any of the system individual instruments or components are repaired or replaced.

Reloading the Downloadable Program (DLP) into the EMC Analyzer

In the event that the EMC analyzer memory is inadvertently cleared and the DLP lost, it can be reloaded from the RAM card using the following procedure.

1. Press the following key sequences:
   a. SAVE/RECALL
   b. `Recall Card`
   c. `CATALOG CARD`
2. Use the step keys or the RPG knob to scroll down to `d84125`.
3. Press `LOAD FILE`.

   The DLP has now been reloaded into the instrument memory and is automatically activated.

Changing the memory card battery

Note The battery will be replaced in the RAM card when the HP 84125A/B system is sent back to Hewlett-Packard for the recommended yearly calibration. In this case, you will not need to replace the battery.

It is recommended that the memory card battery be changed every 2 years. The battery is a lithium commercial CMOS type battery, part number CR 2016. The minimum lifetime of the battery (under ordinary conditions) is more than 2 years.

The date that the memory card battery was installed is either engraved on the side of the memory card or written on a label on the memory card.

If the memory card does not have a label with the date that the battery was installed, use the date code engraved on the side of the memory card. The date code engraved on the memory card consists of numbers and letters engraved in the black plastic on the side of the memory card. Refer to Figure 7-1. The first number indicates the year, the following two characters indicate the month, and the following number indicates the week in the month that the memory card battery was installed. For example, 8OC3 indicates the battery was installed in the third week in October in 1988.

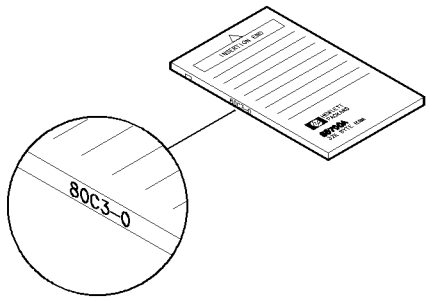


Figure 7-1. Memory Card Battery Date Code Location

Procedure to change the memory card battery

The battery is located beside the card's write-protect switch on the end opposite the connector.

CAUTION

The battery power enables the memory card's memory to retain data. You can lose the data when the battery is removed. Replace the battery while the card is installed in a powered-up instrument.

1. Locate the groove along the edge of the battery clip. Refer to Figure 7-2.
2. Gently pry the battery clip out of the card. The battery fits within this clip.
3. Replace the battery, making sure the plus (+) sign on the battery is on the same side as the plus (+) sign on the clip.
4. Insert the battery clip into the memory card, holding the clip as oriented in Figure 7-2. (Face the "open" edge of the clip toward the write-protect switch on the memory card.)
5. Write the date that the battery was replaced on the memory card label. This will help you to remember when the battery should be replaced.

