Errata

Title & Document Type: 85109B On-Wafer Network Analyzer Sys. Oper. & Svc. Manual

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HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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Agilent Technologies

Contents

1

Section 1.Documentation and System Overview

INTRODUCTION

This manual contains information on the assembly, operation, and repair of the HP 85109 on-wafer network analyzer system.

The HP 85109 system includes the following components, refer to Figure 1-1. The items with an asterisk (*) next to them are factory installed in a system cabinet. Other items are shipped separately.

HP 8350B/HP 83540A sweep oscillator with option 004*

HP 83651 synthesized source*

HP 85105 mm-wave test set controller*

HP 8517A coaxial test set*

HP 8510 network analyzer

HP U85104 option K10 test set

HP U281A adapters (2; shipped in the drawer of the system cabinet)

Test port combiners (2; shipped in the drawer of the system cabinet)

System Cabinet

A probe station and probing equipment is required to make on-wafer measurements. This equipment is available from Cascade Microtech Inc., Beaverton, Oregon.

An HP 9000 Series 200 or 300 computer is required for system operation. The computer must have at least 2 megabytes of available memory.

NOTE:Refer to your probe station instruction manual for information regarding your probe station and probes.

How to Use this Manual

Use this manual for setup, calibration, performance verification, and troubleshooting of the HP 85109 system. Consult the manuals of individual instruments and accessories in the system when necessary for reference.

*These items are factory installed in a system cabinet.

This manual contains the following sections:

Documentation and System Overview

Includes an overview of the documentation and of the HP 85109 system.

System Installation

Includes information on site requirements prior to installation, cabling/configuration diagrams, and an operational test of the system.

Operation

Includes instructions for using the HP 85109 system software to calibrate the system and to measure devices.

Specifications and Performance Verification

Includes instructions for obtaining the specifications of your HP 85109 system and procedures for running a performance verification of your system.

System Service and Troubleshooting

Includes information to troubleshoot the system to the instrument level and system cabling diagrams. When the faulty instrument is identified, refer to its manual for troubleshooting information.

Figure 1-1.HP 85109B On-Wafer Network Analyzer System

HP 85104 Test Set Operation and Service

Includes operating and service information for the highband test set.

HP 85105 mm-wave Controller Operation and Service

Includes operating and service information for the mm-wave controller.

Test Port Combiner Operation and Service

Includes operating and service information for the combiner.

Appendixes

Includes the hardware and instrument states for your system, reference material for biasing your system, and application examples.

Manual History

Includes a log of information that has changed from the original manual, if there have been any changes.

Index

A subject index with alphabetized entries.

System Overview

The HP 85109 makes on-wafer measurements from 45 MHz to 62.5 GHz in a single connection. Lowband data (45 MHz to 40 GHz) is taken from the HP 8517A coaxial test set. Highband data (40 GHz to 62.5 GHz) is taken from the HP U85104A option K10 waveguide test set. The RF signals to and from these two test sets are coupled into a single 1.85 mm coaxial interface through the test port combiner. The combined signals are sent to the probe heads through semi-rigid test port cables. The test port combiner also provides a DC path to the probes; this allows you to bias devices using the bias tees which are inside the HP 8517A test set.

The HP 85109 system software enables you to perform an on-wafer measurement calibration across the entire frequency range (45 MHz to 62.5 GHz). The software automatically switches

test sets and combines data from each test set band, then sends the data back to the HP 8510 to be displayed.

SYSTEMS COVERED BY THIS MANUAL

A serial number label is attached to each HP 85109 system cabinet. This label is located on the front of the cabinet in the lower left corner, and has the serial number of your system printed on it.

Figure 1-2 shows a typical serial number label. The serial number has two parts. The first four digits followed by a letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument (or system). The contents of this manual apply directly to systems having the same serial number prefix or higher as listed on the Title Page of this manual under the heading SERIAL NUMBERS.

Figure 1-2.Typical Serial Number Label

HP 85109 On-Wafer System Options

The following options are available with the HP 85109B system:

Option 002

Deletes the HP 8350B/83540A sweep oscillator, and adds an HP 83621A synthesized source as the LO source.

Option 010

Adds time domain capability to the HP 8510 network analyzer.

WARRANTY

The HP 85109 On-wafer Network Analyzer system carries a one year on-site warranty. If instruments are ordered separately, such as the HP 85104A option K10 and 85105A, they carry the same warranty as long as they are used in an HP 8510 system.

UPGRADE PATHS

Upgrade packages from an HP 8510A, 8510B, and other 8510 systems are available. Contact the nearest Hewlett-Packard office for more information.

Contents

1

Section 2.System Installation

INTRODUCTION

This section contains information on:

Site preparation.

System configuration.

System turn on.

System software installation.

System operational test.

Probe station installation.

The major portion of the HP 85109 system is already rack-mounted, assembled, and has most of the cabling attached when it arrives from the factory.

During the installation, the HP customer engineer (CE) will do the following:

Uncrate the system cabinet and separately-packaged instruments.

Complete the receiving checklist.

Verify that the HP-IB addresses are set properly and turn on the system.

Install the system software.

Run a performance verification of the system, which includes a measurement calibration.

SYSTEM ARRIVAL

The HP 85109 system will arrive with all rack components and instruments assembled and cabled in the system cabinet. The network analyzer, computer, and any peripheral equipment will be shipped separately. The system cabinet is shipped upright, secured to a pallet.

Keep the shipping containers in one area to help verify the receipt of all components ordered. Inspect all shipping containers. Keep the carton and packaging material until the entire shipment has been verified for completeness, and the system has been checked mechanically and electrically. Check all equipment received against the receiving checklist on the following page.

If the shipment is damaged or incomplete, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the packaging material shows signs of stress, notify the carrier as well as the HP customer engineer. Keep the shipping materials for the carrier's inspection. The Hewlett-Packard office will arrange for repair or replacement of damaged equipment without waiting for a claim settlement from the carrier.

HP 85109 Receiving Checklist

When the entire shipment has arrived, contact your nearest HP office to arrange for installation of your system (if installation is available in your area). The HP customer engineer will perform the installation, beginning with the following receiving checklist.

HP 85109B Standard System

Instrument || Manual Part Number ||

HP 8510 Network Analyzer || 08510-90275 ||

HP 83651 Synthesized Source || 08360-90054 ||

HP 8350B/83540A Sweep Oscillator (with Option 004) || 08350-90092 ||

HP 85105A Millimeter-wave Controller (with Option 004) || 85109-90008 ||

HP 85104A K10 Waveguide Test Set || 85109-90008 ||

HP 8517A Coaxial Test Set || 08517-90001 ||

HP U281A Waveguide to Coaxial Adapter (2) || 5952-1910 ||

Test Port Combiner (2) || 85109-90008 ||

HP 92214B System Table || none ||

HP 85109 System Software || 85109-90008 ||

HP 8510 Specifications and Performance Verification Software || 85109-90008 ||

HP 85109B Option 002 - Substitutes HP 83621A for HP 8350B/83540A

HP 85109B Standard System (without HP 8350B/83540A Source) || 85109-90008 ||

HP 83621A Synthesized Source || 08360-90054 ||

HP 85109B Option 010 - Adds Time Domain to the HP 8510

HP 85109B Standard System (HP 8510 has time domain) || 85109-90008 ||

Miscellaneous Equipment

Computer

Plotter

Calibration Kits

Verification Kits

Figure 2-1.HP 85109 On-Wafer Network Analyzer System

SITE PREPARATION

Site preparation includes the environmental and electrical requirements necessary for the HP 85109 system. Make sure your site meets these requirements before installing the system.

Environmental Requirements

The environmental requirements of the HP 85109 system are listed in Table 2-1. Notice that these characteristics are the same as those for the HP 8510C network analyzer.

Note the accuracy-enhanced measurement requirements which follow.

Table 2-1.HP 85109 Environmental Requirements

|| Temperature ||

0° to 55° (+32° to 135°F) ||

|| Relative Humidity ||

5% to 95% at +40°C or less (non-condensing) ||

|| Altitude ||

Up to 4600 metres (approximately 15,000 feet) ||

Accuracy-Enhanced Measurement Requirements

Accuracy-enhanced (error corrected) measurements require the ambient temperature of the HP 85109 system to be maintained within ±1°C of the ambient temperature at measurement calibration. The measurement calibration temperature must be in the operating temperature range of the calibration kit (typically 20° to 26°C). See the appropriate calibration kit manual for the actual operating temperature.

Power Requirements

Install the required AC power at all necessary locations. Place air conditioning equipment or other motor-operated equipment on a different AC line than that used for the system.

Three-wire power cables must be used with all instruments. These cables provide the required ground when connected to an appropriate outlet.

Table 2-2 lists the maximum VA power ratings of the HP instruments used in the HP 85109 system.

System Heating and Cooling

Install air conditioning and heating if required. Air conditioning requirements depend on the amount of heat produced by the instruments. Use the BTU/hour ratings from Table 2-2 to determine the total rating of your system. Each VA rating is multiplied by 3.4 to determine the BTU/hour rating of each instrument.

To convert the total BTU/hour value to “tons”, divide the total BTU/hour value by 12,000. A “ton” is the amount of heat required to melt a ton (907 kg) of ice in one hour.

The cabinet fans may be permanently damaged if a 120V system is plugged into a 230V ac power outlet. The cabinet fans are wired for either 120V or 230V, but not both. Therefore, a

system wired for 120V operation cannot be switched to 230V operation simply by changing individual instrument voltage selection switches.

Consult the individual instrument manuals to change voltages from 120V to 100V (120V systems only), or from 220V to 240V (Option 230, or 230V systems only).

Table 2-2.Maximum VA Ratings and BTU/hour Ratings of HP Instruments

Instrument ||

Maximum

VA Rating1 ||

VA

Subtotal ||

Maximum

BTU/hour ||

BTU/hour

Subtotal ||

Standard Equipment

HP 85101 Display Processor ||

250 || ||

850 || ||

HP 85102 IF Detector || 210 || || 714 || ||

HP 85105 Test Set Controller || 270 || || 918 || ||

HP 8360 Synthesized Source || 400 || || 1,360 || ||

HP 8350 with Plug-in || 375 || || 1,275 || ||

HP 8517 Coaxial Test Set (opt.001) || 95 || || 323 || ||

Totals: ||

Standard System || 1,570 VA || || 5,338 || ||

Option 001/002 || 1,690 VA || || 5,746 || ||

Accessory Equipment

HP 9000 Series 300 ||

250 || ||

850 || ||

HP 98751A 19 inch CRT || 420 || || 1,430 || ||

HP 98752A 19 inch CRT || 420 || || 1,430 || ||

HP 98753A 19 inch CRT || 420 || || 1,430 || ||

HP 98754A 19 inch CRT || 420 || || 1,430 || ||

HP 98785A 16 inch CRT || 200 || || 680 || ||

HP 98789A 16 inch CRT || 200 || || 680 || ||

Typical Hard Disk || 65 || || 222 || ||

HP LaserJet II || 170 to 800 || || 580 to 2,720 || ||

HP PaintJet || 20 || || 68 || ||

HP 7550A Plotter || 100 || || 340 || ||

Your System's Total3 ||

1. Values are based on 120 Vac supplied to each instrument at 60 Hz.

2. The BTU/hour rating of the HP 85104K09 is included in the HP 85105 rating.

3. To convert the total BTU/hour value to "tons," divide the total BTU/hour value by 12,000.

System Voltages

All instruments in the HP 85109 system and the system cabinet must be set to the local voltage.

All system instruments are set to 120 Vac at the factory, except for Option 230 systems, which are set to 220 Vac.

Weights and Dimensions

The approximate weight of the HP 85109 system cabinet (fully loaded) is listed below.

Standard System: ||

264 kg (570 lbs) ||

Option 002: ||

277 kg (598 lbs) ||

The approximate weight of the HP 8510 is 36 kg (77 lbs).

The outside dimensions of the system cabinet and the system table are listed below.

||

System Cabinet || System Table

||

Height: ||

122 cm (48 inches) || 72 cm (28.4 inches) ||

Width: ||

60 cm (23.6 inches) || 112.5 cm (44.3 inches) ||

Depth: ||

80 cm (31.4 inches) || 71.1 cm (28.0 inches) ||

Anti-Static Precautions

The test ports of the coaxial test set and the IF and LO ports on the mm-wave controller are very sensitive to electrostatic discharge. Ground yourself and your system to avoid damage from electrostatic discharge.

SYSTEM CONFIGURATION

The suggested configuration for your on-wafer system is shown in Figure 2-1.

System Table

Unpack and assemble the system table and place it beside the system cabinet as shown in Figure 2-1. Lock the wheels in place.

Install the Network Analyzer

Unpack the network analyzer and place it on the system table as shown in Figure 2-1.

UNPACKING THE SYSTEM CABINET

Figure 2-2 gives instructions for unpacking the system cabinet.

Figure 2-2.Unpacking the System Cabinet

1. || Cut the wrapping bands on the crate. Snap off the retaining clips on the sides of the crate. Remove the cardboard cover. ||

2. || Take out the ramp. The cardboard spacer below it can be discarded, as can the plastic foam around the cabinet. ||

3. || Remove the wooden spacer at the lower end in back of the cabinet. Slide the ramp over the short rear panel at the bottom. ||

At least two people are recommended to control the system cabinet in the next step. The loaded cabinet weighs approximately 400 pounds. DO NOT attempt to lift the cabinet. Do not allow anyone in front of the cabinet when it is being rolled down the ramp.

4. || Have at least two people roll the cabinet down the ramp carefully. Hold back on the front edges of the cabinet, with persons standing on either side of it to avoid getting in the way of the heavy, rolling cabinet. ||

Install the Computer

Place the computer on the system table next to the HP 8510 network analyzer.

SYSTEM CABLING

Figure 2-3 shows the cabling of the standard on-wafer system. Figure 2-4 shows the cabling of the on-wafer system as configured with two synthesized sweepers, option 002.

The racked portion of the system comes already cabled. Connect the HP 8510 as shown in Figure 2-3.

Front Panel Connections

Follow the instructions in Figure 2-5 to make the final connections to the front panels of the test sets before the probe station is connected. It is important that the test port cables be bent as little as possible.

The test ports of the coaxial and waveguide test sets are extremely sensitive to electrostatic discharge (ESD). Ground your work station and yourself before you handle these instruments.

Figure 2-3.HP 85109 Cabling Diagram (standard system)

Figure 2-4.HP 85109 Cabling Diagram (option 002)

Figure 2-5.Front Panel Connections

SYSTEM TURN ON

Turn On System Power

1. Verify that all cables are connected properly (refer to Figure 2-3 or 2-4).

2. Turn on power to all instruments except the network analyzer and the disk drive.

3. Once all the instruments are on, turn on the network analyzer. The disk drive will be turned on later.

HP-IB Addresses

Verify that the instrument addresses are set correctly after system power on. On the network analyzer, press:

SYSTEM

HP-IB ADDRESSES

then press the softkey that corresponds to each instrument in your system to check each address. Press MORE to show additional instrument choices.

Compare the addresses on the network analyzer display with the addresses listed in Table 2-3. To change an address, press the softkey corresponding to the desired instrument, then enter the correct address: n, n, x1

Table 2-3.HP 85109 System HP-IB Addresses

|| Instrument

HP-IB Addresses

|| HP 8510 || 16 ||

|| System Bus || 17 ||

|| Source #1 (RF) ||

19 ||

|| Source #2 (LO) ||

18 ||

|| Test Set: ||

|| HP 8517 || 20 ||

|| HP 85105 || 21 ||

|| RF Switch || 31 ||

HP 85109 SYSTEM SOFTWARE

The HP 85109 system software coordinates the operation of the two test sets in the system, enabling on-wafer calibration and measurement to be performed over the frequency ranges of both test sets. The software controls the stimulus, calibration, and measurement triggering operations normally accessed from the front panel of the network analyzer. Refer to the "Operation" tab for in-depth information about the system software and its operation.

