Agilent Technologies

8510XF Network Analyzer Systems

E7340A & E7342A (2 to 85 GHz)
E7350A & E7352A (2 to 110 GHz)

Operating and Service Manual

Agilent Part Number: E7350-90001
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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. This document still includes references to Hewlett-Packard products, some of which have been transitioned to Agilent Technologies.

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What You'll Find in This Manual…

Chapter 1
- Introduction to the 8510XF

Chapter 2
- How to install the system

Chapter 3
- How to use the system to make measurements

Chapter 4
- How to verify the performance of the system

Chapter 5
- How to maintain the system

Chapter 6
- How to order replacement parts

Chapter 7
- How to find information about menus, softkeys, and commands

Warranty

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Taiwan *(tel)* 0800-047-866 *(fax)* (886) 2 25456723	**People's Republic of China** *(tel) (preferred):* 800-810-0189 *(tel) (alternate):* 10800-650-0021 *(fax)* 10800-650-0121	**India** *(tel)* 1-600-11-2929 *(fax)* 000-800-650-1101	

Safety and Regulatory Information

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. This product has been designed and tested in accordance with international standards.

WARNING

The WARNING notice denotes a hazard. It calls attention to a procedure, practice, or the like, that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

CAUTION

The **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

Instrument Markings

	When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.
	This symbol indicates hazardous voltages.
	The laser radiation symbol is marked on products that have a laser output.
	This symbol indicates that the instrument requires alternating current (ac) input.
	The C-Tick mark is a registered trademark of the Australian Spectrum Agency.
	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.
	The CSA mark is a registered trademark of the Canadian Standards Association.
1SM1-A	This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).
	This ISM device complies with Canadian ICES-001. Cet apppareil ISM est conforme a la norme NMB du Canada.
	This symbol indicates that the power line switch is ON.
	This symbol indicates that the power line switch is OFF or in STANDBY position.

Safety Requirements

This product has been designed and tested in accordance with the IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and maintain the product in a safe condition.

Safety Earth Ground

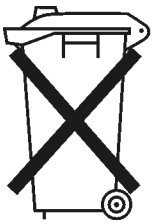
This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired,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

Before Applying Power

Verify that the product is configured to match the available main power source as described in the input power configuration instructions in this manual. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

WARNING

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturers's instructions.



DO NOT THROW BATTERIES AWAY BUT
COLLECT AS SMALL CHEMICAL WASTE.

NOTE

Please refer to the *8510C On-Ssite Service Manual* for additional information (part number 08510-90282).

Typeface Conventions

Italics

- Used to emphasize important information:
  Use this software *only* with the xxxxxX system.
- Used for the title of a publication:
  Refer to the *xxxxxX System-Level User's Guide*.
- Used to indicate a variable:
  Type `LOAD BIN` *filename*.

`Instrument Display`

- Used to show on-screen prompts and messages that you will see on the display of an instrument:
  The xxxxxX will display the message **`CAL1 SAVED`**.

[Keycap]

- Used for labeled keys on the front panel of an instrument or on a computer keyboard:
  Press **[Return]**.

{Softkey}

- Used for simulated keys that appear on an instrument display:
  Press ***{Prior Menu}***.

`User Entry`

- Used to indicate text that you will enter using the computer keyboard; text shown in this typeface must be typed *exactly* as printed:
  Type `LOAD PARMFILE`
- Used for examples of programming code:

```
#endif // ifndef NO_CLASS
```

`Path Name`

- Used for a subdirectory name or file path:
  Edit the file *`usr/local/bin/sample.txt`*

Computer Display

- Used to show messages, prompts, and window labels that appear on a computer monitor:
  The **Edit Parameters** window will appear on the screen.
- Used for menus, lists, dialog boxes, and button boxes on a computer monitor from which you make selections using the mouse or keyboard:
  Double-click **EXIT** to quit the program.

Compliance with Standards

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrerordnung –3.GSGV Deutschand).

Acoustic Noise Emission/Geraeuschemission	
LpA <70 dB Operator position Normal position per ISO 7779	LpA <70 dB am Arbeitsplatz normaler Betrieb nach DIN 45635 t.19

Compliance with EEC Directives

See the declaration of conformity on the following page.

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

Manufacturer's Name:	Agilent Technologies, Inc.
Manufacturer's Address:	1400 Fountaingrove Parkway Santa Rosa, CA 95403-1799 USA

Declares that the products

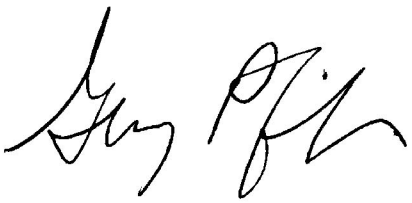
Product Name:	8510XF Single Sweep Systems
Model Number:	E7340A, E7342A, E7345A, E7346A, E7347A, E7350A, E7352A, E7355A, E7356A, E7357A
Product Options:	This declaration covers all options of the above products.

Conform to the following product specifications:

	Standard	Limit
EMC:	CISPR 11:1990 / EN 55011-1991	Group 1, Class A
	IEC 801-2:1984/EN 50082-1:1992	4 kV CD, 8 kV AD
	IEC 801-3:1984/EN 50082-1:1992	3 V/m, 80 - 1000 MHz
	IEC 801-4:1988/EN 50082-1:1992	0.5 kV sig., 1 kV power

Safety: IEC 61010-1:1990 + A1:1992 + A2:1995 / EN 61010-1:1993 +A2:1995
CAN/CSA-C22.2 No. 1010.1-92

Supplementary Information:
The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 14 Feb. 2001

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

Contents

1 Introduction

In This Chapter...

Finding System Information

Sources of Information

Documents provided with the 8510XF include the following:

Table 1-1 Documents Supplied with the System

Document	Part Number	Description
8510XF Operation and Service Manual	E7350-90001	8510XF system manual
8510C Network Analyzer Manuals set 08510-90275 includes:		
8510C Operating and Programming Manual	08510-90281	A detailed operator's guide to the 8510C network analyzer
8510C Introductory User's Guide	08510-90290	A brief introduction to functions, menus, and measurement setups for the 8510C network analyzer
8510C Quick Reference Guide	08510-90292	An abbreviated, pocket-sized guide to codes, commands, and menu maps for the 8510C network analyzer
8510C Keyword Dictionary	08510-90280	A thorough presentation of codes, commands, and menu maps for the 8510C network analyzer
8510C On-Site Service Manual	08510-90282	A detailed guide to maintenance and troubleshooting for the 8510C network analyzer
8360 Series Dedicated Source Manual set 08360-90138 includes:		
83651B & 83621B Manuals	08360-90136 08360-90137	Troubleshooting and service manuals for the RF source and LO source

Another important document is the Operating and Service Manual for the 85059A 1.0 mm Precision Calibration and Verification Kit (the Agilent part number of the manual is 85059-90003).

Where to look

The following table shows where to look first (and second) for particular kinds of information.

Table 1-2 Primary and Secondary Information Sources

Subject	First Source	Other Sources
Installing the system	Chapter 2 of this manual	Chapter 9, *8510C On-Site Service Manual*
Using menus	Chapter 3 of this manual (also see Chapter 7 for menu maps)	Chapter 4, *8510C Operating and Programming Manual*
Using system functions	Chapter 3 of this manual	Chapter 5, *8510C Operating and Programming Manual*
Measurement calibration	Chapter 3 of this manual	Chapter 8, *8510C Operating and Programming Manual*
Verifying performance	Chapter 4 of this manual	Chapter 8, *8510C On-Site Service Manual*
Maintenance	Chapter 5 of this manual	Chapters 7 & 10, *8510C On-Site Service Manual* Also: Supplement to *8510C Operating and Programming Manual* (“Operator’s Check and Routine Maintenance”)
Ordering replacement parts	Chapter 6 of this manual	Chapter 5, *8510C On-Site Service Manual*
GPIB programming	Chapter 7 of this manual	Chapter 13, *8510C Operating and Programming Manual* Also: *8510C Quick Reference Guide* Also: *8510C Keyword Dictionary*
Basics of network analysis	*8510C Introductory User’s Guide*	Chapter 3, *8510C Operating and Programming Manual*
Types of measurement	*8510C Operating and Programming Manual*: • Chapter 9 (Transmission) • Chapter 10 (Reflection) • Chapter 11 (Time Domain) • Chapter 12 (Power Domain)	Chapter 3 of this manual
Printing & plotting	Chapter 6, *8510C Operating and Programming Manual*	
Using the disk drive	Chapter 7, *8510C Operating and Programming Manual*	

8510XF Network Analyzer Systems

The 8510XF is a vector network analyzer with an extremely wide frequency range. It is available in two basic versions, with frequency ranges of 2 to 85 GHz and 2 to 110 GHz. Both ranges can be optionally extended downward to 45 MHz.

The 8510XF uses the same test port connections throughout its entire range of test frequencies. It is never necessary to make and break connections in order to complete a test.

The illustration below shows the 8510XF configured for coaxial measurement; the system can also be configured for on-wafer measurement using a wafer probe test station.

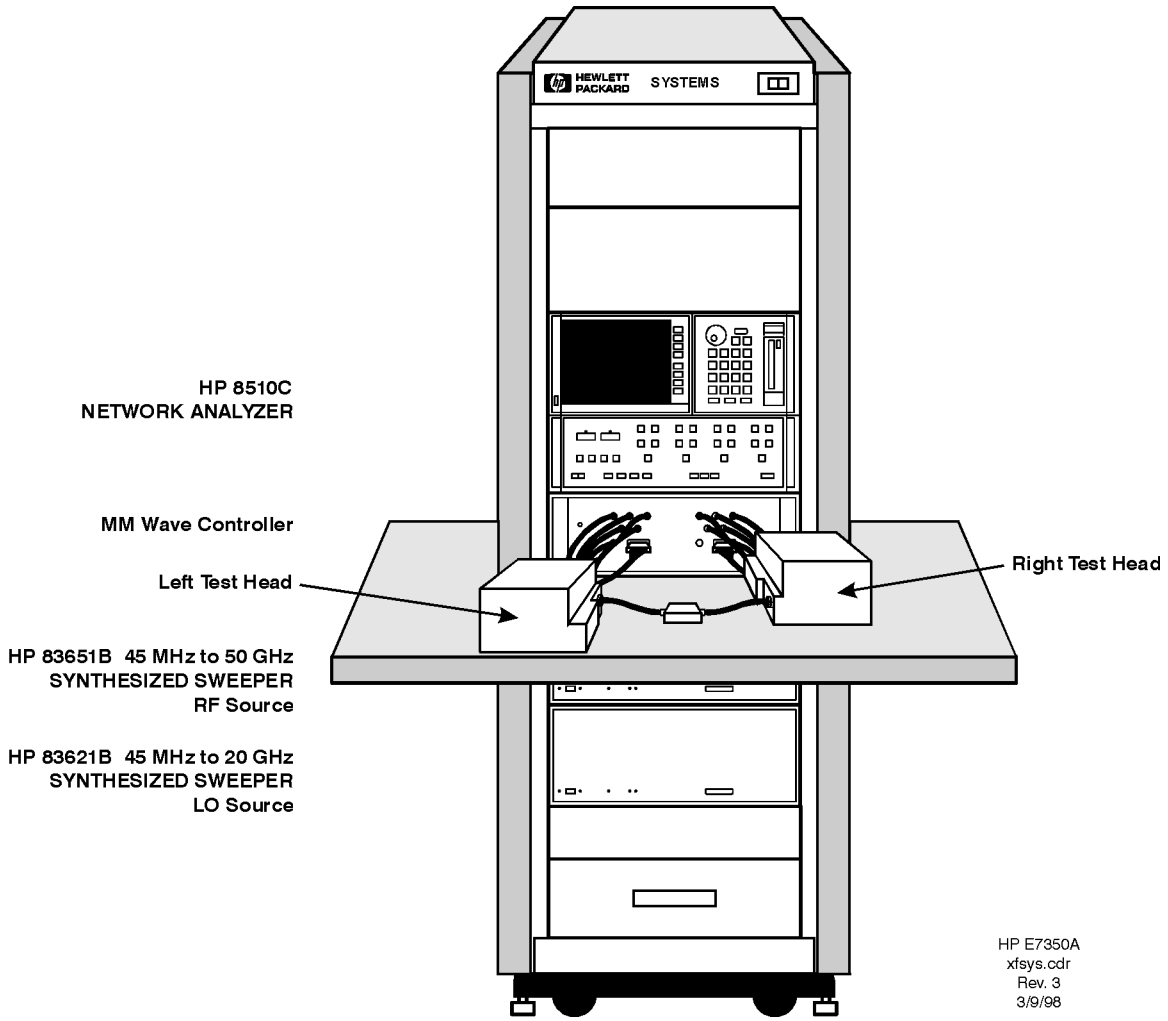


Figure 1-1 8510XF Network Analyzer System

System Description

Two Versions of the 8510XF

The system is available in two basic versions, distinguished by their upper frequency limits. The 85 GHz version is ordered as E7340A; the 110 GHz version is ordered as E7350A.

What's Included

The major components of the 8510XF system are:

- Network analyzer, 8510C
- Synthesized RF source, 83651B
- Synthesized LO source, 83621B
- Millimeter-wave controller, E7341A
- Left test head, E7342L (85 GHz) or E7352L (110 GHz)
- Right test head, E7342R (85 GHz) or E7352R (110 GHz)
- 1.6 meter instrument rack (E3661A)

Frequency Limits

As the list above indicates, the upper frequency limit of the system is determined by the type of test head that is included in it.

The lower frequency limit of an 8510XF system is normally 2 GHz. With Option 005 installed, the lower frequency limit is 45 MHz. (See "Options" on page 1-8.)

Partial Systems

Customers who already have the network analyzer and the sources can order partial systems which omit those items. The partial systems are known as millimeter-wave subsystems; the 85 GHz version is ordered as E7342A, and the 110 GHz version is ordered as E7352A.

In addition, 8510XF upgrade kits are available for other Agilent test systems (see "Upgrade Paths" on page 1-10).

Coaxial Configuration

When the 8510XF is configured for measurement through coaxial connections, the network analyzer, the millimeter-wave controller, and the RF and LO sources are all installed in the rack. The test heads are placed on a work surface which is mounted below the millimeter-wave controller.

The test ports feature 1.0 mm coaxial connectors. The device under test is typically connected to one test port directly, and to the other test port by way of a coaxial cable (or it is connected to the ports through two coaxial cables).

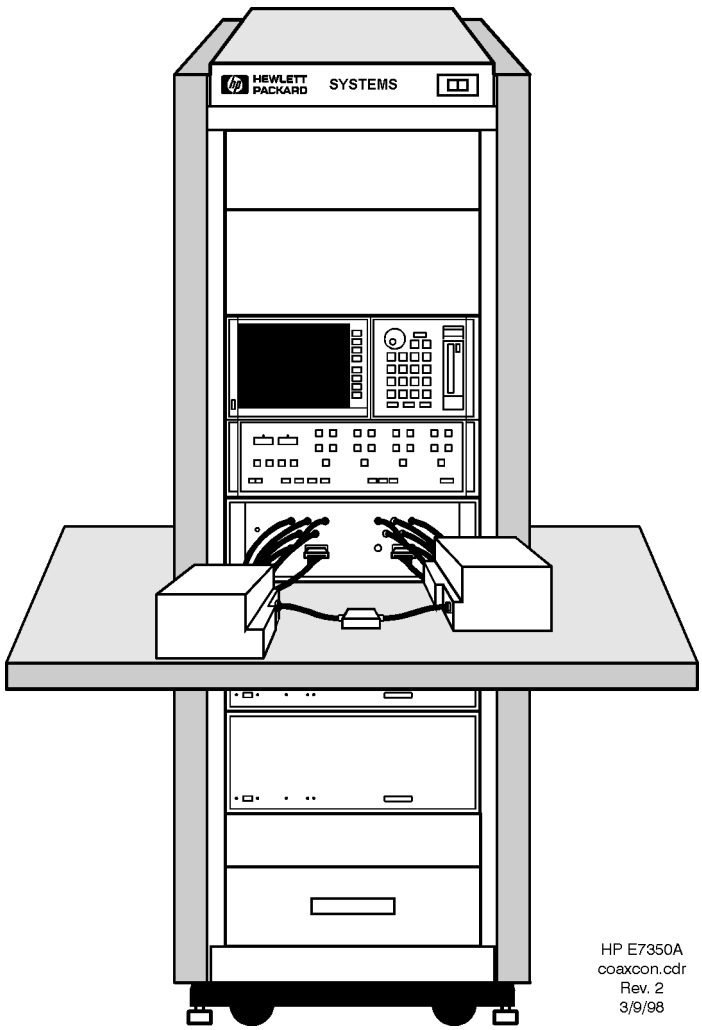


Figure 1-2 8510XF, Configured for Coaxial Measurement

Wafer Probe Configuration

For on-wafer measurements, it is usually best to remove the network analyzer from the instrument rack, and place it on a table adjacent to the probe station. This makes it easy to see and operate the analyzer.

No wafer probe station is supplied with the system; the illustration below simply shows how the 8510XF combines with a typical probe station to create an on-wafer measurement system.

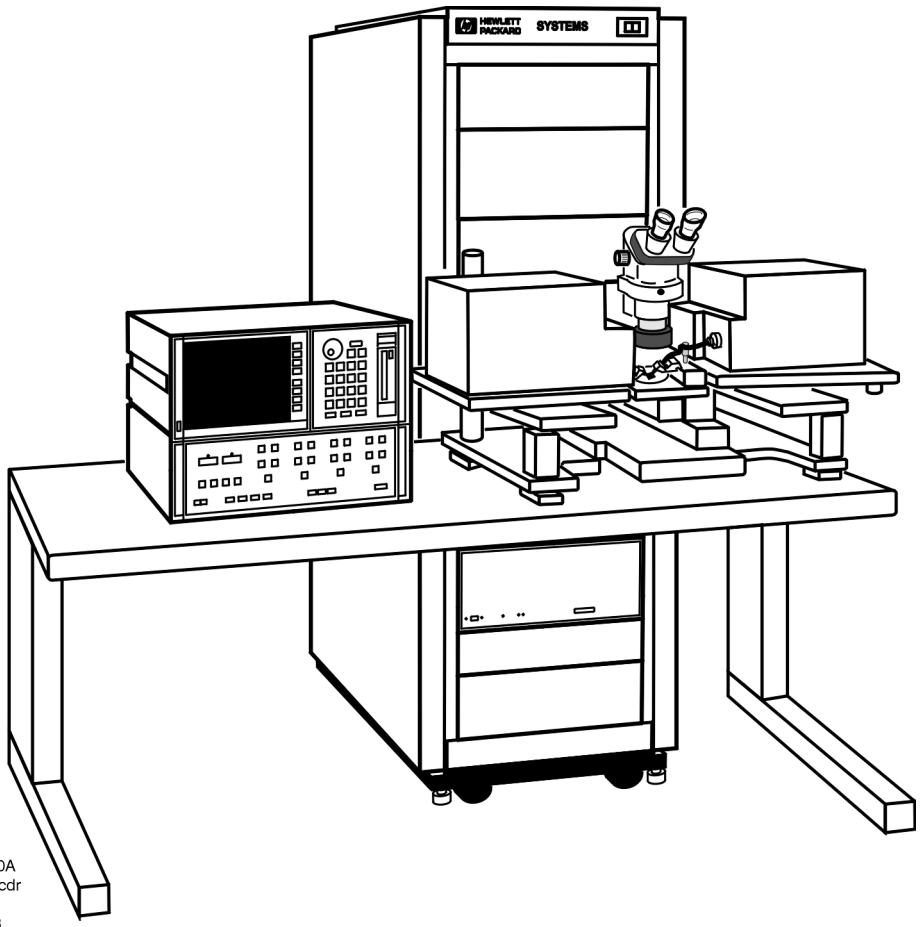


Figure 1-3 8510XF, Configured for Wafer-Probe Measurement

Options

Option 005 (45 MHz to 2 GHz)

This option extends the lower limit of the 8510XF frequency range downward to 45 MHz. The option is implemented by adding four low-frequency mixers, which are dedicated to the .045 to 2 GHz frequency range. These mixers are installed in the millimeter-wave controller.

Option 006 (RF Passthrough)

This option adds a coupler, amplifier, and RF output connector to the millimeter-wave controller. The purpose is to make the RF input to the controller (which is supplied by the 83651B RF source) available as an output, so that it can be routed to other devices or test sets.

The RF output on the rear panel of the millimeter-wave controller is a 2.4 mm coaxial connector. To supply this RF output to another test set, you will need a 2.4 mm coaxial cable of adequate length (this cable is not supplied with the 8510XF).

The system is shipped with a 50 Ω load attached to the RF output connector.

NOTE

The 8510XF firmware does not support multiple test sets. In order to use the Option 006 RF output as the RF source for another test set, you must load the standard 8510C firmware (from a diskette which is supplied with the 8510XF).

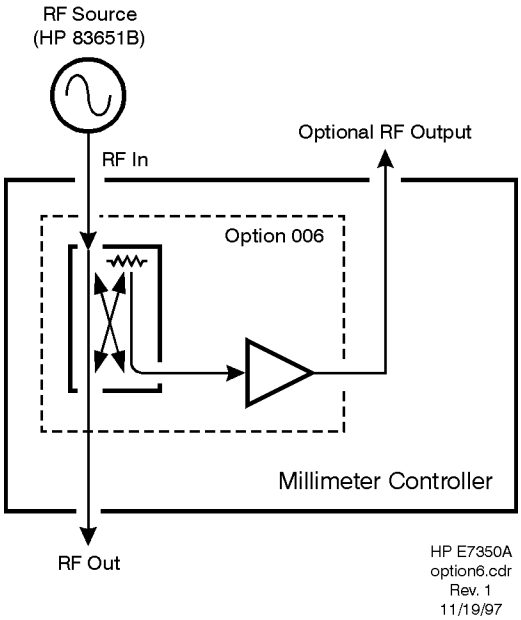


Figure 1-4 Option 006

Option 010 (Time Domain)

This option makes it possible to use the 8510XF in time domain mode. The option is implemented through modification of the network analyzer operating system.

NOTE

Option 010 is available only for complete systems (E7340A and E7350A).

Option 230 (Line Voltage)

This option configures the 8510XF for 220/240 line voltage operation.

Upgrade Paths

Kits are available for upgrading another type of 8510C test system to an 8510XF system, as described below.

Upgrade Kits for the 85107A/B

An 85107A/B can be upgraded to an 8510XF, in either the 110 GHz version (upgrade kit E7355A) or the 85 GHz version (upgrade kit E7345A).

Table 1-3 Contents of Upgrade Kits for the 85107A/B

Item	Part#
Millimeter-wave controller	E7341A
Left test head	E7342L (85 GHz) or E7352L (110 GHz)
Right test head	E7342R (85 GHz) or E7352R (110 GHz)
LO source	83621B
Rack flange kit for LO source	83621B #913
8510XF operating & service manual	E7350-90001
E7345A/E7355A upgrade kit installation manual	E7350-90003
8510XF system software on diskette	E7340-10001
8 chips for expanding non-volatile memory in the 8510C	1818-4075

NOTE

The upgrade kits for the 85107A/B can also be used for an 85109C system which lacks Option 002. To upgrade an 85109C *with* Option 002, see the upgrade kit described on page 1-12).

Upgrade Kits for the 85106C/D

An 85106C/D can be upgraded to an 8510XF, in either the 110 GHz version (upgrade kit E7356A) or the 85 GHz version (upgrade kit E7346A).

Table 1-4 Contents of Upgrade Kits for the 85106C/D

Item	Part#
Millimeter-wave controller	E7341A
Left test head	E7342L (85 GHz) or E7352L (110 GHz)
Right test head	E7342R (85 GHz) or E7352R (110 GHz)
RF source	83651B
Rack flange kit for RF source	83651B #913
8510XF operating & service manual	E7350-90001
E7346A/E7356A upgrade kit installation manual	E7350-90004
8510XF system software on diskette	E7340-10001
8 chips for expanding non-volatile memory in the 8510C	1818-4075

Upgrade Kits for the 85109C (With Option 002)

An 85109C with Option 002 can be upgraded to an 8510XF, in either the 110 GHz version (upgrade kit E7357A) or the 85 GHz version (upgrade kit E7347A).

Table 1-5 Contents of Upgrade Kits for the 85109C

Item	Part#
Millimeter-wave controller	E7341A
Left test head	E7342L (85 GHz) or E7352L (110 GHz)
Right test head	E7342R (85 GHz) or E7352R (110 GHz)
8510XF operating & service manual	E7350-90001
E7347A/E7357A upgrade kit installation manual	E7350-90005
8510XF system software on diskette	E7340-10001
8 chips for expanding non-volatile memory in the 8510C	1818-4075

NOTE

To upgrade an 85109C which lacks Option 002, see the upgrade kit described on page 1-10.

2 Installation

In This Chapter...

Site Preparation

Power Requirements

Before installing the system, be sure that the required ac power is available at all necessary locations.

- Three-wire power cables (which provide a safety ground) must be used with all instruments.
- Air-conditioning equipment (or other motor-operated equipment) should not be placed on the same ac line that powers the system.
- The table below lists the maximum VA ratings and BTU/hour ratings for all instruments in the system. This table can be used to determine both the electrical requirements and the air conditioning requirements of the system.

Table 2-1 Power requirements of the system

Standard Equipment		
Instrument	**Maximum VA Rating**	**Maximum BTU/hour**
85101C display processor	250	850
85102B IF detector	210	714
83621B synthesized source (LO)	400	1360
83651B synthesized source (RF)	400	1360
E7341A millimeter-wave controller	500	1700
E7342L left test head (85 GHz) or E7352L left test head (110 GHz)	(powered from controller)	(powered from controller)
E7342R right test head (85 GHz) or E7352R right test head (110 GHz)	(powered from controller)	(powered from controller)
Total	1760	5984

NOTES:
(1) Values are based on 120 Vac supplied to each instrument at 60 Hz.
(2) The millimeter-wave controller supplies power to the test heads.

Environmental Requirements

The environmental requirements of the system are listed in the table below. Note that these requirements are the same as those of the 8510C Network Analyzer.

Table 2-2 Environmental Requirements

Temperature (Operation)	5 °C to 40 °C (41 °F to 104 °F)
Temperature (Storage)	–40 °C to +65 °C (-40 °F to +158 °F)
Temperature (Measurement Calibration)	20 °C to 26 °C (68 °F to 79 °F)
Temperature (Performance Verification)	Temperature must be within 1 °C (1.8 °F) of the temperature at which the measurement calibration was performed.
Relative Humidity (Operation)	5% to 95% at 40 °C or less (non-condensing)
Relative Humidity (Storage)	5% to 95% at 65 °C or less (non-condensing)
Pressure Altitude (Operation or Storage)	Less than 4600 meters (~15,000 feet)

System heating and cooling

Install air conditioning and heating, if necessary to maintain the ambient temperature within the appropriate range (as given in the table above). Air conditioning capacity must be consistent with the BTU ratings given in the table under “Power Requirements” on page 2-2.

Required conditions for accuracy-enhanced measurement

Accuracy-enhanced (error-corrected) measurements require the ambient temperature of the 8510XF to be maintained within ±1°C of the ambient temperature at calibration.

Weight and dimensions

The table below shows the maximum weight and dimensions of the 8510XF system, as installed in the system rack, with the test heads on an attached work surface.

Table 2-3 System Weight and Dimensions

Weight	Height	Width	Depth
280.3 kg (618 lbs)	162 cm (63.8 in)	Rack only: 60 cm (23.6 in) Plus work surface: 100 cm (39.4 in)	Rack Only: 90.5 cm (35.6 in) Plus work surface: 145.4 cm (57.3 in)

The table below shows the weight and dimensions of a single test head (left or right):

Table 2-4 Test Head Weight and Dimensions

Test Head Model	Weight	Height	Width	Depth
E7342 L/R	9.07 kg (20 lb)	18.5 cm (7.3 in)	24.7 cm (9.7 in)	31.4 cm (12.4 in)
E7352 L/R	9.75 kg (21.5 lb)	18.5 cm (7.3 in)	24.7 cm (9.7 in)	31.4 cm (12.4 in)

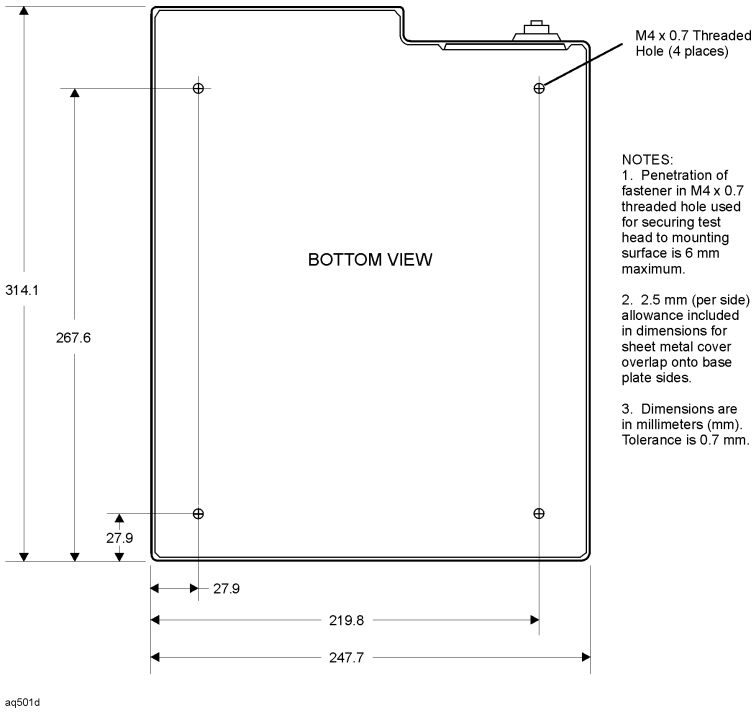


Figure 2-1 Testhead Footprint Dimensions for Mounting (left or right)

Receiving the System

The System as Shipped

The 8510XF system will arrive with all rack components and instruments installed and cabled in the system cabinet. The system cabinet is shipped upright in a special crate (as illustrated in “Unpacking the System” on page 2-11). The work surface is included in the system cabinet packaging. The test heads are packaged separately from the system cabinet, in two padded cartons.

When the entire shipment has arrived, contact your nearest Agilent Technologies office to arrange for system installation, if installation is available in your area (see “Contacting Agilent”).

Agilent Technologies Customer Engineering

An Agilent Technologies Customer Engineer will be assigned to help you install the system. During installation, the Customer Engineer will do the following:

- Uncrate the system cabinet (see “Unpacking the System” on page 2-11).
- Complete the system checklist (see “System Checklists” on page 2-7).
- Assemble the work surface and connect it to the system cabinet.
- Install the test heads.
- Verify that the GPIB addresses are set properly and power up the system.
- Run a performance verification of the system, which includes a measurement calibration.
- Provide user training for one engineer.

In Case of Problems with the Shipment

If the shipment is damaged or incomplete, notify the nearest Agilent Technologies office. If the shipping container is damaged or the packaging material shows signs of stress, notify the carrier as well as the Agilent Technologies Customer Engineer. Keep the shipping materials for the carrier’s inspection. Agilent Technologies will arrange for repair or replacement of damaged equipment without waiting for a claim settlement from the carrier.

Shipping Containers

Keep the shipping containers in one area until the system checklist has been completed. This makes it easier to verify that everything ordered has been shipped.

Keep the containers, and all packing materials, until the entire shipment has been verified for completeness, and the system has been checked mechanically and electrically. The crate may be used one more time *only* to ship the 8510XF cabinet.

If you need to ship your 8510XF system, repackage it in its original shipping crate. Make all surface shipments via padded van with an air suspension ride.

CAUTION

Regardless of the crate style, *all surface shipments must be made via padded van (air suspension ride)*. Surface shipments in vehicles without air suspension may result in damage to the system components, cabinet, and shipping crate.

System Checklists

Use the tables below to verify that the shipment is complete. These are items that are supplied (as indicated below) with E7340A or E7350A complete systems only. For a list of items supplied with upgrade kits see "Upgrade Paths" on page 1-10 through page 1-12.

Standard Items

Items that are supplied with all 8510XF (E7340A or E7350A) systems are listed in Table 2-5.

Table 2-5 8510XF System Checklist (Standard Items)

✔	Equipment	Serial Number
	8510C network analyzer	
	83621B synthesized source (LO source), with 83621B #913 rack flange kit	
	83651B synthesized source (RF source), with 83651B #913 rack flange kit	
	Millimeter-wave controller & test heads -- see "Optional/Variable Items" on page 2-8	See page 2-8
	E3661A system rack (1.6 meter)	
	Cables (for a complete list of cables supplied with the system, see "Cable List" on page 2-32).	N/A
	E7340-10001 (8510XF firmware diskette)	N/A
	System manual: 8510XF Operating and Service Manual, E7350-90001	N/A
	Network analyzer manuals: 8510C Manual set 08510-90275	N/A
	Source manuals: 83651B & 83621B Manual set 08360-90138	N/A

Optional/Variable Items

Table 2-6 lists those items that are supplied only if the applicable frequency range or option has been ordered with the 8510XF (E7340A or E7350A) system.

Table 2-6 8510XF System Checklist (Optional/Variable Items)

✔	Equipment	Included In	Serial Number
	Left test head:		
	E7342L	Systems to 85 GHz	
	E7352L	Systems to 110 GHz	
	Right test head:		
	E7342R	Systems to 85 GHz	
	E7352R	Systems to 110 GHz	
	Millimeter-wave controller:		
	E7341A	Systems without options	
	E7341A #005	Systems with Option 005	
	E7341A #006	Systems with Option 006	
	E7341A #056	Systems with Options 005 & 006	
	8510C #010 (time domain option for network analyzer)	Systems with Option 010	
	85106-60038 (1 meter table top)	E7340A and E7350A complete systems	N/A

Precautions

Safe Installation

Install the system so that the ON/OFF switch is readily identifiable and is easily reached by the operator. The ON/OFF switch or the detachable power cord is the system disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the system. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

Install the system according to the enclosure protection provided:

- The system protects against finger access to hazardous parts within the enclosure.
- The system does not protect against the ingress of water.

CAUTION

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

CAUTION

Always use the three-prong ac power cord supplied with this product. Failure to insure adequate earth grounding by not using this cord may cause product damage.

CAUTION

Before switching on the system, make sure that the correct fuse is installed, and that the supply voltage is in the specified range.

CAUTION

Ventilation requirements:
Convection in and out of the system cabinet must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the system by 4°C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

WARNING

This is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). 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 the product is likely to make the product dangerous. Intentional interruption is prohibited.

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

Electrostatic Discharge

CAUTION The millimeter-wave controller and the test heads are sensitive to electrostatic discharge (ESD). Ground your work station before unpacking and installing the test heads. See "Electrostatic Discharge" on page 5-2 for more information.

System Voltages

All instruments in the 8510XF system must be set to the same voltage as the system rack (either 120 Vac or 220 Vac). 120 Vac is the factory setting.

CAUTION The cabinet fans may be permanently damaged if a 120V system is plugged into a 220V ac power outlet. The cabinet fans can be wired for either 120V or 220V, but not both. Therefore, a system wired for 120V operation cannot be switched to 230V operation simply by changing the voltage selection switches on individual instruments.

Test Port Inputs

CAUTION Input power to the test ports must not exceed +27 dBm. Input power in excess of this level will damage expensive components. Observe proper precautions, especially when measuring amplifiers with gains of 20 dB or greater.

Cleaning

WARNING **To prevent electrical shock, disconnect the E734X/E735X mains before cleaning. Use a dry cloth or one slightly dampened with water to clear the external case parts. Do not attempt to clean internally.**

Unpacking the System

Tools Required

- 9/16 inch wrench or adjustable-end wrench
- Screwdriver (to pry off packing clamps)

CAUTION

When you remove the clamps from the packing crates, be careful not to bend them; they may be reused when the system is repacked.

Figure 2-2 The Outer Packing Crate

NOTE

The figures show a double rack crate. The unpacking procedure is essentially the same for either a single rack or a double rack crate (differences will be noted where they occur).

Figure 2-3 Removing the Outer Packing Crate

WARNING **Always wear safety glasses when removing the clamps and other packing materials from the crates.**

Remove the outer packing crate

1. Remove the clamps holding the packing crate top cover in place. Remove the top cover and set it aside.
2. Remove the clamps holding the first packing crate wall in place. It does not matter which wall you remove first.
3. Remove the other walls. Make sure you have people holding the last two walls in place when you remove the last set of clamps.
4. Set the loading ramp aside for now.

NOTE In double-rack crates, the heaviest wall is the loading ramp. In single rack crates, the loading ramp is shipped inside the package, placed on top of the rack (it is a hinged assembly, shipped in the folded position).

Figure 2-4 Removing the Foam Cover and Plastic Wrapping

Remove the top cover and plastic wrapping

1. Remove the foam top cover. Save the cover for possible future use.
2. Remove the plastic wrapping from the system.

Figure 2-5 Removing the Bolts

Figure 2-6 Removing the Anchor Bolt

Figure 2-7 Replacing the Anchor Bolt

Unload the system

1. Pull out the two bolts (item A) from the base using a screwdriver or pliers. See Figure 2-5 on page 2-14.
2. Remove the brace assembly (item B).
3. Lift the hinged slat (item C) and remove the ramp anchor bolt (item D). See Figure 2-6 on page 2-14.
4. Place one end of the ramp on the ramp ledge. See Figure 2-7 above.
5. Insert the ramp anchor bolt and fold down the hinged slat. To secure the ramp, you may place long wood screws through the ramp and into the ramp edge.
6. Fold down the ramp's end flap (item E).

WARNING

A racked system is tall and top-heavy. It is easy to tip the rack over while moving it, which could result in personal injury or death. Unloading the system safely requires the participation of four persons, and they must exercise care to prevent the rack from tipping over.

Figure 2-8 Moving the System Down the Ramp

7. Make sure the leveling feet are fully retracted and that the cabinet casters are rolling freely.

WARNING **Do not stand in front of the rack as it rolls down the ramp.**

8. Roll the system down the ramp using extreme care.
9. In case you must move the system in the future, you can retain and reuse these packing materials or you can purchase replacement packing materials from Agilent Technologies.

Basic System Configurations

The 8510XF can be used in either of two basic configurations, depending on the means by which the test ports are connected to the device under test.

Coaxial measurement

This configuration is used when the device under test has coaxial connectors. The 8510XF test ports have 1.0 mm coaxial connectors, designed to cover a frequency range of 45 MHz to 110 GHz.

In this configuration, the test heads are placed on a work surface which is attached to the instrument rack, slightly below the millimeter-wave controller.

The device under test is normally connected to the test ports by way of coaxial cables. It is also possible to connect the device to one test port directly, and to the other test port by way of a coaxial cable.

CAUTION

Do not attempt to connect a test device directly between the two test ports, without cables. The test heads will not move freely enough to allow such a connection to be made safely.

Wafer probe measurement

This configuration is used for on-wafer testing; each test port is connected (through a 1.0 mm coaxial cable, or through an adapter and another type of coaxial cable) to a wafer test probe. Contact the manufacturer of the wafer probe station and an Agilent office for information on the cables and adapters needed to connect the test heads to the wafer probe station (refer to “Contacting Agilent” on page -v).

In this configuration, the test heads are placed on X-Y positioners that are mounted to the wafer probe station.

It is usually best to remove the 8510C from the rack, and place it on the work surface beside the probe station; this makes it easier to see the network analyzer’s display and to reach its front panel controls.

Coaxial Configuration

Figure 2-9 shows how the instruments are installed in the rack for the coaxial configuration. The test heads (which are placed on the work surface) are omitted here, in order to give an unobstructed view of the rack instruments.

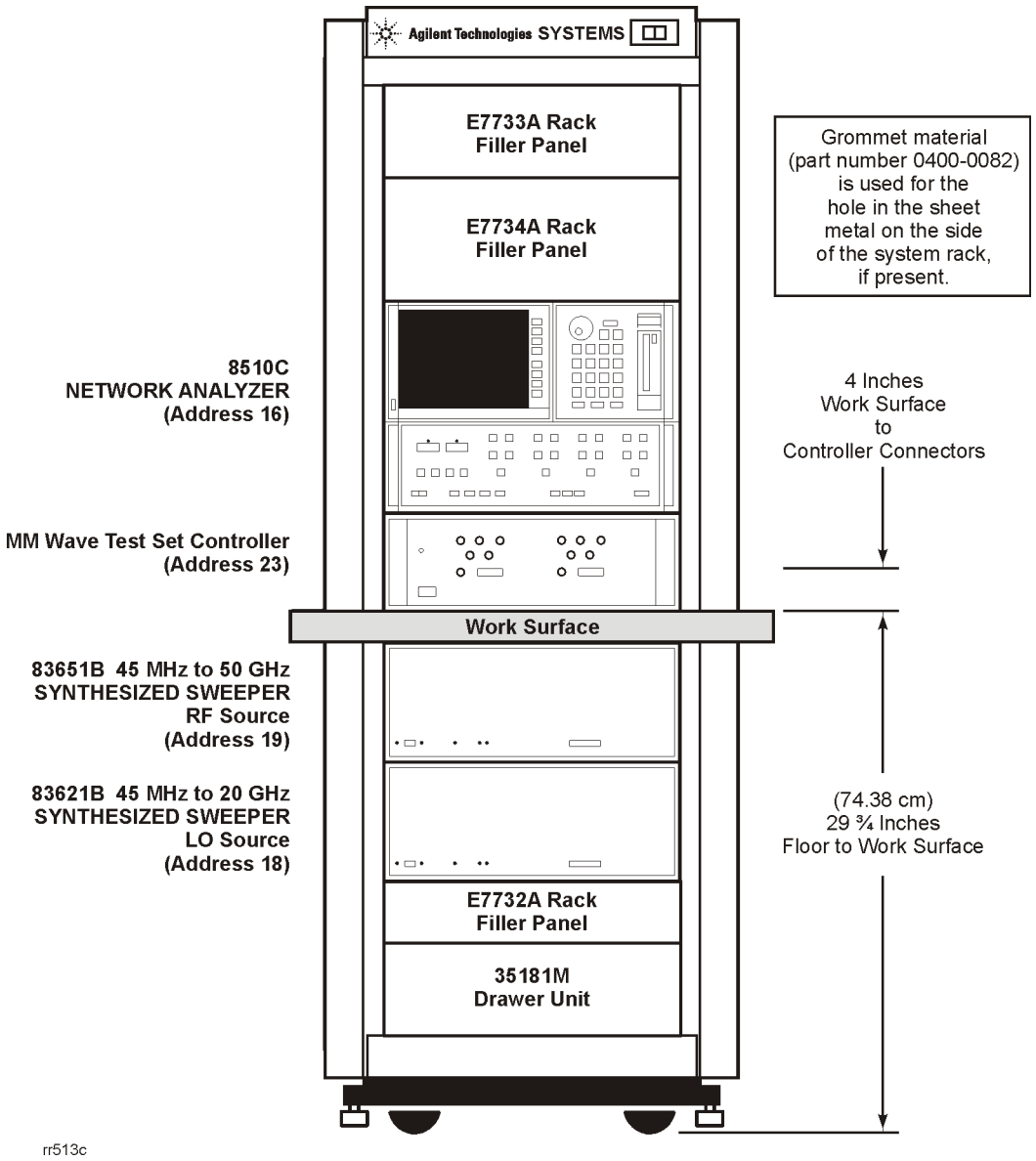


Figure 2-9 Rack Diagram for Coaxial Configuration

Figure 2-10 on page 2-19 shows rack cabling for the coaxial configuration. For cabling between the millimeter-wave controller and the test heads, see "Controller / Test Head Interconnections" on page 2-28.

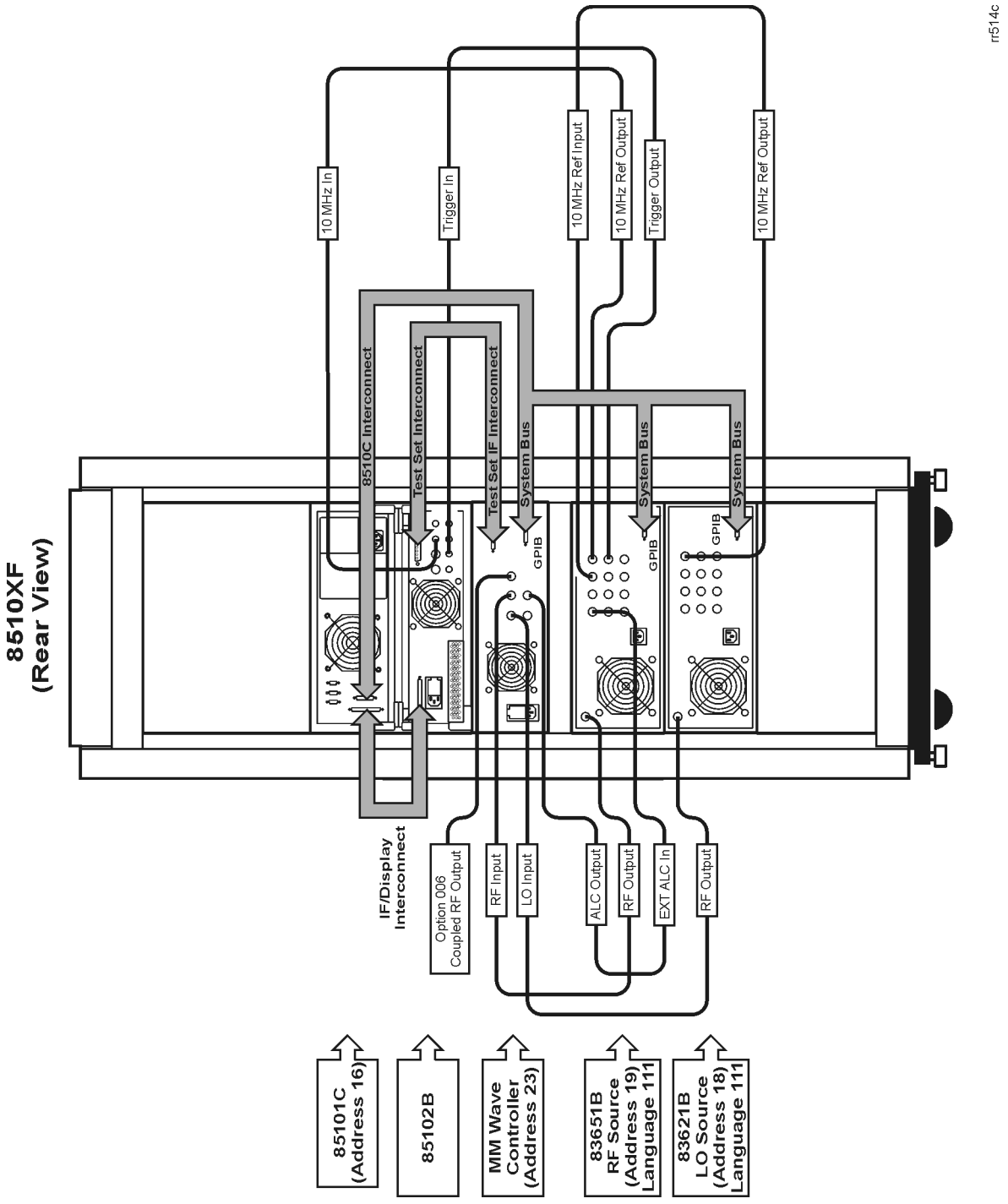


Figure 2-10 Rear-View Cabling Diagram (Coaxial Configuration)

Installing the Work Surface

The work surface is a 1 meter wide table top, to be attached to the system rack just below the millimeter-wave controller.