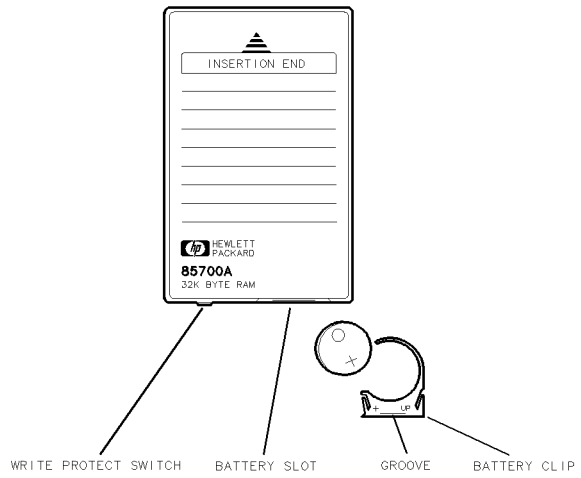


Figure 7-2. Memory Card Battery Replacement

Replaceable Parts

Table 7-1. Replaceable Parts

Part Description	Part Number	Quantity	Reference Designator
Double-Ridged Horn Antenna, 1 to 18 GHz	HP 11966E	1	
Standard Gain Horn Antenna, 18 to 26.5 GHz	84125-80008	1	
Antenna Clamp	84125-20026	1	
Amplifier[1]	HP 83017A	1	
Amplifier[1]	HP 83051A	1	
DC Power Supply	HP 87421A	2	
High-Pass Filter, 1.5 GHz[1]	84300-80037	1	
High-Pass Filter, 3.5 GHz[1]	84300-80038	1	
High-Pass Filter, 8.25 GHz[1]	84300-80039	1	
Filter Clamp	84125-20027		
Clamp Thumb Screw	0515-2212		
RF Cable, semirigid[1]	84125-20041	1	W1
RF Cable, semirigid[1]	84125-20042	1	W2
RF Cable, semirigid[1]	84125-20043	1	W3
RF Cable, semirigid (for an HP 84125B only)	84125-20044	1	W4
RF Cable, semirigid[1]	84125-20045	1	W5
RF Cable, semirigid[1]	84125-20019	1	W9
RF Cable, assembly[1]	84125-60002	1	
Adapter, SMA (m) to (m)	1250-1159	1	
Adapter, 2.4 mm (f) to (f)	1250-2589	1	J1
Adapter, 2.92 mm (f) to (f)	1250-2182	1	J2,J3
Torque Wrench, 5/16 inch 8-in lb	8710-1623	1	

1 If this component is repaired or replaced, a system calibration must be performed to ensure accurate measurement.

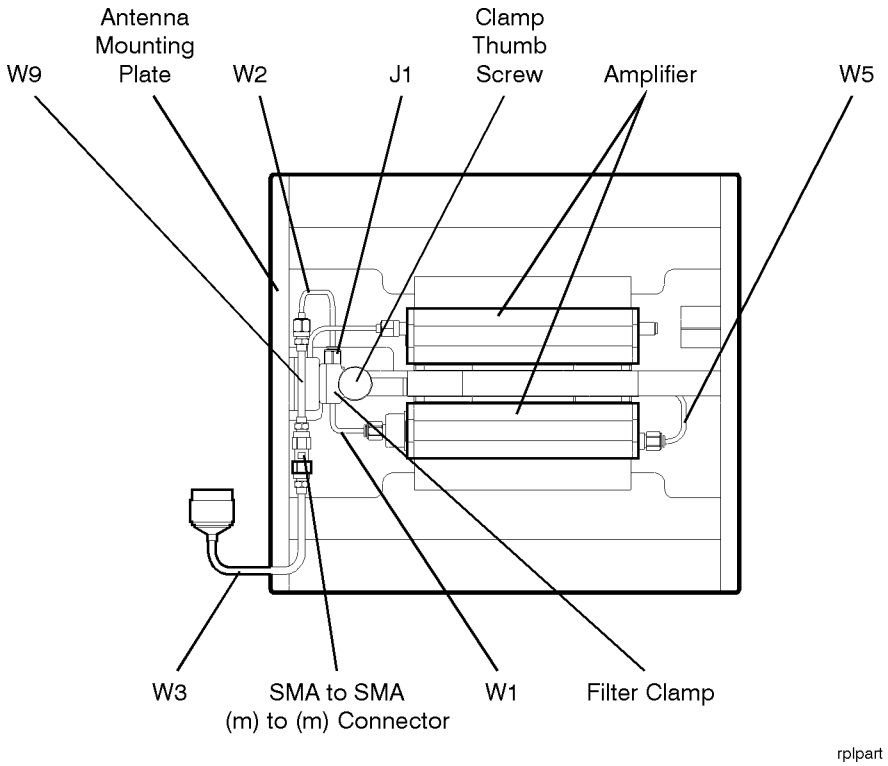


Figure 7-3. Component Location Diagram

Returning the HP 84125A/B System for Calibration or Service

Use the information in this section to return the HP 84125A/B system to Hewlett-Packard.

Note

When returning the HP 84125A/B system for calibration, the EMC analyzer with the HP 84125A/B RAM card and the test set including all cables, filters, and antenna(s) should be returned to the Hewlett-Packard Sales and Service office. We recommend that you return the EMC analyzer, test set, and 1 to 18 GHz antenna in their original packaging containers.

