Notice

Hewlett-Packard to Agilent Technologies Transition

This documentation supports a product that previously shipped under the Hewlett-Packard company brand name. The brand name has now been changed to Agilent Technologies. The two products are functionally identical, only our name has changed. The document still includes references to Hewlett-Packard products, some of which have been transitioned to Agilent Technologies.

Printed in USA March 2000

HP 11758V Digital Radio Test System

User's Guide

For use with HP 11758B and HP 8593E

HP Part No. 11758-90066
Printed in UK
September 1998

Notice

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By internet, phone, or fax, get assistance with all your test and measurement needs.

Table 1-1 Contacting Agilent

Online assistance: `www.agilent.com/find/assist`

United States
(tel) 1 800 452 4844

Latin America
(tel) (305) 269 7500
(fax) (305) 269 7599

Canada
(tel) 1 877 894 4414
(fax) (905) 282-6495

Europe
(tel) (+31) 20 547 2323
(fax) (+31) 20 547 2390

New Zealand
(tel) 0 800 738 378
(fax) (+64) 4 495 8950

Japan
(tel) (+81) 426 56 7832
(fax) (+81) 426 56 7840

Australia
(tel) 1 800 629 485
(fax) (+61) 3 9210 5947

Asia Call Center Numbers

Country	Phone Number	Fax Number
Singapore	1-800-375-8100	(65) 836-0252
Malaysia	1-800-828-848	1-800-801664
Philippines	(632) 8426802 1-800-16510170 (PLDT Subscriber Only)	(632) 8426809 1-800-16510288 (PLDT Subscriber Only)
Thailand	(088) 226-008 (outside Bangkok) (662) 661-3999 (within Bangkok)	(66) 1-661-3714
Hong Kong	800-930-871	(852) 2506 9233
Taiwan	0800-047-866	(886) 2 25456723
People's Republic of China	800-810-0189 (preferred) 10800-650-0021	10800-650-0121
India	1-600-11-2929	000-800-650-1101

Warranty

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

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

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP 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:

1 Improper or inadequate maintenance, adjustment, calibration, or operation by Buyer;

2 Buyer-supplied software, hardware, interfacing or consumables;

3 Unauthorized modification or misuse;

4 Operation outside of the environmental and electrical specifications for the product;

5 Improper site preparation and maintenance; or

6 Customer induced contamination or leaks.

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Certification

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

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Assistance

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

Sales and Service Offices

US FIELD OPERATIONS

Headquarters

Hewlett-Packard Co.
19320 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900

California, Northern

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

California, Southern

Hewlett-Packard Co.
1421 South Manhattan Ave.
Fullerton, CA 92631
(714) 999-6700

Colorado

Hewlett-Packard Co.
24 Inverness Place, East
Englewood, CO 80112
(303) 649-5512

Atlanta Annex

Hewlett-Packard Co.
2124 Barrett Park Drive
Kennesaw, GA 30144
(404) 648-0000

Illinois

Hewlett-Packard Co.
5201 Tollview Drive
Rolling Meadows, IL 60008
(708) 255-9800

New Jersey

Hewlett-PackardCo.
150 Green Pond Rd.
Rockaway, NJ 07866
(201) 586-5400

Texas

Hewlett-Packard Co.
930 E. Campbell Rd.
Richardson, TX 75081
(214) 231-6101

EUROPEAN FIELD OPERATIONS

Headquarters

Hewlett-Packard S.A.
150, Route du Nant-d'Avril
1217 Meyrin 2/Geneva
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(41 22) 780.8111

France

Hewlett-Packard France
1 Avenue Du Canada
Zone D'Activite De Courtaboeuf
F-91947 Les Ulis Cedex
France
(33 1) 69 82 60 60

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Hewlett-Packard GmbH
Hewlett-Packard Strasse
61352 Bad Homburg v.d.H
Germany
(49 6172) 16-0

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Hewlett-Packard Ltd.
Eskdale Road, Winnersh Triangle
Wokingham, Berkshire RG41 5DZ
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(44 1734) 696622

INTERCON FIELD OPERATIONS

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Hewlett-Packard Company
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Palo Alto, California, USA
94304-1316
(415) 857-5027

Australia

Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
(61 3) 895-2895

Canada

Hewlett-Packard (Canada) Ltd.
17500 South ServiceRoad
Trans-Canada Highway
Kirkland, Quebec H9J 2X8
Canada
(514) 697-4232

China

China Hewlett-Packard Company
38 Bei San Huan X1 Road
Shuang Yu Shu
HaiDian District
Beijing, China
(86 1) 256-6888

Japan

Hewlett-Packard Japan, Ltd.
1-27-15 Yabe, Sagamihara
Kanagawa 229, Japan
(81 427) 59-1311

Singapore

Hewlett-Packard Singapore (Pte.)Ltd.
150 Beach Road
#29-00 Gateway West
Singapore 0718
(65) 291-9088

Taiwan

Hewlett-Packard Taiwan
8th Floor, H-PBuilding
337 Fu Hsing North Road
Taipei, Taiwan
(886 2) 712-0404

Declarations of Conformity

Declaration of Conformity

according to ISO/IEC Guide 22 and EN45014

Manufacturer's Name:	**Hewlett-Packard Ltd.**
Manufacturer's Address:	Queensferry Microwave Division South Queensferry West Lothian, EH30 9TG Scotland, United Kingdom

Declares that the product

Product Name:	Digital Radio Test Set
Model Number:	HP 11758B
Product Options:	This declaration covers all options of the above product as detailed in TCF A-5951-9852-02

Conforms with the protection requirements of European Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic compatibility, against EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992

As Detailed in:	Electromagnetic Compatibility (EMC) Technical Construction File (TCF) No. A-5951-9852-02
Assessed by:	DTI Appointed Competent Body EMC Test Centre, GEC-Marconi Avionics Ltd., Maxwell Building, Donibristle Industrial Park, KY11 5LB Scotland, United Kingdom

Technical Report Number:6893/2200/CBR, dated 23 September 1997

Supplementary Information:

The product conforms to the following safety standards:

EN 61010-1(1993) / IEC 1010-1(1990) +A1(1992) +A2(1994)
CSA-C22.2 No. 1010.1-93
EN 60825-1(1994) / IEC 825-1(1993)

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC, and carries the CE marking accordingly.

South Queensferry, Scotland	***01 October 1998***	R M Evans
Location	***Date***	***R.M. Evans / Quality Manager***

Europe Contact:
Your Local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department 2Q / Standards Europe Herrenberger Strasse 130, D7030 Boblinger (Fax: +49-7031-143143)

Declaration of Conformity

according to ISO/IEC Guide 22 and EN45014

Manufacturer's Name:	**Hewlett-Packard Ltd.**
Manufacturer's Address:	Queensferry Microwave Division South Queensferry West Lothian, EH30 9TG Scotland, United Kingdom

Declares that the product

Product Name:	Digital Radio Test Set
Model Number:	HP 11758V
Product Options:	This declaration covers all options of the above product as detailed in TCF A-5951-9852-02

Conforms with the protection requirements of European Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic compatibility, against EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992

As Detailed in:	Electromagnetic Compatibility (EMC) Technical Construction File (TCF) No. A-5951-9852-02
Assessed by:	DTI Appointed Competent Body EMC Test Centre, GEC-Marconi Avionics Ltd., Maxwell Building, Donibristle Industrial Park, KY11 5LB Scotland, United Kingdom

Technical Report Number:6893/2200/CBR, dated 23 September 1997

Supplementary Information:

The individual components of this product meet relevant international safety standards:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC, and carries the CE marking accordingly.

South Queensferry, Scotland	***01 October 1998***	***R.M. Evans / Quality Manager***
Location	***Date***	

Europe Contact:
Your Local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department 2Q / Standards Europe Herrenberger Strasse 130, D7030 Boblinger (Fax: +49-7031-143143)

Statement of Compliance

Electromagnetic Compatibility (EMC) Information

This product has been designed to meet the protection requirements of the European Communities Electromagnetic Compatibility (EMC) directives:

EN55011:1991 (Group 1, Class A)
EN50082-1:1992
- IEC 1000-4-2 (1995) ESD
- IEC 1000-4-3 (1995) Radiated Suseptibility
- IEC 1000-4-4 (1995) EFT

In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specification.

Safety Information

This instrument has been designed and tested in accordance with publication EN61010-1(1993) / IEC 1010-1(1990) +A1(1992) +A2(1994) / CSA C22.2 No. 1010.1(1993) Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, 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.

Noise Declaration

LpA<70dB

am Arbeitsplatz (operator position)

normaler Betrieb (normal position)

nach DIN 45635 pt.19 (per ISO 7779)

General Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

WARNING

This is a Safety Class I instrument (provided with a protective earthing ground, incorporated in the powercord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

DO NOT operate the product in an explosive atmosphere or in the presence of flammable gasses or fumes.

DO NOT use repaired fuses or short-circuited fuseholders: For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type.

DO NOT perform procedures involving cover or shield removal unless you are qualified to do so: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only.

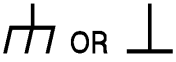
DO NOT service or adjust alone: Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, service personnel must not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

DO NOT substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

Safety Symbols

The following symbols on the instrument and in the manual indicate precautions which must be taken to maintain safe operation of the instrument.

	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 supplied documentation.
	Indicates the field wiring terminal that must be connected to earth ground before operating the equipment - protects against electrical shock in case of fault.
	Frame or chassis ground terminal - typically connects to the equipment's metal frame.
	Alternating current (AC)
	Direct current (DC)
	Indicates hazardous voltages
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, which if not correctly performed or adhered to could result in damage to or destruction of the instrument. Do not proceed beyond a caution note until the indicated conditions are fully understood and met.
	The CE mark shows that the product complies with all relevant European Legal Directives.
ISM 1-A	This is a symbol of an Industrial, Scientific, and Medical Group 1 Class A product.
	The CSA mark is a registered trademark of the Canadian Standards Association, and indicates compliance to the standards layed out by them.
	The C-Tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australian EMC Framework Regulations under the terms of the Radiocommunications Act of 1992.
	This symbol indicates the position of the operating switch for ‘Off’ mode. NOTE: To ensure instrument is isolated from mains, always rempve the appliance coupler (mains power cord) from the power source.
	This symbol indicates the position of the operating switch for ‘On’ mode.
	This symbol indicates the position of the operating switch for ‘Stand-by’ mode. Note, the instrument is NOT isolated from the mains when the switch is in this position. To isolate the instrument, the mains coupler (mains input cord) should be removed from the power supply.

Contents

Figures

Tables

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General Information

Description

The Hewlett-Packard 11758V Digital Radio Test System is designed to test digital radios. It consists of the HP 8593E E02 Spectrum Analyzer, the HP 11758B Digital Radio Test Set and an optional Accessory Kit (Option 301).

The HP 8593E E02 Spectrum Analyzer contains:

Microwave Spectrum Analyzer
IF Tracking Generator
Scalar Analyzer
Flatness Analyzer
Link Analyzer (Option 201)
IF Source
RF Source Control (Option 007)
Frequency Counter
Event Counter
Digital Radio Measurement Personality

The HP 11758B Digital Radio Test Set contains:

Power Meter
Three Tone Source
RF Source (Option 007)
Multipath Fading Simulator
Power Sensor
Crystal Detector
30 dB Reference Attenuator
50 Ω Adaptor
Cables

The Accessory Kit (Option 301) contains:

DADE Switch
IF Amplifier
IF Return Loss Bridge
Attenuators
Cables
Adapters
SMA Wrench

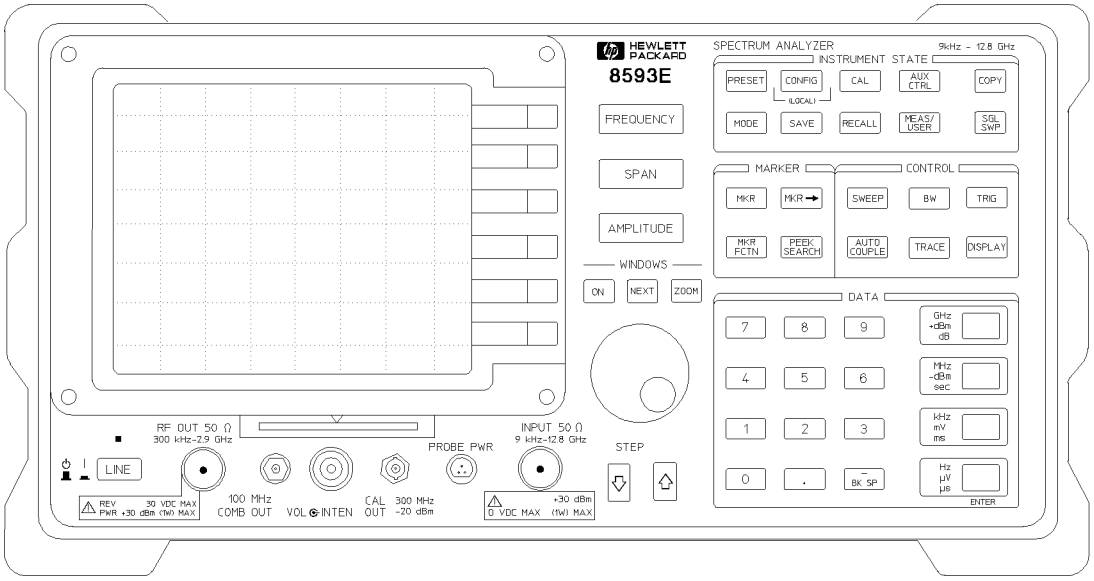

Figure 1-1. HP 8593E E02 Spectrum Analyzer

Spectrum Analyzer

Spectrum Analyzer. The HP 8593E E02 is a programmable, preselected, portable microwave spectrum analyzer with a frequency range of 9 kHz to 22 GHz. Standard features include automatic calibration routines, direct print and plot, trace storage, and a full set of marker commands. The precision frequency timebase and HP-IB interface are included in this system.

IF Tracking Generator/Scalar Analyzer. The IF Tracking Generator is a 300 kHz to 2.9 GHz signal generator. The signals generated by the Tracking Generator track the input frequency of the Spectrum Analyzer. The IF Tracking Generator is controlled by the keys on the Spectrum Analyzer. Using the Tracking Generator with the Spectrum Analyzer provides Scalar Analysis capability.

Frequency Counter. The Frequency Counter is internal to the Spectrum Analyzer. This function allows the user to quickly make accurate frequency measurements with the Spectrum Analyzer.

Event Counter. The Event Counter contains two fully independent counters that can be used to count errors. Both will count the number of occurrences, and one of these also measures interval time. Threshold error seconds can also be directly determined. The start and stop times for the measurement are automatically recorded and are shown along with the results on the Spectrum Analyzer's display.

Flatness Analyzer. The Flatness Analyzer is a calibrated detector with a frequency range of 10 MHz to 18 GHz. This analyzer provides an accurate measurement of small changes in amplitude response versus frequency. Response in dB versus swept frequency is displayed on the Spectrum Analyzer's display. Flatness analysis can be made RF to IF, RF to RF, IF to RF and IF to IF. Use of the Flatness Analyzer at RF frequencies requires the RF Source in the HP 11758B.

Link Analyzer (Option 201). The Link Analyzer can be used to measure the group delay and amplitude flatness characteristics of a radio. The measurements can be made using two spectrum analyzers connected in an **end-to-end** setup, or using one spectrum analyzer in a **loopback** setup. When making end-to-end measurements, the two spectrum analyzers may be located at different stations, synchronized over a radio link, with one analyzer being used as the transmitter and the other as the receiver. In the loopback configuration, one spectrum analyzer is used as both the transmitter and receiver. The measurements are controlled using one of the three link measurement personalities contained on the DRTS ROM Measurement Card.

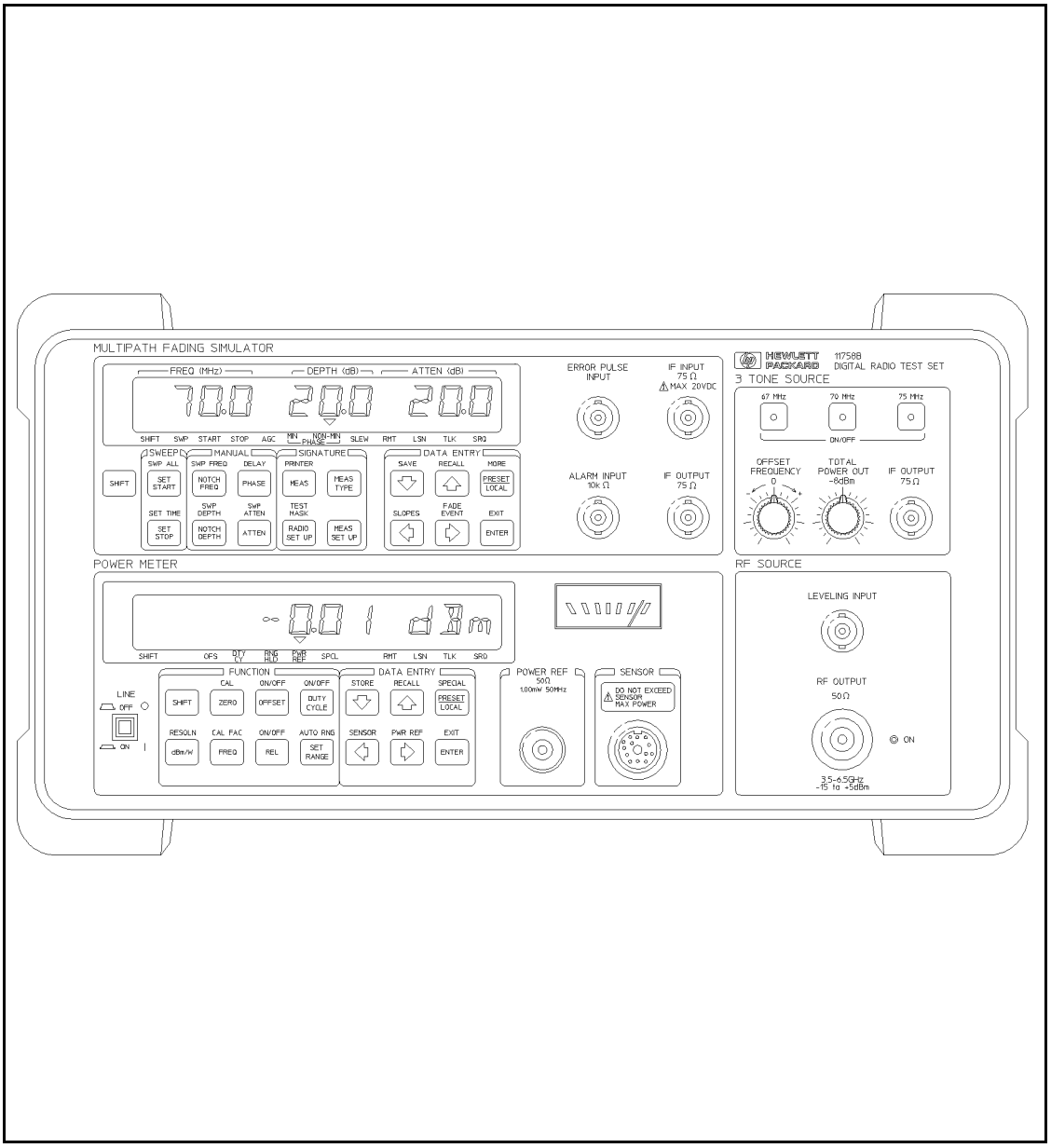

Figure 1-2. HP 11758B Digital Radio Test Set

HP 11758B Digital Radio Test Set

The following equipment is part of the HP 11758B Digital Radio Test Set.

RF Source (Option 007). The RF Source is a 3.5 GHz to 6.5 GHz source (with 10.7 GHz to 11.7 GHz frequency extension if Option 011 is ordered with Option 007) that is controlled by the softkeys of the Spectrum Analyzer. The RF Source uses the Spectrum Analyzer's local oscillator. The RF Source cannot be used independently of the HP 8593E E02.

Power Meter. The Power Meter is similar to an HP 437B Option H01; a programmable, single channel, average power meter. It is used in combination with the HP 8481D Power Sensor or the HP 8485D Power Sensor. Calibrated adapters and fixed attenuators are supplied with the optional Accessory Kit (Option 301) to allow a wide range of power level measurements in both 50Ω and 75Ω impedances.

3 Tone Source. The Three Tone Source consists of three independent signal sources with highly stable output levels. The output frequencies are 67, 70, and 75 MHz (137, 140, and 145 MHz with Option 143). The sources are adjustable in frequency (±2.5 MHz) and level (25 dB dynamic range) as a group. The sources can be turned on and off independently.

Multipath Fading Simulator. The Multipath Fading Simulator (similar to an HP 11757B) inserts a variable notch filter in the IF of a receiver to simulate RF propagation distortion of a microwave radio link. This instrument is used to test the equalizer's ability to function with calibrated amounts of propagation distortion. The mathematical model used is the Rummler Simplified Three Ray model. Notch depths to 40 dB at programmable frequencies are available with

flat fades to 50 dB (65 dB for fades without notches). The design is optimized for dynamic swept simulations.

Sweeps can be made from a start frequency to a stop frequency at a constant notch depth or from a start notch depth to a stop notch depth at a constant frequency. In addition, any combinations of notch depth, frequency and attenuation can be swept simultaneously between any arbitrary start and stop settings. High sweep rates are possible of up to 400 dB per second and 600 MHz per second. The Multipath Fading Simulator can be calibrated to the Spectrum Analyzer and Tracking Generator for optimum accuracy.

HP 11758V Option Information

Options on the System

007	Add 3.5 −6.475 GHz RF Source
011	Add 10.7 −11.7 GHz source
140	140 MHz (only) Fading Simulator and Intermodulation Test Source
147	70 & 140 MHz Fading Simulator and 70 MHz (only) Intermodulation Test Source
201	Link Analyzer for Group Delay and Amplitude Flatness Measurements
270	Spectrum Analyzer Frequency Extension to 26.5 GHz
301	Accessory Kit
908	Rack Mount Kits without Handles
909	Rack Mount Kits with Handles
915	Service package.
916	Additional Operating manual.
H04	Fader High Power Input/Output Capability
H07	Add 6.0 −8.0 GHz source
H08	Add 7.0 −10.0 GHz source
H10	Add 9.5 −13.0 GHz source
H13	Add 6.0 −13.0 GHz source
K01	Soft backpack cases (2)

Accessory Kit

The following table lists the components included in the Option 301 Accessory Kit. This kit contains many of the required components, adapters and cables necessary to use the Digital Radio Test System. If you want to inventory your case, compare the slots in the figure with the items mentioned in the following table. Some items, such as the HP 11708A Reference Attenuator, are included with the standard HP 11758V DRTS rather than the Option 301 Accessory Kit. These parts are labelled (Standard) in the table, and have a slot in the accessory kit box where they can be stored. Other items, such as the 11758-60002 Levelling Head, are only included with certain options of the HP 11758V DRTS. These parts are labelled in the table with the option number concerned.

The items listed in the table with no Slot Number, are included in the Accessory Kit but are stored in a separate compartment.

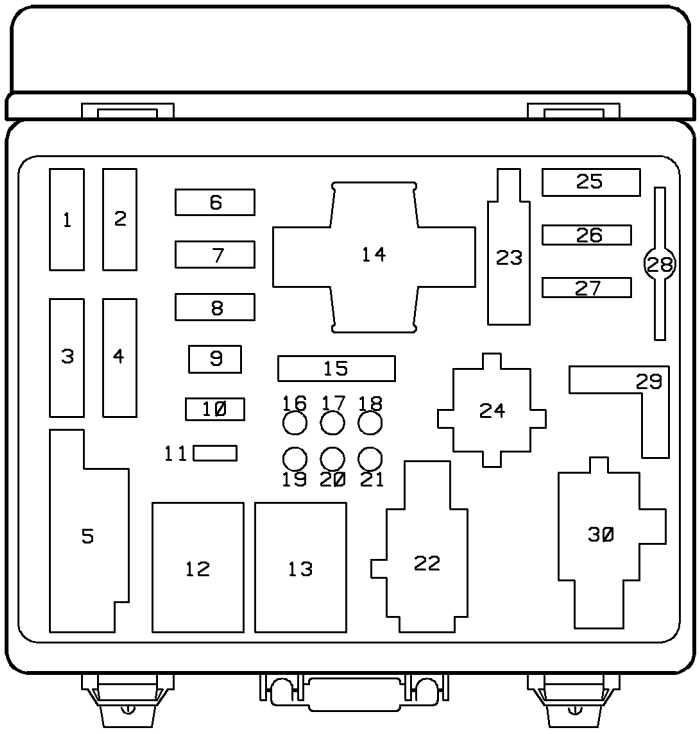

Figure 1-3. HP 11758V Option 301 Accessory Kit

Table 1-1. HP 11758V Standard Accessory Kit

Slot #	Part Description	Part Number	Qty
1,2,3,4	RF Source Filters (Options 007, H07, H08, H10, H13)	Depends on Option	Varies
5	External Leveling Head	11758-60002	1
6	30 dB Reference Attenuator (Standard)	11708A	1
7	30 dB 18 GHz Attenuator	8491B Opt 030	1
8	20 dB 18 GHz Attenuator	8491B Opt 020	1
9	50Ω Nm–Nm	1250-0778	1
10	50Ω Nf–Nf	1250-0777	1
11	75Ω BNCf–BNCf	1250-1287	1
12	DRTS ROM Card	11768-80010	1
13	32K RAM Card	85700A	1
14	30 dB Power Attenuator	8498A Opt 030	1
15	50/75Ω Minimum Loss Pad	11852B	1
16	Transformer 50Ω Nm–75Ω BNCf	9100-4859	1
17,18	Nm–BNCf (Standard)	1250-0780	2
19	APC-3.5f–Nm (Option 270)	1250-1744	1
20,21	50Ω Nf–SMAm	1250-2273	2
22	DADE Switch	11766A	1
23	Power Sensor (Standard/Option 270)	8481D[1]/8485D[2]	1
24	Return Loss Bridge	11769A	1
25	Crystal Detector (Standard)	8470B Opt 012	1
26,27	50/75Ω Matching Pad	11981A	2
28	Wrench Combination 5/16 in	8720-0015	1
29	Right Angle Nm–Nf	1250-2281	1
30	Tracking Generator Amplifier	11767A	1
	Cable, Nm–Nm 6 ft	11500A	1
	Cable, 75Ω BNC 6 ft	11758-60022	2
	Cable, 75Ω BNC 10 ft	11758-60023	1
	Cable, 75Ω BNC 15 ft	11758-60024	1

1 Supplied with Standard 11758V

2 Supplied with 11758V Option 270. Substituted for 8481D.

Documentation

HP 11758V documentation consists of Operating information, Programming information, and Service information. Service information can be obtained when selecting Option 915. Any manual can be ordered from the HP Sales and Service Offices listed inside the rear cover of this manual.

Note

Field Operation HP 11758V documentation is modular. This allows you to choose, from the extensive documentation HP provides, the kind of information you wish to carry into the field. The recommended field operation documentation is:

HP 11758V User's Guide.

HP 11757B Multi-Simulator User's Guide.

"Local Reference" section from the HP 11757B Multipath Fading Simulator Operation and Programming Reference.

HP 11770A Link Measurement Personality User's Guide.

C/N Vs BER DLP Measurement Personality User's Guide.

M-Curve DLP Measurement Personality User's Guide.

Standard Information

Standard operating information is shipped with the instrument. Option 916 provides an additional set of operating information. You should have received the following documentation with your instrument:

HP 11758V User's Guide.

HP 11758T/U Calibration Guide.

HP 11757B Multi-path Fading Simulator User's Guide.

HP 11757B Installation and Calibration Guide.

HP 11757B Support Disk.

HP 11757B Multipath Fading Simulator Operation and Programming Reference.

HP 437B Operation Manual.

C/N Vs BER DLP Measurement Personality User's Guide.

ROM Measurement Card.

M-Curve DLP Measurement Personality User's Guide.

HP 8590 Series Operation.

HP 8593E Quick Reference Guide.

HP 8590 Series Spectrum Analyzer Programming Manual.

HP 8593E Calibration Guide.

HP 11770A Link Measurement Personality User's Guide.

HP 85713A Digital Radio Measurements Personality Operating Guide.

HP 8593E EO2/E04 Supplement.

HP 859X Firmware Note.

HP 859X Cover Letter.

Option 915 Orders

If you ordered an option 915, the following manuals were also sent.

HP 11758T/U Calibration Guide.

HP 11758T/U Service Manual.

HP 11758T/U CLIPS.

HP 11757B Installation and Calibration Guide.

HP 11757B Support Disk.

HP 11757B Service Manual.

HP 11757B CLIPS.

HP 437B Service Manual.

HP 8593E Service Manual.

HP 8593E Component Level Information.

HP 8593E E02/E04 Supplement.

What is in these Manuals

HP 11758V User's Guide Contains system operating information for the entire HP 11758V Digital Radio Test System.

HP 11758T/U Calibration Guide Contains system performance tests and adjustments.

Making Measurements with the HP 11757B explains how to make signature measurements with the Multipath Fading Simulator part of the HP 11758V (the signature capability does not exist with option 001 orders).

HP 11757B Installation and Calibration Guide contains information about conducting automated performance tests and adjustments using the HP 11757B Support Disk.

HP 11757B Support Disk An HP-Basic program to perform automated performance tests and adjustments over HP-IB.

HP 11757B Operating and Programming Manual contains installation, verification, operating, and programming information about the Multipath Fading Simulator part of the HP 11758V.

HP 437B Operating Manual contains operating and programming information about the Power Meter part of the HP 11758V.

C/N DLP Manual describes how to use a DLP (Down Loadable Program) to make Carrier to Noise versus Bit Error Ratio measurements.

M-Curve DLP Manual describes how to use a DLP (Down Loadable Program) to display M-Curve measurement results on the spectrum analyzer display.

HP 8590 Series Operation contains general operating information about the spectrum analyzer.

HP 8593E Quick Reference Guide is a quick reference to the spectrum analyzer.

HP 8590 Series Programming Manual contains HP-IB programming information for the spectrum analyzer.

HP 8593E Calibration Guide contains calibration and performance verification information for the HP 8593E Spectrum Analyzer.