1. Extend the lock feet (located at the bottom of the cabinet) to stabilize the rack.
2. Attach the work surface support rails to the inside of the cabinet.
3. Slide the work surface onto the support rails.

NOTE

The 1 meter table top is included in the E7340A and E7350A complete systems. It is optional in the upgrade kits.

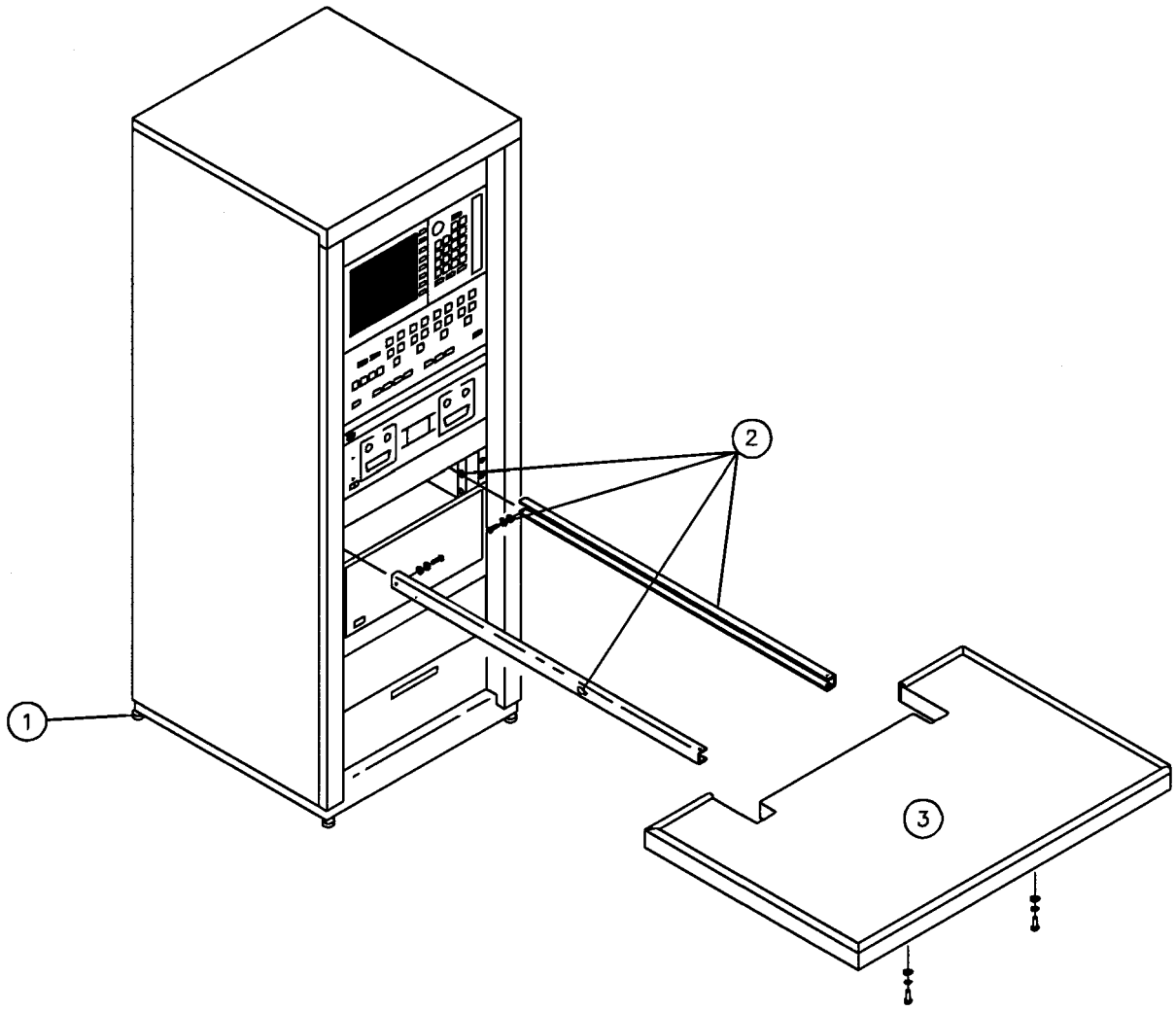


Figure 2-11 Installing the Work Surface

Wafer Probe Configuration

Figure 2-12 shows how the instruments are installed in the rack for the wafer probe configuration. The test heads (which are placed on X-Y positioners mounted to the wafer probe station) are omitted here, in order to give an unobstructed view of the rack instruments.

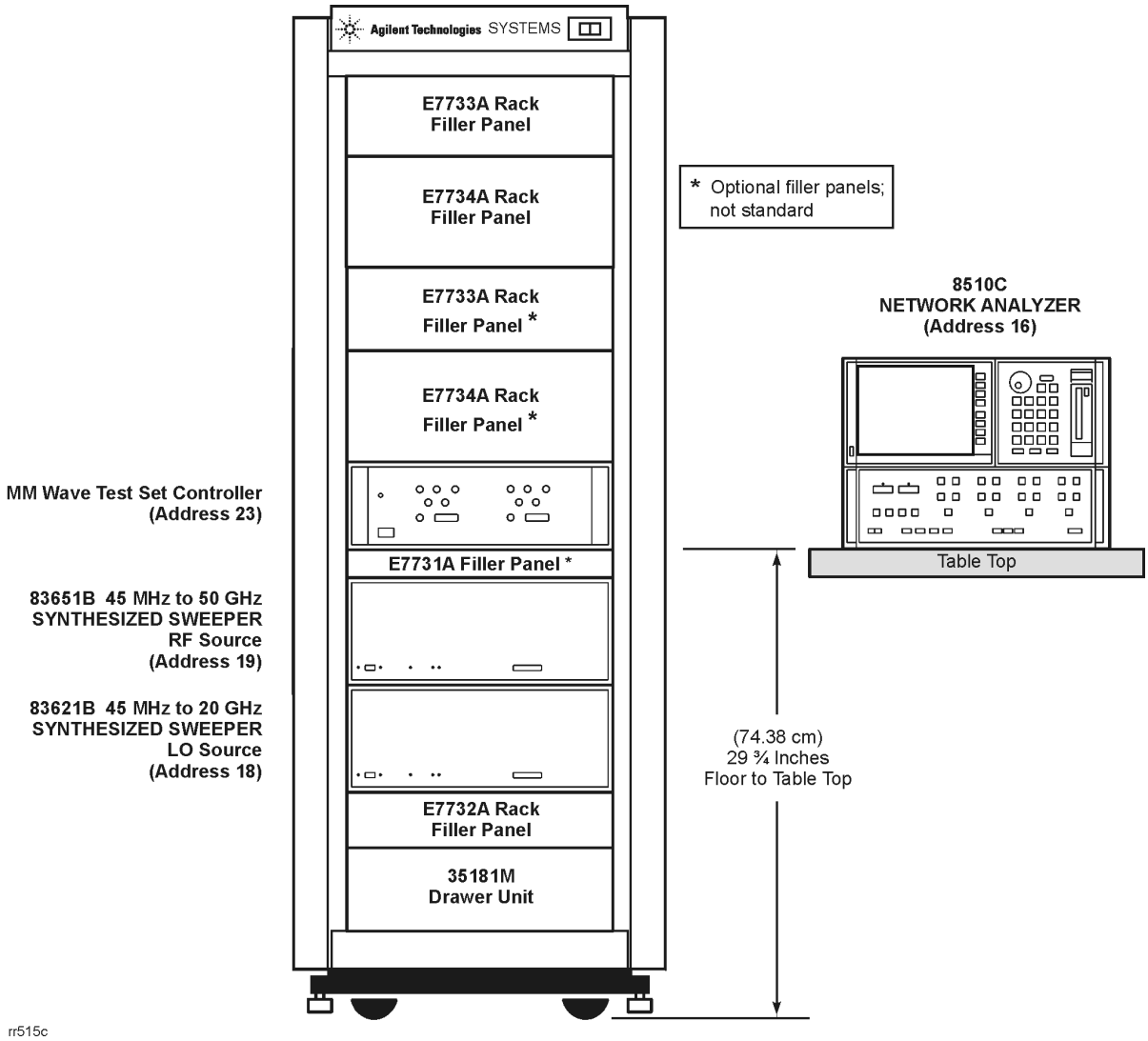


Figure 2-12 Rack Diagram for Wafer Probe Configuration

Figure 2-13 shows rack cabling for the wafer probe configuration. For cabling between the millimeter-wave controller and the test heads, see "Controller / Test Head Interconnections" on page 2-28.

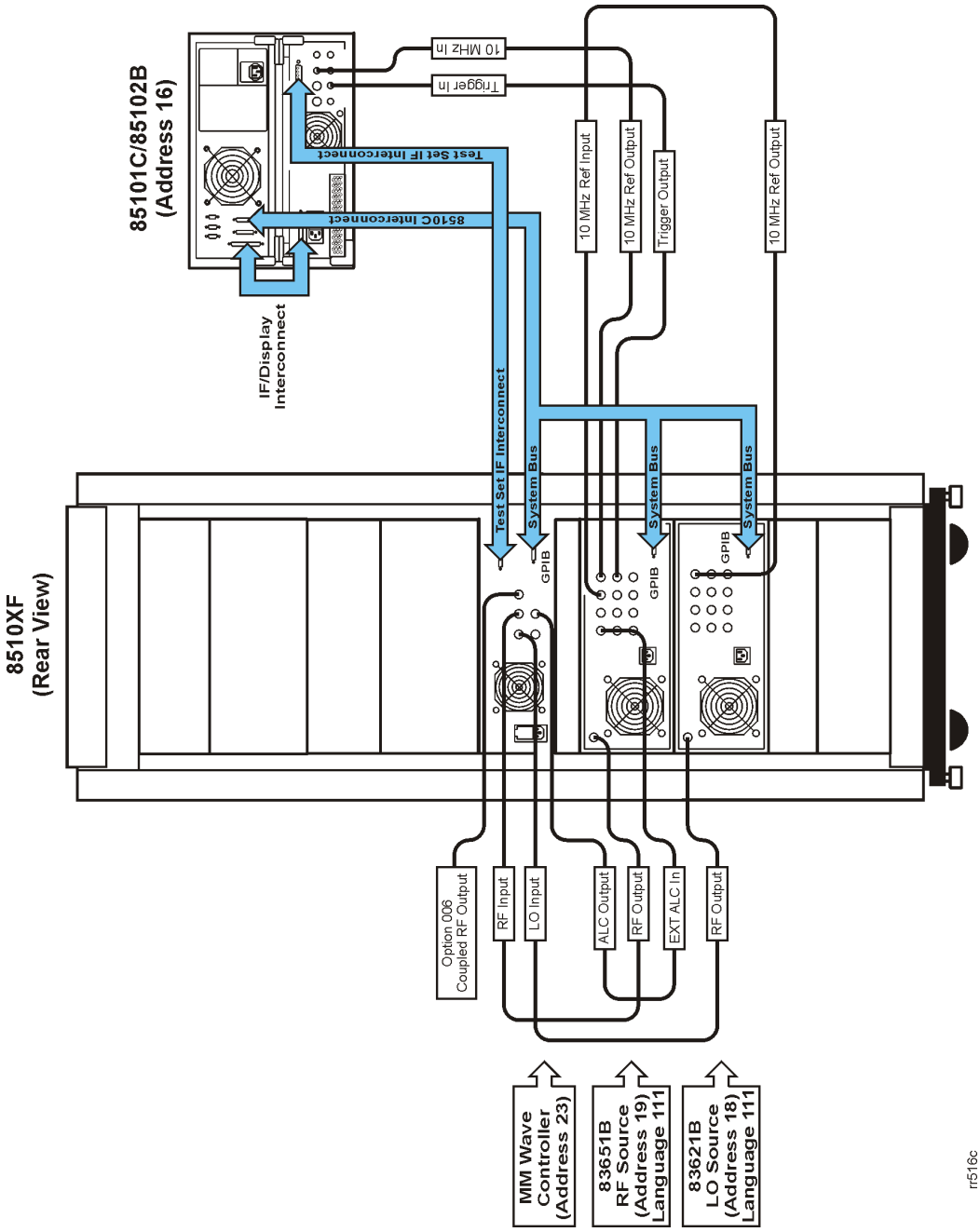
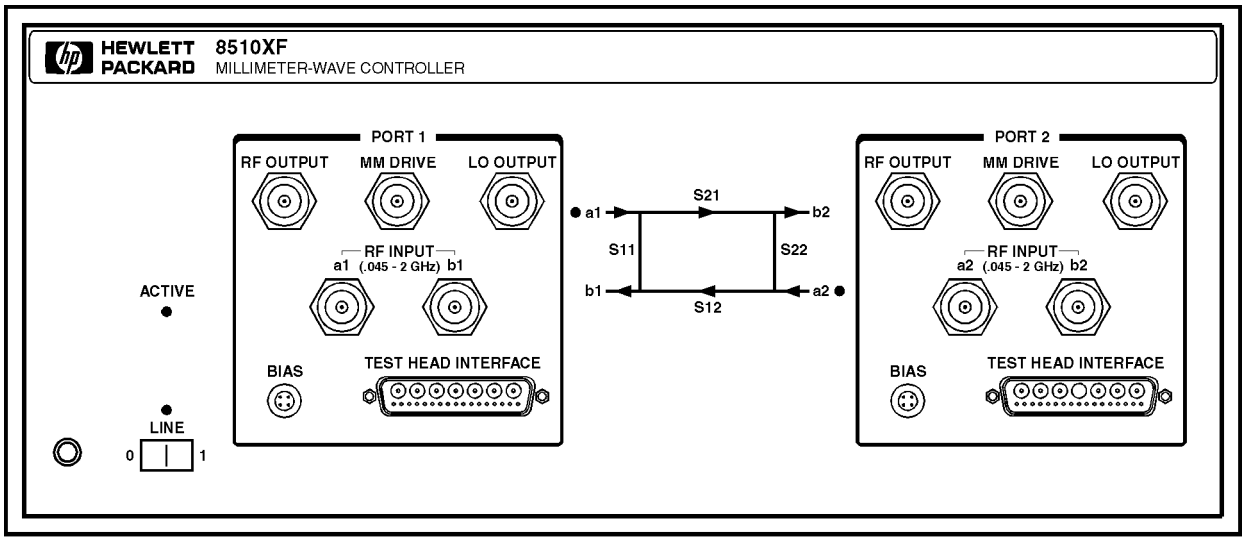


Figure 2-13 Rear-view Cabling Diagram (Wafer-Probe Configuration)

Millimeter-Wave Controller

The front panel of the millimeter-wave controller is illustrated below. (See page 2-28 for information on controller/test head interconnections.)



HP E7350
frntpnl.cdr
Rev. 2
3/4/98

Figure 2-14 Millimeter-Wave Controller

NOTE

The illustration above shows the front panel of the controller as it appears in systems with Option 005 (.045 MHz to 2 GHz range added). If the system does not have Option 005, the four “RF Input” connectors (a1, b1, a2, and b2) will be omitted.

LEDs

Four LEDs are used as indicators on the front panel:

LINE Lights to indicate that line power to the controller is ON.

ACTIVE Lights to indicate that this is the active test set (useful in distinguishing among multiple test sets tied to the same analyzer).

a1 This LED, located at the upper left of the S-parameter diagram, is lit when the RF source is switched to Port 1.

a2 This LED, located at the lower right of the S-parameter diagram, is lit when the RF source is switched to Port 2.

Connectors (Port 1)

RF OUTPUT This 2.4 mm connector provides the left test head with the RF signal that is used for frequencies up to 50 GHz.

MM DRIVE This 2.4 mm connector provides the left test head with the RF signal that is used for frequencies above 50 GHz (this signal is multiplied within the test head).

LO OUTPUT This 3.5 mm connector provides the left test head with the LO signal that is used for all frequencies.

a1 RF INPUT This 3.5 mm connector is installed only in systems that include Option 005; it receives (from the left test head) the “a1” RF input for frequencies below 2 GHz.

b1 RF INPUT This 3.5 mm connector is installed only in systems that include Option 005; it receives (from the left test head) the “b1” RF input for frequencies below 2 GHz.

BIAS This multi-pin connector provides power supply voltages to the left test head.

TEST HEAD INTERFACE This multi-pin connector provides paths for various signals between the controller and the left test head (including 20 MHz IFs from mixers in the test head).

Connectors (Port 2)

RF OUTPUT This 2.4 mm connector provides the right test head with the RF signal that is used for frequencies up to 50 GHz.

MM DRIVE This 2.4 mm connector provides the right test head with the RF signal that is used for frequencies above 50 GHz (this signal is multiplied within the test head).

LO OUTPUT This 3.5 mm connector provides the right test head with the LO signal that is used for all frequencies.

a2 RF INPUT This 3.5 mm connector is installed only in systems that include Option 005; it receives (from the right test head) the “a2” RF input for frequencies below 2 GHz.

b2 RF INPUT This 3.5 mm connector is installed only in systems that include Option 005; it receives (from the right test head) the “b2” RF input for frequencies below 2 GHz.

BIAS This multi-pin connector provides power supply voltages to the right test head.

TEST HEAD INTERFACE This multi-pin connector provides paths for various signals between the controller and the right test head (including 20 MHz IFs from mixers in the test head).

GPIB Address Switch

The millimeter-wave controller has an GPIB address switch located in the lower right area of the rear panel. The address of the controller is normally set to 23 (binary 10111).

The address switch is illustrated below; the individual bits are set by rocker switches (in the illustration, the darkened side of each switch is the side that is pressed in). Note that the switch has the MSB on the right, not the left, so the selected address (binary 10111) reads, left to right, as “11101”.

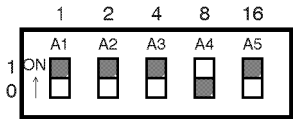
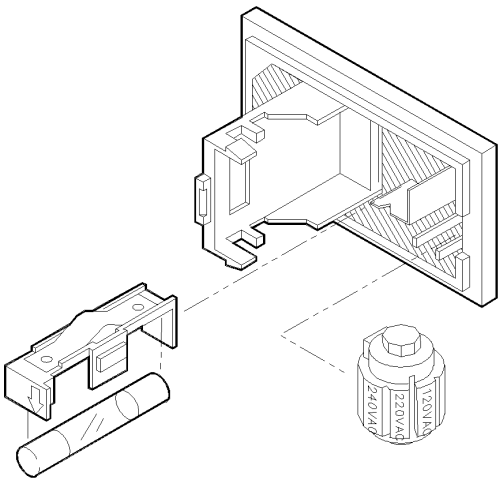


Figure 2-15 GPIB Switch Setting

Fuse

The fuse is located inside the line module on the rear panel of the millimeter-wave controller, as shown in the illustration below. For 110 V operation, the fuse rating should be 6 A; for 220 V operation, it should be 3 A (or 3.15 A). Review the information on the right of the drawing to replace the line fuse or to set the voltage selector cam.

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



CAUTION:

Do not attempt to rotate the voltage selector cam while it is installed in the line module or non-repairable damage will result. The cam must be completely removed from the line module, rotated to the proper position, and reinstalled. Refer to the instruction below.

REPLACEMENT OF FUSE

1. Pry open line module cover door.
2. Pull out fuse carrier.
3. Insert fuse of proper rating.
4. Place carrier back into line module.

SELECTION OF OPERATING VOLTAGE

1. Pry open line module cover door.
2. REMOVE CAM FROM THE LINE MODULE.
3. Rotate the cam to the desired voltage. (When the line module cover is closed, the selected voltage will be visible through a small window).
4. Insert the cam back into the line module.
5. Close the line module cover door.

Figure 2-16 Fuse and Voltage Cam Location

Test Heads

Port 1 and Port 2 are in the left and right test heads, respectively. The test heads are placed on the work surface in front of the system rack, or (for on-wafer measurement), on a wafer probe station.

Connector Positions

The test heads are asymmetrical with regard to the positions of the test port connectors. When the test heads are placed side by side, facing each other, the Port 1 connector is set further back than the Port 2 connector.

It is usually best to position the left test head slightly forward of the right test head, so that the test ports are in line. This reduces strain on test cables.

Power Supply Inputs

The test heads do not have their own power supplies; each head receives dc power supply inputs from the millimeter-wave controller, by way of a multi-pin interface cable.

Illustrations

The left test head is illustrated below; it is shown from the rear (that is, from the point of view of the controller). The multiple-connector panel provides connections between the test head and the controller (see page 2-28 for controller/test head interconnections). The single-connector panel contains test port 1.

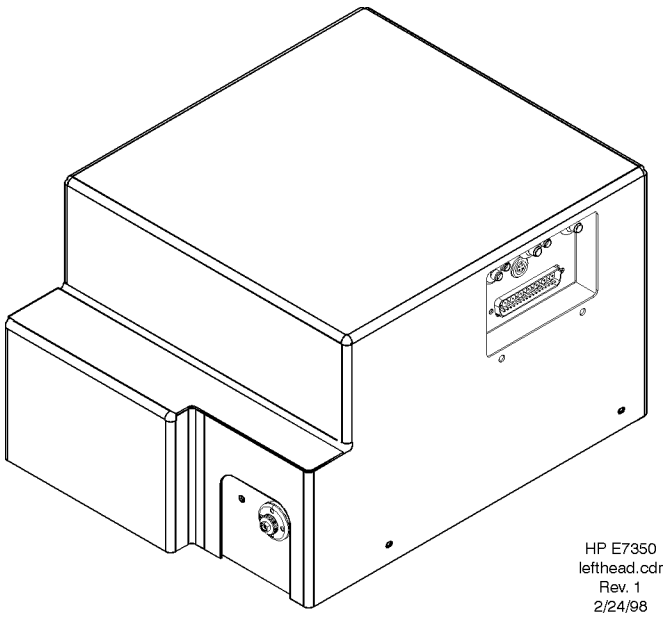


Figure 2-17 Left Test Head

The right test head is illustrated below; it is shown from the rear (that is, from the point of view of the controller). The multiple-connector panel provides connections between the test head and the controller. The single-connector panel contains test port 2.

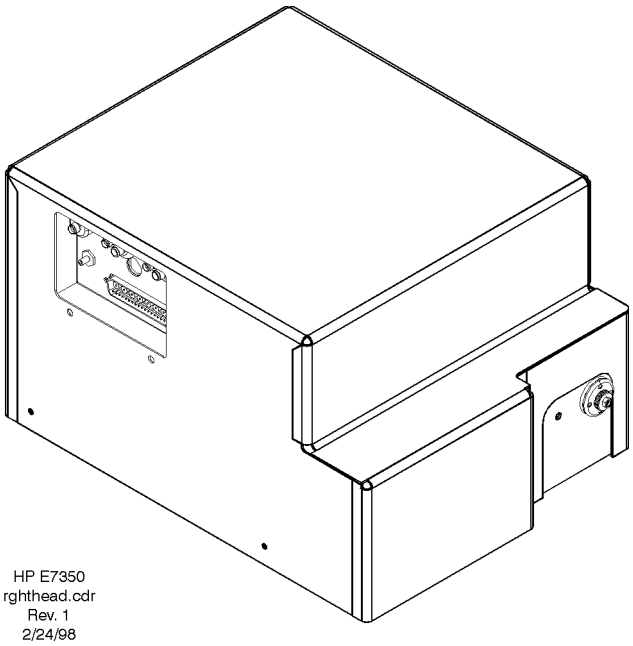


Figure 2-18 Right Test Head

Test Ports

The illustration below shows a test port. The “ON” LED to the left of the test port lights to indicate that the test head is receiving the required DC supply voltages from the controller.

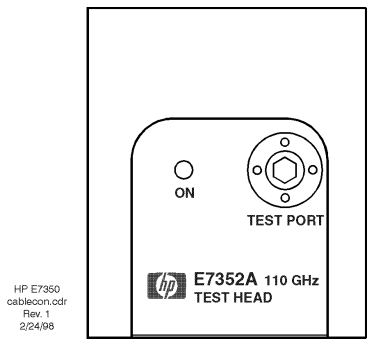


Figure 2-19 Test Port

NOTE

The model number which appears below the test port refers to the millimeter-wave subsystem, which consists of a millimeter-wave controller and two test heads (85 GHz or 110 GHz).

Controller / Test Head Interconnections

Systems With Option 005

The interconnections between the controller and the test heads are shown below, for a system with Option 005 (for systems without this option, see page 2-30).

NOTE

The order in which cables are connected to a test head is significant; see "Sequence of test head connections" on page 2-29.

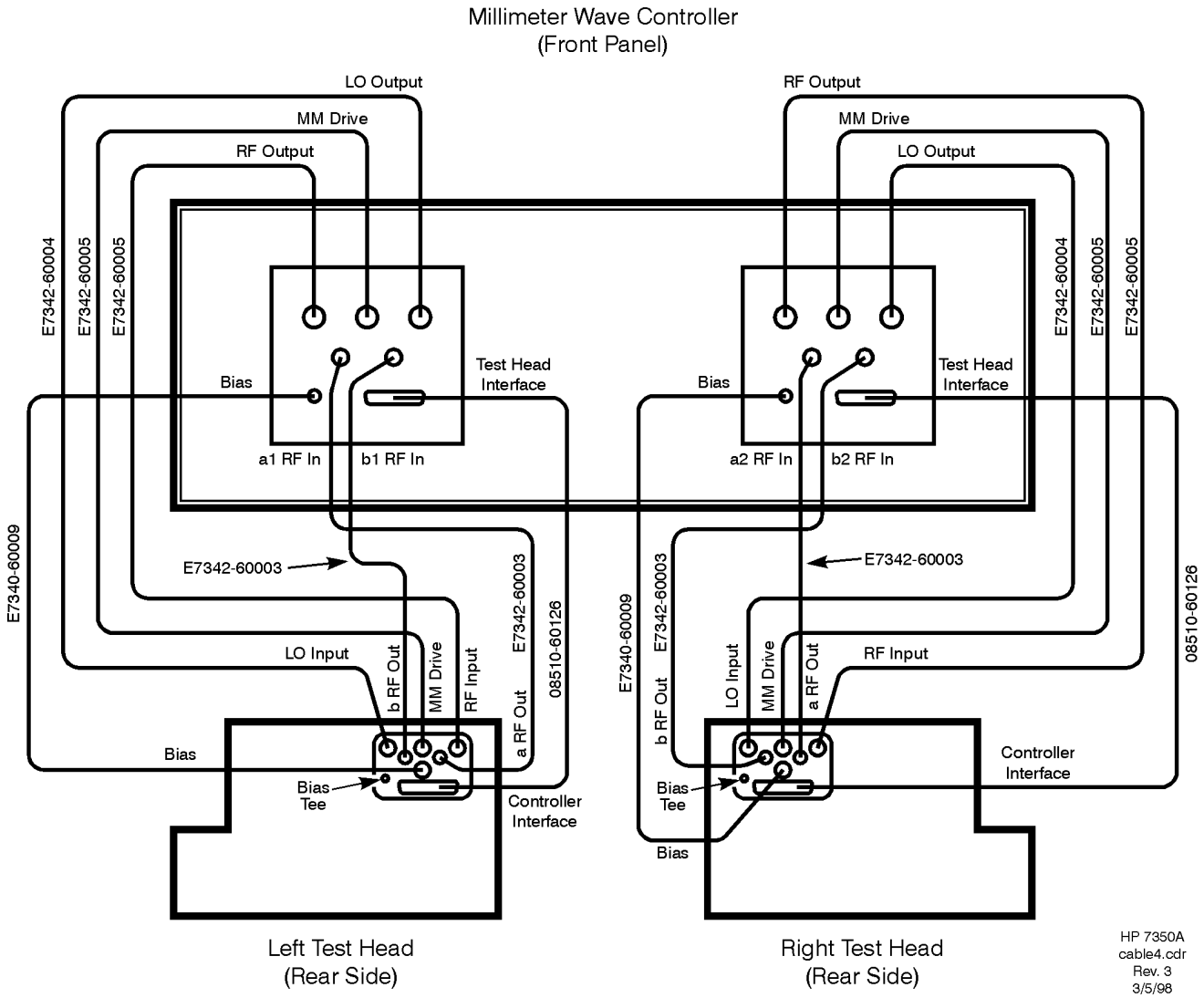


Figure 2-20 Controller / Test Head Cabling Diagram (With Option 005)

Sequence of test head connections

NOTE

Use a 57 N-cm (5 in-lb) torque wrench to tighten the SMA connectors, and a 90 N-cm (8 in-lb) torque wrench to tighten the 2.4 mm and 3.5 mm connectors.

The connectors on the backs of the test heads are very closely spaced. Attaching cables to these connectors is easiest if they are attached in the following sequence (as illustrated in Figure 2-21 below):

1. b RF OUTPUT; SMA connector
   (NOTE: In systems without Option 005, this connector is not used, and should be fitted with a male SMA termination.)
2. a RF OUTPUT; SMA connector
   (NOTE: In systems without Option 005, this connector is not used, and should be fitted with a male SMA termination.)
3. LO INPUT; 3.5 mm connector
4. MM DRIVE; 2.4 mm connector
5. RF INPUT; 2.4 mm connector
6. BIAS; LEMO multi-pin connector
7. BIAS TEE; SMB connector (if not in use, should be fitted with an SMB termination)
8. CONTROLLER INTERFACE (multi-pin connector)

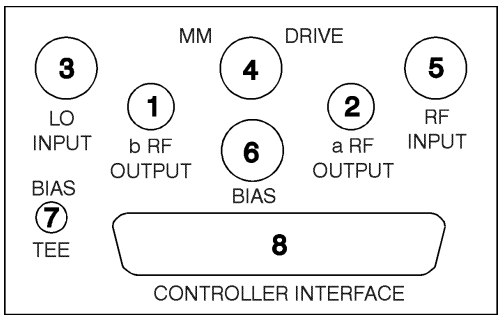


Figure 2-21 Test Head Cabling Sequence

NOTE

To remove cables from the test head, use the reverse of the sequence described above.

Instruments Without Option 005

The interconnections between the controller and the test heads are shown below, for a system without Option 005.

NOTE

The order in which cables are connected to a test head is significant; see "Sequence of test head connections" on page 2-31.

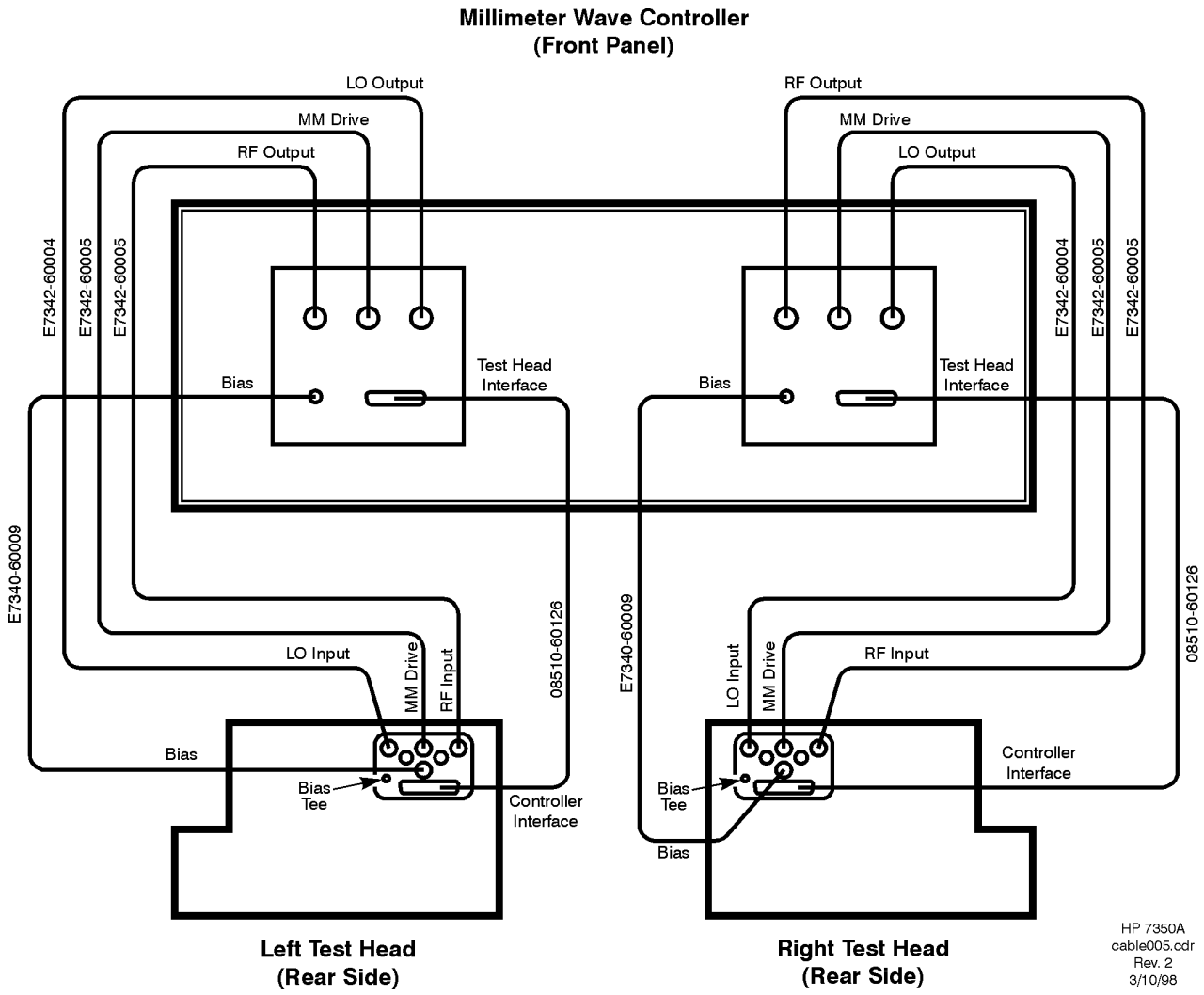


Figure 2-22 Controller / Test Head Cabling Diagram (Without Option 005)

Sequence of test head connections

NOTE

Use a 57 N-cm (5 in-lb) torque wrench to tighten the SMA connectors, and a 90 N-cm (8 in-lb) torque wrench to tighten the 2.4 mm and 3.5 mm connectors.

The connectors on the backs of the test heads are very closely spaced. Attaching cables to these connectors is easiest if they are attached in the following sequence (as illustrated in Figure 2-23 below):

1. b RF OUPTUT: In systems without Option 005, this connector is not used. Check to see that it is fitted with a male SMA termination.
2. a RF OUTPUT: In systems without Option 005, this connector is not used. Check to see that it is fitted with a male SMA termination.
3. LO INPUT; 3.5 mm connector
4. MM DRIVE; 2.4 mm connector
5. RF INPUT; 2.4 mm connector
6. BIAS; LEMO multi-pin connector
7. BIAS TEE; SMB connector (if not in use, should be fitted with an SMB termination)
8. CONTROLLER INTERFACE (multi-pin connector)

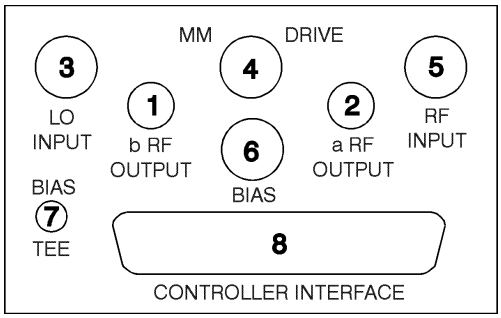


Figure 2-23 Test Head Cabling Sequence

NOTE

To remove cables from the test head, use the reverse of the sequence described above.

Cable List

System cabling for the 8510XF is outlined in the tables below.

Duplicate Listings

In these tables, a complete from/to connection list is given for the network analyzer, the RF source, the LO source, the controller, the left test head, and the right test head. In other words, each cable is listed twice, and can be found by looking up the connection from either end. The duplicate listings make it easier to check the cabling after installation, if a cabling error is suspected.

In the Notes column, the phrase “duplicate listing” means that the cable has already been listed once before. The phrase “factory installed” means that the cable was installed prior to shipment (generally, cables between rack instruments are factory installed; cables between the millimeter-wave controller and the test heads are not).

Table 2-7 Cable List (Connections from the 8510C)

From 85101C...	To:	Notes	Cable Type	Part No.
IF/display interconnect	85102B -- IF/display interconnect	factory installed	Multi-pin	08510- 60101
8510 interconnect	Millimeter-wave controller -- 8510 system bus	factory installed	GPIB	8120-3447 (Model 10833C)
From 85102B...				
IF/display interconnect	85101C -- IF/display interconnect	factory installed; duplicate listing	Multi-pin	08510-60101
Test set interconnect	Millimeter-wave controller -- test set Interconnect	factory installed	Multi-pin	08510-60107
10 MHz in	83651B -- 10 MHz RF output	factory installed	BNC	8120-5370
Trigger in	83651B -- trigger output	factory installed	BNC	8120-5370

Table 2-8 Cable List (Connections from the 83621B)

From 83621B...	To:	Notes	Cable Type	Part No.
10 MHz ref output	83651B -- 10 MHz ref input	factory installed	BNC	8120-1838
RF output	Millimeter-wave controller -- LO input	factory installed	3.5 mm semi-rigid coax	E7340-20076
GPIB	83651B -- GPIB	factory installed	GPIB	8120-3444 (Model 10833D)

Table 2-9 Cable List (Connections from the 83651B)

From 83651B...	To:	Notes	Cable Type	Part No.
10 MHZ ref input	83621B -- 10 MHz ref output	factory installed duplicate listing	BNC	8120-1838
10 MHz ref output	85102B -- 10 MHz in	factory installed duplicate listing	BNC	8120-5370
Trigger output	85102B -- trigger in	factory installed duplicate listing	BNC	8120-5370
GPIB	83621B -- GPIB	factory installed duplicate listing	GPIB	8120-3444 (Model 10833D)
GPIB	Millimeter-wave controller -- 8510 system bus	factory installed	GPIB	8120-3445 (Model 10833A)
Ext ALC in	Millimeter-wave controller -- ALC output	factory installed	BNC	8120-1839
RF output	Millimeter-wave controller -- RF Input	factory installed	2.4 mm semi-rigid coax	E7340-20075

Table 2-10 Cable List (Connections from the Millimeter-Wave Controller)

From Millimeter-Wave Controller, Front Panel:	To:	Notes	Cable Type	Part No.
Port 1 RF output	Left test head -- RF input		2.4 mm RF flex	E7342-60005
Port 1 mm drive	Left test head -- mm drive		2.4 mm RF flex	E7342-60005
Port 1 LO output	Left test head -- LO input		3.5 mm RF flex	E7342-60004
Port 1 RF input (a1) [Option 005 only]	Left test head -- “a” RF output		SMA RF flex	E7342-60003
Port 1 RF input (b1) [Option 005 only]	Left test head -- “b” RF output		SMA RF flex	E7342-60003
Port 1 bias	Left test head -- bias		DC	E7342-60009
Port 1 test head interface	Left test head -- controller interface		Multi-pin	08510-60126
Port 2 RF output	Right test head -- RF input		2.4 mm RF flex	E7342-60005
Port 2 mm drive	Right test head -- mm drive		2.4 mm RF flex	E7342-60005
Port 2 LO output	Right test head -- LO input		3.5 mm RF flex	E7342-60004
Port 2 RF input (a2) [Option 005 only]	Right test head -- “a” RF output		SMA RF flex	E7342-60003
Port 2 RF input (b2) [Option 005 only]	Right test head -- “b” RF output		SMA RF flex	E7342-60003
Port 2 bias	Right test head -- bias		DC	E7342-60009
Port 2 test head interface	Right test head -- controller interface		Multi-pin	08510-60126
From Millimeter-Wave Controller, Rear Panel:				
LO input	83621B -- RF out	factory installed; duplicate listing	3.5 mm semi-rigid coax	E7340-20076
RF input	83651B -- RF out	factory installed; duplicate listing	2.4 mm semi-rigid coax	E7340-20075
RF output [Option 006 only]	(Optional RF passthrough output)			
ALC output	83651B -- ext ALC in	factory installed; duplicate listing	BNC	8120-1839
J16 -- not used	(This connector is not used in the 8510XF.)			
test set interconnect	85102B -- test set interconnect	factory installed; duplicate listing	Multi-pin	08510-60107
8510 system bus	85101C -- 8510 interconnect	factory installed; duplicate listing	GPIB	8120-3447 (Model 10833C)
8510 system bus	83651B -- GPIB	factory installed; duplicate listing	GPIB	8120-3445 (Model 10833A)

Table 2-11 Cable List (Connections from the Left Test Head)

From Left Test Head...	To:	Notes	Cable Type	Part No.
LO input	Millimeter-wave controller -- port 1 LO Output	duplicate listing	3.5 mm RF flex	E7342-60004
b RF output [Option 005 only]	Millimeter-wave controller -- port 1 RF input (b1)	duplicate listing	SMA RF flex	E7342-60003
mm drive	Millimeter-wave controller -- port 1 mm drive	duplicate listing	2.4 mm RF flex	E7342-60005
a RF output [Option 005 only]	Millimeter-wave controller -- port 1 RF input (a1)	duplicate listing	SMA RF flex	E7342-60003
RF input	Millimeter-wave controller -- port 1 RF output	duplicate listing	2.4 mm RF flex	E7342-60005
Bias	Millimeter-wave controller -- port 1 bias	duplicate listing	DC	E7342-60009
Controller interface (NOTE: includes IF outputs)	Millimeter-wave controller -- port 1 test head interface	duplicate listing	Multi-pin	08510-60126
Bias tee (SMB)	(For connection to a user-supplied voltage source. No connecting device is provided.)			
Test port 1 (1.0 mm)	(For connection to a device under test, directly or through a cable and/or wafer test probe.)			

Table 2-12 Cable List (Connections from the Right Test Head)

From Right Test Head...	To:	Notes	Cable Type	Part No.
LO input	Millimeter-wave controller -- port 2 LO Output	duplicate listing	3.5 mm RF flex	E7342-60004
b RF output [Option 005 only]	Millimeter-wave controller -- port 2 RF input (b2)	duplicate listing	SMA RF flex	E7342-60003
mm drive	Millimeter-wave controller -- port 2 mm drive	duplicate listing	2.4 mm RF flex	E7342-60005
a RF output [Option 005 only]	Millimeter-wave controller -- port 2 RF input (a2)	duplicate listing	SMA RF flex	E7342-60003
RF input	Millimeter-wave controller -- port 2 RF output	duplicate listing	2.4 mm RF flex	E7342-60005
Bias	Millimeter-wave controller -- port 2 bias	duplicate listing	DC	E7342-60009
Controller interface (NOTE: includes IF outputs)	Millimeter-wave controller -- port 2 test head interface	duplicate listing	Multi-pin	08510-60126
Bias tee (SMB)	(For connection to a user-supplied voltage source. No connecting device is provided.)			
Test port 2 (1.0 mm)	(For connection to a device under test, directly or through a cable and/or wafer test probe.)			

Other Connections and Settings

GPIB Addresses

When the 8510C power is turned on, all previously assigned GPIB addresses are automatically recalled from memory and assigned to the various system instruments, including the address of the 8510C itself.

The GPIB address switch settings for all instruments must match the addresses assigned by the system. In 8510XF systems, these addresses are set at the factory prior to shipment. For reference, the instruments and the applicable default addresses are listed in the table below.

Table 2-13 8510XF System GPIB Addresses

Instrument	GPIB Address
8510C	16
System Bus	17
83621B LO Source	18
83651B RF Source	19
Millimeter-wave controller	23
Plotter	5
Printer	1
Disk Drive	0

Language Switches

The LANG switches of the 83621B and 83651B sources must be set to 111.

Turning On the System

While turning on the system, be sure to observe all of the precautions stated on page 2-9.

1. Verify that the hardware is properly connected (refer to "Basic System Configurations" on page 2-17).
2. Inspect the test ports before they are connected to any other device (see "Visual inspection" on page 5-4 for information on recognizing defects in a 1.0 mm connector.)
3. Turn on power for the system rack.
4. Turn on power for all system instruments, *except* the network analyzer display unit (the upper portion of the 8510C).
5. Wait 10 seconds, then turn on the network analyzer display unit.
6. The 8510C begins making measurements according to the last recording of instrument state #8. (Instrument State 8 is recalled each time line power to the network analyzer is turned on, and each time **[USER PRESET]** on the 8510C is pressed.)

System Operational Test

This is a basic operator's check, designed to establish that the system is functioning normally. It is not a performance test (the performance verification procedure for the 8510XF is described in Chapter 4).

This test measures the power levels of four signals within the system, and compares them to the typical levels that should be present during normal operation of the system. During the test, you will measure the power levels of the four user parameters: User 1 (a_1), User 2 (b_2), User 3 (a_2), and User 4 (b_1). Measured levels will be compared to the typical levels shown in Table 2-14 on page 2-41.

User parameters are measurements of the IF input levels received by the network analyzer. (Figure 2-24 below shows a typical 8510XF user parameter test plot.) During normal operation of the system, the absolute level of any IF is much less important than the ratio between one IF and another. However, the IF levels give a useful indication that the system is functioning normally.