Packaging the HP 84125A/B System for Shipment

Use the following steps to package the HP 84125A/B system for shipment to Hewlett-Packard for calibration or service:

1. If the HP 84125A/B system is being sent in for repair, include the following information:
   - Any specific information regarding the nature of the problem.
   - Any error messages that appear on the EMC analyzer display.
   - Any specific data on the performance of the HP 84125A/B system.

CAUTION Damage to the HP 84125A/B system can result from using packaging materials other than those specified. Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the instrument or prevent it from shifting in the carton. Styrene pellets cause equipment damage by generating static electricity and by lodging in the fan.

2. Use the original packaging materials or strong containers that are made of double-walled, corrugated cardboard with 159 kg (350 lb) bursting strength. The cartons must be large enough and strong enough and allow at least 3 to 4 inches on all sides of the instrument for packing material.
3. Protect the front panel of the EMC analyzer with cardboard.
4. Surround the EMC analyzer and test set with at least 3 to 4 inches of packing material, or enough to prevent them from moving in the carton. If packing foam is not available, the best alternative is SD-240 Air Cap™ from Sealed Air Corporation (Commerce, CA 90001). Air Cap looks like a plastic sheet covered with 1-1/4 inch air-filled bubbles. Use the pink Air Cap to reduce static electricity. Wrap the instrument several times in the material to both protect the instrument and prevent it from moving in the carton.
5. Seal the shipping container securely with strong nylon adhesive tape.
6. Mark the shipping container "FRAGILE, HANDLE WITH CARE" to ensure careful handling.
7. Retain copies of all shipping papers.

Hewlett-Packard Sales and Service Offices

Sales and service offices are located around the world to provide complete support for your HP 84125A/B system. To obtain servicing information or to order replacement parts, contact your nearest Hewlett-Packard Sales and Service office listed in Table 7-2. In any correspondence or telephone conversations, refer to the HP 84125A/B system by its model number and full serial number. With this information, the HP representative can quickly determine whether your unit is still within its warranty period.

Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your local HP Sales and Service Office.

Table 7-2. HP Sales and Service Offices

US Field Operation Headquarters
Hewlett-Packard Company
19320 Pruneridge Avenue
Cupertino, CA 95014 USA
(800) 752-0900

Georgia
Hewlett-Packard Company
2000 South Park Place
Atlanta, GA 30339
(404) 955-1500

Southern California
Hewlett-Packard Company
1421 South Manhattan Avenue
Fullerton, CA 92631
(714) 999-6700

Illinois
Hewlett-Packard Company
5201 Tollview Drive
Rolling Meadows, IL 60008
(708) 342-2000

Northern California
Hewlett-Packard Company
301 E. Evelyn
Mountain View, CA 94041
(415) 694-2000

New Jersey
Hewlett-Packard Company
150 Green Pond Road
Rockaway, NJ 07866
(800) 403-0801

Colorado
Hewlett-Packard Company
24 Inverness Place
East Englewood, CO 80112
(303) 649-5000

Texas
Hewlett-Packard Company
930 E. Campbell Road
Richardson, TX 75081
(214) 231-6101

HEWLETT PACKARD

FAX Cover Sheet

To: HP EMC Support **FAX Number: (707)577-4200** **Page _____ of _____**

Date Transmitted: _____ **Time Transmitted:** _____

From:

Company: _____

Last Name: _____ First Name: _____

Address: _____

City: _____ State: _____

Country: _____ Postal Code: _____ Mail Stop: _____

Telephone Number **(Include Country Code)**: _____

FAX Number **(required)**: _____

E-Mail Address: _____

DLP Revision Number: _____

Model Number:

☐ HP 84125A ☐ HP 84125B ☐ HP 84125C

Can the problem be reproduced? ☐ Yes ☐ No

Detailed Problem Description: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

A

Amplitude Accuracy

The amplitude accuracy of the HP 84125A/B system is a combination of the accuracy of the measuring receiver and the accuracy of the test set including the RF cable assembly. In general, the amplitude error is calculated by:

[EMC Analyzer Uncertainty] + [Test-Set Uncertainty] + [Temperature Drift*] = Total Uncertainty

*Where temperature drift is the maximum specified test set temperature drift.