Addendum to Calibration Guides contains regulatory information for the HP 8593E Spectrum Analyzer.

HP 11770A Link Measurement Personality User's Guide contains detailed information on making group delay and amplitude flatness measurements using the HP 11770A Link Measurement Personality with the HP 8593E Option E02 Spectrum Analyzer.

HP 85713A Digital Radio Measurements Personality Guide contains information on how to use the downloadable programs shipped with the HP 11758V.

HP 8593E E02/E04 Supplement contains operating, verification, and service information about the spectrum analyzer that is specific to the E02 and E04 options.

Firmware Note gives firmware revision details for the HP 8593E Spectrum Analyzer.

HP 11758T/U Service Manual contains service information for the DRTS system.

HP 11758T/U CLIPS contains schematics, material lists, and component location diagrams for the DRTS system.

HP 11757B Service Manual contains service information for the Multipath Fading simulator part of the HP 11758V.

HP 11757B CLIPS contains schematics, material lists, and component location diagrams for the Multipath Fading simulator part of the HP 11758V.

HP 437B Service Manual contains service information for the Power Meter part of the HP 11758V.

HP 8593E Service Manual contains service information for the Spectrum Analyzer part of the HP 11758V.

HP 8593E CLIPS contains schematics, material lists, and component location diagrams for the Spectrum Analyzer part of the HP 11758V.

2

Installation and Verification

Introduction

This section provides the information needed to install and verify the HP 11758V. Included is information pertinent to initial inspection, power requirements, line voltage selection, power cables, interconnection, environment, instrument mounting, storage, and shipment. To make measurements, the relevant measurement mode must be loaded from the HP 11768-80010 ROM Measurement Card. The procedure for this is discussed later in this section. Also included in this section are procedures for verification of operation of the instruments in the Digital Radio Test System.

Initial Inspection

Warning 

To avoid hazardous electrical shock, do not turn on the instrument when there are signs of shipping damage to any part of the outer enclosure (covers or panels).

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1 and Figure 1-2. Procedures for checking electrical performance are given in the service manual. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of unusual stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

Power Requirements

Note

The following Power Requirements are for mains connected equipment unless stated other wise.

Power Requirements

Operating Voltage Range:115/230V
Operating Frequency Range: 50-60Hz
Power Dissipation: 200 VA (max).

Caution

Before switching on this instrument, make sure that the line voltage selctor switch is set to the voltage of the power supply and the correct fuse is installed. Ensure the power supply voltage is in the specified range.

Mains supply voltage should not exceed ±10% of the nominal selected line voltage.

Warning

Appliance coupler (mains input powercord) is the disconnect device. Do not position the instrument such that access to the coupler is impaired.

For continued protection against fire hazard, replace the line fuse only with the same type and line rating F5A 250V. The use of other fuses or materials is prohibited.

If this instrument is not used as specified, the protection provided by the equipment could be impaired. This instrument must be used in a normal condition only (in which all means for protection are intact).

No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

Line Voltage and Fuse Selection

Caution

BEFORE PLUGGING THIS INSTRUMENT into the line (Mains) voltage, you must set the rear-panel voltage selector switch to correspond to the power source. An improper selector switch setting can damage the instrument when it is turned on.

Set both instruments' rear-panel voltage selector switches to the line voltage range (115V or 230V) corresponding to the available AC voltage. See Figure 2-1. Insert a small screwdriver or similar tool in the slot and slide the switch up or down so that the proper voltage label is visible.

Note

The AC line input fuse is the same value for both the HP 11758B and the HP 8593E, regardless of the input line voltage.

Fuse Ratings and Part Numbers

Line Voltage	Rating	Part Number
115V	F5.0A, 250V	2110-0756
230V	F5.0A, 250V	2110-0756

The line fuse is housed in a small container immediately above the rear-panel power connector. The container provides space for storing a spare fuse. To check the fuse, insert the tip of a screwdriver in the slot at the bottom of the container and pry gently to remove the container.

Note

The fuses are not attached to the container and will drop out.

If the fuse is mechanically defective or missing, install a new fuse in the proper position and reinsert the fuse container.

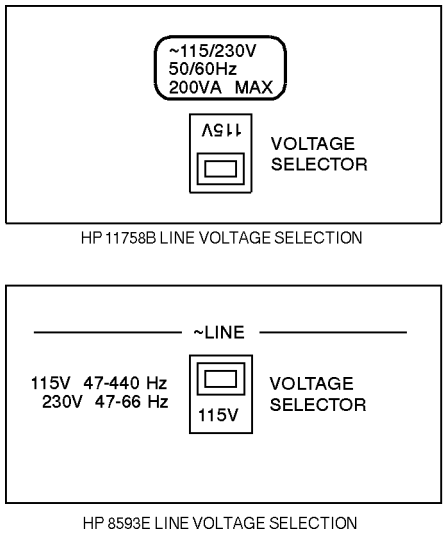

Figure 2-1. Line Voltage Selection

Power Cables

Warning

BEFORE CONNECTING EITHER INSTRUMENT, the protective earth terminals of this instrument must be connected to the protective conductor of the line (Mains) power cable. The line plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection.

Caution

Failure to ground the instrument chassis (that is, using a two-pronged adapter on the line (Mains) power cable) will result in the output amplifier's increased sensitivity to damage by static discharge.

Both instruments are equipped with a three-wire power cable. When connected to an appropriate AC power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. See Figure 2-2, "Power Cable and Line (Mains) Plug Part Numbers", for the part numbers of these power cables. Cables are available in different lengths and some with right angle plugs to the instrument. Check with your nearest HP service center for descriptions and part numbers for these cables.

Cooling

To provide adequate cooling, an air gap of approximately 75mm should be maintained around the instrument.

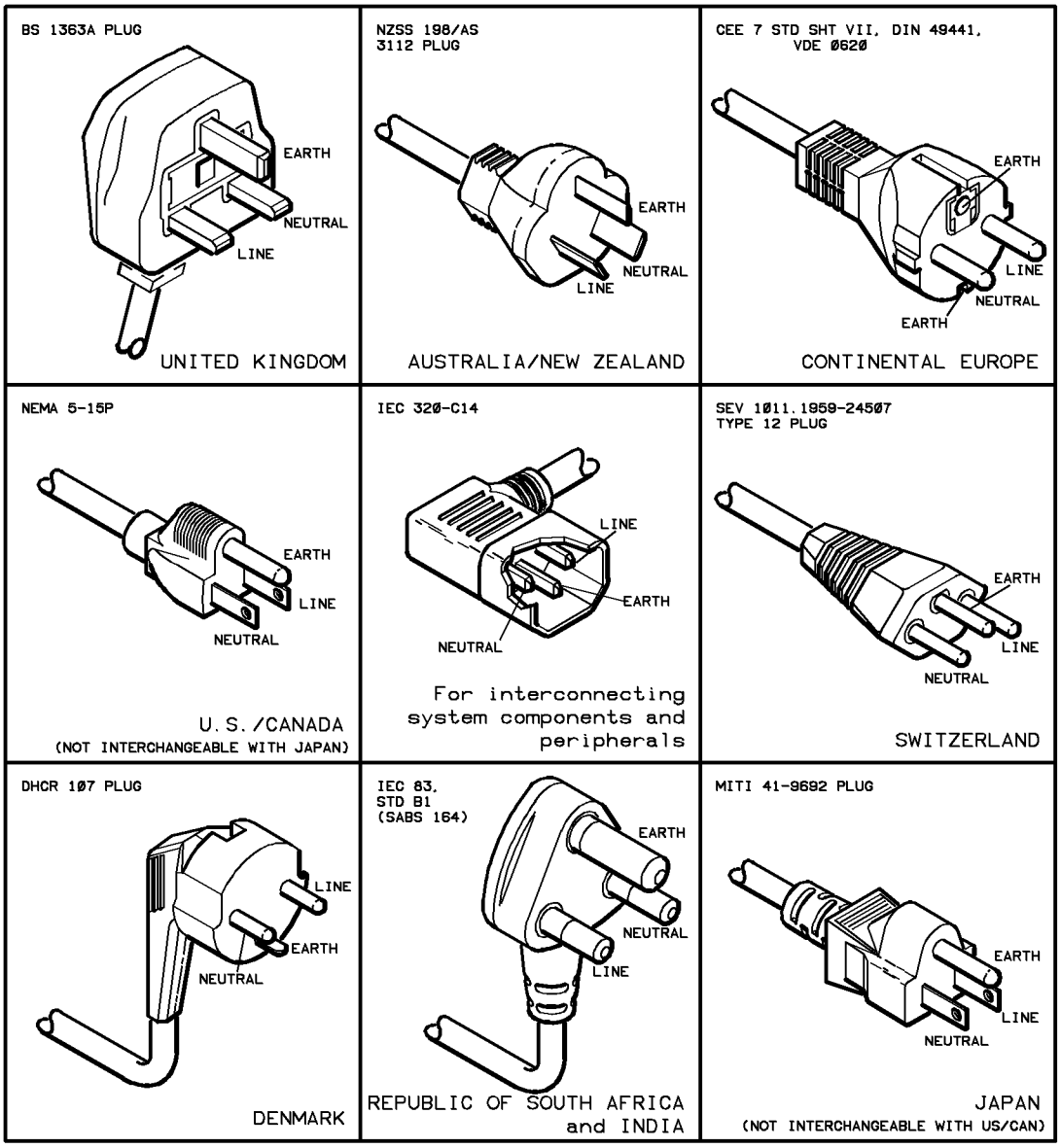

Figure 2-2. Power Cable and Line (Mains) Plug Part Numbers

Operating Environment

This instrument is designed for indoor use only.
The instrument may be operated at temperatures from 0°C to +55°C at altitudes up to 4600m (15,000 ft.).
The instrument may be operated in environments up to 95% relative humidity to 40°C, but it should be protected from temperature extremes which may cause condensation.

Caution

The instrument is designed for use in Istallation Category II and Pollution Degree 2 per IEC1010 and 64 respectively.

Operation

Environment

Temperature: ..... 0°C to +55°C.
Humidity: ..... Up to <95% Relative Humidity to 40°C.
EMC: ..... Meets EN55011:1991 (Group1, Class A), and EN50082-1:1992.

Physical

Weight: 10.0 kg (22.0 lb) nominal

Dimensions (height x width x depth): 163H x 476W x 468D mm nominal (incl. handle).

Both instrument cabinets have an adjustable handle that can be used as a stand for convenience in bench operation. The handle can be folded back to ensure self-aligning of instruments when stacked.

Cleaning

Use a soft, clean damp cloth to clean the front-panel and side covers.

Rack Mounting

Warning 

The HP 11758B weighs 10.0 kg (22.0 lb), and the HP 8593E weighs 15.9 kg (35.0 lb). Care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting.

Rack mounting information is provided with the rack mounting kits. If the kits were not ordered with the instrument as options, they may be ordered through the nearest Hewlett-Packard office. Refer to "Mechanical Options" in Chapter 1 for information regarding rack mounting kits.

Storage and Shipment

Environment

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

Temperature ..... −40°C to +75°C
Humidity ..... <95% relative at 15°C to 40°C
Altitude ..... <15 000 meters (49 200 feet)

Packaging

Tagging for Service. If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the end of this manual and attach it to the instrument.

To minimize repair time, be as specific as possible when describing the failure. Keep the following two items in mind when describing the failure:

1. Describe what makes you think the instrument is failing. An example might be "Power Meter displays

NO SENSOR when a power sensor is connected to the input port".

2. If the failure only occurs under certain conditions, explain how to duplicate the failure. An example might be "After pressing the LINE switch three times, the instrument will not power up".

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. Mark the container "FRAGILE" to encourage careful handling. In any correspondence, refer to the instrument by model number and full serial number.

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

1. Wrap the instrument in heavy paper or plastic. If shipping to a Hewlett-Packard office or service center, complete one of the blue tags mentioned above and attach it to the instrument.
2. Use a strong shipping container. A double-wall carton made of 2.4 MPa(350 psi) test material is adequate.
3. Use enough shock-absorbing material (75 to 100 mm layer; 3 to 4 inches) around all sides of the instrument to provide a firm cushion and prevent movement in the container. Protect the front panel with an appropriate type of cushioning material to prevent damage during shipment.
4. Seal the shipping container securely.
5. Mark the shipping container "FRAGILE" to encourage careful handling.

Setting up the HP 11758V System

The appropriate system configuration depends upon the measurement you want to make. Radio Testing, found in section 3, describes the setup for several of the tests this system is capable of performing.

When setting up the system for measurements there are some backpanel connections standard for most tests. After you make the following connections, you should use the Mode Loader to configure the HP 8593E for use in the Digital Radio Test System.

Backpanel Connections

1. Connect the AUX Interface on the HP 11758B to the AUX Interface on the HP 8593E using cable 8120-5343.
2. Connect the HP-IB port on the HP 11758B to the HP-IB port on the HP 8593E.
3. If your DRTS system includes an RF Source (Option 007), connect the LO OUT on the HP 8593E to the LO IN on the HP 11758B using an RF cable (HP 8120-4948).
4. Check the backpanel of the HP 8593E to confirm that the EXT REF IN is connected to the 10 MHZ REF OUTPUT.
5. Check Figure 2-3 and compare with your connections.

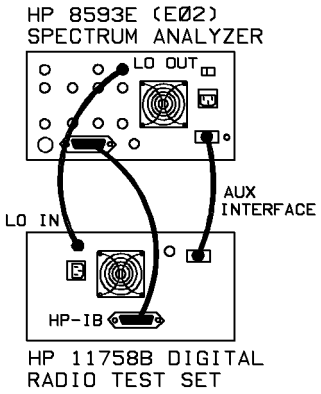

Figure 2-3. HP 11758V Backpanel Connections

Loading the Modes

Note

You must load appropriate modes from the DRTS mode card before making measurements with this system.

Mode Loader

The Mode Loader utility provides a convenient way to automatically dispose of and load the various modes that are provided on the HP 11768-80010 ROM Measurement Card. The total memory size required for these modes is larger than the user memory in the HP 8593E, so it is necessary to load the Modes in smaller groups. While this may be done manually, it is faster and easier to use the Mode Loader.

Loading the Mode Loader

1. Press (MODE) to bring up the Mode Menu. Alternate presses of the (MODE) key will switch between the Main Menu of the current mode and the Mode Menu.

Note

The Mode Menu always has `SPECTRUM ANALYZER` as the first softkey.

2. If `SPECTRUM ANALYZER` is the only softkey displayed on the Mode Menu, then skip to step number 8.
3. If `MODE LOADER` is one of the softkeys, then this utility is already loaded in the Spectrum Analyzer and the rest of this procedure may be skipped. See "Using the MODE LOADER".
4. If other Modes are present on these softkeys they should be disposed of before loading in the MODE LOADER by doing:
5. Press (CONFIG.). Press `MORE 1 of 2`.
6. Press `DISPOSE USER MEM` (an "IF YOU ARE SURE ... " message appears).
7. Press `DISPOSE USER MEM` for a second time.
8. To load the MODE LOADER do the following:
9. Insert the ROM Measurement Card (HP 11768-80010) in to the card reader on the front panel of the HP 8593E Spectrum Analyzer.
10. Press (RECALL).
11. Select the memory card by pressing `INTRNL CRD` to underline CRD.
12. Press `CATALOG CARD`.

13. Press CATALOG ALL. The file "dLOADME" will be highlighted.
14. Press LOAD FILE which loads the highlighted file.
15. MODE LOADER should now be one of the keys on the Mode Menu.
16. If a user Down-Loadable Program (DLP) is to be used in conjunction with the Event Counter mode, it should be loaded in before the Event Counter mode is loaded.

Using the Mode Loader

1. Insert the Digital Radio Test System ROM Measurement Card (HP 11768-80010) in to the card reader on the front panel of the HP 8593E, if not already inserted.

Note The Mode Menu always has SPECTRUM ANALYZER as the first softkey.

2. Press (MODE) to bring up the Mode Menu. (MODE LOADER should be the second softkey.)
3. Press MODE LOADER.
4. Items 1 to 12 can be selected by using the DATA keys to enter the item number and pressing (ENTER). Press NEXT PAGE to access items 13 to 16. It will take 10 to 60 seconds to dispose of the current modes and load in the new ones.

Note When an item number is selected, the Mode Loader first disposes of any other DRTS modes that are resident in the HP 8593E memory, before loading in the new mode(s). If the Multipath DLP is selected (item number 11), the Mode Loader will also delete itself. However,

user defined DLP's will not be disposed (provided that the guidelines for assigning names and keys for user DLP's were followed — as contained in the *HP 8590 Series Spectrum Analyzer Programming Manual*).

Changing Modes and Presetting Modes

1. Once the mode is loaded, a softkey for that mode will appear in the Mode Menu. Press (MODE) to display the Mode Menu and then press the softkey for that mode you want to use. If a mode is reentered it will be in the same state as when it was left, provided (PRESET) has not been pushed.
2. To return to the Spectrum Analyzer mode, press (MODE) to bring up the Mode Menu and then `SPECTRUM ANALYZER`. The Spectrum Analyzer will be returned to the same state as when it was left.
3. The green (PRESET) key may be used to take the instrument back to the Spectrum Analyzer mode, but this will also preset the instrument, including all modes, to the default state.

Note

The green (PRESET) key should seldom need to be used. It is not necessary to press (PRESET) before switching to another mode.

4. An individual mode may be preset to its default state without affecting other modes by use of the mode `PRESET` softkey that is in the Main Menu of that mode.

Accessing the Main Menu of a Mode

1. Press (MODE) and then the mode name softkey.
2. Or press (MODE) (MODE).

Verifying the HP 11758V System

Introduction

The following procedure is intended to test the functionality of the HP 11758V Digital Radio Test System without using external test equipment. Successful completion of this procedure indicates that all major features of the Test System are functioning. This procedure, however, does not test to performance specifications. To test performance specifications, refer to the HP 11758T/U Calibration Guide (part number listed under Documentation in Chapter 1 of this manual).

Performing the verification check is recommended after installation of the system, when a failure in the HP 11758V is suspected or any time confidence in the system needs to be reestablished. If a failure of the HP 11758V has occurred, this procedure will determine which instrument (HP 8593E, HP 11758B or Option 301 Accessory Kit) needs to be returned to Hewlett-Packard for service.

Note

The sequence in which these checks are run is critical for accurate troubleshooting.

The functional check is comprised of the following tests:

- **Spectrum Analyzer Check**
  Perform the amplitude and frequency auto calibration routines.
- **Power Meter Check**
  Zero the Power Sensor and check the Power Reference and Offset function.

- **Flatness Analyzer Check**
  Checks a flatness calibration for repeatability.
- **Multipath Fading Simulator Check**
  Checks the functionality of the notch filter.
- **3 Tone Source Check**
  Display the 3 Tones on the 8593E Spectrum Analyzer.
- **RF Source Check**
  If your system has an RF Source (Option 007), this test will measure the power level of the output signal.
- **Event Counter Check**
  Checks the accuracy of the event counter and interval counter readings.
- **Link Analyzer Check**
  Checks the main functions of the group delay and amplitude flatness measurements capability.

Spectrum Analyzer Check

Description

The HP 8593E internal frequency and amplitude calibration routines are run and a confidence test is performed. This procedure will exercise all the major Spectrum Analyzer functions and return a message should any problems be encountered. This check takes approximately 15 minutes to run.

If either calibration routine or the confidence test fail to run successfully, there may be a problem with the Spectrum Analyzer. This check is internal to the Spectrum Analyzer and is independent of HP 11758B functionality. If this test fails, return the Spectrum Analyzer to HP for servicing.

Procedure

1. Connect a 50Ω coaxial cable (such as HP 10503A) between the front panel CAL OUT and the

INPUT 50Ω connectors (you will need an Nm-BNCf adaptor).

2. Perform the frequency and amplitude calibration routine by pressing (CAL) and CAL FREQ & AMPTD.

   During the frequency routine, CAL:SWEEP, CAL:FREQ, and CAL:SPAN are displayed as the sequence progresses. During the amplitude routine, CAL:AMPTD, CAL:3 dB BW, CAL:ATTEN, and CAL:LOGAMP are displayed as the sequence progresses. CAL:DONE appears when the routine is completed. Any failures or discrepancies produce a message on the screen. See appendix C of this manual for error messages.

3. If desired, when the frequency and amplitude calibration routines have been completed successfully, store the data by pressing CAL STORE.

   The calibration routines calibrate the analyzer by generating correction factors. The softkey CAL STORE stores the calibration correction factors in the area of analyzer memory accessed at power up. The analyzer will automatically apply these factors in future measurements, even if the analyzer has been turned off.

4. Perform a confidence test by pressing (CAL), MORE 1 OF 3, and CONF TEST.

   The analyzer performs a self test of several major functions. The test is performed within one to two minutes. If the unit does not function properly, a message appears on the screen. See Chapter 3 in the *HP 8593E Service Manual* for an explanation of the message.

   When the calibration routines have been completed successfully, the analyzer is ready for normal operation.

Power Meter Check

The functions of the Power Meter are checked using power sensors and sensor cables. These checks provide reasonable assurance that most of the front panel controlled functions are being executed by the Power Meter.

1. Turn on the Power Meter and observe the power up routine with no power sensor connected to the input. During power up the diagnostics stored in ROM are executed under microprocessor control and turn on all the display segments and annunciators.

   When the self-test is finished, the Power Meter will display "SELF TEST OK". It will then display "NO SENSOR".

   If an error occurs during the power-up tests, the Power Meter will display an error code. For information about the specific error, refer to "Error Messages" in Appendix A in the *HP 437B Operating Manual*.

2. Press (PRESET/LOCAL), then (ENTER).

3. Zero the sensor:

   a. Connect the power sensor to the power meter using the HP 11730B power sensor cable.

   b. Disconnect the power sensor from any power sources.

   c. Press (ZERO). The power meter will display "ZEROING *****". When zeroing is finished, this message will disappear.

4. Calibrate the sensor:

   a. Set up the power meter as shown in Figure 2-4.

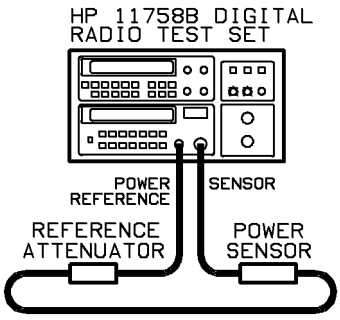

Figure 2-4. Power Meter Verification Setup

Caution

Always use the 30 dB reference attenuator when calibrating the power meter with the HP 8481D Power Sensor (or HP 8485D if your system has Option 270).

b. Press [SHIFT] [ZERO] (CAL). The power meter will display the reference calibration factor (Ref Cal Factor) that is currently set.

c. Examine the power sensor to determine the required Ref Cal Factor.

d. Use the arrow keys if required, to enter this value into the power meter, then press [ENTER].

e. The power meter will display "CAL *****". When the calibration is finished, this message will disappear.

5. Enter the offset factor for the attenuators:

a. Check the labels of the attenuators used, to find the offset factors. These values are dependent on the frequency at which you are measuring. Add together the offset factors of all the attenuators.

b. Press [OFFSET] on the power meter, then enter the combined offset factor.

6. Enter the calibration factor for the sensor:

a. Check the label of the power sensor to find the calibration factor. This value is dependent on the frequency at which you are measuring.

b. Press (SHIFT) (FREQ) (CAL FAC), then use the arrow keys to enter the calibration factor.

7. Press (SHIFT) (▶) (PWR REF). The PWR REF annunciator will be enabled.
8. The Power Meter will display −30.00 dBm, ±0.02 dBm.
9. Press the (dBm/W) key to display dBm.
10. Press the (OFFSET) key. The display will read "OFS +00.00 dB."
11. Using the arrow keys modify the display to read "OFS +30.00 dB."
12. Press the (ENTER) key.
13. The Power Meter will display 0.00 dBm ±0.02 dBm.

Flatness Analyzer Check

Description

The HP 8470B Crystal Detector is used to measure the swept output of the IF Tracking Generator (mode of HP 8593E). The level and stability of that measurement are checked.

Procedure

1. Press the (MODE) key on the HP 8593E Spectrum Analyzer. Press the `FLATNESS & SOURCES` softkey. If Flatness and Sources has not been loaded, insert the DRTS Measurement Card into the mode loader and press `MODE LOADER` (4) (ENTER).
2. Connect the BNC end of the HP 8470B Crystal Detector to the Detector Input on the rear panel

of the HP 8593E using a BNC cable. Connect the Type N end of the Detector to the RF OUT 50Ω connector on the HP 8593E front panel.

3. Press: Sources
4. Press: SOURCE IF RF so that IF is underlined.
5. Press: CENTER FREQ, then enter a center frequency of 1.5 GHz.
6. Press: SPAN, then enter a span of 1 GHz.
7. Press: SRC PWR, and set the source power to 0 dBm.
8. Select a Scale Log (amplitude) of 0.1 dB/div.
9. Normalize the trace by pressing (CAL), CAL TRANS, STORE THRU.
10. A normal trace would be very flat, with no sharp spikes, noise or deviations that are greater than 2 minor divisions. If your trace is not what is to be expected, check your connections for tightness, reconnect the detector if necessary, and press the CAL TRANS softkey again.

Multipath Fading Simulator Check

Description

This check runs the main functions of the Multipath Fading Simulator. The HP 8593E is used as a spectrum analyzer to check the functionality of the notch filter of the MFS.

Equipment

Spectrum Analyzer	HP 8593E
50Ω-75Ω Matching Pad (2)	HP 11981A
Adapter, Type N(m) to BNC(f) ...	HP 1250-0780
75Ω BNC Cable (2)	HP 8120-3616

Procedure

1. Connect the equipment as shown in Figure 2-5. Note that all cables are 75Ω.

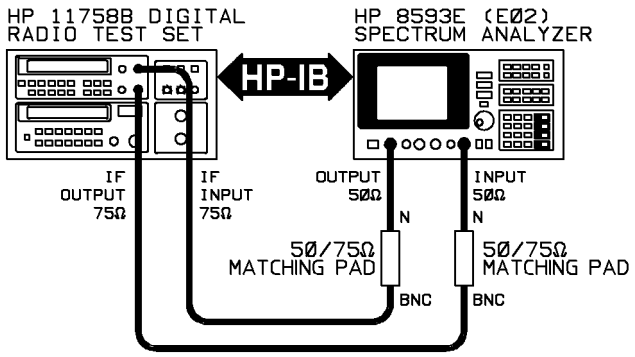

Figure 2-5. Multipath Fading Simulator Check Setup

2. Set the HP 8593E for use as a spectrum analyzer.
   a. Press: SPECTRUM ANALYZER
   b. Press: PRESET SPECTRUM
3. If your Multipath Fader is configured for 70 MHz band, set up the spectrum analyzer for a span from 40 to 100 MHz. On the spectrum analyzer:
   a. Press: START FREQ
   b. Press: 4 0 MHZ
   c. Press: STOP FREQ
   d. Press: 1 0 0 MHZ
4. Turn on the RF Output of the spectrum analyzer.
   a. Press: MKR
   b. Press: AUX CTRL
   c. Press: TRACK GEN

d. Press: SRC PWR ON (you may have to push twice to get ON underscored)

e. Press: 1 0 −dBm

5. Now set the Multipath Fading Simulator for a notch sweep:

   a. Press: SET START

   b. The frequency display will blink. Use the arrow keys to display 40.0, then press ENTER

   c. The depth display will blink. Use the arrow keys to display 20.0, then press ENTER

   d. The attenuator display will blink. Use the arrow keys to display 00.0, then press ENTER

   e. Press: SET STOP

   f. The frequency display will blink. Use the arrow keys to display 100.0, then press ENTER

   g. The depth display will blink. Use the arrow keys to display 20.0, then press ENTER

   h. The attenuator display will blink. Use the arrow keys to display 00.0, then press ENTER

6. Set the time for the sweep. Press: SHIFT SET STOP (SET TIME). Use the arrow keys to set the sweep for 3 seconds. Press: ENTER

7. Start the sweep. Press: SHIFT SET START (SWP ALL)

8. Observe the spectrum analyzer display. You should observe a notch sweeping across from 40 to 100 MHz. The notch stays at 20 dB and the flat fade attenuation at 0 dB.

9. To stop the sweeping press: SHIFT SET START again.

10. Set the notch frequency to 70 MHz. Press: (NOTCH FREQ) and use the arrow keys to set the display to 70.0, press (ENTER).
11. Check the notch to see if it is at 70 MHz.
    a. Press: (MKR)
    b. Press: MKR→MIN
    c. Verify that the frequency of the marker is 70 MHz.
12. Check that the notch is of 20 dB depth:
    a. Press: MARKER DELTA
    b. Press: (NOTCH DEPTH), then enter 0 dB. Read the Marker Delta value in the upper right corner of the spectrum analyzer display and verify that it reads 20 dB ± 1 dB.
13. Zero the marker. Press: (MKR) MARKER DELTA.
14. Set the flat fade attenuation to 10 dB. Press: (ATTEN), and use the arrow keys to set the display to read 10.0, then press (ENTER).
15. Read the marker delta in the upper right corner of the spectrum analyzer display. It should read −10 dB ±1 dB.

3 Tone Source Check

Description

This check looks at the output of the 3 Tone Source on the HP 8593E Spectrum Analyzer. The frequencies and approximate level of the 3 Tones are checked. This check tests the HP 11758B, and for troubleshooting purposes is completely independent of the HP 8593E.