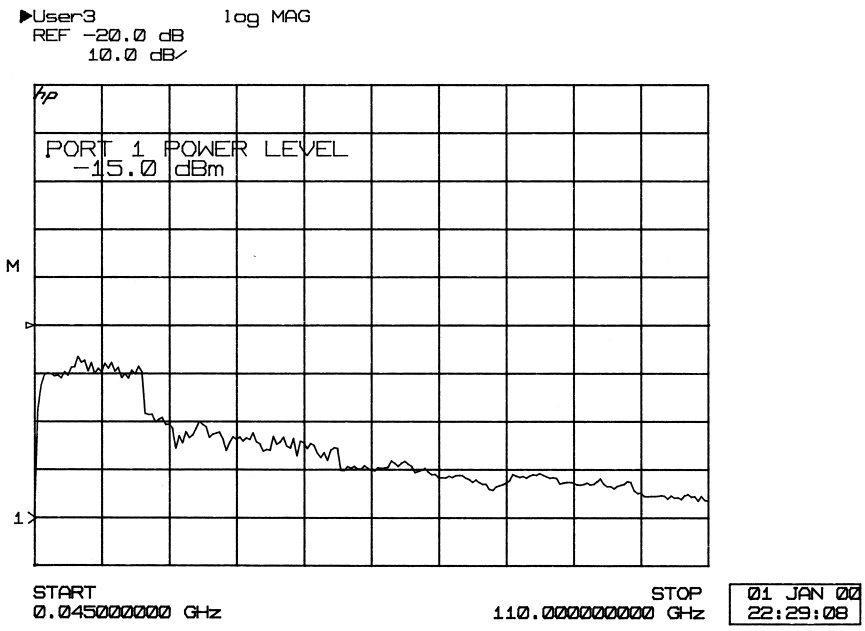


Figure 2-24 Typical User Parameter Test Plot (User 3, a_2)

Test Procedure

Setup

1. Perform a factory preset, using the key sequence:
   [RECALL] ***{MORE} {FACTORY PRESET}***
   (This sets up the system to measure across its entire frequency range, at a –15 dBm RF level.)
2. Turn averaging off, using the key sequence:
   RESPONSE [MENU] ***{AVERAGING OFF}***
3. Connect shorts to both test ports (for the purposes of this test, any of the shorts in the 85059A 1.0 mm calibration kit will serve).

Measurement

1. Measure the a1 IF, using the key sequence:
   PARAMETER [MENU] ***{USER 1 a1}***
   {REDEFINE PARAMETERS} {DRIVE} {PORT1} {REDEFINE DONE}

NOTE

At the default reference level setting (0 dB), the entire trace may not be visible on the screen. To change the reference value, press **RESPONSE [REF VALUE]**, and adjust the value using the up/down arrow keys (–20 dB is the recommended setting). This adjustment will have to be made repeatedly, because each of the user parameters starts out at the default reference level.

2. Compare the measured levels with the minimum levels shown in Table 2-14 on page 2-41.
3. Measure the b1 IF, using the key sequence:
   PARAMETER [MENU] ***{USER 4 b1}***
   {REDEFINE PARAMETERS} {DRIVE} {PORT1} {REDEFINE DONE}
4. Compare the measured levels with the minimum levels shown in Table 2-14 on page 2-41.
5. Measure the a2 IF, using the key sequence:
   PARAMETER [MENU] ***{USER 3 a2}***
   {REDEFINE PARAMETERS} {DRIVE} {PORT2} {REDEFINE DONE}
6. Compare the measured levels with the minimum levels shown in Table 2-14 on page 2-41.
7. Measure the b2 IF, using the key sequence:
   PARAMETER [MENU] ***{USER 2 b2}***
   {REDEFINE PARAMETERS} {DRIVE} {PORT2} {REDEFINE DONE}
8. Compare the measured levels with the minimum levels shown in Table 2-14 on page 2-41.

Conclusion If all of the measured levels are at or above the minimum levels shown in Figure 2-14, this indicates that the 8510XF is functioning normally, and is ready to be used.

Table 2-14 Minimum Levels (All User Parameters)

Frequency Range (GHz)	Minimum Level (dBm)
<2	–63
2 to <18	–38
18 to <50	–58
50 to <75	–61
>75	–63

NOTE: frequencies below 2 GHz are rolled off sharply, owing to the characteristics of the directional couplers in the test heads.

Operating Notes

Once the system is configured according to the instructions in the previous section, it is ready for normal operation. The following should be noted:

Frequency Resolution

At test frequencies above 50 GHz, the frequency resolution of the 8510XF is limited by harmonic multiplication of the RF source. Therefore, some frequency settings will be slightly modified by the network analyzer (59.999999996 GHz instead of a requested 60 GHz, for example).

User Parameters

If you are looking at unratioed user parameters (al, bl, a2, b2) you may see a discontinuity at the beginning and end of the trace, or at band changes.

User Preset

You may press the green **[USER PRESET]** key at any time to return the network analyzer to a predefined state. The preset function performs all necessary internal network analyzer initialization, then recalls Instrument State 8. **[USER PRESET]** does not send an initialization signal to the other instruments on the system bus.

Factory Preset

To re-initialize the network analyzer to the 8510XF factory settings, select **[RECALL]** ***{MORE} {FACTORY PRESET}***. This preset initializes all instrument state functions to their default conditions (except for the frequency range); it also initializes all instruments on the System Bus.

Power Domain Default Settings

In the 8510XF, the factory preset default settings for power domain measurement are as follows:

- Start: –35 dBm
- Stop: –15 dBm

IF Frequency Default Setting

In the 8510XF, the factory preset default value of the network analyzer IF is 20.000017 MHz (in other words, an offset of 17 Hz has been added to the nominal 20 MHz IF). See “IF Frequency” on page 3-42 for information about this offset, and instructions on how to modify it.

CAUTION

If the operating system is reloaded, it is necessary to perform the detector gain calibration (refer to “Detector Gain Calibration” on page 5-6).

3 Operation

In This Chapter...

NOTE

The functional core of the 8510XF system is the 8510C network analyzer. Operating the system mainly means operating the analyzer, as described in the 8510C manuals (see "Finding System Information" on page 1-2). This chapter is primarily concerned with operational information which is *not* found in the 8510C manuals, because it is specific to the 8510XF.

8510XF Operating System

In the 8510XF, the network analyzer runs a specially modified version of the 8510C operating system firmware. Some of the user menus are changed as a result, but the majority of them remain identical to the standard 8510C menus, as they are described in the 8510C Keyword Dictionary.

The present chapter includes information on the specific areas in which the standard menus are changed. A complete set of menu maps for the 8510XF, including equivalent GPIB commands, is presented in Chapter 7, “Menus & Commands” of this manual.

Checking the Operating System

The network analyzer is capable of running either the 8510XF version or the operating system, or the standard 8510C version. You can verify that the correct version is installed, by using the key sequence:
[SYSTEM] ***{MORE} {SERVICE FUNCTIONS} {SOFTWARE REVISION}***

The name of the displayed revision should begin with “8510XF,” not “8510C.”

The appropriate (CRT or LCD) 8510XF version of the operating system is installed at the factory; it can be re-loaded, if necessary, from a diskette (Agilent part number E7340-10001) that is supplied with the system.

The appropriate (CRT or LCD) 8510C version of the operating system can be loaded, if necessary, from a diskette supplied with the accessories to the 8510C (Agilent part number 85101-80116).

NOTE

To load the operating system, use the key sequence: **[SYSTEM]** ***{MORE} {SERVICE FUNCTIONS} {TEST MENU}*** to call up the main service functions menu, and enter **[1][9] [=MARKER]** to select **`LOAD PROGRAM DISK`**.

Menu Conventions Used in this Chapter

Softkeys

The names of softkeys are represented in italics, to distinguish them from keys that are marked with a permanent title. For example, the sequence **[CAL]** ***{MORE}*** ***{SET Z_0}*** means “press the **[CAL]** key, followed by the ***{MORE}*** softkey and the ***{SET Z_0}*** softkey.”

Menu Illustrations

In this chapter, several menus are illustrated with excerpts from the menu maps which are shown (in their entirety) in Chapter 7. These menu maps show both the softkeys and (to the right of the menu rectangle) the equivalent GPIB commands, if any.

In the menu illustration below, the softkey names (as they are displayed on the screen of the network analyzer) are shown within the rectangle; the GPIB commands that are equivalent to these softkeys are shown to the right of the rectangle. For example, the GPIB command “REFL” is equivalent to the softkey ***{REFLECT'N}.***

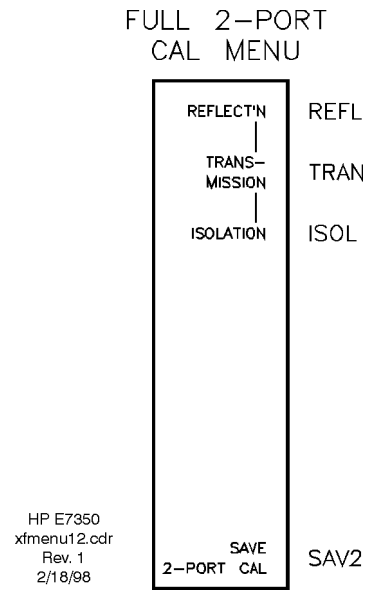


Figure 3-1 Illustration of a Menu with GPIB Commands at Right

Menu Changes (Overview)

The **[CAL]**, **[DOMAIN]**, **[PARAMETER]**, **STIMULUS [MENU]**, and **[SYSTEM]** menus have all been modified for the 8510XF, as noted briefly below.

CAL Menu

The **[CAL]** menu is changed in the following areas:

- ***{TRIM SWEEP}*** is deleted.
- The contents of the **[CAL]** menu (and most of its submenus) reflect the name of the calibration kit that is in use, as well as the names of the calibration standards in that kit. A calibration kit (85059A) has been developed specifically for the 8510XF; the menu maps in Chapter 7 reflect the contents of that kit.

The **[CAL]** menu and its submenus are discussed later in this chapter (see "Calibration Types" on page 3-13).

DOMAIN Menu

The **[DOMAIN]** menu is changed as follows:

{PULSE PROFILE} is deleted.

PARAMETER Menu

The **[PARAMETER]** menu is changed as follows:

{PHASE LOCK} is deleted.

STIMULUS Menu

STIMULUS [MENU] is changed in the following areas:

- The submenu called up by the ***{POWER}*** softkey is substantially revised. ***{ATTENUATOR PORT 1}***, ***{ATTENUATOR PORT 2}***, and ***{POWER FLATNESS}*** are deleted. Also, new port power functions are added (see "Port Power" on page 3-28).
- ***{RAMP}*** is deleted.
- ***{COUPLED CHANNELS}*** and ***{UNCOUPLED CHANNELS}*** are deleted.

SYSTEM Menu

The **[SYSTEM]** menu is changed in the following areas:

- ***{PULSE CONFIG}*** is deleted.
- ***{EDIT MULT. SRC.}*** is deleted (but see ***{SERVICE FUNCTIONS} {IF GAIN}*** below, which replaces part of the functionality of ***{EDIT MULT. SRC.}***).
- ***{SYSTEM PHASELOCK}*** is deleted.
- ***{POWER LEVELING}*** is deleted (but see ***{RF POWER CONFIG}*** and ***{LO POWER CONFIG}*** below).
- ***{RF POWER CONFIG}*** is added (see "RF Power" on page 3-30).
- ***{LO POWER CONFIG}*** is added (see "LO Power" on page 3-36).
- ***{IF FREQ}*** is added. This function makes it possible to specify the IF frequency (nominally 20 MHz) that is used by he network analyzer (see "IF Frequency" on page 3-42).
- The menu called up by ***{SERVICE FUNCTIONS}*** is substantially revised:
  - ***{IF GAIN}*** is moved to the ***{85102 SERVICE}*** menu (see below).
  - ***{PEEK/POKE LOCATION}***, ***{PEEK}***, and ***{POKE}*** are deleted (but are duplicated under the ***{85102 SERVICE}*** and ***{XF TEST SET SERVICE}*** menus (see below).
- ***{85102 SERVICE}*** is added (see "Service" on page 3-38).
- ***{XF TEST SET SERVICE}*** is added (see "Service" on page 3-38).

Measurement Calibration

Why Calibration Is Essential

During measurement calibration, a standard device with known characteristics is measured, and the results of the measurement are used to create a set of error coefficients. During subsequent measurements, the network analyzer uses the error coefficients to correct for its own measurement errors.

The accuracy of the network analyzer is very much dependent on this error-correction technique; therefore, the analyzer must be calibrated before it is used to make measurements.

When to Repeat the Calibration

The 8510XF is designed for exceptional stability; after it has been calibrated, the specified measurement accuracy of the system is guaranteed, provided that the conditions of measurement remain the same. However, certain changes to the measurement conditions may invalidate the calibration, as described below.

- A calibration is only valid for the frequency range over which it was performed; if the frequency range has changed, the calibration must be repeated.
- A calibration is only valid for the number of points over which it was performed; if the number of points has been increased, the calibration must be repeated.
- If test port cables have been kinked, replaced, or disconnected and reconnected, the calibration may be invalid, and should be checked.
- If connectors have been degraded by wear, the calibration may be invalid, and should be checked.
- If the ambient temperature changes by ±1 °C or more, the calibration may be invalid, and should be checked.

Checking the Calibration

A common practice for making a rough check of a calibration is to remeasure one of the devices used in the calibration procedure (or verification procedure). For example, if you reconnect a short that was used during calibration, it should appear as a near-perfect short, across the frequency range of calibration.

NOTE

The shorts used in the 85059A 1.0 mm calibration kit are offset shorts. When measured, the offset shorts will exhibit the characteristics of a flush short that is placed at the end of an airline (there will be a change in phase and an increasing amount of loss with increasing frequency).

Another practice is to measure a device that had been measured with a previous good calibration, and compare the present measurement to the earlier one (if there are any changes exceeding the limits of acceptable accuracy, a new calibration is needed). For example, measure one of the verification devices that was used during performance verification, and compare it to the data that was taken at that time.

However, these methods give only an approximate confirmation that the calibration is good. The only way to make an accurate check is to run the 8510C Specification and Performance Verification software, which runs on a PC or controller (the procedure for this is presented in Chapter 4, "Performance Verification").

Calibration Techniques

A variety of calibration techniques can be used with the 8510XF, including the following:

- SOLT (Short-Open-Load-Thru)
- Offset Shorts (Shorts with different offset lengths)
- TRL (Thru-Reflect-Line)
- TRM (Thru-Reflect-Match)

The calibration technique used depends in part on the type of calibration kit used. The 1.0 mm calibration kit (85059A), which was designed specifically for the 8510XF, uses a combination of two calibration techniques (SOLT calibration, for frequencies up to 50 GHz, and Offset Shorts calibration, for frequencies above 50 GHz). This combination of techniques provides the best possible calibration results on the 8510XF.

Types of Calibration Kits

1.0 mm calibration kit

The calibration procedures in this chapter are based on the assumption that the 1.0 mm coaxial calibration kit (85059A) will be used to calibrate the system. This kit was designed specifically for the 8510XF, and provides coverage over a frequency range of 45 MHz to 110 GHz. (The standards in the kit have 1.0 mm coaxial connections; they cannot be used for on-wafer measurement calibration.) Refer to the 85059A calibration kit manual for more information (part number 85059-90003).

NOTE

If a calibration kit other than the 85059A is used, please refer to the documentation for that kit.

The 1.0 mm calibration kit also supports two quick calibration techniques, which can be used in certain situations where measurement accuracy is not critical; for details, see “Alternative 1.0 mm Calibrations” on page 3-43.

Other coaxial calibration kits

It is possible to use other coaxial calibration kits with the 8510XF, provided that appropriate adapters are connected to the 1.0 mm test ports. However, this type of calibration will *not* cover the entire frequency range of the 8510XF.

For example, a 2.4 mm coaxial calibration kit could be used, provided that adapters (1.0 mm to 2.4 mm) were connected to the test ports. However, this would prevent the system from making calibrated measurements above 50 GHz.

On-wafer calibration

When the 8510XF is configured for on-wafer measurement, the calibration process must be adapted to the accessories that are being used (including the on-wafer calibration standards). See “Operation Using a Wafer Probe Station” on page 3-46.

Calibration Procedure

NOTE

The following procedure assumes that the 1.0 mm calibration kit (85059A) will be used to calibrate the 8510XF.

Load Calibration Constants

Before you can calibrate the system, you must load the appropriate calibration constants into the system.

1. Insert the calibration data disk (included with the 1.0 mm calibration kit) into the 8510C disk drive.
2. Press **[DISC]** ***{LOAD}***.
   The analyzer displays **`SELECT DATA TYPE TO LOAD`**.
3. Select ***{CAL KIT 1}*** or ***{CAL KIT 2}***.
   The analyzer displays **`USE KNOB OR STEP KEYS TO SELECT A FILE.`**
4. Select **`CK_1MMA1A`** from the display menu.
   (This file is the recommended choice for normal operation; the other file, **`CK_1MMA1B`**, is discussed under "Broadband Standards" on page 3-43).
5. Select ***{LOAD FILE}***. This loads the calibration constants into the memory of the network analyzer. A screen message indicates when the load process is complete (**`FILE 'CK_1MMA1A' LOADED FROM DISK`**).
6. Remove the disk from the drive.

Set Up the Analyzer

1. Set the desired frequency range for the calibration, using the **STIMULUS** keys.
2. Select step mode, using **STIMULUS [MENU]** ***{STEP}***.
3. Set the desired number of points, using **STIMULUS [MENU]** ***{NUMBER OF POINTS}***.
4. Set the desired averaging value, using **RESPONSE [MENU]** ***{AVERAGING ON/restart}***.
5. Be sure that the system impedance is set to 50Ω, by pressing:
   [CAL] ***{MORE} {SET Z0}***
   (If the display does *not* read **`50.0`**Ω, press: **[5] [0] [X1]**.)
6. Press **[CAL]** ***{CAL 1}*** or ***{CAL 2}***

7. Select a calibration type from the menu. The available types are:
   - Response
   - Response & Isol'n
   - S11 1-Port
   - S22 1-Port
   - One-Path 2-Port
   - Full 2-Port
   - TRL 2-Port [actually TRM 2-port, in the case of the 8510XF]
8. The appropriate calibration submenu will appear, listing the calibration standards that are needed for the selected calibration type. (For many types of calibration, the standards are listed on sub-submenus, sorted by categories such as "Shorts" or "Transmission".)

Connect and Measure the Calibration Standards

1. The standards listed on the calibration-type submenu are all of the standards that apply to that particular type of calibration. Among these possibilities, determine which standards are appropriate to the frequency range being calibrated (and also appropriate to the sex of the test port or cable). See "Choosing Calibration Standards" on page 3-11.
2. Starting from the top down, connect the first standard that is appropriate to the calibration.
3. Select the softkey associated with the standard, and wait for the 8510XF to complete its calibration run for that standard (the softkey name will be underlined when the calibration run is complete).
4. Disconnect the standard (unless the same standard, connected to the same port, is needed for the next step).
5. Repeat steps 2 through 4 until all appropriate standards shown on the menu have been measured and are underlined.
6. When all appropriate standards on the menu have been measured and are underlined, select the ***{DONE}*** or ***{SAVE}*** softkey at the bottom of the menu.
   a. If the menu includes a ***{DONE}*** softkey, this indicates that this submenu is complete, but the calibration as a whole is not. Selecting this softkey leads back to the menu that still needs to be completed.
   b. If the menu includes a ***{SAVE}*** softkey, no other calibration submenus are required to complete the calibration. Selecting this softkey saves the calibration.

Choosing Calibration Standards

Connector Sex

The connector sex of a 1.0 mm calibration standard can have a significant effect on its electrical characteristics. Many of the standards in the 1.0 mm calibration kit have separate standard definitions for male and female versions. It is very important to use the correct definition for the sex of the standard you are measuring.

NOTE

The standard labels which appear in the calibration menus specify connector sex as “(M)” or “(F)”. The parentheses around the sex designator mean that it refers to the sex of the port to which the standard is connected (*not* the sex of the standard itself).

For example:

- “(M) OPEN” means an open that connects to a male port (in other words, the open itself has a female connector).
- “(F) SHORT” means a short that connects to a female port (in other words, the short itself has a male connector).
- Whenever a device is described as “M” or “F” *without* parentheses, the letter indicates the sex of the device itself.

Offset Shorts

In the 8510XF, at frequencies above 50 GHz, offset shorts are used in the place of opens and loads. The “OPEN” category is therefore renamed “OPEN/SHORT”, and the “LOAD” category is renamed “LOAD/SHORT”.

The offset shorts that are included in the 1.0 mm calibration kit have different offset lengths. To distinguish them clearly, each offset short is assigned a number (1 to 4), and that many rings are engraved on the body of the device (that is, Short 2 has two rings, and Short 4 has four rings).

The offset shorts have different standard definitions for the versions with male or female connectors. For example, when using Short 3, the standard definition to use is “(M) SHORT3”, if the device is connected to a male port, or “(F) SHORT3” if it is connected to a female port.

Banded Standards

Some of the calibration standards in the 1.0 mm calibration kit are limited to a particular frequency band. Calibration standards that are limited in this way are shown in Table 3-1 below. During the calibration process, be sure to use all the standards that are needed to cover the frequency range in which you will be making measurements. Refer to the 85059A calibration kit manual for more information.

Table 3-1 Banded Standards

Standard Type	.045 to 50 GHz	50 to 75 GHz	75 to 110 GHz	Combined Ranges
"Open/Short"	(M) OPEN (F) OPEN	(M) SHORT3 (F) SHORT3	(M) SHORT3 (F) SHORT3	(combine the standards shown in the columns to the left, as appropriate)
"Shorts"	(M) SHORT3 (F) SHORT3	(M) SHORT1 (F) SHORT1	(M) SHORT1 (F) SHORT1	(combine the standards shown in the columns to the left, as appropriate)
"Load/Short"	50GHZ LOAD	(M) SHORT4 (F) SHORT4	(M) SHORT2 (F) SHORT2	(combine the standards shown in the columns to the left, as appropriate)
"Match" (TRL/TRM Calibration)	50GHZ LOAD (both ports)	N/A	N/A	(TRM calibration is not used above 50 GHz)
"Isolation"	50 GHz LOAD	Load BB[1]	Load BB[1]	Load BB[1]

1. The broadband load is a combination of a lossy delay line plus a 50 GHz load (refer to the 85059A calibration kit manual).

Non-Banded Standards

Other standards in the 1.0 mm calibration kit, which are not limited to a particular frequency range, are shown in Table 3-2 below. The right column of the table refers to some devices that were also listed in Table 3-1; here they are used differently. For example, Short No. 3 was limited to 50 GHz as a "Shorts" standard, but not when it is used as a "Response" standard.

Table 3-2 Calibration Standards Used at All Frequencies

Standard Types	Device or Connection
"Response" (for S11 or S22)	Choose one of the following: • (M) SHORT3 or (F) SHORT3 • (M) OPEN or (F) OPEN
"Response" (for S21 or S12)	• THRU (connect Port 1 to Port 2 via cable)
"S11REFLECT SHORT" (TRL menu)	Connect a short to Port 1: (M) SHORT3 or (F) SHORT3
"S22REFLECT SHORT" (TRL menu)	Connect a short to Port 2: (M) SHORT3 or (F) SHORT3
"THRU" (various menus)	Connect Port 1 to Port 2 via cable

Calibration Types

Selecting **[CAL]** ***{CAL 1}*** or **[CAL]** ***{CAL 2}*** will call up the Calibration Type menu:

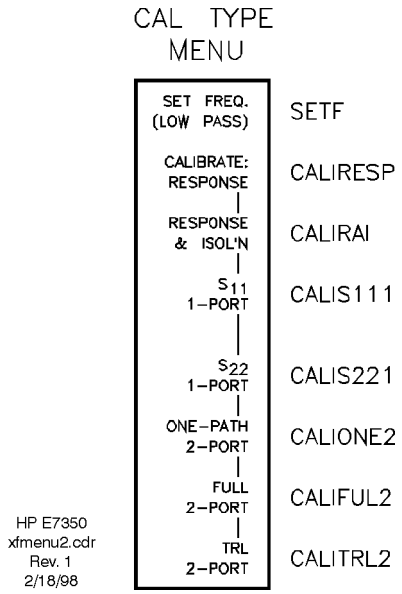


Figure 3-2 CAL TYPE Menu & Equivalent GPIB Commands

All of these softkeys, except for the first, represent different types of calibration. Each type of calibration requires its own particular set of calibration standards, as described in the following pages.

Response

This is a very limited calibration, which corrects only for frequency response, not for directivity or source match errors. The performance of the 8510XF is not specified, if this calibration is used. To perform this calibration using the 1.0 mm calibration kit, select:

[CAL] ***{CAL1*** or ***CAL2} {CALIBRATE: RESPONSE}***

This calls up the response standard select menu, as shown on the right of the illustration below:

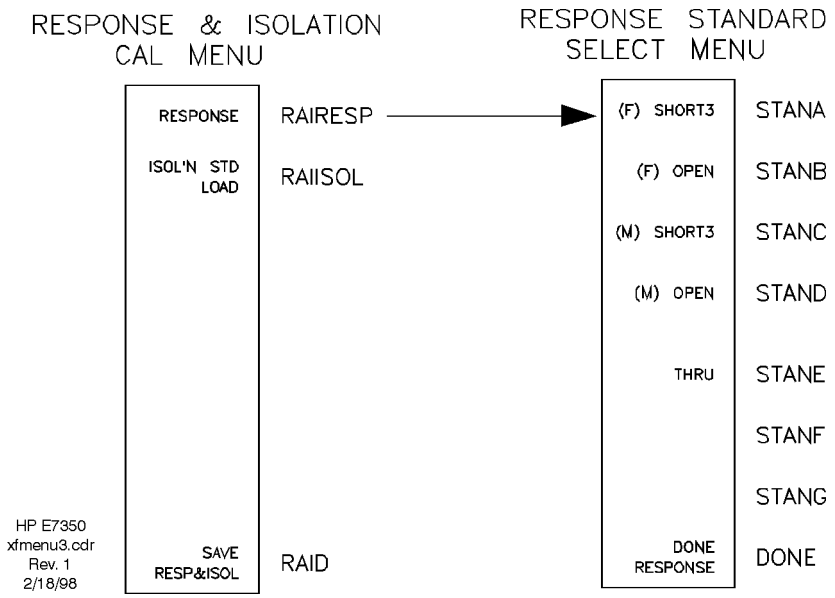


Figure 3-3 Response Menu (Right) & Equivalent GPIB Commands

Select ONE of the Response Standards

For Reflection Measurements (S11, S22), select one of the following:

{(F) SHORT3}	Refers to offset short No. 3 with a male connector (that is, the short is to be connected to a female port).
{(F) OPEN}	Refers to an open with a male connector (that is, the open is to be connected to a female port).
{(M) SHORT3}	Refers to offset short No. 3 with a female connector (that is, the short is to be connected to a male port).
{(M) OPEN}	Refers to an open with a female connector (that is, the open is to be connected to a male port).

For Transmission Measurements (S12, S21), select:

{THRU}	Connect Port 1 to Port 2 by way of a cable.

Response & Isolation

This is a very limited calibration, which corrects only for frequency response and isolation, not for directivity or source match errors. The performance of the 8510XF is not specified, if this calibration is used. To perform this calibration using the 1.0 mm calibration kit, select:

[CAL] ***{CAL1*** or ***CAL2} {RESPONSE & ISOL'N}***

This will call up the menu and submenu shown below:

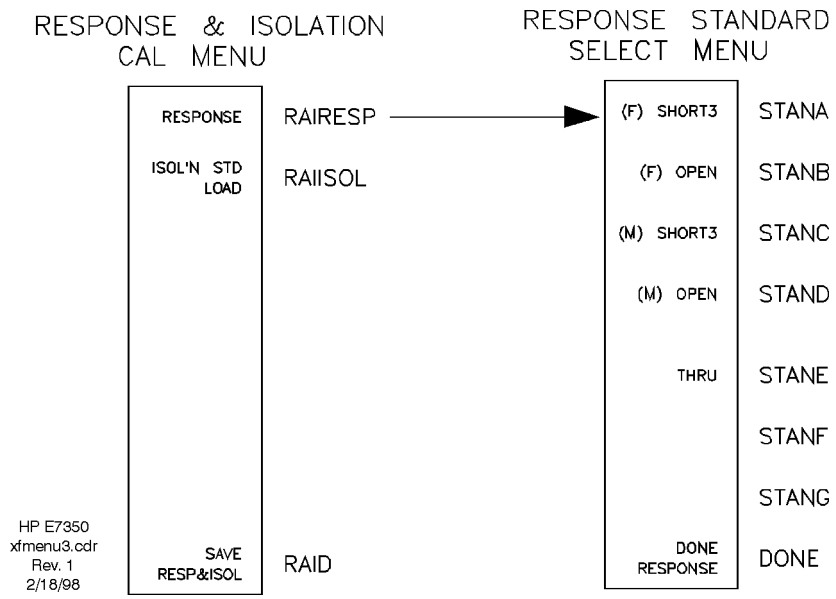


Figure 3-4 Response & Isolation Menu, Response Menu, and Equivalent GPIB Commands

Select ONE of the Response Standards

For Reflection Measurements (S11, S22), select one of the following:

{(F) SHORT3} Refers to offset short No. 3 with a male connector (that is, the short is to be connected to a female port).

{(F) OPEN} Refers to an open with a male connector (that is, the open is to be connected to a female port).

{(M) SHORT3} Refers to offset short No. 3 with a female connector (that is, the short is to be connected to a male port).

{(M) OPEN} Refers to an open with a female connector (that is, the open is to be connected to a male port).

For Transmission Measurements (S12, S21), select:

{THRU} Connect Port 1 to Port 2 by way of a cable.

Isolation Standard

{ISOL'N STD LOAD} Refer to "Isolation" under "Banded Standards" in Table 3-1 on page 3-12.

S11 1-Port

This calibration is for reflection measurements using the left test port (within those operational limits, however, it is a thorough and accurate calibration). To perform this calibration using the 1.0 mm calibration kit, select:

[CAL] ***{CAL1*** or ***CAL2} {S11 1-PORT}***

This calls up the following menu:

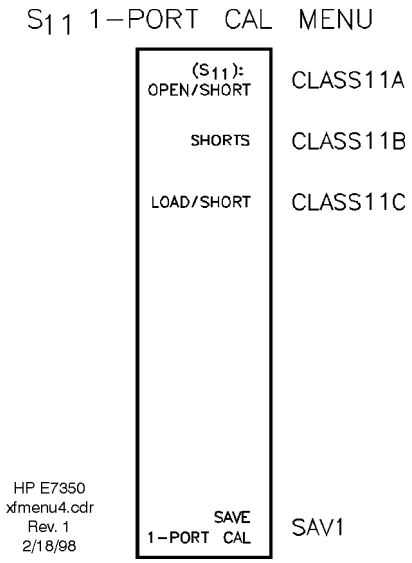


Figure 3-5 S11 1-Port Menu & Equivalent GPIB Commands

For notes on the three types of standards involved in this calibration, see the following:

- “Open/Short Standards” on page 3-21
- “Shorts Standards” on page 3-22
- “Load/Short Standards” on page 3-23

S22 1-Port

This calibration is for reflection measurements using the right test port (within those operational limits, however, it is a thorough and accurate calibration). To perform this calibration using the 1.0 mm calibration kit, select:

[CAL] ***{CAL1*** or ***CAL2} {S22 1-PORT}***

This calls up a menu which is identical to the one shown in Figure 3-5 above, except that it is identified as S22 rather than S11.

One Path 2-Port

This calibration is for reflection and transmission measurements, in one direction only (with Port 1 defined as the source). To perform this calibration using the 1.0 mm calibration kit, select:

[CAL] ***{CAL1*** or ***CAL2} {ONE PATH 2-PORT}***

This calls up the following menu:

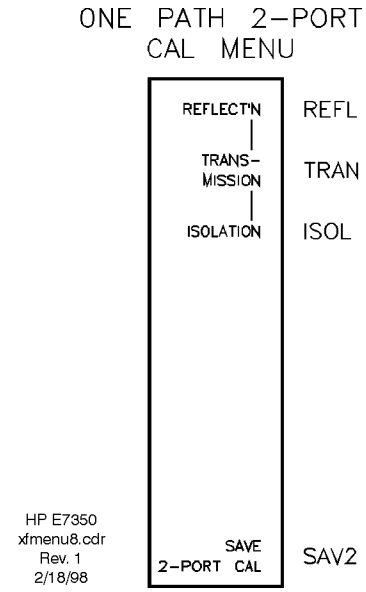


Figure 3-6 One Path 2-Port Menu & Equivalent GPIB Commands

Notes on the Standards

{REFLECT'N}

These are the same standards that are used for the S11 and S22 1-port calibrations, except that in this case both ports are calibrated. The reflection standards are sorted into three categories:

- See "Open/Short Standards" on page 3-21
- See "Shorts Standards" on page 3-22
- See "Load/Short Standards" on page 3-23

{TRANS-MISSION}

See "One-Path Transmission Standards" on page 3-24.

{ISOLATION}

See "One-Path Isolation Standard" on page 3-25.

Full 2-Port

This is a very thorough calibration, which takes measurements of reflection, transmission, and isolation for both ports. This type of calibration (when performed using the 1.0 mm calibration kit) combines the SOLT calibration technique (for frequencies up to 50 GHz) with the Offset Shorts calibration technique (for frequencies above 50 GHz). This combination yields the best possible calibration results, for measurement over the full frequency range of the 8510XF.

For this calibration, select:
[CAL] ***{CAL1*** or ***CAL2} {FULL 2-PORT}***

This calls up the following menu:

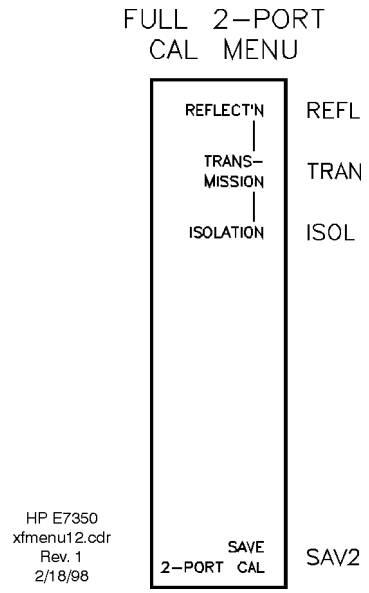


Figure 3-7 Full 2-Port Menu & Equivalent GPIB Commands

Notes on the Standards

{REFLECT'N} These are the same standards that are used for the S11 and S22 1-port calibrations, except that in this case both ports are calibrated. The reflection standards are sorted into three categories:

- See “Open/Short Standards” on page 3-21
- See “Shorts Standards” on page 3-22
- See “Load/Short Standards” on page 3-23

{TRANS-MISSION} See “Full 2-Port Transmission Standards” on page 3-26.

{ISOLATION} See “Full 2-Port Isolation Standards” on page 3-27.

TRL (TRM) 2-Port

The 1.0 mm calibration kit does not include a precision transmission line; therefore a TRM (Thru-Reflect-Match) calibration must be used in place of the TRL (Thru-Reflect-Line) calibration indicated by the menu title.

NOTE

The 1.0 mm calibration kit only supports TRM 2-port calibration for measurement up to 50 GHz.

For this calibration, select:
[CAL] ***{CAL1*** or ***CAL2} {TRL 2-PORT}***

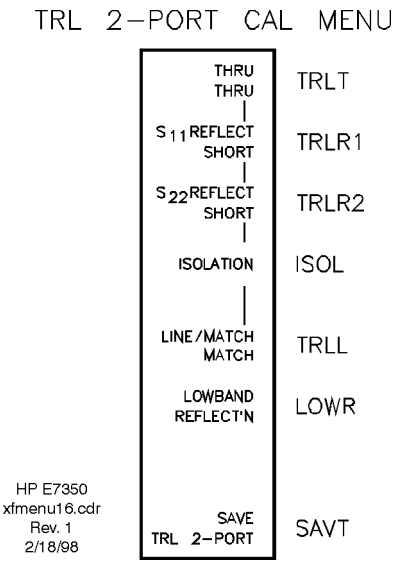


Figure 3-8 TRL 2-Port Menu & Equivalent GPIB Commands

Notes on the Standards

{THRU} — Connect Port 1 to Port 2.

{S11 REFLECT SHORT} — Connect a short to Port 1. You will be prompted to select ***{(F) SHORT3}*** or ***{(M) SHORT3}***.

{S22 REFLECT SHORT} — Connect a short to Port 2. You will be prompted to select ***{(F) SHORT3}*** or ***{(M) SHORT3}***.

{ISOLATION LOAD} — See "Full 2-Port Isolation Standards" on page 3-27.

{LINE MATCH MATCH} — Connect 50 GHz loads to Port 1 and Port 2.

{LOWBAND REFLECT'N} — This standard is not used in connection with the 1.0 mm calibration kit (for information regarding its use with other calibration kits, see the manuals for those kits).

Standard Types

Standards Already Described

Some of the standards have already been described, in connection with the calibration types with which they are associated.

- Response standards (required for Response calibrations) are described on page 3-14.
- Response & Isolation standards (required for Response & Isolation calibrations) are described on page 3-15.
- TRM standards (required for Thru-Reflect-Match calibrations) are described on page 3-19.

Other Standards

The remaining standard types require a more detailed presentation, and are described in the following pages.

Open/Short Standards

These standards are used to measure reflection for:

- S11 1-Port calibrations
- S22 1-Port calibrations
- One-Path 2-Port calibrations
- Full 2-Port calibrations

When you perform any of these calibrations using a 1.0 mm calibration kit, you will see the following menu:

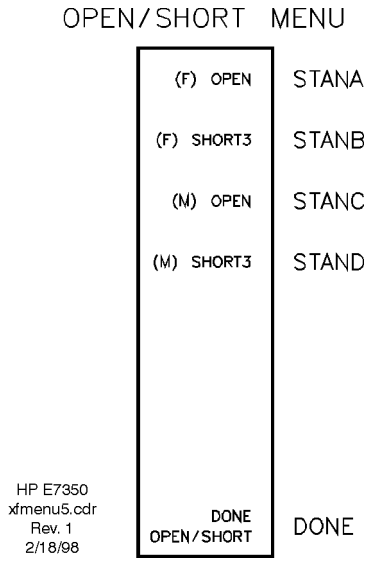


Figure 3-9 Open/Short Standard Menu & Equivalent GPIB Commands

Notes on the Standards

{(F) OPEN} Refers to an open which has a male connector (that is, the open is to be connected to a female port). This standard is used for frequencies up to 50 GHz.

{(F) SHORT3} Refers to Short No. 3 with a male connector (that is, the short is to be connected to a female port). This standard is used for frequencies above 50 GHz.

{(M) OPEN} Refers to an open which has a female connector (that is, the open is to be connected to a male port). This standard is used for frequencies up to 50 GHz.

{(M) SHORT3} Refers to Short No. 3 with a female connector (that is, the short is to be connected to a male port). This standard is used for frequencies above 50 GHz.

Shorts Standards

These standards are used to measure reflection for:

- S11 1-Port calibrations
- S22 1-Port calibrations
- One-Path 2-Port calibrations
- Full 2-Port calibrations

When you perform any of these calibrations using a 1.0 mm calibration kit, you will see the following menu:

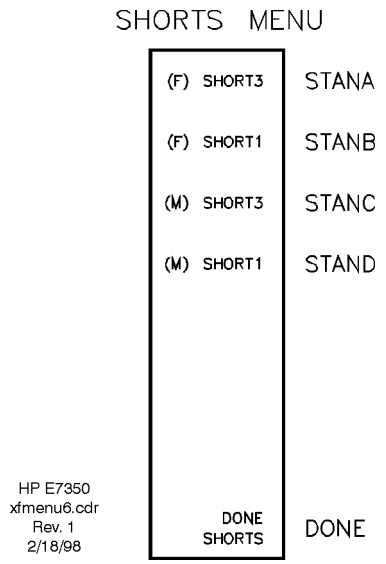


Figure 3-10 Shorts Standard Menu & Equivalent GPIB Commands

Notes on the Standards

{(F) SHORT3} Refers to Short No. 3 with a male connector (that is, the short is to be connected to a female port). This standard is used for frequencies up to 50 GHz.

{(F) SHORT1} Refers to Short No. 1 with a male connector (that is, the short is to be connected to a female port). This standard is used for frequencies above 50 GHz.

{(M) SHORT3} Refers to Short No. 3 with a female connector (that is, the open is to be connected to a male port). This standard is used for frequencies up to 50 GHz.

{(M) SHORT1} Refers to Short No. 1 with a female connector (that is, the short is to be connected to a male port). This standard is used for frequencies above 50 GHz.

Load/Short Standards

These standards are used to measure reflection for:

- S11 1-Port calibrations
- S22 1-Port calibrations
- One-Path 2-Port calibrations
- Full 2-Port calibrations

When you perform any of these calibrations using a 1.0 mm calibration kit, you will see the following menu:

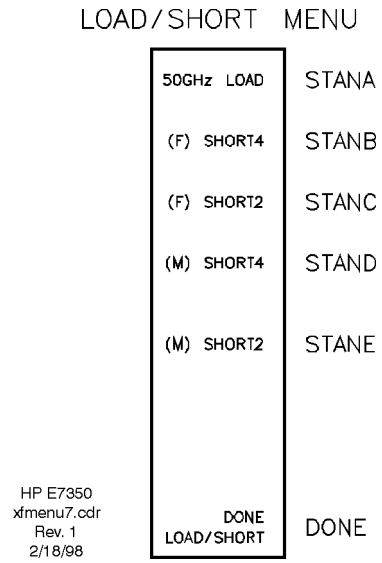


Figure 3-11 Load/Short Standard Menu & Equivalent GPIB Commands

Notes on the Standards

{50GHz LOAD} Refers to either of two 50 GHz loads (with male and female connectors, as appropriate). This standard is used for frequencies up to 50 GHz.

{(F) SHORT4} Refers to Short No. 4 with a male connector (that is, the short is to be connected to a female port). This standard is used for frequencies from 50 to 75 GHz.

{(F) SHORT2} Refers to Short No. 2 with a male connector (that is, the short is to be connected to a female port). This standard is used for frequencies above 75 GHz.

{(M) SHORT4} Refers to Short No. 4 with a female connector (that is, the open is to be connected to a male port). This standard is used for frequencies from 50 to 75 GHz.

{(M) SHORT2} Refers to Short No. 2 with a female connector (that is, the short is to be connected to a male port). This standard is used for frequencies above 75 GHz.

One-Path Transmission Standards

These standards are used to measure transmission and match for one-path 2-port calibrations. When you perform a calibration of that type using a 1.0 mm calibration kit, you will see the following menu:

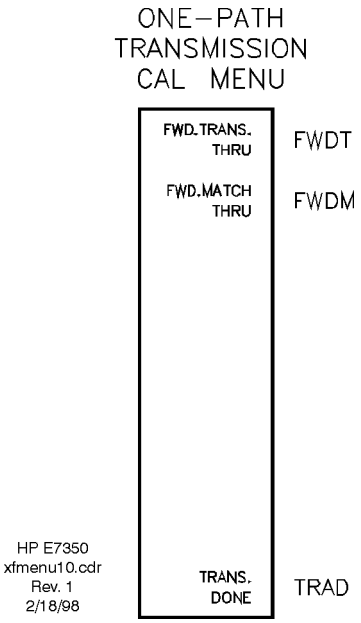


Figure 3-12 One-Path Transmission Calibration Menu & Equivalent GPIB Commands

Notes on the Standards

{FWD.TRANS. THRU} Make a “thru” connection (that is, connect one port to the other through a cable).

{FWD.MATCH THRU} Make a “thru” connection (that is, connect one port to the other through a cable).

NOTE It is necessary to make both of these measurements.

One-Path Isolation Standard

This standard is used to measure forward isolation for one-path 2-port calibrations. When you perform a calibration of that type using a 1.0 mm calibration kit, you will see the following menu:

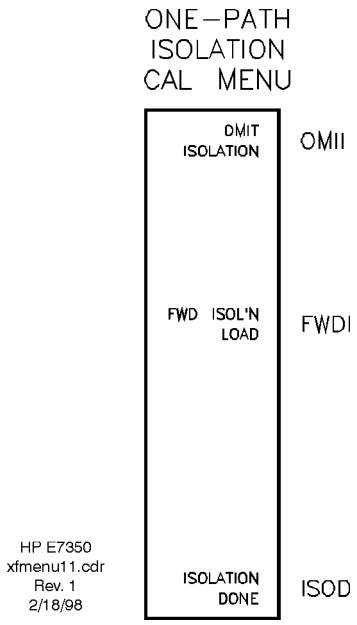


Figure 3-13 One-Path Isolation Calibration Menu & Equivalent GPIB Commands

Note on the Standard

{FWD ISOL'N LOAD}

Refer to “Isolation” under “Banded Standards” in Table 3-1 on page 3-12.

NOTE

To skip the isolation part of the calibration, select ***{OMIT ISOLATION}***.

Full 2-Port Transmission Standards

These standards are used to measure transmission and match for full 2-port calibrations. When you perform a calibration of that type using a 1.0 mm calibration kit, you will see the following menu:

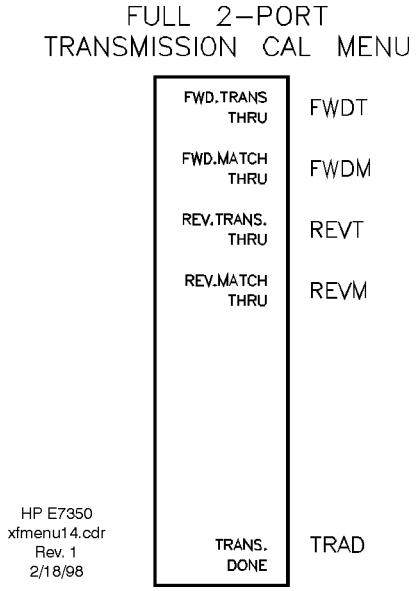


Figure 3-14 Full 2-Port Transmission Calibration Menu & Equivalent GPIB Commands

Notes on the Standards

{FWD. TRANS. THRU} Make a “thru” connection (that is, connect one port to the other through a cable).