The system software sets the hardware and instrument states required for on-wafer operation. Therefore, the system software must be loaded before any operational tests can be performed.

The system software is written in HP BASIC. BASIC 5.0 or higher must be loaded in your computer before running the system software. Refer to "Load BASIC and BIN Files" in this section for instructions.

Load HP BASIC and BIN Files

Before you can run the system software you must load BASIC 5.0 (or higher) into your computer. The computer must be an HP 9000 series 200 or 300 workstation with at least 2 megabytes of available RAM after BASIC has been loaded. Follow this procedure to load BASIC.

NOTE:This procedure assumes you are using an HP 9122C disk drive.

1. Set the disk drive HP-IB address switch to 0.

2. Connect the disk drive HP-IB to the computer's HP-IB.

3. Turn the disk drive ON.

4. Insert the HP BASIC System disk in the disk drive.

5. Turn the computer ON. The computer will load HP BASIC 5.0 automatically.

6. Remove the HP BASIC System disk and insert the HP BASIC Drivers and Language Extensions disk.

7. Load the following HP BASIC drivers and language extensions binary files:

Type: load bin “filename” then press RETURN/ENTER

to load each of the following files.

GRAPH (and GRAPHX for color computer displays)

IO

MAT

MS

ERR

CS80

HP-IB

CRTA

CRTB

COMPLEX

8. To verify that all binary files are loaded:

Type: list bin press RETURN/ENTER

9. Remove the Drivers and Language Extensions disk.

This completes the procedure for loading HP BASIC and the system software can be run. Refer to “Load and Run the System Software” below, for information regarding the system software.

Load and Run the System Software

Load HP BASIC (if not already done) prior to loading and running the HP 85109 system software. Refer to the paragraph “Load BASIC and BIN Files” earlier in this section for instructions.

1. Insert the HP 85109 System Software disk into the default disk drive.

2. Type: load “HP85109B” press RETURN/ENTER

The program takes less than 30 seconds to load.

3. To run the program:

Type: run press RETURN/ENTER

A welcome screen is presented when program execution begins. Press RETURN/ENTER

to clear the welcome screen and enter the HP 85109 software.

SYSTEM OPERATIONAL TEST

The following operational test is intended to provide assurance that your HP 85109 system is operating properly. This test is performed before the probe station is connected to the system. Follow the procedure below to verify the basic operation of your system.

Load the system software if you have not already done so. Once the system software has loaded, the Main Menu will be displayed on the computer and a trace similar to Figure 2-6 will be displayed on the network analyzer CRT.

The system is configured without the probe station and test port return cables connected to the combiner.

Figure 2-6.HP 85109 System Initial Trace

1. On the computer, press the function key that corresponds to Lowband. The software will initialize the system and configure it for lowband measurements using the coaxial test set. The network analyzer should display a trace similar to Figure 2-7.

The system is configured without the probe station and test port return cables connected to the combiner.

Figure 2-7.HP 85109 Lowband Trace

2. On the computer, press the function key that corresponds to Highband. The software will initialize the system and configure it for highband measurements using the waveguide test set. The network analyzer should display a trace similar to Figure 2-8.

The system is configured without the probe station and test port return cables connected.

Figure 2-8.HP 85109 Highband Trace

Unratioed Power Level Test

In addition to the System Operational Test (above), you may want to perform the Unratioed Power Level Test to further confirm the operation of your system. Figure 2-9 shows the approximate IF signal levels of a1 and b1 for both the lowband and highband portions of the system.

The a2 and b2 IF levels should be similar to a1 and b1, respectively.

Figure 2-9.Unratioed Power Levels

In order to drive power out of port 2 (to test a2 and b2), the drive paths and the phase lock must be redefined. On the HP 8510, press the following keys to redefine a2:

PARAMETER MENU

User 3 a2

REDEFINE PARAMETER

DRIVE

Port 2

PHASE LOCK

a2

REDEFINE DONE

To redefine b2, press:

PARAMETER MENU

User 2 b2

REDEFINE PARAMETER

DRIVE

Port 2

PHASE LOCK

a2

REDEFINE DONE

PROBE STATION INSTALLATION

If your system is being installed for the first time, or if it has just been repaired, a measurement calibration and performance verification must be done before you install the probe station. Refer to the Specifications and Performance Verification tab for more information.

1. Connect the semi-rigid test port return cables to your system as shown in Figure 2-10.

2. Place the probe station on a table. Move the table to the front of the system cabinet and lock the table feet as shown in Figure 2-11.

3. Choose a pair of semi-rigid cables from the sets supplied with your system. Both cables must be the same length. Carefully bend the cables to connect the test ports to the probe heads without putting stress on the probe heads or the test ports. Avoid sharp bends which may change the impedance of the lines.

4. Connect the test port return cables to your probe station. Tighten these connections to the proper torque of 8 in-lb (90 N-cm).

Refer to your probe station manual for instructions on the set up and use of the probe station and vacuum.

Figure 2-10.Test Port Return Cable Installation

Figure 2-11.Probe Station Installation

Typical Thru Measurement

Figure 2-12 shows a typical on-wafer Thru measurement (lowband and highband) using the HP 85109 system with a Cascade Microtech Model 42 probe station (20 inch test port cables), and a Cascade Microtech ISS calibration kit. After you install the probe station, place the ISS calibration kit on the probe station, bring the port 1 and port 2 probes down on a thru connection, and configure your system as follows to verify that the system and probe station are operating properly. Consult your probe station or probe head manual for proper operation and probe deflection.

1. On the HP 8510, press S21

2. On the computer, press Lowband. The trace on the network analyzer should be similar to the lowband trace in Figure 2-12.

3. On the computer, press Highband. The trace on the network analyzer should be similar to the highband trace in Figure 2-12.

If your system does not look similar to Figure 2-12, verify that your connections are correct and are tightened to the proper torque. If your Thru measurements look similar to Figure 2-12, the installation is complete and your system is ready for use.

Lowband THRU Highband THRU

Figure 2-12.Typical Thru Measurement (lowband and highband)

Contents

1

Section 3. Operation

INTRODUCTION

This section contains information on:

HP 85109 system software.

Measurement calibration.

Operating notes.

Software duplication.

SYSTEM DESCRIPTION

The HP 85109 on-wafer network analyzer system provides a single RF connection to measure on-wafer devices from 45 MHz to 60 GHz. Two test sets are used to cover this broad frequency range; a coaxial test set for the low end of the frequency range, and a waveguide test set for the high end of the frequency range. A low loss test port combiner combines the signals from each test set to provide a single connection (through wafer probes) to on-wafer devices.

HP 85109 SYSTEM SOFTWARE

The HP 85109 system software coordinates the operation of the two test sets in the system, enabling on-wafer calibrations and measurements to be performed over the frequency range of both test sets. The software controls the stimulus, calibration, and measurement triggering operations normally accessed from the front panel of the network analyzer.

A broadband frequency range is specified by the external computer. The system software breaks this broadband frequency range into two measurement bands; lowband and highband. Lowband data is taken with the coaxial test set. Highband data is taken with the millimeter-wave test set. Data from each measurement band is combined in the computer before being returned to the network analyzer for display.

On-wafer calibration is controlled by the computer. The calibration sequence on the computer is executed in the same fashion as the network analyzer's manual calibration sequence. Calibration standards are connected once and measured in both the lowband and highband frequency ranges. The software supports 2-port error corrected measurements only.

The system software is written in HP BASIC. BASIC 5.0 or higher must be loaded in your computer before you can run the software. Refer to "Load BASIC and BIN Files" in the "System Installation" section for instructions.

Load and Run the System Software

If you have not already done so, load HP BASIC prior to running the HP 85109 system software. Refer to "Load BASIC and BIN Files" in the "Installation" section for instructions.

1. Insert the HP 85109B System Software disk into the default disk drive.

2. Type: load "HP85109B" press RETURN/ENTER

The program takes less than 30 seconds to load.

3. To run the program:

Type: run press RETURN/ENTER

A welcome screen is presented when program execution begins. Press RETURN/ENTER to clear the welcome screen and enter the HP 85109 software program.

Main Menu Features

Figure 3-1 shows the Main Menu of the system software. There are five softkeys in the Main Menu: Stimulus, Calibrate, Lowband, Highband, and Measure. The softkeys on the CRT are selected by pressing the function keys on the computer keyboard. Pressing a softkey will either bring up another menu or activate the function.

Figure 3-1.HP 85109 Main Menu Screen

Figure 3-2 shows a flowchart of the software operation. Use the flowchart to get an overview of the measurement and calibration process. The Main Menu softkey choices are described briefly after the flowchart. They are described in detail later in this section. Refer to the detailed descriptions for in-depth information on each stimulus setting, calibration, and measurement function.

Figure 3-2.Software Operation Flowchart

Main Menu Softkey Choices

Stimulus

Selects the frequency range, power level, step attenuation, and number of points of your system.

Calibrate

Selects the calibration kit you will use and guides you through an on-wafer calibration.

Lowband

Puts the system in the lowband portion of the currently defined frequency range. If the currently defined frequency range is entirely above the test set crossover frequency then selecting Lowband will have no affect.

Highband

Puts the system in the highband portion of the currently defined frequency range. If the currently defined frequency range is entirely below the test set crossover frequency then selecting Highband will have no affect.

Measure

Triggers a measurement over the current frequency range.

STIMULUS SCREEN OPERATION

Use the Stimulus Screen to select the desired power level, frequency range, step attenuation, and number of points of your system.

Screen Organization

The Stimulus Screen is made up of five sections. Figure 3-3 shows the different components of the Stimulus Screen and their organization.

Figure 3-3.Stimulus Screen Organization

Instructions give a general idea of how to operate the software within the Stimulus Screen.

The Dialog Box allows you to choose which setup parameter to activate in the Stimulus Screen. Current values are shown below the entry parameter. Select OK to accept changes made to stimulus parameters in the Dialog Box. Select Cancel to cancel any changes made to stimulus parameters in the Dialog Box.

Changes in stimulus parameters are not made on the HP 85109 system until OK is pressed in the Dialog Box.

The Prompt Line allows you to enter the selected setup parameter.

The Entry Terminator softkeys complete the entry of a setup parameter.

The Function softkeys set up pre-defined frequency ranges.

Using the Stimulus Screen

Press the Stimulus key in the Main Menu to set up the Stimulus Screen, shown in Figure 3-4.

Figure 3-4.Stimulus Screen

Use the Dialog box to enter new stimulus parameters. The “cursor” points to stimulus parameters in the Dialog Box. Use the UP/DOWN arrow keys to move the cursor to the desired stimulus parameter then press RETURN/ENTER.

The stimulus parameters are:

Start Frequency

The start frequency for the system must be between 45 MHz and 62.5 GHz. Enter the desired frequency then press either the GHz or MHz softkey to terminate the entry. The new start frequency will be displayed in the Dialog Box.

Stop Frequency

The stop frequency for the system must be between 45 MHz and 62.5 GHz. Enter the desired frequency then press either the GHz or MHz softkey to terminate the entry. The new stop frequency will be displayed in the Dialog Box.

Number of Points

The number of points for the system must be between 1 and 401. Enter the desired number of points then press the x1 softkey. The new number of points will be displayed in the Dialog Box.

Power Level

This stimulus parameter requires the entry of three power levels: lowband RF power level, highband RF power level, and highband LO power level. Enter each desired power level and press the dBm softkey to terminate the entry, or press the No Entry softkey if you do not want to change the indicated value. The new power levels will be displayed in the Dialog Box as Lowband RF, Highband RF, and Highband LO. The default values for the power levels keep adequate power at the probe tip and ensure proper system setup. The default power levels are:

Lowband RF = +10 dBm

Highband RF = −20 dBm

Highband LO = +3 dBm

NOTE:These power levels should remain at the default values unless an "IF Overload" error is displayed on the HP 8510 CRT. Lower the RF power level in the affected band to correct an "IF Overload" condition. Press ENTRY OFF on the network analyzer to clear the error message.

Step Attenuation

This stimulus parameter indicates the setting of the step attenuators. The step attenuators are in series with the incident power to the test ports in the lowband test set. You must enter two values; the first value is for port 1 and the second is for port 2.

Selecting OK

in the Dialog Box will accept the changes made to stimulus parameters. Selecting Cancel in the Dialog Box will cancel any changes made to the stimulus parameters.

Using the Function Softkeys

Use the function softkeys to select pre-defined frequency ranges or to select a frequency range for low pass time domain operation. The function softkeys are:

Set lowpass

Sends the current start and stop frequencies to the network analyzer and selects low pass time domain operation. The network analyzer will alter the start and stop frequencies so that the start frequency is harmonically related to the step frequency. Low pass time domain analysis can then be performed when a broadband measurement is returned to the network analyzer.

CALIBRATE SCREEN OPERATION

The Calibrate Screen allows you to calibrate your system over the full frequency range of the measurement. This method of measurement calibration is intended to be used with your probe station and on-wafer calibration devices for error-corrected measurements. Refer to the "Specifications and Performance Verification" tab for information regarding the type of calibration necessary for a performance verification.

The Calibrate Screen transfers the calibration sequence of the network analyzer to the external computer. Measurements of each calibration standard are taken for every band in the system. The raw calibration standard measurements are combined in the computer to create "broadband" calibration data. This "broadband" information is downloaded to the network analyzer, which calculates the error terms over the broadband frequency range.

Operating the Calibration Screen is very similar to performing a calibration from the front panel of the network analyzer, and you can use any calibration kit defined in the network analyzer. The following types of calibrations are supported in the software:

OSLT (open, short, load, thru) two-port calibrations

TRL (thru-reflect-line) two-port calibrations

LRM (line-reflect-match) two-port calibrations

Operation of the Calibration Screen for OSLT, TRL, and LRM 2-port calibrations is similar. Individual calibration standards are underlined when they are measured. When a class of standards is complete, the class label is underlined. All standards necessary for each class must be measured before that standard class is complete. All standard classes must be complete before a calibration can be saved.

Measure Softkey Operation

Press the Measure softkey in the Main Menu to trigger a measurement. When you press Measure you will be instructed to connect the device under test and press the Continue softkey. The four uncorrected S-parameters of the device are measured in both the lowband and the highband. The uncorrected S-parameters are sent to the network analyzer for error correction and display of the combined, broadband results. The computer puts the HP 8510 in the HOLD trigger mode at the end of a measurement sequence. Selecting another trigger mode (SINGLE or CONTINUOUS) from the front panel of the network analyzer (after the measurement sequence) will invalidate the current measurement.

The software returns to the Main Menu after each measurement sequence. Press Measure again to make additional measurements.

SYSTEM MEASUREMENT CALIBRATION

A perfect vector network analyzer would exhibit flat frequency response, no impedance mismatches, and infinite isolation between channels. In an actual system, all of these characteristics are imperfect, but are generally repeatable and predictable. To correct for these systematic errors, measurement calibration is performed using known impedance standards connected at the measurement ports. The required on-wafer standards are available from Cascade Microtech.

Warm-up Time

Allow the system to run at least 30 minutes (one hour is recommended) to reach a stable temperature before performing a calibration. In addition, a stable ambient temperature will help minimize time base variations as well as physical dimension changes which appear as short or long term drift in magnitude and phase measurements.

Choose a Calibration Method

Two different procedures for measurement calibrations can be performed on an on-wafer system. One procedure is a broadband on-wafer calibration using the system software, the other procedure is a separate calibration of the coaxial test set and the waveguide test set using coaxial and waveguide calibration devices, without the probe station connected.