Equipment

50Ω-75Ω Matching Pad ..... HP 11981A

Adapter, Type N(m) to BNC(f) ... HP 1250-0780
75Ω BNC Cable ..... HP 8120-3616

Procedure

1. Connect the equipment as shown in Figure 2-6.
2. Press the PRESET key on the Spectrum Analyzer.
3. Set the Spectrum Analyzer to the following settings:

   Center Frequency ..... 70 MHz
   SPAN ..... 25 MHz
   Reference Level ..... 0 dBm
   Attenuator ..... 20 dB
   Resolution Bandwidth ..... 100 kHz
   Video Bandwidth ..... 300 kHz
   Marker ..... ON

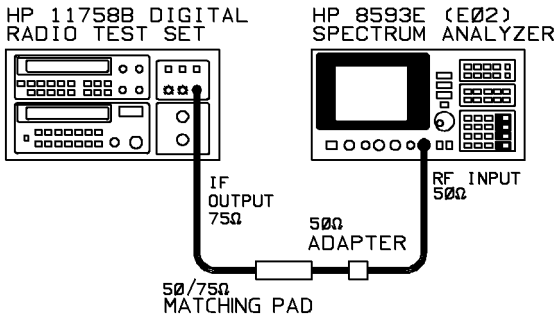

Figure 2-6. 3 Tone Source Verification Check Setup

4. On the HP 11758B 3 Tone Source, turn all three tones on and set both the LEVEL and FREQUENCY knobs to their center position.
5. Press SHIFT PRESET on the Multipath Fading Simulator keyboard. Press ▲ or ▼ until `3 TONE READ` appears on the display. Press ENTER. Verify that the frequency offset is ±1.0 MHz and the power level reads -8 dBm.

6. Observe the 3 Tone Spectrum on the Spectrum Analyzer. Using the marker, verify the frequencies of the 3 Tones. They should be 67, 70 and 75 MHz Look for a level of approximately −11 dBm per tone.
7. Rotate the FREQUENCY knob on the 3 Tone Source. All 3 tones should vary in frequency as the knob is rotated. Return the knob to its center position.
8. Rotate the LEVEL knob. All 3 tones should vary in level as the knob is rotated. Return the knob to its center position.
9. Look at spurious signals emanating from the 3 Tone Source. Check that they are at least 60 dB below the 3 Tones.
10. Turn off each of the 3 Tones in sequence and ensure that they decrease in amplitude at least 40 dB when turned off.
11. If the 3 Tone Source fails any of the above tests, return the HP 11758B Digital Radio Test System to Hewlett-Packard for servicing.

RF Source Check

Description

This check should be made if your system has an RF Source (Option 007). The check ensures that the RF Source is outputting sufficient power and that it covers the appropriate frequency range. The RF Source is dependent on both the HP 11758B Digital Radio Test Set and the HP 8593E Spectrum Analyzer. The RF Source output is measured using the Power Meter.

Equipment

Power Sensor ..... HP 8481D (or HP 8485D)
30 dB Attenuator ..... HP 8491A Opt. 030
Leveling Head ..... HP 11758-60002

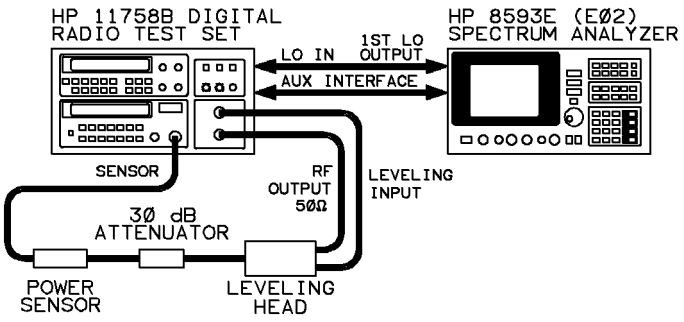

Figure 2-7. RF Source Verification Check Setup

Procedure

1. Connect the equipment as shown in Figure 2-7.
2. Using the Mode Loader, load the Flatness and Sources menu from the DRTS Measurement Card.
   a. Press: (MODE)
   b. Press: `MODE LOADER`
   c. Press: (4) (ENTER), then wait for the program to load.
   d. Press: `FLATNESS & SOURCES`
3. Using the `SOURCES` menu (in Flatness & Sources mode) on the HP 8593E, select `SOURCE RF`. Then set the CENTER FREQ to 6.4 GHz, the SPAN to 0, and the SRC PWR to 0 dBm.
   a. Press: `SOURCES`
   b. Press the `SOURCE IF RF` softkey so that RF is underscored.
   c. Press: `CENTER FREQ` (6) (.) (4) (GHz)
   d. Press: `ZERO SPAN`

e. Press: SRC PWR and SCR PWR ON OFF so that ON is underscored.

f. Press: 0 dBm

4. Enter the offset factor for the attenuators:

   a. Check the labels of the attenuators used, to find the offset factors. These values are dependent on the frequency at which you are measuring. Add together the offset factors of all the attenuators.

   b. Press OFFSET on the power meter, then enter the combined offset factor.

5. Enter the calibration factor for the sensor:

   a. Check the label of the power sensor to find the calibration factor. This value is dependent on the frequency at which you are measuring.

   b. Press SHIFT FREQ (CAL FAC), then use the arrow keys to enter the calibration factor.

6. Read the RF Source output power level on the Power Meter. The power level should read 0 dBm ±2 dB.

7. From the SOURCES menu, change SRC PWR to −10 dBm. Verify that the output level of the RF Source has decreased approximately 10 dB.

8. Set the SRC PWR to 0 dBm. Change the output frequency to 3.5 GHz. Repeat steps 3 and 4 for the 3.5 GHz output frequency.

9. If the RF Source passes all the above criteria, it is functioning correctly. If the power level is good at 0 dBm, but does not change, or changes incorrectly when set to −10 dBm, then the fault is in the HP 11758B.

10. If power is low in any case, disconnect the cable between the HP 11758B RF Source LEVELING

INPUT and the LEVELING HEAD (11758-60017). If the power level now increases to > +5 dBm, then the fault is in the HP 11758B.

11. If the cause of the problem is still undetermined, measure the signal at the HP 8593E's 1ST LO OUTPUT. Measure this signal at the end of the cable that connects to the HP 11758B, so that the cable is checked also. The level of this signal must be > −10 dBm. If this level is low check it again at the 1ST LO OUTPUT in order to determine if the cable or the HP 8593E is the problem.
12. If the cause of the problem is still undetermined, disconnect the LEVELING HEAD from the HP 11758B and measure the power coming out of the HP 11758B's RF OUTPUT port. If this power level is > +5 dBm then the LEVELING HEAD is the problem and it should be returned to Hewlett-Packard for service. If the power level is < +5 dBm then the problem is in the HP 11758B and it should be returned to Hewlett-Packard for service.

Event Counter Check

Description

The Spectrum Analyzer's HIGH SWEEP output is used as a stimulus for the event counter and interval counter inputs. The event counter and interval counter readings are checked.

Procedure

1. Connect a BNC cable between the HIGH SWEEP IN/OUT and EVENT CNTR INPUT jacks on the Spectrum Analyzer rear panel.

2. On the Spectrum Analyzer, press:
   a. (PRESET)
   b. Insert the DRTS Measurement Card in the mode loader.
   c. (MODE)
   d. `MODE LOADER`
   e. (5) (ENTER)
   f. `EVENT COUNTER`
   g. `More 1 of 2`
   h. `DSPLY SA ON OFF` (set to ON)
   i. (SPAN)
   j. `ZERO SPAN`
   k. (SWEEP), (2) (0) (ms)
3. After a few seconds, the EVENT CNTR display should read a count of approximately 10. A variation of ±2 counts between gate periods is normal.
4. Connect a BNC cable between the HIGH SWEEP IN/OUT and INTERVAL CNTR INPUT jacks on the rear panel.
5. After a few seconds, the INTERVAL CNTR display should read a count of approximately 10 and a time of approximately 0.800 seconds.

Link Analyzer Check

The performance of the link analyzer can be checked using the Group Delay Verification mode. This mode consists of a series of confidence test routines which check the main functions of the link analyzer.

If the link analyzer is faulty, the confidence tests will return an error message. Take a note of the error message and return the analyzer to HP for servicing.

Procedure

1. Ensure that the HP 8593E Spectrum Analyzer is calibrated and is functioning correctly. Refer to Chapter 8 of the *HP 8590 Series Spectrum Analyzer User's Guide* for details on how to calibrate the spectrum analyzer and check for basic problems.
2. On the Spectrum Analyzer, press:
   a. (PRESET)
   b. Insert the DRTS Measurement Card in the mode loader.
   c. (MODE)
   d. `MODE LOADER`
   e. (1) (6) (ENTER)
   f. `GRP DLY VERIFY`.
3. Start the first set of tests as follows:
   a. Press `VERIFY CARD`.
   b. A drawing of the analyzer will appear on the screen, prompting you to connect CAL OUT to INPUT.

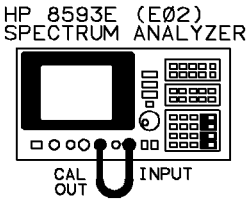

Figure 2-8. Link Analyzer Verification Setup 1

c. Make the connections shown and press `CONTINUE`. This will start the first set of tests which will last approximately 30 seconds.

4. You will then be prompted to connect the OUTPUT to INPUT.

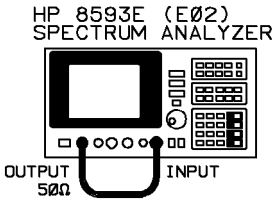

Figure 2-9. Link Analyzer Verification Setup 2

a. Make the connections shown and press `CONTINUE`. This will start the second set of tests which will last approximately 30 seconds.

b. If no error is found, the message `NO ERROR FOUND` will appear on the screen. Press `OK`. This will return you to the Group Delay Verification mode main menu.

5. To exit the Group Delay Verification mode, press `DISPOSE VERIFY` twice.

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3

Operation

Introduction

This chapter provides operating information for the HP 11758V Digital Radio Test System. This chapter is separated into two parts:

- **Radio Testing**

  The "Radio Testing" section shows the user how to make specific radio receiver and transmitter measurements using the Digital Radio Test Set.

- **Operation**

  The "Operation" section provides more detailed descriptions of the functions of the HP 11758V System.

Neither of these sections provides an in-depth discussion of all of the features of the HP 11758V. The purpose of both of these sections is to help the user become familiar with the HP 11758V System and begin making measurements in the minimum amount of time. For more detailed information, see the Operating and Service Manuals for the individual instruments in the Service Package of the HP 11758V.

Operator's Maintenance

Warning 

For continued protection against fire hazard, replace the line fuse with a fuse of the same rating only. Do not use repaired fuses or short-circuited fuse holders.

Operator's maintenance consists of replacing defective fuses. The primary power fuse is located within the Line Power Module Assembly. Refer to Chapter 2, "Installation and Verification", for instructions on how to change the fuse.

If the instrument does not operate properly and is being returned to Hewlett-Packard for service, please complete one of the blue tags located at the end of this manual and attach it to the instrument. Refer to Chapter 2, "Installation and Verification", for packaging instructions.

The following pages contain figures introducing the user to front panel features of the Digital Radio Test Set.

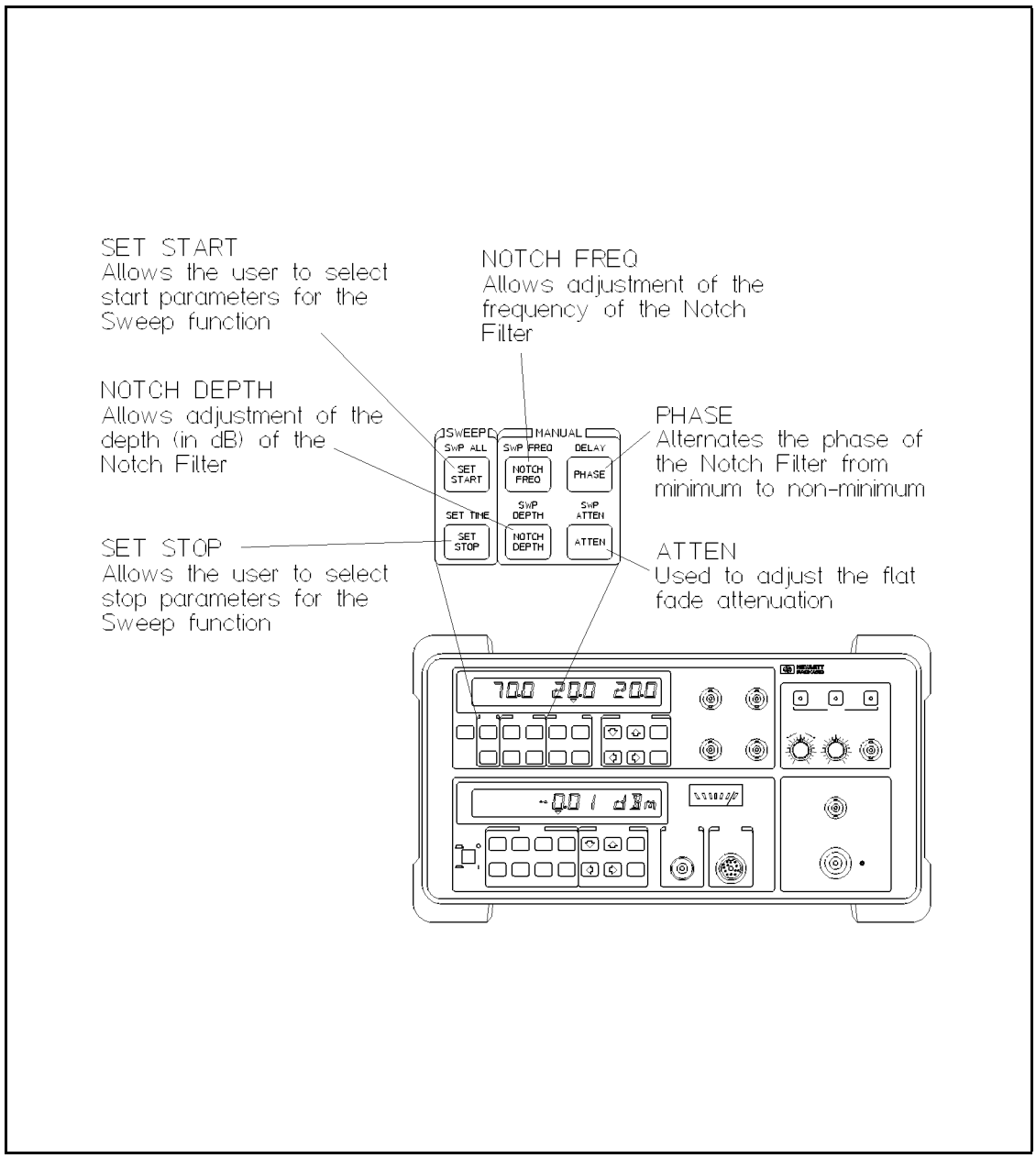

Figure 3-1.
HP 11758B Simplified Front Panel Features (MPF Simulator)

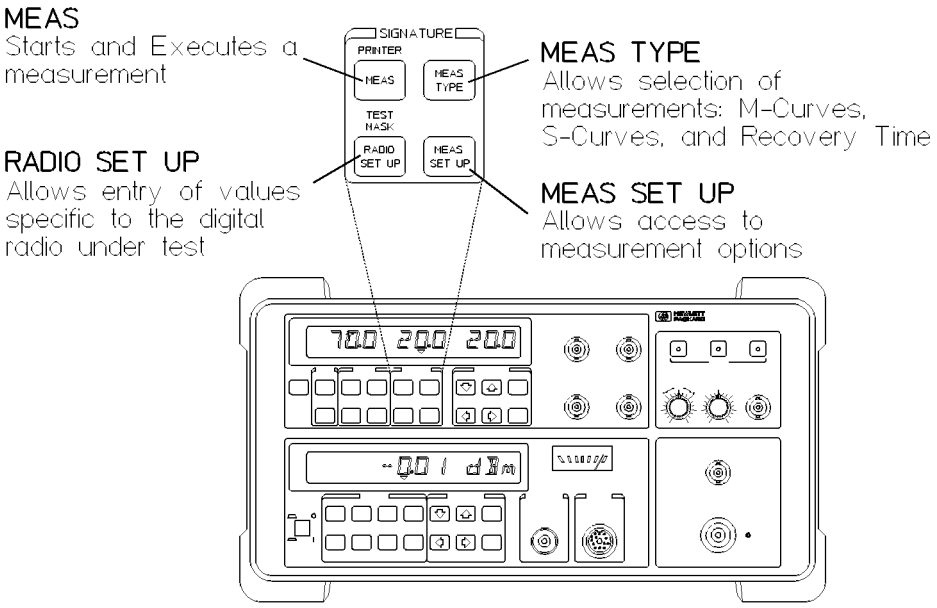

Figure 3-2.
HP 11758B Simplified Front Panel Features (MPF Simulator)

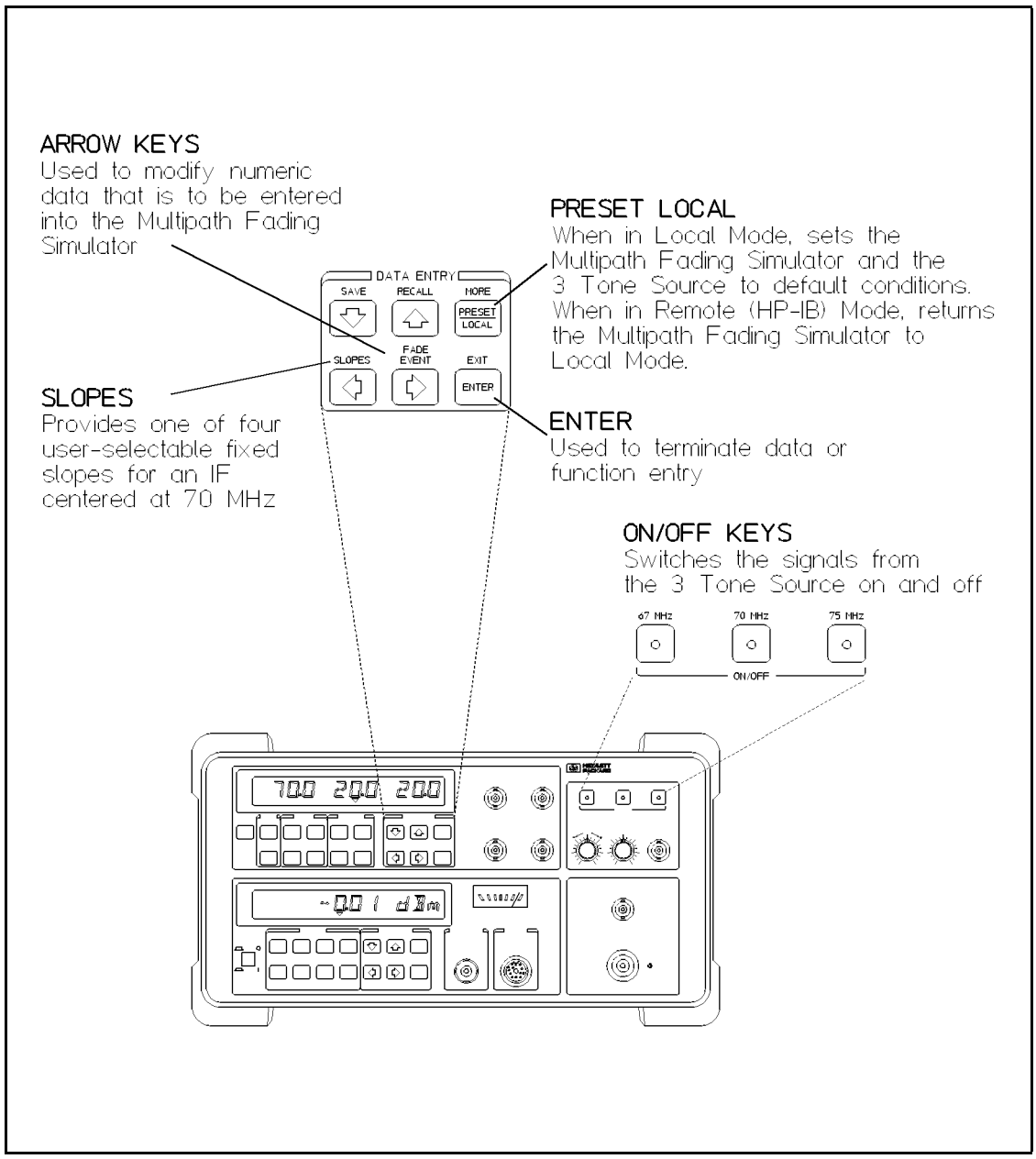

Figure 3-3.
HP 11758B Simplified Front Panel Features
(MPF Simulator and 3-Tone Source)

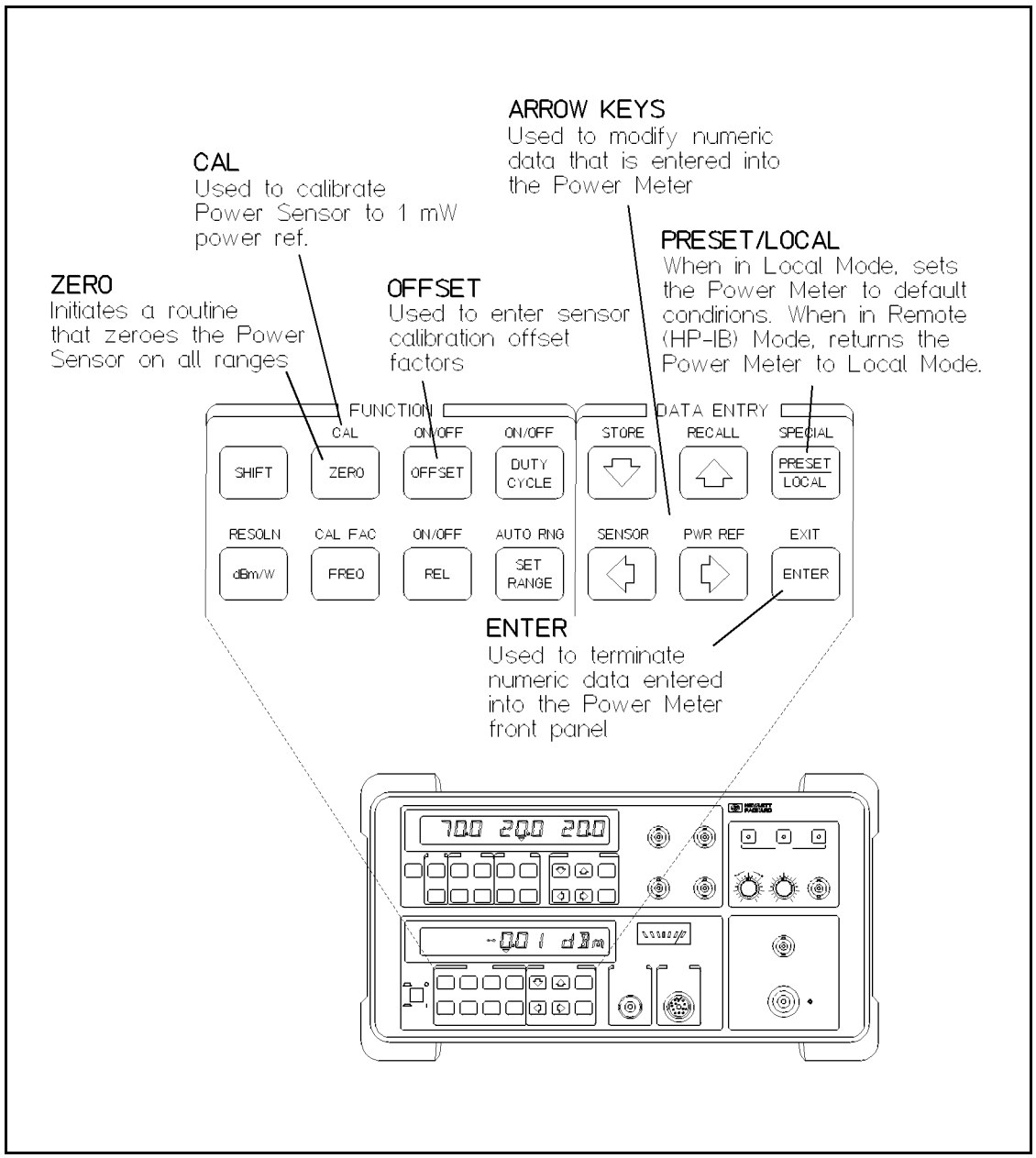

Figure 3-4.
HP 11758B Simplified Front Panel Features (Power Meter)

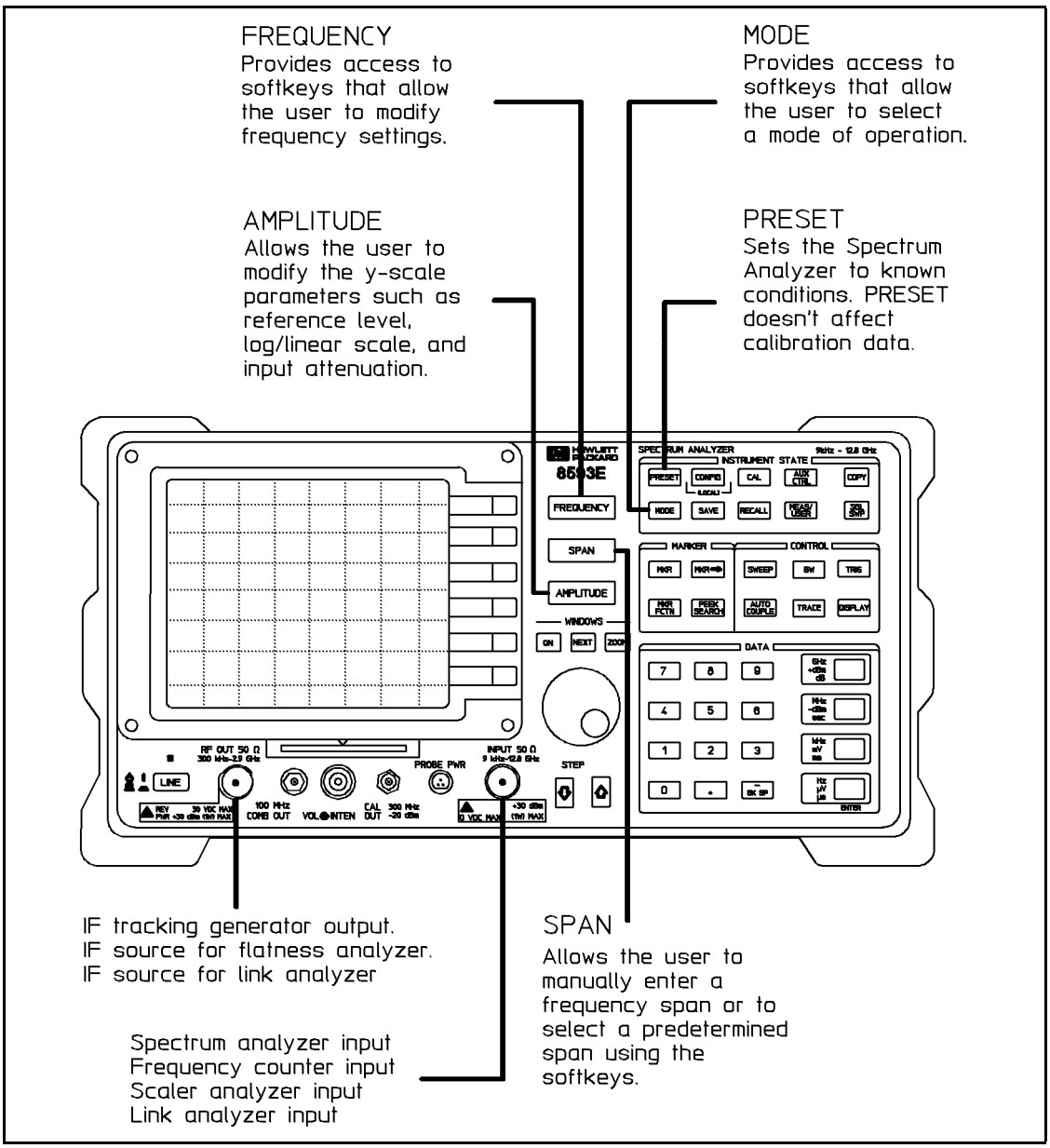

Figure 3-5. HP 8593E Simplified Front Panel Features

Caution

Ensure that the instrument is set for the proper power line voltage. Check the position of the voltage selector switches on the rear panels of the instruments. See Chapter 2, "Installation and Verification", for more information before proceeding.

Note

Allow 1/2 hour warm-up time for maximum accuracy.

PRESET

The PRESET function sets the instruments in the Digital Radio Test System to a known state. It is good practice to PRESET each instrument at the beginning of each measurement session.

1. Press the [PRESET/LOCAL] key on the Multipath Fading Simulator.
2. Press the [ENTER] key on the Multipath Fading Simulator.
3. Press the [PRESET/LOCAL] key on the Power Meter.
4. Press the [ENTER] key on the Power Meter.
5. Press the [PRESET] key on the Spectrum Analyzer.

Caution

When measuring power levels above +30 dBm with the spectrum analyzer, use a 30 dB high power attenuator to avoid damage. A suitable attenuator is the HP 8498A Option 030 which is available with the Option 301 Accessory Kit.

Radio Testing

The HP 11758V Digital Radio Test System has the capability of meeting many standard test requirements. This section has procedures for the following tests:

Group Delay (End-to-End Setup)
Group Delay (Loopback Setup)
Spectral Occupancy
RF Output Power
IF Output Power
IF Frequency Measurement
Flatness through Upconverter
Flatness through Downconverter
Intermodulation Distortion
Antenna Return Loss
Susceptibility to Multipath Fading
Error Counting

In addition, you may use the HP 11758V to make the following tests:

Transmitter Tests:

Local Oscillator Frequency
Local Oscillator Power
Coupler Calibration
ALC Range
IF slope (flatness)
TWT Intermodulation distortion
Predistorter Intermodulation distortion
Modulator output level
Power spectral density measurements
IF Return Loss

Receiver Tests:

Local Oscillator Frequency
Local Oscillator Power
Receive Input Level
IF slope (flatness)
IF Signal level

Signal to Interference susceptibility
Adaptive Slope Equalizer Performance
Transversal Equalizer Performance
Attenuator Calibration
Composite Fade Margin
(thermal+dispersive+interference)

Terminal Tests:

Frame and Clock Frequency
Carrier Frequency
Signal to Interference susceptibility
Transversal Equalizer Performance

Note

The tests that follow assume that you have already set up your Digital Radio Test System, and have familiarized yourself with the Mode Loader. For details on using the mode loader, refer to the "Setting Up the HP 11758V System" in Chapter 2.