{FWD.MATCH THRU} Make a “thru” connection (that is, connect one port to the other through a cable).

{REV.TRANS. THRU} Make a “thru” connection (that is, connect one port to the other through a cable).

{REV.MATCH THRU} Make a “thru” connection (that is, connect one port to the other through a cable).

NOTE It is necessary to make all four of these measurements.

Full 2-Port Isolation Standards

These standards are used to measure forward and reverse isolation for full 2-port calibrations. When you perform a calibration of that type using a 1.0 mm calibration kit, you will see the following menu:

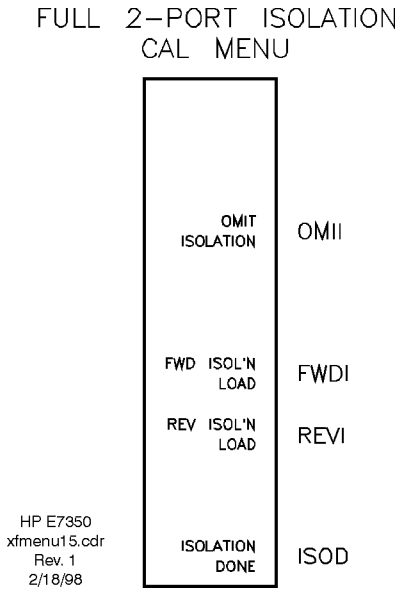


Figure 3-15 Full 2-Port Isolation Calibration Menu & Equivalent GPIB Commands

Notes on the Standards

{FWD ISOL'N LOAD}

Refer to “Isolation” under “Banded Standards” in Table 3-1 on page 3-12.

{REV ISOL'N LOAD}

Refer to “Isolation” under “Banded Standards” in Table 3-1 on page 3-12.

NOTE

To skip the isolation part of the calibration, select ***{OMIT ISOLATION}***.

Port Power

Port-specific power settings are made using this menu:
STIMULUS [MENU] ***{POWER MENU}***

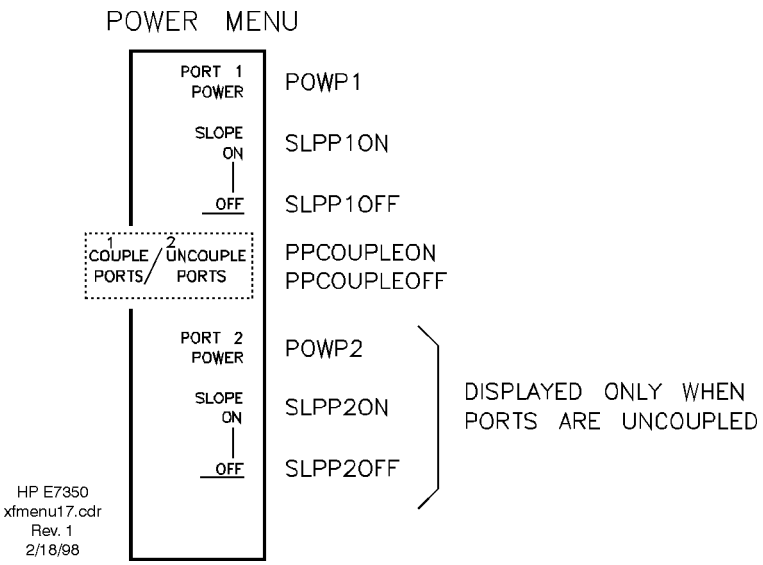


Figure 3-16 Power Menu & Equivalent GPIB Commands

NOTE

The port power functions are valid only if ***{RF LEVEL / SYSTEM}*** is selected on the **[SYSTEM]** ***{MORE} {RF POWER CONFIG}*** menu (see "RF Power Configuration" on page 3-30).

Port 1 Power Functions

The first three softkeys control the power level from Port 1 (and also from Port 2, if the ports are coupled).

{PORT1 POWER}, followed by a number, specifies a power level setting for Port 1, in dBm. If the ports are coupled, this setting applies also to Port 2.

{PORT1 SLOPE ON} and ***{PORT1 SLOPE OFF}*** are used to enable and disable power slope for Port 1. ***{PORT1 SLOPE ON}***, followed by a number, specifies the power slope setting for Port 1, in dB/GHz. If the ports are coupled, this setting applies also to Port 2.

NOTE

During operation in the power slope mode, the power at the first frequency of the sweep is the current port power level; slope is applied as frequency increases. Power slope has no effect on CW measurements.

Port Coupling

Softkey #4 is a toggle key, alternately representing ***{COUPLE PORTS}*** or ***{UNCOUPLE PORTS}***. Pressing this softkey selects the displayed function, but changes the display to show the opposite function. If you press ***{COUPLE PORTS}***, the Port 1 power level setting and power slope setting are applied to Port 2. If you press ***{UNCOUPLE PORTS}***, the two ports have independent power level settings and power slope settings.

Port 2 Power Functions

The last three softkeys control the power level from Port 2. These softkeys are displayed only if the ports are uncoupled.

{PORT2 POWER}, followed by a number, specifies a power level setting for Port 2, in dBm.

{PORT2 SLOPE ON} and ***{PORT2 SLOPE OFF}*** are used to enable and disable power slope for Port 2. ***{PORT2 SLOPE ON}***, followed by a number, specifies the power slope setting for Port 2, in dB/GHz.

NOTE

During operation in the power slope mode, the power at the first frequency of the sweep is the current port power level; slope is applied as frequency increases. Power slope has no effect on CW measurements.

RF Power

RF power functions that are not port-specific are accessed using the RF Power Configuration and RF Power Settings menus, described below.

RF Power Configuration

[SYSTEM] ***{MORE} {RF POWER CONFIG}*** calls up the following menu:

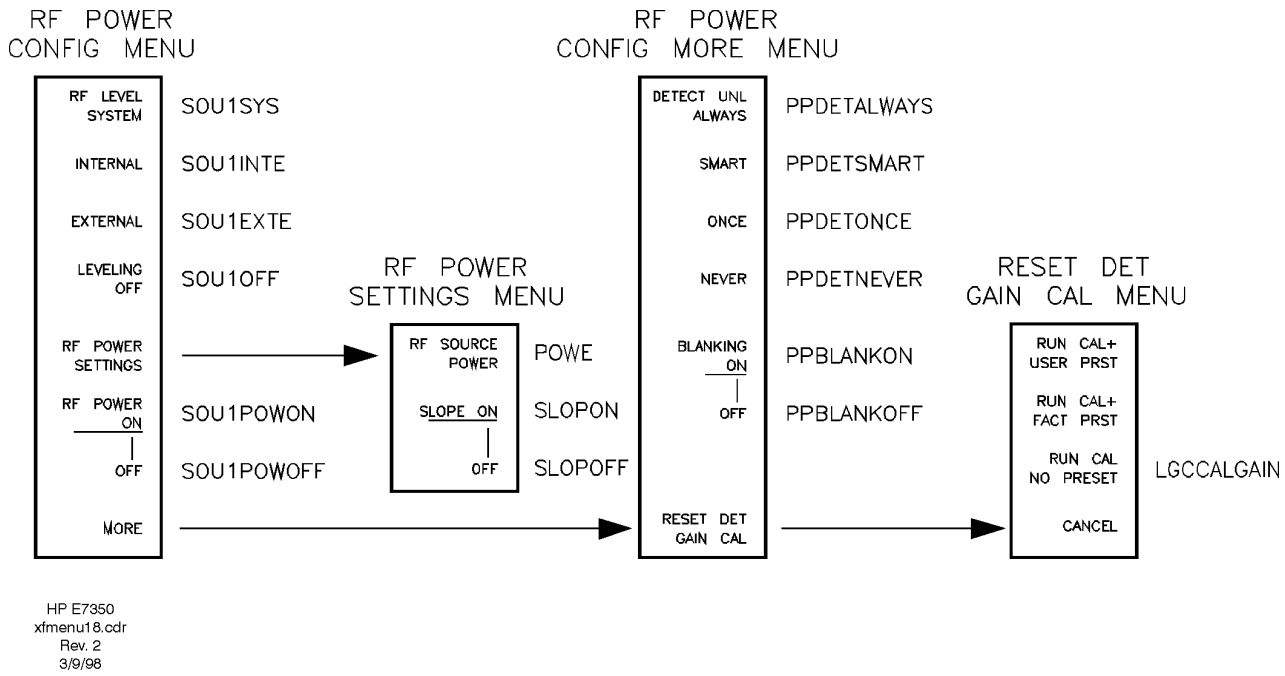


Figure 3-17 ***RF Power Configuration Menu, Submenus, and Equivalent GPIB Commands***

RF Leveling Functions

The first four softkeys specify different methods of controlling RF power.

If ***{RF LEVEL / SYSTEM}*** is selected, leveling of RF power at the test ports is controlled entirely by the 8510XF system. ***This is the normal operating mode.***

NOTE

The remaining “RF LEVEL” selections are provided as a convenience for use in unusual applications; they are not recommended for normal operation of the 8510XF.

If ***{RF LEVEL / INTERNAL}*** is selected, the RF source (83651B) performs its own leveling, using an internal detector.

- To use the ***{RF LEVEL / INTERNAL}*** mode, you must break the connection between the ALC output of the millimeter-wave controller and the ALC input of the RF source.
- To return to normal operation, you must restore that connection.

If ***{RF LEVEL / EXTERNAL}*** is selected, the RF source performs its own leveling, using an external detector.

If ***{RF LEVEL / LEVELING OFF}*** is selected, the RF source is set to the unleveled mode.

RF Power Settings

The ***{RF POWER SETTINGS}*** softkey calls up a submenu (see "RF Power Settings" on page 3-33).

RF Power On/Off

The softkeys ***{RF POWER /ON}*** and ***{RF POWER /OFF}*** activate and deactivate RF source power.

Unleveled/Overmod Detection

On the second page of the menu (called up by the ***{MORE}*** softkey), the first four softkeys determine how the network analyzer processes error information while it is sweeping. This has an impact on sweep speed.

Explanation

In frequency sweeping, an RF blanking interval occurs at each frequency change (see "Blanking circuit" on page 5-17). To the RF source, this blanking interval looks like an error condition ("unleveled" or "overmod"). To prevent the RF source from generating a spurious error message every time the frequency changes, SRQ triggering for these errors is disabled at the RF source throughout the sweep.

Triggering of "overmod" errors remains disabled throughout the sweep (detection of this type of error is incompatible with 8510XF sweep operation). However, the network analyzer is able to poll the source *after* each blanking interval, and determine the status of the "unleveled" condition flag (this verifies that no actual unleveled error occurred).

This polling process adds from 3 to 6 milliseconds of delay for each frequency point. Some users will want to limit the amount of error polling done by the analyzer, in order to speed up the sweep.

Choices

If ***{DETECT UNL / ALWAYS}*** is selected, the 8510C polls for errors during every sweep.

If ***{DETECT UNL / SMART}*** is selected, the 8510C polls for errors during the first sweep following a frequency change, and thereafter only if an error was detected during the first sweep. *This is the default mode.*

If ***{DETECT UNL / ONCE}*** is selected, the 8510C polls for errors only during the first sweep following a frequency change.

If ***{DETECT UNL / NEVER}*** is selected, the 8510C does not poll for errors during any sweep.

Blanking On/Off

The softkeys ***{BLANKING /ON}*** and ***{BLANKING /OFF}*** activate and deactivate port power blanking during frequency or port drive transitions. (See "Blanking circuit" on page 5-17).

Reset Detector Gain Calibration

The ***{RESET DET GAIN CAL}*** softkey calls up a submenu (see "Reset Detector Gain Calibration" on page 3-34).

RF Power Settings

[SYSTEM] ***{MORE} {RF POWER CONFIG} {RF POWER SETTINGS}*** calls up the following submenu:

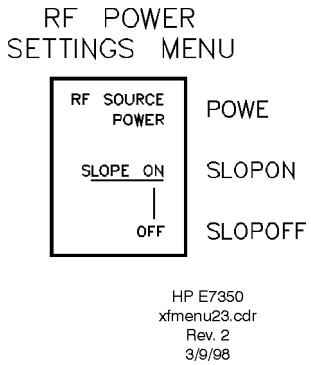


Figure 3-18 RF Power Settings Submenu & Equivalent GPIB Commands

NOTE

The functions represented on this menu will not work if ***{RF LEVEL / SYSTEM}*** is selected on the **[SYSTEM]** ***{MORE} {RF POWER CONFIG}*** menu (see "RF Power Configuration" on page 3-30). These functions are not used during normal operation of the system; they are made available for service use, or for unusual measurement situations.

RF Source Power

{RF SOURCE POWER}, followed by a number, specifies a power level setting for the 83651B RF source, in dBm.

RF Source Slope

{SLOPE ON} and ***{SLOPE OFF}*** are used to enable and disable power slope for the RF source. ***{SLOPE ON}***, followed by a number, specifies the power slope setting for the RF source, in dB/GHz.

Reset Detector Gain Calibration

[SYSTEM] ***{MORE} {RF POWER CONFIG} {MORE} {RESET DET GAIN CAL}*** calls up the following submenu:

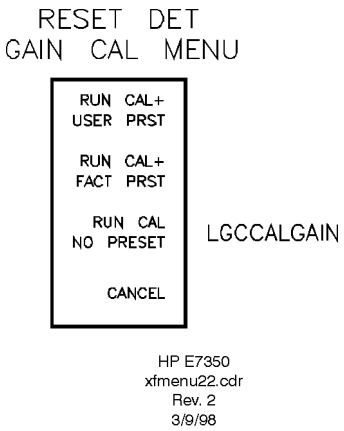


Figure 3-19 Reset Detector Gain Calibration Submenu & Equivalent GPIB Commands

The functions on this menu are used to calibrate the programmable gain portion of the level control circuit (see "Level Control" on page 5-14). This calibration is one of the processes which, in combination, insure that absolute power levels at the test ports are accurate and repeatable.

NOTE

Running this calibration takes about one minute.

For measurements in which absolute power levels are critical, perform this calibration before every measurement calibration (see page 3-6). If absolute power levels are not important, you can perform this calibration infrequently (on a monthly basis, for example).

Practical Considerations

The detector gain calibration process causes some settings to change, and these are not restored to their original conditions afterward. Therefore, after the calibration, the system needs to be returned to a known state. The first two softkeys (which combine the cal process with a user preset or factory preset) are included in the menu as a convenience (and as a reminder of the need to save the present settings *before* running the calibration).

"RUN CAL" Functions

If ***{RUN CAL + USER PRST}*** is selected, the detector gain calibration routine is run, and is followed by a user preset.

If ***{RUN CAL + FACT PRST}*** is selected, the detector gain calibration routine is run, and is followed by a factory preset.

If ***{RUN CAL NO PRESET}*** is selected, the detector gain calibration routine is run, but is not followed by a preset (system settings that are altered by the calibration routine will not be restored to their original conditions afterward).

Use ***{CANCEL}*** to exit the menu without running the calibration routine.

LO Power

LO power functions are accessed using the LO Power Configuration and LO Power Settings menus, described below.

LO Power Configuration

[SYSTEM] ***{MORE} {LO POWER CONFIG}*** calls up the following menu:

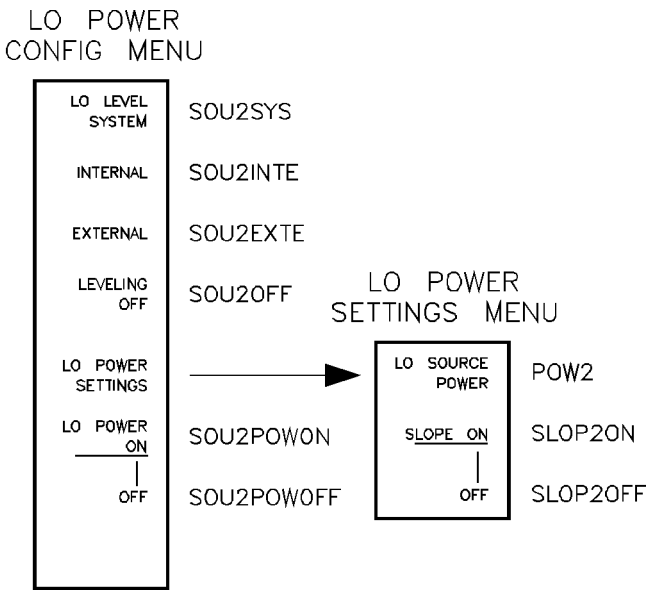


Figure 3-20 ***LO Power Configuration Menu, LO Power Settings Submenu, and Equivalent GPIB Commands***

LO Leveling Functions

The first four softkeys specify different methods of leveling for the 83621B LO source.

If ***{LO LEVEL / SYSTEM}*** is selected, leveling of the LO source (83621B) is controlled entirely by the 8510XF system. ***This is the normal operating mode.***

NOTE

The remaining “LO LEVEL” selections are provided as a convenience for use in unusual applications; they are not recommended for normal operation of the 8510XF.

If ***{LO LEVEL / INTERNAL}*** is selected, the LO source performs its own leveling, using an internal detector.

If ***{LO LEVEL / EXTERNAL}*** is selected, the LO source performs its own leveling, using an external detector.

If ***{LO LEVEL / LEVELING OFF}*** is selected, the LO source is set to the unleveled mode.

LO Power Settings

The ***{LO POWER SETTINGS}*** softkey calls up a submenu (see "LO Power Settings" below).

LO Power On/Off

The softkeys ***{LO POWER /ON}*** and ***{LO POWER /OFF}*** activate and deactivate LO source power.

LO Power Settings

[SYSTEM] ***{MORE} {LO POWER CONFIG} {LO POWER SETTINGS}*** calls up the submenu which is shown on the right of Figure 3-20 on the previous page.

NOTE

The functions represented on this submenu will not work if ***{LO LEVEL / SYSTEM}*** is selected on the **[SYSTEM]** ***{MORE} {LO POWER CONFIG}*** menu (see "LO Power Configuration" on page 3-36). These functions are not used during normal operation of the system; they are made available for service use, or for unusual measurement situations.

LO Source Power

{LO SOURCE POWER}, followed by a number, specifies a power level setting for the 83621B LO source, in dBm.

LO Source Slope

{SLOPE ON} and ***{SLOPE OFF}*** are used to enable and disable power slope for the LO source. ***{SLOPE ON}***, followed by a number, specifies the power slope setting for the LO source, in dB/GHz.

Service

Service functions are accessed using the 85102 Service and XF Test Set Service menus, described below.

85102 Service

[SYSTEM] ***{MORE} {SERVICE FUNCTIONS} {85102 SERVICE}*** calls up the menu shown on the right of the figure below:

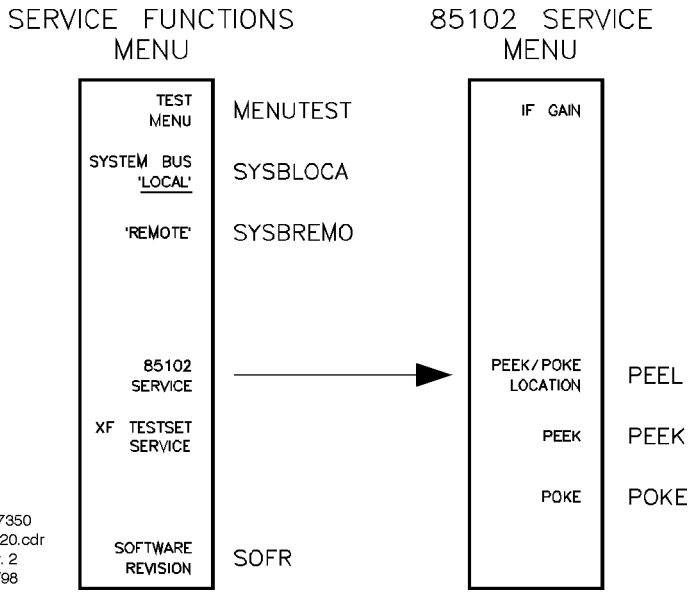


Figure 3-21 Service Functions Menu, 85102 Service Submenu, and Equivalent GPIB Commands

This menu includes those service functions which apply specifically to the network analyzer, rather than to the test set.

These functions are intended to be used only by Agilent service engineers.

NOTE

"85102" refers to the IF/detector section of the 8510C network analyzer, which is placed below the display/processor section.

IF Gain Submenu

The ***{IF GAIN}*** softkey calls up the IF gain submenu, which is identical in the 8510XF to the submenu which appears in the standard 8510C operating system under **[SYSTEM]** ***{MORE} {SERVICE FUNCTIONS} {IF GAIN}***. This submenu makes it possible to disable the automatic gain control system which normally regulates IF levels within the network analyzer, and specify a fixed gain setting instead.

Peek/Poke Functions

The last three softkeys make it possible to read from, or write to, a location within the memory of the network analyzer.

- ***{PEEK/POKE LOCATION}*** specifies the memory location to be read from, or written to.
- ***{PEEK}*** reads data from the memory location already specified.
- ***{POKE}*** writes data to the memory location already specified.

XF Test Set Service

[SYSTEM] ***{MORE} {SERVICE FUNCTIONS} {XF TESTSET SERVICE}*** calls up the following menu:

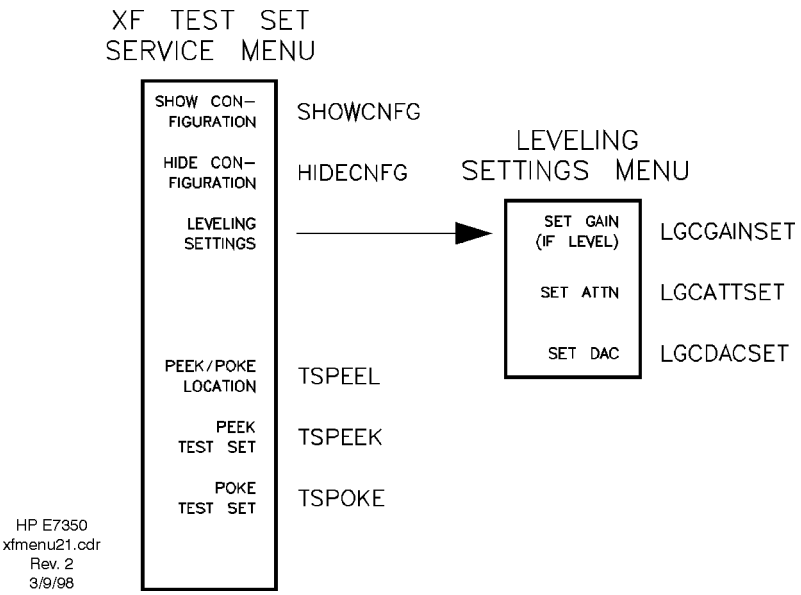


Figure 3-22 XF Test Set Service Menu, Leveling Settings Submenu, and Equivalent GPIB Commands

This menu includes those service functions which apply specifically to the test set (that is, the millimeter-wave controller and the test heads), rather than to the network analyzer.

These functions are intended to be used only by Agilent service engineers.

Show/Hide Configuration

The first softkey toggles between two modes:

- If ***{SHOW CONFIGURATION}*** is selected, information about the system hardware configuration (frequency bands, test heads, etc.) is displayed.
- If ***{HIDE CONFIGURATION}*** is selected, information about the system hardware configuration is not displayed.

Leveling

The ***{LEVELING SETTINGS}*** softkey calls up a submenu (see "Leveling Settings" on page 3-41).

Peek/Poke Functions

The last three softkeys make it possible to read from, or write to, a location within the memory of the millimeter-wave controller.

- ***{PEEK/POKE LOCATION}*** specifies the memory location to be read from, or written to.
- ***{PEEK TEST SET}*** reads data from the memory location already specified.
- ***{POKE TEST SET}*** writes data to the memory location already specified.

Leveling Settings

[SYSTEM] ***{MORE} {SERVICE FUNCTIONS} {XF TESTSET SERVICE} {LEVELING SETTINGS}*** calls up the submenu shown on the right of Figure 3-22 on the previous page.

These functions relate to detector gain calibration (see "Reset Detector Gain Calibration" on page 3-34). They are intended to be used only by Agilent service engineers.

{SET GAIN (IF LEVEL)} makes it possible to specify the gain (in dB) of the programmable gain portion of the level control circuit. (Perform a detector gain calibration *before* selecting this function.)

{SET ATTN} makes it possible to specify the attenuator setting for the programmable gain portion of the level control circuit. Possible values are 0 to 133, with each increment representing 0.5 dB of attenuation.

{SET DAC} makes it possible to specify a multiplier value for the DAC in the programmable gain portion of the level control circuit. Possible values are 0 to 255.

IF Frequency

The IF used by the network analyzer is nominally 20 MHz. However, it is desirable to add a slight offset to that frequency; the offset provides immunity against spurious 20 MHz signals, which can have a detectable impact on measurement when averaging is used. In the 8510XF, the factory preset default value of the IF is 20.000017 MHz (in other words, an offset of 17 Hz has been added).

The key sequence **[SYSTEM]** ***{MORE} {IF FREQ}***, followed by a frequency, can be used to change the value of the IF frequency. The effective range of modification is restricted by hardware performance characteristics (typically, the IF range is 20 MHz ±10 kHz).

NOTE

At measurement frequencies greater than 18 GHz, the actual IF may differ slightly from the set value, owing to the frequency resolution of the RF and LO sources.

Alternative 1.0 mm Calibrations

NOTE

The two calibration techniques described here are simplified broadband calibrations, which save time at the expense of accuracy. These calibrations are meant to be used *only* in situations where measurement accuracy is not critical.

Broadband Standards

The broadband calibrations use a separate set of calibration standard definitions, which are included on the calibration data disk that is supplied with the 1.0 mm calibration kit (85059A).

Loading the broadband standards

1. Insert the calibration data disk into the 8510C disk drive.
2. Press **[DISC]** ***{LOAD}***.
   The analyzer displays **`SELECT DATA TYPE TO LOAD`**.
3. Select ***{CAL KIT 1}*** or ***{CAL KIT 2}***.
   The analyzer displays **`USE KNOB OR STEP KEYS TO SELECT A FILE.`**
4. Select **`CK_1MMA1B`** from the display menu. (This is the file that contains the broadband standards.)
5. Select ***{LOAD FILE}***. This loads the calibration constants into the memory of the network analyzer. A screen message indicates when the load process is complete (**`FILE 'CK_1MMA1B' LOADED FROM DISK`**).
6. Remove the disk from the drive.

Broadband SOLT Calibration

This is a method of calibrating across the entire frequency range of the 8510XF, using the Short-Open-Load-Thru technique, without differentiating the range into separate frequency bands.

NOTE

When this technique is used, the performance of the 8510XF is not specified. Use broadband SOLT calibration *only* in situations where saving time is more important than insuring accuracy.

Broadband SOLT Standards

The broadband SOLT calibration process is a simplification of the SOLT process already described under "Full 2-Port" on page 3-18; there are simply fewer standards to choose from, and no frequency bands:

{OPEN} You will be prompted to select ***{(F) OPEN}*** or ***{(M) OPEN}***.

{SHORT} You will be prompted to select ***{(F) SHORT3}*** or ***{(M) SHORT3}***.

{LOAD} The broadband load standard consists of a 50 GHz load (male or female, as appropriate) combined with a lossy delay line from the 1.0 mm calibration kit (male or female, as appropriate).

{THRU} The broadband thru standard is a port to port connection made through a cable.

Broadband TRM

This is a method of calibrating across the entire frequency range of the 8510XF, using the Thru-Reflect-Match technique.

NOTE

When this technique is used, the performance of the 8510XF is not specified. Use broadband TRM calibration *only* in situations where saving time is more important than insuring accuracy.

Broadband TRM Standards

The broadband TRM calibration process is essentially the same as TRM process already described under "TRL (TRM) 2-Port" on page 3-19:

{THRU} Connect Port 1 to Port 2 through a cable.

{S11 REFLECT SHORT} Connect a short to Port 1 (use offset short No. 1, male or female, as appropriate).

{S22 REFLECT SHORT} Connect a short to Port 2 (use offset short No. 1, male or female, as appropriate).

{ISOLATION LOAD} Connect isolation standards to Port 1 and Port 2. The isolation standard is a broadband load, which consists of a 50 GHz load (male or female, as appropriate) combined with a lossy delay line from the 1.0 mm calibration kit (male or female, as appropriate).

{LINE MATCH MATCH} Connect match standards to Port 1 and Port 2. The match standard is a broadband load, which consists of a 50 GHz load (male or female, as appropriate) combined with a lossy delay line from the 1.0 mm calibration kit (male or female, as appropriate).

{LOWBAND REFLECT'N} This standard is not used in connection with the 1.0 mm calibration kit (for information regarding its use with other calibration kits, see the manuals for those kits).

Operation Using a Wafer Probe Station

System Configuration

For on-wafer measurements, it is usually best to remove the network analyzer from the instrument rack, and place it on a table adjacent to the probe station. This allows for easy viewing of the analyzer display, and easy access to the analyzer's front panel controls.

The test heads are placed on X-Y positioners on the probe station. Locations on a probe station are conventionally referred to in terms of compass points; accordingly, the left test head is placed on the "west" positioner, and the right test head is placed on the "east" positioner.

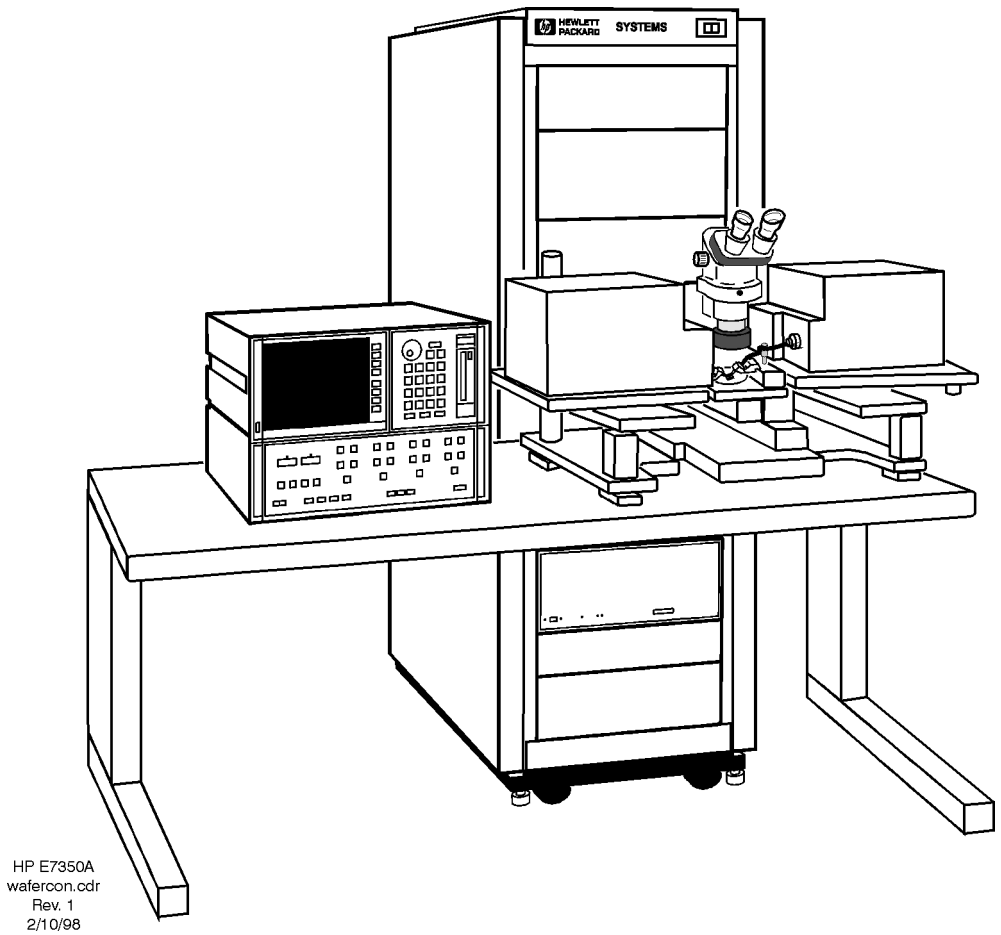


Figure 3-23 Wafer Probe Configuration

Available Equipment

Agilent Technologies does not manufacture or supply a probe station for the 8510XF. The recommended supplier of probe stations is:

Cascade Microtech, Inc.
2430 NW 206th Ave., Beaverton, Oregon 97006, USA
Telephone: (503) 601-1000 Fax: (503) 601-1002
Japan: (03) 5478-6105 Europe: +44 (0) 1295-812828
E-mail: sales@cmicro.com Web site: www.cascademicrotech.com

In addition to probe stations, Cascade offers a variety of accessories that are compatible with the 8510XF (including positioners, wafer test probes, calibration substrates, and calibration software).

Device Connections

Each test port of the 8510XF is connected to a wafer test probe (through a 1.0 mm coaxial cable, or through an adapter and another type of coaxial cable). Contact the manufacturer of the wafer probe station and an Agilent office for information on the cables and adapters needed to connect the test heads to the wafer probe station (refer to "Contacting Agilent" on page -v). The probe tips make direct contact with the on-wafer devices to be measured.

Positioners on the probe station adjust the position of the probe tips, in three axes of movement: left-right motions along the X axis, forward-back motions along the Y axis, and up-down motions along the Z axis. Motion in the Z-axis is typically controlled by a micropositioner to which the wafer probe (but not the test head) is attached.

In order to measure an on-wafer device, you will maneuver the probe tip into a position directly above the device, and then bring the tip down to contact the substrate. A microscope mounted on the probe station provides a close-up view of this process.

Types of Probe Stations

Probe stations are classified as manual, semi-automatic, and fully automatic.

- A manual probe station requires the operator to make all position adjustments manually, using a microscope to watch the position of the probe tips.
- Semi-automatic probe stations can be programmed with a wafer map, so that the system automatically locates and measures every device on the wafer. (Or, in "indexing" mode, the system measures the first device, and waits for the operator to push a button before it proceeds to the next device.)
- Fully automatic probe stations are able to load a series of wafers from a cassette, automatically measuring each DUT on each wafer (using a wafer map) before replacing the wafer in the cassette.

- In automatic and semi-automatic probe stations, the adjustments in the X, Y, and Z axes are used to get the test probe into the proper positions relative to one another; a positioner under the wafer itself then moves the wafer so that the probe tips are brought into contact with each on-wafer device.

On-Wafer Calibration

The measurement calibration process of the 8510XF must be adapted to the particular wafer test probes and on-wafer calibration standards that are in use.

You will need to develop or purchase a calibration program that is appropriate to the equipment and accessories you are using.
Cascade Microtech provides calibration substrates and calibration software that are compatible with the 8510XF.

NOTE

The calibration process described elsewhere in this manual applies specifically to coaxial calibration kits; it is not applicable to on-wafer calibration.

4 Performance Verification

In This Chapter...

Verification Overview

NOTE

The verification procedures in this chapter work for all 8510 and 8510XF hardware configurations by substituting the proper 8510 source, test set, accessories, and millimeter wave controller.

Performance verification software Rev. A.05.01 or greater is available in DOS or LIF format, and will work with laptops or PCs that have the required accessories installed. Refer to"Materials Required" on page 4-3.

When to Verify

After installation of the system is complete, a performance verification is necessary to assure proper system operation. This initial verification is included with the installation.

After the initial verification, the verification should be repeated once a year. This recommended interval assumes that Agilent cables are used with the system.

If non-Agilent cables, adaptors, or other fixtures are used, the verification schedule must be determined by the user, as the characteristics of these devices are unknown. In establishing a verification schedule, the following factors should be considered:

- Frequency of use
- Amount of cable movement
- Amount of drift occurring between prior verifications

NOTE

Performance verification of a system performed at long intervals is *not* to be confused with measurement calibration. Measurement calibration typically is performed on a daily basis, or when measurement setup or conditions have changed.

Materials Required

The following materials are required to run the tests:

- 8510XF system with accessories
- 85059A 1.0 mm Precision Calibration and Verification Kit
- PC-based, 8510 Specification and Performance Verification Software (Rev. A.05.00 or greater; p/n 08510-10033)
- Laptop or PC running BASIC for Windows (3.1/95/NT) (Rev. 6.3 or greater)
- GPIB Card for PCs (National Instruments or HP)
- PCMCIA Card for Omnibook or laptop
- GPIB cable from PC to 8510XF

Calibration and Frequency Ranges

The 8510XF requires separate verifications for frequencies below and above 50 GHz (see on "Frequency ranges" on page 4-4).

A special two-band calibration procedure is required for the performance verification of the 8510XF system (a measurement calibration is *not* sufficient). There are up to three different calibrations and corresponding frequency ranges required, which are stored in suggested locations in the 8510 analyzer (Refer to Table 4-1 on page 4-3). For more information refer to the section on "Frequency ranges" on page 4-4. The parameters for these calibrations are set up automatically on the analyzer by the performance verification software.

Table 4-1 Calibration Storage Locations

File Location Name:	Frequency Range of Data Stored:
Cal Set 1	1-50 GHz[1] (2-50 GHz)[2]
Cal Set 2	45 MHz[1]
Cal Set 3	50-110 GHz[3]

1. This calibration is for Option 005 systems only.
2. The frequency for standard systems is 2-50 GHz.
3. The frequency range shown is for the E7352A system only. The E7342A system's frequency range will be: 50-85 GHz.

Frequency ranges

For most of the menu items in the software, there are two or more selections that pertain to the 8510XF. These menu selections are differentiated by:

A. The frequency range of the millimeter wave subsystem

- E7352A: 110 GHz subsystem
- E7342A: 85 GHz subsystem
- Option 005: 45MHz to 2 GHz

B. The portion of the subsystem's frequency range that is being verified (the ranges above and below 50 GHz are verified separately).

The menu selections are broken down in Tables 4-2 and 4-3, below.

Table 4-2 System Hardware Configuration (E7352A -- 110 GHz System)

Hardware	Selection (<50 GHz Range)	Selection (>50 GHz Range)
Network Analyzer	8510C -- Vector Network Analyzer	8510C -- Vector Network Analyzer
Test Set	E7352A -- 1.0 mm Subsystem (2-50 GHz) E7352A005 -- 1.0 mm Subsystem (45MHz-50GHz)	E7352A110 -- 1.0 mm (50 GHz-110 GHz)
Source	8365xXF -- Synthesizer (45 MHz-50 GHz)	836xxXF -- Multiplied Synth. (above 50 GHz)
Calibration Kit[1]	85059A -- 1.0 mm (45 MHz-50 GHz) [Use w/ E7342A/52A]	85059A110 -- 1.0 mm (50 GHz-110 GHz)
Calibration Technique	BL -- Broadband Load Cal	OS -- Offset Short Cal
Test Port Cables	DIRECTXF -- for 8510XF verification (1.0 mm-1.0 mm)	DIRECTXF -- for 8510XF verification (1.0 mm-1.0 mm)
Verification Kit	85059AOV -- 1.0 mm (45 MHz-50 GHz)	85059AOV110 -- 1.0 mm (above 50 GHz)

1. The 85059A --1.0 mm (45MHz-50GHz) [Use w/ 8517A/B] selection is not used for the 8510XF Performance Verification.

Table 4-3 System Hardware Configuration (E7342A -- 85GHz System)

Hardware	Selection (<50 GHz Range)	Selection (>50 GHz Range)
Network Analyzer	8510C -- Vector Network Analyzer	8510C -- Vector Network Analyzer
Test Set	E7342A -- 1.0 mm Subsystem (2-50 GHz) E7342A005 -- 1.0 mm Subsystem (45 MHz-50GHz)	E7342A85 -- 1.0 mm (50 GHz-85 GHz)
Source	8365xXF -- Synthesizer (45 MHz-50 GHz)	836xxXF -- Synth. (above 50 GHz)
Calibration Kit[1]	85059A -- 1.0 mm (45 MHz-50 GHz) [Use w/ E7342A/52A]	85059A85 -- 1.0 mm (50 GHz-85 GHz)
Calibration Technique	BL -- Broadband Load Cal	OS -- Offset Short Cal
Test Port Cables	DIRECTXF -- for 8510XF verification (1.0 mm-1.0 mm)	DIRECTXF -- for 8510XF verification (1.0 mm-1.0 mm)
Verification Kit	85059AOV -- 1.0 mm (45 MHz-50 GHz)	85059AOV110 -- 1.0 mm (above 50 GHz)

1. The 85059A --1.0 mm (45MHz-50GHz) [Use w/ 8517A/B] selection is not used for the 8510XF Performance Verification.

Verification Setup

General Preparation

Prepare for performance verification by completing the following steps:

1. Measure the environment temperature and humidity. The temperature must be between +20 °C and +26 °C. Additionally, the temperature cannot vary by more than 1°C after calibration.
2. Perform a good installation “preflight” checkout on the 8510XF system.
3. Power on the system components in the following order:
   a. Sources
   b. Millimeter wave controller
   c. 8510XF
   d. Controller (PC or laptop)
4. Remember to allow at least one hour for warm up of the components.

Software Installation

In order to verify performance, you must first install BASIC for Windows and the 8510C Specification and Performance Verification software on a PC (or controller).

NOTE

This manual documents the use of the verification software on a PC. Use of the software on a controller is not documented.

The PC must have an INTEL 486 processor or higher, and must have at least eight megabytes of memory available. The PC must also have an GPIB card in order to communicate with the 8510XF.

1. Install BASIC for Windows (Revision 6.3 or later) on the PC following the instructions on the first BASIC disk. The program will guide you through the installation process. (For more detailed information, refer to *BASIC for Windows, Installing and Using Guide*.) If you are installing Revision 7.1 or later install the Legacy Version.
2. Install the specification and performance verification software by following the instructions on the disk label. The installation program will lead you through the installation. In the process, a new program group will be created, which includes the “Spec8510” icon.

NOTE

Rev. A.05.00 or greater of the performance verification software is backwards compatible. So, it is okay to replace the older version you have on the PC.

3. Run the program by clicking on the “Spec8510” icon or selecting: **Start, Programs, 8510, Spec8510**. The following warning messages will be displayed:

   A valid Basic for Windows GPIB driver for your board (if any) has not been loaded. You can run the Specifications and Uncertainty portions of the 8510 software but can not run the Verification portion as this requires communication. Press CONTINUE to load and run the 8510 software without GPIB or:

   To load the correct driver EDIT this program and Remove the “!” from in front of the LOAD statement for your GPIB board.

   After editing, type RE-STORE “AUTOST” to store the modified program. Then, close this window and re-select the Specifications and Verification icon to re-run the program. The 8510 software should now load and run.

4. Edit the AUTOST program according to the instructions in the warning message. (However, if you do not want to run the verification portion of the software, you can skip this step by selecting **CONTINUE**.)

NOTE

For additional information on running the system specifications, system uncertainty, and edit system specifications portions of the program please refer to the “Performance Verification and Specifications” chapter in the *8510C On-Site Service Manual*.

5. After editing and storing the **AUTOST** file, exit the program by closing the window and then restart the 8510 Specification & Performance Verification Program.

Software Configuration

NOTE

Once the Specifications and Verification Software is running, there is no *functional* difference between operation on a PC and operation on a controller.

1. Verify the GPIB cable is connected from the PC to the GPIB Bus (also referred to as the Public Bus) on the Analyzer.
2. After the program is started, the program title (8510 Specifications and Performance Verification Software) and copyright notices are displayed. Select **RESUME**.

3. A screen prompt will give you the opportunity to set the date and time. Press the **[Y]** key on the PC to skip this step, or press **[N]** to set the date and time.

4. The program loads the System Configuration file, and displays the System Hardware Configuration Menu. Use this menu to specify the equipment you are using, and the frequency range you are verifying (refer to "Frequency ranges" on page 4-4).

   To setup for the first performance verification, select the proper hardware setup for Low Band Verification (< 50 GHz) using Table 4-2 on page 4-4 for the E7352A 110 GHz system or Table 4-3 on page 4-4 for the E7342A 85 GHz system.

   a. Select **NEXT** or **PREVIOUS** to step through the list of selections for each menu item.

   b. Use the up and down arrow keys on the PC to advance from one menu item to another.

   c. Select **DONE** when you have made a selection for each menu item.

5. The main menu is displayed (see Table 4-4).

Table 4-4 Main Menu

Softkey	Description
System Config	System Hardware and Software Configuration Menu
System Specs	System Spec Table Menu
System Uncert	System Uncertainty & Dynamic Accuracy Plot/Table Menu
Edit Specs	Edit the System Specifications
Verify System	System Performance Verification Menu
Quit Progam	Quit this Program

Printer Selection

1. From the Main Menu (choosing printer options):
   a. Select **System Config.**
   b. Select **Software Config.**
   c. Select **Printer Connected to:**
2. Select printer output choice (refer to Table 4-5)

.

Table 4-5 Printer Table of Selections

Printer Connected To:
GPIB
WIN Printer[1]
LPT1
LPT2
File[2]

1. Windows default printer
2. Under Printer Redirection (File): Verify directory path exists before entering name of path.

3. Select **Done** and **Previous Menu** to return to Main Menu.

Verification Procedures

Low Band Verification (< 50 GHz)

The following steps assume the hardware configuration has been previously setup for Low Band Verification (< 50 GHz) in step 4 on page 4-7 under Software Configuration.

1. From the Main Menu select **Verify System** to go to the System Performance Verification Menu.
2. Select **Serial Numbers** to enter serial numbers of system and components.
3. Select **System Cal** and follow the program prompts to calibrate the system for frequencies <50 GHz. See Table 4-1 on page 4-3 for the calibrations required and suggested calibration storage locations (also refer to the "Two-Band Calibration Procedure for 8510XF Performance Verification" foldout at the end of this chapter).
   a. Install the 1.0 mm female to female cable (8.8 cm, Agilent part number 11500-60001) onto the right test head (port 2) prior to calibration. This cable is part of the 85059A 1.0 mm Precision Calibration and Verification Kit and is considered to be a *test port* cable.
   b. A full two-port calibration is required. A table of calibration standards required for each frequency range can be found in the 85059A 1.0 mm precision calibration and verification kit manual, or on the foldout at the end of this chapter.

CAUTION

Do *not* remove this test port cable once the Calibration/Verification process has begun. If the test port cable becomes loose or is removed during the calibration/verification process, the calibration is *invalid*.