Coaxial and waveguide calibration

The probe station is disconnected from the system and the coaxial and waveguide test sets are calibrated separately using coaxial and waveguide calibration devices. Choose this calibration procedure if a performance verification of the system is necessary. Refer to the "Specifications and Performance Verification" section for more information.

On-wafer calibration

The probe station is connected to the system and the HP 85109 system software is used with on-wafer calibration devices to calibrate the system. Choose this calibration procedure unless a performance verification of the system is required.

Prior to Measurement Calibration

Verify that the following conditions are met before you start a calibration:

1. Choose a calibration type. LRM is recommended for on-wafer measurements.

2. Delete cal sets so you have at least two empty registers. Do not store your calibration data in cal sets 7 or 8, these registers are used by the system software to store the lowband and highband calibrations.

3. If you will be making time domain Low Pass measurements you must configure your system for time domain before you perform a broadband calibration. In the Main Menu press Stimulus

and set up the system for time domain Low Pass operation.

NOTE:Time domain Band Pass does not require the Low Pass setup and may be turned on at any time after a measurement calibration.

Typical Impedance Standard Substrate1 (ISS) Devices

Figure 3-5 shows several examples of each type of ISS standard used in an LRM calibration. It is necessary to measure only one of each type.

Measure one of each standard type.

Figure 3-5.Typical Impedance Standard Substrate (ISS) Devices (for ground-signal-ground probe configuration)

Perform A Broadband Measurement Calibration

Use the system software to perform a broadband measurement calibration of your system using your microwave probe station and the standards on the ISS substrate. Be sure the stimulus parameters are correct for your desired measurements, since they should not be changed after calibration. If the stimulus parameters are changed after calibration the measurement calibration may not be valid.

Load the calibration constants from the tape that came with your calibration kit into the network analyzer.

1. A product of Cascade Microtech, Inc.

On the network analyzer press:

TAPE/DISC

LOAD

CAL KIT 1-2

CAL KIT *1

or CAL KIT *2

Run the HP 85109 system software.

Press Calibrate on the computer and select a calibration kit and an error model to use in the calibration. The two currently defined calibration kits will be presented as softkeys and the three error model choices will be presented: OSLT, TRL, and LRM. Press the desired softkeys to respond to these prompts.

NOTE:An Abort softkey is present during the calibration sequence to abort the calibration process. Once you abort a calibration, the sequence can not be resumed.

If the LRM calibration was selected with a calibration kit defined for LRM operation, the first screen of the calibration sequence would be as shown in Figure 3-6.

Figure 3-6.LRM Calibrate Screen

The software's calibration sequence works in much the same way as the HP 8510 network analyzer front panel calibration sequence. Instead of softkeys to the right of the network analyzer CRT, softkeys are presented on the right portion of the computer CRT. Use the UP/DOWN arrow keys then press RETURN/ENTER to activate the softkeys on the external computer display.

The cursor (arrow) points to the calibration standard to be measured when RETURN/ENTER

is pressed. When the standard is selected, it is measured over the currently defined frequency range. When the measurement of the standard is complete, the standard label is underlined. The calibration labels on the computer display are the same as those on the network analyzer display. If there is more than one standard defined for a class of calibration standards, another menu of softkeys is presented. To remeasure any standard, move the cursor to the desired standard label and press RETURN/ENTER.

LRM Calibration

Use the following step-by-step procedure to perform an LRM calibration.

1. Press Calibrate

in the Main Menu. In the next menu, select the corresponding LRM calibration kit and LRM as the error model. Set the averaging to the desired value from the network analyzer front panel (128 is enough for most purposes). Press LOCAL on the network analyzer to gain access to the front panel keys.

2. Measure the standards in any sequence. Move the cursor to the desired standard by using the UP/DOWN arrow keys. The first selection in the LRM calibrate screen is the Thru. Connect a thru between test ports 1 and 2 then press RETURN/ENTER on the computer to start the measurement.

When the thru is finished measuring, the THRU standard label will be underlined.

Figure 3-6 shows the first menu of an LRM calibration. The Thru standard (with standard definition label defined as THRU) has already been measured as shown by the standard definition label being underlined.

3. Two standards have been defined for S11 Reflect; a SHORT and an OPEN. Only one of the two is required for this calibration. It is important to make the reflection measurement the same on each port. This is fairly easy to do by simulating an open circuit:

a. Raise the probe tips off of the substrate to the same height.

b. Move the probe tips away from each other.

c. Move the substrate so there is not a circuit directly underneath the probes.

Align the probes to simulate an open circuit, make sure the cursor is opposite the S11 Reflect standard label then press RETURN . Move the cursor so it is opposite the OPEN standard label and press RETURN again to start the measurement. Repeat this step for S22 Reflect.

4. The next standard label is Isolation. Isolation measurements should be done when making high dynamic range measurements or measuring high loss devices (approximately 50 dB or more).

To omit this measurement, make sure the cursor is opposite the Isolation standard label then press RETURN Omit isolation.

To make the measurement, terminate both ports (50 loads are recommended), make sure the cursor is opposite the isolation standard label, then press RETURN. Press RETURN again to start the measurement.

5. The final measurement to make is the Match. Connect a 50 load between ports 1 and 2, make sure the cursor is opposite the Match standard label, then press RETURN. Press RETURN again to start the measurement.

When all of the standard labels are underlined press Save LRM 2-Port. Save the calibration in any calibration set from 1 through 6.

All necessary standards must be measured before selecting Save LRM 2-Port. The software does not allow a calibration to be resumed after the Save Cal is selected.

6. When the calibration sequence is complete store the broadband calibration in any calibration set from 1 through 6.

NOTE:Do not store your calibration in calibration set 7 or 8. The software automatically downloads the lowband calibration to calibration set 7, and the highband calibration to calibration set 8.

The maximum number of standards allowed in each class are:

Type of Calibration Max. Number of Standards

OSLT ||

S11A,S11B,S11C,FWDT,FWDM,REVT,REVM,

FWDI,REVI (one standard) ||

TRL, LRM || TRLT,FWDI,REVI (one standard)

S11 Reflect, S22 Reflect (two standards)

TRLL (three standards) ||

MAKING A MEASUREMENT

After the above measurement calibration has been completed, the system is ready to make S-parameter measurements of your device.

1. Connect your device between test ports 1 and 2, apply bias if required, and then press Measure.

Refer to Appendix B for information about biasing your test devices.

The system will measure your device in both the lowband and highband frequency ranges, and then display the combined broadband results on the network analyzer display.

2. Remove any bias applied to the device. Move to the next device and repeat step 1 to measure this device's S-parameters.

Refer to Appendix C for examples of a transmission line measurement and a MODFET device measurement.

OPERATING NOTES

Use of the HP 8510 PRESET Key

The PRESET key modifies some instrument states in the network analyzer. If you use the PRESET key press Lowband or Highband on the computer to reconfigure the system to the desired frequency range.

Time Domain Measurements

If you will be making time domain low pass measurements you must configure your system for time domain before you perform a broadband calibration (the frequency ranges are slightly different when time domain low pass is used). In the Main Menu press Stimulus, make the desired entries, then press Set Lowpass. Time domain bandpass does not have this requirement.

DUPLICATING THE SYSTEM SOFTWARE

It is a good idea to make a backup copy of your system software for everyday use and to store the original in a safe place. To make a backup copy of the software:

1. Initialize a blank disk.
2. Insert the master copy into the default drive and load the disk.
3. Remove the master copy, insert the blank (initialized) disk, and save the data onto this disk.
4. Remove the backup copy, label, and write protect it.

Contents

1

Section 4.Specifications and Performance Verification

INTRODUCTION

Specifications for the HP 85109 System are generated by using the HP 8510 Specification and Performance Verification software. Specifications must be generated for the lowband and highband frequency ranges separately.

To generate specifications for your system, continue with the performance verification procedure and, at the appropriate time, select SYSTEM SPECS.

After installation of the system is complete, a performance verification is necessary to assure proper system operation. A performance verification is included as part of the HP 85109 installation.

Performance verification of your on-wafer network analyzer system will be performed at the end of the semi-rigid coaxial lines that connect to the probe heads.

The system performance verification consists of:

1. Disconnecting the probe station.
2. Supporting the calibration and verification standards.
3. Connecting the computer and warming up the system.
4. Loading BASIC and BIN files.
5. Loading the HP 85109A System Software.
6. Loading and running the performance verification software.
7. Performance testing in 2.4 mm.

a. Setting the configuration.

b. Measurement calibration.

c. Measuring the verification standards.

8. Performance testing in WR-19.

a. Setting the configuration.

b. Measurement calibration.

c. Measuring the verification standards.

9. Reconnecting the probe station.

Figure 4-1 is a simplified flow diagram of the HP 8510 specifications and Performance Verification software program. The flow diagram shows the main menus and paths of the program.

ADDITIONAL REQUIRED EQUIPMENT

Two HP U281A waveguide to coaxial adapters are required to complete the WR-19 portion of the performance verification procedure. These two adapters are in addition to the two adapters you connect to the HP U85104A Option K09 test ports.

RECOMMENDED PERFORMANCE VERIFICATION CYCLE

The recommended performance verification cycle for the HP 85109 system is once a year, initially, and after the system is repaired. You can vary the cycle time of once a year depending on the results of your performance verification. Additionally, an operation verification is required every year (or after repair) on all HP 8360 series sources. Refer to your source manual for the operation verification procedure.

DISCONNECT THE PROBE STATION

1. Carefully remove the semi-rigid test port 1 and test port 2 return cables at the ends connected to the coplanar probe heads. The cable connectors are 8 mm (5/16-inch).

2. Remove any grounding connections between the probe station and the network analyzer measurement system.

3. Release the caster locks and roll the probe station out of the way. Relock the casters.

Figure 4-1. Specifications and Performance Verification Software Simplified Flow Diagram

SUPPORT THE CALIBRATION AND VERIFICATION STANDARDS

A flat work surface of at least 40 cm wide by 30 cm deep is needed to support the calibration and verification standards when they are connected to the measurement system. The work surface should be at approximately the same height as the probes, and located where the probes would normally be located. See Figure 4-2.

Figure 4-2.Worksurface for Calibration and Verification Standards

CONNECT THE COMPUTER AND WARM UP THE SYSTEM

1. Connect the HP 9000 series 200 or 300 work station HP-IB to the network analyzer system HP-IB. Connect a 3.5“floppy disk drive to the computer HP-IB and set its HP-IB address to 0.”

2. Turn on the instruments in the network analyzer measurement system (network analyzer last). The measurement system requires approximately one hour to stabilize at its operating temperature. Perform the next three steps (loading BASIC and BIN files, loading the system software, and loading and running the performance verification software) while the system is stabilizing.

Load BASIC and BIN Files

The program will run on most 200 and 300 series computers, except for a 9826 because of its limited CRT display. The computer must have at least 2 megabytes of memory.

1. BASIC loading procedure:

a. While the computer is OFF, insert the BASIC language system disk in the default drive (typically 0). Then turn the computer ON.

b. When BASIC is loaded, the drive LED will go off and a prompt will appear on the computer display: BASIC Ready. Remove the disk.

c. Insert the Language Extensions disk in the drive and, one at a time, load the following files. For example, type:

LOAD BIN “ERR”

Language Extension files: ERR, CLOCK, GRAPH, MAT, IO

Then press the CONTINUE softkey on the computer keyboard. When the file is loaded the drive LED will go OFF. After loading all the Extensions, remove the disk. Insert the Drivers disk and load the following files in the same manner.

Driver files: HPIB, (DISC and CS80 for stand alone drives)

After loading all the drivers, remove the disk.

Load the HP 85109 System Software

2. Insert the HP 85109 System Software disk into the default disk drive.

3. Type: load “HP85109B” press RETURN/ENTER.

The program takes less than 30 seconds to load.

4. To run the program:

Type: run press RETURN/ENTER

A welcome screen is presented when program execution begins. Press RETURN/ENTER to clear the welcome screen and enter the HP 85109 software.

5. a. Press LOWBAND. Allow the system to be set up for lowband operation, then press HIGHBAND and allow the system to be set up for highband operation.

b. Stop the program by pressing the STOP key on the stop. Type "SCRATCH A" and press RETURN/ENTER.

The system is now configured as an on-wafer system with the multiple source.

Run the Specifications and Performance Verification Software

6. Insert the HP 8510 Specifications and Performance Verification software disk into the default drive or the drive specified as the MSI (mass storage is). Type the load command and the filename as shown below. Press RETURN or EXECUTE. Type it exactly as shown:

LOAD "SPECS 8510" Type: run, then press RETURN/ENTER

The program's title banner and a RESUME softkey should be displayed on the computer.

HP 8510 Specification and Performance Verification Software

Press the RESUME softkey.

7. The program will load the subroutines from this disk; during this time the CRT will be blank.

8. Next, the program will load the following system files:

* MENUS (ITF or 236) — CRT menu displays

* DESCRIPT — descriptions of the ERROR terms

* SOFTWARE — software configuration menu

* TABLE — the tables that will list specs

* UNCPLOT — plotting the specs

* VERIF — the verification menu

* SERNO — the serial number forms

* ETERMS — the Eterm menu

9. The next CRT display allows you to set the date and time on the computer display.

At this point, you can press the computer Y key and the program will continue, or you can press the computer N key for NO and set the date and time. When your entries are complete, press the keyboard ENTER or RETURN key.

10. The program will load the SYSTEM CONFIGURATION menu file HARDWARE. After this file is loaded the HARDWARE CONFIGURATION menu will be displayed. This menu allows you to select the type of system equipment that you want. Here is a brief explanation of the main menu choices:

SYSTEM CONFIG — Select this menu if you want to return to the Hardware Configuration menu or use the software configuration menu to set the addresses of your HP 8510, printer/plotter, or select plot trace pens/colors. This menu also allows you to reset the program — all menu choices will be returned to the program's default state and the program will begin again from the time and date setting.

QUIT PROGRAM — Always use this selection when you are finished using this program.

VERIFY SYSTEM — Select this menu when you want to verify system performance. Do not choose this selection until the Hardware and Software Configuration menus have been set.

SYSTEM UNCERT — Select this menu when you want to see the calculated uncertainty limits for each type of S-parameter measurement. Do not press this selection now.

SYSTEM SPECS — Select this menu to generate the specifications for your system.

PERFORMANCE TESTING IN 2.4 mm

SET THE CONFIGURATION

The following example shows the equipment used in a typical coaxial system:

Network Analyzer: HP8510B — Enhanced Model

Test Set: HP 8516A — 2.4 mm S-Parameter (45 MHz-40 GHz)

Source: HP 836X016 — 836X and 8516 Synth. (10 MHz-40 GHz)

Calibration Kit: HP 85056A — 2.4 mm Slottless Standard Grade

or HP 85056D — 2.4 mm Slottless Economy Grade

Calibration Technique: SL — Sliding Load Cal (BL — Broadband Load Cal for 85056D)

Test Port Cables: HP 85109A-U-band Combiner used with 8516 and U85105

Verification Kit: HP 85057A — 2.4 mm

11. Select the equipment above for your system. The CRT display will have a highlighted field around the active selection. Use the NEXT and PREVIOUS keys to change the selection in the highlighted area, if required.

Make all the selections you want until the hardware configuration is correct.

12. Press the softkey labeled DONE and the program will load.

The MAIN menu will now appear on the computer display.

13. At this point, be sure you have the following items ready to use:

* Calibration kit and its tape. The model number of the calibration kit must match the one you select in the Configuration menu.

* Verification kit and its tape. The model number of the verification kit must match the one you select in the Configuration menu.

NOTE:If you want to generate system specifications press SYSTEM SPECS and follow the program prompts.

14. Press VERIFY SYSTEM. If the program acknowledges the system over the HP-IB, it will display the System Performance Verification Menu on the computer display.