Group Delay (End-to-End Setup)

This test uses the Link Transmitter mode and Link Receiver mode to measure the group delay and amplitude flatness of a digital microwave radio link. The test requires two HP 8593E Spectrum Analyzers, one located at the transmitter and the other at the receiver. The HP 8593E Spectrum Analyzers must be fitted with the Group Delay and Amplitude Flatness card (HP 8593E Option E02). The group delay capability can be ordered with a new DRTS (HP 11758V Option 201), a stand-alone spectrum analyzer (HP 859XE Option E02), or as a retrofit (HP 11768A).

The real-time group delay and amplitude responses can be displayed on the receiving analyzer's screen, enabling the radio receiver to be adjusted for optimum performance.

All the parameters used in this test can be changed to customize the test as required.

Test Equipment

Spectrum Analyzers (2)	HP 8593E Opt. E02
75Ω BNC Cables (2)	11758-60022
50Ω-75Ω Matching Pad (2)	HP 11981A
50Ω Nm to BNCf (2)	1250-0780

Transmitter Setup

The following procedure describes how the spectrum analyzer should be setup at the *transmitter* station. If you are at the *receiver* station, refer to the *Receiver Setup* procedure.

1. Connect the HP 8593E Spectrum Analyzer as shown in Figure 3-6.

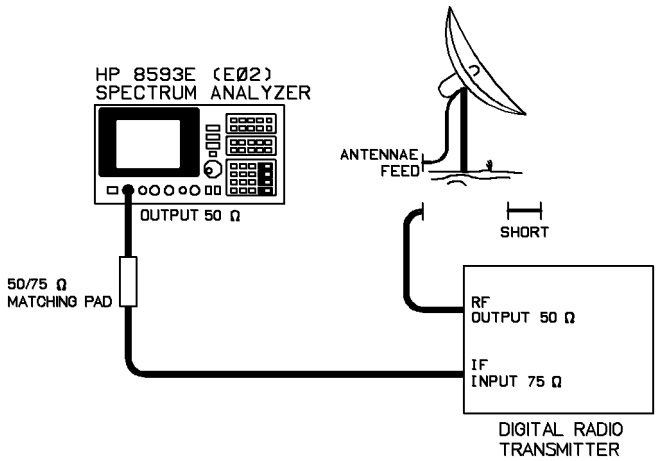

Figure 3-6. Link Transmitter Setup

2. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
3. When the mode loader is running, select the Link Transmitter mode as follows:
   a. Press: 1 4 ENTER
   b. Wait until the program has loaded before continuing.
   c. Press: `LINK TRANSMTR`. The TX Setup Window will appear on the screen, showing the default measurement parameters.

Note

It is essential that the Frequency Span and Baseband Frequency must be set to the same values as those set at the receiver. This also applies to the center frequency, unless there is a frequency translation in the system.

4. Set the parameters as follows:

a. Press: FREQUENCY, 7 0 MHZ.

b. Press: SPAN, 4 0 MHZ.

c. Press: FREQUENCY, BB FREQ, MORE 1 of 2, 250 kHz.

d. Press: AUX CTRL, SRC PWR, 0 dBm. Press SRC PWR so that **ON** is underlined.

e. Check that the parameters shown in the TX SETUP WINDOW are as required, and are the same as those set at the receiver.

Note

The matching pad shown in Figure 3-6 has a power loss of approximately 5.7 dB. Remember to take this into account when choosing the output power from the spectrum analyzer.

Receiver Setup

The following procedure describes how the spectrum analyzer should be setup at the *receiver* station. If you are at the *transmitter* station, refer to the *Transmitter Setup* procedure.

1. Connect the HP 8593E Spectrum Analyzer as shown in Figure 3-7.

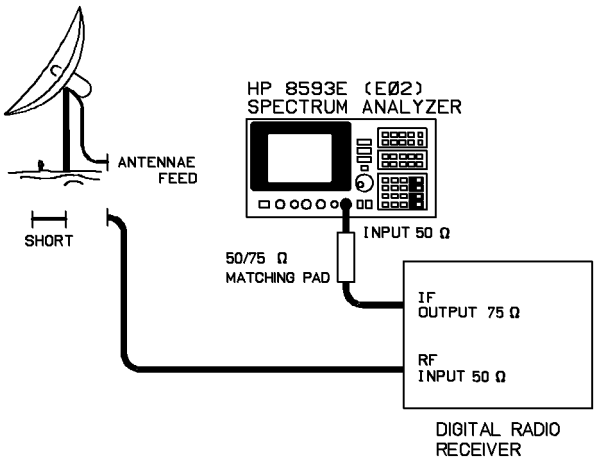

Figure 3-7. Link Receiver Setup

2. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
3. When the mode loader is running, select the Link Receiver mode as follows:
   a. Press: 1 5 ENTER
   b. Wait until the program has loaded before continuing.
   c. Press: `LINK RECEIVER`.

Note

It is essential that the Frequency Span and Baseband Frequency must be set to the same values as those set at the transmitter. This also applies to the center frequency, unless there is a frequency translation in the system.

4. Set the parameters as follows:

a. Ensure that the message `Receiver Unlocked` is shown on the HP 8593E display. If it is not, press [TRIG] so that it appears.

b. Press: [FREQUENCY], [7] [0] [MHZ].

c. Press: [SPAN], [4] [0] [MHZ].

d. Press: [FREQUENCY], `BB FREQ`, `MORE 1 of 2`, `250 kHz`.

e. Press: [AMPLITUDE], `SET INP LEVEL`. This step sets the internal attenuation of the analyzer to a suitable level.

5. Before any measurements are made, the receiver may need to be calibrated. This should be performed if the message `Frequency Uncal` is shown on the display.

   a. Press: [CAL], `CAL ALL`.

   b. The analyzer will prompt you to connect RF OUT to INPUT. This connection should be made using any hardware that will be used in the actual test (with the exception of the DUT). Figure 3-8 shows the spectrum analyzer connected with the matching pads and the same cables that will be used in the test.

Note

Although only one matching pad will be used in the actual test, both of the pads shown in Figure 3-8 should be used for the calibration, to avoid an impedance mismatch. However, any unflatness in the matching pad will cause a slight inaccuracy in the calibration.

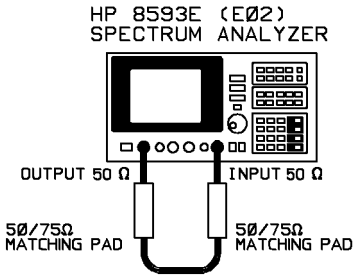

Figure 3-8. Calibration Setup

c. The calibration can be performed over the whole frequency range of the analyzer, or over the frequency range that is currently selected. The latter option provides the most accurate calibration. Press the bottom CONTINUE key to select a calibration frequency range of 50 MHz to 90 MHz.

6. Press: (TRIG). The receiving analyzer will automatically lock up to the swept signal from the transmitter.

7. At this stage the scale settings may be such that the traces are not shown on the display. Press: (AMPLITUDE), AUTO SCALE.

8. The group delay characteristic should now be shown on the display as a solid line. The amplitude characteristic should also be shown, represented by a broken line. You can choose which of the traces are displayed as follows:

   a. Press: (DISPLAY).

   b. Press: DISPLAY A G A+G until A, G or A+G are underlined, depending on the combination required.

Group Delay (Loopback Setup)

This test uses the Link Loopback mode to measure the group delay and amplitude flatness of a digital microwave radio link. The test requires only one HP 8593E spectrum analyzer (with Option E02), which is used as both the transmitter and receiver.

The real-time group delay and amplitude responses can be shown on the analyzer's screen, enabling the radio to be adjusted for optimum performance.

All the parameters used in this test can be changed to customize the test as required.

Test Equipment

Spectrum Analyzer	HP 8593E Opt. E02
75Ω BNC Cables (2)	11758-60022
50Ω-75Ω Matching Pad (2)	HP 11981A
50Ω Nm to BNCf (2)	1250-0780

1. Connect the HP 8593E Spectrum Analyzer as shown in Figure 3-9.

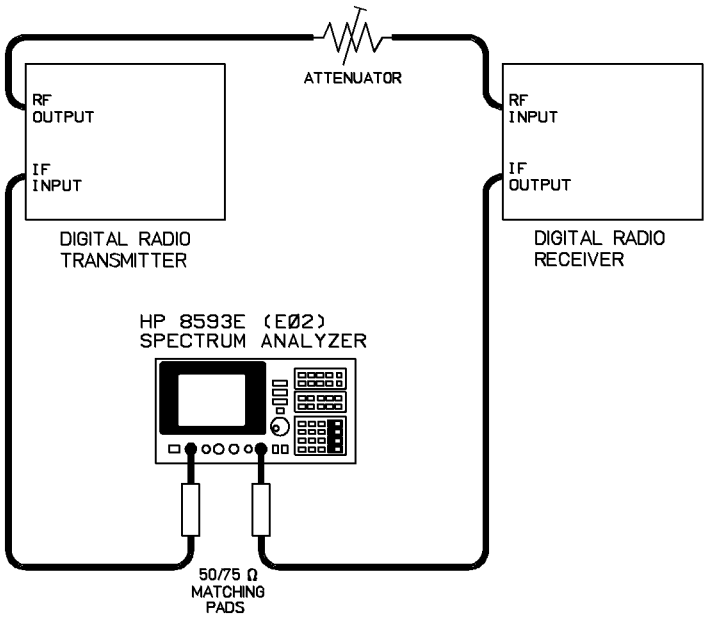

Figure 3-9. Link Loopback Setup

2. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
3. When the mode loader is running, select the Link Loopback mode as follows:
   a. Press: 1 3 ENTER
   b. Wait until the program has loaded before continuing.
   c. Press: LINK LOOPBACK.
4. Set the parameters as follows:
   a. Press: FREQUENCY, 7 0 MHZ.
   b. Press: SPAN, 4 0 MHZ.

c. Press: (FREQUENCY), BB FREQ, MORE 1 of 2, 250 kHz.

d. Press: (AUX CTRL), SRC PWR, (0) (dBm). Press SRC PWR so that **ON** is underlined.

e. Press: (AMPLITUDE), SET INP LVL. This step sets the input attenuation of the analyzer to a suitable level.

Note

The matching pads shown in Figure 3-9 have a power loss of approximately 5.7 dB per pad. Remember to take this into account when choosing the output power from the spectrum analyzer.

5. Before any measurements are made, the analyzer may need to be calibrated. This should be performed if the message Frequency Uncal is shown on the display.

   a. Press: (CAL), CAL ALL.

   b. The analyzer will prompt you to connect RF OUT to INPUT. This connection should be made using any hardware that will be used in the actual test (with the exception of the DUT). Figure 3-8 shows the spectrum analyzer connected with the matching pads and the same cables that will be used in the test.

   c. The calibration can be performed over the whole frequency range of the analyzer, or over the frequency range that is currently selected. The latter option provides the most accurate calibration. Press the bottom CONTINUE key to select a calibration frequency range of 50 MHz to 90 MHz.

6. The group delay characteristic should now be shown on the display as a solid line. The amplitude characteristic should also be shown, represented by a broken line. You can choose which of the traces are displayed as follows:

   a. Press: (DISPLAY).

   b. Press: `DISPLAY A G A+G` until `A`, `G` or `A+G` are underlined, depending on the combination required.

Spectral Occupancy

This test measures the spectral occupancy of a transmitter and compares it with predefined masks to see if it falls within qualified bandwidth requirements. The measurement can be taken from an RF monitor port, or from the RF output if it is sufficiently attenuated.

Test Equipment

Spectrum Analyzer ..... HP 8593E
Type N cable ..... HP 11500A

1. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
2. When the mode loader is running, select the required mask as follows:

   a. Press: (6) (ENTER)

   b. Wait until the masks are loaded.

   c. Press: `Digital Radio`

d. Press: `Agency Masks`

e. Select the mask appropriate for your radio. The masks are `4 GHZ FCC MASK`, `6 GHZ FCC MASK`, `11 GHZ FCC MASK`, `13 GHZ UK MASK`, and `13 GHZ FRG MASK`.

Note

If you need to define your own mask, or for more detail, refer to the HP 85713A Digital Radio Measurements Operating Guide.

Once a mask has been defined, it can be moved to a different center frequency by pressing (CENTER FREQ) and using the rotary knob or data keys. Press (MODE) twice, to return to the masks mode.

3. Connect the test setup as shown in Figure 3-10 below.

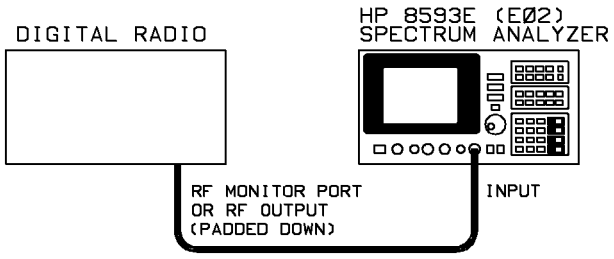

Figure 3-10. Spectral Occupancy Setup

Caution

The spectrum analyzer input is rated at 1 Watt (30 dBm). If the power output from your radio is greater than −30 dBm, then attenuators, such as those provided with the Option 301 Accessory Kit should be used. If the high power attenuator is used, ensure this is placed closest to the RF Output.

Note

If your radio has additional filters between the RF monitor port and the RF output, then it may be necessary to make the spectral occupancy test at the RF output. These filters are often responsible for keeping the sidelobes below the required mask.

4. Press: `Compare to Mask`

5. The spectrum analyzer display will show the mask and the spectrum of the radio. If the radio spectrum does not fall within the mask, a message will be displayed indicating failure.

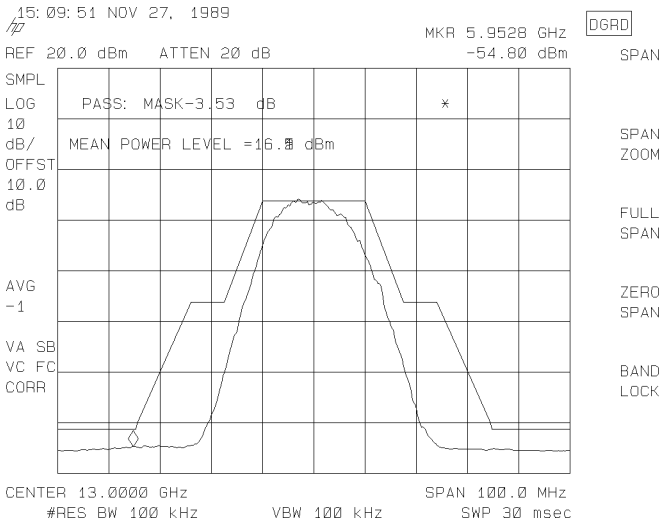

Figure 3-11. Display of Relative Mask

Shown in Figure 3-11 is a relative mask. You also have the option of displaying an absolute mask, which references the top of the mask to the peak of the unmodulated carrier level.

RF Output Power

This test measures the output power of the radio transmitter. Care must be taken to input appropriate levels into the power sensor. Check the radio's documentation to determine the approximate output power and frequency to be measured.

Test Equipment

Digital Radio Test Set	HP 11758B
Power Sensor	HP 8481D (or HP 8485D)
Power Sensor Cable	HP 11730B
30 dB Reference Attenuator ...	HP 11708A
30 dB High Power Attenuator ..	HP 8498A Opt. 030
30 dB Attenuator	HP 8491B Opt. 030
Type N Elbow	1250-1741

To test output power:

1. Zero the sensor:
   a. Connect the power sensor to the power meter using the HP 11730B power sensor cable.
   b. Disconnect the power sensor from any power sources.
   c. Press (ZERO). The power meter will display "ZEROING *****". When zeroing is finished, this message will disappear.
2. Calibrate the sensor:
   a. Set up the power meter as shown in Figure 3-12.

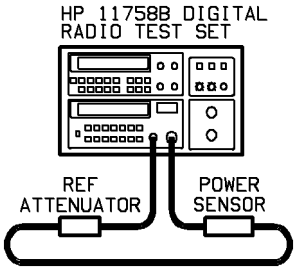

Figure 3-12. Reference Calibration

Caution Always use the 30 dB reference attenuator when calibrating the power meter with the HP 8481D Power Sensor (or HP 8485D if your system has Option 270).

3. Press (SHIFT) (ZERO) (CAL). The power meter will display the reference calibration factor (Ref Cal Factor) that is currently set.
4. Examine the power sensor to determine the required Ref Cal Factor.
5. Use the arrow keys if required, to enter this value into the power meter, then press (ENTER).
6. The power meter will display "CAL *****". When the calibration is finished, this message will disappear.
7. Enter the offset factor for the attenuators:
   a. Check the labels of the attenuators used, to find the offset factors. These values are dependent on the frequency at which you are measuring. Add together the offset factors of all the attenuators.
   b. Press (OFFSET) on the power meter, then enter the combined offset factor.
8. Enter the calibration factor for the sensor:

a. Check the label of the power sensor to find the calibration factor. This value is dependent on the frequency at which you are measuring.

b. Press (SHIFT) (FREQ) (CAL FAC), then use the arrow keys to enter the calibration factor.

9. Connect the equipment as shown in Figure 3-13. Allowing for the losses across the pad and the attenuator, this setup would be used to measure the RF Output power from approximately 0 dBm to +40 dBm.

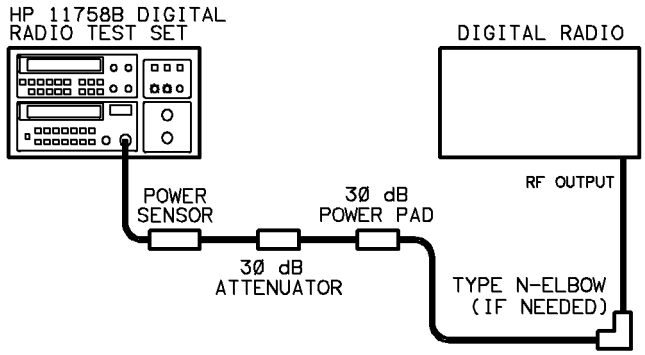

Figure 3-13. RF Output Power Setup

Caution

Make sure that the high power attenuator is placed closest to the RF Output.

Notes

- Because of the additional weight of the attenuators and power sensor, the type N elbow should be used to prevent strain and possible damage to the connectors. Using the type N elbow may however cause a deterioration in the measurement accuracy.
- It may be necessary to use a waveguide to type N adapter to connect to the RF output.

- Read power and record.

Note

A similar measurement is usually made on the RF monitor port. Since the RF monitor port is a coupled output, it will be at a lower power level. Ensure the appropriate attenuators and correction factors are used for the measurement.

IF Output Power

This test measures the IF output power of a radio. Care must be taken to input appropriate levels into the power sensor. Check the radio's documentation to determine the approximate power level of the IF port.

Test Equipment

Digital Radio Test Set	HP 11758B
Power Sensor	HP 8481D (or HP 8485D)
Power Sensor Cable	HP 11730B
Reference Attenuator	HP 11708A
50Ω-75Ω Minimum Loss Pad ...	HP 11852B

To test output power:

1. Zero the sensor:
   a. Connect the power sensor to the power meter using the HP 11730B power sensor cable.
   b. Disconnect the power sensor from any power sources.
   c. Press (ZERO). The power meter will display "ZEROING *****". When zeroing is finished, this message will disappear.
2. Calibrate the sensor:

a. Set up the power meter as shown in Figure 3-14.

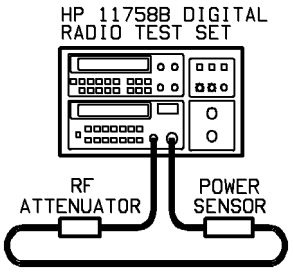

Figure 3-14. Calibration Setup

Caution

Always use the 30 dB reference attenuator when calibrating the power meter with the HP 8481D Power Sensor (or HP 8485D if your system has Option 270).

3. Press (SHIFT) (ZERO) (CAL). The power meter will display the reference calibration factor (Ref Cal Factor) that is currently set.
4. Examine the power sensor to determine the required Ref Cal Factor.
5. Use the arrow keys if required, to enter this value into the power meter, then press (ENTER).
6. The power meter will display "CAL *****". When the calibration is finished, this message will disappear.
7. Enter the offset factor for the attenuators:
   a. Check the labels of the attenuators used, to find the offset factors. These values are dependent on the frequency at which you are measuring. Add together the offset factors of all the attenuators.
   b. Press (OFFSET) on the power meter, then enter the combined offset factor.
8. Enter the calibration factor for the sensor:

a. Check the label of the power sensor to find the calibration factor. This value is dependent on the frequency at which you are measuring.

b. Press (SHIFT) (FREQ) (CAL FAC), then use the arrow keys to enter the calibration factor.

9. Connect the equipment as shown in Figure 3-15. Allowing for the losses across the pads and the attenuator, this setup would be used to measure the IF Output power from approximately −30 dBm to +10 dBm.

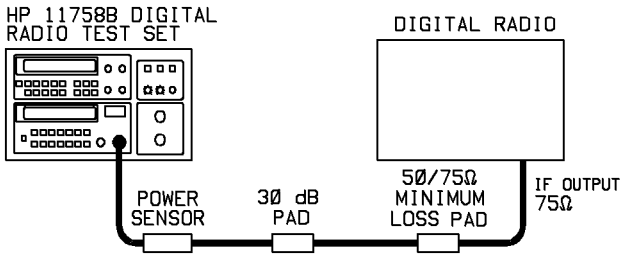

Figure 3-15. IF Output Power Setup

10. Read power level on the power meter. To read the level in Watts, toggle the dBm/Watts key.

IF Frequency Measurement

This measurement checks the IF frequency of a radio. The same technique can be used to measure the local oscillator used in the modulator or upconverter sections of the radio. It may also be used to measure the LO of the demodulator or downconverter.

Test Equipment

Spectrum Analyzer	HP 8593E
75Ω BNC Adapter	Depends on radio connector
75Ω BNC Cable	11758-60022
50Ω-75Ω Matching Pad	HP 11981A
50Ω Nm to BNCf	1250-0780

1. Set up equipment as shown in Figure 3-16.

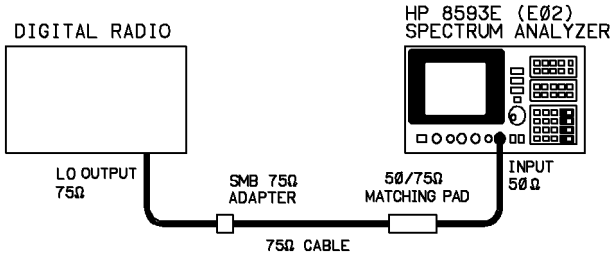

Figure 3-16. IF Frequency Measurement

2. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
3. When the mode loader is running, select the Frequency Counter mode as follows:
   a. Press: 7 ENTER
   b. Wait until the program has loaded before continuing.
   c. Press: FREQ COUNTER

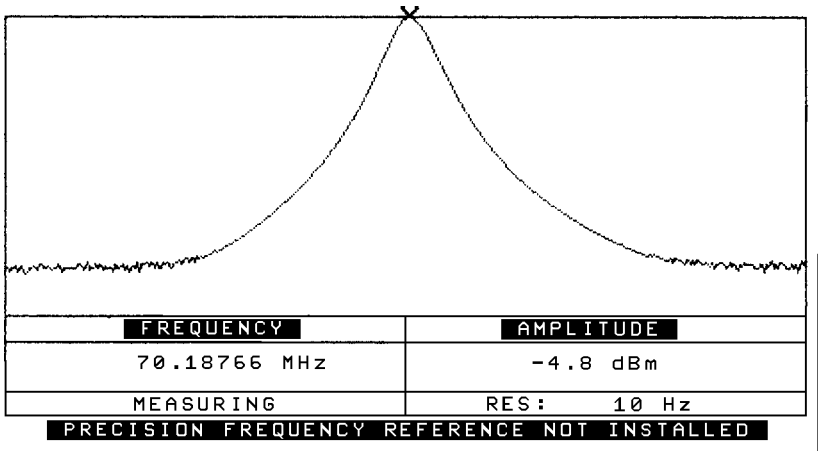

Figure 3-17. Frequency Counter Display

4. Check to make sure 2.9 GHz is underlined in the softkey display (or 22 GHz if the frequency is between 2.9 GHz and 22 GHz). Pressing the softkey toggles between 2.9 GHz and 22 GHz.
5. Press: (RESET)
6. Read frequency

Flatness through Upconverter

This test checks the upconverter section of the transmitter for flatness of power across the frequency bandwidth.

A similar procedure can be used to measure flatness through any IF subsection. If the overall flatness measurement is not within specification, measure the individual sections until the defective section can be determined.

Test Equipment

Spectrum Analyzer	HP 8593E
Crystal Detector	HP 8470B Opt 012
75Ω BNC Adapter	Depends on radio connector
2 75Ω BNC Cable (2)	11758-60022
Type N Cable	HP 11500A
50Ω-75Ω Matching Pad	HP 11981A
Attenuator	Depends on RF output power
50Ω Nm to BNCf	1250-0780

1. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
2. When the mode loader is running, select the Flatness Analyzer and Sources mode as follows:
   a. Press: (4) (ENTER)
   b. Wait until the program has loaded before continuing.
   c. Press: `FLATNESS AND SOURCES`
3. Press: `Sources`
4. Select the desired source frequency range using the `SOURCE IF RF` softkey.

Note

Use IF for source frequencies 300 kHz to 2.9 GHz. Use RF for source frequencies above 3.5 GHz. See the next procedure "Flatness through Downconverter." This example procedure uses the IF Source only.

5. Press: `CENTER FREQ`
6. Enter the center frequency using the DATA keys.
7. Press: `SPAN`

8. Enter the span using the DATA keys. The span should be the bandwidth over which the flatness is specified.
9. Press: SRC PWR
10. Enter the desired source power level using the DATA keys.

Note

The maximum output power from the IF Tracking Generator can be extended to approximately +10 dBm using the HP 11767A TG Amplifier. This can be used over the frequency range 45 MHz to 190 MHz.

11. Configure the calibration setup as shown in Figure 3-18.

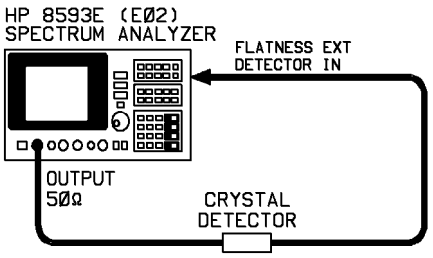

Figure 3-18. Flatness Calibration, 0 to 2.9 GHz

12. Press: MAIN MENU
13. Press: CAL
14. Press: CAL TRANS
15. Press: STORE THRU and wait until calibration finishes. A "THRU Cal Stored" message will appear.

Note

If the frequency parameters or the source power are changed after performing a CAL TRANS, the calibration will be in error and another CAL TRANS will need to be done. Changing the amplitude parameters will not affect the calibration.

If the IF input of your transmitter is at 75Ω, then the 50Ω-75Ω Matching Pad shown in Figure 3-19 should be used. However, because the calibration setup shown in Figure 3-18 is all at 50Ω, the Matching Pad cannot be used in the calibration. Any unflatness inherent in the Matching Pad will therefore cause an error in the measurement.

16. Set up equipment as shown in the Figure 3-19.

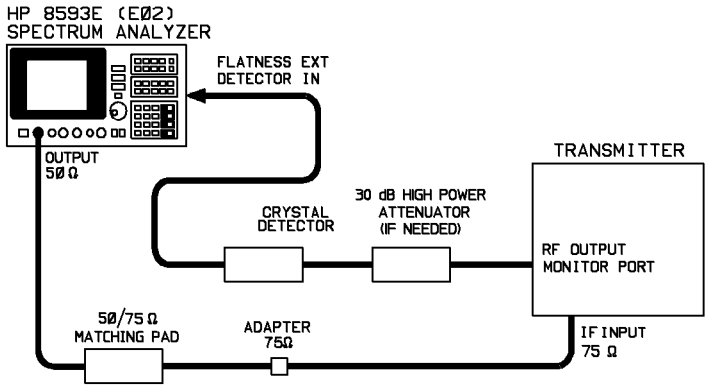

Figure 3-19. Flatness through Upconverter

Note

For levels greater than +20 dBm, use the 30 dB Attenuator before the crystal detector.

17. Press: `MAIN MENU`, wait, then press: `MEAS`

18. Set the `AMPL TRK` softkey to ON.

19. Flatness will be displayed on the Spectrum Analyzer screen.
20. Adjust SCALE LOG for the desired vertical scale (dB/div).
21. Press Peak-to-peak measurement to read maximum amplitude variation over measured bandwidth. The measurement should be less than the flatness specified.

Flatness through Downconverter

This test checks the Downconverter section of the receiver for flatness of power across the frequency bandwidth.

Test Equipment

Spectrum Analyzer	HP 8593E
Digital Radio Test Set	HP 11758B
Crystal Detector	HP 8470B Opt 012
Type N Barrel	HP 1250-0778
Leveling Head	HP 11758-60002
External Level Head Cable	HP 11758-60021
75Ω BNC Cable	11758-60022
50Ω-75Ω Matching Pad	HP 11981A

1. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
2. When the mode loader is running, select the Flatness Analyzer and Sources mode as follows:
   a. Press: 4 ENTER
   b. Wait until the program has loaded before continuing.

c. Press: FLATNESS AND SOURCES

3. Press: Sources
4. Select the desired source frequency range using the SOURCE IF RF softkey. (Use IF for source frequencies 300 kHz to 2.9 GHz. Use RF for source frequencies above 3.0 GHz).
5. Press: CENTER FREQ
6. Enter the center frequency using the DATA keys.
7. Press: SPAN
8. Enter the span using the DATA keys.
9. Press: SRC PWR
10. Enter the desired source power level using the DATA keys.
11. The procedure starts with a calibration of the test equipment which normalizes out any variations in the setup. Configure the calibration setup as shown in Figure 3-20

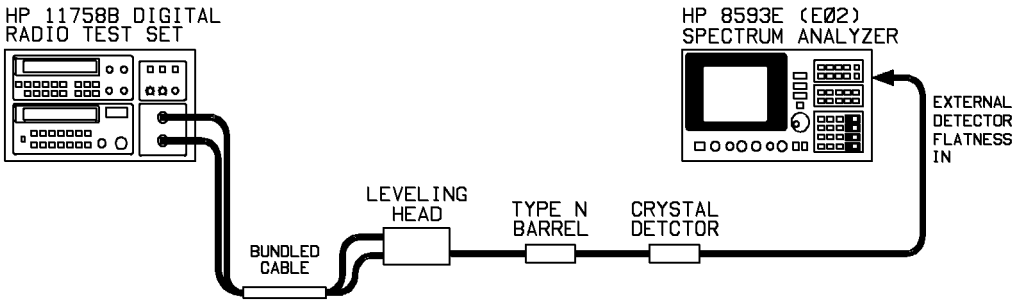

Figure 3-20. Flatness Calibration, > 3 GHz

Note

To calibrate frequency bands greater than 3 GHz, connect the output of the External Leveling Head through a Type-N barrel to the HP 8470B Crystal Detector.