CAUTION

Do not pull on the connectors on the ends of the test port cable —this will damage the cable. Avoid damaging the cable once it is connected to port 2 by carefully making the thru connection between the two test heads. This is best done by placing the two test heads on a smooth surface and gently sliding the right test head (port 2) towards the left test head (port 1).

c. To make the thru connection, gently slide the right test (port 2) towards the left test head (port 1) a little bit at a time, while turning the threaded ring on the left head test port connector by hand onto the cable attached to the right test head. Do *not* use the threaded ring on the test port connector to pull the cable into the connector. Repeat this process until the cable is firmly seated into port 1, then make the threaded ring barely finger tight. Finally use the torque wrench on the port 1 threaded ring and a backup wrench on the cable to tighten the connection.

4. Select **Select Standard** to go to the Standard Selection Menu.
5. To verify the system use the Verification Standards provided with the 85059A 1.0 mm Precision Calibration and Verification Kit (refer to Table 4-6). Using the menu select the verification standard and enter the standard's serial number. The verification standards may be measured in any order.

Table 4-6 Verification Standards from 1.0 mm Calibration and Verification Kit

Type of Standard	Part Number
Mismatched Thru Adapter	85059-60016
Match Thru Adapter	85059-60017

NOTE

It is recommended to connect the Verification Standards to the cable on port 2 prior to attempting to connect to port 1. Then follow the recommended procedure for making a thru connection outlined under step 3 above to avoid damaging the cable.

6. Use defaults for **Cal Set for Broadband Measurement: 1** and **Cal Set for 45 MHz Measurement (If Required): 2** in the Standard Menu.
7. If your system has Option 005, verify that **Cal Set for 45 MHz Measurement (If Required)** is set to **Yes**. Otherwise, set to **No**.
8. Select **Done** and follow the program prompts.
9. Select **Measure Data** to measure the verification standards. Follow the program prompts.
10. When verification has been completed view the data, then print or save (if required). If needed the verification standard can be remeasured by selecting **Repeat Measure**.

11. Select **Select Standard** to return to the Standard Selection Menu. Repeat steps 5 through 10 above for the other verification standard (refer to Table 4-6).
12. Select **Prior Menu** until the Main Menu appears.

High Band Verification (> 50 GHz)

NOTE

Before verification of the high band frequencies it is necessary to: 1) select new hardware for the system and 2) perform a calibration (for the frequency band > 50 GHz).

1. From the Main Menu select **System Config** then **Hardware Config.**
2. Select the proper hardware setup for High Band Verification (> 50 GHz) using Table 4-2 on page 4-4 for the E7352A 110 GHz System *or* Table 4-3 on page 4-4 for the E7342A 85 GHz System.
3. Select **Done** and **Prior Menu** to return to Main Menu.
4. Select **Verify System** to go to the System Performance Verification Menu.
5. Select **System Cal** and follow the program prompts to calibrate the system for frequencies >50 GHz. See Table 4-1 on page 4-3 for the calibrations required and suggested calibration storage locations (refer to step 3 on page 4-9).
6. Select **Select Standard** to go to the Standard Selection Menu.
7. To verify the system use the Verification Standards provided with the 85059A 1.0 mm Precision Calibration and Verification Kit (refer to Table 4-6 on page 4-10). Using the menu select the verification standard and enter the standard's serial number. The verification standards may be measured in any order.

NOTE

It is recommended to connect the Verification Standards to the cable on port 2 prior to attempting to connect to port 1. Then follow the recommended procedure for making a thru connection outlined under step 3 on page 4-9 to avoid damaging the cable.

8. Change default for **Cal Set for Broadband Measurement** from **1** to **3.**

NOTE

It is suggested that the High Band Calibration be stored in Cal Set 3 (Refer to Table 4-1 on page 4-3).

9. Verify **Cal Set for 45 MHz Measurement (If Required)** is set to **No.**
10. Select **Done** and follow the program prompts.
11. Select **Measure Data** to measure the verification standards. Follow the program prompts.

12. When verification has been completed view the data, then print or save (if required). If needed the verification standard can be remeasured by selecting: **Repeat Measure.**
13. Select **Select Standard** to return to the Standard Selection Menu. Repeat steps 7 through 12 above for the other verification standard (refer to Table 4-6 on page 4-10).
14. Select **Prior Menu** until the Main Menu appears.
15. Select **Quit Program** to exit the program, then close the program window to finish.

CW Frequency Accuracy Test

NOTE The CW frequency accuracy test should be performed prior to doing the conversion loss calibration adjustment or detector gain calibration.

Source frequency accuracy is tested across the entire sweep range for 8360 sources. The CW frequency accuracy is measured with a frequency counter.

Materials Required

The following materials are required to run the tests:

- 5343 Option 001, 10 MHz to 26.5 GHz frequency counter
- 10 dB pad

NOTE If the source and test set operate below 500 MHz, connect the test set output to the 10 Hz - 500MHz BNC connector on the frequency counter. The input switch on the frequency counter must also be in the 10 Hz - 500 MHz position.

Procedure

1. Connect the equipment as shown in Figure 4-1.

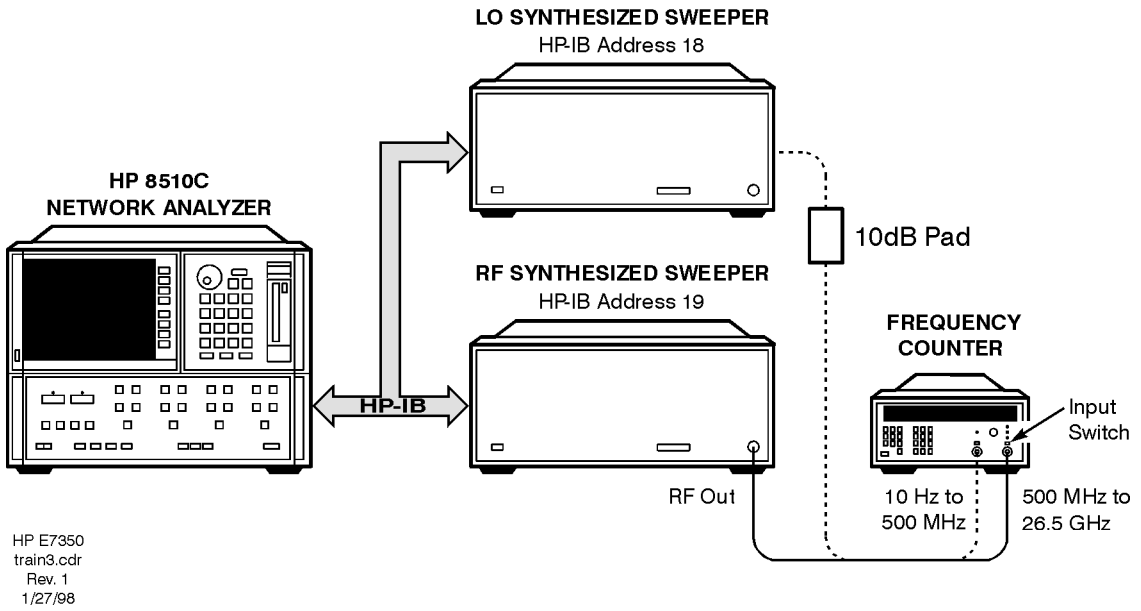


Figure 4-1 CW frequency accuracy equipment setup

2. To preset the instruments, press **INSTRUMENT STATE [RECALL]** ***{MORE}*** ***{FACTORY PRESET}***. Disregard any error messages.

3. To set the frequency using the analyzer front panel, press **STIMULUS [CENTER] [MENU]** ***{SINGLE POINT}***.

   Enter the start frequency of the source.

4. Measure RF and LO frequencies with the counter, and record these values on the test record at the end of this section.

5. From the analyzer front panel, enter the frequency per the tables at the end of this section.

NOTE

Be sure to connect RF and LO output to the 500 MHz - 26.5 GHz input on the frequency counter. Also set the input switch to the 500 MHz - 26.5 GHz position.

6. Measure the frequency with the counter, then record the value on the test record at the end of this section.

In Case of Difficulty

If the measured values do not meet the specifications listed on the test record, refer to your source manual for adjustment and troubleshooting instructions.

Performance Test Record

Record the measured frequencies for RF source readings on Table 4-7, and for LO source on Table 4-8.

Table 4-7 Performance Test Record for CW Frequency Accuracy Test (RF Source)

Instrument Model: _____ **Report Number:** _____ **Date:** _____

Frequency	Minimum Specification	Recorded Results	Maximum Specification	Uncertainty[1]
45 MHz	44.999955 MHz		45.000045 MHz	10 Hz
2 MHz	1.999998 GHz		2.000002 GHz	10 Hz
20 GHz[2]	19.99998 GHz		20.00002 GHz	4 kHz
26 GHz	26.4999735 GHz		26.5000256 GHz	5 kHz

1. The measurement uncertainty is quoted for these performance tests using only the recommended models specified in Table 8-1 of the “Equipment Required” chapter of the On-Site Service Manual. The quoted uncertainty represents limits of 3 times the equivalent standard deviation (3s) and is intended to represent 90% confidence level.

2. For 83620A/B or 83621A/B only.

Table 4-8 Performance Test Record for CW Frequency Accuracy Test (LO Source)

Instrument Model: _____ **Report Number:** _____ **Date:** _____

Frequency	Minimum Specification	Recorded Results	Maximum Specification	Uncertainty[1]
45 MHz	44.999955 MHz		45.000045 MHz	10 Hz
2 MHz	1.999998 GHz		2.000002 GHz	10 Hz
20 GHz[2]	19.99998 GHz		20.00002 GHz	4 kHz

1. The measurement uncertainty is quoted for these performance tests using only the recommended models specified in Table 8-1 of the “Equipment Required” chapter of the On-Site Service Manual. The quoted uncertainty represents limits of 3 times the equivalent standard deviation (3s) and is intended to represent 90% confidence level.

2. For 83620A/B or 83621A/B only.

Two-Band Calibration Procedure for 8510XF Performance Verification

The 8510XF requires separate verifications for frequencies below and above 50 GHz (see "Frequency Ranges" in this same chapter).

A special two-band calibration procedure is required for the performance verification of the 8510XF System (a single full-band measurement calibration is *not* equivalent).

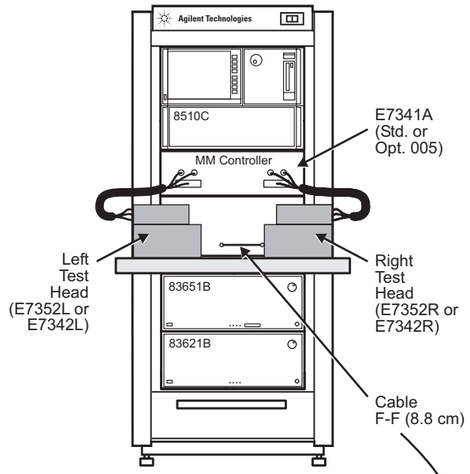
There are up to three different full 2-port calibrations and corresponding frequency ranges required, which are stored in suggested locations in the 8510 analyzer.

Calibration Storage Locations

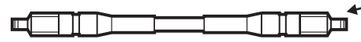
File Location Name:	Frequency Range of Data Stored:
Cal Set 1	1–50 GHz[1] (2–50 GHz)[2]
Cal Set 2	45 MHz[1]
Cal Set 3	50–110 GHz[3]

1. This calibration is for Option 005 systems only.
2. The frequency for standard systems is 2–50 GHz.
3. The frequency range shown is for the E7352A system only. The E7342A system's frequency range will be: 50–85 GHz

For more information refer to the section on "Frequency Ranges" in this same chapter. The parameters for these calibrations are set up automatically on the analyzer by the performance verification software.



Full 2-port calibration system configuration for performance verification in 1.0 mm coax.



Cable F-F (8.8 cm) 11500-60001
From 85059A calibration verification kit

Calibration Techniques and Standards

Calibration Kit Label: 1.00mmA.1A
Disk File Name: CK_MMKA1A

Frequency Range	Calibration Technique	"Open" Standard (Reflection)	"Short" Standard (Reflection)	"Load" Standard (Reflection)	"Thru" Standard (not used for 1-port cal)	"Isolation" Standard
DC–50 GHz[3]	SOLT[1]	Open	Short 3	50 GHz Load	Thru	50 GHz Load
50–110 GHz	Offset Shorts	Short 3	Short 1	Short 4 Short 2	Thru	Load BB[2]

1. SOLT = Short, Open, Load and Thru standards
2. The broadband load is a combination of a lossy delay line plus a 50 GHz load.
3. Also used for 45 MHz frequency point.

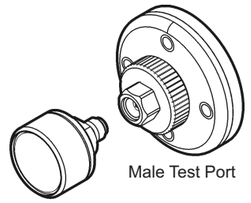
Calibration Techniques:

A variety of calibration techniques can be used with the 8510XF, including the following:

- **SOLT** (Short-Open-Load-Thru) Used for performance verification 45 MHz to 50 GHz.
- **Offset Shorts** (Shorts with different offset lengths) Used for performance verification 50 GHz to 110 GHz.
- **TRL** (Thru-Reflect-Line)**
- **TRM** (Thru-Reflect-Match)**

** Note: Not used for performance verification

The calibration technique used depends in part on the type of calibration kit used. The 1.0 mm calibration kit (85059A) was designed specifically for the 8510XF, and uses a combination of two calibration techniques: SOLT calibration for frequencies up to 50 GHz, and offset shorts calibration for frequencies above 50 GHz. This combination of techniques provides the best possible calibration results on the 8510XF.



Female Calibration Standard

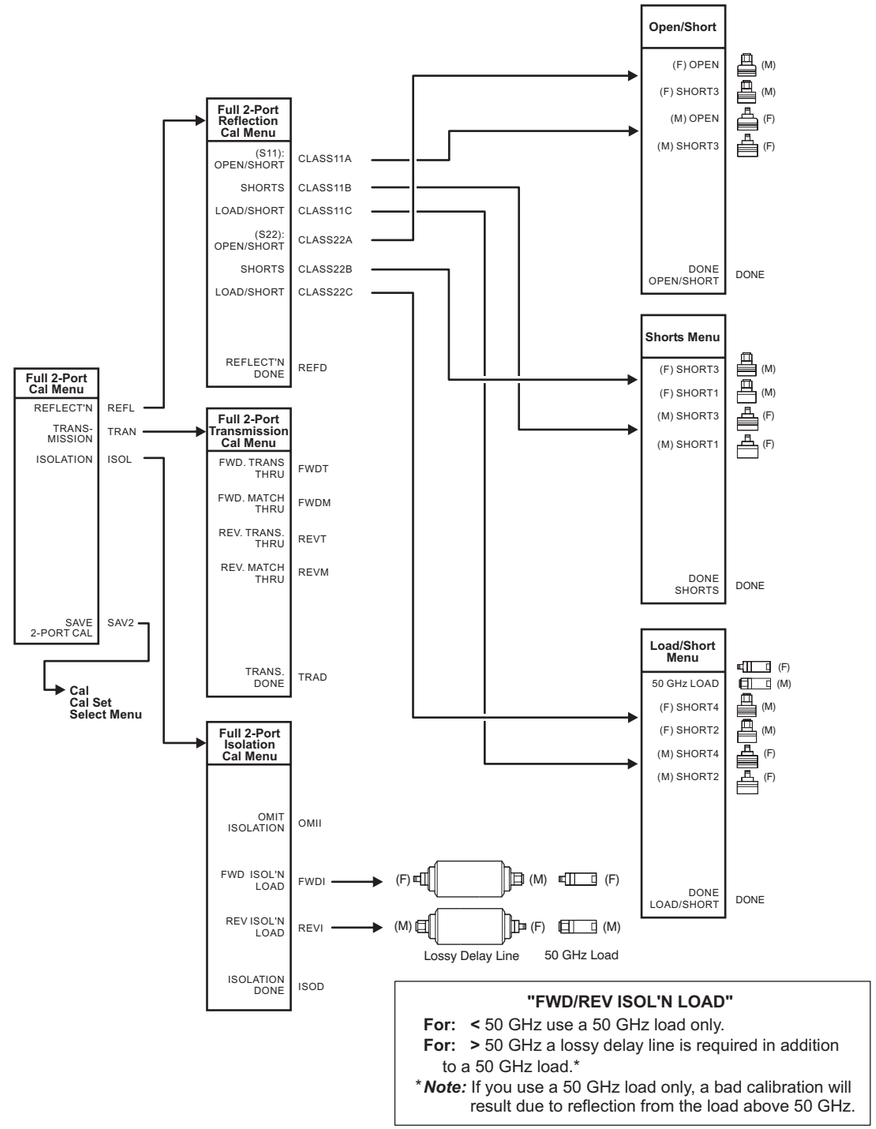
Male Test Port

Clarifying Connector Sex:

The calibration standard labels that appear in the 8510XF softkey calibration menus specify connector sex as "(M)" or "(F)". The sex designator refers to the sex of the test port connector to which the calibration standard is connected (*not* the sex of the calibration standard connector).

Offset Shorts:

Offset shorts are used in the place of opens and loads at frequencies above 50 GHz. The "OPEN" category is therefore renamed "OPEN/SHORT," and the "LOAD" category is renamed "LOAD/SHORT" on the calibration menu softkey labels.



"FWD/REV ISOL'N LOAD"

For: **<** 50 GHz use a 50 GHz load only.
For: **>** 50 GHz a lossy delay line is required in addition to a 50 GHz load.*
* ***Note:*** If you use a 50 GHz load only, a bad calibration will result due to reflection from the load above 50 GHz.

5 System Maintenance

In This Chapter...

Electrostatic Discharge

Static electricity builds up on the body and on tools (including calibration components and devices under test). When static electricity is accidentally discharged, sensitive circuit elements can be damaged.

Circuit elements within a device can be damaged in this way from outside the device (for example, through accidental contact with the center conductor of a connector). Even a discharge that is too small to be felt can cause circuit damage.

CAUTION

Protection against electrostatic discharge (ESD) is essential while connecting, cleaning, or inspecting connectors attached to a static–sensitive circuit (such as those found in test sets). Protective measures appropriate to the 8510XF are described below).

- Always have a grounded anti-static mat in front of your test equipment, and wear a grounded wrist strap attached to it.
- Ground yourself before you clean, inspect, or make a connection to a static–sensitive device or test port. (You can, for example, grasp the grounded outer shell of the test port briefly to discharge static from your body.)
- Discharge static electricity from a device before connecting it: touch the device briefly (through a resistor of at least 1 MΩ) to either the outer shell of the test port or to another exposed ground. This discharges static electricity and protects test equipment circuitry.

ESD Accessories

The following accessories for preventing electro-static discharge can be ordered from Agilent Technologies:

Table 5-1 ESD Accessories

Item Description	Part Number
Grounding wrist strap	9300–1367
Grounding cord for wrist strap (5 ft)	9300-0980
Conductive table mat (2 x 4 ft) with ground wire (15 ft)	9300–0797
ESD heel strap (for conductive floors)	9300–1126

1.0 mm Connector Care

In order to accommodate an extremely wide frequency range in a single-connect system, the 8510XF uses 1.0 mm connectors on its test heads. These connectors, because of their small dimensions and high replacement cost, require careful use and maintenance.

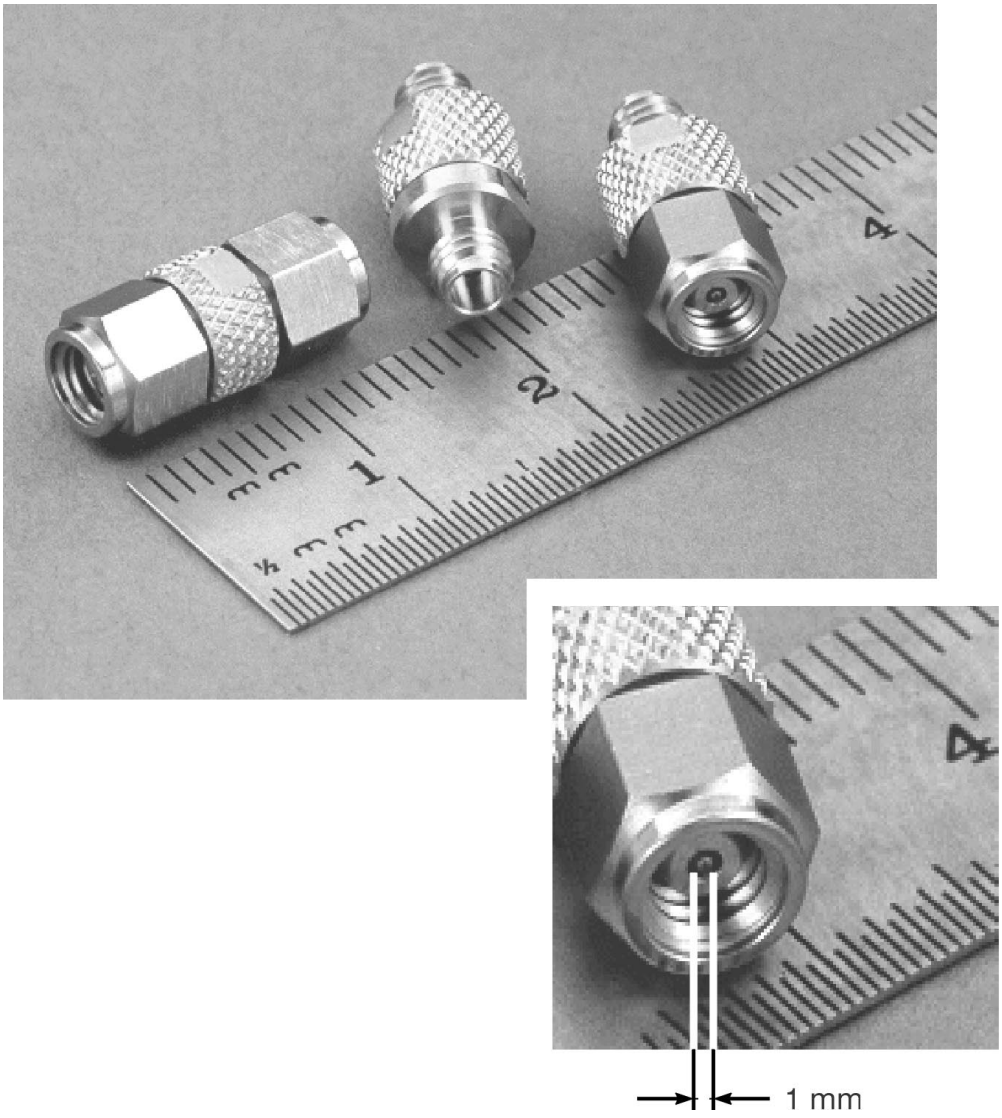


Figure 5-1 1.0 mm Connectors

Care of 1.0 mm connectors is discussed throughout the manual of the 85059A 1.0 mm calibration kit (Agilent part number: 85059-90003). The basics of connector care are outlined below.

Free movement during connection

When you connect two devices, at least one of them should be able to move freely. If both devices must be rigidly clamped or fixtured, pay careful attention to connector alignment in the fixture setup. In the case of misaligned connection, there is a great risk of resulting stress damage.

Mating plane surfaces

Flat contact between the connectors at all points on their mating plane surfaces is required for a good connection. If a connector is dirty or defective, it will not make a good connection, and the attempt to connect it may cause further damage. For this reason, connectors require frequent inspection and cleaning.

Connector wear

Connector wear eventually degrades performance; worn connectors must be replaced. The more a connector is used, the faster it wears and degrades. The wear is greatly accelerated when connectors are not kept clean.

Calibration devices should have a long life if their use is on the order of a few times per week. Test port connectors may have many connections each day, and are therefore more subject to wear. To minimize wear, use an adapter (available as part of the 85059A Calibration Kit) as a test port saver.

Visual inspection

Connector threads and mating surfaces should be inspected using a magnifying lens (at least 10X magnification). Good lighting (such as a halogen task light) is necessary to see damage on a connector. Defects to look for include:

- Badly worn plating (burrs, blisters, exposed metal)
- Deformed threads
- Bent, broken, or misaligned center conductors
- Dirt (particularly in the form of loose metal particles)
- Deep scratches or dents
- Any sign of damage from uneven wear or misalignment

NOTE

Light burnishing of the mating plane surfaces is normal, and is evident as light scratches or shallow circular marks distributed more or less uniformly over the mating plane surface. Other small defects and cosmetic imperfections are also normal.

If a connector appears defective, clean and inspect it again. Damaged connectors should be discarded or sent for repair. Try to determine the cause of damage before connecting a new, undamaged connector in the same configuration.

Cleaning connectors

1. Inspect the connectors for dirt or debris.
2. Blow off any accumulated dust, using clean (filtered) compressed air.
3. Dip the cleaning swab in isopropyl alcohol.

NOTE

Do not pour alcohol directly on the parts to be cleaned, and *do not* allow alcohol to wash down inside the connectors. An excessive flow of alcohol may carry residue into the interior of the connectors.

4. Gently wipe all connecting surfaces with the end of the cleaning swab.
5. Dry with compressed air.
6. Inspect the connectors again, and repeat the cleaning procedure if necessary.

Connector care supplies

The following supplies can be ordered from Agilent Technologies:

Item Description	Part Number
Magnifying lens (10x)	1000-1114 (included in Calibration Kit)
Isopropyl Alcohol (30 ml, 99.5%)	8500-5344
Cleaning Swabs (100 each)	9301-1243
Torque Wrench (6 mm, 4 in-lb)	8710-2079 (included in Calibration Kit)
Open End Wrench (6 mm)	8710-2156 (included in Calibration Kit)

Detector Gain Calibration

Purpose of the Calibration

This is the first of two calibrations which, in combination, insure the accuracy of absolute power levels at the test ports (the other is conversion loss calibration, which is described on page 5-8).

The level control system includes a programmable gain circuit, which uses step attenuators to adjust the level of the detector feedback signal, in .5 dB steps. To compensate for imprecision in these attenuation steps, correction factors must be applied to the programmable gain circuit.

Detector gain calibration is the process by which these correction factors are gathered. For more information, see "The Leveling Loop" on page 5-15, and "Level Calibration" on page 5-18.

The Calibration Process

During detector gain calibration, the 8510XF measures the effect of every possible gain setting on the detector feedback level. Correction factors for these gain settings are stored in an EEPROM within the millimeter-wave controller.

The correction factors are taken at one fixed frequency, and then at another fixed frequency. This process is automatic; the frequencies are specified in firmware, and are chosen so as to give the level control system the greatest possible dynamic range.

When to Calibrate

Running detector gain calibration takes about a minute. In choosing an appropriate interval between calibrations, use the following guidelines:

- For measurements in which absolute power levels are critical, perform this calibration before every measurement calibration (see Chapter 3, "Measurement Calibration").
- If absolute power levels are not critical, you can perform this calibration infrequently (on a monthly basis, for example).
- If the controller or one of the test heads has been repaired or replaced, perform this calibration before making measurements with the system.
- If the 8510XF has been transported, or exposed to wide temperature variations, perform this calibration before making measurements with the system.
- If the operating system firmware is reloaded, it is necessary to perform the detector gain calibration.

Procedure

The calibration process consists of running a firmware routine that is internal to the 8510XF; no external test equipment is required.

1. Be aware that the detector gain calibration process causes some 8510C settings to change, and that the settings are not restored to their original conditions afterward. If you want to return to the present settings, save them before running the calibration.
2. Disconnect any devices from the test ports. During the calibration, the 8510XF will step through its entire power range; any device connected to the test ports could be at risk of damage from excessive RF input levels.
3. Call up the detector gain calibration menu by pressing:
   [SYSTEM] ***{MORE} {RF POWER CONFIG} {MORE} {RESET DET GAIN CAL}***
4. Choose one of the options from the menu:
   a. If ***{RUN CAL + USER PRST}*** is selected, the detector gain calibration routine is run, and is followed by a user preset. This returns the system to instrument state #8, and is the recommended option.
   b. If ***{RUN CAL + FACT PRST}*** is selected, the detector gain calibration routine is run, and is followed by a factory preset.
   c. If ***{RUN CAL NO PRESET}*** is selected, the detector gain calibration routine is run, but is not followed by a preset.
5. The calibration run takes about a minute, after which the system returns to normal operation.

Conversion Loss Calibration

Purpose of the Calibration

This is the second of the two calibrations that insure the accuracy of absolute power levels at the test ports.

The RF-to-IF conversion loss of a mixer varies with frequency. To compensate for these frequency-related variations, correction factors must be applied to the level control system. Conversion loss calibration is the process by which these correction factors are gathered.

(For more detail, see "The Leveling Loop" on page 5-15, and "Level Calibration" on page 5-18.)

The Calibration Process

During conversion loss calibration, the test ports are monitored with a power meter while the 8510XF steps through its frequency range. Based on the measured power levels, correction factors for each frequency are stored in an EEPROM within the millimeter-wave controller.

Measurement frequencies occur at intervals of 25 MHz, up to 18 GHz. Above 18 GHz, measurement frequencies occur at intervals of 50 MHz.

When to Calibrate

Calibration is performed at the factory prior to shipment; thereafter it should be performed as required.

NOTE

Conversion loss calibration data applies only to the specific combination of controller and test heads calibrated together as a set. The cables connecting the test heads to the controller also become part of the calibration. If the controller or one of the test heads is repaired or replaced, the old calibration data will no longer be valid.

Agilent Technologies Customer Engineering

This calibration requires expensive test instruments, software and accessories. For this reason, conversion loss calibration is to be performed by an Agilent Technologies Customer Engineer or the factory only. Contact your nearest Agilent Technologies office to order this service (refer to "Contacting Agilent" on page v).

Theory of Operation

Signal Separation

The illustration below shows how directional couplers are used to separate incident RF signals (“a1” and “a2”) from reflected or transmitted RF signals (“b1” & “b2”). The separated RF signals are mixed with a common LO signal, in order to generate the four IF inputs to the network analyzer.

This process is typical of 8510C mixer-based test sets generally; it is not unique to the 8510XF.

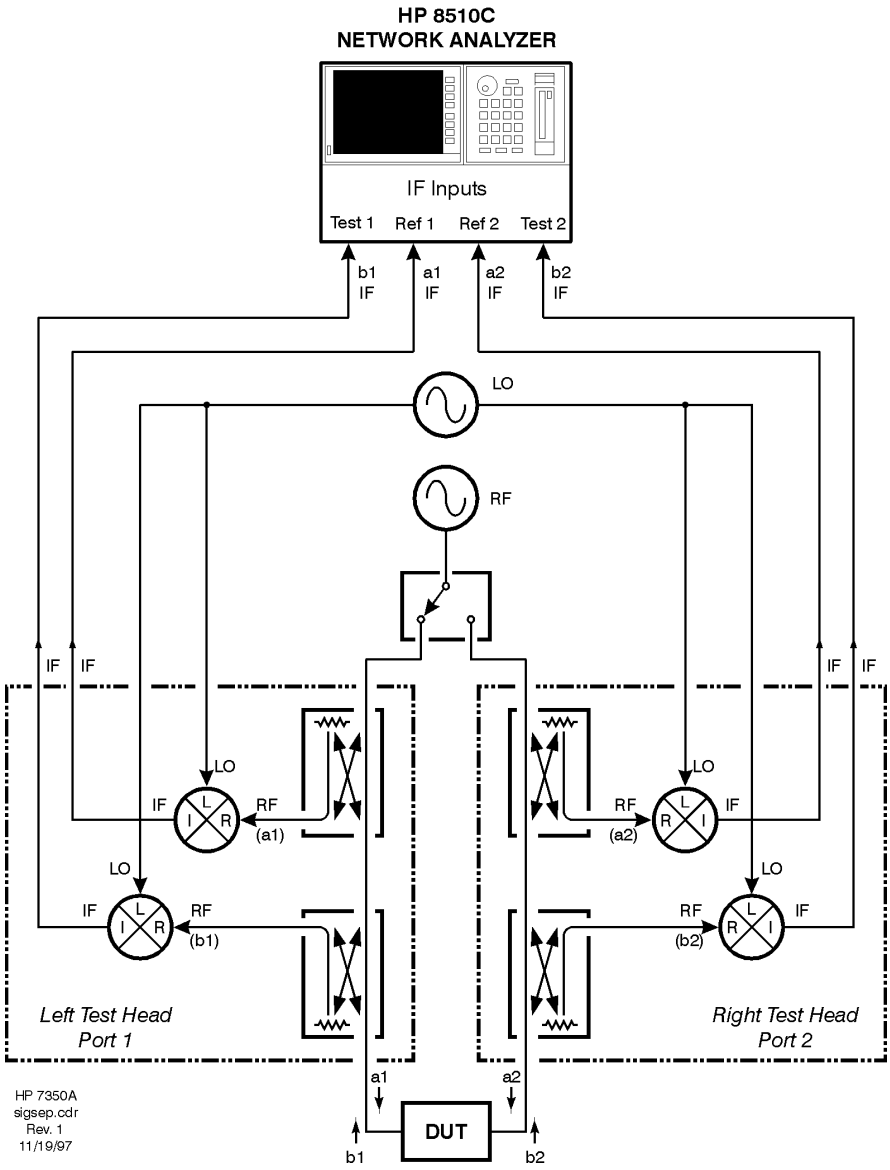


Figure 5-2 Signal Separation and Mixing

Frequency Control

The preceding diagram is a simplification, in that it shows a total of four mixers. For any given test frequency, four mixers are sufficient to generate the four IF inputs required by the network analyzer. However, four mixers are not sufficient to cover the entire frequency range of the 8510XF.

The maximum frequency range of the 8510XF (45 MHz to 110 GHz) is divided into four bands, each of which employs its own set of four mixers:

Band	Included In
.045 to 2 GHz	8510XF systems with Option ‘005
2 to 50 GHz	All 8510XF systems
50 to 85 GHz 50 to 75 GHz	E7340A systems/E7342A subsystems E7350A systems/E7352A subsystems
75 to 110 GHZ	E7350A systems/E7352A subsystems

Depending upon the frequency range of the model and option selected, the 8510XF can have up to 16 mixers.

Mixer Locations

Figure 5-3 shows the locations of the mixers for different frequency bands in an E7350A/E7352A with Option 005. For the sake of simplicity, the figure shows only half of the test set. An actual test set would include another test head, and another pair of low-band mixers in the controller; the total number of mixers would be doubled.

Note that all bands make use of the same output/input path, the same connection to the DUT, and the same directional couplers.

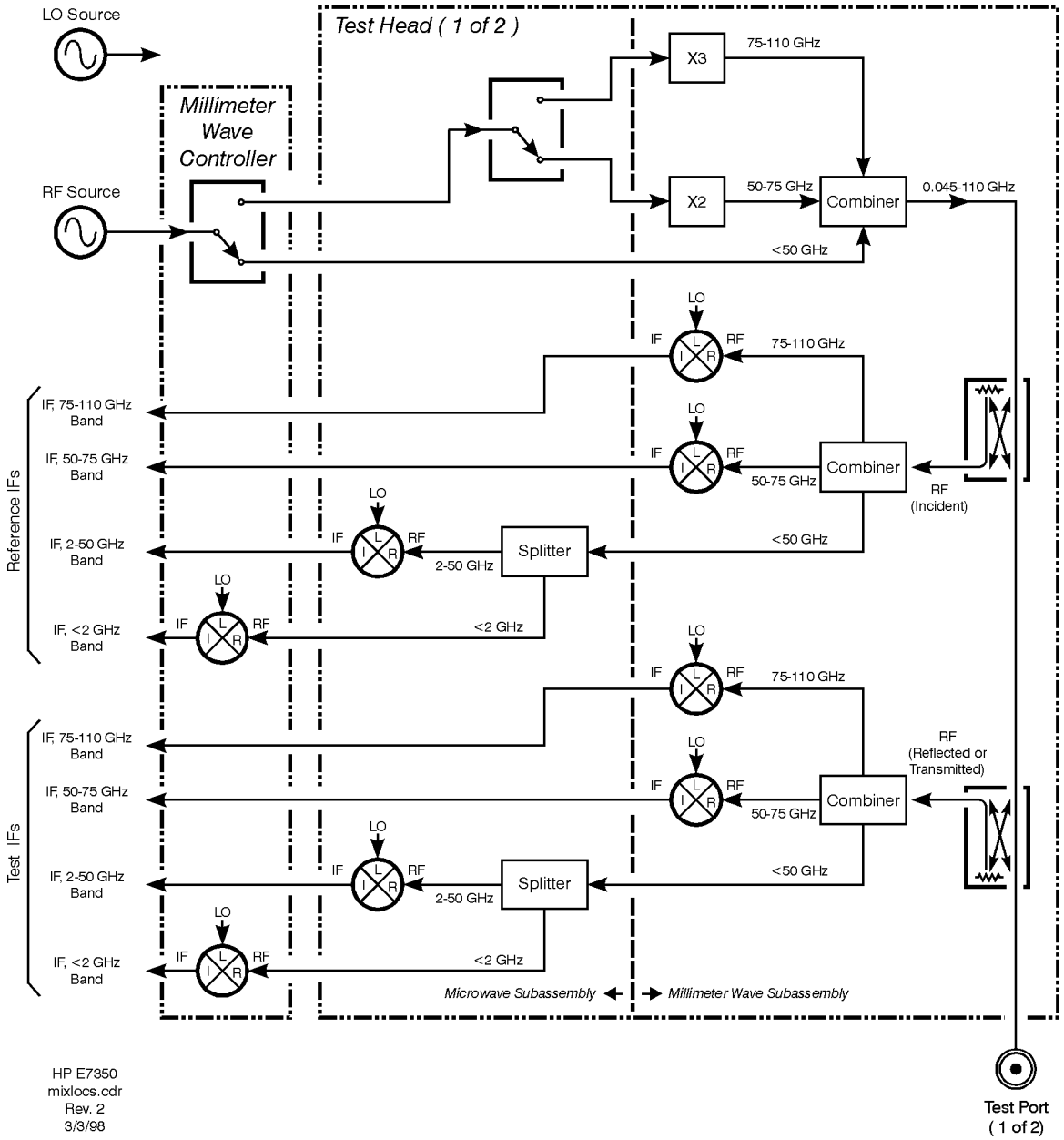


Figure 5-3 Mixer Locations

Multiplication

Harmonic multiplication is used to generate RF frequencies above 50 GHz (the upper range of the 83651B RF source). The signals from the LO source are also multiplied, in the sense that the mixers in certain ranges use a harmonic of the LO input, and not the fundamental.

The four basic frequency bands (.045 to 2, 2 to 50 , 50 to 75, and 75 to 110 GHz) are further subdivided, in terms of how the RF and LO frequencies are multiplied in order to achieve the desired test frequency. This subdivision of ranges is somewhat different for 110 GHz systems and 85 GHz systems.

Table 5-2 and Table 5-3 below show how the ranges are subdivided for 110 GHz systems versus 85 GHz systems. Under “Harmonic of RF”, a “2” is listed where the RF source frequency is doubled; a “3” is listed where it is tripled. Various harmonics of the LO source frequency are used in different portions of the system’s frequency range.

Table 5-2 8510XF Frequency Bands (Systems to 110 GHz)

Test Frequency (GHz)	Harmonic of RF	Harmonic of LO	Mixers Used
.045 to <2 (Option 005)	1	1	<2 GHz mixers, in the millimeter-wave controller
2 to 18	1	1	2 to 50 GHz mixers, in the microwave subassembly of the test head
>18 to 50	1	3	2 to 50 GHz mixers, in the microwave subassembly of the test head
>50 to 64.2	2	12	V-band mixers, in the millimeter-wave subassembly of the test head
>64.2 to 75	2	14	V-band mixers, in the millimeter-wave subassembly of the test head
>75 to 85.5	3	14	W-band mixers, in the millimeter-wave subassembly of the test head
>85.5 to 97.7	3	16	W-band mixers, in the millimeter-wave subassembly of the test head
>97.7 to 110	3	18	W-band mixers, in the millimeter-wave subassembly of the test head

Table 5-3 8510XF Frequency Bands (Systems to 85 GHz)

Test Frequency (GHz)	Harmonic of RF	Harmonic of LO	Mixers Used
.045 to < 2 (Option 005)	1	1	<2 GHz mixers, in millimeter-wave controller
2 to 18	1	1	2 to 50 GHz mixers, in the microwave subassembly of the test head
>18 to 50	1	3	2 to 50 GHz mixers, in the microwave subassembly of the test head
>50 to 64.2	2	12	V-band mixers, in the millimeter-wave subassembly of the test head
>64.2 to 85	2	14	V-band mixers, in the millimeter-wave subassembly of the test head

The frequency bands are described individually below.

0.045 to 2 GHz Band

In the .045 to 2 GHz range, the signal from the RF source is not multiplied; it is applied directly to the mixers. The mixers for this range are located in the millimeter-wave controller.

The mixers use the fundamental of the LO input frequency, rather than a harmonic of it. During operation in this band, the RF source and LO source generate a pair of frequencies 20 MHz apart, in order to create a 20 MHz IF output from the mixer.

2 to 50 GHz Band

In the 2 to 50 GHz range, the signal from the RF source is not multiplied; it is applied directly to the mixers. The mixers for this range are located in the test heads (in the upper half of the test head, which is designated the microwave subassembly).

In the 2 to 18 GHz portion of this band, the mixers use the fundamental of the LO input frequency; the RF and LO frequencies are 20 MHz apart.

In the 18 to 50 GHz portion of this band, the mixers use the third harmonic of the LO input frequency, rather than the fundamental. The LO frequency is roughly one-third of the RF frequency (with a slight frequency offset, to create the 20 MHz IF).

50 to 75 GHz Band or 50 to 85 GHz Band

In the 50 to 75 GHz range, the signal from the RF source is applied to a frequency doubler in the test head. The mixers for this range are located in the test heads (in the lower half of the test head, which is designated the millimeter-wave subassembly). The range of this band becomes 50 to 85 GHz, in systems for which 85 GHz is the upper frequency limit.

The mixers use different harmonics of the LO input frequency in different portions of the band, as shown in Table 5-2 and Table 5-3.

Because of the doubler in the test head, the frequency at the test port is twice the frequency of the RF source.

75 to 110 GHz Band

In the 75 to 110 GHz range, the signal from the RF source is applied to a frequency tripler in the test head. The mixers for this range are located in the test head (in the lower half of the head, which is designated the millimeter-wave subassembly).

The mixers use different harmonics of the LO input frequency in different portions of the band, as shown in Table 5-2.

Because of the tripler in the test head, the frequency at the test port is three times the frequency of the RF source.

Level Control

In some applications of network analysis (particularly in testing of passive devices), absolute power levels are less important than relative power levels. However, in other applications, absolute power levels are very significant, and must be controlled.

For example, when active devices are tested, level control is needed as a safeguard against applying excessive input power. Control of absolute power levels is also necessary for purposes of performance verification (for example, to test the dynamic range of the network analyzer).

RF Leveling vs. IF Leveling

In a typical level control circuit, a coupler is placed in the RF path, and the coupled RF signal is applied to a detector. The detector voltage is fed back to an amplifier which controls the RF source. This loop amplifier drives the RF source so as to achieve a particular detected RF level.

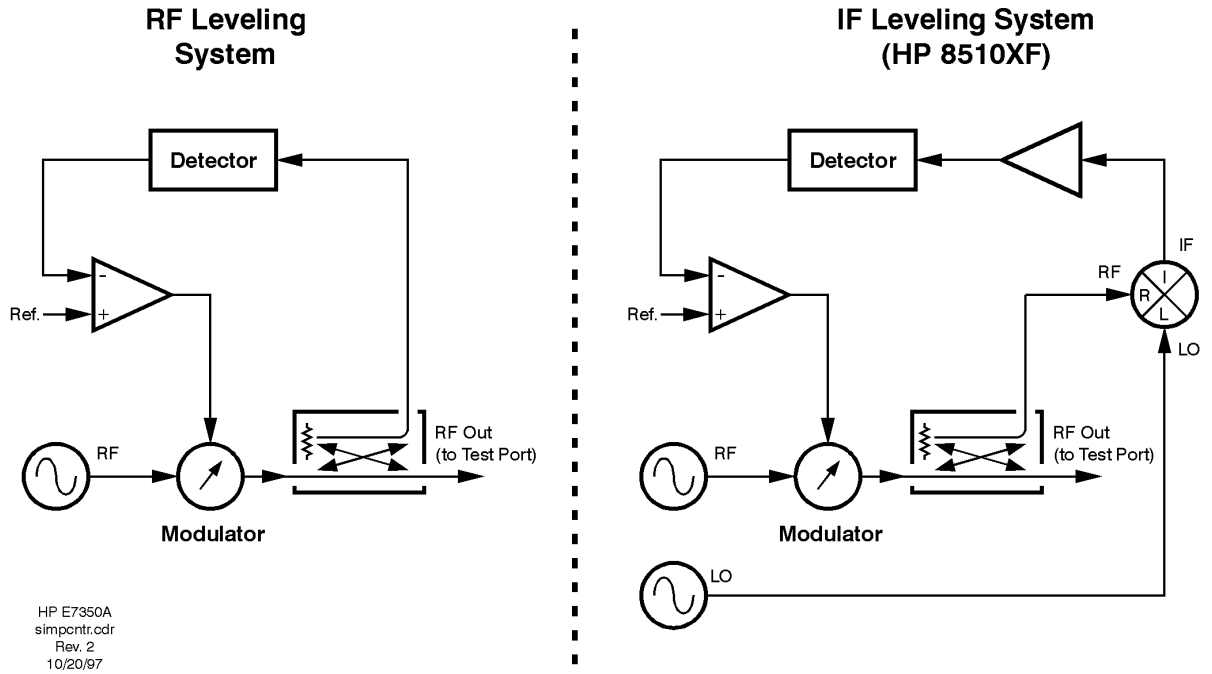


Figure 5-4 Comparing RF and IF Leveling Systems

The level control circuit in the 8510XF includes a refinement of this basic leveling loop design: the coupled RF signal is not directly detected. Instead, the RF signal is applied to a mixer, and the IF output of the mixer is detected (the difference between these two approaches is illustrated in Figure 5-4).

Because the IF level varies with the RF level, the IF (suitably amplified) can be substituted for the RF in the leveling loop. The loop amplifier drives the RF source so as to achieve a particular detected *IF* level (and therefore a particular RF level).