15. Press SERIAL NUMBERS. Enter the serial numbers and the NBS numbers only if you want them to appear on the printout of your performance test results for each verification device. The serial numbers are usually located on the rear panels. NBS test numbers are on the Certificate of Calibration that accompanies your verification kit.

When you are finished with this menu, press DONE.

16. You should now be back in the System Performance Verification Menu. Press SYSTEM CAL. The configuration information will be displayed; make sure it agrees with the system

you are going to verify. If it does, press RESUME to continue. If it does not, return to the Hardware Configuration Menu to correct it.

Measurement Calibration

17. DO NOT follow the "Test Set Cable Connections" instructions, instead connect the 2.4 mm female to 2.4 mm male adapter HP part number 85056-60007 to the end of the port 1 semi-rigid cable. Use an 8 mm (5/16-inch) wrench to hold the adapter stable and use the 8 mm 90 N-cm torque wrench to tighten the cable nut. Repeat the procedure to attach the 2.4 mm female to female adapter, HP part number 85056-60006 to the port 2 semi-rigid cable. Gently bend the semi-rigid test port cables so that the 2.4 mm adapters face each other and the standards can be connected between them as required. See Figure 4-3.

Press the RESUME softkey once and follow the screen prompts to load the verification tape.

Figure 4-3.2.4 mm Cable Configuration

18. Press YES to indicate that you want to perform a 45 MHz verification.

19. Load the Cal Kit Tape as follows:

Insert the standards definition tape and press TAPE/DISC STORAGE IS TAPE LOAD Cal Kit 1-2. Then press CAL KIT *1 *File 1 and if an asterisk (*) appears next to file 2, press it after file 1 is loaded.

Press CAL again to verify that the proper files were loaded. The HP 8510 softkey field should display the type of calibration and the cal kit tape constants revision number. After the tape is loaded, remove it from the drive. Press RESUME.

20. Before you proceed, set the HP 8510 hardware states as follows. Your verification will be invalid if you fail to set these states.

TEST SET ADDRESS

Press SYSTEM HP-IB ADDRESSES TEST SET 2 1 x1 2 0 x1

MULTIPLE SOURCES

Press SYSTEM MORE EDIT MULT. SRC. MULT. SRC:OFF/SAVE.

SYSTEM PHASELOCK

Press SYSTEM MORE SYSTEM PHASELOCK INTERNAL

POWER LEVELING

Press SYSTEMMORE POWER LEVELING SOURCE 1:INTERNAL

SOURCE 2:INTERNAL.

21. Press RESUME.

22. The verification program initializes the system and changes some instrument states. For operation with the HP 8516A test set only, these values must be set to their required values. The prompt Initializing System Prior to Calibration will be displayed on the computer.

Set the following instrument state before continuing with the calibration procedure. Your verification will be invalid if you fail to set this state.

SYSTEM Z0

Press CAL MORE SET Z0 5 0 X1.

These conditions will be recalled automatically during the verification.

23. Perform the Calibration (the measurement system must be warmed up and stabilized before continuing).

You need a Full 2-port calibration for S-parameter test sets, as in the HP 85109 system.

24. On the HP 8510 press CAL. Then select the 2.4 mm cal kit in CAL 1 or CAL 2. Then select FULL 2-PORT.

25. Next, a series of softkey selections will appear on the CRT: REFLECT'N TRANSMISSION, ISOLATION. When you press one of these keys, another set of softkeys will appear. Connect each device as directed; the HP 8510 will underline each device label when the measurement is complete. After all of the devices are measured (for S11 and S22), press the DONE softkey.

To achieve the greatest measurement accuracy, bending of the semi-rigid test port return cables should be minimized. When connecting the standards, take care to minimize any cable flexing or stressing.

26. After you have made all the calibration measurements, press the appropriate DONE softkey when the last measurement is complete. Then store the calibration in a Cal Set Register (1 through 8) by pressing the accompanying softkey. If an asterisk (*) appears alongside one of the cal set registers, it means that a calibration is already stored there. If all of the registers are full, go ahead and press a key and respond to the prompts. You will delete the contents of that register and store your calibration there.

Press RESUME.

27. If you indicated that you want a 45 MHz verification earlier in this procedure, the system will initialize again and prompt you to perform another calibration. For this 45 MHz calibration, it is necessary to measure only a short, an open, and a lowband load. Store the calibration in a Cal Set Register (1 through 8).

When the calibration is complete, press the program RESUME key and the program will reset the HP 8510 to REMOTE operation and return you to the System Performance Verification Menu.

Measure the Verification Standards

28. Selecting the Verificaton Standard

Press SELECT STANDARD. The program will display the Verification Kit Device Selection Menu. This menu is a form that allows you to select the standard you want to measure, enter its serial number, change the averaging factor for measurement, select the Cal Set register, and enter any comments.

A complete verification requires that you measure all devices in the kit. However, you must select the devices, one at a time, from the Verify Standard menu.

29. When this form is complete, press DONE. Insert the Verification Kit data tape into the HP 8510 tape drive and press RESUME. The program will read the tape and compare device serial numbers. If the numbers do not match, you can change them by responding to the program prompts.

30. Measuring the Standard and Displaying the Data

When you are ready to measure the device, press MEASURE DATA and respond to the prompts on the computer display. The program will initialize the system and give you instructions for making the proper connections. Measure all of the devices in your kit.

Press PRINT ALL and the program will print out a complete results sheet for the measurement of the device. If the device fails at any frequency, the letter F will appear in the column and a failure notice will appear at the bottom of the sheet.

31. Disconnect the 2.4 mm to 2.4 mm adapters from the test port cables. This completes the 2.4 mm performance tests.

PERFORMANCE TESTING IN WR-19

The following procedure assumes that you have already loaded the required software and files into the computer. Refer to the beginning of this section for instructions, if necessary.

SET THE CONFIGURATION

Press Prior Menu until you return to the Main Menu. Press SYSTEM CONFIG HARDWARE CONFIG.

The following example shows the equipment used in a typical millimeter-wave system:

Network Analyzer: HP8510B — Enhanced Model

Test Set: U85105A — U-Band S-Parameter (40 GHz-60 GHz)

Source: U85104A — U-Band Synthesizer (40 GHz-60 GHz)

Calibration Kit: U11644A — U-Band (40 GHz-60 GHz)

Calibration Technique: TL — Thru-Reflect-Line (TRL) Cal

Test Port Cables: HP 85109A U-Band Combiner used with HP 8516 and U85105

Verification Kit: U11645A — U-band

32. Select the equipment above for your system. The CRT display will have a highlighted field around the active selection. Use the NEXT and PREVIOUS keys to change the selection in the highlighted area, if required.

Make all the selections you want until the hardware configuration is correct.

33. Press the softkey labeled Done and the program will load.

Press Prior Menuto return to the Main Menu.

34. At this point, be sure you have the following items ready to use:

* Calibration kit and its tape. The model number of the calibration kit must match the one you select in the Configuration menu.

* Verification kit and its tape. The model number of the verification kit must match the one you select in the Configuration menu.

NOTE:If you want to generate system specifications press SYSTEM SPECSand follow the program prompts.

35. Press VERIFY SYSTEM. If the program acknowledges the system over the HP-IB, it will display the System Performance Verification Menu on the computer display.

36. Press SERIAL NUMBERS. Enter the serial numbers and the NBS numbers only if you want them to appear on the printout of your performance test results for each verification device. The serial numbers are usually located on the rear panels. NBS test numbers are on the Certificate of Calibration that accompanies your verification kit.

When you are finished with this menu, press DONE.

37. You should now be back in the System Performance Verification Menu. Press SYSTEM CAL. The configuration information will be displayed; make sure it agrees with the system you are going to verify. If it does, press RESUME to continue. If it does not, return to the Hardware Configuration Menu to correct it.

Measurement Calibration

38. DO NOT follow the "Test Set Cable Connections" instructions, instead connect the U281A WR-19 waveguide to 1.85 mm coax adapters to the ends of the semi-rigid test port return cables. Align the adapters so the waveguide ends face each other, refer to Figure 4-4. Press RESUME.

Figure 4-4.WR-19 Cable Configuration

39. Load the Cal Kit Tape as follows:

Insert the standards definition tape and press TAPE/DISC STORAGE IS TAPE LOAD Cal Kit 1-2. Then press CAL KIT *1 or CAL KIT *2 *File 1 and if an asterisk (*) appears next to file 2, press it after file 1 is loaded.

Press CAL again to verify that the proper files were loaded. The HP 8510 softkey field should display the type of calibration and the cal kit tape constants revision number. After the tape is loaded, remove it from the drive.

40. Before you proceed, set the HP 8510 hardware states as follows. Your verification will be invalid if you fail to set these states. Ignore any beeping or running error messages on the HP 8510 at this time.

TEST SEST ADDRESS

Press SYSTEM HP-IB ADDRESS TEST SET 2 1 x1.

MULTIPLE SOURCES

Press SYSTEM MORE EDIT MULT. SRC. MULT. SRC:ON/SAVE.

SYSTEM PHASELOCK

Press SYSTEM MORE SYSTEM PHASELOCK EXTERNAL.*

* Set Phaselock to NONE for all sources except the HP 8350B, which is set to EXTERNAL.

POWER LEVELING

Press SYSTEMMORE POWER LEVELING SOURCE 1:EXT LEVEL

SOURCE 2:INTERNAL.

41. Press RESUME.

42. The verification program initializes the system and changes some instrument states. For WR-19, these values must be set to their required values. The prompt Initializing System Prior to Calibration will be displayed on the HP 8510 CRT.

SOURCE POWER LEVEL

Press STIMULUS MENU POWER MENU POWER SOURCE 1 \)20 X1 POWER SOURCE 2 3 X1.

The beeping and running error messages should be gone.

SYSTEM Z0

Press CAL MORE SET Z0 1 X1.

These conditions will be recalled automatically during the verification.

43. Perform the Calibration

You need a Full 2-port calibration for S-parameter test sets, as in the HP 85109 system.

On the HP 8510 press CAL. Then select the WR-19 cal kit in CAL 1 or CAL 2. Then select TRL 2-PORT.

44. The network analyzer will display the TRL calibration menu. Connect the calibration standards as directed in a. through f. below.

* To achieve the greatest measurement accuracy, minimize bending of the semi-rigid test port return cables.

* When making waveguide connections, first tighten screws equally finger tight, then equally tighten to the final torque.

a. Connect the U281A adapters directly together as shown in Figure 4-5a. Press the THRU THRU softkey. The network analyzer will display 'WAIT—MEASURING CAL STANDARD' and take six trace sweeps. When complete 'CONNECT STD THEN PRESS KEY TO MEASURE' will be displayed.

b. Connect the waveguide short standard to the port 1 adapter as shown in Figure 4-5b. Press the S11 REFLECT SHORT softkey. The network analyzer will take one measurement sweep.

c. Connect the waveguide short standard to the port 2 adapter as shown in Figure 4-5c. Press the S22 REFLECT SHORT softkey. The network analyzer will take one measurement sweep.

d. Connect the 1/4 wavelength section between the adapters on port 1 and 2 as shown in Figure 4-5d. Press the LINE LINE softkey. The network analyzer will take six sweeps.

e. Press the ISOLATION softkey. Connect the moving load to the port 1 adapter as shown in Figure 4-5e. Press the FWD ISOL'N ISOL'N STD softkey. The network analyzer will take one sweep.

f. Connect the moving load to the port 2 adapter as shown in Figure 4-5f. Press the REV ISOL'N ISOL'N STD softkey. The network analyzer will take one sweep.

a. Connect the two waveguide adapters directly together. ||

b. Connect the waveguide short to the port 1 adapter.

c. Connect the waveguide short to the port 2 adapter. || d. Connect the 1/4 wavelength section between adapters.

||

e. Connect the moving load to the port 1 adapter. || f. Connect the moving load to the port 2 adapter.

||

Figure 4-5.Waveguide TRL Connections

g. Press the SAVE TRL 2-PORT softkey. Save the calibration in a register (1 through 8). If an asterisk (*) appears alongside one of the cal registers, it means that a calibration is already stored there.

45. The WR-19 measurement calibration is complete.

When the calibration is complete, press the program RESUME key and the program will reset the HP 8510 to REMOTE operation and return you to the System Performance Verification Menu.

Measure the Verification Standards

46. Selecting the Verificaton Standard

Press SELECT STANDARD. The program will display the Verification Kit Device Selection Menu. This menu is a form that allows you to select the standard you want to measure, enter its serial number, change the averaging factor for measurement, select the Cal Set register, and enter any comments.

A complete verification requires that you measure all devices in the kit. However, you must select the devices, one at a time, from the Verify Standard menu.

47. When this form is complete, press DONE. Insert the Verification Kit data tape into the HP 8510 tape drive and press RESUME. The program will read the tape and compare device serial numbers. If the numbers do not match, you can change them by responding to the program prompts.

48. Measuring the Standard and Displaying the Data

When you are ready to measure the device, press MEASURE DATA and respond to the prompts on the computer. The program will initialize the system and give you instructions for making the proper connections. Measure all of the devices in your kit.

Press PRINT ALL and the program will print out a complete results sheet for the measurement of the device. If the device fails at any frequency, the letter F will appear in the column and a failure notice will appear at the bottom of the sheet.

49. To quit the program, press PRIOR MENU until you can select the QUIT PROGRAM softkey.

50. Disconnect the U281A adapters from the cable ends.

The system performance verification is complete.

Reconnect the Probe Station

1. Remove the verification work surface.

2. Unlock the casters on the probe station table and roll the probe station back into place. Lock the casters.

3. Reconnect the semi-rigid cables to the probes.

NOTE:Clear your computer's memory by typing: SCRATCH A and pressing RETURN or ENTER prior to running the System Software in the next step.

4. Load and run "HP85109A" software.

Contents

1

Section 5.Service and Troubleshooting

INTRODUCTION

Follow this procedure to troubleshoot the HP 85109 system to the instrument level. This procedure was written for HP 85109 factory-racked systems. When the faulty instrument is found, stop this procedure and follow the respective instrument troubleshooting procedure to locate the faulty assembly.

Each instrument in the HP 8510 system contains lethal voltages when the instrument has AC power applied. Refer to the HP 8510 safety information included in the "Service Overview" section of the HP 8510B Network Analyzer Service Manual, included with each HP 85109 system. Servicing must be performed by qualified personnel only.

A system-level replaceable parts list is included at the end of this section.

TROUBLESHOOTING STRATEGY

Troubleshooting the system is done in three stages:

1. The pre-operational check can quickly identify many failures.

2. Using the HP 8510 internal diagnostics determines if the analyzer itself is functional.

3. Specific procedures are used for certain symptomatic failures. Hardware service tools are used to emulate source and test set functions, to identify a cause of failure outside the analyzer.

The first part of troubleshooting consists of a pre-operational check of the system that helps to verify that the system is cabled correctly, and that things such as firmware revisions, HP-IB addresses, voltages, and configuration and language switch settings are correct.

The HP 8510 Network Analyzer is the core instrument around which the HP 85109 system is built. The HP 8510 incorporates many internal diagnostics that check operation of the analyzer during initial application of AC line power and continuously while the instrument is running. The faulty system component can be isolated most effectively when these diagnostics are used to confirm or deny operation of the HP 8510.

During the pre-operational check, note any indications of failure that occurred before troubleshooting. These indications may be self-test failure messages, running error messages (caution type), measurement errors, performance test problems, or display hang-ups. Stay with the procedure; these will be discussed at the proper time. Refer to Figures 5-1 or 5-2 System Block Diagrams as needed throughout this procedure.