EMC Analyzer Uncertainties

- **Calibrator amplitude uncertainty** is the difference between the actual level of the front-panel calibrator and the nominal level (−20 dBm). The calibrator signal is used as a reference for the EMC analyzer self calibration.
- **Receiver flatness uncertainty** is caused by the imperfect frequency response of the EMC analyzer. This error is the difference between the receiver response at the measurement frequency and the response at the calibrator frequency.
- **Receiver attenuator uncertainty** occurs when the EMC analyzer attenuator is set to 0 dB (HP 84125A/B system default value) instead of 10 dB factory calibration setting. This optimizes the HP 84125A/B system for highest sensitivity.
- **Reference level uncertainty** is caused by the addition of IF gain in the measuring receiver. It occurs when the reference level of the EMC analyzer is set to a value other than 87 dBμV. The EMC analyzer reference level is equal to the displayed reference level (in dBμV/m) plus the system correction factor. The EMC analyzer reference level can be read directly from the EMC analyzer by turning the correction factors off.
- **Resolution bandwidth switching uncertainty** is the error associated with the stability and switching of the resolution bandwidth filters.
- **Receiver scale fidelity uncertainty** occurs when measuring a signal when its amplitude is below the top graticule of the display. This can be minimized by adjusting the reference level so that the peak of the signal is at the top of the screen.

HP 84125A/B Test-Set Uncertainties

- **Antenna factor uncertainty** is the antenna manufacturer's uncertainty of characterizing the antenna factor.
- **Antenna mismatch uncertainty** is caused by the VSWR pattern created when the antenna is connected to the test-set input. The magnitude of this error depends on the VSWR of both the antenna and the test set.
- **Calibration data uncertainty** is a measure of the uncertainty of the factory calibration of the HP 84125A/B test set at the calibration frequencies.
- **Test-set flatness uncertainty** includes the mismatch error between the EMC analyzer input and test-set output plus the maximum interpolation error that occurs at frequencies other than the calibration frequencies.
- **Test-set repeatability uncertainty** consists of the errors caused by the RF cable assembly being flexed, the amplifiers drifting between calibrations, and the repeatability of the connectors used to interconnect the filters and the antennas.
- **Test-set maximum temperature drift uncertainty** is a maximum amplitude error that will occur due to temperature drift. This error is valid when the HP 84125A/B system is used in an ambient temperature range of 20 °C to 30 °C.

To calculate the total amplitude uncertainty, the individual uncertainties described above must be combined. In combining them, we recommend following the procedure in the National Measurement Accreditation Service (NAMAS), Publication NIS 81. (NAMAS is now known as United Kingdom Accreditation Service, UKAS.)

This publication specifically addresses the calculation of measurement uncertainty in EMC measurements. This procedure involves the following steps:

1. Determine the type of each uncertainty and its probability distribution.
2. Convert each uncertainty to a "standard" uncertainty. Refer to NAMAS, publication NIS 81.
3. Combine the standard uncertainties by either using Root Sum Square (RSS) or direct addition depending on whether it is random or systematic, and whether or not they are correlated with each other.
4. Multiply your result by a factor (typically 1 to 3) to arrive at the desired confidence level for your measurement. The following example, uses 2 which is recommended by NAMAS, Publication NIS 81. This factor corresponds to a confidence level of 95%.

The following example uses the 1 to 18 GHz antenna with the EMC analyzer in Logarithmic-scale mode ((AMPLITUDE), SCALE LOG LIN With LOG underlined).

Measurement parameters for this example are:

Measurement frequency:	18 GHz
Displayed signal amplitude:	64 dBμV
Reference level:	74 dBμV/m*
Resolution bandwidth:	1 MHz
Input attenuation:	0 dB
Antenna VSWR	2.8:1
Test-Set VSWR	3.2:1

*Approximately 62 dBμV for the EMC analyzer. The EMC analyzer reference level is found by turning off the correction data on the EMC analyzer (CAL, More 1 of 4, CORRECT ON OFF with OFF underlined).