Advantages of IF leveling

Because the IF output of the mixer is fixed at 20 MHz, IF leveling has important advantages over RF leveling:

- There is no need for expensive broadband detectors.
- The IF can be narrowly filtered, to keep noise to a minimum (typical RF leveling schemes, which use broadband coupler/detectors, are inherently noisy).
- The detector is always reading a 20 MHz signal, so the frequency response of the detector itself is not an issue.

The Leveling Loop

The 8510XF leveling loop is described in more detail below (see Figure 5-5 on page 5-16 for an illustration of the loop).

Feedback Path

The IF feedback path from the mixer to the level-control amplifier passes through the millimeter-wave controller, and includes the following: a programmable gain circuit, a detector, a multiplying DAC, and a blanking circuit. These are described individually below.

NOTE

There is only one feedback path, but the IF input to that path can come from any of the reference mixers (that is, the mixers for the “a1” and “a2” channels, in the active frequency range). The active test port, and the current test frequency, determine which mixer is supplying the IF feedback at any one time.

Programmable gain

This circuit includes, in series, three fixed amplifiers and three step-attenuators. Each attenuator includes three pads which can be switched into the IF path (the smallest of these is a 0.5 dB pad).

By programming the attenuators, so that some or all of the pads are switched into the IF path, it is possible to offset some of the gain from the amplifiers. The result is that the overall gain of the circuit is programmable, in steps of 0.5 dB, over a 66.5 dB range.

Detector

The amplified IF is applied to a detector, and converted to a dc voltage which is proportional to the level of the amplified IF input.

Multiplying DAC

The dc voltage from the detector is applied to an 8-bit multiplying DAC; the multiplier is a digital input from the 8510C, and is used to apply correction factors to the detector voltage.

Correction factors are needed because of (1) imprecision in the step attenuators, and (2) variations in RF power across the frequency range of the 8510XF. These issues are discussed under "Level Calibration" on page 5-18.

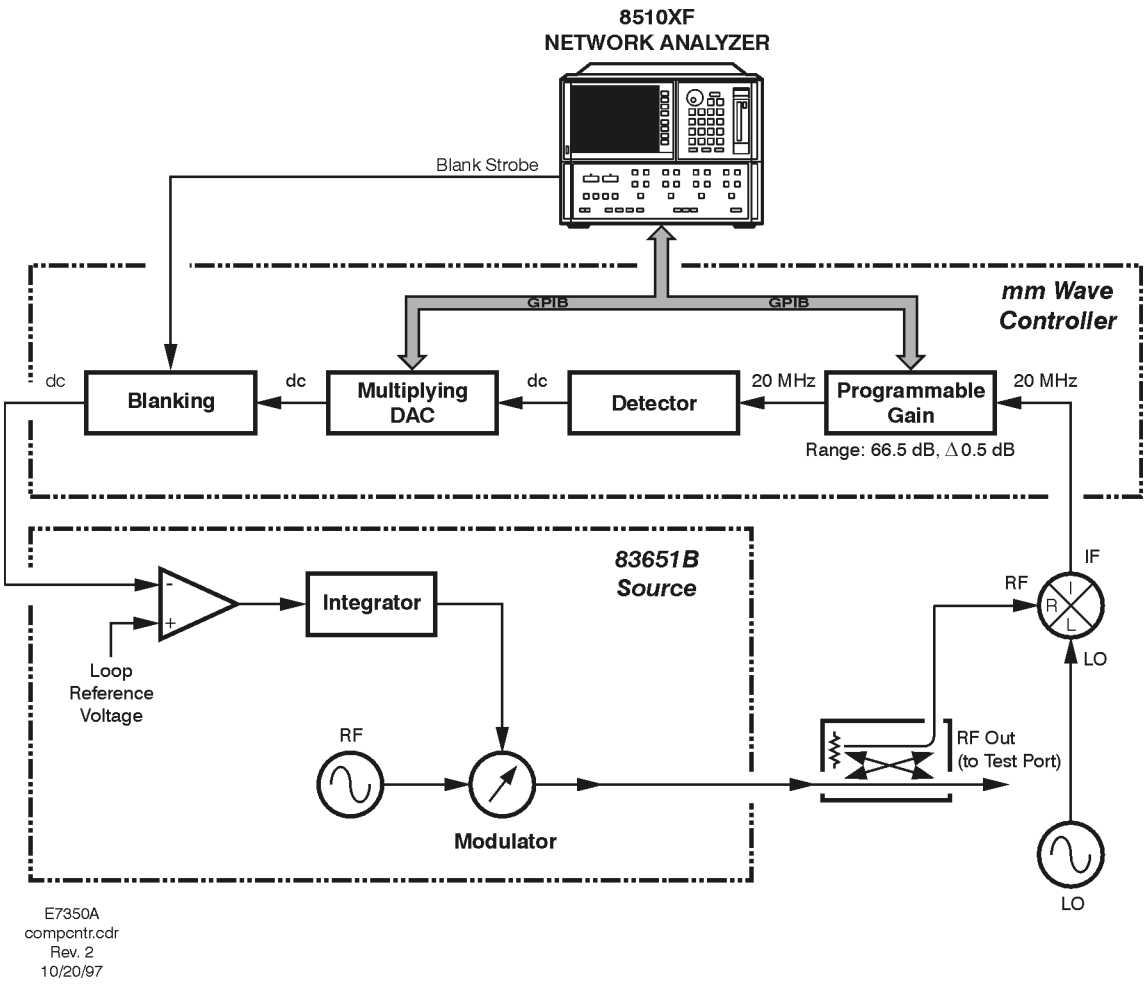


Figure 5-5 8510XF Level Control

Blanking circuit

During transitions from one frequency to another, the RF source power is briefly interrupted. As a result, the IF disappears. When the IF is lost, the normal tendency of the leveling loop is to try to recapture it, by driving the RF source to maximum power. This tendency needs to be counteracted during frequency changes; otherwise, power spikes would occur immediately after every frequency change (because the RF source would be at maximum power when it was turned back on).

In order to prevent these power spikes, a blanking circuit is placed between the output of the multiplying DAC and the dc output to the loop amplifier. During each frequency change, a blanking strobe is received from the 8510C, and the blanking circuit drives the dc output to a maximum. This gives the level control circuit a false indication that the RF level is too high, rather than too low. The result is that the loop amplifier and integrator drive the modulator so as to reduce RF power to a minimum.

When the next frequency point is reached, blanking is turned off. The RF output of the source is reactivated, and the detector signal is allowed to pass through to the loop amplifier. The RF level is brought up from its temporary minimum-power setting to the requested level. The integrator insures that the RF level is brought up smoothly and rapidly.

Spurious error messages

When the blanking circuit drives the modulator so as to minimize the RF level, this event is interpreted by the RF source as an error condition (“unleveled” and/or “overmod”), and an SRQ is sent over the GPIB to the 8510C. If this error-detection system were not modified during sweep operation, it would generate a large number of spurious error messages.

Therefore, during a sweep, SRQ triggering for “unleveled/overmod” errors is disabled at the source. Triggering of “overmod” errors remains disabled throughout the sweep (detection of this type of error is incompatible with 8510XF sweep operation). However, the network analyzer is able to poll the source *after* each blanking interval, and determine the status of the “unleveled” condition flag (if there is an actual error, it will then be detected).

Because the polling process adds from 3 to 6 milliseconds of delay for each frequency point, many users will want to control the amount of polling that takes place. The menu called up by **[SYSTEM]** ***{MORE} {RF POWER CONFIG}*** offers four different ways to regulate the error-polling process during a sweep:

ALWAYS If this option is selected, the source is polled for errors during every sweep.

SMART If this option is selected, the source is polled for errors during the first sweep, and thereafter only if a genuine error condition was detected during the first sweep. (This is the default mode.)

ONCE If this option is selected, the source is polled for errors only during the first sweep.

NEVER If this option is selected, the source is not polled for errors during any sweep.

NOTE If any of the basic conditions of the sweep (frequency range, number of points, or power level) are changed, the entire sweep process (including polling) begins over again.

Loop Amplifier

This portion of the level control circuit is located within the 83651B RF source. The loop amplifier compares the input from the detector feedback path with a reference voltage. (The reference voltage is fixed; this leveling system specifies an RF level not by setting the reference voltage, but by setting the amount of gain in the feedback loop).

The output of the amplifier is applied to an integrator, which responds rapidly to any change on its input, and drives the modulator in the RF output path, so as to adjust the output power from the 83651B.

Level Calibration

There are two level calibration processes, designed to counteract two different sources of error:

- Imprecision in the step attenuators
- Frequency-related variations in mixer performance

NOTE The correction factors taken during these calibration processes are valid only for a particular millimeter-wave controller, left test head, and right test head calibrated together as a set. The cables connecting the testheads to the controller also become part of the calibration. If a test head or the controller is replaced, both calibration processes must be repeated.

Detector gain calibration

The step-attenuators in the programmable gain circuit are not precise enough to be used without correction. Attenuator settings of (for example) 5 dB and 6 dB are nominally 1 dB apart, but the actual difference between the two settings might be 0.9 dB or 1.1 dB. In order to regularize the increments of attenuation (so that the actual effect of each attenuator setting is predictable), a specific correction factor must be applied for each of the possible attenuator settings.

The correction factors are collected by means of a special calibration procedure (detector gain calibration), in which the programmable gain circuit is stepped through its range, at a fixed frequency. The process is then repeated at a second frequency. (The two calibration frequencies are specified in the firmware; they are chosen in order to achieve the greatest possible leveling range.) Refer to page 5-6 for more information.

Frequency-related variations

The RF-to-IF conversion loss of a mixer varies with frequency. To counteract these variations, a second set of correction factors is needed. This set of correction factors is gathered by a special calibration procedure (conversion loss calibration), in which the test ports are monitored with a power meter while the 8510XF steps through its frequency range.

This calibration procedure is performed at the factory prior to shipment; afterwards it is performed as required (to be performed by an Agilent Technologies Customer Service engineer or the factory only). Refer to page 5-8 for more information.

Level control performance

Test port RF levels are controlled with a typical accuracy of ±0.5 dB. The level control range is at least 20 dB, if the entire frequency range of the 8510XF is used. If a smaller portion of the frequency range is used, the level control range is typically greater.

LO Levels

The LO signal from the 83621B is amplified, divided, and distributed to the various mixers in the test heads (and in the millimeter-wave controller, in the case of the optional 0.045–2 GHz band). Each mixer must receive an LO input signal that has been sufficiently amplified to satisfy its input level requirements.

The mixers used for frequencies below 50 GHz are not highly sensitive to variations in the level of the LO input signal, provided that the minimum required input is present. However, the mixers used for frequencies above 50 GHz require LO input levels within a relatively narrow window. In order to insure that the LO inputs to these mixers stay within acceptable limits, a leveling loop is included in each test head.

Each of the two LO leveling loops consists of an amplifier, coupler, pad, detector, and ALC circuit, all located within the microwave subassembly of the test head.

- The LO input to the loop (received from the millimeter-wave controller) is applied, though the amplifier and coupler, to the millimeter-wave subassembly, where it is distributed to the >50 GHz mixers.
- The coupled LO signal is applied, through a pad, to a diode detector.

- The detector signal is applied to the ALC circuit, which compares the detector voltage with a reference voltage, and feeds back a control signal to the amplifier. The gain of the amplifier is adjusted so that the detector voltage matches the reference voltage. In this way, the LO input to the >50 GHz mixers is maintained at a constant level.

System Block Diagrams

110 GHz Systems

The illustrations on the following three pages show block diagrams for the test heads and the millimeter-wave controller, in a 110 GHz system.

The test head is subdivided internally into a millimeter-wave assembly (the bottom half), and a microwave assembly (the top half). These subassemblies are depicted in separate diagrams.

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Left Test Head

Millimeter Wave Subassembly

U14 Combiner

U12 X3 — AR5 — S1 (1, 2, C) — mm Wave Input — mm Wave Out

FL3 — U11 X2 — AR4

A2 Bias Tee — AR6 — RF In — RF Out

Bias Tee In

U13 — LO In — LO Out — LO LO LO LO

DC2 — a1 — U16 Combiner

- AT6 — LO — RF >75 — L R I — IF — U18 — a1 IF In (for W Band)
- AT8 — LO — RF 50-75 — L R I — IF — U20 — a1 IF In (for V Band)
- <50 — a1 RF In (for <50 Band)

DC3 — b1 — U15 Combiner

- AT5 — LO — RF >75 — L R I — IF — U17 — b1 IF In (for W Band)
- AT7 — LO — RF 50-75 — L R I — IF — U19 — b1 IF In (for V Band)
- <50 — b1 RF In (for <50 Band)

Port 1

Microwave Subassembly (See Page 2 for Block Diagram)

mm Wave Out

RF Out

Bias Tee In

LO Out

a1 IF In (for W Band)

a1 IF In (for V Band)

a1 RF In (for <50 Band)

b1 IF In (for W Band)

b1 IF In (for V Band)

b1 RF In (for <50 Band)

Millimeter Wave Controller (See Page 3 for Block Diagram)

Right Test Head

Microwave Subassembly (See Page 2 for Block Diagram)

mm Wave Out

RF Out

Bias Tee In

LO Out

a2 IF In (for W Band)

a2 IF In (for V Band)

a2 RF In (for <50 Band)

b2 IF In (for W Band)

b2 IF In (for V Band)

b2 RF In (for <50 Band)

Millimeter Wave Subassembly

S1 (1, 2, C) — mm Wave Input — mm Wave Out

AR5 — U12 X3 — AR4 — U11 X2 — FL3 — U14 Combiner

AR6 — A2 Bias Tee — RF In — RF Out

Bias Tee In

U13 — LO In — LO Out — LO LO LO LO

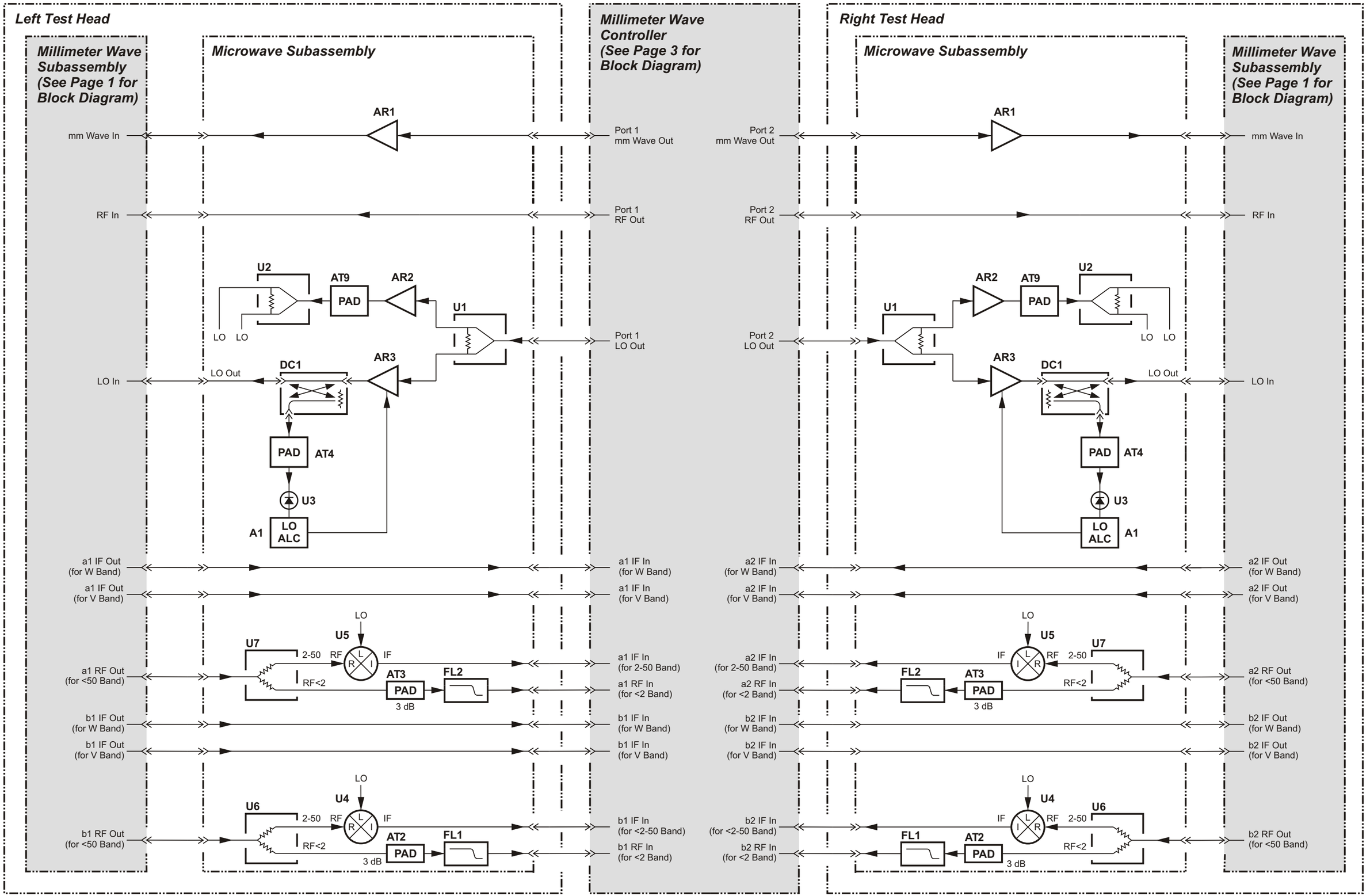
- AT6 — LO — RF >75 — L R I — IF — U18 — a2 IF In (for W Band)
- AT8 — LO — RF 50-75 — L R I — IF — U20 — a2 IF In (for V Band)
- <50 — a2 RF In (for <50 Band)

U16 Combiner — a2 — DC2

- AT5 — LO — RF >75 — L R I — IF — U17 — b2 IF In (for W Band)
- AT7 — LO — RF 50-75 — L R I — IF — U19 — b2 IF In (for V Band)
- <50 — b2 RF In (for <50 Band)

U15 Combiner — b2 — DC3

Port 2



HP E7350 Block Diagram (2 of 3)

Left Test Head (See Page 2 for Block Diagram)

Millimeter Wave Controller

Right Test Head (See Page 2 for Block Diagram)

Option 006

DC1

AR1

S1

RF In (from HP 83651B Source)

AR11

Option 006 Coupled RF Out

2.4mm 50 Ω Termination

Port 2 mm Wave Out

Port 2 RF Out

mm Wave In

RF In

Port 1 mm Wave Out

Port 1 RF Out

Port 1 mm Wave Out

Port 1 RF Out

mm Wave In

RF In

LO In

AR5

U2

LO In

Option 005

U1

LO In (from HP 83621B Source)

AT2

PAD

AR13

U3

AR6

U4

AR12

U5

LO LO LO LO

A16

Leveling DAC

ALC Output to HP 83651B

A7

Variable Gain

S4

AR9

AR10

S5

a1 IF Out (for W Band)

a1 IF Out (for V Band)

a1 IF Out (for 2-50 Band)

a2 IF Out (for W Band)

a2 IF Out (for V Band)

a2 IF Out (for 2-50 Band)

LO

U8

RF L R I IF

FL7

a1 RF Out (for <2 Band)

FL8

IF L I R RF

U9

LO

a2 RF Out (for <2 Band)

S2

AR7

AR8

S3

b1 IF Out (for W Band)

b1 IF Out (for V Band)

b1 IF Out (for 2-50 Band)

b2 IF Out (for W Band)

b2 IF Out (for V Band)

b2 IF Out (for 2-50 Band)

LO

U6

RF L R I IF

FL5

b1 RF Out (for <2 Band)

FL7

IF L I R RF

U7

LO

b2 RF Out (for <2 Band)

IF Outputs to HP 8510C

HEWLETT PACKARD

HP E7350
e7350bk3.cdr
Rev. 8 3/12/98

HP E7350 Block Diagram (3 of 3)

85 GHz Systems

The illustrations on the following three pages show block diagrams for the test heads and the millimeter-wave controller, in an 85 GHz system.

The test head is subdivided internally into a millimeter-wave assembly (the bottom half), and a microwave assembly (the top half). These subassemblies are depicted in separate diagrams.

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Left Test Head

Millimeter Wave Subassembly

U14 Combiner
FL3
U11 X2
AR4
mm Wave Input
mm Wave Out
A2 Bias Tee
AR6
RF In
RF Out
Bias Tee In
U13
AT9 PAD 3 dB
LO In
LO Out
LO LO
DC2
U16 Combiner
a1
AT8
LO
RF 50-85 IF
U20
a1 IF In (for V Band)
<50
a1 RF In (for <50 Band)
DC3
U15 Combiner
b1
AT7
LO
RF 50-85 IF
U19
b1 IF In (for V Band)
<50
b1 RF In (for <50 Band)
Port 1

Microwave Subassembly (See Page 2 for Block Diagram)

mm Wave Out
RF Out
Bias Tee In
LO Out

Millimeter Wave Controller (See Page 3 for Block Diagram)

Right Test Head

Microwave Subassembly (See Page 2 for Block Diagram)

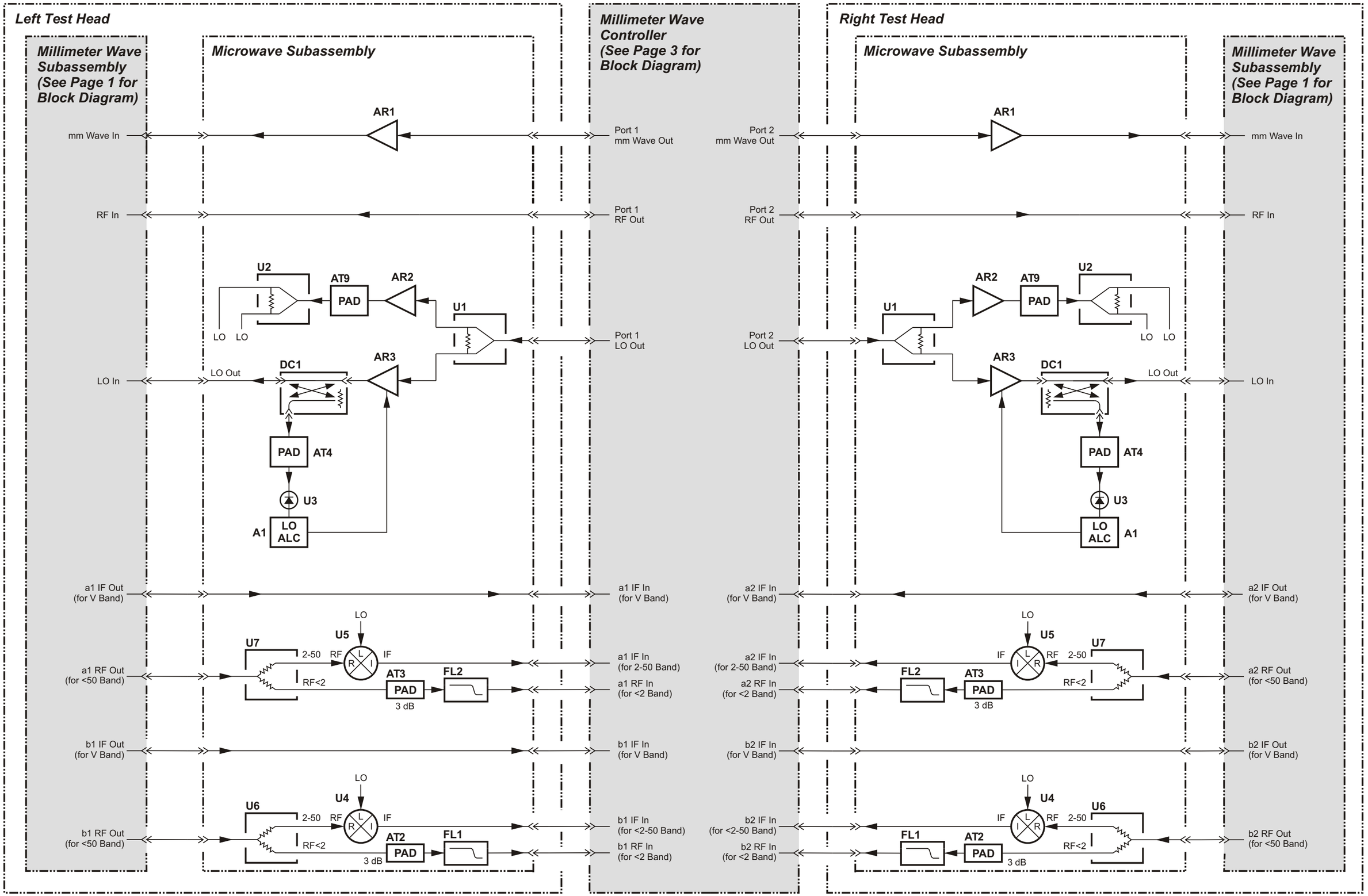
mm Wave Out
RF Out
Bias Tee In
LO Out
a2 IF In (for V Band)
a2 RF In (for <50 Band)
b2 IF In (for V Band)
b2 RF In (for <50 Band)

Millimeter Wave Subassembly

mm Wave Input
AR4
U11 X2
FL3
U14 Combiner
AR6
A2 Bias Tee
RF In
U13
AT9 PAD 3 dB
LO In
LO LO
DC2
U16 Combiner
a2
AT8
LO
IF RF 50-85
U20
<50
DC3
U15 Combiner
b2
AT7
LO
IF RF 50-85
U19
<50
Port 2

HEWLETT PACKARD
HP E7340
e7340bk1.cdr
Rev. 6 2/17/98

HP E7340 Block Diagram (1 of 3)



HEWLETT PACKARD

HP E7340
e7340bk2.cdr
Rev. 7 3/5/98

HP E7340 Block Diagram (2 of 3)

Left Test Head (See Page 2 for Block Diagram)

Millimeter Wave Controller

Right Test Head (See Page 2 for Block Diagram)

Option 006

DC1

AR1

S1

RF In (from HP 83651B Source)

C

Port 2 mm Wave Out

Port 2 RF Out

mm Wave In

RF In

AR11

Option 006 Coupled RF Out

2.4mm 50 Ω Termination

mm Wave In

RF In

LO In

Port 1 mm Wave Out

Port 1 RF Out

Port 1 mm Wave Out

Port 1 RF Out

AR5

U2

LO In

Option 005

U1

LO In (from HP 83621B Source)

AT2

PAD

AR13

U3

AR6

U4

AR12

U5

LO LO LO LO

A16

Leveling DAC

ALC Output to HP 83651B

A7

Variable Gain

S4

S5

AR9

AR10

NC

C

NC

a1 IF Out (for V Band)

a1 IF Out (for 2-50 Band)

a2 IF Out (for V Band)

a2 IF Out (for 2-50 Band)

LO

U8

FL7

FL8

U9

RF

IF

a1 RF Out (for <2 Band)

a2 RF Out (for <2 Band)

S2

S3

AR7

AR8

b1 IF Out (for V Band)

b1 IF Out (for 2-50 Band)

b2 IF Out (for V Band)

b2 IF Out (for 2-50 Band)

U6

FL5

U7

b1 RF Out (for <2 Band)

b2 RF Out (for <2 Band)

IF Outputs to HP 8510C

HEWLETT PACKARD

HP E7340
e7340bk3.cdr
Rev. 9 3/12/98

HP E7340 Block Diagram (3 of 3)

Troubleshooting

If the system appears to be malfunctioning, the process described below can be used look for possible causes and solutions, or to isolate the fault to a particular part of the system.

Cycle Power

This is the quickest and simplest way to eliminate a temporary computer problem that might have been triggered by a line power fluctuation or other elusive cause:

- Turn off power to all system instruments.
- Turn them all back on, except the display portion network analyzer.
- Wait 10 seconds, and turn on the display portion of the network analyzer.

Hardware Configuration Check

If cycling power does not restore normal functioning, the next step is to verify that the system hardware has been set up properly:

Line power

Power switches and/or power indicators must be ON for:

- 85101C *and* 85102B
- Millimeter-wave controller
- 83651B
- 83621B

If the power indicator for any instrument is dark, despite the line switch being in the ON position, check the power line connection and fuse for that instrument.

Test head indicators

The “ON” LEDs (located near the test ports) should be lit, indicating that the test heads are receiving power supply voltages from the millimeter-wave controller.

“Active” indicator

This LED (on the front panel of the millimeter-wave controller) should be lit, indicating that the controller is in communication with the network analyzer, and is selected as the active test set.

GPIB address switches

All of the rack instruments must be set to the correct GPIB addresses; see page 2-37 for a list of addresses.

Language switches

Check the Language Switches for the 83621B and 83651B. Both should be set to “111”.

Cabling

Check the interconnections between the system instruments (see “Cable List” on page 2-32).

Firmware Configuration Check

If no fault can be found in the hardware configuration, the next step is to verify that the system firmware has been set up properly:

Firmware version

The installed firmware must be the 8510XF firmware, *not* the standard 8510C firmware. To check, press:

[SYSTEM] ***{MORE} {SERVICE FUNCTIONS}***
{SOFTWARE REVISION}

If necessary, reload the 8510XF operating system firmware.

System leveling

On the **[SYSTEM]** ***{MORE} {RF POWER CONFIG}*** menu, ***{RF LEVEL / SYSTEM}*** should be selected. This is the normal operating mode for the 8510XF; in most applications, the system will not function if ***{RF LEVEL / SYSTEM}*** is not selected.

System/instrument state

Press **[RECALL]** ***{MORE} {FACTORY PRESET}*** to initialize the entire system to a known valid state.

Reloading firmware

If all of the above are correct, it may be necessary to reload the 8510XF operating system firmware. Refer to the *8510C On-Site Service Manual* section “System, Disc, and Service Commands” under “Self Test Failures” in chapter 4 for more information on reloading the operating system program.

Diagnostics

The 8510XF is not designed to be repaired by the user in the event of a malfunction.

WARNING

Each instrument in the 8510XF system contains lethal voltages when the instrument has ac power applied. Refer to the safety information included in the "Safety/Licensing" section of the *851OC Network Analyzer On-Site Service Manual*, which is included with each 8510XF system. Servicing must be performed by qualified personnel only.

If you are unable to resolve the problem using the procedures above, you will need to contact Agilent Technologies customer engineering (see "Contacting Agilent" on page v).

Before calling for service, however, it is a good idea to take certain preparatory steps, so that the problem can be resolved as quickly as possible:

Define the problem

The more clearly the problem is defined, the more quickly it can be solved. Which functions of the system are affected? Does the malfunction occur only in a particular frequency range, or only in a particular operating mode? Are all four S-parameters affected in the same way?

Record any error messages

Does the network analyzer screen display any error/caution messages? If so, make a note of them. Although the significance of a particular message may not be obvious at the time it is displayed, the information will later be useful to customer engineers in tracking down the cause of the problem.

For help in interpreting error/caution messages, see Chapter 4 of the *8510C On-Site Service Manual*. Also, see "New Messages" on page 7-49 of this manual for messages that are specific to the 8510XF.

8510C diagnostics

Run the built-in diagnostic routines of the 8510C (described in the "Self Test Failures" section of the *8510C On-Site Service Manual*). If no faults are detected, this indicates that the failure is not caused by a malfunction in the network analyzer itself.

Check unratioed power levels

The procedure for checking unratioed power levels is described under "System Operational Test" on page 2-39. There, the procedure is used as a quick check of system functionality; it can also be used as a diagnostic tool, to establish whether or not the network analyzer is receiving an appropriate IF signal for each of the four S parameters.

6 Replaceable Parts

In This Chapter...

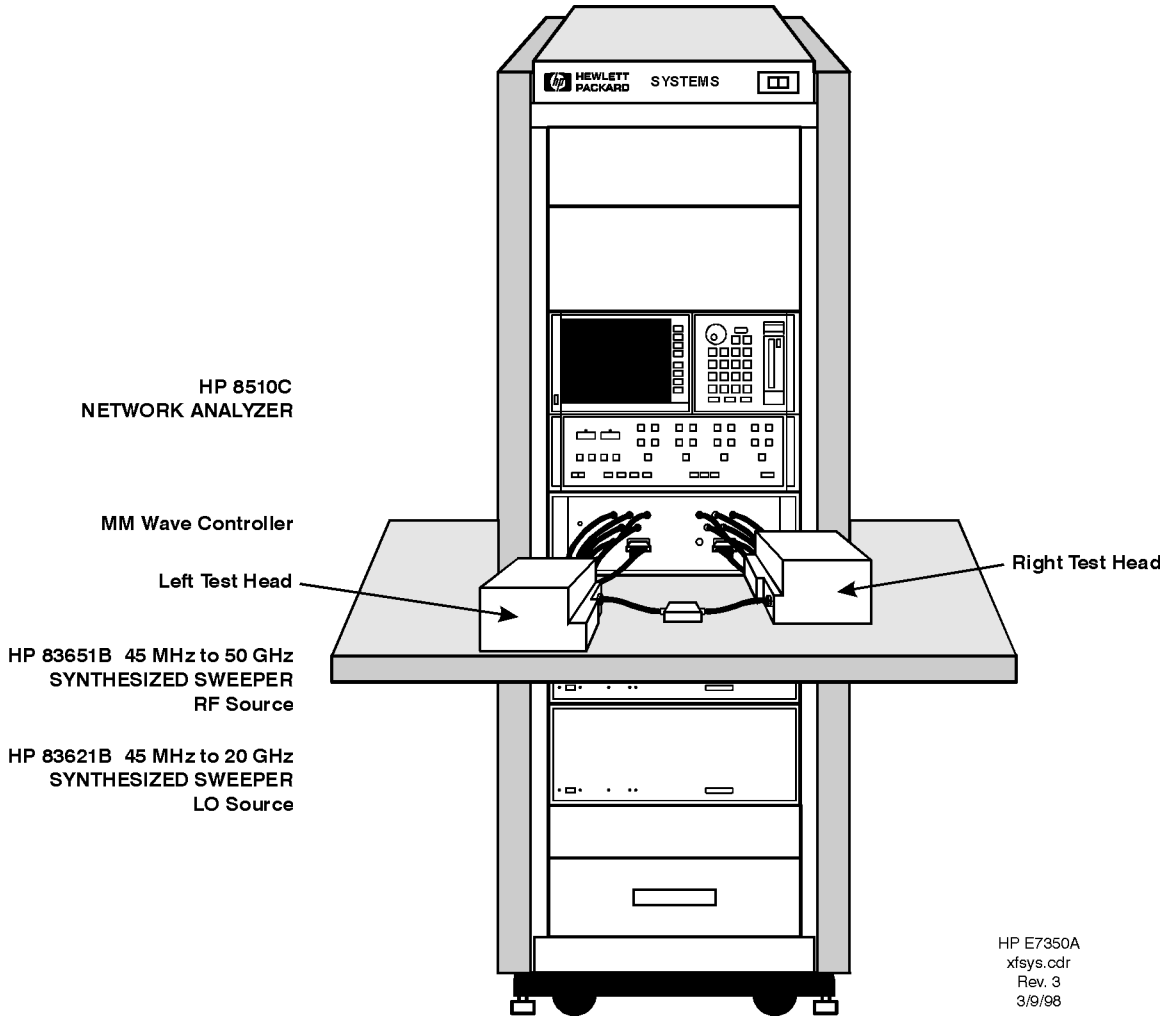


Figure 6-1 Major Components of the 8510XF

Parts Listed

This chapter lists the field-replaceable components (such as instruments, cables, and circuit boards) of the 8510XF. It is not a complete listing of component parts; hardware, for example, is not included. The parts are listed by their Agilent part numbers and/or model numbers.

How to Order

To order replacement parts or spares, contact your local Agilent office. The offices are listed under "Contacting Agilent" on page v. To place an order, you will need to know the Agilent part number and the quantity needed.

Frequency Ranges

In the parts lists on the following pages, 110 GHz systems and 85 GHz systems are presented separately.

Categorization of Components

The components of a complete 8510XF single sweep system can be divided into two categories: those that are already used in a variety of 8510C-based systems, and those that have been created specifically for the 8510XF.

Table 6-1 Generic and Specific System Components

Generic System Components	8510XF-Specific System Components
8510C network analyzer	Millimeter-wave controller
83621B synthesized source	Left test head
83651B synthesized source	Right test head

For the benefit of customers who already have some or all of the generic system components, the 8510XF-specific components are grouped together as a “millimeter-wave subsystem,” which can be ordered separately.

In the parts lists on the following pages, millimeter-wave subsystems and complete systems are listed separately.

NOTE

8510XF upgrade kits are available for other test systems (see “Upgrade Paths” on page 1-10). An upgrade kit typically consists of the millimeter-wave subsystem, supplemented by whatever generic system components are not included in the system being upgraded.

110 GHz Systems

Complete System

The Agilent part number of the complete 110 GHz system is E7350A.

Table 6-2 Parts List for E7350A

Part Number	Description	Quantity	Reference Designator
11900B	ADAPTER 2.4MM F/F	1	
E7732A	RACK FILLER PANEL-3.5 INCH	1	
E7733A	RACK FILLER PANEL-5.25 INCH	1	
E7734A	RACK FILLER PANEL-7.0 INCH	1	
35181M	DRAWER ASSEMBLY	1	
5061-5311	CONNECTOR-3.5MM F/F	1	
E3663-00001	RAIL-INSTRUMENT SUPPORT	12	
E7340-20075	CABLE-RF	1	W1
E7340-20076	CABLE-RF	1	W2
E7340-60009	CABLE ASSEMBLY-DC PLUG	2	
E7342-60004	CABLE 3.5 MM 914D	2	
E7342-60005	CABLE 2.4 MM 9140	4	
7121-4965	LABEL ‘PART OF AUTOMATIC SYSTEM’	8	
8120-1348	CABLE 03C 03F-03M LINE CORD, BLACK	2	
8120-1405	CABLE 03C 03F-03M LINE CORD, GREY	2	
8120-1838	CABLE BNC 1 FOOT	1	
8120-1840	CABLE BNC 4 FEET	1	
8120-3444	CABLE GPIB 0.5 METER (Model 10833D)	2	
8120-3445	CABLE GPIB 1 METER (Model 10833A)	3	
8120-3447	CABLE GPIB 4 METER (Model 10833C)	1	
8120-5370	CABLE BNC/BNC 2438C	2	
83621B	SYNTHESIZED SWEEPER 45 MHz-20 GHz, LO SOURCE	1	
83621B #913	RACK MOUNT FLANGE KIT	1	
83651B	SYNTHESIZED SWEEPER 45 MHz-50 GHz, RF SOURCE	1	
83651B #913	RACK MOUNT FLANGE KIT	1	

Part Number	Description	Quantity	Reference Designator
85106-60038	TABLE TOP ASSEMBLY 1 METER	1	
8510C	NETWORK ANALYZER	1	
08510-60107	CABLE-INTERCONNECT	1	
08510-60126	CABLE 24C 2.4 MM M/F	2	
C2786-60005	FAN ASSEMBLY 220V (OPTION 230 ONLY)	1	
C2786-60024	FAN ASSEMBLY 110 V	1	
E4455A	POWER DISTRIBUTION UNIT 120 V US FOR 1.6 METER CABINET	1	
C2786-63007	POWER DISTRIBUTION UNIT 240 V EUROPEAN FOR 1.6 METER CABINET (OPTION 230 ONLY)	1	
E3661A	RACK-1.6 METER	1	
E3661A #AW3	NORTH AMERICAN LOCALIZATION 120V, 16 A (THIS OPTION DETERMINES PDU AND FAN)	1	
E3661A #AW5	EUROPEAN LOCALIZATION 240V, 8A (THIS OPTION DETERMINES PDU AND FAN)	1	
E3663-00001	RAIL, INSTRUMENT SUPPORT	12	
E7350-80001	LABEL ID E7350A	1	
E7350-90001	OPERATING & SERVICE MANUAL E7340/E7350A	1	
E7341A	MILLIMETER-WAVE CONTROLLER	1	
E7352L	TEST HEAD ASSEMBLY-LEFT	1	
E7352R	TEST HEAD ASSEMBLY-RIGHT	1	

Millimeter-Wave Subsystem

The Agilent part number of the 110 GHz millimeter-wave subsystem is E7352A.

Table 6-3 Parts list for E7352A

Part Number	Description	Quantity	Reference Designator
08510-60107	CABLE-INTERCONNECT	1	
08510-60126	CABLE-24C 2.4 MM M/F	2	
11900B	ADAPTER-2.4 MM F/F	1	
5061-5311	3.5 MM CONNECTOR F/F	1	
8120-1405	CABLE 03C 03F-03M LINE CORD, GREY	1	
8120-3447	CABLE GPIB 4 METER (Model 10833C)	1	
E7340-20075	RF CABLE	1	W1
E7340-20076	RF CABLE	1	W2
E7341A	MILLIMETER-WAVE CONTROLLER	1	
E7340-60009	CABLE ASSEMBLY-DC PLUG	2	
E7342-60004	CABLE 3.5 MM 914D	2	
E7342-60005	CABLE 2.4 MM 9140	4	
E7350-90001	OPERATING & SERVICE MANUAL E7340A/E7350A	1	
E7352L	TEST HEAD ASSEMBY-LEFT	1	
E7352R	TEST HEAD ASSEMBY-RIGHT	1	

85 GHz Systems

Complete System

The Agilent part number of the complete 85 GHz system is E7340A.

Table 6-4 Parts List for E7340A

Part Number	Description	Quantity	Reference Designator
08510-60107	CABLE-INTERCONNECT	1	
08510-60126	CABLE 24C 2.4MM M/F	2	
11900B	ADAPTER-2.4MM F/F	1	
E7732A	RACK FILLER PANEL-3.5 INCH	1	
E7733A	RACK FILLER PANEL-5.25 INCH	1	
E7734A	RACK FILLER PANEL-7.00 INCH	1	
35181M	DRAWER ASSEMBLY	1	
7121-4965	LABEL 'PART OF AUTOMATIC SYSTEM'	8	
8120-1348	CABLE 03C 03F-03M 120V LINE CORD, BLACK	2	
8120-1405	CABLE 03C 03F-03M 120V LINE CORD, GREY	2	
8120-1838	CABLE BNC 1 FOOT	1	
8120-1840	CABLE BNC 4 FEET	1	
8120-3444	CABLE GPIB 0.5 METER (Model 10833D)	2	
8120-3445	CABLE GPIB 1 METER (Model 10833A)	3	
8120-3447	CABLE GPIB 4 METER (Model 10833C)	1	
8120-5370	CABLE BNC 2438C	2	
83621B	SYNTHESIZED SWEEPER 45 MHz-20 GHz, LO SOURCE	1	
83621B #913	RACK MOUNT FLANGE KIT	1	
83651B	SYNTHESIZED SWEEPER 45 MHz-50 GHz, RF SOURCE	1	
83651B #913	RACK MOUNT FLANGE KIT	1	
85106-60038	TABLE TOP ASSEMBLY 1 METER	1	
8510C	NETWORK ANALYZER	1	
C2786-60005	FAN ASSEMBLY 220 V (OPTION 230 ONLY)	1	
C2786-60024	FAN ASSEMBLY 110 V	1	

Part Number	Description	Quantity	Reference Designator
E4455A	POWER DISTRIBUTION UNIT 120 V US 1.6 METER	1	
C2786-63007	POWER DISTRIBUTION UNIT 240 V EUROPEAN FOR 1.6 METER CABINET (OPTION 230 ONLY)	1	
E3661A	RACK-1.6 METER	1	
E3661A #AW3	NORTH AMERICAN LOCALIZATION 120V, 16 A (THIS OPTION DETERMINES PDU AND FAN)	1	
E3661A #AW5	EUROPEAN LOCALIZATION 240V, 8A (THIS OPTION DETERMINES PDU AND FAN)	1	
E3663-00001	RAIL, INSTRUMENT SUPPORT	12	
E7340-20075	RF CABLE	1	W1
E7340-20076	RF CABLE	1	W2
E7342-60004	CABLE 3.5 MM 914D	2	
E7342-60005	CA 2.4 MM 9140	4	
E7340-60009	CABLE ASSEMBLY DC PLUG	2	
E7341A	MILLIMETER-WAVE CONTROLLER	1	
E7342L	TEST HEAD ASSEMBLY, LEFT	1	
E7342R	TEST HEAD ASSEMBLY, RIGHT	1	
E7350-90001	OPERATING & SERVICE MANUAL 7340/50A	1	

Millimeter-Wave Subsystem

The Agilent part number of the 85 GHz Millimeter-Wave Subsystem is E7342A.

Table 6-5 Parts list for E7342A

Part Number	Description	Quantity	Reference Designator
08510-60107	CABLE-INTERCONNECT	1	
08510-60126	CABLE 2.4MM F/F	2	
11900B	ADAPTER-2.4 MM F/F	1	
5061-5311	3.5 MM F/F CONNECTOR	1	
8120-1405	CABLE 03C 03F-03M LINE CORD, GREY	1	
8120-3447	CABLE GPIB 4 METER (Model 10833C)	1	
E7340-20075	RF CABLE	1	W1
E7340-20076	RF CABLE	1	W2
E7340-60009	CABLE ASSEMBLY-DC PLUG	2	
E7341A	MILLIMETER-WAVE CONTROLLER	1	
E7342L	TEST HEAD ASSEMBLY-LEFT	1	
E7342R	TEST HEAD ASSEMBLY-RIGHT	1	
E7342-60004	CABLE 3.5 MM 914D	2	
E7342-60005	CABLE 2.4 MM 9140	4	

Millimeter-Wave Controller

The figure below shows the locations of circuit boards and major assemblies within the millimeter-wave controller. The parts list for the controller appears on the following page.