DOCUMENTATION REQUIRED

Throughout this procedure, you are referred to other documentation for information and in-depth troubleshooting procedures. The following manuals are referenced, and are therefore required to perform this troubleshooting procedure:

HP 8510C Service Manual (HP part number 08510-90275)

HP 8517A Operating and Service Manual (HP part number 08517-90001)

HP 8360 series Calibration and Installation Manual (HP part number 83621-90024 for the HP 83651A synthesized sweeper)

HP 8350B Operating and Service Manual (HP part number 08350-90092) — not required for Option 002 (two synthesizers) systems.

Figure 5-1.HP 85109 Standard System Block Diagram

Figure 5-2.HP 85109 Option 002 System Block Diagram

1.>PRE-OPERATIONAL SYSTEM CHECK

Perform a pre-operational check of the HP 85109 system as indicated in Table 5-1.

Table 5-1.Pre-Operational Check Table

Check

Should be:

Additional Information

|| ||

Front/rear panel control settings on the HP 8510: ||

Intensity knob ||

Approximately 75% of fully clockwise

Service Switch ||

System-controlled position ||

On rear panel of HP 85101 ||

Operating System firmware revision of HP 8510 ||

C.06.00 or higher ||

On label of operating system tape cartridge ||

Cabling connections ||

Tight connections ||

See figures 5-3 & 5-4 ||

HP 8510 System Bus HP-IB addresses: ||

RF source ||

LANG = 001

ADDRESS = 10011 (binary) ||

See HP 8360 series Source Language and HP-IB Address selection

LO source if

HP 8350B ||

18 (decimal) ||

See HP 8350 Source HP-IB Address Check

LO source if

HP 8360 series ||

LANG = 001

ADDRESS = 10010 (binary) ||

See HP 8360 series Source

Language and HP-IB Address Selection

||

||

||

HP 85105A

test set ||

10101 (reversed binary)

HP 8517A

test set ||

00101 (reversed binary) ||

See Test Set System Bus

Address Check ||

Controller HP-IB Bus addresses: ||

3.5 in. floppy disk drive ||

700 (decimal) ||

See your disk drive manual for HP-IB address switch location.

HP 8510 ||

716 (decimal) ||

Will be checked after the system is powered up. ||

Figure 5-3.Racked HP 85109 Standard

Figure 5-4.Racked HP 85109 Option 002 Cabling Diagram

HP 8360 Series Source Language and HP-IB Address Selection

The HP 8360 series synthesizers use one of the following external interface languages: TMSL (Test and Measurement System Language) or Analyzer Language. Operation in an HP 8510 system requires that the synthesizer be set to Analyzer Language.

The language configuration and the synthesizer HP-IB address are both set with a switch located on the rear panel of the synthesizer. The factory default setting for this switch is Analyzer Language at an HP-IB address of 19. This is the setting normally used for HP 8510 system source #1.

Check the rear panel switch (Figure 5-5) of the RF source to make sure that Analyzer Language and HP-IB address 19 have been set, as shown in the figure.

Figure 5-5.HP 8360 Series Source Rear Panel HP-IB Switch

The HP-IB address of the source used for the LO is 18. If your LO source is an 8360 series synthesizer, set the HP-IB LANG ADDRESS switch to 00110010 (reversed binary).

HP 8350 Source HP-IB Address Check

With the HP 8510 network analyzer off, turn on the HP 8350 source, then press the INSTR PRESET key. When the source has completed the preset sequence, press the shift key (the large blue key in the 'DATA ENTRY' key area) and the LCL key. The HP-IB address will then be displayed on the "FREQUENCY/TIME" display of the source. If the address is not 18, enter the correct address by pressing the 1 8 GHz DATA ENTRY keys.

Test Set System Bus Address Check

The HP 85105 should be set to address 21 (decimal) and the HP 8517A should be set to address 20 (decimal). Refer to Figure 5-6 below for address switch location and setting. If the address is incorrect, turn off the instrument before setting it to the correct value.

Figure 5-6.Test Set System Bus Address Switch

2.>>TURN ON SYSTEM POWER AND OBSERVE INSTRUMENT> > FRONT PANELS

NOTE:In the next step, observe the preset routines for each instrument as AC line power is applied. Note any errors.

First, switch off AC line power to all system instruments. Next, apply AC line power to the following system instruments in the order shown:

Sources

Millimeter-wave controller

Test set

Disk drive (connected to computer HP-IB bus)

When all system instruments have completed their preset routines and are ready, apply AC line power to the HP 8510.

NOTE:If the HP 8510 hardware state and instrument state are incorrect or not loaded, the HP 8510 may display an error message and a beeper may sound. The beeper may be turned off by pressing the following HP 8510 front panel buttons:

SYSTEM

BEEPER OFF

3.>CYCLE THE AC LINE POWER

Turn the HP 8510 AC line power off and after 10 seconds turn on. Do not press PRESET! Check the RF power and sweep functions of the HP 8510 by observing the display and/or blinking sweep LED on the HP 8350B sweeper front panel.

NOTE:If the HP 8510 locks up, the HP 8510 operating system may have to be re-loaded.

4.>CHECK HP 8510 DIAGNOSTICS

When the HP 8510 is energized, it runs an internal self-test check of several internal assemblies. Failure messages appear on the HP 8510 display, along with messages that may indicate the failure. During normal operation, the HP 8510 performs continuous internal diagnostics which indicate failures of the network analyzer during operation. These running error messages (caution type) are also shown on the display.

Self-Test Failure

If one or more self-tests fail, the HP 8510 display will show an "INTERNAL SELF TEST HAVE REPORTED A FAILURE" message. Refer to the "Self Test Failures" tab in the HP 8510 Service Manual.

Ignore any beeping and running errors until after the system software is loaded.

Turn on the computer, load BASIC, and then load and run the system software.

If the message "An HP-IB Timeout has occurred. Check connections." appears on the computer display after the system software tries to initialize the system, check the HP-IB cable connection between the computer and the HP 85101.

If the HP-IB cable and connections are okay, check the HP 8510 HP-IB addresses as follows:

1. On the network analyzer press SYSTEM HP-IB ADDRESSES ADDRESS OF 8510. Address 16 should be displayed.

Press SYSTEM BUS. Address 17 should be displayed.

If either address is incorrect, set to the correct address with the entry keys or RPG knob, then press x1.

Other addresses can be checked by pressing the appropriate softkey. Here is a list of the correct addresses:

ADDRESS OF 8510 || 16 ||

SYSTEM BUS || 17 ||

SOURCE #1 || 19 ||

TEST SET || 21 ||

PLOTTER || 5 ||

PRINTER || 1 ||

DISC || 0 ||

SOURCE #2 || 18 ||

PASS THRU || 31 ||

RF SWITCH || 31 ||

Running Error Messages (Beeping)

If a running error message (caution type) appears on the HP 8510 display after the system software is running, press the ENTRY OFF key. If the running error message reappears, then refer to the "Running Error Messages" tab in the HP 8510 Service Manual.

5.>SYMPTOMATIC FAILURE TYPES

The nature of some types of failures is known. For instance, you may know that the system fails verification. The following paragraphs give suggested courses of action based upon the failure symptom. Based upon your problem, go to one of the following headings in this procedure:

* Phase Lock, Power Loss, or Frequency Related Problems

* Calibration/Verification Problems

* Software Problems

* All Other Problems

Phase Lock, Power Loss, or Frequency Related Problems

Check Unratioed Power LevelsRefer to the test titled "Check Unratioed Power Levels" later in this troubleshooting procedure. Return to this location if the tests do not help solve the problem.

NOTE:When checking any unratioed power levels, make sure that averaging on the HP 8510 is turned off. Refer to "Unratioed Power Test" in the HP 8517A Operating and Service Manual. This procedure allows you to check the output power level of each test set sampler/mixer assembly and its associated IF amplifier individually. Depending on the test outcome, the procedure directs you to the most probable cause of failure.

Power Supply Problems

Each instrument in the HP 8510 system contains lethal voltages when the instrument has AC power applied. Refer to the HP 8510 safety information included in the "Service Overview" section of the HP 8510B Network Analyzer Service Manual, included with each HP 85109A system. Servicing must be performed by qualified personnel only.

Check all AC line (110V/220V) fuses and power switches. Remove the top covers of the following instruments:

HP 85101 network analyzer display/processor

HP 85102 network analyzer IF/detector

HP 85105A millimeter-wave controller

Sources

Check the LED power and service indicator lights. Measure each power supply voltage with a digital voltmeter. The HP 85102 power switch LED is supplied by the +5V supply in the HP 85101.

Refer to the "Power Supply Failures" tab in the HP 8510C Service Manual for more information.

Calibration/Verification Problems

Read the respective manual for the calibration kit used and the connector care manual to review inspection, gauging, cleaning, and use of the calibration and verification devices and test port return cables.

Refer to the "Performance Test Failure" tab in the HP 8510C Service Manual, or the information behind the "Performance Verification" tab in this HP 85109 system manual.

Software Problems

First try loading the standard operating system firmware into the HP 8510 from the backup copy. This operating system firmware must be revision C.06.00 or later in order for the HP 85109 system to function properly.

There is a chance that you encountered a software "bug" that is already known. Contact HP and explain the details so that the problem can be duplicated and checked.

Continue with "All Other Problems" in this troubleshooting procedure.

ALL OTHER PROBLEMS

The best approach to repair the HP 85109 at this point is to verify that the HP 85101 display/processor is working properly. When its operation is verified, it will act as your diagnostic controller.

Disconnect from the HP 85109 system bus any printer, plotter, disk drive, of other accessory. The instruments attached to the system now should be:

HP 8510 network analyzer

HP 85104A millimeter-wave test set

HP 8517A S-parameter test set

Test port combiners

HP U281A adapters

HP 85105A millimeter-wave controller

Two sources

The computer and its disk drive can remain connected to the network analyzer's HP-IB bus.

Run the Service Program

This group of internal diagnostics, called the Service Program, will give the fastest and most complete check of the HP 85109 system. Whenever your HP 85109 system appears to have a failure, you can use this program to check the boards in the HP 8510 and HP 85105.

In general, the Service Program is used for the following purposes:

1. When there is a self-test failure, run the Service Program diagnostics for the board that failed, to verify the failure.

2. When there is a running error message (caution type), run the Service Program diagnostics for those board assemblies indicated in the "Running Error Messages" section in the HP 8510B Service Manual. The Service Program will verify if the board has a detectable problem.

3. When there is any reason to suspect a board level problem, run the Service Program diagnostics to check the boards.

4. After a board assembly is replaced, run the appropriate Service Program diagnostics again to verify that the board level failure has been repaired.

Service Hardware Tools

Two service tools are especially designed for use with these diagnostics. They are a service adapter and an 85102 test emulator. In addition, you will also need two BNC-to-BNC cables (not included). The HP 8510 will display a message to alert you when these tools are required in the Service Program.

Test OutcomeIf a Service Program test fails and indicates a faulty board, you can be reasonably sure that the board should be replaced. If there is another test for the board in question, you should perform the test to further verify the failure.

If running any of the Service Program tests does not verify or isolate the problem, refer to the information after the "Service Program" tab in the HP 8510C Service Manual.

Symptoms Versus Failure CausesBe sure that you have not overlooked any fundamental problems that can be disguised by a symptom of the real failure. Some of these fundamental problems include incorrect cabling/connections, instruments with incorrect firmware, error messages due to boards improperly seated in their sockets, and so forth.

Overall Service Program FlowchartFigure 5-7 illustrates the overall Service Program flowchart including HP 8510 key presses to access all the tests included in this diagnostic.

NOTE:All tests used to generate signature analysis patterns are for factory repair and are not intended for on-site service. Also, you can always use the front panel recessed TEST button to exit the Service Program and reset the HP 8510. Be sure to properly reconnect the system.

Figure 5-7.Overall Service Program Flowchart

Service Program Procedure Using HP 85101 Tests

Figure 5-8 illustrates the Service Program flowchart for the HP 85101 tests. Run the program now using all the bulleted () tests in the HP 85101 test menu. These tests can find 95% of all HP 85101 failures, and require approximately ten minutes to complete.

The bulleted steps under the HP 85101 test menu are the most important HP 85101 tests. Those tests not bulleted in the same group are mainly adjustments that increase troubleshooting time and are not needed.

Figure 5-8.HP 85101 Service Program Flowchart

Service Program Procedure Using HP 85102 Tests

If the HP 85101 is working properly, then the problem is probably the HP 85102, the sources, or their interfaces. Verify operation of the HP 85102 by running the following HP 85102 Service Program tests.

Figure 5-9 illustrates the Service Program flowchart for the HP 85102 tests. Run the program now. These tests can find 80% of all HP 85102 failures and require approximately one minute to complete.

Figure 5-9.HP 85102 Service Program Flowchart

CHECK UNRATIOED POWER LEVELS

This procedure allows you to check the output power level of each sampler/mixer assembly and its associated IF amplifier individually.

The normal power level display, S11 for example, is a ratio (in this case, b1/a1). The network analyzer automatically applies power to and phase locks a predefined port or ports to make the measurement selected. Ratioed measurements provide useful data but they can mask certain malfunctions. Assume for example that the task is to measure an S-parameter at a specific power level. If the test set has a 20 dB power hole due to a faulty RF input connector, that deficiency would be invisible (ratioed out) in a ratioed measurement. But the data would be incorrect; it would not have been taken at the specified power level. Similarly, troubleshooting system faults in a ratioed measurement mode can be deceptive.

The solution is to test each channel singly to check the power in an unratioed mode. To do so requires specifying which port receives the driven power, and which channel is phase-locked.

The following procedure includes steps to redefine parameters as required. The power levels given are approximate. Figure 5-10 shows which assemblies are parts of the signal path of each channel. Knowing that some assemblies are common to two, or all four channels is a powerful troubleshooting tool.

Figure 5-10.Simplified Signal Path of Unratioed Power Test when the HP 85105A is Active

The mixers shown in the test set block of Figure 5-10 are harmonic mixers. They mix the multiplied signal from the RF source and a harmonic of the signal from the LO source to produce a 20 MHz IF output.

Procedure start conditions:

Probe station and probes connected to the system.

System power on and system software running.

System operating in lowband (HP 8517A test set active).

Averaging is OFF.

To check all of the IF signals in the test sets, the a2 and b2 phase lock and drive paths must be redefined.

On the HP 8510, press the following keys to redefine a2:

PARAMETER MENU

User 3 a2

REDEFINE PARAMETER

DRIVE Port 2

PHASE LOCK a2

REDEFINE DONE

To redefine b2, press:

User 2 b2

REDEFINE PARAMETER

DRIVE Port 2

PHASE LOCK a2

REDEFINE DONE

NOTE:Be sure any DC bias supply is set to zero volts before continuing.

Bring the port 1 and 2 probes down on short circuit connections.

On the HP 8510, press the following keys to check the IF signals indicated and compare with the typical Lowband traces in Figure 5-12.

`User 1 a1` checks the a1 incident IF signal

`User 2 b2` checks the b2 reflected IF signal

`User 3 a2` checks the a2 incident IF signal

`User 4 b1` checks the b1 reflected IF signal || Four user channels ||

Lowband Minimum Unratioed Power Levels:

a1 or a2 should be at least −40 dB across lowband with ≤10 dB variation.

b1 or b2 should appear similar to each other.

The maximum power level must not activate the IF OVERLOAD running error message.

Press the Highband softkey on the controller to switch the system.

Check User 1 through 4 and compare with the typical Highband traces in Figure 5-12.

Highband Minimum Unratioed Power Levels:

a1 or a2 should be at least −18 dBm across highband with ≤5 dB variation.

b1 or b2 should appear similar to each other.

If All Four User Channels Fail the Unratioed Power TestIf the power levels on all four channels fail in either band, the most likely cause of failure is in the RF or LO source paths from the sources to the mixers or samplers.