If your RF input frequency is less than 2.9 GHz, use the RF output on the spectrum analyzer instead of RF output on HP 11758B.

12. Press: `MAIN MENU`
13. Press: `CAL`
14. Press: `CAL TRANS`
15. Press: `STORE THRU` and wait until calibration finishes. A "THRU Cal Stored" message will appear.

Note

If the frequency parameters or the source power are changed after performing a CAL TRANS, the calibration will be in error and another CAL TRANS will need to be done. Changing the amplitude parameters will not affect the calibration.

16. Set up equipment as shown in the following Figure 3-21.

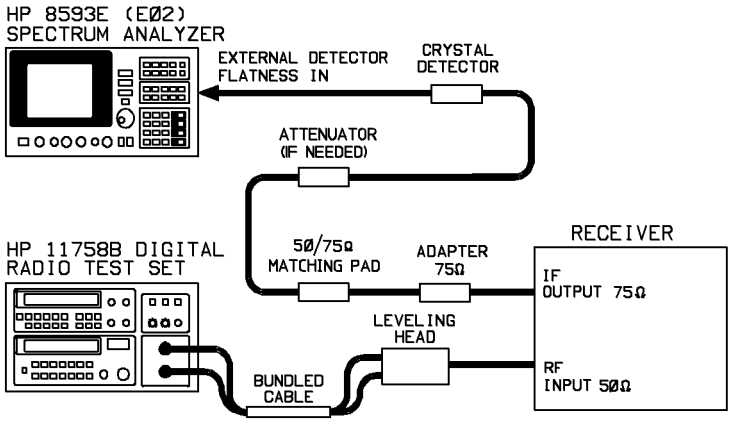

Figure 3-21. Flatness through Downconverter

Note

If the IF output of your receiver is at 75Ω, then the 50Ω-75Ω Matching Pad shown in Figure 3-21 should be used. However, because the calibration setup shown in Figure 3-20 is all at 50Ω, the Matching Pad cannot be used in the calibration. Any unflatness inherent in the Matching Pad will therefore cause an error in the measurement.

For levels greater than +20 dBm, use the 30 dB Attenuator before the crystal detector.

17. Press: `MAIN MENU`, wait, then press: `MEAS`
18. Set the `AMPL TRK` softkey to ON.
19. Flatness will be displayed on the Spectrum Analyzer screen.
20. Adjust `SCALE LOG` for the desired vertical scale (dB/div).

Intermodulation Distortion

This measurement verifies that the predistorters are adjusted properly and that the high power amplifier's distortion is not out of specification. This is done by injecting 3 independent frequency tones into the IF input before the predistorter, and examining the intermodulation distortion products after the high power amplifier.

Test Equipment

Spectrum Analyzer	HP 8593E
Digital Radio Test Set	HP 11758B
Type N Cable	HP 11500A
75Ω BNC Cable	11758-60022

1. Set up equipment as shown in the Figure 3-22.

Caution

Ensure that there is sufficient padding between the transmitter RF Output and the Spectrum Analyzer, so as not to damage the spectrum analyzer. The maximum power that should be connected to the INPUT connector on the spectrum analyzer is 30 dBm. Figure 3-22 shows the HP 8498A 30 dB High Power Attenuator connected between the radio output and the analyzer. If necessary use additional attenuators.

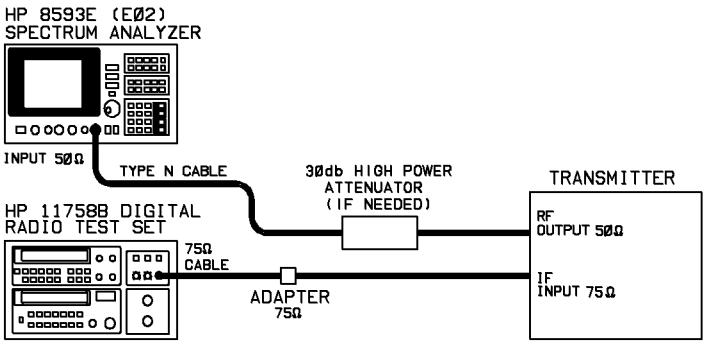

Figure 3-22. Predistortion Setup

2. Check the radio's documentation to determine the necessary IF input level.
3. Adjust the 3 Tone Source's power output to match the power typically input to the transmitter IF.

Note

The (MORE) key on the Multipath Fading Simulator can be used to access a function (6) that reads the 3 Tone Source power output. This function allows you to read the power level as you adjust the Total Power Out dial on the 3 Tone Source. This function can be used for a rough estimate only. For more accurate setting of output power, use the power meter.

4. Use the (AMPLITUDE) key on the Spectrum Analyzer to check to see if the 3 Tone Source is overdriving the input. This can be verified by stepping the attenuation up and down while observing the intermodulation products.
5. Vary the frequency knob of the 3 Tone Source, so that the intermodulation components are at their highest.
6. Use the (MKR), (MARKER DELTA) and (PEAK SEARCH) keys to check intermodulation levels. Move the marker to

the highest peak of the distortion components (not the 3 input tones).

Antenna Return Loss

This test measures return loss in an antenna feed system. To set up this test you must take the radio off line and open the antenna feed. The RF Source of the HP 11758B supplies a signal sweep over the operating frequencies of the radio. This sweep passes through a directional coupler to the antenna. The return signal passes back through the coupler, where it is coupled off and measured.

The return loss is the ratio of the magnitude of the forward signal to the reflected signal. Ideally, all the forward signal passes through the directional coupler. In practice, however, directional couplers do not possess perfect directivity; some of the forward signal is coupled off and added to the return signal. The directional coupler should have a directivity greater than or equal to 40 dB. This will allow you to make return loss measurements up to about 30 dB.

Procedure

The following procedure measures return loss from 10.7 to 11.7 GHz. If you want to measure another of the radio ranges supported by the DRTS, enter the appropriate parameters where indicated.

The procedure starts with a calibration of the test equipment. A short is placed on the directional coupler to establish a reference level. The level measured represents a return loss of 0 dB. Further measurements are referenced to this calibration level.

Equipment

Spectrum Analyzer	HP 8593E
Digital Radio Test Set	HP 11758B
External Leveling Head	HP 11758-60002
External Level Head Cable	HP 11758-60021
Crystal Detector	HP 8470B Opt 012
75Ω BNC Cable	11758-60022

The following items are not included with the accessory kits, but are necessary for this measurement:

Test Equipment	**Condition**
Directional Coupler	Depends on Waveguide Flanges
Waveguide Short	Depends on Waveguide Flanges
Waveguide to Coax adaptors (2)	Depends on Waveguide Flanges

1. Configure equipment as shown in Figure 3-23.
2. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
3. When the mode loader is running, select the Flatness Analyzer and Sources mode as follows:
   a. Press: 4 ENTER
   b. Wait until the program has loaded before continuing.
   c. Press: FLATNESS AND SOURCES
4. Press: PRESET FLATNESS
5. Set the source power and frequency.

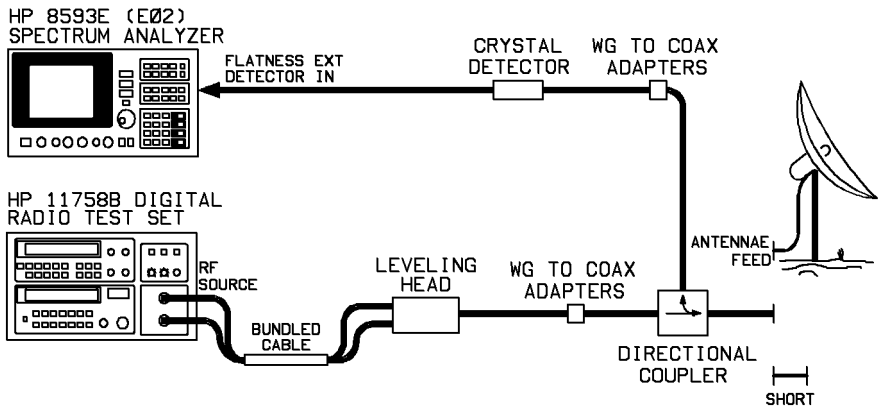

Figure 3-23. Return Loss Setup

Note

If you are measuring the return loss of an antenna that operates at less than 2.9 GHz, use the RF output on the spectrum analyzer without the leveling head.

a. Press: SOURCES

b. Press: SOURCE RF

c. Press: CENTER FREQ 1 1 . 2 GHz (or the frequency appropriate for your radio)

d. Press: SPAN 1 0 0 MHz

e. Press: SRC PWR 5 dBm

f. Press: MAIN MENU

6. Connect the short to the output of the directional coupler.

7. Calibrate the measurement.

a. Press: CAL

b. Press: CAL TRANS

c. Press: `STORE THRU`

d. Press: `MAIN MENU`

8. Remove the short and attach the antenna to the coupler.

9. Measure the return loss.

   a. Press: `MEAS`

   b. Press: `AMPL TRK`

The return loss is given by the magnitude of the trace.

Susceptibility to Multipath Fading

Multipath fading results when signals from the transmitter arrive out of phase at the receiver because they have taken different paths due to reflection and refraction. The direct signal from the source is interfered with by the signals which take alternative paths. This causes attenuation of the signal at some frequencies in the transmitted spectrum. To simulate multipath fading the DRTS creates a notch that can be swept or stepped through the IF bandwidth of the receiver.

The following test interrupts the IF section of the receiver with an adjustable notch filter. The notch is adjusted until an error condition results. How you detect an error condition depends on your radio. The method shown here uses a BER (Bit Error Ratio) test set to monitor the error ratio. You can however use other methods, such as the Event Counter to count the pulses from the error output on your radio.

Test Equipment

Digital Radio Test Set ..... HP 11758B
75Ω BNC Cables (2) 11758-60022
BER Test Set

The multipath fading simulator is capable of making the following automatic measurements:

- Static M-Curve Measurement
- Dynamic M-Curve Measurement
- Dynamic S-Curve Measurement
- Hysteresis M-Curve Measurement
- Recovery Time Test
- Bit Error Rate Test

For detailed information about each of these, refer to *Making Measurements with the HP 11757B Multipath Fading Simulator*. The following procedure is for the Static M-Curve Measurement.

1. Connect the equipment as shown in Figure 3-24.

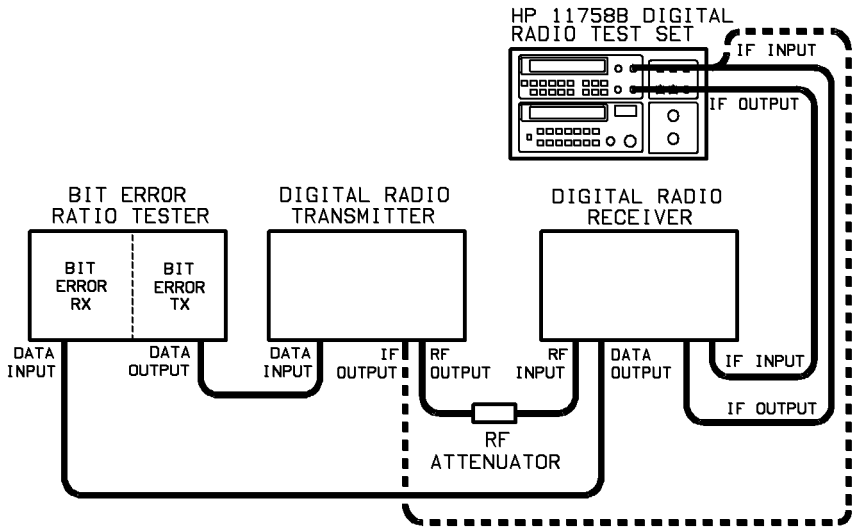

Figure 3-24. Susceptibility Measurement

2. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
3. When the mode loader is running, select the Multipath Fade DLP mode as follows:
   a. Press (1) (1) (ENTER)
   b. Wait until the program has loaded before continuing
   c. Press: `MCURVE DISPLAY`
4. Enter the correct HP 11758B HP-IB address:
   a. Press: `MISC MENU`
   b. Press: `FADER ADDRESS`, then enter the correct address.
   c. Press: `MAIN MENU`.

5. The following procedure describes a typical measurement setup. Change the parameters of the measurement to suit your radio.

   a. Press (PRESET) (ENTER)

   b. Press (MEAS TYPE). Use the (▲) key until the display shows STATIC, then press (ENTER).

   c. Press (RADIO SETUP).

      i. 0 BIT RATE should be displayed. Press (ENTER), then use the arrow keys to set the required bit rate. Press (ENTER) again.

      ii. 1 ERROR TERM should be displayed. Press (ENTER) to find the present setting. Use the (▲) key to toggle to the termination appropriate for your BERT, then press (ENTER).

      iii. 1.1 ERROR THR should be displayed. Press (ENTER) to see what the variable error threshold is set to. If you want to set a different threshold use the arrow or data keys. Choose a threshold setting (combined with the ERROR TERM setting) that is appropriate for your BERT, then press (ENTER).

      iv. 2 ALARM POL should be displayed. You will not need to set this unless you are planning to use the ALARM INPUT for this test. Press the (▲) key to advance to the next feature.

      v. 3 SCALE FACT should be displayed. The default scale factor is 1.0, and this should only be changed if your BERT's error output rate is different to the detection rate. For example, if the error output of your BERT is sending one pulse for every four errors, the scale factor should be set to four. To set the

SCALE FACTOR press [ENTER], then use the [▲] arrow key to display the required value. Press [ENTER].

vi. 4 AGC ON/OFF should be displayed. The AGC (Automatic Gain Control) ensures the power level of the signal sent through the Fader remains constant. Press [ENTER], then use the [▲] key to toggle the AGC on or off as required. Press [ENTER].

vii. 5 AGC FREQ should be displayed. If the AGC is ON, you should ensure that the correct AGC center frequency is set. Press [ENTER]. The display will change to show the current AGC center frequency setting. Use the arrow keys or the data keys to set the desired frequency, then press [ENTER].

viii. 6 AGC BW should be displayed. Press [ENTER], then use the arrow keys or the data keys to set the frequency bandwidth of the AGC. Set a value close to the channel bandwidth of the radio, then press [ENTER].

ix. 7 WAIT TIME should be displayed. This enables you to set a time delay after each notch movement. This delay allows your radio some settling time before a Bit Error Rate measurement is made by the Fader. This generally does not need to be changed from its preset value. Press [ENTER] to see the current setting. Use the arrow keys or the data keys to set a new value if required, then press [ENTER].

x. 8 MAX SLEW should be displayed. This enables you to set the maximum slew rate of the notch during measurements. This generally does not need to be changed from its preset value. Press [ENTER] to see the current setting.

Use the arrow keys or the data keys to set a new value if required, then press (ENTER).

xi. 9 SYMBL TIME should be displayed. This enables you to set the symbol time of your radio. You will not need to set this unless you are planning to perform a CCIR DFM calculation. CCIR DFM is only available in serial prefixes 3215A and above.

xii. The radio should now be set up correctly and be ready to make measurements.

d. Set up the measurement as follows:

i. Press (MEAS SETUP).

ii. 0 DATA PTS should be displayed. This specifies the number of frequency points that will be measured. The frequency points are spaced linearly throughout the selected frequency bandwidth. Press (ENTER), then use the arrow keys or the data keys to enter the number of points. Press (ENTER). A typical number of data points is 11.

iii. The next parameters to be set are the start and stop frequencies of the notch. Press (ENTER), then set the start frequency of the notch and press (ENTER) again (for this example set the start frequency to 45 MHz). Press (ENTER), then set the stop frequency of the notch and press (ENTER) again (for this example set the stop frequency to 95 MHz).

iv. The next two items displayed are 3 START RATE and 4 STOP RATE. These parameters are used for S-Curve measurements and will be ignored when making STATIC (M-Curve) measurements. Press (▼) until the display reads 5 ERROR BITS.

v. ERROR BITS determines the number of errors that are counted before a final bit error rate calculation is made. You may enter any power of 2, from 2^2 to 2^{15}. Press (ENTER), then use the (▲) arrow key to select 2^{11} (2048). Press (ENTER).

vi. 6 PHASE should be displayed. Press (ENTER) and use the (▲) arrow key to toggle between MIN, NON-MIN and BOTH. When BOTH is displayed, press (ENTER).

vii. 7 CRITERIA should be displayed, which indicates the decision criteria for drawing an M-Curve. Press (ENTER) and use the (▲) arrow key to toggle through the options: ALARM, 1E-3, 3E-4, 1E-4, 3E-5, 1E-5 and 1E-6. Unless you have opted to use the ALARM INPUT to make the measurement, select one of the other criteria and press (ENTER).

viii. 8 SPEED should be displayed. This applies only to Dynamic M-Curve measurements, and will be ignored for Static M-Curve measurements. Press (▼).

ix. 9 DEVIATION should be displayed. This applies only to Dynamic M-Curve, and will be ignored for Static M-Curve measurements. Press (▼).

x. 10 EDGE ZOOM should be displayed. This feature increases measurement resolution near the edges of the measurement, but will only be activated if you have specified at least 15 data points (we specified just 11 earlier in this example). Use the (▼) key to move to the next feature.

xi. 11 MK SEARCH should be displayed. This algorithm will initiate worst case searches

during the measurement. For a full description see MK SEARCH in the *HP 11757B Local and Remote Reference Manual*. Since this feature can increase measurement time, press (ENTER) to ensure that it is set to OFF, then press (ENTER) again.

xii. `12 DFM TYPE` should be displayed. This allows selection of the type of DFM calculation performed. For a full description see MEAS in the HP 11757B Local Reference.

6. You are now ready to make the actual measurement. Press (MEAS). The display will indicate that the measurement is in progress. When the measurement has finished, the display will return to normal. If you press the (PRESET/LOCAL) key on the Fader front panel during the measurement, the measurement will be interrupted and stop.
7. After the measurement is complete, press `NEW MEAS` on the spectrum analyzer. The measurement will download from the fading simulator to the spectrum analyzer. When the data has transfered the message TRANSFER COMPLETE will be displayed.
8. Press `GRAPH` to view the measurement

Error Counting

The Event Counter (and Interval Counter) are functions independent of the operation of the spectrum analyzer. The event counter is used to count negative going pulses: a falling edge followed by a rising edge. The INTERVAL CNTR INPUT is used to measure the accumulated time that a pulse is low during the gate time interval. The gate time can be set to 100 ms, 1 sec, and 10 sec, or a value entered using data control keys.

The Event Counter is useful for counting the number of data errors over a period of time. You can set the instrument to total the number of seconds, or some other period of gate time, that the radio produces errors in over a length of time (perhaps all night). The start and stop times for the measurement are automatically recorded and are shown along with the results on the Spectrum Analyzer's display. The following procedure shows how to set up the Event Counter and test for errors.

Test Equipment

Spectrum Analyzer ..... HP 8593E
2 75Ω BNC Cable 11758-60022

1. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
2. When the mode loader is running, select the Event Counter mode as follows:
   a. Press: 5 ENTER
   b. Wait until the program has loaded before continuing.
   c. Press: `EVENT COUNTER`
3. Set up the equipment as shown in Figure 3-25.

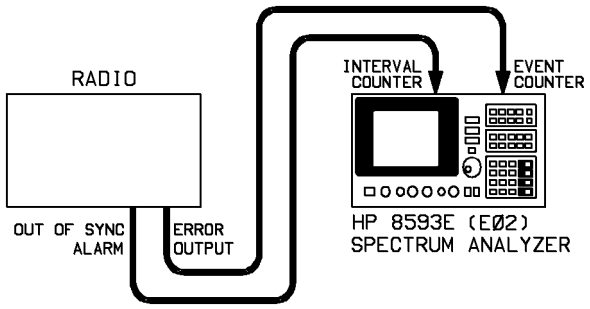

Figure 3-25. Event Counter Test Setup

4. Press: `MORE`
5. Press: `EVENT THRESHOLD`
6. Press: `MORE`
7. Press: `GATE TIME`
8. Press: `1 SEC`
9. Press: `MAIN MENU`
10. Press: `TOTALIZE` so that the ON is underscored.
11. Run for a significant period of time (perhaps overnight).
12. Read the Threshold Errored Seconds. This value tells you in how many seconds of the test period the error ratio exceeded the value set for your radio.

Note

See the reference pages "EVENT COUNTER MODE" found later in this section. The Event Counter and Interval Counter can be used independently of each other.

Instrument Operation

This section contains additional information to familiarize the user with the individual instruments contained in the Digital Radio Test System. These instruments include:

- Multipath Fading Simulator
- Power Meter
- 3 Tone Source
- Spectrum Analyzer
- Link Analyzer
- Flatness Analyzer
- Event Counter
- Frequency Counter
- Scalar Analyzer

Multipath Fading Simulator

The front panel operation of the Multipath Fading Simulator part of your instrument is identical to that of the HP 11757B Multipath Fading Simulator with the following minor differences:

PRESET/LOCAL

PRESET also presets the 3 Tone Source. See the 3 Tone Source Operation for more information.

MORE

MORE operations are activated when you press SHIFT PRESET/LOCAL. The operations are accessed via the ▲ and ▼ keys and is firmware version dependent. Your firmware version is displayed on the Fader screen at power up. These operations are as follows:

Version 9.2	Version 9.3	Version 11.7	Version 12.1/12.6
0 SLEW TIME	0 SLEW TIME	0 SLEW TIME	0 SLEW TIME
1 SINGLE SWEEP	1 SINGLE SWEEP	1 SINGLE SWEEP	1 SINGLE SWEEP
2 AGC ON/OFF	2 AGC ON/OFF	2 AGC ON/OFF	2 AGC ON/OFF
3 AGC FREQ	3 AGC FREQ	3 AGC FREQ	3 AGC FREQ
4 AGE BW	4 AGC BW	4 AGC BW	4 AGC BW
5 HP-IB ADRS	5 HP-IB ADRS	5 HP-IB ADRS	5 HP-IB ADRS
6 3 TONE READ	6 TIMER READ	6 3TONE READ	6 3TONE READ
7 TIMER READ	7 TIMER RST	7 SYNC SOUR	7 SYNC SOUR
8 TIMER RST	8 SYNC SOUR	8 SELF TEST	8 SELF TEST
9 SYNC SOUR	9 SELF TEST	9 SERVICE	9 SERVICE
10 SELF TEST	10 SERVICE	10 INIT	10 INIT
11 SERVICE	11 INIT	11 SET HMS	11 SET HMS
12 INIT		12 SET YMD	12 SET YMD
		13 MASK CTRL	13 MASK CTRL

For detailed operating instructions refer to the Local Operation section of the HP 11757B Multipath Fading Simulator Operation and Programming Reference. Making Measurements With the HP 11757B Multipath Fading Simulator contains instructions for many of the common uses of your instrument. The part numbers for these manuals are listed under Documentation located in Chapter 1 of this manual.

Calibration Procedure

This procedure calibrates the accuracy of the Multipath Fading Simulator. Recalibrating the instrument is not required for normal operation.

Connection

Connect the equipment as shown in Figure 3-26.

Note

- Make sure no other controllers share the HP-IB bus.
- Allow 30 minutes for the instruments to warm up.
- The calibration procedure takes approximately 45 minutes for the standard HP 11758B and 75 minutes for the Option 140. The calibration procedure takes approximately 120 minutes for the Option 147.

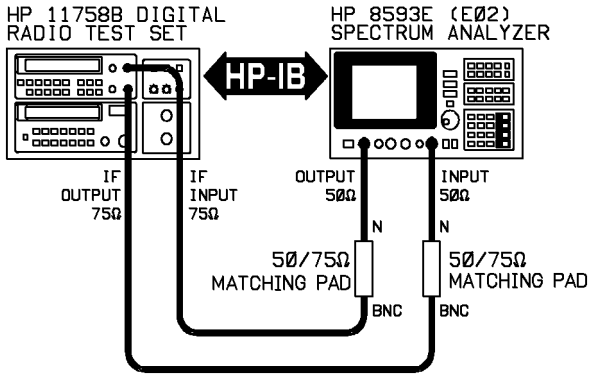

Figure 3-26. Multipath Fading Simulator Calibration Setup

1. Load and run the DRTS Mode Loader. Refer to the "Setting Up the HP 11758V System" in Chapter 2 for details on using the mode loader.
2. When the mode loader is running, select the Multipath Fading Simulator Calibrate mode as follows:
   a. Press: 1 0 ENTER
   b. Wait until the program has loaded before continuing.
   c. Press: FADER CAL.
3. Follow the instructions on the display of the Spectrum Analyzer.

Calibration Check

1. Keep the equipment connected as it was for the calibration.
2. Press [PRESET] and [ENTER] on the Multipath Fading Simulator.
3. Place a marker at 70 MHz on the Spectrum Analyzer's display.
4. Set the marker function to DELTA mode.
5. Set the NOTCH DEPTH to 10 dB on the Multipath Fading Simulator.
6. By reading the marker value, measure the notch's depth and frequency. A successful calibration will have values within the following limits:

   ```
   Frequency = 70 MHz ±.2 MHz
   Notch Depth = 10 ±.3 dB
   ```

7. If the Test System fails this test, rerun the calibration and calibration check.

Power Meter

Connection

Connect the HP 8481D Power Sensor (or HP 8485D if your system has Option 270). to the Power Meter using the HP 11730B Power Sensor Cable.

Allow 5 minutes for the Power Sensor to warm up.

Preset

PRESET is used to set the Power Meter to a known state. The PRESET conditions are shown as follows:

Parameter	Condition
FREQ	50 MHz
RESOLN	0.01 dB
DUTY CYCLE	1.000%, Off
REL	0.0 dB, Off
OFFSET	0.00 dB, Off
PWR REF (reference oscillator)	Off
Range	AUTO
dBm/W	dBm
Low Limit	−90.000 dB
High Limit	+90.00 dB
Limit Checking	Off

1. Press the [PRESET/LOCAL] key.
2. Press the [ENTER] key.

Note

The Power Meter operation instructions assume that the Power Meter has been PRESET.

Zero

ZERO is used to adjust the Power Meter's internal circuits for a zero power indication when no power is applied to the sensor.

1. Disconnect the Power Sensor from any sources of input power.
2. Press the [ZERO] key. The Power Meter will display `ZEROING:*****`.
3. When the `ZEROING:*****` display disappears, zeroing has finished.

Calibration

The CAL key is used to calibrate the Power Meter and Power Sensor to a known reference.

1. Connect the HP 11708A Reference Attenuator to the POWER REF Connector.
2. Connect the power sensor to the Reference Attenuator.
3. Press the [CAL] key (SHIFTed [ZERO]).
4. Verify that the calibration factor displayed on the Power Meter is the same as that shown on the power sensor label.
5. Press the [ENTER] key.
6. Disconnect the Power Sensor from the reference attenuator.

Power Level and Frequency

The power level and frequency range of the signal to be measured requires a combination of attenuators and adapters on the power sensor. These attenuators and adapters are available with the Option 301 Accessory Kit. The attenuator and adapter combinations necessary for various power levels and frequency measurements are listed in Table 3-1, below.

Table 3-1. Attenuator & Adapter Combinations

Power Level	50 to 75Ω Adapter	Attenuator
IF TESTING		
Between −64 dBm and −15 dBm	HP 11981A 50 to 75Ω Matching Pad	
Between −34 and +15 dBm	HP 11981A 50 to 75Ω Matching Pad	HP 8491A 30 dB Attenuator.
RF TESTING		
Between −70 dBm and −20 dBm		
Between −40 and +10 dBm		HP 8491A 30 dB Attenuator
Between −10 and +40 dBm		HP 8491A 30 dB Attenuator plus the HP 8498B 30 dB high power Attenuator.

Power Measurement

Caution 

Excessive power levels will damage the Power Sensor. Before measuring power, ensure that the proper combination of attenuators and adapters has been connected to the Power Sensor.

1. Connect Power Sensor, attenuator, and adapter combination to the power source to be measured. Check the labels on the power sensor and attenuators, then enter the correct calibration factor and offset factor for the measurement you are about to make.
2. The output power of the power source will be shown on the Power Meter's display.

3. If Display reads INPUT OVL, remove Power Sensor from power source and add attenuators as listed for higher power level in Table 3-1.
4. If the Display reads UNDER RANGE the power level is below the minimum level for the combination of attenuators on the power sensor. Connect the proper combination of adapters and attenuators for the power level to be measured as shown in Table 3-1.

3 Tone Source

On/Off

The three tones can be turned on and off in any combination. The annunciators in the ON/OFF keys indicate the status of the individual tones.

Offset Frequency

The 67, 70, and 75 MHz tones can be adjusted in frequency by the OFFSET FREQUENCY knob. The three tones retain their relative frequency spacing to each other as the OFFSET FREQUENCY knob is rotated.

1. Rotate the OFFSET FREQUENCY knob to change the frequencies of the three tones.
2. Clockwise rotation increases frequency, counter-clockwise rotation decreases frequency.
3. When the knob is aligned at 0, the three tones are 67, 70, and 75 MHz, ±0.5 MHz.

Total Power Out

The output level of the 67, 70, and 75 MHz tones can be adjusted by the TOTAL POWER OUT knob. The individual tones are always equal in power.

1. Rotate the TOTAL POWER OUT knob to change the output level.
2. Clockwise rotation increases output power, counter-clockwise rotation decreases output power.
3. When the knob is aligned at −8 dBm and the three tones are on, the total power out is −8 dBm ±0.5 dBm. The reference marks surrounding the TOTAL POWER OUT knob are for visual reference only.