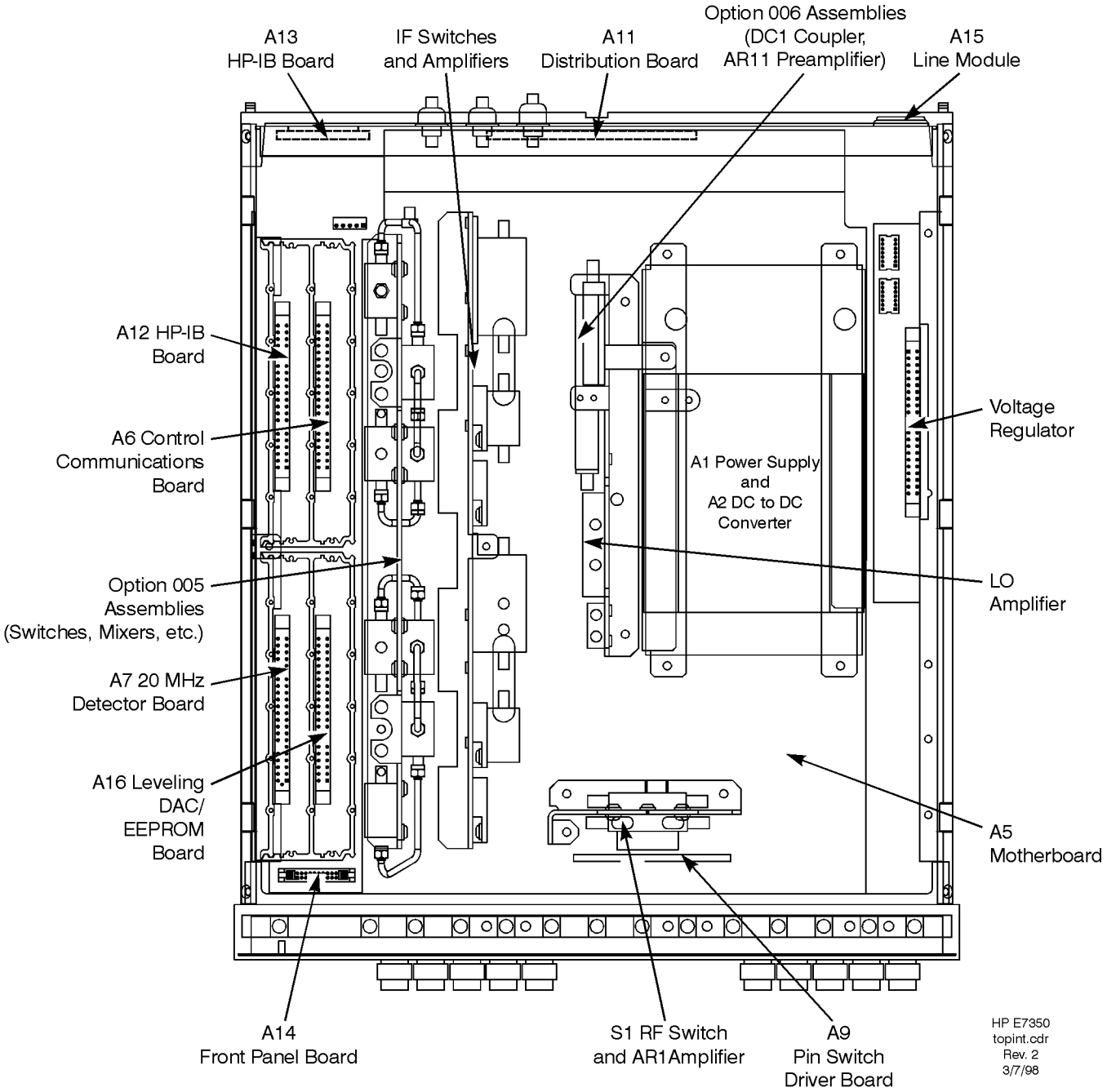


Figure 6-2 Assembly Locations within the Controller

Table 6-6 Parts list for the E7341A Millimeter-Wave Controller

Part Number	Description	Quantity	Reference Designator
0950-3236	POWER SUPPLY	1	A1
0950-3241	DC TO DC CONVERTER	1	A2
85105-60010	MOTHERBOARD ASSEMBLY	1	A5
E7340-60014	BOARD ASSEMBLY, CONTROL COMMUNICATIONS	1	A6
E7340-60015	BOARD ASSEMBLY, 20 MHz DETECTOR	1	A7
E7340-60016	BOARD ASSEMBLY, REGULATOR	1	A8
E7340-60060	PIN SWITCH DRIVER BOARD	1	A9
E7340-60069	BOARD ASSEMBLY, DISTRIBUTION	1	A11
E7340-60103	BOARD ASSEMBLY, GPIB XF	1	A12
08513-60006	BOARD ASSEMBLY, GPIB INTERCONNECT	1	A13
08513-60005	BOARD ASSEMBLY, FRONT PANEL	1	A14
9135-0217	FILTER, LINE MODULE	1	A15
E7340-60094	BOARD ASSEMBLY, LEVELING DAC	1	A16
5086-7530	AMPLIFIER 1 TO 20 GHz	1	AR5
5086-7650	AMPLIFIER, INPUT	1	AR1
0955-0612	AMPLIFIER,16 dB, 10 MHz TO 2 GHz, SMA (OPTION 005 ONLY)	3	AR6, AR12, AR13
11636B	POWER DIVIDER (OPTION 005 ONLY)	1	U1
0955-0504	SPLITTER, 1 TO 2.5 GHz SMA (OPTION 005 ONLY)	3	U3,U4,U5
0955-0122	ATTENUATOR 10 dB 2W SMA (OPTION 005 ONLY)	1	AT2
0955-0648	MIXER, 10 MHz TO 3 GHz SMA (OPTION 005 ONLY)	4	U6,U7,U8,U9
0955-0791	FILTER, LOW PASS,SMA (OPTION 005 ONLY)	4	FL5,FL6,FL7,FL8
5086-7653	PREAMPLIFIER, 50 GHz (OPTION 006 ONLY)	1	AR11
5086-7658	COUPLER/ 50 GHz (OPTION 006 ONLY)	1	DC1

7 Menus & Commands

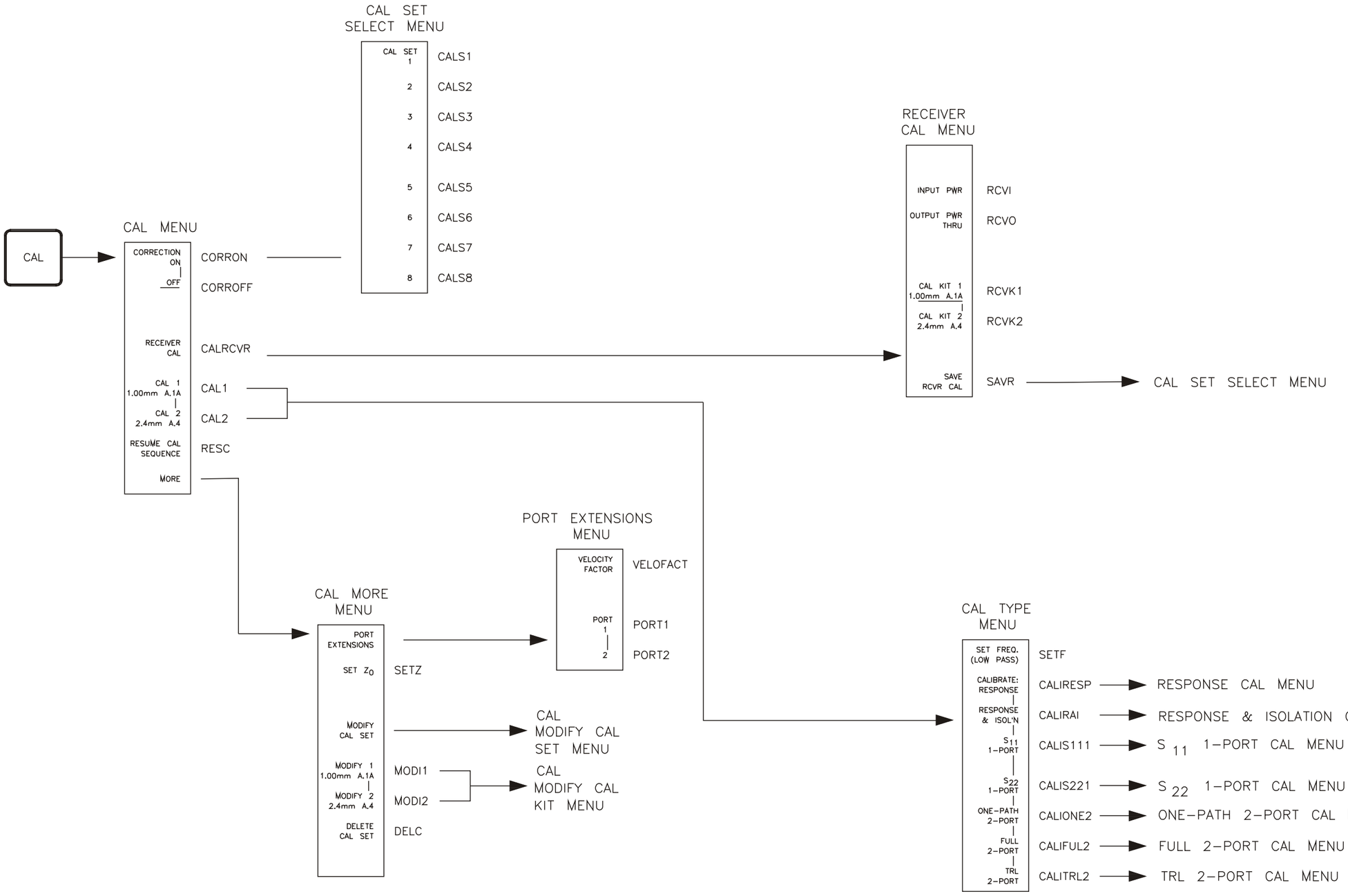
In This Chapter...

Menu Maps

The following pages include a complete set of menu maps for the 8510C network analyzer, including all special modifications that have been implemented for the 8510XF system. Most of these menus are the same as those shown in the 8510C Network Analyzer Keyword Dictionary.

For a review of the differences between the 8510XF menus and standard 8510C menus, see “8510XF Operating System” on page 3-2.

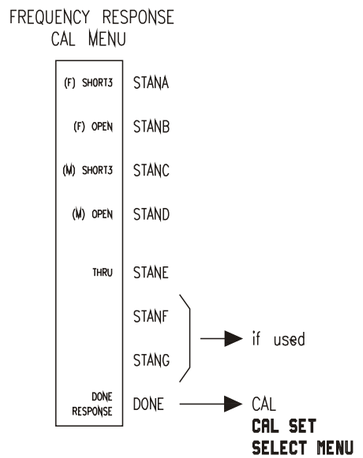
Table 7-1 Sequence of Menu Maps



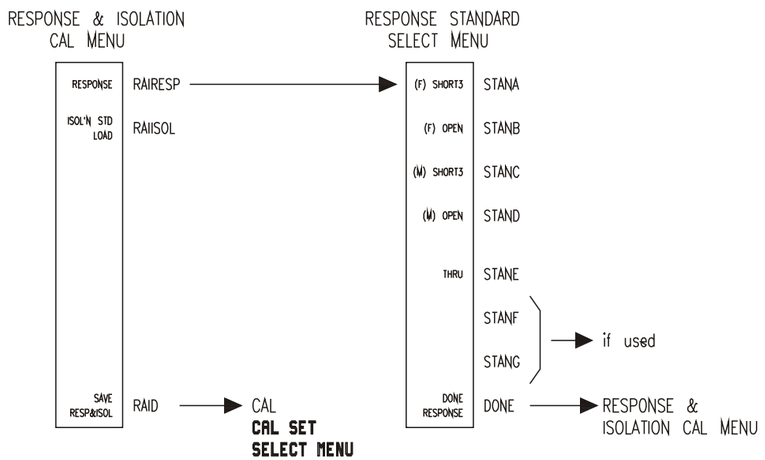
HP E7350
calmenu.eps
Rev. 2
2/9/98

HEWLETT PACKARD

CAL
RESPONSE CAL

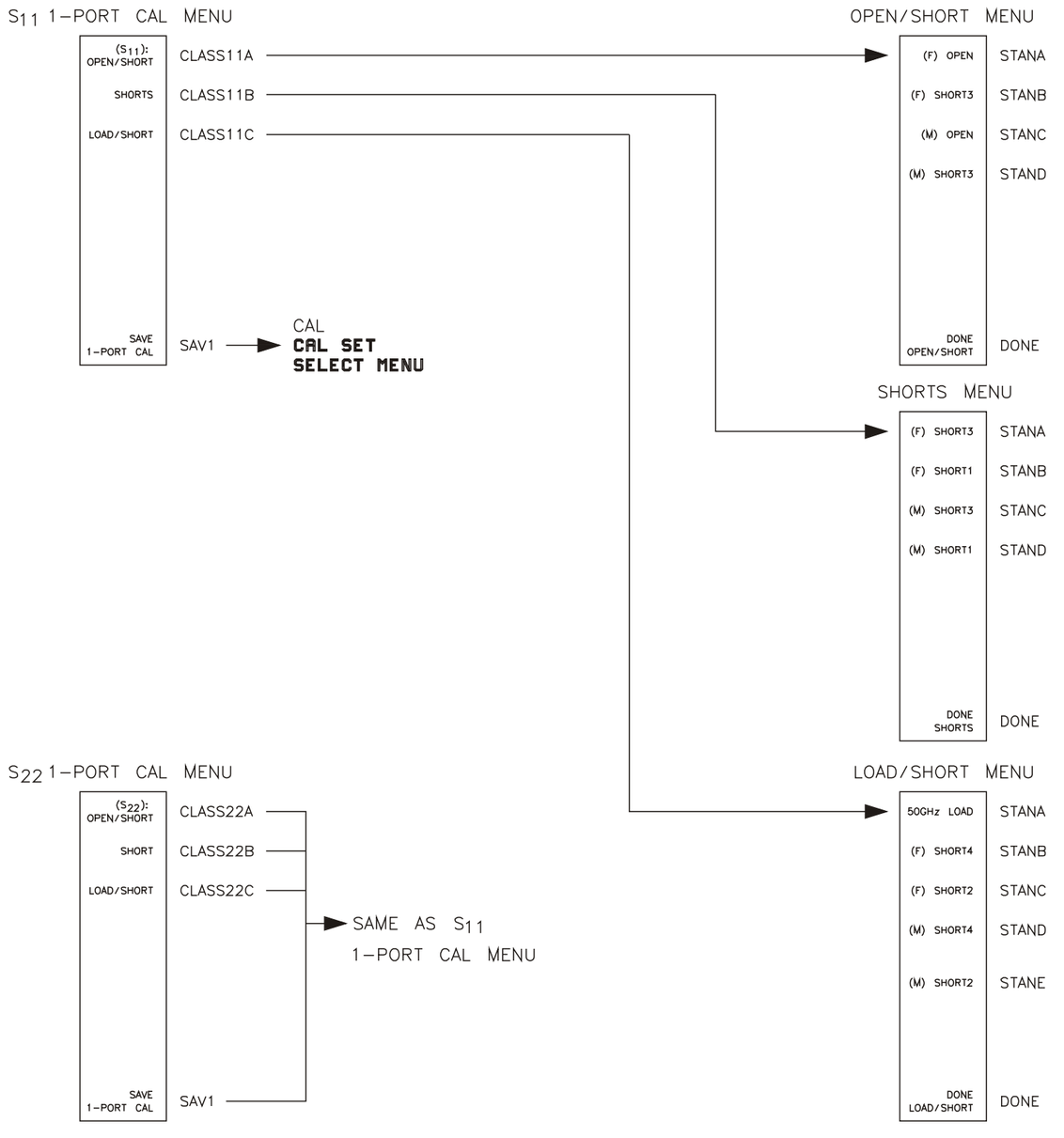


CAL
RESPONSE AND ISOLATION CAL



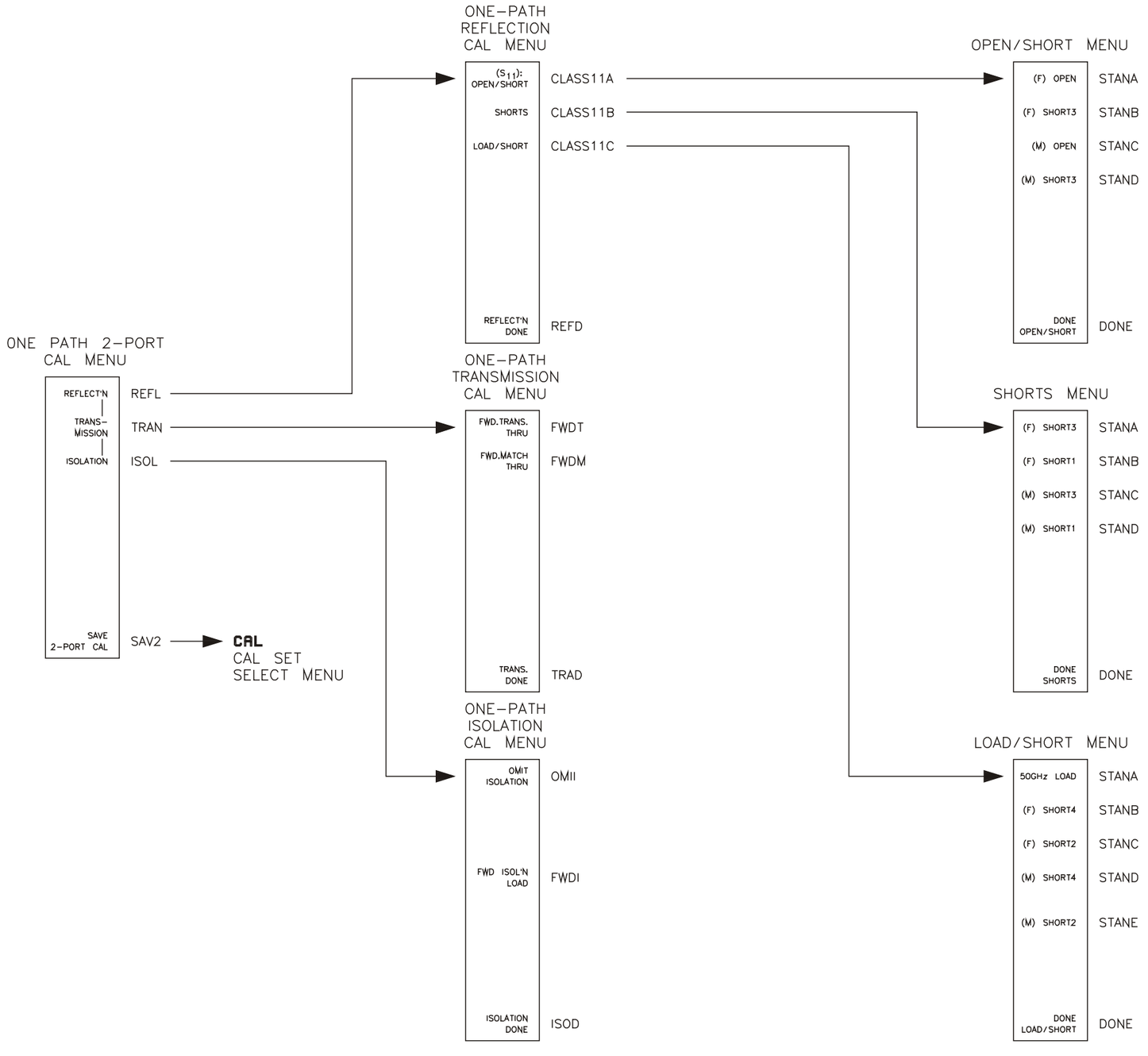
HP E7350
coresp.eps
Rev. 2
2/12/88

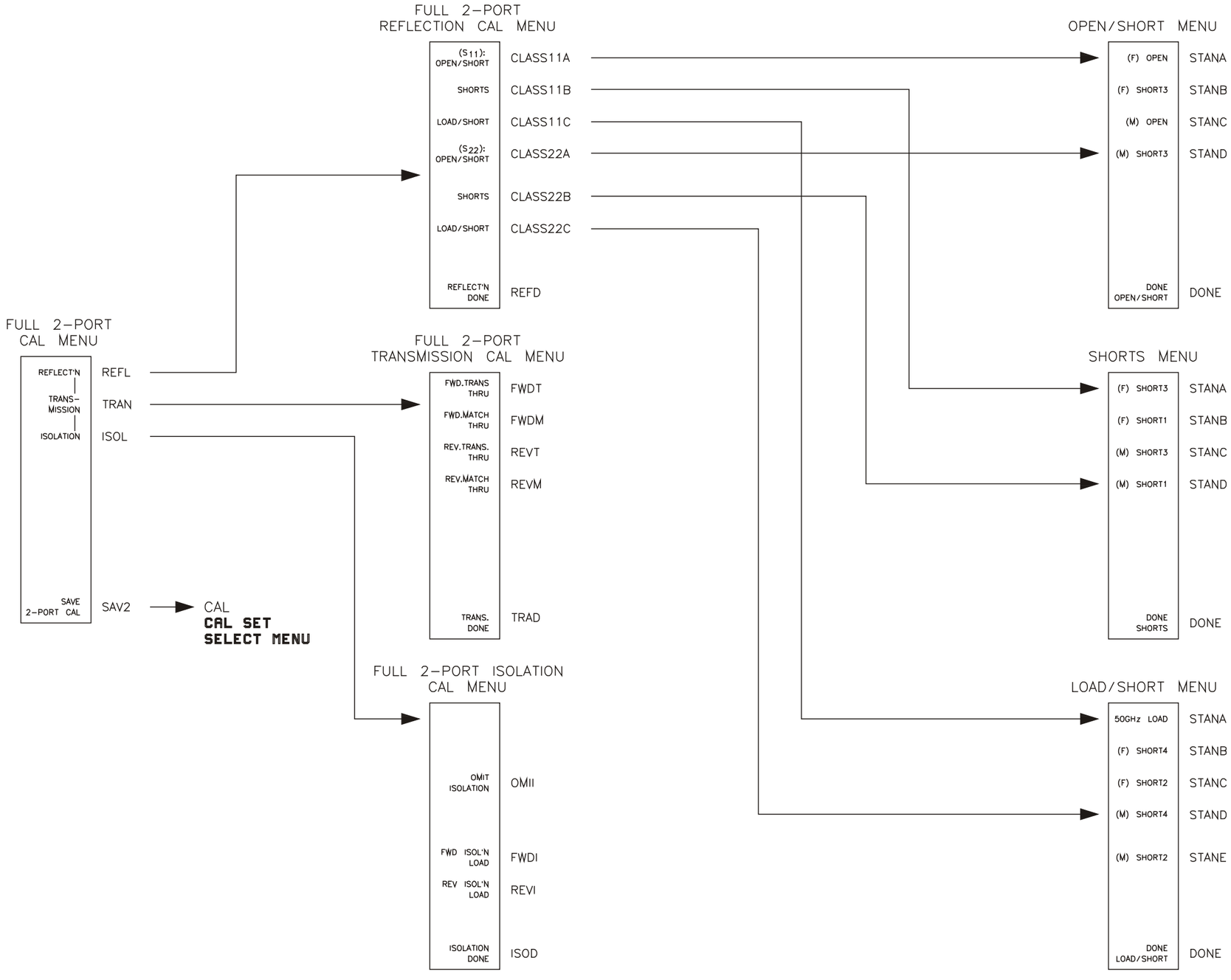
HEWLETT ®
PACKARD



HP E7350
cal1port.egs
Rev. 2
2/12/98

HEWLETT PACKARD

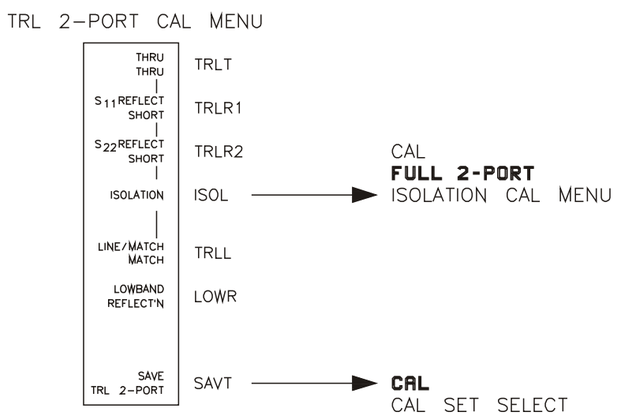

ONE PATH 2-PORT CAL MENU
REFLECT'N
TRANS-MISSION
ISOLATION
SAVE 2-PORT CAL
REFL
TRAN
ISOL
SAV2
CAL SET SELECT MENU
ONE-PATH REFLECTION CAL MENU
(S11): OPEN/SHORT
SHORTS
LOAD/SHORT
REFLECT'N DONE
CLASS11A
CLASS11B
CLASS11C
REFD
ONE-PATH TRANSMISSION CAL MENU
FWD.TRANS. THRU
FWD.MATCH THRU
TRANS. DONE
FWDT
FWDM
TRAD
ONE-PATH ISOLATION CAL MENU
OMIT ISOLATION
FWD ISOL'N LOAD
ISOLATION DONE
OMII
FWDI
ISOD
OPEN/SHORT MENU
(F) OPEN
(F) SHORT3
(M) OPEN
(M) SHORT3
DONE OPEN/SHORT
STANA
STANB
STANC
STAND
DONE
SHORTS MENU
(F) SHORT3
(F) SHORT1
(M) SHORT3
(M) SHORT1
DONE SHORTS
STANA
STANB
STANC
STAND
DONE
LOAD/SHORT MENU
50GHz LOAD
(F) SHORT4
(F) SHORT2
(M) SHORT4
(M) SHORT2
DONE LOAD/SHORT
STANA
STANB
STANC
STAND
STANE
DONE



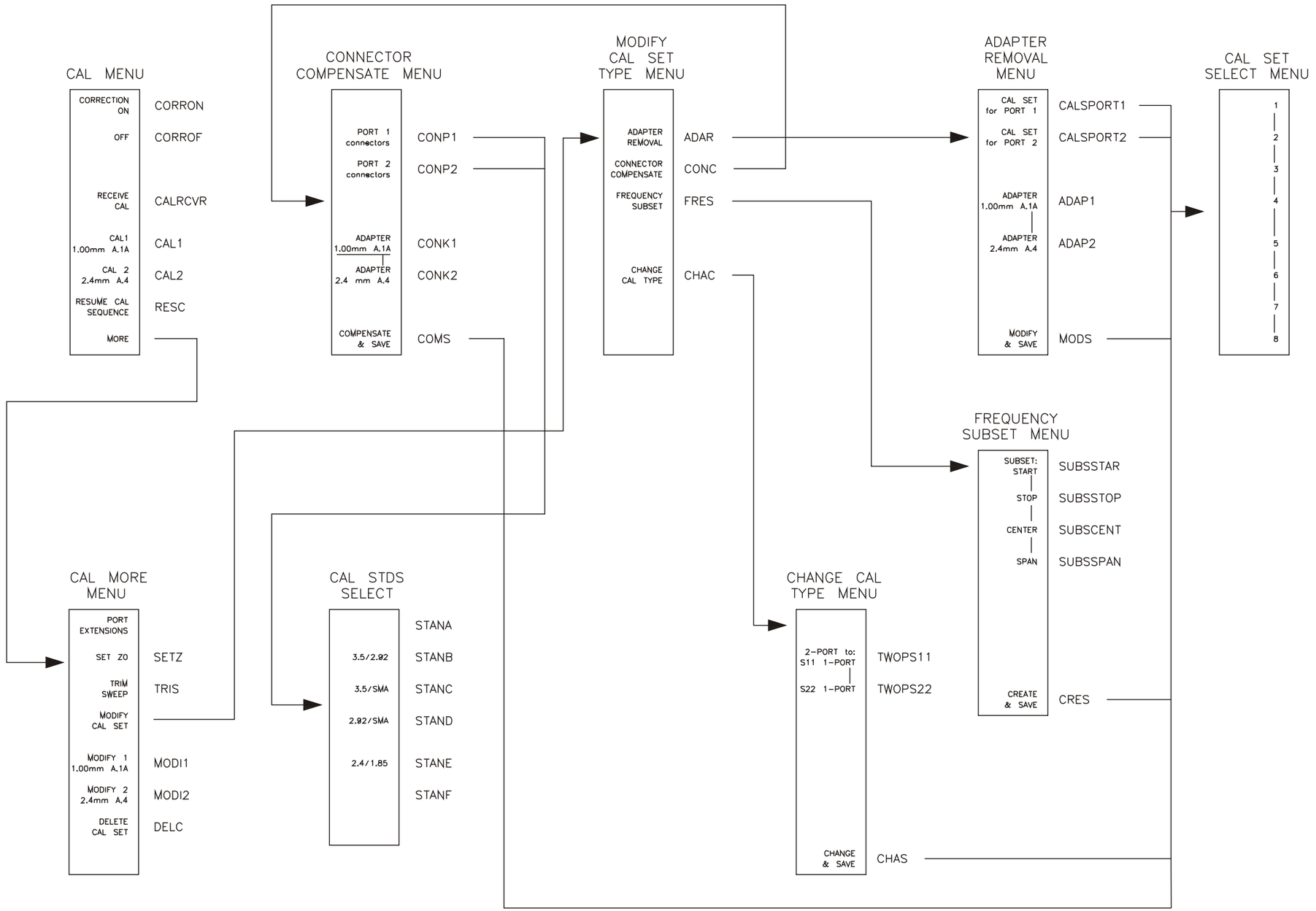
HP E7350
calfull2.egs
Rev. 2
2/12/98

HEWLETT PACKARD

CAL
TRL 2-PORT

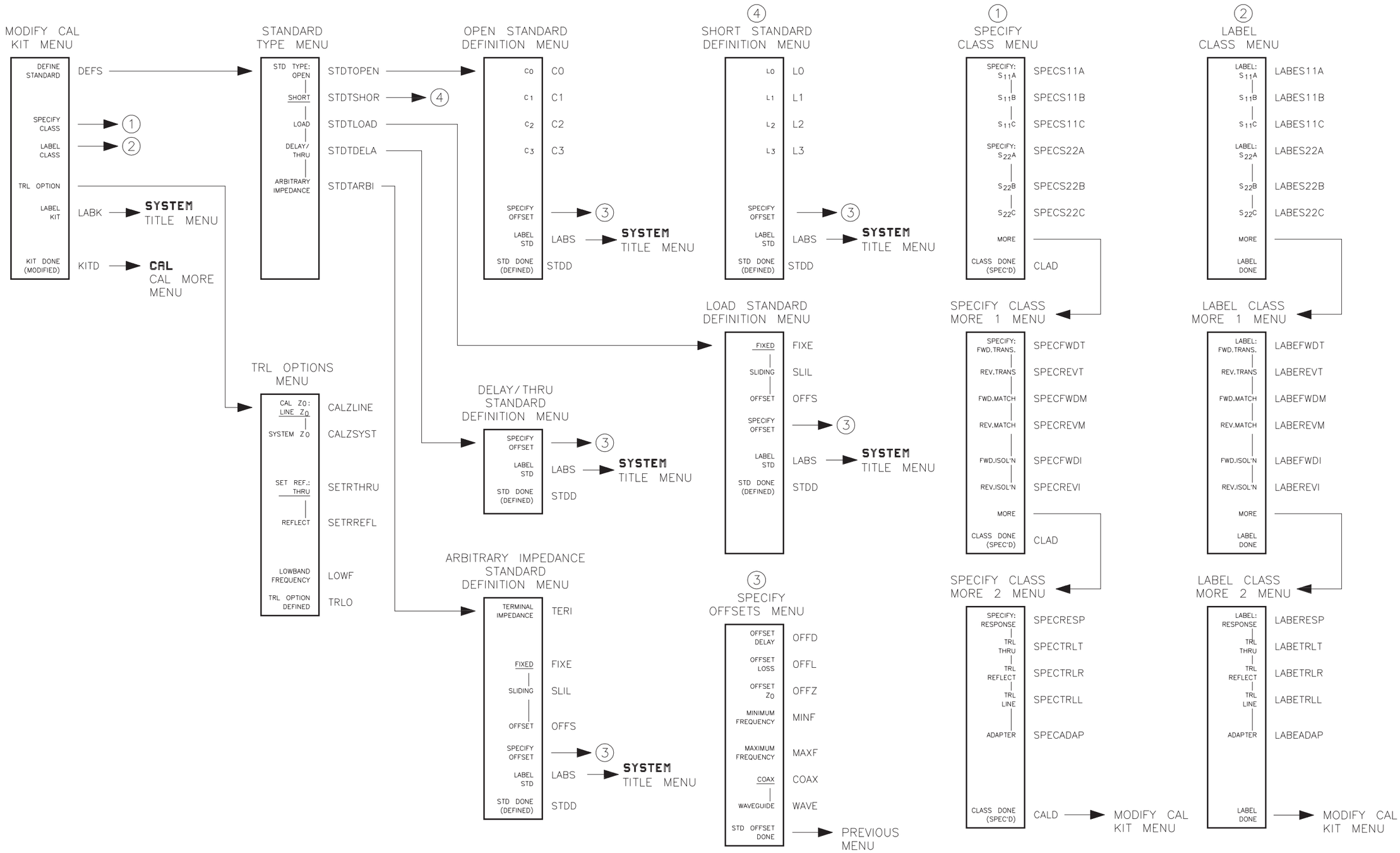


CAL
MODIFY CAL SET



HP E7350
colmcset.eps
Rev. 2
2/9/98

HEWLETT PACKARD


MODIFY CAL KIT MENU
DEFINE STANDARD
DEFS
SPECIFY CLASS
1
LABEL CLASS
2
TRL OPTION
LABEL KIT
LABK
SYSTEM TITLE MENU
KIT DONE (MODIFIED)
KITD
CAL CAL MORE MENU
STANDARD TYPE MENU
STD TYPE: OPEN
SHORT
LOAD
DELAY/ THRU
ARBITRARY IMPEDANCE
STDTOPEN
STDTSHOR
4
STDTLOAD
STDTDELA
STDTARBI
OPEN STANDARD DEFINITION MENU
C0
C1
C2
C3
SPECIFY OFFSET
3
LABEL STD
LABS
SYSTEM TITLE MENU
STD DONE (DEFINED)
STDD
4
SHORT STANDARD DEFINITION MENU
L0
L1
L2
L3
SPECIFY OFFSET
3
LABEL STD
LABS
SYSTEM TITLE MENU
STD DONE (DEFINED)
STDD
1
SPECIFY CLASS MENU
SPECIFY: S11A
S11B
S11C
SPECIFY: S22A
S22B
S22C
MORE
CLASS DONE (SPEC'D)
SPECS11A
SPECS11B
SPECS11C
SPECS22A
SPECS22B
SPECS22C
CLAD
2
LABEL CLASS MENU
LABEL: S11A
S11B
S11C
LABEL: S22A
S22B
S22C
MORE
LABEL DONE
LABES11A
LABES11B
LABES11C
LABES22A
LABES22B
LABES22C
TRL OPTIONS MENU
CAL Z0: LINE Z0
SYSTEM Z0
SET REF.: THRU
REFLECT
LOWBAND FREQUENCY
TRL OPTION DEFINED
CALZLINE
CALZSYST
SETRTHRU
SETRREFL
LOWF
TRLO
DELAY/ THRU STANDARD DEFINITION MENU
SPECIFY OFFSET
3
LABEL STD
LABS
SYSTEM TITLE MENU
STD DONE (DEFINED)
STDD
ARBITRARY IMPEDANCE STANDARD DEFINITION MENU
TERMINAL IMPEDANCE
FIXED
SLIDING
OFFSET
SPECIFY OFFSET
3
LABEL STD
LABS
SYSTEM TITLE MENU
STD DONE (DEFINED)
TERI
FIXE
SLIL
OFFS
STDD
LOAD STANDARD DEFINITION MENU
FIXED
SLIDING
OFFSET
SPECIFY OFFSET
3
LABEL STD
LABS
SYSTEM TITLE MENU
STD DONE (DEFINED)
FIXE
SLIL
OFFS
STDD
3
SPECIFY OFFSETS MENU
OFFSET DELAY
OFFSET LOSS
OFFSET Z0
MINIMUM FREQUENCY
MAXIMUM FREQUENCY
COAX
WAVEGUIDE
STD OFFSET DONE
OFFD
OFFL
OFFZ
MINF
MAXF
COAX
WAVE
PREVIOUS MENU
SPECIFY CLASS MORE 1 MENU
SPECIFY: FWD.TRANS.
REV.TRANS
FWD.MATCH
REV.MATCH
FWD.ISOL'N
REV.ISOL'N
MORE
CLASS DONE (SPEC'D)
SPECFWDT
SPECREVT
SPECFWDM
SPECREVM
SPECFWDI
SPECREVI
CLAD
LABEL CLASS MORE 1 MENU
LABEL: FWD.TRANS.
REV.TRANS
FWD.MATCH
REV.MATCH
FWD.ISOL'N
REV.ISOL'N
MORE
LABEL DONE
LABEFWDT
LABEREVT
LABEFWDM
LABEREVM
LABEFWDI
LABEREVI
SPECIFY CLASS MORE 2 MENU
SPECIFY: RESPONSE
TRL THRU
TRL REFLECT
TRL LINE
ADAPTER
CLASS DONE (SPEC'D)
SPECRESP
SPECTRLT
SPECTRLR
SPECTRLL
SPECADAP
CALD
MODIFY CAL KIT MENU
LABEL CLASS MORE 2 MENU
LABEL: RESPONSE
TRL THRU
TRL REFLECT
TRL LINE
ADAPTER
LABEL DONE
LABERESP
LABETRLT
LABETRLR
LABETRLL
LABEADAP
MODIFY CAL KIT MENU

COPY

MENUCOPY

COPY MENU

PLOT TO PRINTER — PRINALL

PLOT TO PLOTTER

LIST TRACE TO PRINTER

SYS / OPER PARAMETERS

DEFINE PRINT

DEFINE PLOT

DEFINE LIST

ABORT PRINT/PLOT — ABORPRIP

PLOT TO PLOTTER MENU

PLOT: ALL	PLOTALL
DATA	PLOTDATA
MEMORY	PLOTMEMO
GRATICULE	PLOTGRAT
MARKER(S)	PLOTMARK
TITLE	
TEXT	PLOTTEXT
LIMITS	PLOTLIMI

LIST TRACE TO PRINTER MENU

LIST TRACE VALUES	LIST
LIST ALL S PARAMETERS	LISALL

SYS / OPER PARAMETER MENU

SYSTEM PARAMETERS	SYSP
OPERATING PARAMETERS	OPEP

SYSTEM PARAMETERS MENU

RESTORE DISPLAY — RESD

PRINT PARAMETERS — PRIP

PLOT PARAMETERS — PLOP

hp

SYSTEM PARAMETER	ADDRESS	INTERFACE TYPE
8510 HP-IB ADDRESS	16	HPIB (SYSTEM BUS)
SYSTEM BUS ADDRESS	17	HPIB (SYSTEM BUS)
PASS-THRU ADDRESS	31	
USER DISPLAY ADDRESS	31	HPIB (8510 BUS)
SOURCE HP-IB ADDRESS	19	HPIB (8510 BUS)
SOURCE 2 HP-IB ADDRESS	31	HPIB (8510 BUS)
TEST SET HP-IB ADDRESS	20	HPIB (8510 BUS)
RF SWITCH ADDRESS	31	HPIB (8510 BUS)
POWER METER ADDRESS	13	HPIB (8510 BUS)
PLOTTER ADDRESS	5	HPIB (8510 BUS)
PRINTER ADDRESS	2	HPIB (8510 BUS)
DISC ADDRESS	INTERNAL	INTERNAL
SQR MASK (PRIMARY)	0	
SQR MASK (SECONDARY)	0	

SET PEN NUMBERS MENU

SOFTKEYS PEN: 1	PENNSOFT
WARNING PEN: 2	PENNWARN
S11 DATA PEN: 3	PENNS11D
S22 DATA PEN: 4	PENNS22D
S21 DATA PEN: 5	PENNS21D
S12 DATA PEN: 6	PENNS12D
GRATICULE PEN: 1	PENNGRAT
MORE	

SET PEN NUMBERS MORE MENU

MARKERS PEN: 1	PENNMARK
NOT USED PEN: 2	PENNNUO9
S11 MEM PEN: 3	PENNS11M
S22 MEM PEN: 4	PENNS22M
S21 MEM PEN: 5	PENNS21M
S12 MEM PEN: 6	PENNS12M
LIMITS	PENNLIMI
STIMULUS PEN: 1	PENNSTIM

DEFINE PRINT MENU

PRINT TYPE MONOCHROME	PRINTYPEMONO
COLOR	PRINTYPECOLR
PRINT: PORTRAIT	PRINORIEPOR
LANDSCAPE	PRINORIELAN
AUTO FEED ON	PRINAUTFON
OFF	PRINAUTFOFF
SELECT	PRINFORF
MORE	

DEFINE PRINT MORE MENU

PRINTER RESOLUTION	PRINRESO
TOP MARGIN	PRINTOPMAR
* LEFT MARGIN	PRINSIDMAR
PTINT WIDTH	PRINWID

DEFINE PLOT MENU

PLOT TYPE: MONOCHROME	PLOTTYPEMONO
COLOR	PLOTTYPECOLR
SET PEN NUMBERS	
DEFAULT PEN NUMBRS	DEFPENCOLR
AUTO FEED ON	PLOTAUTFON
OFF	PRINAUTFOFF
FORM FEED	PRINFORF
SELECT QUADRANT	

OPERATING PARAMETERS MENU

RESTORE DISPLAY — RESD

PRINT PARAMETERS — PRIP

PLOT PARAMETERS — PLOP

hp

OPERATING PARAMETER	Channel 1	Channel 2
NUMBER of POINTS	201	201
SWEEP TIME	100.0 ms	100.0 ms
SOURCE POWER	10.0 dBm	10.0 dBm
POWER SLOPE	0.0 dB/GHz	0.0 dB/GHz
	OFF	OFF
PORT 1 ATTEN.	0.0 dB	0.0 dB
PORT 2 ATTEN.	0.0 dB	0.0 dB
ELECTRICAL DELAY	0.0 s	0.0 s
PHASE OFFSET	0.0 deg.	0.0 deg.
MAGNITUDE SLOPE	0.0 dB/GHz	0.0 dB/GHz
MAGNITUDE PHASE	0.0 dB	0.0 dB
IF AVERAGING FACTOR	1.0	1.0
	OFF	OFF
SMOOTHING APERTURE	0.0 % SPAN	0.0 % SPAN
	OFF	OFF

PAGE PARAMETERS — PAGP

continued

RESTORE DISPLAY — RESD

PRINT PARAMETERS — PRIP

PLOT PARAMETERS — PLOP

hp

OPERATING PARAMETER	Channel 1	Channel 2
PORT 1 EXTENSION	0.0 s	0.0 s
PORT 2 EXTENSION	0.0 s	0.0 s
ZO	50.0	50.0
CAL TYPE	UNDEFINED	UNDEFINED
	OFF	OFF
GATE START	-500.0 ps	-500.0 ps
GATE STOP	500.0 ps	500.0 ps
WINDOW	NORMAL	NORMAL
GATE SHAPE	NORMAL	NORMAL
	OFF	OFF
MARKER 1	4.0 GHz	4.0 GHz
MARKER 2	4.0 GHz	4.0 GHz
MARKER 3	4.0 GHz	4.0 GHz
MARKER 4	4.0 GHz	4.0 GHz
MARKER 5	4.0 GHz	4.0 GHz

PAGE PARAMETERS — PAGP

DEFINE LIST MENU

LIST SKIP FACTOR	PRINSKIP
LIST FORMAT	COL1WIDT
	DEC1POSI
AUTO FEED ON	COL2WIDT
OFF	DEC2POSI
FORM FEED	

LIST FORMAT MENU

STIMULUS WIDTH	LISSTIMWIDT
DECIMAL POSITION	LISSTIMDECP
UNITS	
COLUMN 1 WIDTH	LISCOL1WID
DECIMAL POSITION	LISCOL1DECP
COLUMN 2 WIDTH	LISCOL2WID
DECIMAL POSITION	LISCOL2DECP

STIMULUS UNITS MENU

UNITS: Giga	PRIUPICO
Mega	PRIUNANO
Kilo	PRIUMICR
x 1	PRIUMILLI
Milli	PRIUUNIT
Micro	PRIUKILO
Nano	PRIUMEGA
Pico	PRIUGIGA

SELECT QUADRANT MENU

X - LEFT - - UPPER	LEFU
- - LEFT X - LOWER	LEFL
- X RIGHT - - UPPER	RIGU
- - RIGHT - X LOWER	RIGL
X - FULL X - PAGE	FULP

* The softkey "LEFT MARGIN" becomes "RIGHT MARGIN" when the print orientation is set to "LANDSCAPE". The programming code stays the same.

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DISC
MENUDISC

DISC MENU

- DIRECTORY → DIRE
- STORE → STOR
- LOAD → LOAD
- DELETE → DELE
- UN-DELETE → UNDE
- STORAGE IS INTERNAL | EXTERNAL
- SET UP DISC → SETUP DISC MENU

DIRECTORY DISPLAY AND MENU

RESTORE DISPLAY → PREVIOUS MENU

USE KNOB OR STEP KEYS TO SELECT A FILE

	FILE NAME	CONTENTS	TYPE	CREATED
->	IS_FILTER	INST STATE	BIN	90/12/13 01:37:18 <-
	IS_JOE	INST STATE	BIN	90/12/04 01:51:25
	IS_SETUP	INST STATE	BIN	90/12/06 02:36:08

3 FILES ON DISC

INSTRUMENT STATE SELECT MENU

INST STATE
- • 1 → INSS1
- • 2 → INSS2
- • 3 → INSS3
- • 4 → INSS4
- • 5 → INSS5
- • 6 → INSS6
- • 7 → INSS7
- USER PRESET • 8 → INSS8

DATA TYPE SELECT MENU

INST STATE 1–8 | ALL → INSSALL

MEMORY 1–8 | ALL → MEMOALL

CAL SET 1–8 | ALL → CALSALL

CAL KIT 1–2

MORE → DATA TYPE SELECT MORE MENU

TO ①, ② OR ③

MEMORY SELECT MENU

MEMORY
- • 1 → MEMO1
- • 2 → MEMO2
- 3 → MEMO3
- 4 → MEMO4
- 5 → MEMO5
- 6 → MEMO6
- 7 → MEMO7
- 8 → MEMO8

TO ①, ② OR ③

CAL SET SELECT MENU

CAL SET
- • 1 → CALS1
- 2 → CALS2
- 3 → CALS3
- 4 → CALS4
- 5 → CALS5
- 6 → CALS6
- 7 → CALS7
- 8 → CALS8

CAL KIT SELECT MENU

CAL KIT
- • 1 → CALK1
- • 2 → CALK2

SETUP DISC MENU

SEE NOTE

- DISC UNIT NUMBER → DISCUNIT
- DISC VOLUME → DISCVOL
- INITIALIZE DOS DISC → INITIALIZE DOS DISC MENU
- INITIALIZE LIF DISC → INITIALIZE LIF DISC MENU

INITIALIZE DOS DISC MENU

INIT DOS?
- YES
- NO

INITIALIZE LIF DISC MENU

INIT LIF?
- YES
- NO → INID

DATA TYPE SELECT MORE MENU

- DATA: RAW → DATARAW
- DATA → DATADATA
- FORMATTED → DATAFORM
- DELAY TABLE → DELT
- USER DISPLAY → USED
- HARDWARE STATE → HARS
- MACHINE DUMP → MACD

NOTE: THE SOFTKEYS 'DISC UNIT NUMBER' AND 'DISC VOLUME' DO NOT APPEAR IN THIS MENU IF THE INSTRUMENT HAS INTERNAL STORAGE SELECTED.