Remove the HP-IB and RF power cables from the HP 85109 system to isolate the sources. Refer to the appropriate source manual to troubleshoot the HP 8350B and 8360 series sources. Be sure to check the power levels out of the sources and the RF cables from the sources to the HP 85109 system.

NOTE:Make sure the source is switched to internal power leveling before disconnecting to measure power levels.

Consider substituting known good sources and cables for the suspected sources, if they are available.

If the sources are all good, then continue this procedure with "If One, Two, or Three Channels Fail the Unratioed Power Test."

If One, Two, or Three User Channels Fail the Unratioed Power TestIf the power levels on at least one but not all of the four channels fail, the most likely cause of failure is the HP 8517A test set for lowband operation or the HP 85104A S-parameter test set/HP 85105A millimeter-wave controller for highband operation.

If the problem is in the highband, use the following procedure to determine which of the two instruments (HP 85105A or 85104A) is defective:

1. Swap the LO input, RF input and module interface cable connections between port 1 and port 2 on the rear panel of the HP 85104A.

2. If the problem changes from one user channel to another, then the failure is most likely in the HP 85105A or connection cables.

If the problem stays in the same user channel, then the failure is most likely in one of the port modules of the HP 85104A.

3. Go to the troubleshooting procedure of the failed instrument.

To help narrow the problem to the faulty instrument, the service adapter and service tools are used to emulate the operation of the source and test set and check unratioed power levels into the HP 85102 IF/detector.

Set the system to the band (lowband or highband) that had the failure.

Run the Service Program procedure (Figure 5-11) using the Test Set HP-IB Commands tests. These tests can find approximately 15% of all HP 85105 millimeter-wave controller or HP 8516A failures and requires approximately one minute to complete. The digital control functionality of the HP 85105 is checked with this test, not the RF paths.

NOTE:Do not perform Test number 5 “Increment Active Attenuator” in the “Test Set HP-IB Commands” menu if the millimeter-wave controller is active, since it does not contain any step attenuators.

Figure 5-11.Test Set Service Program Flowchart

Troubleshoot the HP 85105A millimeter-wave controller using the procedure in the HP 85105A section of this Manual.

Troubleshoot the HP 85104A S-parameter test set using the procedure in the HP 85104A section of this manual.

Figure 5-12.User Channel Traces with Shorts Connected

LOWBAND HIGHBAND a1 b1 a2 b2 Port 1 Port 2

SYSTEM REPLACEABLE PARTS

The following replaceable parts list contains the most common replaceable parts in the HP 85109 system. For part numbers of other replaceable parts related to the HP 85109 system, refer to the service manual of the specific instrument or the appropriate section of this manual.

ItemHP Part/Model Number

Software

HP 85109 System Software 85109-10002

HP 8510 Specifications and 08510-10033

Performance Verification Software

Cables

Flexible RF Cable

18-inch 8120-4396

Interconnect Cable 08510-60102

Test Port Cable-combiner to probe heads

18-inch 85109-20003

22-inch 85109-20004

Semi-rigid RF cable-combiner to wvgd adapter

6-inch 85109-20001

Adapters

WR-19 Waveguide to Coaxial HP U281A

Female BNC to female BNC 1250-0080

Female SMA to female SMA 1250-1158

Miscellaneous

Combiner 85109-60002

Contents

1

Section 6.HP 85104A Option K10 Test Set

INTRODUCTION

This section documents the operation, troubleshooting techniques, and replaceable parts of the HP 85104A Option K10 test set.

DESCRIPTION OF THE INSTRUMENT

The HP 85104A Option K10 test set (Figure 6-1) is used in conjunction with an HP 85105A millimeter-wave controller to make either reflection/transmission or S-parameter measurements at millimeter-wave frequencies.

WARRANTY

Refer to the "Documentation and System Overview" section of this manual for warranty information regarding the HP 85104A Option K10 test set.

RECEIVING CHECKLIST

With your HP 85104A Option K10 test set you should have received:

4 Flexible source cables (18 inches long)

2 test set interconnect cables

OPERATION

The features and functions of the test set are described and shown below.

FRONT AND REAR PANEL FEATURES

Figure 6-1.Front and Rear Panel Features of the HP 85104A Option K10 Test Set

1. Test Port Connector.The incident and reflected RF signals pass through this port. The connector is WR-19 waveguide.

2. LO Input Cable.The LO signal enters the test set from the HP 85105A through this cable.

3. RF Input Cable.The RF signal enters the test set from the HP 85105A through this cable.

4. Module Interface Cable.Voltage and ground lines enter the test set from the HP 85105A through this cable. Incident and reflected IF signals are returned to the analyzer, and an ALC signal is returned to the RF source through this cable.

INSTALLATION

Refer to "System Installation" for a cabling diagram of the HP 85104A Option K10 test set as part of an HP 85109 system.

SPECIFICATIONS

Specifications describe the warranted performance of the instrument. The electrical specifications of the HP 85104A Option K10, when used in an HP 85109 system, are defined in the "Specifications and Performance Verification" section of this manual.

SUPPLEMENTAL CHARACTERISTICS

The supplemental characteristics listed below are intended to provide information useful in applying the instrument by giving typical but non-warranted performance parameters.

HP 85104A Option K10 Supplemental Characteristics

Max RF Input Power (damage level) || >+27 dBm ||

(into the test port) ||

HP 85104A Power Requirements and Physical Characteristics

Operating Temperature: ||

0°C to 55 °C ||

Power: ||

All power to the HP 85104A Option K10 test set is supplied by the HP 85105A. ||

Dimensions: ||

422 mm x 178 mm x 502 mm (16.625 x 7 x 19.75 inches) ||

Weight (approximate): ||

14.9 kg, 33 lb ||

TROUBLESHOOTING

The troubleshooting strategy for the test set is similar to that of the HP 85109 system. Refer to the "System Service and Troubleshooting" section, if you have not already done so, to verify that your test set is faulty.

Follow the troubleshooting flowchart (Figure 6-2) to identify the faulty assembly. The flowchart is keyed to numbered troubleshooting procedures. As you progress through the flowchart perform the numbered procedure associated with each block. A block diagram of the test set (Figure 6-6) is included in this section to assist you in understanding the operation of this test set.

THEORY OF OPERATION

The HP 85104A Option K10 test set is used in conjunction with an HP 85105A millimeter-wave (mm-wave) controller to provide all of the features and functions of a full S-parameter test set. The mm-wave controller routes the LO and RF signals from the sources to the test set. Switching from port 1 to port 2 is also performed by the mm-wave controller. The test set separates the incident from the reflected RF signal and then down converts those signals to a 20 MHz IF frequency.

Refer to the HP 85104A Option K10 block diagram (Figure 6-6) while you read the following description. The RF is received from the mm-wave controller and input to the source module block of the test set module. The RF is then multiplied 3 times for U-band. The RF continues through an isolator and a dual directional coupler. A portion of the incident signal is coupled off and passed through an isolator and into a harmonic mixer, A11. The signal received at the test port (either transmitted from the other test port of the test set, or reflected from a device under test) is coupled off and passed through an isolator and into a harmonic mixer, A12. The 2-8 GHz LO signal is input from the source through the mm-wave controller. The signal is then divided and input to the harmonic mixers. The LO harmonic product must be 20 MHz higher in frequency than the RF signal. The IF frequencies (incident and reflected) are then output to the mm-wave controller for further processing. The

mixing harmonic for U-band is 10. The isolators in the test set are used to reduce unwanted reflections.

TROUBLESHOOTING PROCEDURES

The following troubleshooting procedures correspond to the troubleshooting flowchart in Figure 6-2. Use the flowchart and the troubleshooting procedures to troubleshoot your test set.

This procedure assumes you have completed the system level troubleshooting and determined which port of the test set is faulty. If you have not done this, return to the "System Service and Troubleshooting" section to determine which instrument in your system is faulty.

The following tools are required to perform these procedures, but are not supplied.

Table 6-1.Required Equipment

||

Item

Size

HP Part/

Model Number

|| Power Meter || N/A || HP 436A, 437B, or 438A ||

|| Power Sensor || N/A || HP 8485A ||

|| Power Meter || N/A || Anritsu ML83A ||

|| Power Sensor || N/A || Anritsu MP715A-004 ||

|| Waveguide Bend || WR-19 || HP U897A ||

|| Torx-head screwdriver || T-10 || 8710-1623 || ||

|| Torx-head screwdriver || T-8 || 8710-1644 ||

|| Hex-head balldriver || 3/32 || 8710-1539 ||

|| Pozidriv screwdriver || 1 pt || 8710-0899 || ||

|| Open-end wrench || 5/16 inch || 8720-0015 ||

|| Wrist strap || N/A || 9300-1383 ||

|| Conductive mat || N/A || 9300-0797 ||

Some of the microcircuits in the test set are extremely sensitive to electrostatic discharge (ESD). Ground your work station and yourself before you handle this instrument.

TROUBLESHOOTING SETUP

Once you have checked the IF power levels (user parameters) of your system and recorded which path is bad, continue with this setup.

1. Turn off power to the HP 85105A, disconnect the HP 85104A from the system, and remove it from the rack.

2. Place the HP 85104A on a table behind the rack. Reconnect all cables.

3. Remove the top cover and side panels from the HP 85104A.

4. Label the components of the suspect port module with an "S" (on a piece of tape) to differentiate them from the same components in the other port module when you swap parts.

5. Run the system software in the highband portion. Save this information in an instrument state so you don't have to re-run the software every time you turn the HP 85105A off.

On the HP 8510, press the following keys:

INSTRUMENT STATE SAVE, then select a register (1 through 7) to store the information in.

TROUBLESHOOTING SEQUENCE

A flowchart of the troubleshooting sequence is illustrated below. Use this flowchart to determine the faulty assembly in the test set.

Troubleshooting Without a Power Meter

If you do not have the equipment required to perform these procedures, you can still troubleshoot the instrument by swapping components between the two port modules.

Figure 6-2.HP 85104A Troubleshooting Flowchart (1 of 3)

Figure 6-2.HP 85104A Troubleshooting Flowchart (2 of 3)

Figure 6-2.HP 85104A Troubleshooting Flowchart (3 of 3)

PROCEDURE 1:>>REMOVE THE ISOLATOR/MIXER ASSEMBLY> > (A9/A11 or A10/A12)

1. Turn off the power to the HP 85105A mm-wave controller and unplug the AC line cable.

2. Perform the "Main Instrument" disassembly procedure, located later in this section.

3. Disconnect the LO Input and LO Output cables from the power divider.

4. Disconnect the mixer bracket from the A11 mixer (incident signal path).

5. Disconnect the A9 isolator at the coupler interface (incident signal path).

6. Lift the isolator/mixer assembly out of the test set and replace it with the incident arm assembly from the other port module.

6. Reattach the isolator to the coupler. Be sure to use good waveguide connection techniques (refer to the "Module Assembly" procedure in this section).

7. Reattach the LO Input and Output cables to the mixer.

8. Reconnect the AC line cable to the HP 85105A and turn it back on. Recheck the unratioed power levels.

9. Return to the troubleshooting flowchart.

Switch Mixers (A11 or A12)

1. Turn off the power to the HP 85105A mm-wave controller and unplug the AC line cable.

2. Remove the IF and LO cables from the mixer inputs.

3. Disconnect the isolator at the mixer interface.

4. Remove the mixer bracket.

5. Replace the mixer with a mixer from the other port module.

6. Attach the new mixer to the isolator and connect the IF and LO input cables. Be sure to use good waveguide connection techniques (refer to the "Module Assembly" procedure in this manual).

7. Connect the mixer clamp to reduce the stress on the waveguide interface.

8. Reconnect the AC line cable to the HP 85105A and turn the HP 85105A on. Recheck the unratioed power levels.

9. Return to the troubleshooting flowchart.

PROCEDURE 2: CHECK THE RF POWER OUT OF THE SUSPECT PORT

The following equipment is required to perform this procedure:

Power Meter Anritsu ML 83A

Power Sensor Anritsu MP715A-004

1. Turn on the power meter and zero it according to the manufacturer's instructions.

2. Connect the power sensor to the test port of the suspect module.

3. Recall the instrument state stored in step 5 of the "Troubleshooting Setup" procedure.

4. On the HP 8510, press STIMULUS MENU SINGLE POINT then STIMULUS CENTER.

5. Enter the frequencies listed below and note the corresponding power levels. The power level at all frequencies between 40 and 62.5 GHz should be $\geq$0 dBm.

6. Compare the power levels from the suspect port with the power levels from the other port. The difference in power levels between port 1 and port 2 should be $\leq$4 dB.

Frequency Suspect Port Power Level

($\geq$ 0 dBm) || Other Port Power Level

(≥ 0 dBm) || Difference between Port 1 and Port 2

(≤ 4 dB) ||

40 GHz || || || ||

45 GHz || || || ||

50 GHz || || || ||

55 GHz || || || ||

60 GHz || || || ||

62.5 GHz || || || ||

7.

Return to the troubleshooting flowchart.

PROCEDURE 3:>> CHECK THE RF POWER INTO THE> > SOURCE BLOCK (A13)

The following equipment is required to perform this procedure:

Power Meter HP 436A, 437B, or 438A

Power Sensor HP 8485A

1. Make sure your system is operating in the highband portion of the software..

2. Store this instrument state in a register by pressing INSTRUMENT STATE SAVE, then select a register (1 through 7) to store it in.

3. Turn off the power to the HP 85105A and unplug the AC line cable.

4. Perform the "Main Instrument" disassembly procedure, located later in this section.

5.

Remove the RF cable, W13 or W15, from the coaxial barrel and connect the RF cable to the power sensor.

6. Reconnect the AC line cable to the HP 85105A and turn the power on.

7. On the HP 8510, recall the instrument state you stored in step 3 of this procedure.

Press: INSTRUMENT STATE RECALL, then select the register number.

8. On the HP 8510, press: STIMULUS MENU SINGLE POINT then STIMULUS CENTER.

9. Enter the frequencies listed below and note the corresponding power level. The power level at all frequencies between 40 and 60 GHz should be approximately 21 dBm ± 1 dB.

Frequency || RF Power Level

(approximately 21 dBm ± 1 dB) ||

40 GHz || ||

45 GHz || ||

50 GHz || ||

55 GHz || ||

60 GHz || ||

62.5 GHz || ||

10.

Disconnect the power sensor and reconnect the RF cable to the coaxial barrel.

11. Return to the troubleshooting flowchart.

PROCEDURE 4:>>CHECK THE RF POWER OUT OF THE> SOURCE BLOCK (A13)

The following equipment is required to perform this procedure:

Power Meter Anritsu ML 83A

Power Sensor Anritsu MP715A-004

1. Make sure your system is operating in the highband portion of the software.

2. Store the instrument state in a register. On the HP 8510, press: INSTRUMENT STATE SAVE, then select a register (1 through 7) to store it in.

3. Turn off power to the HP 85105A and unplug the AC line cable.

4. Perform the "Main Instrument" disassembly procedure, located later in this section.

5. Remove the main isolator (A7).

6. Attach the waveguide bend to the source block (where the arm of the main isolator was connected). Refer to Figure 6-3.

–

Figure 6-3.Power Level Test Setup7.

Attach the power sensor to the waveguide bend.

8. Reconnect the AC line cable to the HP 85105A and turn the power on.

9. Recall the instrument state you stored in step 2 of this procedure.

On the HP 8510, press: INSTRUMENT STATE RECALL, then select the register number.

10. On the HP 8510, press: STIMULUS MENU SINGLE POINT, then STIMULUS CENTER.

11. Enter the frequencies listed below and note the corresponding power level. The power level at all frequencies between 40 and 62.5 GHz should be approximately 3 dBm.

Frequency ||

RF Power Level

(approximately 3 dBm) ||

Frequency ||

RF Power Level

(approximately 3 dBm) ||

40 GHz || || 55 Ghz || ||

45 GHz || || 60 GHz || ||

50 GHz || || 62.5 GHz || ||

12.