Readout

There is a special function in the Multipath Fading Simulator that will display the 3 Tone Source offset frequency and total power out. This allows a more accurate setting of the knobs than would be possible otherwise.

Note

The Multipath Fading Simulator will not sweep while in this special function.

1. Press the [MORE] (SHIFTed [PRESET/LOCAL]) key.
2. Press [▲] or [▼] until the display reads `5 3TONE READ`.
3. Press the [ENTER] key.

Preset/Local

The PRESET and LOCAL functions of the 3 Tone Source are controlled with the Multipath Fading Simulator.

Spectrum Analyzer

Preset

The green (PRESET) key presets the complete Spectrum Analyzer instrument state, including all the Modes. It does not alter the instrument states saved by the user, traces saved by the user, or instrument calibration data.

Frequency

The FREQUENCY key is used to set frequency parameters. When the FREQUENCY key is pressed, a group of softkeys is accessed that allow parameter setting. The softkeys allow the user to modify the center frequency, the start and stop frequencies, the center frequency step size, and the offset frequency.

To set the center frequency:

1. Press the (FREQUENCY) key.
2. Enter the desired center frequency using the DATA keys, the (▲) or (▼) keys, or the knob.

Span

The SPAN key allows the user to adjust the frequency span of the display. The amount of span can be manually entered using the DATA keys, or a predetermined span can be selected using the softkeys.

To manually enter a span:

1. Press the (SPAN) key.
2. Enter the desired frequency span using the DATA keys.

To select a predetermined span:

1. Press the (SPAN) key.
2. For a full span, press the `FULL SPAN` softkey.
3. For a zero span, press the `ZERO SPAN` softkey.

4. To limit SPAN to a single band, press the BANDLOCK softkey, then the BAND 0, BAND 1, BAND 2, BAND 3 or BAND 4 softkey.

Amplitude

The AMPLITUDE key allows the user to adjust the vertical parameters of the display. When the AMPLITUDE key is pressed, a group of softkeys is accessed that allows parameter modification. The user can modify the reference level, the scale (log or linear), and input attenuation.

To set the reference level:

1. Press the AMPLITUDE key.
2. Enter the desired reference level using the DATA keys, the ▲ or ▼ keys, or the knob.

Preselector Alignment

The Spectrum Analyzer includes an internal preselector to filter out spurious signals from the display. The preselector is automatically adjusted for best tracking at a given frequency by using the PRESEL PEAK softkey. The Spectrum Analyzer must have a microwave input during the procedure. The following procedure will align the preselector.

Preselector peak automatically adjusts the preselector tracking to peak the signal at the active marker. Using preselector peak prior to measuring a signal yields the most accurate amplitude reading at the specified frequency. To maximize the peak response of the preselector and adjust the tracking, tune the marker to a signal and press AMPLITUDE, PRESEL PEAK.

Notes

1. PRESEL PEAK maximizes the peak response of the signal of interest but may degrade the frequency response at other frequencies. Use PRESEL DEFAULT or (PRESET) to clear PRESEL PEAK before measuring another frequency.

   PRESEL DEFAULT provides best full single-band flatness for viewing several signals simultaneously.

2. PRESEL PEAK works in harmonic bands only (bands 1 through 4).

Example: Using the knob, step keys, or (PEAK SEARCH), place the marker on your signal, and press PRESEL PEAK. The message CAL:PEAKING appears in the active function block while the routine is working.

If PRESEL PEAK has more than a 2 dB effect on signal amplitude when in BAND 1 or above and in a single-band sweep, perform CAL YTF with the COMB OUT signal, and store the data with CAL STORE. CAL YTF improves the PRESEL DEFAULT values.

CAL YTF

1. Press the (PRESET) key.
2. Connect the 100 MHz COMB OUT connector to the INPUT 50Ω connector using the special cable supplied.
3. Press the (CAL) key.
4. Press CAL YTF softkey.
5. Press the CAL STORE softkey.
6. Press the (PRESET) key.

Marker

A diamond-shaped marker can be placed on the signal peak to find the signal's frequency and amplitude. The marker can be placed manually or automatically. The signal's frequency and amplitude appear in the upper right corner of the display.

Placing a marker manually:

1. Ensure that the signal to be measured is displayed on the Spectrum Analyzer's screen.
2. Press the (MKR) key.
3. Press the MARKER NORMAL softkey.
4. Turn the knob to place the marker at the signal peak.

Placing a marker automatically:

1. Ensure that the signal to be measured is displayed on the Spectrum Analyzer's screen.
2. Press the (PEAK SEARCH) key.

   The marker will be automatically placed on the highest peak of the trace.

Modes

Pressing the (MODE) key on the Spectrum Analyzer front panel accesses the Mode Menu that provides a selection of the modes currently in the memory of the HP 8593E Spectrum Analyzer. Other modes can be loaded in from a Memory Card to replace those that are currently installed in the Spectrum Analyzer.

Some of these modes make measurements using the Spectrum Analyzer Input, while others make measurements on signals applied to various rear panel inputs. When switching between installed modes, the state of the last mode is automatically saved, and the state of the new mode is automatically recalled. The following Modes are included on the HP 11768-80010 Digital Radio Test System ROM Measurement Card:

MODE LOADER
FLATNESS ANALYZER & SOURCES
EVENT COUNTER
DIGITAL RADIO MASKS
FREQUENCY COUNTER
SCALAR ANALYZER
LOW FREQUENCY OSCILLOSCOPE
MULTIPATH FADING SIMULATOR CALIBRATE
MULTIPATH FADE DLP
CARRIER TO NOISE DLP
LINK LOOPBACK
LINK TRANSMITTER
LINK RECEIVER
GROUP DELAY VERIFICATION

Mode Loader

The Mode Loader utility provides a convenient way to automatically dispose of and load the various modes that are provided on the HP 11768-80010 ROM Measurement Card. The total memory size required for these modes is larger than the user memory in the HP 8593E, so it is necessary to load in the Modes in smaller groups. While this may be done manually, it is faster and easier to use the Mode Loader.

Loading the Mode Loader

1. Press (MODE) to bring up the Mode Menu. Alternate presses of the (MODE) key will switch between the Main Menu of the current mode and the Mode Menu.

Note

The Mode Menu always has `SPECTRUM ANALYZER` as the first softkey.

2. If `SPECTRUM ANALYZER` is the only softkey displayed on the Mode Menu, then skip to step number 8.

3. If MODE LOADER is one of the softkeys, then this utility is already loaded in the Spectrum Analyzer and the rest of this procedure may be skipped. See "Using the MODE LOADER".
4. If other Modes are present on these softkeys they should be disposed of before loading in the MODE LOADER by doing:
5. Press (CONFIG.). Press MORE 1 of 2.
6. Press DISPOSE USER MEM (an IF YOU ARE SURE ... message appears).
7. Press DISPOSE USER MEM for a second time.
8. To load the MODE LOADER do the following:
9. Insert the Digital Radio Test System ROM Measurement Card (HP 11768-80010) in to the card reader on the front panel of the HP 8593E Spectrum Analyzer.
10. Press (RECALL).
11. Select the memory card by pressing INTRNL CRD to underline CRD.
12. Press CATALOG CARD.
13. Press CATALOG ALL. The file dLOADME will be highlighted.
14. Press LOAD FILE which loads the highlighted file.
15. MODE LOADER should now be one of the keys on the Mode Menu.
16. If a user Down Loadable Program (DLP) is to be used in conjunction with the Event Counter mode, it should be loaded in before the Event Counter mode is loaded.

Using the Mode Loader

1. Insert the Digital Radio Test System ROM Measurement Card (HP 11768-80010) in to the card reader on the front panel of the HP 8593E, if not already inserted.

Note

The Mode Menu always has `SPECTRUM ANALYZER` as the first softkey.

2. Press (MODE) to bring up the Mode Menu. (`MODE LOADER` should be the second softkey.)
3. Press `MODE LOADER`.
4. Select the desired Mode or Mode Group by number using the (DATA) keys and press (ENTER) ((Hz) key). Usually, items 1, 2, or 3 would be selected, each of which loads several modes. Other item numbers allow the modes to be loaded in separately; which then leaves more room for user DLP's (Down Loadable Programs). It will take 10 to 60 seconds to dispose of the current modes and load in the new ones.

Note

When an item number is selected, the Mode Loader first automatically disposes of any other DRTS modes that are resident in the HP 8593E memory, before loading in the new mode(s). However, user defined DLP's will not be disposed (provided that the guidelines for assigning names and keys for user DLP's was followed — as contained in the *HP 8590 Series Spectrum Analyzer Programming Manual*). An Instrument Preset command is automatically done after the new mode is loaded.

Changing Modes and Presetting Modes

1. Once the mode is loaded, a softkey label for that mode will exist in the Mode Menu. Press (MODE) to display the Mode Menu and then press the mode

name softkey to change to that mode. If a mode is reentered it will be in the same state as when it was left, provided (PRESET) has not been pushed.

2. To return to the Spectrum Analyzer mode, press (MODE) to bring up the Mode Menu and then SPECTRUM ANALYZER. The Spectrum Analyzer will be returned to the same state as when it was left.
3. The green (PRESET) key may be used to take the instrument back to the Spectrum Analyzer mode, but this will also preset the instrument, including all modes, to the default state.

Note

The green (PRESET) key should seldom need to be used. It is not necessary to press (PRESET) before switching to another mode.

4. An individual mode may be preset to its default state without affecting other modes by use of the mode PRESET softkey that is in the Main Menu of that mode.

Accessing the Main Menu of A Mode

1. Press (MODE) and then the mode name softkey.
2. Or press (MODE) (MODE).

Setting Date and Time

Press (CONFIG), press TIME DATE, press SET DATE or SET TIME.

SET DATE sets the date of the real-time clock. Enter the date in the YYMMDD format using the number keypad and press (ENTER). Valid year (YY) values are 00 through 99. Valid month (MM) values are from 01 to 12, and valid day (DD) values are from 01 to 31.

SET TIME sets the time of the real-time clock. Enter the time in 24-hour, HHMMSS format, using the number keypad and enter the time by pressing (ENTER). Valid hour (HH) values are from 00 to 23. Valid minute (MM) and second (SS) values are from 00 to 59.

Digital Radio Mask Mode

The Digital Radio Mask mode uses the Spectrum Analyzer to measure spectral occupancy of digital radio signals. The transmitted spectrum of a digital radio is automatically measured and compared to agency or user defined mask limits. Mean power, frequency response, and transient analysis measurements may also be made in this mode. For more information refer to the *HP 85713A Digital Radio Measurements Operating Guide*.

Link Analyzer

The Link Analyzer consists of the HP 8593E Spectrum Analyzer and the following three personalities:

- Link Loopback Mode
- Link Transmitter Mode
- Link Receiver Mode

Group delay and amplitude flatness measurements can be made over a Digital Microwave Radio link using two spectrum analyzers, or locally using one spectrum analyzer as both the transmitter and receiver. Examples of both of these configurations are described in the *Radio Testing* section in this chapter.

The link analyzer uses the spectrum analyzer hardkeys to access softkey menus. The contents of each of the menus is partly dependent on the mode that is being used. This section describes some of the functions of the

link analyzer and details how each of the hardkeys are used.

Amplitude

In the Link Receiver and Link Loopback modes, AMPLITUDE accesses the softkeys that enable you to change the scale and offset of the traces, both manually and automatically. The softkeys in this menu also enable you to automatically center the traces and set the input attenuation of the analyzer. In the Link Transmitter mode, AMPLITUDE accesses the AUX CTRL menu.

Aux Ctrl

In the Link Transmitter and Link Loopback modes, the softkey menu accessed by AUX CTRL, contains `SRC PWR OFF ON` which allows you to set the tracking generator output power. Also included in this menu are some other functions that are used in the Spectrum Analyzer mode.

In the Link Receiver mode, the only softkey in the menu is `INP LVL OFFSET` which enables you to set an offset on either of the displayed traces.

BW

This key is active in the Link Receiver and Link Loopback modes only. The activated menu contains `VID BW 3kHz` and `VID AVG OFF ON` which can be used to remove unwanted noise from the display. Video averaging is not available when both traces are selected hence, `VID AVG OFF ON` will be blanked.

Cal

This key is active in the Link Receiver and Link Loopback modes only. It activates the calibration menu which enables you to calibrate the group delay scale and the measurement flatness.

Config

Accesses the same menus that are used in the Spectrum Analyzer mode, except that an extra key has been added. This key is `DISPOSE LOOPBACK`, `DISPOSE RECEIVER` or `DISPOSE TRANSMTR`, depending on which mode is running.

Display

In the Link Receiver and Link Loopback modes, the menu activated by this key enables you to select the type of measurement you want to make, that is group delay only, amplitude flatness only or both. You can also choose to make Diversity Antenna Delay Equalization (DADE) measurements. The menu also enables you to turn off the graticule and the annotation, and change the title of the display.

In the Link Transmitter mode, the key is used to refresh the display.

Frequency and Span

The menu activated by pressing FREQUENCY or SPAN accesses softkeys which enable you to set the Center Frequency, Span, and Baseband Frequency of the measurement. In the Link Transmit and Link Loopback modes, the Frequency Deviation can be set using `FM DEV`.

Meas/User

This key is active in the Link Receiver and Link Loopback modes only. The menu that it activates, enables you to measure the peak-to-peak values of the traces, the linear delay distortion and the parabolic delay distortion. Also, when making DADE measurements, you can calculate the length of cable required for delay equalization.

Mkr This key is active in the Link Receiver and Link Loopback modes only. It accesses the softkeys that enable you to use markers to make measurements. When `DADE OFF ON` is `ON`, this key will not display any menu, it will simply toggle markers on and off.

Mode Pressing (MODE) displays which modes are loaded into the memory.

Preset The green (PRESET) key presets the complete Spectrum Analyzer instrument state, including all the Modes. It does not alter the instrument states, traces or calibration data, saved by the user.

Save and Recall (SAVE) enables you to store test states and traces to the analyzers internal memory or to an external RAM card. (RECALL) can be used to recover the saved data.

Trace (TRACE) is used in the Link Receiver and Link Loopback modes only. It enables you to *freeze* the display using `TRC HOLD OFF ON`. Using `TRC ID OFF ON`, you can identify which trace is which by showing the amplitude flatness trace as a broken line (the default for this function is `ON`).

Trig (TRIG) is used in the Link Receiver mode only. Pressing this key, toggles the receiver in and out of the `Receiver Unlocked` state.

Flatness Analyzer

Flatness

Note

This section serves as a reference guide for the Flatness Analyzer mode. For an operating procedure, see the "Getting Started Guide".

This mode is used to make swept flatness measurements. The source signal, connected to the input of the device under test, may come from either the IF Tracking Generator or the RF Source. An external HP 8470B Crystal Detector is connected to the output of the device under test. The output of the 8470B is connected to the FLATNESS EXT DET IN connector on the rear panel of the HP 8593E E02. Measurements can be made IF to IF, RF to RF, IF to RF, or RF to IF.

Caution

Do not apply more than +20 dBm to the detector. Use attenuators if necessary.

Note

For IF measurements, use an HP 11981A Matching Pad, available from the Option 301 Accessory Kit.

Following is a list of softkeys that are available in the Flatness & Sources mode.

`PRESET FLATNESS` sets the Flatness Analyzer to a known initial state.

SOURCE	IF
SRC PWR (IF)	OFF, 0 dBm
SRC PWR (RF)	OFF, −10 dBm
SRC PWR OFFSET (IF)	0 dB
SRC PWR OFFSET (RF)	0 dB
PWR SWP	OFF
REF LVL	0 dBm
LOG SCALE	1 dB/div
NORM REF POSN	7
SWEEP TIME	AUTO SCALAR
VBW	1 kHz
TRANS/REFL	TRANS
AMPL TRK	OFF
NORMALIZE	OFF
CENTER FREQ	70 MHz
SPAN	40 MHz

Sources

This section of the Flatness & Sources Mode controls the IF and RF sources. These sources are used with the Flatness Analyzer and may also be used independently to provide either swept or CW signal sources.

The RF Source output is on the front panel of the HP 11758B. The RF Source is controlled by the softkeys of the Spectrum Analyzer. the frequency range is determined by the options configuration. The output level is adjustable from +5 to −15 dBm.

The Spectrum Analyzer includes a tracking generator that operates from 300 kHz to 2.9 GHz. The output is adjustable from +1 dBm to −10 dBm. The IF Tracking Generator Output is on the front panel of the HP 8593E Spectrum Analyzer and is labeled RF OUT 50Ω. For 75Ω output, use the HP 11981A Matching Pad on the RF OUT 50Ω connector.

The Sources softkey or (AUX CTRL) hardkey activates the SRC PWR function and accesses the Sources menu. The Sources menu has the following softkeys:

SOURCE IF RF selects either the RF Source or the IF Tracking Generator. The source must be selected before setting Frequency, Span, or Source Power.

CENTER FREQ is used to set the selected source's frequency using the data keys, the arrow keys, or the knob.

SPAN allows the frequency range to be changed symmetrically about the center frequency.

SRC PWR ON OFF turns the source power on or off, and allows control of the output power level of the source. This separately controls the IF source or RF source, depending upon which is selected by the SOURCE IF RF softkey. If this function is active (SRC PWR highlighted), pressing it will toggle the function from on to off or from off to on. If this function is not active, pressing it will make it active.

The Src Pwr Menu softkey accesses the source power menu.

SRC PWR OFFSET adds in an offset number to the displayed value of the Source Power. This separately controls the IF source or RF source, depending upon which is selected by the SOURCE IF RF softkey.

PWR SWP ON OFF turns the power sweep function on or off, and allows control of the power sweep range of the IF source (Tracking Generator). This function sweeps the power as a function of the horizontal sweep ramp. It is used in Zero Span to make swept power measurements. It may be used with Span to provide slope compensation as a function of frequency.

Calibration

The CAL or CAL softkey accesses the Flatness Calibration menu that has the following softkeys:

CAL TRANS is used to calibrate the measurement setup for transmission measurements. The message Connect THRU, Store when ready is displayed.

STORE THRU performs the actual transmission calibration by adjusting the peak of the response to the Reference Level, storing a reference trace, and then turning the normalization on. After calibration is completed, the message THRU Cal stored, Normalization ON is displayed.

CAL REFL is used to calibrate the measurement setup for reflection measurements. The message Connect SHORT, Store when ready is displayed.

STORE SHORT performs the actual reflection calibration by adjusting the peak of the response to the Reference Level, storing a reference trace, and then turning the normalization on. After calibration is completed, the message SHORT Cal stored, Normalization ON is displayed.

CANCEL stops the calibration without storing a new reference trace.

NORMLIZE ON OFF switches the normalization on and off.

Note

The normalize reference position is at the seventh graticule line. It is indicated by the ">" and "<" marks. The unnormalized reference position is at the top graticule.

Measure

The (MEAS/USER) key or MEAS softkey accesses the measurement menu that has the following softkeys.

REFL TRANS selects between reflection and transmission measurements. When switching from one to the other, some of the measurement conditions at the time of calibration are recalled; including the reference trace, Reference Level, and Log Scale. The source power and frequency parameters are not recalled, but must be the same for both reflection and transmission; except they may be different if the IF source is used for one measurement and the RF source for the other.

AMPL TRK ON OFF switches the Amplitude Track function on or off. With this function on, the Ref Level is automatically adjusted on each sweep to keep the maximum value of the trace approximately at the Reference Position. This is very useful when making flatness adjustments in 0.1 dB/div; as the gain of a device often varies considerably as the flatness is adjusted. Without this function, the user might need to repeatedly adjust the Ref Level to keep the trace on screen.

SCALE LOG sets the vertical graticule scale in dB per div.

Meas Fcns accesses the special functions menus. Refer to the *HP 8591A/8593A Quick Reference Guide* or the *HP 8591A/8593A Operating Manual* for a description of these functions.

Front Panel Hard Keys

(AMPLITUDE) activates the reference level function and accesses the amplitude menu.

(REF LVL) sets the absolute level at the Reference Position on the screen. This is the level at the input to the

HP 8470B Crystal Detector. When the calibration is performed, and the normalized trace displayed, both absolute reference and relative reference values are displayed. This differs from the Scalar mode where only the relative values are displayed when normalized. When the Amplitude Track function is on, the Ref Level is automatically adjusted.

(BW) accesses the Bandwidth menu, which has the following softkeys in the Flatness Analyzer Mode.

`VID BW` sets the amount of post detection filtering. Decreasing this reduces trace noise. As the Video BW is decreased, the sweep time is automatically increased to maintain amplitude calibration.

`VID AVG ON/OFF` turns the averaging function on and off.

(SWEEP) activates the SWP TIME function and accesses the sweep menu.

Event Counter

The Event Counter operation is independent of the Spectrum Analyzer operation. There are two TTL compatible inputs for this mode on the Spectrum Analyzer rear panel. The EVENT CNTR INPUT is used to count negative going pulses (a falling edge followed by a rising edge) occurring during the Gate Time interval. The INTERVAL CNTR INPUT is used for measuring the accumulated time that a pulse is low during the Gate Time interval. The number of negative going pulses is also displayed for this input, thus it can also be used as a second event counter. The counters display the count at the end of the Gate Time and are automatically restarted to do another count. If a continuous count for an indefinite time period is desired, the Totalize function

may be used. Note that the Gate Time, Totalize, and Stop Cntrs functions control all counters together.

Following is a list of the softkeys that are available in the Event Counter mode.

Note

For maximum operation speed, the Event Counter mode needs to be loaded into the Spectrum Analyzer memory last. The mode loader does this automatically for the DRTS modes. If a user DLP is used, it should be loaded into memory before loading the DRTS modes. This speed issue is primarily of concern for Threshold Errored Second measurements with Gate Times of less than one second.

`PRESET EVNT CNT` sets the Event Counter to a known initial state.

GATE TIME ..... 1 sec
TOTALIZE ..... OFF
STOP CNTRS ..... OFF
EVNT THLD ..... 50000 cnt/sec
Counter Values 0

`RESET CNTRS` resets all the counters to zero and starts a new count.

`STOP CNTRS` turns off the counters and holds the last value of each on the display. The counters are reset to zero and restarted by pressing `RESET CNTRS`, changing the Gate Time, or turning Totalize on or off.

`GATE TIME` accesses the menu in which the Gate Time is selected. Keys are provided for 100 ms, 1 sec, and 10 sec. Or a value may be entered by using any of the data controls.

`TOTALIZE ON OFF` switches the counter between Totalize and Gate Time count. In Totalize, the counters keep incrementing until they are manually reset. With Totalize Off, the counters are reset and a new count is

started at the end of every Gate Time interval. With Totalize On, the Threshold Errored Seconds value is also displayed. This value will increase by one Gate Time interval; if during that gate interval, either the Event Counter value increases by more than the Event Threshold value, the Interval Counter value increases by any amount, or the Interval Counter Time increases by any amount.

For Totalize with Gate Times less than 300 ms, XX is displayed for the Event and Interval Counters. To display these values, press `STOP CNTRS`.

`DSPLY SA ON OFF` turns the Spectrum Analyzer display on and off. When on, this allows simultaneous viewing of both Spectrum Analyzer and Event Counter displays. The Spectrum Analysis display is set to 15 dB/div, so that its display will not interfere with that of the Event Counter. The Spectrum Analyzer operation may be changed in the normal fashion by using the hard keys. The DSPLY SA function is automatically locked-out for Totalize with a Gate Time of less than one second.

`EVENT THRESHLD` allows the threshold value for the Event Counter to be changed. This is used in conjunction with Threshold Errored Seconds measurements when in Totalize.

`Sources` accesses the menu that allows control of the IF and RF sources. To have access to this menu, the Flatness & Sources mode needs to be resident in the Spectrum Analyzer along with the Event Counter mode. The sources parameters may be changed while the counters are running, except for Totalize with a Gate Time of less than one second; in which case the counters are automatically stopped when the sources menu is accessed. For a description of the operation of the keys in this menu, refer to Flatness & Sources in this section of the manual.

Gate Indicator. A " " is displayed on the CRT during the gate interval and momentarily flashes off at the end of the gate interval.

Frequency Counter

The Frequency Counter mode uses the Spectrum Analyzer to make highly accurate frequency measurements. The highest level signal applied to the Spectrum Analyzer's INPUT 50Ω connector is automatically found and its frequency and amplitude are displayed. The user needs to set just two parameters; the frequency band and the desired resolution. If the input signal is changed, the analyzer will automatically find and measure the new signal provided it is in the displayed frequency band.

Note

The frequency of a signal other than the highest can be determined in the Spectrum Analyzer mode by using the MKR CNT function. The accuracy is the same as when using the Frequency Counter mode.

Following is a list of softkeys that are available in Frequency Counter mode.

`PRESET FREQ CNT` sets the Frequency Counter to a known initial state.

RESOLN ..... 100 Hz
FREQ 2.9
DSP HOLD ..... OFF

`RESET` restarts the search for the highest level signal present in the selected Band. This function seldom needs

to be used, as searching automatically commences when no input signal above the threshold level is present.

FREQ 2.9 22. This softkey selects the Frequency Band. The Analyzer will search for the highest level signal only in the selected Band. The 2.9 band is 10 MHz to 2.9 GHz. The 22 band is 2.75 to 22 GHz.

RESOLN accesses the menu in which Frequency Resolution is selected. Keys are provided for 1 Hz, 10 Hz, 100 Hz, 1 kHz, and 10 kHz.

DSP HOLD ON OFF switches the Display Hold function on and off. When it is on, the value displayed on the CRT is held.

Searching. A SEARCHING message is displayed if the counter has not acquired a signal.

Measuring. A MEASURING message is displayed when a frequency counter measurement is being made.

Scalar Analyzer

The Scalar Analyzer mode is used to make swept scalar stimulus-response measurements. The source signal, connected to the input of the device under test, comes from the IF Tracking Generator's RF OUT 50Ω connector on the Spectrum Analyzer. The output of the device under test is applied to the Spectrum Analyzer's INPUT 50Ω connector.

Following is a list of softkeys that are available in Scalar Analyzer mode.

PRESET SCALAR sets the Scalar Analyzer to a known initial state.

SRC PWR ..... OFF at 0 dBm
SRC PWR STP SIZE ..... AUTO

SRC PWR OFFSET	0 dB
PWR SWP	OFF
LOG SCALE	10 dB/div
NORM REF POSN	Top graticule
REF LVL	0 dBm
TRANS/REFL	TRANS
NORMALIZE	OFF
NORM REF LVL	0 dB
SWEEP TIME	AUTO SCALAR
RES BW	10 kHz
VBW	AUTO
DET	SMPL
START FREQ	0 Hz
STOP FREQ	2.9 GHz

Source

The `SOURCE` softkey or (AUX CTRL) hardkey activates SRC PWR and accesses the Source menu that has the following softkeys:

Note

Use the `Source` softkey in the Scalar Analyzer menu.

Do not use the `Sources` softkey in the Flatness Analyzer menu.

`SRC PWR ON OFF` turns the source power on or off, and allows control of the output power level of the source. If this function is active (SRC PWR highlighted), pressing it will toggle the function from on to off or from off to on. If this function is not active, pressing it will make it active.

`SRC PWR OFFSET` adds in an offset number to the displayed value of the Source Power.

`PWR SWP ON OFF` turns the power sweep function on or off, and allows control of the power sweep range of the

Tracking Generator. This function sweeps the power as a function of the horizontal sweep ramp. It is used in Zero Span to make swept power measurements. It may be used with Span to provide slope compensation as a function of frequency.

Calibration

The `cal` softkey or (CAL) hardkey accesses the Scalar Calibration menu which has the following softkeys:

Note 

It is good practice to perform a TRACKING PEAK function at the beginning of each measurement session before performing a calibration.

`CAL REFL` is used to calibrate the Scalar measurement setup for reflection measurements. The message `Connect OPEN, Store When Ready` is displayed, followed by `Connect SHORT, Store When Ready`.

`STORE OPEN` or `STORE SHORT` performs the actual calibration. A reference trace is stored, normalization is turned on and the normalized trace is displayed on the screen when this key is pressed. The message `OPEN/SHORT stored, Normalization ON` is displayed.

Note 

An external directional coupler is required to make reflection (return loss) measurements.

`CANCEL` stops the calibration without storing a new reference trace.

`CAL TRANS` is used to calibrate the Scalar measurement setup for thru measurements. The

message Connect THRU, Store when ready is displayed.

STORE THRU performs the actual calibration. A reference trace is stored, normalization is turned on, and the normalized trace is displayed on the screen when this key is pressed. The message THRU Cal Stored, Normalization ON is displayed.

CANCEL stops the calibration without storing a new reference trace.

TRACKING PEAK performs an automatic routine to set the Tracking Generator frequency to precisely the same frequency as the Spectrum Analyzer. It is necessary to have a cable or the device under test connected between the Tracking Generator and Spectrum Analyzer before pushing this key.

NORMLIZE ON OFF switches the normalization On and Off.

Main Menu returns to the SCALAR menu.

Measurement

REFL selects reflection measurement for display on the screen. When switching from TRANS to REFL, the reflection reference trace and reflection amplitude parameters are recalled, and normalization is turned on.

TRANS selects transmission measurement for display on the screen. When switch from REFL to TRANS, the transmission reference trace and transmission amplitude parameters are recalled, and normalization is turned on.

Note

REFL and TRANS have independent reference traces and amplitude parameters that are automatically saved and recalled when switching between the two measurements.

The frequency and source power parameters are shared by both.

`NORMLIZE ON OFF` switches the normalization On and Off.

`Meas Fcns` accesses the special functions menus. Refer to the *HP 8591A/8593A Quick Reference Guide* or the *HP 8591A/8593A Operating Manual* for a description of these functions.

Front Panel Hard Keys

Most of the Front Panel hard keys may be used in this mode. Their operation is very similar to that for the Spectrum Analyzer Mode. Some of the softkeys are different to better match the requirements for the Scalar Analyzer Mode. The most important hard keys and related softkeys are described below.

(FREQUENCY) activates the Center Frequency function and allows selection of the frequency at the center of the screen. It also accesses the FREQUENCY menu.

(SPAN) activates the Span function and allows the frequency range to be changed symmetrically about the center frequency. It also accesses the SPAN menu.

(AMPLITUDE) activates the Reference Level function and accesses the amplitude menu.