① STORE DISC FILE DISPLAY AND MENU

REPLACE MENU

DISPLAY SECTION

ENTER (see FILE TYPES below) FILE NAME: THEN PRESS 'STORE'

XX_ → SELECT LETTER

ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789

BACK SPACE

ERASE NAME

STORE FILE → DISF

FILE TYPES

CAL KIT	CK_	INST ALL	IA_
CAL SET	CS_	RAW DATA	RD_
CAL ALL	CA_	DATA	DD_
MEMORY FILE	DM_	FORMATTED	FD_
MEMORY ALL	MA_	DISPLAY	UD_
INST STATE	IS_	DELAY TABLE	DT_
HDW STATE	HS_	MACH. DUMP	MD_
PROGRAM	PG_		

OR ② OR ③

REPLACE, LOAD, DELETE DISC FILE SELECT DISPLAY

REPLACE LOAD DELETE

USE KNOB OR STEP KEYS TO SELECT A FILE

	FILE NAME	CONTENTS	TYPE	CREATED
->	IS_FILTER	BIN	90/12/13	09:31:52 <-
	IS_JOE	BIN	90/12/04	10:06:35
	IS_SETUP	BIN	90/12/06	10:13:37

3 INST STATE FILES ON DISC

REPLACE FILE → DISF
LOAD FILE → DISF
DELETE FILE → DISF

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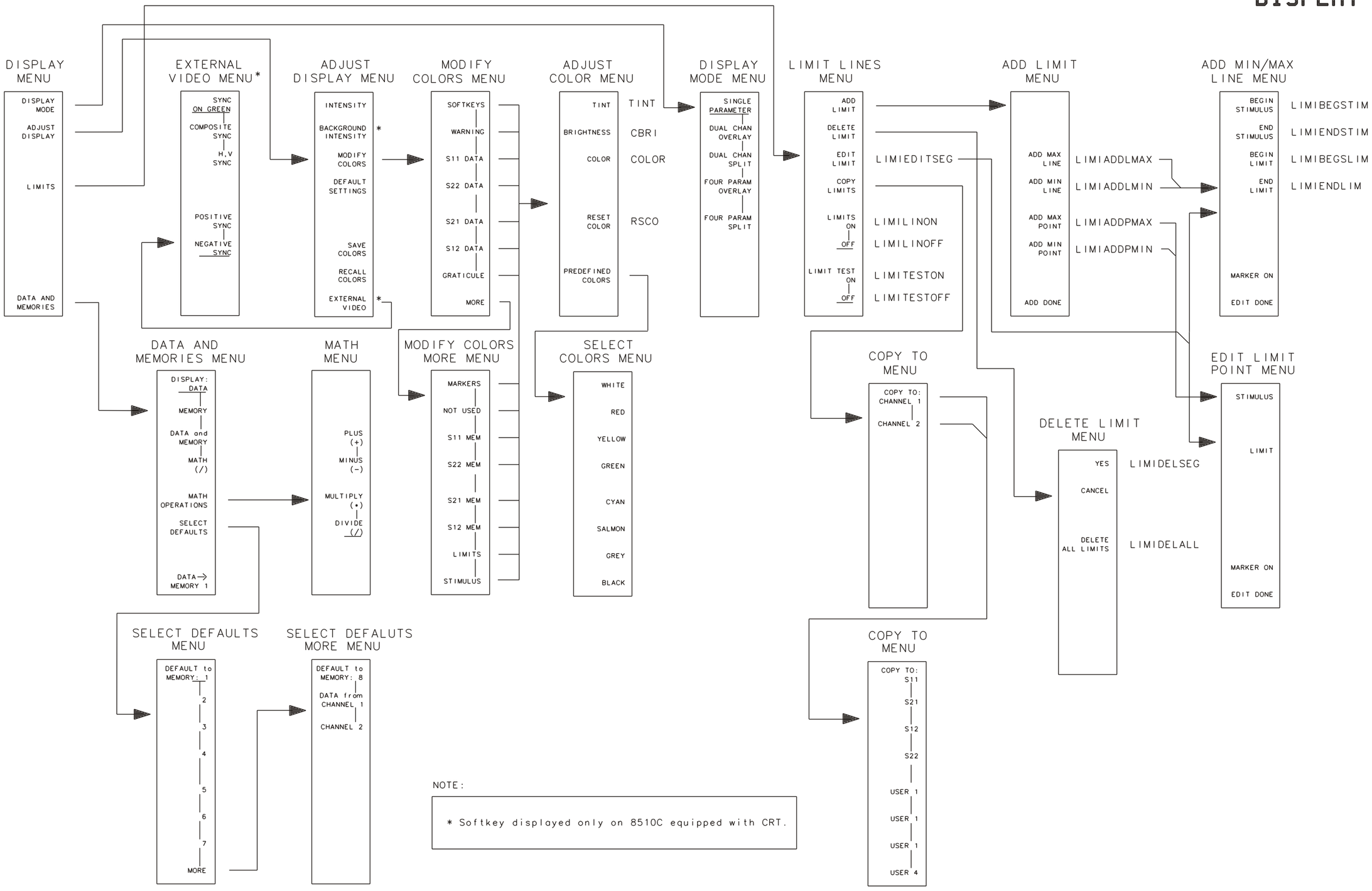
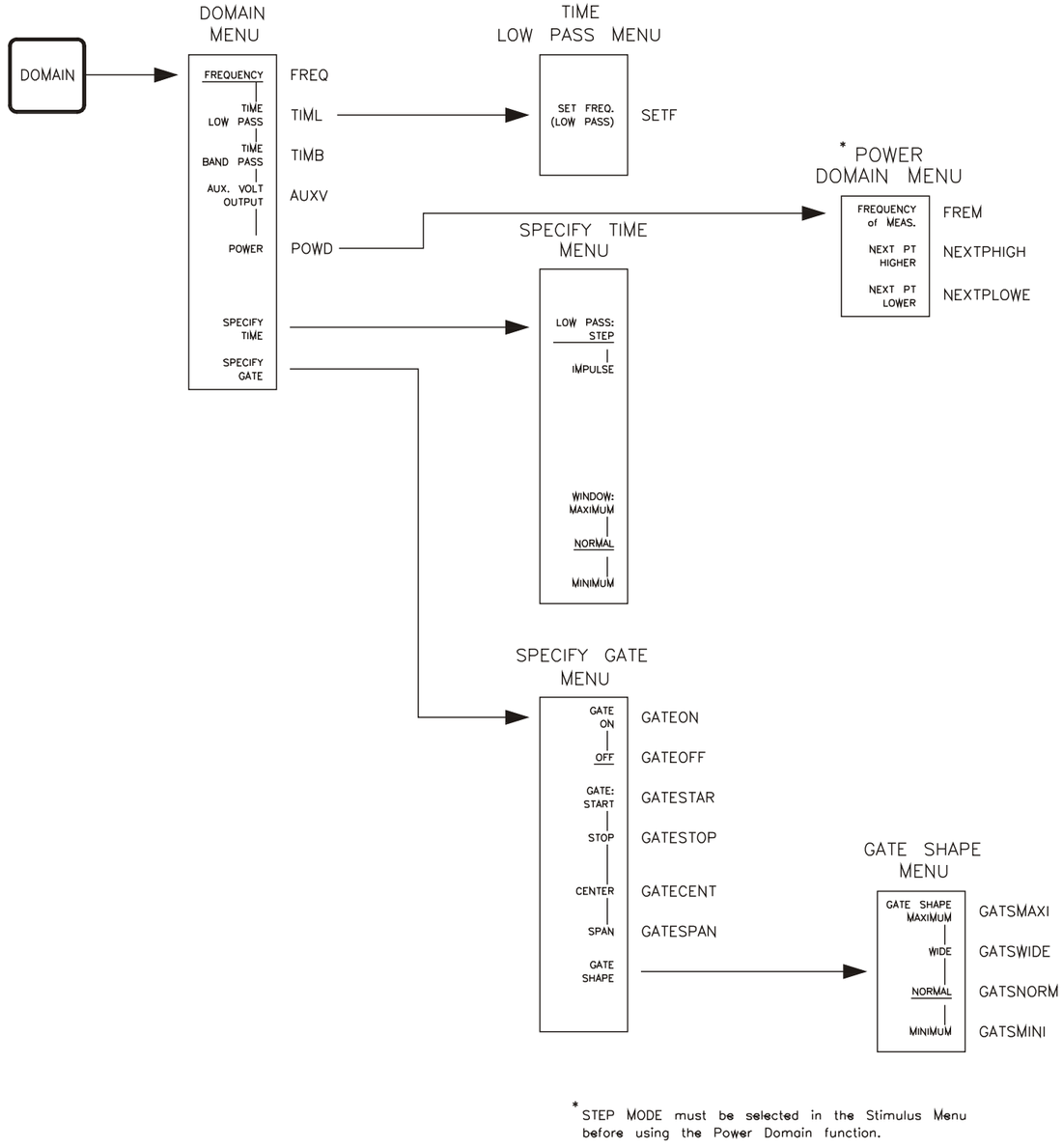
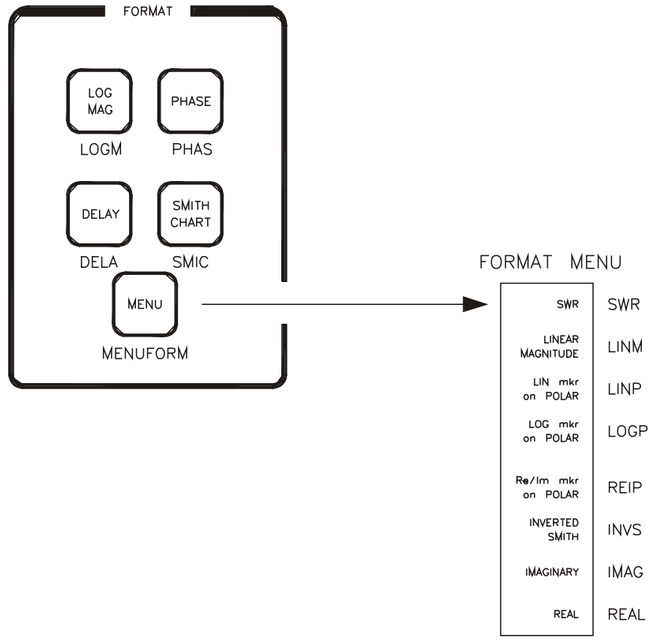


NOTE:

* Softkey displayed only on 8510C equipped with CRT.



* STEP MODE must be selected in the Stimulus Menu before using the Power Domain function.



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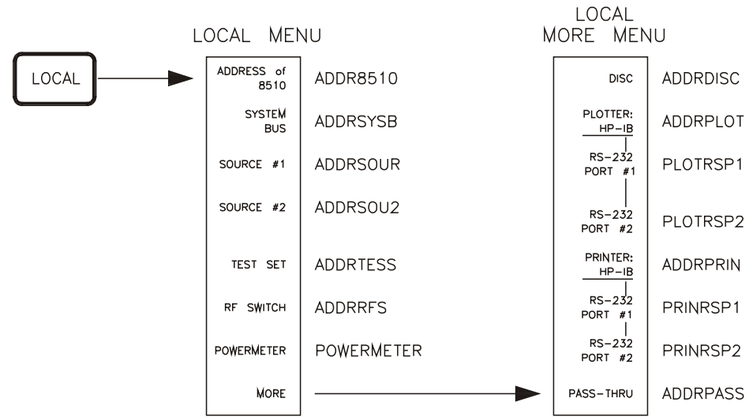

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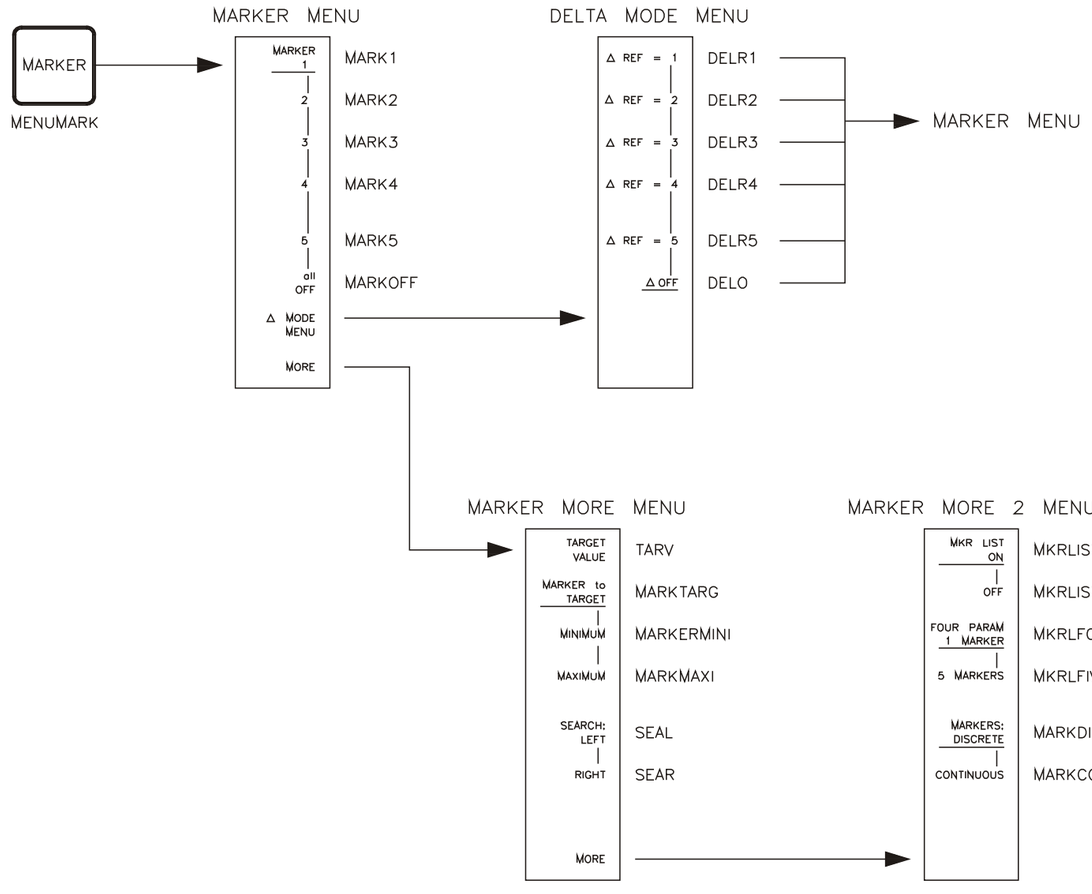

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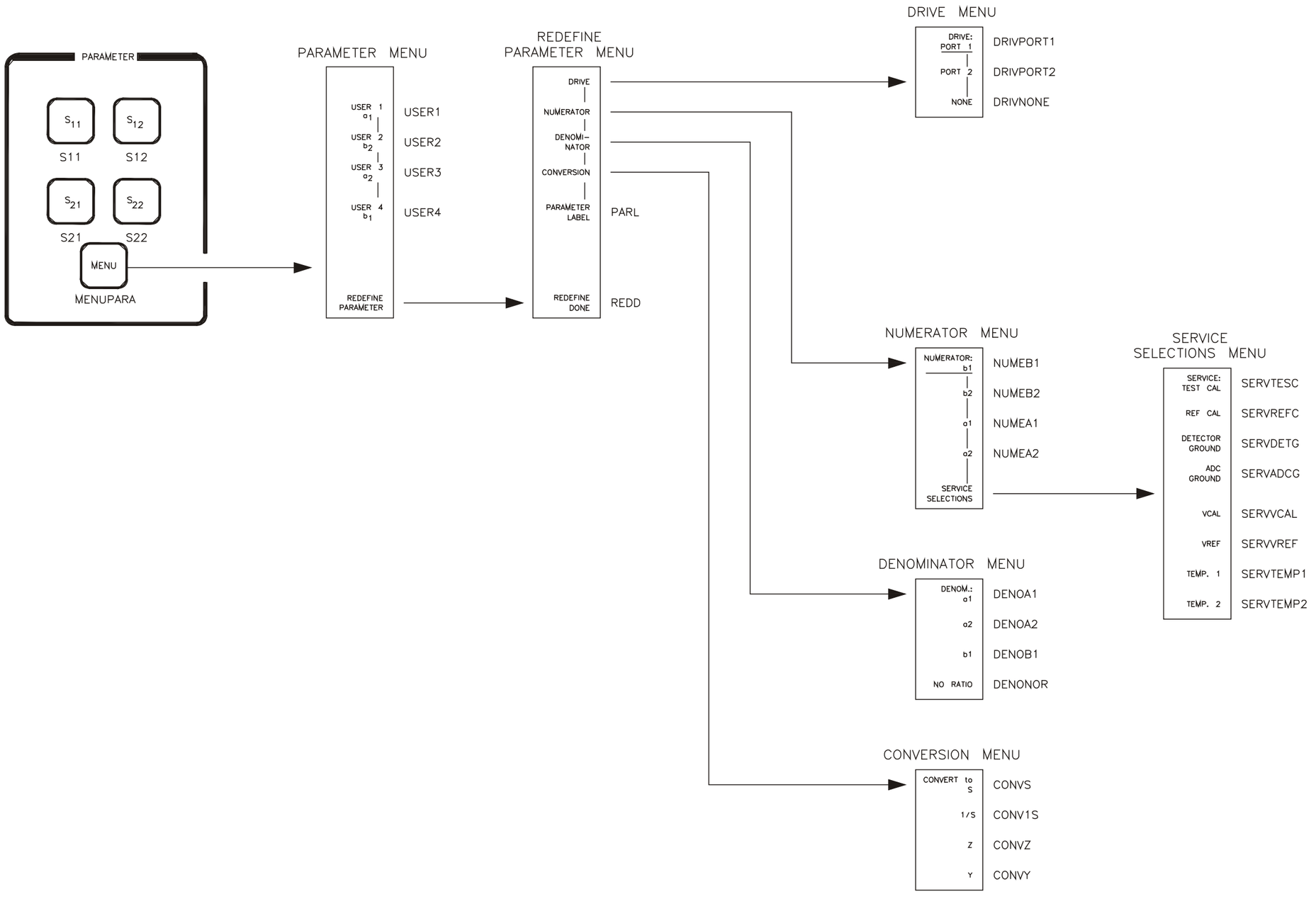
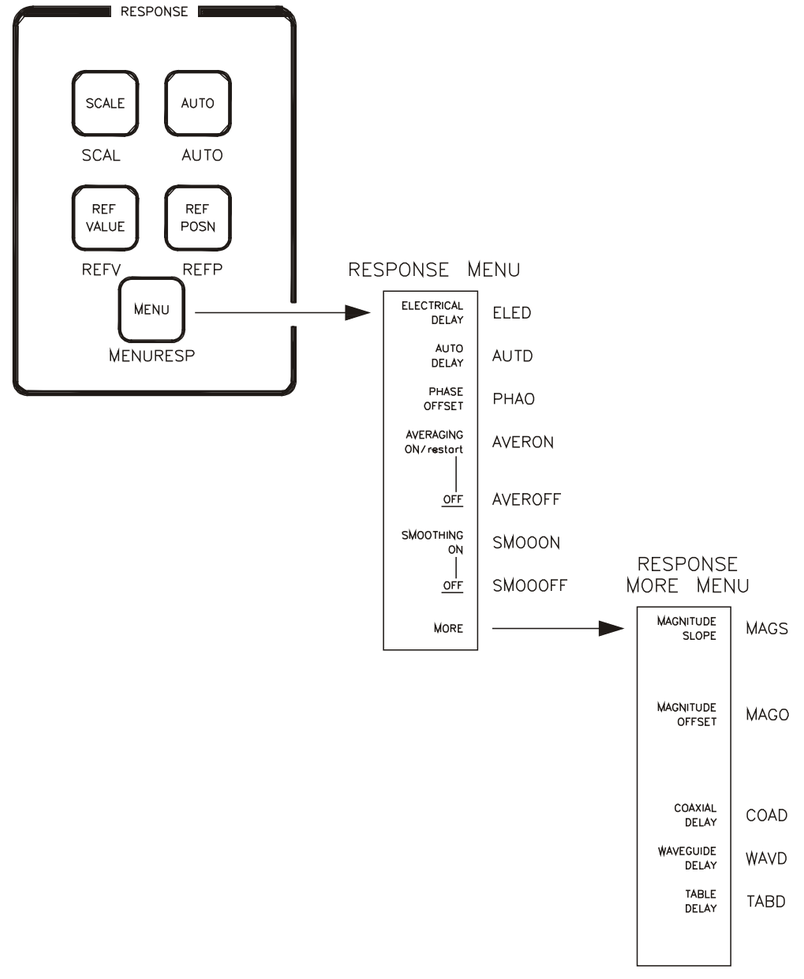

PARAMETER
S11
S12
S21
S22
MENU
MENUPARA
PARAMETER MENU
USER 1
o1
USER 2
b2
USER 3
o2
USER 4
b1
REDEFINE PARAMETER
USER1
USER2
USER3
USER4
REDEFINE PARAMETER MENU
DRIVE
NUMERATOR
DENOMI-NATOR
CONVERSION
PARAMETER LABEL
REDEFINE DONE
PARL
REDD
DRIVE MENU
DRIVE: PORT 1
PORT 2
NONE
DRIVPORT1
DRIVPORT2
DRIVNONE
NUMERATOR MENU
NUMERATOR: b1
b2
o1
o2
SERVICE SELECTIONS
NUMEB1
NUMEB2
NUMEA1
NUMEA2
SERVICE SELECTIONS MENU
SERVICE: TEST CAL
REF CAL
DETECTOR GROUND
ADC GROUND
VCAL
VREF
TEMP. 1
TEMP. 2
SERVTESC
SERVREFC
SERVDETG
SERVADCG
SERVVCAL
SERVVREF
SERVTEMP1
SERVTEMP2
DENOMINATOR MENU
DENOM.: o1
o2
b1
NO RATIO
DENOA1
DENOA2
DENOB1
DENONOR
CONVERSION MENU
CONVERT to S
1/S
Z
Y
CONVS
CONV1S
CONVZ
CONVY



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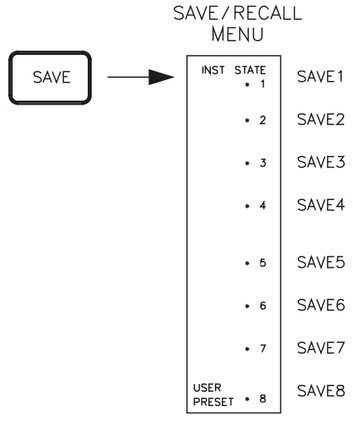

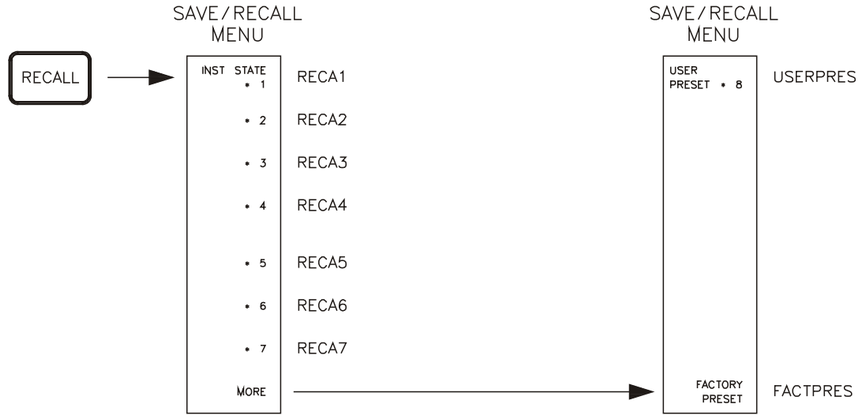

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STIMULUS

START
STOP
STAR
STOP
CENTER
SPAN
CENT
SPAN
MENU
MENUSTIM

STIMULUS MENU

POWER MENU
DWELL TIME — DWET
NUMBER of POINTS
FREQUENCY LIST — LISFREQ
SINGLE POINT — SINP
STEP — STEP
MORE

POWER MENU

PORT 1 POWER — POWP1
SLOPE ON — SLPP1ON
OFF — SLPP1OFF
1 COUPLE PORTS / 2 UNCOUPLE PORTS — PPCOUPLEON, PPCOUPLEOFF
PORT 2 POWER — POWP2
SLOPE ON — SLPP2ON
OFF — SLPP2OFF

DISPLAYED ONLY WHEN PORTS ARE UNCOUPLED

NUMBER of POINTS MENU

POINTS: 51 — POIN51
101 — POIN101
201 — POIN201
401 — POIN401
801 — POIN801

FREQUENCY LIST SEGMENT SELECT MENU

SINGLE SEGMENT — SSEG
ALL SEGMENTS — ASEG

STIMULUS MORE MENU

HOLD — HOLD
SINGLE — SING
NUMBER of GROUPS — NUMG
CONTINUAL — CONT
TRIGGER MODE — TRID
EDIT LIST — EDITLIST

TRIGGER MODE MENU

TRIGGER DELAY — TRID
TRIGGERING INTERNAL — EXITOFF
EXTERNAL — EXTTPOIN

EDIT FREQUENCY LIST DISPLAY AND MENU

hp
SEG START (GHz) STOP (GHz) POINTS
SEGMENT — SEGM
EDIT — SEDI
DELETE — SDEL
ADD — SADD
DUPLICATE POINTS
CLEAR LIST
DONE — EDITDONE

SEGMENT EDIT MENU

SEGMENT: START — STAR
STOP — STOP
CENTER — CENT
SPAN — SPAN
NUMBER of POINTS — POIN
STEP SIZE — STPSIZE
CW — CWFREQ
DONE — SDON → EDIT FREQUENCY LIST MENU

DUPLICATES MODE MENU

DUPLICATES DELETED — DUPD
DUPLICATES MEASURES — DUPM

STIMULUS MENU

CLEAR LIST MENU

CLEAR LIST YES — CLEL
CANCEL

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SYSTEM

MENUSYST

SYSTEM MENU

- DISPLAY FUNCTIONS
- HP-IB ADDRESSES — LOCAL MENU
- HP-IB CONFIGURE
- BEEPER ON / OFF — BEEPON / BEEPOFF
- RESET IF CORRECTION — RESI
- MORE

DISPLAY FUNCTIONS MENU

- TITLE — TITL
- DATE/TIME FUNCTIONS
- CRT OFF — CRTO
- FREQUENCY OFF — FREQ

TITLE MENU

hp

POINT WITH KNOB: THEN PRESS 'SELECT LETTER'

TITLE

ABCDEFGHIJKLMNOPQRSTUVWXYZ.0123456789()+- ·/=abm

↑

- SPACE
- SELECT LETTER
- BACK SPACE
- ERASE TITLE
- TITLE DONE — TITL → PREVIOUS MENU

HP-IB CONFIGURE MENU

- HP-IB USES USR PRESET / FACTORY PRESET

SYSTEM MORE MENU

- RF POWER CONFIG
- LO POWER CONFIG
- IF FREQ — IFFREQ
- ANALOG OUT ON / OFF — ANAOON / ANAOOFF
- SERVICE FUNCTIONS

RF POWER CONFIG MENU

- RF LEVEL SYSTEM — SOU1SYS
- INTERNAL — SOU1INTE
- EXTERNAL — SOU1EXTE
- LEVELING OFF — SOU1OFF
- RF POWER SETTINGS
- RF POWER ON / OFF — SOU1POWON / SOU1POWOFF
- MORE

RF POWER SETTINGS MENU

- RF SOURCE POWER — POWE
- SLOPE ON / OFF — SLOPON / SLOPOFF

RF POWER CONFIG MORE MENU

- DETECT UNL ALWAYS — PPDETALWAYS
- SMART — PPDETSMART
- ONCE — PPDETONCE
- NEVER — PPDETNEVER
- BLANKING ON / OFF — PPBLANKON / PPBLANKOFF
- RESET DET GAIN CAL

RESET DET GAIN CAL MENU

- RUN CAL+ USER PRST
- RUN CAL+ FACT PRST
- RUN CAL NO PRESET — LGCCALGAIN
- CANCEL

LO POWER CONFIG MENU

- LO LEVEL SYSTEM — SOU2SYS
- INTERNAL — SOU2INTE
- EXTERNAL — SOU2EXTE
- LEVELING OFF — SOU2OFF
- LO POWER SETTINGS
- LO POWER ON / OFF — SOU2POWON / SOU2POWOFF

LO POWER SETTINGS MENU

- LO SOURCE POWER — POW2
- SLOPE ON / OFF — SLOP2ON / SLOP2OFF

DATE/TIME FUNCTIONS MENU

- DATE/TIME ON / OFF — DATETIMEON / DATETIMEOFF
- SET: MINUTE — SETMINUTE
- HOUR — SETDAY
- DAY — SETDAY
- MONTH — SETMONTH
- YEAR — SETYEAR

SERVICE FUNCTIONS MENU

- TEST MENU — MENUTEST
- SYSTEM BUS 'LOCAL' — SYSBLOCA
- 'REMOTE' — SYSBREMO
- 85102 SERVICE
- XF TESTSET SERVICE
- SOFTWARE REVISION — SOFR

MAIN SERVICE FUNCTIONS MENU

LOOPING SELF TESTS		SYSTEM COMMANDS	
1	A5 PROCESSOR EPROM	15	RUN MAIN PROGRAM
2	A5 PROCESSOR RAM	16	MEMORY OPERATIONS
3	A7 DATA BUS	17	RERUN SELF TEST
4	A4 DISPLAY PROCESSOR	18	REPEAT TEST LOOP
5	A4 DISPLAY RAM		
6	A7 TIME/CLOCK/RS-232		DISK COMMANDS
7	A7 PUBLIC HPIB		
8	A7 SYSTEM BUS	19	LOAD PROGRAM DISK
9	INTERRUPT SYSTEM	20	RECORD PROGRAM DISK
10	A5 MULTIPLIER	21	INITIALIZE DISK
11	A7 DISK CONTROLLER		
12	A8 NON-VOLATILE MEMORY		SERVICE COMMANDS
13	IF DETECTOR DATA	22	RUN SERVICE PROGRAM
14	KEYBOARD	23	DIAGNOSE A FAILURE

ENTER SELECTION, THEN PRESS =MARKER

85102 SERVICE MENU

- IF GAIN
- PEEK/POKE LOCATION — PEEL
- PEEK — PEEK
- POKE — POKE

XF TEST SET SERVICE MENU

- SHOW CONFIGURATION — SHOWCNFG
- HIDE CONFIGURATION — HIDECNFG
- LEVELING SETTINGS
- PEEK/POKE LOCATION — TSPEEL
- PEEK TEST SET — TSPEEK
- POKE TEST SET — TSPOKE

LEVELING SETTINGS MENU

- SET GAIN (IF LEVEL) — LGCGAINSET
- SET ATTN — LGCATTSET
- SET DAC — LGCDACSET

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New GPIB Commands

The table below lists the 8510C GPIB commands that have been added with the 8510XF firmware.

Table 7-2 New GPIB Commands

COMMAND	EQUIVALENT SOFTKEY	FUNCTION
HIDECNFG	**[SYSTEM]** ***{MORE} {SERVICE} {XF TESTSET SERVICE} {HIDE CONFIGURATION}***	Hides the configuration display.
IFFREQ<freq>	**[SYSTEM]** ***{MORE} {IF FREQ}***	Sets the IF frequency. Under normal operation, the frequency is fixed at 20 MHz; this command can be used to modify the frequency for special applications. The effective range of modification is restricted by hardware performance characteristics; typically, the 20 MHz IF can be increased or decreased by about 10 kHz.
INPULGCFRQ<frequency part of correction table>	No softkey equivalent	Used by Agilent service engineers to load values into the frequency part of the correction table in the memory of the 8510C.
INPULGCPWR<power part of correction table>	No softkey equivalent	Used by Agilent service engineers to load values into the power part of the correction table in the memory of the 8510C.
LGCATTSET<att>	**[SYSTEM]** ***{MORE} {SERVICE} {XF TESTSET SERVICE} {LEVELING SETTINGS} {SET ATTN}***	Used by Agilent service engineers to set the attenuator in the programmable gain portion of the level control circuit. Values range from 0 to 133; LSB = 0.5 dB.
LGCCALGAIN	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {MORE} {RESET DET GAIN CAL} {RUN CAL NO PRESET}***	Runs the detector gain calibration routine (without presetting the system afterwards).
LGCDACSET<dac>	**[SYSTEM]** ***{MORE} {SERVICE} {XF TESTSET SERVICE} {LEVELING SETTINGS} {SET DAC}***	Used by Agilent service engineers to set the multiplying DAC in the programmable gain portion of the level control circuit. Values range from 0 to 255.
LGCGAINSET<iflevel-dB>	**[SYSTEM]** ***{MORE} {SERVICE} {XF TESTSET SERVICE} {LEVELING SETTINGS} {SET GAIN}***	Used by Agilent service engineers to set the relative IF level, by setting the attenuator and DAC in the programmable gain portion of the RF level control circuit. Detector gain calibration must be done first, in order for this function to work.

COMMAND	EQUIVALENT SOFTKEY	FUNCTION
LGCLOADCORR	No softkey equivalent	Used by Agilent service engineers to load conversion loss calibration data from the test set EEPROM to the memory of the 8510C.
LGCLOADSCALE	No softkey equivalent	Used by Agilent service engineers to load detector gain calibration data from the test set EEPROM to the memory of the 8510C.
LGCSAVECORR	No softkey equivalent	Used by Agilent service engineers to save conversion loss calibration data from the memory of the 8510C to the test set EEPROM.
LGCSAVESCALE	No softkey equivalent	Used by Agilent service engineers to save detector gain calibration data from the memory of the 8510C to the test set EEPROM.
OUTPULGCFRQ<frequency part of correction table>	No softkey equivalent	Used by Agilent service engineers to read values from the frequency part of the correction table in the memory of the 8510XF.
OUTPULGCPWR<power part of correction table>	No softkey equivalent	Used by Agilent service engineers to read values from the power part of the correction table in the memory of the 8510XF.
POWP1	**STIMULUS [MENU]** ***{POWER MENU} {PORT1 POWER}***	Port 1 power (level in dBm can be specified)
POWP2	**STIMULUS [MENU]** ***{POWER MENU} {PORT2 POWER}***	Port 2 power (level in dBm can be specified)
PPBLANKON	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {MORE} {BLANKING ON}***	Enables port power blanking during frequency transitions or port drive transitions.
PPBLANKOFF	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {MORE} {BLANKING OFF}***	Disables port power blanking during frequency transitions or port drive transitions.
PPBLANK?	No softkey equivalent	Queries the status of port power blanking (0 for OFF, 1 for ON).
PPCOUPLEON	**STIMULUS [MENU]** ***{POWER MENU} {COUPLE PORTS}***	Couples the Port 2 power setting to the Port 1 Power setting.
PPCOUPLEOFF	**STIMULUS [MENU]** ***{POWER MENU} {UNCOUPLE PORTS}***	Uncouples the Port 2 power setting from the Port 1 power setting
PPCOUPLE?	No softkey equivalent	Queries the status of port power coupling (0 for OFF, 1 for ON).
PPDETALWAYS	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {MORE} {DET UNL ALWAYS}***	Enables detection of “unleveled” errors, during every sweep.
PPDETNEVER	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {MORE} {DET UNL NEVER}***	Disables detection of “unleveled” errors while sweeping.

COMMAND	EQUIVALENT SOFTKEY	FUNCTION
PPDETONCE	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {MORE} {DET UNL ONCE}***	Enables detection of “unleveled” errors while sweeping, during the first sweep after any frequency change.
PPDETSMART	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {MORE} {DET UNL SMART}***	Enables detection of “unleveled” errors while sweeping, during the first sweep after any frequency change, and during subsequent sweeps if an “unleveled” error was detected during the first sweep.
PPDET?	No softkey equivalent	Queries the status of “unleveled” error detection (returns ALWAYS, NEVER, SMART, or ONCE).
SHOWCNFG	**[SYSTEM]** ***{MORE} {SERVICE} {XF TESTSET SERVICE} {SHOW CONFIGURATION}***	Shows the configuration display.
SLPP1OFF	**STIMULUS [MENU]** ***{POWER MENU} {PORT 1 SLOPE OFF}***	Disables power slope for Port 1.
SLPP1ON<slope dB/GHz>	**STIMULUS [MENU]** ***{POWER MENU} {PORT 1 SLOPE ON}***	Enables power slope for Port 1 (value in dB/GHz can be specified)
SLPP1?	No softkey equivalent	Queries the status of power slope for Port 1 (0 for OFF, 1 for ON).
SLPP2OFF	**STIMULUS [MENU]** ***{POWER MENU} {PORT 2 SLOPE OFF}***	Disables power slope for Port 2.
SLPP2ON<slope dB/GHz>	**STIMULUS [MENU]** ***{POWER MENU} {PORT 2 SLOPE ON}***	Enables power slope for Port 2 (value in dB/GHz can be specified)
SLPP2?	No softkey equivalent	Queries the status of power slope for Port 2 (0 for OFF, 1 for ON).
SOU1LEV?	No softkey equivalent	Queries the status of level control for the 83651B RF source (returns the strings SYSTEM, INTERNAL, EXTERNAL, or OFF).
SOU1OFF	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {RF LEVEL -- LEVELING OFF}***	Places the 83651B RF source in leveling-off mode.
SOU1POWOFF	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {RF POWER OFF}***	Deactivates RF power from the 83651B RF source.
SOU1POWON	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {RF POWER ON}***	Activates RF power from the 83651B RF source.
SOU1POW?	No softkey equivalent	Queries the status of RF power (0 for OFF, 1 for ON).
SOU1SYS	**[SYSTEM]** ***{MORE} {RF POWER CONFIG} {RF LEVEL -- SYSTEM}***	Places leveling of the 83651B RF source under control of the 8510XF.
SOU2LEV?	No softkey equivalent	Queries the status of level control for the 83621B LO source (returns the strings SYSTEM, INTERNAL, EXTERNAL, or OFF).

COMMAND	EQUIVALENT SOFTKEY	FUNCTION
SOU2OFF	**[SYSTEM]** ***{MORE} {LO POWER CONFIG} {LO LEVEL -- LEVELING OFF}***	Places the 83621B LO source in leveling-off mode.
SOU2POWOFF	**[SYSTEM]** ***{MORE} {LO POWER CONFIG} {LO POWER OFF}***	Deactivates RF power from the 83621B LO source.
SOU2POWON	**[SYSTEM]** ***{MORE} {LO POWER CONFIG} {LO POWER ON}***	Activates RF power from the 83621B LO source.
SOU2POW?	No softkey equivalent	Queries the status of LO power (0 for OFF, 1 for ON).
SOU2SYS	**[SYSTEM]** ***{MORE} {LO POWER CONFIG} {LO LEVEL -- SYSTEM}***	Places leveling of the 83621B LO source under control of the 8510XF.
TSPEEK	**[SYSTEM]** ***{MORE} {SERVICE} {XF TESTSET SERVICE} {PEEK TEST SET}***	Used by Agilent service engineers to read from a location (specified by the TSPEEL command) in the memory of the millimeter- wave controller.
TSPEEL	**[SYSTEM]** ***{MORE} {SERVICE} {XF TESTSET SERVICE} {PEEK/POKE LOCATION}***	Used by Agilent service engineers to specify a location in the memory of the millimeter-wave controller.
TSPOKE <byte>	**[SYSTEM]** ***{MORE} {SERVICE} {XF TESTSET SERVICE} {POKE TEST SET}***	Used by Agilent service engineers to write a byte of data to a location (specified by the TSPEEL command) in the memory of the millimeter-wave controller.

Unsupported GPIB Commands

The table below lists GPIB commands that are supported by the standard 8510C firmware, but are *not* supported by the 8510XF firmware.

Sending these commands to the 8510XF will not cause a problem; the system will ignore them. However, if you use a test program that was developed for other 8510C test sets, be aware that the commands listed below will have no effect.

Table 7-3 GPIB Commands Not Supported by 8510XF

COMMAND	FUNCTION	ACTIVE FUNCTION?
CONF	Constant frequency value	YES
COUC	Couple channel 1 & 2 stimulus and calibration sets	NO
DEFA	Multiple source default equation	NO
DEFIRECV	Multiple source define receiver equation	NO
DEFISOUR1	Multiple source define RF source #1	NO
DEFISOUR2	Multiple source define LO source #2	NO
DETENORB	Select the 10 KHz IF path and detectors	NO
DETEWIDB	Select the 3 MHz IF bandwidth path and detectors	NO
DUTC	Set the duty cycle of the internally generated trigger	YES
EDITMULS	Edit multiple source equations	NO
FLATON	Enable flatness correction calibration.	NO
FLATOFF	Turn off flatness correction calibration.	NO
FLAT?	Queries status of flatness correction calibration.	NO
LOCKA1	Select a1 as phaselock input for current parameter	NO
LOCKA2	Select a2 as phaselock input for current parameter	NO
LOCKNONE	Do not attempt receiver phaselock	NO
LOCSFAST	Select fast system phaselock	NO
LOCSNORM	Select normal system phaselock	NO

Table 7-3 GPIB Commands Not Supported by 8510XF

COMMAND	FUNCTION	ACTIVE FUNCTION?
LOCTEXTE	Select system 1st IF phaselock to external LO	NO
LOCTNONE	Do not phase lock 1st IF	NO
LOCTINTE	Select system 1st IF phaselock to internal LO	NO
MULD	Multiple source multiplier denominator	YES
MULN	Multiple source multiplier numerator	YES
MULSOFF	Turn OFF multiple source mode	NO
MULSON	Turn ON multiple source mode	NO
NORMSTEP	Select normal data acquisition cycle	NO
OFFF	Multiple source offset frequency	YES
PULOHIGH	Set pulse output active high	NO
PULOLOW	Set pulse output active low	NO
PULP	Select pulse profile domain	NO
PULW	Set width of internally generated pulse	YES
QUICSTEP	Select the quick step phase lock mode	NO
RAMP	Ramp sweep mode	NO
TRIS	Trim sweep value (command exist but value is ignored)	YES
UNCC	Uncoupled channels	NO

New Messages

Informational messages

The following informational messages (which are displayed in white letters on the screen of the 8510C) were created specifically for the 8510XF firmware.

Table 7-4 Informational Messages (Text Displayed in White)

MESSAGE	NOTES
SETTING UP STEP MODE	During operation above 50 GHz, the frequencies of the RF and LO sources must be calculated for each step; this setup causes a delay.
CONFIGURING FOR LVL DET GAIN CALIBRATION CALIBRATING LVL DET GAIN, N% DONE. PLEASE WAIT LVL DET GAIN CAL COMPLETE SAVING GAIN CAL N% DONE. PLEASE WAIT VERIFYING GAIN CAL N% DONE. PLEASE WAIT LOADING GAIN CAL N% DONE. PLEASE WAIT.	These messages are displayed in connection with the detector gain cal process.
SAVING CONV LOSS CAL N% DONE. PLEASE WAIT. VERIFYING CONV LOSS CAL N% DONE. PLEASE WAIT. LOADING CONV LOSS CAL N% DONE. PLEASE WAIT.	These messages are displayed in connection with the conversion loss cal process.

Warnings messages

The following warning messages (which are displayed in red letters on the screen of the 8510C) were created specifically for the 8510XF firmware.

Table 7-5 Warning Messages (Text Displayed in Red)

MESSAGE	NOTES
RPG INACTIVE FOR STEP MODE STIMULUS	The "RPG" knob cannot be used in connection with this function.
STEP KEYS INACTIVE FOR STEP MODE STIMULUS	The step keys cannot be used in connection with this function.
FUNCTION NOT VALID WITHOUT SYSTEM PWR LEVELING (GPIB Status Message: 206) CANNOT POWER SWEEP WITHOUT SYSTEM PWR LEVELING (GPIB Status Message: 202)	These functions can be used only if SYSTEM leveling is selected on the [SYSTEM] *{MORE} {RF POWER CONFIG}* menu (see "RF Power Configuration" on page 3-30).
FUNCTION NOT VALID IN SYSTEM PWR LEVELING (GPIB Status Message: 203)	This function cannot be used if SYSTEM leveling is selected on the [SYSTEM] *{MORE} {RF POWER CONFIG}* menu (see "RF Power Configuration" on page 3-30).
GAIN CAL (or CONVERSION LOSS CAL) LOAD/SAVE FROM TESTSET EEPROM FAILED (GPIB Status Message: 204)	The GAIN CAL (or CONV LOSS CAL) data cannot be loaded from the EEPROM in the millimeter wave controller (however, no functionality is disabled).
LVL DET GAIN CAL PROBLEM (RANGE/RESOLUTION) (GPIB Status Message: 207)	Detector gain cal routine failed; indicates hardware failure or improper installation of system or cabling. No functionality is disabled.
SUBSET CANNOT CONTAIN MORE THAN 801 PTS	Equivalent message in standard 8510C firmware reads "792 PTS".
REQUESTED SWEEP MODE NOT SUPPORTED	8510XF does not support ramp mode.
PORT 1, 2 to 50 GHz MIXER NOT DETECTED PORT 2, 2 to 50 GHz MIXER NOT DETECTED PORT 1, V BAND MIXER NOT DETECTED PORT 2, V BAND MIXER NOT DETECTED	These hardware failures are detected by a self-test routine, which is run at power-up or when the test set address is changed.

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