Disconnect the power sensor and waveguide bend, and reconnect the main isolator.

13. Return to the troubleshooting flowchart.

PROCEDURE 5:>>CHECK CONTINUITY OF INTERCONNECT> > CABLE (W17)

The following equipment is required to perform this procedure:

Multimeter HP 3468A/B

1. Turn off power to the HP 85105A and unplug the AC line cable.

2. Disconnect the interconnect cable of the suspect port at the rear panel of the HP 85104A test set.

3. Perform the "Main Instrument" disassembly procedure, located in this section.

4. Remove P1 from its socket, located on the A5 board. Refer to Figure 6-4.

Figure 6-4.A5 P1 Socket Location5.

Measure the continuity between the pins on the interconnect cable and the corresponding pin of A5P1. Refer to Figure 6-5.

6. Reconnect P1 to the A5 board and reconnect the interconnect cable to the HP 85104A. Reconnect the AC line cable to the HP 85105A and turn the HP 85105A on.

7. Return to the troubleshooting flowchart.

Figure 6-5.W17 Continuity Test

PROCEDURE 6:>SWAP MAIN LINE ISOLATOR (A7)

1. Turn off the power to the HP 85105A and unplug the AC line cable.

2. Perform the "Main Instrument" disassembly procedure, located later in this section.

3. Replace the suspect isolator with the isolator from the other port module.

4. Reconnect the AC line cable to the HP 85105A and turn the HP 85105A on. Recheck the unratioed power levels.

5. Return to the troubleshooting flowchart.

PROCEDURE 7:>SWAP THE COUPLER (A8)

1. Turn off the power to the HP 85105A and unplug the AC line cable.

2. Perform the "Main Instrument" disassembly procedure, located later in this section.

3. Remove the screws where the main isolator (A7) and the coupler (A8) meet.

4. Remove the screws from the coupler bracket (2 on each side) and remove the coupler.

5. Swap the suspect coupler with the coupler from the other port module.

6. Reconnect the AC line cable to the HP 85105A and turn the HP 85105A on. Recheck the unratioed power levels.

7. Return to the troubleshooting flowchart.

PROCEDURE 8:>SWAP THE POWER DIVIDER (A6)

1. Turn off the power to the HP 85105A and unplug the AC line cable.

2. Perform the "Main Instrument" disassembly procedure, located later in this section.

3. Disconnect the LO In and LO Out cables from the power divider.

4. Remove the 2 screws from the power divider and slide the divider out of the assembly.

5. Replace the power divider with the power divider from the other port module.

6. Reattach the LO input cables.

7. Reconnect the AC line cable to the HP 85105A. Turn the HP 85105A on and recheck the unratioed power levels.

8. Return to the troubleshooting flowchart.

Swap LO Input Cables (W10)

1. Turn off the power to the HP 85105A and unplug the AC line cable.

2. Perform the "Main Instrument" disassembly procedure, located later in this section.

3. Using a 5/16 inch open end wrench, disconnect the suspect W10 cable and swap it with the same cable of the other port module.

4. Reconnect the AC line cable to the HP 85105A. Turn the HP 85105A on and recheck the unratioed power levels.

5. Return to the troubleshooting flowchart.

PROCEDURE 9:>CHECK LO INPUT TO POWER DIVIDER (A6)

The following equipment is required to perform this procedure:

Power Meter HP 436A, 437B, or 438A

Power Sensor HP 8485A

1. Make sure your system is operating in the highband portion of the software.

2. Store the instrument state in a register. On the HP 8510, press: INSTRUMENT STATE SAVE, then select a register (1 through 7) to store it in.

3. Turn off power to the HP 85105A and unplug the AC line cable.

4. Follow the "Main Instrument" disassembly procedure, located later in this section.

5. Disconnect W14 or W16 from the power divider.

6. Connect the power sensor to W14 or W16.

7. Reconnect the AC line cable to the HP 85105A and turn the power on.

8. Recall the instrument state you stored in step 2 of this procedure.

On the HP 8510, press: INSTRUMENT STATE RECALL, then select the register number.

9. On the HP 8510, press: STIMULUS MENU SINGLE POINT, then STIMULUS CENTER.

10. Enter the frequencies listed below and note the corresponding power level.

Frequency ||

RF Power Level

(typically 21 dBm) ||

Frequency ||

RF Power Level

(typically 21 dBm) ||

40 GHz || || 55 Ghz || ||

45 GHz || || 60 GHz || ||

50 GHz || || 62.5 GHz || ||

11.

Disconnect the power sensor and W14/W16 to the power divider.

12. Return to the troubleshooting flowchart.

PROCEDURE 10: CHECK CONTINUITY OF IF CABLES

1. Refer to procedure 5 for instructions on checking the IF cables.

2. Return to the troubleshooting flowchart.

Figure 6-6.HP U85104A Block Diagram

6-19/6-20

DISASSEMBLY PROCEDURE

This section provides a disassembly procedure for the HP 85104A Option K10 test set. The procedure is divided into three sections:

1. A disassembly procedure for the main pieces of the instrument (ie. support hardware, cables).

2. A disassembly procedure for the two modules contained in the instrument.

3. A disassembly procedure to remove an entire module from the instrument (without disassembling the module).

The assembly procedure is the reverse of the disassembly procedure unless a separate assembly procedure in given, as with the modules. Refer to Figure 6-7 to determine which procedure you should start with.

Required Tools

The following tools are necessary to perform the disassembly procedures of the HP 85104A Option K10 test set.

Table 6-2. Required Tools

|| Tool

Size

HP Part Number

|| Torx-head screwdriver || T-10 || 8710-1623 ||

|| Torx-head screwdriver || T-8 || 8710-1644 ||

|| Hex-head balldriver || 3/32 || 8710-1539 ||

|| Pozidriv screwdriver || 1 pt || 8710-0899 ||

|| Wire cutter || N/A || 8710-0012 ||

|| Open-end wrench || 5/16 inch || 8720-0015 ||

|| Wrist strap || N/A || 9300-1383 ||

|| Conductive mat || N/A || 9300-0797 ||

Main Instrument Disassembly

1. Turn off power to the HP 85104A Option K10, disconnect it from the other instruments in the rack, and remove it from the rack to a table.

2. Remove the top cover and the side panels. The screws are located on the pieces at the rear of the instrument.

3. Remove the support bars (two screws on each end).

4. Remove the brackets from the couplers (two screws on each side).

The main instrument disassembly procedure is complete. Continue with either the module disassembly procedure or the module removal procedure. Reverse this procedure to replace the parts that have been removed.

Figure 6-7.Main Instrument Disassembly

Module Disassembly Procedure

This section provides one disassembly procedure that completely disassembles one module of the HP 85104A Option K10 test set. The two modules are identical. Follow the procedure in order, and stop at the level of disassembly needed for your repair.

Some of the microcircuits in the test set are extremely sensitive to electrostatic discharge (ESD). Ground your work station and yourself before you handle this instrument.

Procedure

The step numbers correspond to the numbers shown in Figure 6-8. Refer to this figure as you disassemble the port module.

1. Perform the “Main Instrument” disassembly procedure.

2. Disconnect the rear panel semi-rigid cables (RF and LO).

3. Disconnect the IF cabling (red/white and blue/white) from the mixers.

4. Disconnect the module interface connector from the A5 board, which is part of the A13 source block.

5. Disconnect the ALC cable (yellow/white) from the A5 board.

6. Remove the semi-rigid coaxial cables from the LO power divider to the mixers.

7. Remove 4 mixer bracket screws and remove the mixer bracket from both sides of the source block.

8. Disconnect the isolator-mixer assembly arms by removing the screws from the flange at the coupler interface.

9. Remove the mixer clamp.

10. Remove the screws from the LO power divider and remove the power divider.

11. Disconnect the main line isolator arm at the source interface by removing the 4 hex-head screws from the flange.

12. Remove the hex-head screws from the coupler bracket.

13. Slide the coupler/isolator assembly to the rear of the instrument and remove it.

14. Remove the torx-head screws from the coupler bracket and remove the bracket.

15. Remove the test port extension at the coupler interface.

16.

Turn the source block over and remove the baseplate.

This completes the disassembly procedure for the HP 85104A test set module. Refer to the assembly procedure to reassemble the test set module.

NOTE:The assembly procedure must be followed in sequence; it is not the reverse of the disassembly procedure.

Module Removal Procedure

NOTE:It is not necessary to remove the module from the instrument for troubleshooting or disassembly. This procedure is given as an option.

1. Complete the “Main Instrument” disassembly procedure.

2. Remove the interface cable connector (of the desired port) from the rear panel by removing the two screws on the connector.

3. Remove the six screws from the baseplate of the desired module.

4. Lift and slide the module toward the rear of the instrument to remove it. The waveguide test port slides through the front panel grommet.

The procedure to remove the module from the instrument is complete. Reverse this procedure to install the module into the instrument.

Figure 6-8.Module Disassembly Procedure

ASSEMBLY PROCEDURE

This section provides one assembly procedure that completely assembles one of the port modules in the HP 85104A Option K10 test set. Follow the procedure in order, starting at the step number needed for your repair.

NOTE:The assembly procedure must be followed in sequence; it is not the reverse of the disassembly procedure.

Table 6-3 Required Tools

|| Tool

Size

HP Part Number

|| Torx-head screwdriver || T-10 || 8710-1623 ||

|| Torx-head screwdriver || T-8 || 8710-1644 ||

|| Hex-head balldriver || 3/32 || 85104-20035 ||

|| Pozidriv screwdriver || 1pt || 8710-0899 ||

Waveguide Connections

To connect the precision flanges:

1. Install the captive screws in all four tapped holes in one of the flanges.

2. Bring the flanges together using the guide pins for alignment, then gradually tighten all four screws in an X pattern to the final torque.

Procedure

The step numbers correspond to the numbers in Figure 6-9. Refer to this figure as you assemble the module.

1. Attach the baseplate to the source block (A13) and put the source block inside the instrument. Use 6 screws to attach the baseplate to the deck.

NOTE:Do not tighten the screws from the baseplate to the deck at this time; the module's position may need adjusting later in the procedure.

2. Place the coupler bracket on the source block (A13) and attach it with torx-head screws.

3. Using the guide pins, align the flange of the coupler/isolator assembly with the flange of the source block. Hold the mating surfaces in contact while engaging the first few threads of each screw (use 4 long hex-head screws). Follow the standard flange connection technique above.

NOTE:You may have to hold the opposite end of the coupler higher in order to mate the surfaces of the isolator and source block.

4. Once a good connection has been made at the source/isolator interface, insert the hex-head coupler bracket screws.

5. Attach the test port extension to the coupler interface. Adjust the module so the test port flange is centered on the front panel.

6. Position the LO power divider on the source block with the input port towards the right side of the instrument, referenced from the front of the instrument.

7. Attach the bottom mount to the coupler using hex-head screws.

8. Install the test set interconnect cable assembly into the rear panel of the test set.

9. Attach the module interface connector to A5.

10. Attach the ALC cable (yellow/white) to A5.

11. Place a mixer clamp on each side of the housing across from the coupler bracket side mount.

12. Attach a mixer/isolator assembly to each mixer clamp by aligning the isolator flange with the coupler interface (use the guide pins). Follow the waveguide connection procedure above to connect the flanges.

13. Attach a mixer bracket to each mixer using 2 screws on the mixer clamp and 2 screws on the coupler bracket.

14. Attach the semi-rigid coaxial cables from the LO power divider to the mixers; W10 to the incident mixer, and W11 to the reflected mixer.

15. Attach the IF cables to the mixers (red/white to the incident mixer, blue/white to the reflected mixer).

16. Attach the semi-rigid RF and LO cables.

NOTE:It may be necessary to adjust the position of the module slightly to attach the semi-rigid cables.

17. Tighten the screws on the baseplate.

18. Reverse the "Main Instrument" disassembly procedure to complete this procedure.

The assembly procedure of the test set is complete. Perform the operator's check for the HP 85109 system located in the "System Installation" section of this manual. If the unit is working, a performance verification should be done to assure that the system is operating within its specifications. Refer to the "Specifications and Performance Verification" section of this manual for information.

Figure 6-9.Module Assembly Procedure

REPLACEABLE PARTS

This section contains information about ordering replaceable parts for the HP 85104A Option K10 test set. Figures 6-10 through 6-12 list the replaceable parts in reference designator order.

Ordering Information

To order a part listed in this section, quote the Hewlett-Packard part number, indicate the quanity required, and address your order to the nearest Hewlett-packard office.

Figure 6-10.HP U85104A Replaceable Parts — Mechanical (1 of 2)

185104-000111Rear Panel|| 28480 ||85104-00011

285104-000211Front Dress Panel|| 28480 ||85104-00021

385104-000141Bottom Deck|| 28480 ||85104-00014

485104-000152Top Bracket|| 28480 ||85104-00015

585104-000162Bracket|| 28480 ||85104-00016

685104-200264Stiffening Bar|| 28480 ||85104-20026

785104-200272Baseplate|| 28480 ||85104-20027

885104-200284Top Mount|| 28480 ||85104-20028

1085104-400022Front Panel Grommet|| 28480 ||85104-40002

1185104-200192Cable Clamp|| 28480 ||85104-20019

W1385104-200291RF Cable - Port 1|| 28480 ||85104-20029

W1485104-200301RF Cable - LO Port 1|| 28480 ||85104-20030

W1585104-200311RF Cable - Port 2|| 28480 ||85104-20031

W1685104-200321RF Cable - LO Port 2|| 28480 ||85104-20032

W1785104-600322Interconnect Cable Assembly|| 28480 ||85104-60032

Figure 6-10.HP 85104A Option K09 Replaceable Parts — Mechanical (2 of 2)

Figure 6-11.HP U85104A Replaceable Parts — Module (1 of 2)

485104-000162Coupler Bracket|| 28480 ||85104-00016

685104-200204Mixer Clamp|| 28480 ||85104-20020

785104-000084Mixer Bracket|| 28480 ||85104-00008

1085104-400022Front Panel Grommet|| 28480 ||85104-40002

A60955-02642Power Divider|| 28480 ||0955-0264

A785104-600392Isolator|| 28480 ||85104-60039

A885104-600182Dual Directional Coupler|| 28480 ||85104-60018

A985104-600202Incident Isolator|| 28480 ||85104-60020

A1085104-600202Reflected Isolator|| 28480 ||85104-60020

A1111643-600292Incident Mixer|| 28480 ||11643-60029

A1211643-600292Reflected Mixer|| 28480 ||11643-60029

A1385104-600122U-band Source Module Assy|| 28480 ||85104-60012

E11250-11582ADPT F SMA F SMA|| 28480 ||1250-1158

W1085104-200082Incident LO Input Cable|| 28480 ||85104-20008

W1185104-200092Reflected LO Input Cable|| 28480 ||85104-20009

NOT SHOWN

5062-40721Rack Mount Kit|| 28480 ||5062-4072

8120-43964RF Cable, 18 inch|| 28480 ||8120-4396

08510-601022Interconnect Cable|| 28480 ||08510-60102

HARDWARE

0515-037310SMM 3.0 10 PN TX|| 28480 ||0515-0373

0515-20072SMM 2.5 16 PN TX|| 28480 ||0515-2007

2200-01552SM 440 1.000 PNPD|| 28480 ||2200-0155

2360-01158SM 632 .312 PNPD|| 28480 ||2360-0115

3030-022123SS 440 .375|| 28480 ||3030-0221

2190-003027WSHR LK .115ID 4|| 28480 ||2190-0030

2260-00091Nut-hex 4-40|| 28480 ||2260-0009

3050-010527WSHR FL .125ID 4|| 28480 ||3050-0105

MISCELLANEOUS

11644-600332Wavegd Straight, 10 cm|| 28480 ||11644-60033

8710-15391Ball Driver|| 28480 ||8710-1539

PARTS NEEDED BUT NOT SUPPLIED

8710-08991Pozi Screwdriver, 1|| 28480 ||8710-0899

8710-16231Torx Screwdriver, 10|| 28480 ||8710-1623

8710-16441Torx Screwdriver, 8|| 28480 ||8710-1644

8720-00151Open-end Wrench 5/16|| 28480 ||8710-0015

9300-13831Wrist Strap|| 28480 ||9300-1383

9300-07971Conductive Mat|| 28480 ||9300-0797

Figure 6-11.HP U85104A Replaceable Parts — Module (2 of 2)

Figure 6-12.HP 85104A Replaceable Parts — Chassis (1 of 2)

15021-58061Rear Frame|| 28480 ||5021-5806

25021-58371Corner Strut|| 28480 ||5021-5837

35021-84051Front Frame|| 28480 ||5021-8405

45021-84972Trim Front Handle|| 28480 ||5021-8497

55041-88014Foot|| 28480 ||5041-8801

65041-88021Trim Strip|| 28480 ||5041-8802

75041-88214Standoff Rear Panel|| 28480 ||5041-8821

85062-37351Top Cover|| 28480 ||5062-3735

95062-37471Bottom Cover|| 28480 ||5062-3747

105062-37622Side Cover|| 28480 ||5062-3762

115062-38002Handle Assembly|| 28480 ||5062-3800

Figure 6-12.HP 85104A Replaceable Parts — Chassis (2 of 2)

Contents

1

Section 7.HP 85105A Option 054 Operation and Service

INTRODUCTION

The information in this section documents the operation, troubleshooting techniques and replaceable parts for the HP 85105A Option 054 millimeter-wave controller.