`REF LVL (RANGE)` sets the absolute level at the Reference Level Position on the screen (the top horizontal graticule) before calibration. This is the level at the input to the Spectrum Analyzer.

`SCALE LOG` sets the vertical graticule scale in dB per div.

NORM REF LVL sets the relative level at the normalized reference position. It can be set either before or after calibration.

NORM REF POSN moves the position at which the normalized reference level applies. This reference level is indicated by ">" and "<" on the display when Normalization is on.

(BW) activates the RES BW function and accesses the BW menu.

RES BW sets the bandwidth of the IF bandpass filters. Narrowing the RES BW gives increased sensitivity, and hence increased dynamic range. As the RES BW is decreased, the Sweep Time is automatically increased to maintain amplitude calibration. Note that the RES BW does not restrict the bandwidth that can be measured on the device under test.

VID BW sets the amount of post detection filtering. Decreasing this reduces trace noise. As the Video BW is decreased, the Sweep Time is automatically increased to maintain amplitude calibration.

VID AVG ON/OFF turns the averaging function on and off.

(SWEEP) activates the SWP TIME function and accesses the Sweep menu.

SWP TIME When active (highlighted), the Sweep Time can be entered from the data control keys. AUTO or MANual operation may also be chosen. In Auto operation, the Sweep Time is automatically set as a function of RES BW and Video BW to give a correct amplitude display with most devices under test. If the device has unusually sharp skirts or resonances, a slower sweep in the manual mode may be required. Conversely, if the response is very flat a faster Sweep Time could be used if desired. This can be easily tested: the Sweep

Time is not too fast if increasing it one increment produces no noticeable change (or an acceptable change) on the display.

(MKR) turns on the normal marker and accesses the marker menu. These functions are very useful for the Scalar Analyzer mode. See the Spectrum Analyzer operation for detailed description.

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A

HP-IB

Hewlett-Packard Interface Bus

The HP 11758V Digital Radio Test System has implemented IEEE 488.1 interface functions indicated by the following codes: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, C0, and E2. An explanation of the compatibility code can be found in IEEE Standard 488 (1978), "IEEE Standard Digital Interface for Programmable Instrumentation" or the identical ANSI Standard MC1.1.

The HP 11758V has three separate HP-IB addresses and behaves as three independent instruments. The instruments and their addresses as set at the factory are:

Power Meter 13
Multipath Fading Simulator ... 14
Spectrum Analyzer 18

Where to Find HP-IB Information

HP-IB programming commands for the Digital Radio Test Set can be found in the operating manuals for the instruments found in the system. Part numbers for the manuals are:

HP 11757B Operating Manual 11757-90051
HP 437B Operating Manual 00437-90036

HP 8590 Series Programming Manual .. 5958-7094

Refer to these manuals for information on HP-IB programming and commands. For the 3 Tone Source and the RF Source refer to this chapter.

HP-IB Address Selection

When shipped from the factory, the address of the Power Meter is 13, the address of the Multipath Fading Simulator is 14, and the address of the Spectrum Analyzer is 18. HP-IB addresses from 0 to 30 can be used.

HP-IB addresses are set as follows:

Power Meter

1. Press the [SPECIAL] key (SHIFTed PRESET/LOCAL).
2. Press [▲] or [▼] until the display reads `4 HP- IB ADRS`.
3. Press the ENTER key. The display will read `ADDRESS 13`.
4. Press [▲], [▼], [◀], or [▶] until the desired HP-IB address is displayed.
5. Press the [ENTER] key.

Multipath Fading Simulator

1. Press the [SPECIAL] (SHIFTed [PRESET/LOCAL]) key.
2. Press [▲] or [▼] until the display reads `5 HP- IB ADRS`.
3. Press the [ENTER] key. The display will read `ADDRESS 14`.
4. Press [▲], [▼], [◀], or [▶] until the desired HP-IB address is displayed.
5. Press the [ENTER] key.

Spectrum Analyzer

1. Press the CONFIG key.
2. Press the MORE, 1 OF 2 softkey.
3. Press the ANALYZER ADDRESS softkey.
4. Enter the desired HP-IB address using the DATA keys.
5. Press the ENTER key.

3 Tone Source Commands

You have complete control of 3 Tone Source functions over HP-IB using just a few commands. The commands simulate front panel control of the POWER OUT and OFFSET FREQUENCY knobs, as well as control of the 67, 70 and 75 MHz ON/OFF keys.

Power Level

The power level of each tone can be set from −60 dBm to +10 dBm. The preset value is −60 dBm. The syntax is as follows:

```
SOURce2:|TSOurce:
POWer:LEVel:IMMediate:AMPLitude
[ num DBM ]
| MINimum |
[ MAXimum ]
```

For example, to set the power level to −7 dBm:

```
OUTPUT 714;"TSO:POW:LEV:IMM:AMPL 7 DBM"
```

The specifiers LEV, IMM, and AMPL are all optional, so the above can be shortened to:

```
OUTPUT 714;"TSO:POW 7 DBM"
```

If you want to measure the approximate total output power of the 3 Tone Source, use the command sequence:

```
OUTPUT 714;"MEAS:TSO:POW?"
```

The measured value may be different from the value set by "TSO:POW" because the measurement is only approximate.

Frequency Offset

A frequency offset for the three tones may be set up to ±5 MHz. The preset value is 0 MHz.

```
SOURce2:|TSOource:FREQuency:OFFSet [ num | MAXimum | MINimum ]
[ MHZ ]
```

The terminator may be any IEEE multiplier.

For example, to offset a frequency by −3 MHz:

```
OUTPUT 714;"TSO:FREQ:OFFS −3MHZ"
```

To measure the frequency offset of the 3 Tone Source, enter the following command sequence:

```
OUTPUT 714;"MEAS:TSO:FREQ?"
```

The measured value may be different from the "TSO:FREQ:OFFS" setting because the measurement is only approximate.

Use the LIST command to specify which of the 3 tones are on.

Turning Tones ON/OFF

The LIST command specifies the tones to be enabled. You may list one, two or all three of the tones. The preset condition has all three frequencies enabled (67, 70, and 75 MHz). When listing more than one tone, separate each entry with a comma.

SOURce2:|TSOurce:LIST:FREQ [67MHZ | 70MHZ | 75MHZ | MAXimum | MINimum]

If the frequency is left empty, all tones go off.

The following example will turn on the 67 and 75 MHz tones, and turn off the 70 MHz tone if it is on:

```
OUTPUT 714;"TSO:LIST:FREQ 67MHZ,75MHZ"
```

To turn all tones off:

```
OUTPUT 714;"TSO:LIST:FREQ"
```

To query the contents of the the enable tone list:

```
OUTPUT 714;"TSO:LIST:FREQ?"
```

If the list is empty, the string NONE is returned.

POINts? queries the number of values currently in the frequency enable list.

```
OUTPUT 714;"TSO:LIST:FREQ:POIN?"
```

B

Specifications

The specifications in the following tables are of two types: Warranted and Supplemental. The supplemental specifications are non-warranted and are provided to supply typical performance information. Supplemental specifications are placed *in italics* to distinguish them from warranted specifications.

The specifications are divided into three tables:

1. The HP 11758B specifications. This includes specifications of the
   - Power Meter
   - Three-Tone Source
   - RF Signal Source
   - Multipath Fading Simulator
2. The HP 8593E Specifications, including frequency and amplitude specifications.
3. The HP 8593E Option E02 Specifications, including specifications for the
   - Spectrum Analyzer
   - IF Tracking Generator
   - Event Counter
   - Flatness Analyzer
   - Link Analyzer
   - Frequency Counter

Specifications

Table B-1. HP 11758B Specifications

Electrical Characteristics	Performance Limits	Conditions
Compatibility	HP-IB interface	SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, C0, E2.
Power Meter		Using HP 8481D Power Sensor
Frequency Range	10 MHz to 300 MHz	IF range
	100 MHz to 18 GHz	RF range
Power Range	+15 to −64 dBm	IF range
	+40 to −70 dBm	RF range
HP 8481D IF Return Loss		75 Ω nominal impedance
10 MHz to 14 MHz	≥20 dB	< −25 dBm input power
	≥30 dB	for −24 to +25 dBm
14 MHz to 30 MHz	≥23 dB	< −25 dBm input power
	≥30 dB	for −24 to +25 dBm
30 MHz to 300 MHz	≥26 dB	< −25 dBm input power
	≥30 dB	for −24 to +25 dBm
HP 8481D RF Return Loss		50Ω nominal impedance
30 MHz to 10 GHz	≥20 dB	<20 dBm input
10 GHz to 18 GHz	≥18 dB	<20 dBm input power
10 GHz to 18 GHz	≥20 dB	>20 dBm input
Instrumentation Accuracy	<±0.02 dB	Worst case for 1 year
Power Reference	1 dBm ±1.2%	
Three-Tone Source		
Center frequencies	67 MHz (137 MHz)	Standard (Option 140)
	70 MHz (140 MHz)	Standard (Option 140)
	75 MHz (145 MHz)	Standard (Option 140)
Frequency adjustment	±2.5 MHz	Around 0 on OFFSET FREQUENCY knob.

Table B-1. HP 11758B Specifications (continued)

Electrical Characteristics	Performance Limits	Conditions
Three-Tone Source (cont'd)		
Frequency Accuracy	±0.5 MHz	With 70 MHz (or 140 MHz) signal set to 0 position on OFFSET FREQUENCY knob.
Maximum Output Level	> −7 dBm	Individual tone.
	> −2 dBm	RMS sum of all three tones.
Flatness	< 0.5 dB	0°C to 40°C
Spectral Purity	< −65 dBc	Output level set to −8 dBm.
Output attenuator	75Ω nominal impedance,	
	0 to 25 dB	Continuously variable range.
RF Signal Source		
Output level range	-15 dBm to +5 dBm	(3.5 to 13 GHz)
Output Level Resolution	0.1 dB	
Frequency Range	3.75 GHz to 6.475 GHz	Option 007
	10.7 GHz to 11.7 GHz	Option 011
	3.5 GHz to 13 GHz	Option H13
Frequency Accuracy	1E-6 x center freq + 1.5% of span + 2 kHz[1]	< 6.5 GHz
	1E-6 x center freq + 1.5% of span + 4 kHz[1]	> 6.5 GHz

1 Frequency Reference Error = (Aging rate x period of time since adjustment + initial achievable accuracy + temperature stability).

Table B-1. HP 11758B Specifications (continued)

Electrical Characteristics	Performance Limits	Conditions
RF Signal Source (cont'd)		
Sweep Span Range	0 (zero span), (10 x N) to 2.7 GHz	
Residual FM in CW Mode		Using 50 Hz to 15 kHz post detector bandwidth.
	30 kHz pk-pk	N=1
	50 kHz pk-pk	N=2
Spurious Signals		
3.75 to 6.475 GHz	< -64 dBc	At $>$ 30 kHz from CW signal
6.5 to 13 GHz	< -58 dBc	At $>$ 30 kHz from CW signal
Harmonic and Sub-harmonics	< -40 dBc	
Output impedance	50Ω nominal impedance	
Multipath Fading Simulator		
Notch Frequency Bands		
Notch Frequency Range	40 MHz to 100 MHz	Standard
	90 MHz to 190 MHz	Option 140
	40 MHz to 100 MHz and 90 MHz to 190 MHz	Option 147
Resolution	100 kHz	
Accuracy	±300 kHz	70 MHz Band, 20 dB notch depth
	±400 kHz	140 MHz Band, 20 dB notch depth
Notch Depth Range	0 to 40 dB	
Resolution	0.1 dB	
Accuracy	±0.75 dB to 20 dB depth	±20MHz, 15° to 35°C, 20 dB notch depth
	±3.0 dB to 40 dB depth	±20MHz, 15° to 35°C, 40 dB notch depth

Table B-1. HP 11758B Specifications (continued)

Electrical Characteristics	Performance Limits	Conditions
Multipath Fading Simulator (cont'd)		
Flat Fade Gain/Attenuation		
Gain Range	0 to 12 dB	at 70 or 140 MHz
Attenuation Range	0 to 50 dB	
Resolution	0.1 dB	
Accuracy	± 2.0 dB	from 0 dB to 30 dB flat fade
Signature Types	Static M-Curve Dynamic M-Curve Dynamic S-Curve Hysteresis M-Curve	
Recovery Time		
Range	1 msec to 6 sec	
Accuracy	1 msec	
Resolution	1 msec	
Setting Ranges		
Bit Rate	10 kHz to 200 MHz	
BER Threshold	1E-3, 3E-4, 1E-4, 3E-5, 1E-5, 1E-6	
Dynamic S-Rates	1 MHz/s to 6 GHz/s	
Dynamic M-Rates	10, 20, 100, 300, 600, 1200 MHz/s	
Dynamic M Deviations (±)	1, 2, 4, 6, 10, 20 MHz	
Measurement Speed	< 1 minute	Static M-Curve, one phase, 10 data points, BER=1E-3, bit rate=44.7 Mb/s, error bits=2048
Automatic Gain Control (AGC)	Maintains constant average gain.	For notch depths up to 40 dB over 1.0 MHz to 40 MHz bandwidths.

Table B-1. HP 11758B Specifications (continued)

Electrical Characteristics	Performance Limits	Conditions
Multipath Fading Simulator (cont'd)		
Error Pulse In		
Termination	75 Ω, 10 kΩ	
Threshold	-5 V to +5 V	
Minimum Pulse Width	2.5 ns	
Minimum Pulse Interval	25 ns	
Simulated variable delay		
Range	1 ns to 25 ns	
Resolution	0.1 ns	
Internal fading event memory		
Number of fade event sequences	10	
Number of Data Sets	2000	Each data set contains notch frequency, notch depth, minimum / non minimum phase, flat attenuation and sweep time per data set
Sweep		
Sweep Time	10 ms to 99s	
Time Resolution	10 ms	
Slew		
Slew Time	100 ms to 99s	
Time Resolution	100 ms	
Maximum Slew rate		
Attenuation	6500 dB/sec	
Notch Frequency	6000 MHz/sec	
Notch Depth	4500 dB/sec	

Table B-1. HP 11758B Specifications (continued)

Electrical Characteristics	Performance Limits	Conditions
Noise Emission	LpA <70 dB(A)	
Noise figure	≤ 15 dB	Measured with 12 dB gain.
Insertion loss	0 dB	
Input level	0 to 1 mW (0 dBm)	
Spurious Signals	< −60 dBm	
Three Tone Intermodulation Response		-4 dBm input power, gain ≤ 0 dB
70 MHz Band	≤ −50 dBc	
140 MHz Band	≤ −47 dBc	
Attenuation accuracy	0.1 dB per 10 dB step	relative accuracy
Frequency accuracy	±150 kHz	
Notch Depth Accuracy	±1.0 dB at 40 dB	Notch Depth at 25°C
	±0.2 dB at 20 dB	Notch depth at 25°C
Frequency response		
Amplitude variation	≤± 0.2 dB	at 70 MHz ±20 MHz
Group Delay variation	≥ ±1 ns	(0 dB notch) at 70 MHz ±20 MHz.
Sweep linearity		
Notch Frequency	Linear in MHz	
Attenuation	Linear in dB	
Notch Depth	Linear in dB	
Outputs	Front and rear panel	
Slopes	+0.5 dB per MHz −0.5 dB per MHz +0.33 dB per MHz −0.33 dB per MHz	Centered at 70 MHz; (70 and/or 140 MHz, depending on the Option)

Table B-2. HP 8593E Specifications

GENERAL SPECIFICATIONS	
All specifications apply over 0°C to +55°C. The analyzer will meet its specifications after 2 hours of storage at a constant temperature, within the operating temperature range, 30 minutes after the analyzer is turned on and after CAL FREQ, CAL AMPTD and CAL YTF have been run.	
Temperature Range	
Operating	0°C to +55°C
Storage	−40°C to +70°C
EMI Compatibility	Meets EN55011:1991 (Group 1, Class A), and EN50082-1:1992.
Audible Noise	<37.5 dBA pressure and <5.0 Bels power (ISODP7779)
Power Requirements	
ON (LINE 1)	90 to 132 V rms, 47 to 440 Hz 198 to 264 V rms, 47 to 66 Hz Power consumption <500 VA; <180 W
Standby (LINE 0)	Power consumption <5 watts
FREQUENCY SPECIFICATIONS	
Frequency Range	9 kHz to 22 GHz
(Option 026)	9 kHz to 26.5 GHz
Band **LO Harmonic (N)**	
0 1−	9 kHz to 2.9 GHz
1 1−	2.75 GHz to 6.5 GHz
2 2−	6.0 GHz to 12.8 GHz
3 3−	12.4 GHz to 19.4 GHz
4 4−	19.1 GHz to 22 GHz
4 4− *(Option 026)*	19.1 GHz to 26.5 GHz

Table B-2. HP 8593E Specifications (continued)

FREQUENCY SPECIFICATIONS (cont'd)	
Precision Freq. Reference	
Aging	$\pm 1 \times 10^{-7}$/year
Settability	$\pm 1 \times 10^{-8}$
Temperature Stability	$\pm 1 \times 10^{-8}$
Frequency Accuracy	
Readout Accuracy (Start, Stop, Center, Marker)	±(frequency readout × frequency reference error † + span accuracy + 1% of span + 20% of RBW + 100 Hz + N‡)
Marker Count Accuracy*	
Frequency Span ≤ 10 MHz × N ‡	±(marker frequency × frequency reference error† + counter resolution + 100 Hz × N‡)
Frequency Span > 10 MHz × N ‡	±(marker frequency × frequency reference error† + counter resolution + 100 Hz × N‡)
Counter Resolution, Span ≤ 10 MHz × N‡	Selectable from 10 Hz to 100 kHz
Counter Resolution, Span >10 MHz × N‡	Selectable from 100 Hz to 100 kHz

† Frequency Reference Error = (Aging rate × period of time since adjustment + initial achievable accuracy + temperature stability).
‡ N=LO harmonic.
* Marker level to displayed noise level > 25 dB, RBW ≥300 Hz, RBW/Span ≥0.01. Span ≤300 MHz. Widen RES BW annotation is displayed when RBW < 30 Hz. Reduce SPAN annotation is displayed when RBW/Span <0.01.

Table B-2. HP 8593E Specifications (continued)

FREQUENCY SPECIFICATIONS (cont'd)	
Frequency Span	
Range	0 Hz (zero span), (10 kHz × N) to 19.25 GHz
(Option 270)	0 Hz, (zero span), (10 kHz × N) to 23.75 GHz
Resolution	4 digits
Accuracy, Span ≤10MHz × N[1]	±2% of span
Accuracy, Span >10MHz × N[1]	±3% of span
Frequency Sweep Time	
Range	20 ms to 100 s
Accuracy	
20 ms to 100 s	±3%
Sweep Trigger	Free run, Single, Line, Video, External
Stability	
Noise Sidebands	(1 kHz RBW, 30 Hz VBW and sample detector)
>10 KHz offset from CW signal	≤−90 dBc/Hz + 20 Log N[1]
>20 KHz offset from CW signal	≤−100 dBc/Hz + 20 Log N[1]
>30 KHz offset from CW signal	≤−105 dBc/Hz + 20 Log N[1]
Residual FM	
1 kHz RBW, 1 kHz VBW	≤(250 ×N[1])Hz pk-pk in 100 ms
30 Hz RBW, 30 Hz VBW	≤(30 ×N[1])Hz pk-pk in 300 ms
System Related Sidebands	<−65 dBc + 20 Log N[1] at >30 kHz offset from CW signal
Calibrator Output Frequency	300 MHz fundamental frequency
Accuracy	Frequency reference error[2]
Comb Generator	100 MHz fundamental frequency
Frequency Accuracy	± 0.007%

1 N=LO harmonic

2 frequency reference error = (aging rate x period of time since adjustment + initial achievable accuracy + temperature stability) See "Frequency Characteristics" in this table.

Table B-2. HP 8593E Specifications (continued)

AMPLITUDE SPECIFICATIONS	
Amplitude Range	−114 dBm to +30 dBm
Maximum Safe Input Level	
Average Continuous Power	+30 dBm (1W, 7.1 Vrms), Input Atten ≥10 dB in bands 1 −4
Peak Pulse Power	+50 dBm (100W) for <10 μs pulse width and <1% duty cycle, Input Atten ≥ 30 dB
DC	0 V DC
Gain Compression (>10 MHz)	≤0.5 dB (total power at input mixer = −10 dBm)[1]
Displayed Average Noise Level	(Input terminated, 0 dB attenuation, 30 Hz VBW, sample detector)
	1 kHz RBW
400 kHz to 2.9 GHz	≤−112 dBm
2.75 GHz to 6.5 GHz	≤−114 dBm
6.0 GHz to 12.8 GHz	≤−102 dBm
12.4 GHz to 19.4 GHz	≤−98 dBm
19.1 GHz to 22 GHz	≤−92 dBm
19.1 GHz to 26.5 GHz *(Option 270)*	≤−87 dBm
Spurious Responses	
Second Harmonic Distortion	
10 MHz to 2.9 GHz	<−70 dBc for −40 dBm tone at input mixer[1]
> 2.75 GHz	<−100 dBc for −10 dBm tone at input mixer[1] (or below displayed average noise level)
Third Order Intermodulation Distortion	
>10 MHz	<−70 dBc for two −30 dBm tones at input mixer[1] and >50 kHz separation
Other Input Related Spurious	
9 kHz to 18 GHz	<−65 dBc at ≥ 30 kHz offset, for −20 dBm tone at input mixer ≤18 GHz.
18 GHz to 22 GHz	<−60 dBc at ≥ 30 kHz offset, for −20 dBm tone at input mixer ≤22 GHz

1 Mixer Power Level (dBm) = Input Power (dBm) − Input Attenuator (dB).

Table B-2. HP 8593E Specifications (continued)

AMPLITUDE SPECIFICATIONS (cont'd)	
Residual Responses	(Input terminated and 0 dB attenuation)
150 kHz to 2.9 GHz (Band 0)	<−90 dBm
2.75 GHz to 6.5 GHz (Band 1)	<−90 dBm
Display Range	
Log Scale	0 to −70 dB from reference level is calibrated; 0.1, 0.2, 0.5 dB/division and 1 to 20 dB/division in 1 dB steps; eight 8 divisions displayed
Linear Scale	8 divisions
Scale Units	dBm, dBmV, dBμV, volts and watts
Marker Readout Resolution	0.05 dB for log scale 0.05% of reference level for linear scale
Reference Level	
Range	
Log Scale	−114 dBm to +30 dBm
Linear Scale	−99 dBm to maximum amplitude
Resolution	
Log Scale	±0.01 dB
Linear Scale	0.12% of reference level
Accuracy[1]	
0 dBm to −59.9 dBm	±(0.3 dB +.01 × dB from −20 dBm)
−60 dBm and below	
1kHz to 3 MHz RBW	±(0.6 dB + .01 × dB from -20 dBm)
30 Hz to 300 Hz RBW	±(0.7 dB + .01 × dB from -20 dBm)

1 (Referenced to −20 dBm reference level 10 dB input attenuation, at a single frequency, in a fixed RBW.)

Table B-2. HP 8593E Specifications (continued)

AMPLITUDE SPECIFICATIONS (cont'd)		
Calibrator Output Amplitude	−20 dBm ±0.4 dB	
Absolute Amplitude Calibration Uncertainty[1]	±0.15 dB	
Input Attenuator Range	0 to 70 dB, in 10 dB steps	
Resolution Bandwidth Switching Uncertainty	(At reference level, referenced to 3 kHz RBW)	
3 kHz to 3 MHz RBW	±0.4 dB	
1 kHz RBW	±0.5 dB	
Frequency Response	(10 dB input attenuation)	
Preselector peaked in band > 0	**Absolute**[2]	**Relative Flatness**[3]
9 kHz to 2.9 GHz	±1.5 dB	±1.0 dB
2.75 GHz to 6.5 GHz	±2.0 dB	±1.5 dB
6.0 GHz to 12.8 GHz	±2.5 dB	±2.0 dB
12.4 GHz to 19.4 GHz	±3.0 dB	±2.0 dB
19.1 GHz to 22 GHz	±3.0 dB	±2.0 dB
19.1 GHz to 26.5 GHz Opt. 270	±5.0 dB	±2.0 dB
Log to Linear Switching	±0.25 dB at reference level	
Display Scale Fidelity		
Log Maximum Cumulative	(0 to − 70 dB from Reference Level)	
3 kHz to 3 MHz RBW	±(0.3 dB + 0.01 × dB from reference level)	
RBW ≤ 1 kHz	±(0.4 dB + 0.01 × dB from reference level)	
Log Incremental Accuracy	±0.4 dB/4 dB (0 to −60 dB from Reference Level)	
Linear Accuracy	±3% of reference level	

1 Uncertainty in the measured absolute amplitude of the CAL OUT signal at the reference settings after CAL FREQ amd CAL AMPTD self-calibration. Absolute amplitude reference settings are: Reference Level − 20 dBm; Input Attenuation 10 dB; Center Frequency 300 MHz; Res BW 3 kHz; Video BW 300 Hz; Scale Linear; Span 50 kHz; Sweep Time Coupled, Top Graticule (reference level), Corrections ON.

2 Referenced to midpoint between highest and lowest frequency response deviations

3 Referenced to 300 MHz CAL OUT

Table B-2. HP 8593E Specifications (continued)

FREQUENCY CHARACTERISTICS	
Precision Frequency Reference	
Aging	5×10^{-10}/day, 7 day average after being powered on for 7 days.
Warm-up	1×10^{-8} after 30 minutes on.
Initial Achievable Accuracy	$\pm 2.2 \times 10^{-8}$, after being powered on for 24 hours.
Stability	
Drift[1](after warmup at stabilized temperature)	
Frequency Span $\leq$ (10 $\times$ N) MHz	$\leq$ (2 $\times$N) kHz/minute of sweep time[1] (N=LO harmonic)
Resolution Bandwidth (−3 dB)	
Range	1 kHz to 3 MHz, selectable in 1, 3 and 10 increments and 5 MHz. Resolution bandwidths may be selected manually, or coupled to frequency span.
Shape	Synchronously tuned 4 poles. Approximately Gaussian shape.
60 dB/3 dB Bandwidth Ratio (Resolution BW)	
100 kHz to 3 MHz	15:1
30 kHz	16:1
3 kHz to 10 kHz	15:1
1 kHz	16:1

1 Drift occurs only during the time of one sweep because the analyzer is locked at the center frequency before each sweep. For Line, Video or External trigger, additional drift occurs while waiting for the appropriate trigger signal.

Table B-2. HP 8593E Specifications (continued)

FREQUENCY CHARACTERISTICS (cont'd)			
Video Bandwidth (−3 dB)			
Range	30 Hz to 1 MHz, selectable in 1, 3, 10 increments, accuracy ±30% and 3 MHz. Video bandwidths may be selected manually, or coupled to resolution bandwidth and frequency span.		
Shape	Post detection, single pole low-pass filter used to average displayed noise.		
FFT Bandwidth Factors	**Flattop**	**Hanning**	**Uniform**
Noise Equivalent Bandwidth[1]	3.63×	1.5×	1×
3 dB Bandwidth[1]	3.60×	1.48×	1×
Sidelobe Height	<−90 dB	−32 dB	−13 dB
Amplitude Uncertainty	0.10 dB	1.42 dB	3.92 dB
Shape Factor(60 dB BW/3 BW)	2.6	9.1	>300

1 Multiply entry by one-divided-by-sweep time.

Table B-2. HP 8593E Specifications (continued)

AMPLITUDE CHARACTERISTICS			
Log Scale Switching Uncertainty	Negligible error.		
Input Attenuation Uncertainty[1]	(Attenuator Setting 10 to 70 dB)		
Attenuator Setting	**9 kHz to 12.4 GHz**	**12.4 to 19 GHz**	**19 to 22 GHz**
0 dB	±0.75 dB	±1.0 dB	±1.0 dB
10 dB	Reference	Reference	Reference
20 dB	±0.75 dB	±0.75 dB	±1.0 dB
30 dB	±0.75 dB	±1.0 dB	±1.25 dB
40 dB	±0.75 dB	±1.25 dB	±2.0 dB
50 dB	±1.0 dB	±1.5 dB	±2.5 dB
60 dB	±1.5 dB	±2.0 dB	±3.0 dB
70 dB	±2.0 dB	±2.5 dB	±3.5 dB
Input Attenuator 10 dB Step Uncertainty	(Attenuator Setting 10 to 70 dB)		
Center Frequency			
9 kHz to 19 kHz	±1.0 dB/10 dB		
19 GHz to 22 GHz	1.5 dB/10 dB		
Input Attenuator Repeatability	±0.05 dB		
RF Input SWR			
10 dB Attenuation			
300 MHz	1.15:1		
10 dB to 70 dB Attenuation			
9 kHz to 2.9 GHz	1.3:1		
2.75 GHz to 6.5 GHz	1.5:1		
6.0 GHz to 12.8 GHz	1.6:1		
1.4 GHz to 19.4 GHz	2.0:1		
19.1 GHz to 22.0 GHz	3.0:1		

1 Referenced to 10 dB input attenuator setting. See "Frequency Response" in this table.

Table B-2. HP 8593E Specifications (continued)

AMPLITUDE CHARACTERISTICS (cont'd)

DYNAMIC RANGE

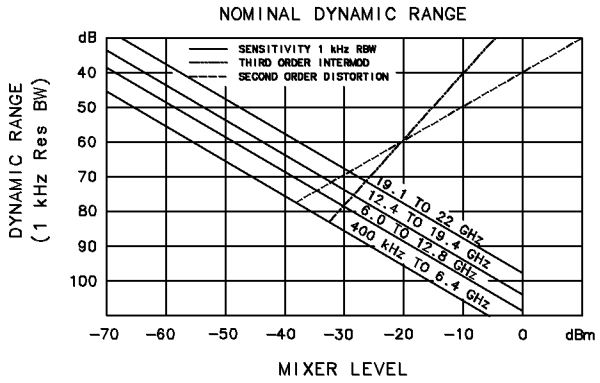

Figure B-1. HP 8593E Dynamic Range

FRONT PANEL INPUT / OUTPUT	
INPUT 50Ω	
Connector	Type N female
Impedance	50Ω nominal
100 MHz COMB OUT	
Connector	SMA female
Output Level	+27 dBm
Frequency	100 MHz fundamental
RF OUT	
Connector	Type N female
Impedance	50Ω nominal
PROBE POWER[1]	
Voltage/Current	+15 V DC, ±7% at 150 mA max
	−12.6 V DC ±10% at 150 mA max

1 Total current drawn from the +15 V DC on the PROBE POWER and the AUX INTERFACE cannot exceed 150 mA. Total current drawn from the −12.6 V DC on the PROBE POWER and the −15 V DC on the AUX INTERFACE cannot exceed 150 mA.