The measurement uncertainties are found in *HP 8590 EM Series EMC Analyzer Calibration Guide*. The measurement uncertainties for the EMC analyzer using the instrument settings above are:

Calibrator uncertainty:	0.4 dB
Calibration repeatability:	0.15 dB
Receiver flatness uncertainty:	3.0 dB
Receiver attenuator uncertainty:	1.0 dB
Reference level uncertainty:	0.55 dB
Resolution bandwidth switching uncertainty:	0.4 dB
Receiver scale fidelity uncertainty:	0.42 dB

The measurement uncertainties for the HP 84125A/B test set are found in Test Set and Antenna Factor Accuracy specifications found earlier in this chapter. The measurement uncertainties for the HP 84125B test set using the measurement parameters above are:

Antenna factor uncertainty	2.0 dB
Antenna / test-set mismatch uncertainty	2.4 dB
Calibration data uncertainty	0.9 dB
Test-set flatness uncertainty	1.7 dB
Test-set repeatability uncertainty	0.7 dB
Test-set maximum temperature drift	1.5 dB

Table A-1 lists the uncertainties along with the required information to calculate the measurement uncertainty. Refer to NAMAS, Publication NIS 81 for the procedure on calculation of standard errors.

Table A-1. HP 84125A/B System Uncertainties

Error Source	Where Obtained	Type of Limit	Type of Probability Distribution	Stated Limit	Standard Uncertainty
HP 8593EM EMC Analyzer Uncertainties					
Calibrator Uncertainty	EMC analyzer specifications	3 sigma specification	normal	0.4 dB	0.133 dB
Calibrator Repeatability	EMC analyzer specifications	3 sigma specification	normal	0.15 dB	0.05 dB
Receiver Flatness Uncertainty	EMC analyzer specifications	3 sigma specification	normal	3.0 dB	1.0 dB
Receiver Attenuator Uncertainty	EMC analyzer specifications	3 sigma specification	normal	1.0 dB	0.33 db
Reference Level Uncertainty	EMC analyzer specifications	3 sigma specification	normal	0.55 dB	0.18 dB
Resolution Bandwidth Switching Uncertainty	EMC analyzer specifications	3 sigma specification	normal	0.4 dB	0.13 dB
Receiver Scale Fidelity Uncertainty	EMC analyzer specifications	3 sigma specification	normal	0.42 dB	0.14 dB
HP 84125A/B Test Set and System Uncertainties					
Antenna Factor Uncertainty	HP 84125A/B specifications	specification	assumed uniform	2.0 dB	1.16 dB
Antenna to Test Set Mismatch	HP 84125A/B specifications	calculated maximum error	U-shaped	2.4 dB	1.70 dB
Calibration data Uncertainty	HP 84125A/B specifications	3 sigma specification	normal	0.9 dB	0.30 dB
Test Set Flatness Uncertainty	HP 84125A/B specifications	3 sigma specification	normal	1.7 dB	0.57 dB
Test Set Repeatability Uncertainty	HP 84125A/B specifications	3 sigma	normal	0.7 dB	0.23 dB
Test Set Temperature Drift (maximum) Uncertainty	HP 84125A/B specifications	3 sigma	normal	1.5 dB	applied directly

To calculate the total system amplitude uncertainty, these uncertainties must be combined. The uncertainties which are random and uncorrelated (except for the test-set temperature drift uncertainty) will be combined using the Root Sum Square (RSS) method. This result will be multiplied by 2 to obtain a 95% confidence level. Then the test-set temperature drift uncertainty will be added to the result.

Therefore, the total standard error for this example is:

$$\sqrt{(.13)^2 + (.05)^2 + (1)^2 + (.33)^2 + (.18)^2 + (.13)^2 + (.14)^2 + (1.16)^2 + (1.7)^2 + (.3)^2 + (.57)^2 + (.23)^2} = 2.43dB$$

The total amplitude uncertainty is:

2*(2.43) + 1.5 = 6.36 dB

This is the total amplitude uncertainty in the measured field strength of the HP 84125A/B system for these measurement settings. The uncertainty for each set of measurement conditions must be calculated separately. It is recommended that you follow the procedure in NAMAS, Publication NIS 81 for a complete understanding of your measurement uncertainties.

Index