Table B-2. HP 8593E Specifications (continued)

AMPLITUDE CHARACTERISTICS (cont'd)	
REAR-PANEL INPUTS / OUTPUTS	
10 MHz REF OUTPUT	
Connector	BNC female
Impedance	50Ω
Output Amplitude	>0 dBm
EXT REF IN	
Connector	BNC female
	Note: Analyzer noise sideband and spurious response performance may be affected by the quality of the external reference used.
Input Amplitude Range	−2 to +10 dBm
Frequency	10 MHz
AUX IF OUTPUT	
Frequency	21.4 MHz
Amplitude Range	−10 to −60 dBm
Impedance	50Ω nominal
AUX VIDEO OUTPUT	
Connector	BNC female
Amplitude Range	0 to 1 volt (uncorrected)
EARPHONE (Option 102)	
Connector	1/8 inch monaural jack
EXT ALC INPUT	
Input Impedance	>10 kΩ
Polarity	Use with negative detector
EXT KEYBOARD (Option 021/023)	Interface compatible with HP part number C1405 Option ABA and most IBM/AT non-auto switching keyboards.

Table B-2. HP 8593E Specifications (continued)

REAR-PANEL INPUTS / OUTPUTS (cont'd)	
EXT TRIG INPUT	
Connector	BNC female
Trigger Level	Positive edge initiates sweep in EXT TRIG mode (TTL).
HI-SWEEP IN/OUT	
Connector	BNC female
Output	TTL high=sweep, low=retrace
Input	Open collector, low stops sweep.
MONITOR OUTPUT	
Connector	BNC female
Format	
SYNC NRM	Internal Monitor
SYNC NTSC	NTSC Compatible (15.75 kHz horiz. rate, 60 Hz vert. rate)
SYNC PAL	PAL Compatible (15.625 kHz horiz. rate, 50 Hz vert. rate)
REMOTE INTERFACE	
Option 021, HPIB	
HPIB Codes	SH1, AH1, T6, SR1, RL1, PP0, DC1, C1, C2, C3 and C28
SWEEP OUTPUT	
Connector	BNC female
Amplitude	0 to +10 volt ramp

AUX INTERFACE				
Connector Type: 9 Pin Subminiature "D"				
Connector Pinout				
Pin #	Function	Current	"Logic" Mode	"Serial Bit" Mode
1	Control A		TTL Output Hi/Lo	TTL Output Hi/Lo
2	Control B		TTL Output Hi/Lo	TTL Output Hi/Lo
3	Control C		TTL Output Hi/Lo	Strobe
4	Control D		TTL Output Hi/Lo	Serial Data
5	Control I		TTL Input Hi/Lo	TTL Input Hi/Lo
6	Gnd		Gnd	Gnd
7[1]	−15 V DC ±7%	150 mA		
8[2]	+5 V DC ±5%	150 mA		
9[1]	+15 V DC ±5%	150 mA		

1 Total current drawn from the +15 V DC on the PROBE POWER and the AUX INTERFACE cannot exceed 150 mA. Total current drawn from the −12.6 V DC on the PROBE POWER and the −15 V DC on the AUX INTERFACE cannot exceed 150 mA.

2 Exceeding the +5 V current limits may result in loss of factory correction constants.

Table B-3. HP 8593E Option E02 Specifications

These are in addition to the standard HP 8593E Specifications in Table 1-4. All specifications apply over 0°C to +55°C. The analyzer will meet its specifications after 2 hours of storage at a constant temperature within the operating temperature range, 30 minutes after the analyzer is turned on and after CAL FREQ, CAL AMPTD and CAL YTF have been run.	
SPECTRUM ANALYZER	
Frequency Specifications	
Frequency Range Band 1	2.75 GHz to 6.5 GHz
Resolution Bandwidth	
Selectivity of 1 kHz Resolution Bandwidth setting (60 dB:6 dB Ratio)	<13:1
Precision Frequency Reference	
Aging	<±0.10 ppm per year <±0.15 ppm per 2 years
Settability	<±0.01 ppm
Temperature Stability	<±0.01 ppm
Amplitude Specifications	
Spurious Responses	
3-tone intermodulation distortion	Three −30 dBm tones at input mixer with 2.75 MHz separation
10 MHz to 1.5 GHz	<−70 dBc
1.5 GHz to 12 GHz	<−67 dBc
Maximum Dynamic Range	
Signal to TOI distortion −30 dBm input with 0 dB input attenuation	70 dB
Precision Frequency Reference	
Aging	0.005 ppm/day, 7 day average after being turned on for 7 days
Warm-up	±0.01 ppm within 15 minutes of turn-on ±0.1 ppm within 5 minutes of turn-on
Initial Achievable Accuracy	±0.022 ppm within 24 hours of turn-on

Table B-3. HP 8593E Option E02 Specifications (continued)

IF TRACKING GENERATOR The following specifications apply after TRACK PEAK has been run.	
Frequency Range	
Direct	300 kHz to 2.9 GHz
w/Multipath Fading Simulator	40 MHz to 170 MHz
Frequency Span Range	
Direct	Zero span, 10 kHz to 2 GHz, full span
w/Multipath Fading Simulator	Zero span, 10 kHz to 170 MHz
Frequency Accuracy	
Span > 0	±(frequency readout × frequency reference error[1] + span accuracy + 1% of span + 20% of resolution bandwidth + 2 kHz)
Zero Span (CW)	±3 kHz after 15 minute warm-up
Dynamic Range	
Direct	>112 dB
Output Level Range	
Direct	−66 dBm to +1.0 dBm with 50Ω load
w/Multipath Fading Simulator	−50 dBm to +10 dBm with 75Ω load
Output Level Resolution	
Direct	0.01 dB
w/Multipath Fading Simulator	0.1 dB
Output Level Vernier Accuracy[2]	
Incremental	±0.20 dB/dB
Cumulative	±0.50 dB Total
Output Level Absolute Accuracy[2]	
Direct	±0.75 dB referenced to 0 dBm at 300 MHz
w/Multipath Fading Simulator	±2.75 dB

1 Frequency Reference Error = (aging rate × period of time since adjustment + initial achievable accuracy + temperature stability).

2 Referenced to −20 dBm at 300 MHz, 16 dB attenuation, 25°C ±10°C

Table B-3. HP 8593E Option E02 Specifications (continued)

IF TRACKING GENERATOR (cont'd)	
RF Output	
Connector	Type N Female
Impedance	50Ω
Return Loss	>13 dB for attenuation ≥8 dB >6 dB for 0 db attenuation
Maximum safe reverse level without damage	+30 dBm (1 Watt), 30 V DC
Level Flatness, Unnormalized[1]	
Direct	
40 MHz to 300 MHz	±1.5 dB
10 MHz to 2.9 GHz	±2 dB
300 kHz to 10 MHz	±3 dB
Level Flatness, Normalized[2]	
Direct	±0.2 dB
w/Multipath Fading Simulator	±0.05 dB per 40 MHz
Output Attenuator Range	0 to 56 dB in 8 dB step
Output Level Stability	
At constant temperature	
Direct	±0.05 dB per 15 minutes ±0.1 dB per 24 hours
Power Sweep Range	(−10 dBm to −1 dBm) − Source Attenuator Setting
Spectral Purity(−1 dBm output power)	
Residual FM in CW Mode	<500 Hz rms using a 50 Hz to 15 kHz post detection bandwidth
Residual AM in CW Mode	<−60 dBc using a 50 Hz to 15 kHz post detection bandwidth
Spurious (Harmonic and non-harmonic)	
< 400 MHz	< −25 dBc
≥ 400 MHz	< −15 dBc

1 At -20 dBm, referenced to 300 MHz

2 At constant temperature, excluding errors due to mismatch.

Table B-3. HP 8593E Option E02 Specifications (continued)

IF TRACKING GENERATOR (cont'd)	
LO Feedthrough	
3.9217 GHz to 6.8214 GHz	<−16 dBm
Residuals	
300 kHz to 2.9 GHz, SRC PWR off	<−120 dBm
Sweep Time Range	20 ms to 100 s
EVENT COUNTER	
Maximum Pulse Rate	
Driven from open collector TTL with 1 kΩ pull-up	100 kHz
Minimum Pulse Width	
Driven from open collector TTL with 1 kΩ pull-up	1 μs negative, 5 μs positive
Maximum Input Cable Length	25 ft of 75Ω cable
Gate Time	
Range	10 ms to 163 s in 10 ms steps and totalize (continuous)
Accuracy	±0.1%
Event Cntr	
CNTR INPUT	
Max Number of Counts	4×10^9
Resolution	1 count
Interval Cntr	
CNTR INPUT	
Max Number of Counts	4×10^9
Resolution	1 count
Counts total time that INTERVAL CNTR INPUT is low	
Max Interval Time	163 s
Resolution per pulse	2.5 ms
Input Level	TTL, HCMOS, open collector TTL
Maximum Pulse Rate	
Driven from TTL or HCMOS	1.6 MHz
Minimum Pulse Width	
Driven from TTL or HCMOS	300 ns negative or positive

Table B-3. HP 8593E Option E02 Specifications (continued)

EVENT COUNTER (continued)	
Input Impedance	
AC	75 Ω
DC	2 kΩ (pull-up to +5 V)
Maximum Safe Input Level	±15 V
Rear Panel Connectors	
EVENT CNTR INPUT	BNC female
INTERVAL CNTR INPUT	BNC female
FLATNESS ANALYZER when used with HP 8470B Detector	
Frequency Range	10 MHz to 18 GHz
Flatness	±0.05 dB per 40 MHz (normalized) does not include mismatch errors.
Input Level	−30 to +20 dBm at diode detector.
Log Scale	0.1 to 1 dB/div in 0.1 dB steps, 8 divisions displayed.
Return Loss at Diode Detector	
75Ω system	
10 MHz to 2 GHz	>26 dB when used with HP 11981A 75Ω to 50Ω matching pad.
50Ω system	
10 MHz to 4 GHz	>23 dB
4 GHz to 15 GHz	>18 dB
15 GHz to 18 GHz	>15 dB
Rear Panel Connector	
FLATNESS EXT DET IN	BNC female
Maximum Safe Input Level at HP 8470B Detector	200 mW continuous 1 W for <1 min 0 V DC
Maximum Safe Input Level at rear panel connector	
Inner Conductor	±15 V
Outer Conductor	±5 V

Table B-3. HP 8593E Option E02 Specifications (continued)

FLATNESS ANALYZER (continued) when used with HP 8470B Detector		
Display Scale Fidelity 25°C ±10°C Reference level (dBm)	**Log Incremental Accuracy (dB/2dB step)**	**Log Maximum Cumulative (dB)**
−30 to −20.1	0.7	0.7
−20 to +15.9	0.4	0.6
+16 to +20.0	0.8	1.2
Operational Features	"Single button" calibration (normalization) Amplitude Track	
LINK ANALYZER		
Frequency Range	300 kHz to 2.9 GHz	
Frequency Span Range	500 KHz to 100 MHz	
Input Level Receiver/Loopback Modes	−50 dBm to +30 dBm	
Output Level Transmitter/Loopback Modes	−1 dBm to −66 dBm *+2 dBm to −66 dBm (<200 MHz)*	
Baseband Frequencies	55.60 kHz, 66.70 kHz, 83.33 kHz, 92.59 kHz, 200.00 kHz, 250.00 kHz, 277.78 kHz, 500.00 kHz and 555.56 kHz.	
FM Deviation Range Transmitter/Loopback Modes	< 2.1 × BB Frequency (kHz RMS)	
Amplitude Flatness Scale	0.1 dB/div to 2 dB/div	
Group Delay Scale Receiver/Loopback Modes	0.1 ns/div to 50 ns/div (BB Freq = 555 kHz) 0.1 ns/div to 500 ns/div (BB Freq = 55 kHz)	
Spurious (Harmonic and non-harmonic) < 400 MHz ≥ 400 MHz	 < −25 dBc < −15 dBc	
Sweep Time	20 ms	
Sweep Shape	Sawtooth	
Video Averaging	1-100 Samples	

Table B-3. HP 8593E Option E02 Specifications (continued)

LINK ANALYZER (continued)	
Maximum Range	
Amplitude Flatness	16 dB
Group Delay	±2000 ns (BB Freq = 55 kHz) ±200 ns (BB Freq = 555 kHz)
Maximum Sensitivity	
Amplitude Flatness	0.1 dB/div
Group Delay	0.1 ns/div
Residual Flatness (Carrier Frequency = 70/140 MHz ±20 MHz)	
Amplitude Flatness	0.1 dB (Loopback Measurement) *±0.15 dB (End-to-End Measurement)*
Group Delay	0.1 ns (Loopback Measurement) *±0.15 ns (End-to-End Measurement)*
Noise	
Group Delay	0.1 ns rms (Loopback Measurement, BB Freq = 250 kHz, FM Dev = 200 kHz, Video BW = 1 kHz) *0.1 ns rms (End-to-End Measurement, BB Freq = 250 kHz, FM Dev = 200 kHz, Video BW = 1 kHz)*

Table B-3. HP 8593E Option E02 Specifications (continued)

FREQUENCY COUNTER	
Frequency Range	10 MHz to 2.9 GHz (N=1) 2.75 GHz to 6.5 GHz (N=1) 6.0 GHz to 12.8 GHz (N=2) 12.4 GHz to 19.4 GHz (N=3) 19.1 GHz to 22.0 GHz (N=4)
Sensitivity	<−40 dBm
Frequency Measurement Accuracy	±(frequency readout × frequency reference error[1] + counter resolution + 100 Hz ×N[2])
Usable Counter Resolution	5 Hz, 10 Hz, 100 Hz, 1 kHz, 10 kHz
*Front Panel Connector**	
INPUT 50Ω	Type N female
Input Impedance	50Ω
WEIGHT	
Net	
HP 8593E	16.4 kg (36 lb)
Shipping	
HP 8593E	19.1 kg (42 lb)

1 Frequency Reference Error = (aging rate × period of time since adjustment + initial achievable accuracy + temperature stability). The frequency reference is the HP 8593E E02 Spectrum Analyzer Frequency Reference.

2 N=LO Harmonic. See "Frequency Range".

C

Error Messages

Error Messages

This section contains a listing of Spectrum Analyzer and Power Meter messages that may be read from displays of the HP 11758V system. The Multipath Fading Simulator does not display error messages on its liquid crystal display. It will return error messages to an HP-IB controller. See Appendix A of the HP 11757B Multipath Fading Simulator Operating Manual for complete information and instructions.

Spectrum Analyzer Error Messages

The analyzer can generate various messages that appear on its screen during operation to indicate a problem.

There are three types of messages: hardware error messages (H), user-created error messages (U), and informational messages (M).

- Hardware error messages indicate the analyzer hardware is probably broken.
- User-created error messages appear when the analyzer is used incorrectly. They are usually generated during remote operation (entering programming commands using a controller or the external keyboard). See the *HP 8590 Series Spectrum Analyzer Programming Manual* for more information.
- Informational messages indicate the analyzer's progress within a specific procedure.

The messages are listed in alphabetical order on the

following pages; each message is defined, and its type is indicated by an (H), (U), or (M).

ADC-GND FAIL
Indicates a failure in the processor. (H)

ADC-TIME FAIL
Indicates a failure in the processor. (H)

ADC-2V FAIL
Indicates a failure in the processor. (H)

CAL:_ _ _
During the self-calibration routine, messages may appear on the display indicating the routine is progressing: SWEEP, FREQ, SPAN, AMPTD, 3dB BW, ATTEN, LOG AMP, PEAKING, YTF. FREQ UNCAL appears briefly during `CAL FREQ`. This is normal and does not indicate a problem. (M)

CAL: DATA NOT STORED
CAL AMP NEEDED
The correction factors are corrupt and cannot be stored. Perform the `CAL FREQ & AMPTD` routine. (U) (H)

CAL: cannot execute CALAMP
enter: 0 dB PREAMP GAIN
The preamp gain should be set to 0 dB before the CAL AMPTD routine is performed. The preamp gain is set by using `EXT PREAMP`. (U) (H)

CAL: FM SPAN SENS FAIL
The analyzer could not set up span sensitivity of the FM coil. (H)

CAL: GAIN FAIL
Indicates the signal amplitude is too low during the `CAL AMPTD` routine. (H)

CAL: LOST COMB SIGNAL
Indicates the amplitude of the comb generator signal is

insufficient to complete the CAL YTF. Be sure to use a low- loss cable (SMA-to-type N cable) to connect the comb generator output the analyzer input before when using `CAL YTF`. (U) (H)

CAL: NO YTF IN 8590/1
The CAL YTF programming command is available for the HP 8592B and the HP 8593E only. (U)

CAL: NO YTO AVAILABLE
The CAL DLY programming command is no longer necessary. (U)

CAL: PASSCODE NEEDED
Indicates that the function cannot be accessed without the pass code. (M)

CAL: RES BW AMPL FAIL
The relative insertion loss of the resolution bandwidth is incorrect. (H)

CAL SIGNAL NOT FOUND
Indicates the CAL OUT signal cannot be found. Check that the CAL OUT is connected to the analyzer input connector using an appropriate cable. If the CAL OUT signal is connected to the analyzer input but cannot be found, press (FREQUENCY), −37 (Hz) before performing the `CAL FREQ` or `CAL FREQ & AMPTD`. (U) (H)

CAL: SPAN SENS FAIL
The self-calibration span sensitivity routine failed. (H)

CAL: USING DEFAULT DATA
Indicates the calibration data is corrupt and default correction factors are being used. Interruption of the self-calibration routines or an error can cause this problem. (M)

COMB SIGNAL NOT FOUND
The comb signal cannot be found. Check that 100 MHz COMB OUT is connected to the analyzer input.

The comb generator is available with the HP 8592B or HP 8593E only. (U) (H)

COMMAND ERROR:_ _ _
The specified programming command is not recognized by the analyzer. (U)

CONFLICT TABLE OVERFLOW
Indicates that too many two-letter compatible commands have been used. See Table 4-3 in the *HP 8590 Series Spectrum Analyzer Programming Manual* for information about substituting alternate commands for two-letter compatible commands. (U)

CONF TEST FAIL
Indicates that the confidence test failed. (H)

DECR SPAN
Indicates the resolution bandwidth to span ratio is too small to use the marker count function. Check the span and bandwidth settings. (U)

FAIL:_ _ _
An error was discovered during the power-up check. The 4-digit by 10-digit code indicates the type of error. Error codes are described in the analyzer Service Manual. (H).

FREQ UNCAL
Indicates a YTO-tuning failure. This may occur when using default correction factors. Performing the `CAL FREQ` routine may eliminate the failure. The FREQ UNCAL message appears briefly during the `CAL FREQ` routine or when changing the frequency value with the knob (it does not indicate a problem). (U) (H)

INVALID ACTDEF: _ _ _
The specified ACTDEF name is not valid. See the ACTDEF programming command. (U)

INVALID AMPCOR: FREQ
For the AMPCOR command, the frequency data must be in increasing order. See the AMPCOR programming command. (U)

INVALID AUNITS:_ _ _
The amplitude units are not valid. See the AUNITS programming command. (U)

INVALID BLOCK FORMAT: IF STATEMENT
An invalid block format appeared within the IF statement. (U)

INVALID CARD: DIRECTORY
Indicates the memory card has not been formatted. (U)

INVALID CARD: NO CARD
Indicates a memory card has not been inserted. (U)

INVALID CARD
Indicates a card reader is not installed, the memory card is write-protected, the memory card is a read-only card, or a memory card has not been inserted. (U)

INVALID CARD: TYPE
Indicates a card reader is not installed, the memory card is write-protected, the memory card is a read-only card, or a memory card has not been inserted. (U)

INVALID CHECKSUM: USTATE
The user-defined state does not follow the expected format. (U)

INVALID COMPARE OPERATOR
An IF/THEN or REPEAT/UNTIL routine is improperly constructed. Specifically, the IF or UNTIL operands are incorrect. (U)

INVALID DETECTOR: _ _ _
The specified detector is not valid. See the DET programming command. (U)

INVALID ENTER FORMAT
The enter format is not valid. See the appropriate programming command description to determine the correct format. (U)

INVALID FILE: NO ROOM Indicates that there is not enough available space on the memory card to store the data. (U)

INVALID HP-IB ADDRESS/OPERATION
An HP-IB operation was aborted due to an incorrect address or invalid operation. Check that there is only one controller (the analyzer) connected to the printer. (U)

INVALID HP-IB OPERATION REN TRUE
The HP-IB operation is not allowed. (This is usually caused by print/plot when a controller is on the interface bus.) (U)

INVALID ITEM:
Indicates an invalid parameter has been used in a programming command. (U)

INVALID KEYNAME:_ _ _
The specified key name is not allowed. (The key name may have conflicted with an analyzer programming command.) Use an underscore as the second character in the key name, or avoid beginning the key name with the following pairs of letters: LB, OA, OL, TA, TB, TR, MA, MF, TS, OT, and DR. (U)

INVALID OUTPUT FORMAT
The output format is not valid. See the appropriate programming command description to determine the correct format. (U)

INVALID REGISTER NUMBER
The specified trace register number is invalid. (U)

INVALID REPEAT MEM OVFL
Memory overflow occurred due to a REPEAT routine. This occurs if the repeat statements are too long. (U)

INVALID REPEAT NEST LEVEL
The nesting level in the REPEAT routine is improperly constructed. This can occur if too many REPEAT routines are nested. (U)

INVALID SAVEREG
Data has not been saved in the specified state or trace register, or the data is corrupt. (U)

INVALID STORE DEST: _ _ _
The specified destination field is invalid. (U)

INVALID SYMTAB ENTRY: SYMTAB OVERFLOW
There is a symbol table overflow. This can occur if there are too many user-defined items (functions, variables, key definitions) or downloadable programs in analyzer memory. Use `DELETE FILE` or `DISPOSE USER MEM` to delete unnecessary items. This can also occur when the processor board has failed. See the analyzer's Service Manual for more information. (U)

INVALID TRACE: _ _ _
The specified trace is invalid. (U)

INVALID TRACE NAME: _ _ _
The specified trace name is not allowed. Use an underscore as the second character in the trace name, or avoid beginning the trace name with the following pairs of letters: LB, OA, OL, TA, TB, TR, MA, MF, TS, OT, and DR. (U)

INVALID TRIGGER MODE: _ _ _
The specified trigger mode is invalid. See the TM programming command. (U)

INVALID VALUE PARAMETER: _ _ _
The specified value parameter is invalid. (U)

INVALID VARDEF: _ _ _
The specified variable name is not allowed. Use an underscore as the second character in the variable label, or avoid beginning the variable label with the following pairs of letters: LB, OA, OL, TA, TB, TR, MA, MF, TS, OT, and DR. (U)

INVALID WINDOW TYPE: _ _ _
The specified window is invalid. See the TWNDOW programming command. (U)

MEAS UNCAL
The measurement is uncalibrated. Check the sweep time, span, and bandwidth settings. (U)

NO CARD FOUND
Indicates that the memory card is not inserted. (U)

OVEN COLD
Indicates that the analyzer has been powered up for less than 5 minutes. (Option 004 only.) (M)

PARAMETER ERROR: _ _ _
The specified parameter is not recognized by the analyzer. See the appropriate programming command description to determine the correct parameters. (U)

POS-PK FAIL
Indicates the positive-peak detector has failed. (H)

RES-BW SHAPE FAIL
Indicates the 3 dB bandwidth is not within specifications. (H)

REF UNLOCK
Indicates that the frequency reference is not locked to the external reference input. Check that the 10 MHz REF OUT is connected to the EXT REF IN, or that an external 10 MHz reference source is connect to the

EXT REF IN (when using an external reference). (M) (H)

RES-BW NOISE FAIL
Indicates the noise floor level is too high at the indicated bandwidth. (H)

SAMPLE FAIL
Indicates the sample detector has failed. (H)

SOFTKEY OVFL
Softkey nesting exceeds the maximum number of levels. (U)

SRQ _ _ _
The specified service request is active. Service requests are a form of informational message and are explained in Appendix B. (M)

STEP GAIN ATTEN FAIL
Indicates the step gain has failed. (H)

TABLE FULL
Indicates the upper or lower table of limit lines contains the maximum number of entries allowed. Additional entries to the table are ignored. (U)

TG SIGNAL NOT FOUND
Indicates the tracking generator output signal cannot be found. Check that the tracking generator output (RF OUT 50Ω or RF OUT 75Ω) is connected to the analyzer input connector using an appropriate cable. (U)

TG UNLVL
Indicates that the source power is set higher or lower than the analyzer can provide (HP 8591A with Option 010 or 011 only). See "Stimulus-Response Measurements" in Chapter 6 for more information.

UNDEF KEY
A softkey referred to is not recognized by the analyzer. (U)

VID-BW FAIL
Indicates the video bandwidth(s) have failed. (H)

Power Meter Error Messages

Description

The Power Meter generates error messages to indicate operating problems, incorrect HP-IB entries, and service-related problems.

Error messages are grouped as follows:

Errors 01 through 49

These are measurement errors, which indicate that not all conditions have been met to assure a calibrated measurement. Measurement errors can usually be cleared by readjusting the front panel controls or changing the equipment setup.

Errors 50 through 59 and 80 through 99

These are entry errors, which indicate that an invalid HP-IB entry has been made. These errors require that a new HP-IB entry be made.

Errors 60 through 79

These are service errors, which provide service-related information.

Error Displays

Errors 1 through 49, 57, and 80 are indicated by a brief message that appears in the Power Meter's display. See Table 3-2 for an explanation of these errors.

HP-IB Output Format

As long as the front panel display indicates a measurement error, the instrument sends 9.00XXE+40 as the measured data when addressed to talk. XX in the Data message is the error code for that particular error.

If an error condition generates SRQ, the status byte and status message latch the error until the status message (program code SM) has been read by the HP-IB controller. Once the status message has been read, the status byte and status message are cleared if the error condition no longer exists. If multiple errors occur, the status message indicates the most recent error.

If an error condition does not generate SRQ (for example, the Service Request Mask has been set such that measurement or entry errors do not set the status byte's RQS bit true), the status byte and status message latch all entry errors. Measurement errors, however, are latched only if 9.00XXE+40 has been sent over the HP-IB. The status byte and status message are cleared by removing the cause of the error and then reading the status message over the HP-IB.

Power Meter Error Messages

Table 3-2, Error Messages, describes all measurement and entry errors. The error code, front panel error display, message, and action typically required to remove the error-causing condition are given.

Error Message

Table C-2. Power Meter Error Messages

Error Code	Error Display	Message	Action Required
01	CANNOT ZERO	Power Meter cannot zero the sensor	Ensure that no RF power is being applied to the sensor during zeroing
05	CAL ERROR	Power Meter cannot calibrate sensor	Make sure power sensor is connected to a 1 mW 50 MHz source
11	INPUT OVL	Input overload on sensor	Reduce input power to sensor
15	PLEASE ZERO	Sensor's zero reference has drifted negative	Zero sensor. If error persists, check input power
17	UP RANGE	Input power on sensor is too high for current range	Select a higher range, reduce input power to sensor, or use AUTO RNG
21	OVER LIMIT	Power reading over high limit	Check input power at sensor, adjust limit, or disable limit checking function
23	UNDER LIMIT	Power reading under low limit	Check input power at sensor, adjust limit, or disable limit checking function
31	NO SENSOR	No sensor connected to the input	Connect a sensor to the input
33	2 SENSOR ERR	Both front and rear sensor inputs have sensors connected (Option 002 or Option 003 only)	Remove one of the 2 sensors connected to sensor input
		ENTRY ERRORS	
50		Entered cal factor is out of range	Reenter value between 1.0 and 150.0
51		Entered offset is out of range	Reenter value between -99.99 and +99.99

Table C-2. Power Meter Error Messages (continued)

Error Code	Error Display	Message	Action Required
52		Entered range number is out of range	Reenter range number between 0 and 5.
54		Entered recall register number is out of range	Reenter register number between 0 and 10.
55		Entered storage register number is out of range	Reenter register number between 1 and 10
56		Entered reference cal factor is out of range	Reenter CAL value between 50.0 and 120.0
57	RECALL FAIL	RAM ID check failure	Refer to footnote below
		HARDWARE ERRORS	
61–69		Service-related errors	Refer to Service-Related Errors in Service Manual
		ENTRY ERRORS	
80	NO TBL DATA	No calibration data loaded in the selected sensor data table	Enter calibration data into the table for the selected sensor via the SPECIAL key, select a different table, or enter a calibration factor via the CAL FAC key
81		Entered duty cycle value out of range	Reenter duty cycle value between 0.001 and 99.999%
82		Entered frequency value out of range	Reenter frequency value between 100 kHz and 999.9999 GHz

Table C-2. Power Meter Error Messages (continued)

Error Code	Error Display	Message	Action Required
85		Entered resolution is out of range	Reenter resolution number between 1 and 3
86		Sensor table reference calibration factor is out of range	Reenter reference cal factor between 50.0 and 120%
87		Sensor selection out of range	Reenter sensor number between 0 and 9
88		Sensor ID characters invalid	Reenter sensor ID number using only alphanumeric characters (1-9 and A-Z)
90		HP-IB data without valid prefix	Check, then reenter valid prefix with data
91		Invalid HP-IB code	Check, then reenter correct HP-IB code
92		Event status enable mask out of range	Reenter status enable mask value
93		SRQ mask value out of range	Reenter mask value between 0 and 255

Error 57 occurs when the instrument is turned on on and the internal RAM contents have been lost. This is generally due to battery failure, but may also occur when the Power Meter executes the self test function or is powered down during the end of a zero or calibration sequence. The error indication is cleared after two seconds or by selecting another function (the selected function will be executed). Once the error indication is cleared, the Power Meter is configured in the PRESET state.

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