Option 054 provides for rear panel output of the port 1 and 2 RF, LO, and Module Interface connectors as well as a 50 Ghz coaxial switch. These connectors are deleted on the front panel.

DESCRIPTION OF THE INSTRUMENT

The HP 85105A Option 054 millimeter-wave (mm-wave) controller (Figure 7-1) is designed to be used in conjunction with an HP 8510, an HP U85104A option K10 test set, and a coaxial test set. The HP 85105A provides an amplified LO signal to each of the mm-wave modules to drive the harmonic mixers. An amplified RF signal (up to 21 GHz) is applied to the active test set, either port 1 or port 2 for S-parameter measurements. The incident and reflected IF signals from the test sets are returned to the HP 85105A, amplified and then output to the analyzer to be processed and displayed. A leveling signal is passed from the test set through the controller to the RF source to provide leveled power. When the coaxial test set is selected by the HP 8510 software, the HP 85105A switches the RF (up to 50 GHz) to the test set and routes the IF from the test set to the analyzer. No re-connections are required when switching between millimeter-wave and microwave operation. The HP 85105A is equipped with the IF and RF switching capability for routing these signals to either the millimeter-wave or microwave test set.

Figure 7-1.HP 85105A Option 054 Simplified Block Diagram

Accessories

Accessories supplied with the HP 85105A, including part numbers, are listed in the Replaceable Parts list.

WARRANTY INFORMATION

Warranty information for the HP 85105A may be found immediately following the title page of this manual.

SAFETY

The voltages in this instrument warrant normal caution for operator safety. Service should be performed only by qualified personnel. Before removing the instrument covers to troubleshoot problems or replace assemblies, refer to the HP 8510 Service Manual "Service Overview" section for information on hazardous voltage locations and general safety cautions.

INSTRUMENT OPERATION

The following information illustrates the features and functions of the HP 85105A Option 054 millimeter-wave controller. The use of multiple coaxial test sets is also described.

Information on cabling the HP 85105A Option 054 millimeter-wave controller as part of an HP 85109 system may be found in the "System Installation" section of this manual. The switching functions of the controller are performed by the HP 8510 operating system and may be accessed through the front panel pushbuttons on the HP 8510 analyzer. For additional information on operation refer to the section of this manual titled "Operation."

FRONT PANEL FEATURES

Figure 7-2.Front Panel Features of the HP 85105A

1. Line Switch. This switch turns the instrument on and off. When the side of the switch labeled O is depressed, the instrument is off; when the other side is depressed the line power is on.

2. Line LED. This LED goes on and off with the instrument line switch to indicate the status of line voltage applied to the instrument.

3. Active LED. This LED is lit when the mm-wave test set is selected by the analyzer.

4. a1 LED. This LED indicates that port 1 is selected and the RF source is switched to port 1. This LED lights for about 2 seconds and then goes off when power is first turned on.

5. a2 LED. This LED indicates that port 2 is selected and the RF source is switched to port 2. This LED lights for about 2 seconds and then goes off when power is first turned on.

REAR PANEL FEATURES

Figure 7-3.Rear Panel Features of the HP 85105A Option 0541.

Line Module. This assembly houses the line cord connector, line fuse and line voltage selector. Pull out the top side of the line module cover to replace or change the fuse or to change the voltage selection. Note that the voltage selector drum must be removed to rotate it to a different voltage setting. Recommended fuse values are printed on the rear panel.

2. .5 V/GHz. This input to the instrument comes from the RF source. A voltage level of one half volt is input to this connector for every GHz of RF source frequency. Pin number 14 of the module interface on the front panel of the HP 85105A carries this voltage to the test set modules.

3. LO Input. This input to the instrument comes from the LO source. The signal is split and amplified then output to the front panel of the HP 85105A.

4. ALC Output. This dc level is input to the RF source. The ALC signal is either generated by the highband test set or the HP 85105A. If a test set is used, the ALC signal generated by the test set is input to the HP 85105A via the front panel module interface. If a highband test set is not sensed by the HP 85105A, the internal ALC signal generated on the RF Leveling Amplifier Assembly is routed to this connector.

5. RF Input. This input to the instrument comes from the RF source. The signal is input to a switch. When the highband test set is selected by the HP 8510 the RF is amplified and then input to another switch that directs the RF to either port 1 or port 2. When the coaxial test set is selected by the HP 8510 the RF is switched to the connector labeled "RF Output" on the rear panel of the HP 85105A. Both connectors are 2.4 mm (f) to allow operation to 50 GHz.

6. RF Output. The RF exiting this connector was routed from the RF source to the coaxial test set by the HP 85105A. See the description for RF input. This connector is 2.4 mm (f).

7. J10 Test Set Interconnect. Should be connected to J11 of the coaxial test set. This connector transmits the IF signals from the test set to the HP 85105A.

8. J11 Test Set Interconnect. Should be connected to the J1 Test Set Interconnect on the HP 85102 IF detector. This connector transmits the IF signals from the HP 85105A to the HP 85102 IF Detector. It also transmits control signals.

9. HP 8510 System Bus Address Switch. This five-pole binary-weighted switch sets the system bus address of the instrument. The binary weight of each pole is indicated on the rear panel as are the on and off positions. Decimal twenty one binary 10101 (on, off, on, off, on) is the default setting.

10. J12 HP 8510 System Bus Connector. This connector is used for system HP-IB communications with the HP 85101 display/processor.

11. Test Set Mode Toggle Switch. Set to R/T for Reflection/Transmission test set mode, or to S-P for full S-Parameter test set mode. Usually this switch is in the S-P position. The R/T position is used primarily with HP 11643A series test set kits in a reflection/transmission test set up.

The features for port 1 and port 2 are identical. The following descriptions apply equally to both ports.

12. RF Output. When the port is selected by the analyzer, an amplified RF source signal is available to a highband test set.

13. LO Output. An amplified LO signal is always available to a highband test set.

14. Module Interface. The highband test set plugs into this interface. This interface supplies dc voltages and ground highband lines to the test set and returns incident and reflected IF signals and an ALC signal to the analyzer and RF source respectively.

MODULE INTERFACE

The module interface connectors for port 1 and port 2 of the HP 85105A are identical. The following information may be used for troubleshooting purposes or for constructing a system without using the HP 85104A test set.

Figure 7-4.Module Interface Connections

COAXIAL WIRES

Jack A2 IF InputThis is the incident IF signal input connection. a1 for port 1 and a2 for port 2.

Jack A4 ALC InputThe ALC signal input connection from the HP 85104A test set.

Jack A7 IF InputThis is the reflected IF signal input connection. b1 for port 1 and b2 for port 2.

PIN CONNECTIONS

Pin Number 1 and 2These two pins are used for analog and dc supply ground lines.

Pin Number 4This pin is a +15.0 Vdc supply.

Pin Number 6 and 7These two pins are both +8.0 Vdc supplies.

Pin Number 9This pin is a +5.0 Vdc supply.

Pin Number 11This pin is a −15.0 Vdc supply.

Pin Number 13This is the Module Sense line. When a highband test set is connected to the module interface of the HP 85105A a +5.0 Vdc level is input to this pin. The result is that the ALC from the test set is routed through the HP 85105A to the RF source. If the +5.0 Vdc is missing from this pin, the internal ALC of the HP 85105A is routed to the RF source.

Pin Number 14This is the +0.5 Vdc/GHz line. See the description of the .5 V/GHz feature described in “Rear Panel Features.”

Pin Number 16 and 17These two lines are digital ground.

The remaining pins and jacks on this connector are not used.

CONTROLLING MULTIPLE TEST SETS

Because the HP 85105A option 054 has multiple test set switching (option 001) as standard, it can control one HP U85104A option K10 S-parameter test set and one coaxial test set without the need for external switches or instruments. Should it be necessary to control more than one coaxial test set, option 001 must be installed in each test set (except for the last one in the chain) and the following procedures may be used.

Option 001 for the HP 851X series test sets allows an HP 8510 to alternately control up to a total of four coaxial test sets (Figure 7-5). The HP 85105A must be the first test set. While a measurement is proceeding on test set number 1, which is equipped with option 001, test device hookup can be accomplished on test set number 2, which does not need to be equipped with option 001, unless another test set is to be connected. When the measurement on test set number 1 is complete, then the HP 8510 can control test set number 2.

In a standard test set, the 20 MHz IF and control signals are applied directly to J11 TEST SET INTERCONNECT, which connects to the HP 8510. Option 001 adds a set of IF switches, control switches, and the J10 TEST SET INTERCONNECT connector. This allows the selection of 20 MHz test set IF signals. As shown in Figure 7-5, test set number 1 can apply its IF to the HP 8510 or it can switch to pass the IF from test set number 2 through the J10 TEST SET INTERCONNECT to the HP 8510.

INSTALLATION

Set each test set rear panel address switch to the address listed in Figure 7-5, if configuring three or four test sets. Use the supplied test set interconnect cable to connect test set number 1, J11 to the HP 8510. Use the supplied test set interconnect cable to connect test set number 2, J11 to test set number 1, J10. You may continue this test set "daisy chain" to include up to four test sets if the total length of all test set interconnect cables does not exceed 13 meters (about 40 feet). The last test set in the chain does not require option 001.

If the RF coaxial switches are not incorporated into the system, then the RF input to the test set must be manually switched to the active test set.

OPERATION

Initialization at Power-up

Upon power-up, the IF switches must be configured so that only one system test set is active. The following procedure shows how to make one test set active.

1. Check the active lights of all system test sets.

2. Check the HP 8510's expected test set address by pressing LOCAL TEST SET. This should match the address of the desired test set. If not, change the address. See Figure 7-5 for recommended test set addresses.

3. If unselected test sets are active, (active light ON), deactivate the test set by temporarily addressing it. Then return to the desired address.

NOTE:

1. || Contact the factory for information on 50 GHz switches. ||

2. || Not all system connections are shown. ||

3. || In dual source configurations, the second can be multiplexed in a similar manner. If only one dual source test set is used, the second source can be directly connected to the appropriate test set. ||

4. || The HP 85105A must be the first test set in line and the HP 8517A test set must be second. ||

Coaxial Switch Positions with four test sets.

New ADDRESS of

TEST SET ||

Test Set

Selected ||

Coaxial Switch Port Selected

||

Switch #1 ||

Switch #2 ||

21 || 1 || Port 1 || Port 1 ||

20 || 2 || Port 1 || Port 2 ||

22 || 3 || Port 2 || Port 1 ||

23 || 4 || Port 2 || Port 2 ||

Figure 7-5.RF and IF Switching with Four Test Sets

Selecting a Test Set

Test Set IF SwitchingThe active test set is selected by the built-in capability of the HP 8510 to generate an addressed command to the test set. Each time the HP 8510 ADDRESS of TEST SET function is changed (see the HP 8510 LOCAL menu), the HP 8510 switches the previously addressed test set IF to external and the newly addressed test set IF to internal. The test set front panel active indicator shows the test set status. When the test set is active the IF signals from the test set are applied directly to J11 TEST SET INTERCONNECT. When the test set is inactive the IF signals appearing at J10 are passed through to J11 and on to the next test set or the HP 8510.

The address of the test set can be changed manually from the HP 8510 front panel by selecting the ADDRESS of TEST SET function then entering the address of the test set and pressing x1, or it can be changed under program control using the HP 8510 HP-IB ADDRESS; command. The HP-IB address of a particular test set is set by address switches on the test set rear panel.

RF Switch Driver CommandsA related feature of the HP 8510 is that when the HP 8510 ADDRESS of TEST SET function is changed, a code sequence is automatically issued over the HP 8510 system bus to the device at the ADDRESS of RF SWITCH. In the recommended configuration, this device is an HP 11713A attenuator/switch driver which in turn controls

one or more HP 33311C coaxial switches. As shown in Figure 7-5, these switches are used to select which of the test sets receive the RF output of the network analyzer source. The exact command issued depends upon the new value of the ADDRESS of TEST SET function, also shown in Figure 7-5.

Measurement Calibration

After selecting the active test set, perform the system calibration procedure as usual. When selecting a different test set, make sure that you recall the Cal Set that applies to that test set.

Since the Cal Set Limited Instrument State does not include the number of the active test set, a Cal Set which does not apply to the current test set can be turned on without any HP 8510 caution messages appearing. This will cause errors in the displayed data because incorrect error coefficients are applied to the measured data.

Operational Checks

To check the operation of a multiple test set configuration, first connect a device with a known response at test set number 2, then press HP 8510 LOCAL TEST SET ADDRESS of TEST SET, enter the address of test set number 2 (this would be 20), then press x1. The test set number 2 measurement should appear. Press DISPLAY DATA MEMORY DISPLAY:DATA and MEMORY to store the trace for comparison later. Use ADDRESS of TEST SET to select test set number 3, then switch back to test set number 2. Observe any difference in the response between the stored trace and the result after switching back and forth between the test sets. Any difference in the data believed due to the option 001 IF switch or RF switching must be investigated.

Performance Verification

Standard system performance verification procedures are used to verify the operation of the option 001 test set as test set number 1. To verify the performance of another test set in the chain, select it as the active test set and proceed as usual.

SPECIFICATIONS

Specifications describe the warranted performance of the instrument. The electrical specifications of the HP 85105A millimeter-wave controller when used in a HP 85106 or 85109 system are defined in the “Performance Verification” section of this manual.

SUPPLEMENTAL CHARACTERISTICS

The supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.

HP 85105A Supplemental Characteristics

Test Ports

RF and LO Connector Type: || precision 3.5 mm male ||

Connector torque: || 90 N-cm (8 in.-lb) ||

Nominal operating power level: ||

OPERATING LEVEL || PORT1 || PORT2 ||

RF 8 to 20 GHz || >+17 dBm || >+17 dBm (>+16 dBm 20 to 21 GHz) ||

LO 2 to 8 GHz || >+20 dBm || >+20 dBm ||

NOTE:The RF level can be adjusted more than 10 dB down from nominal by use of the Source 1 power level menu on the HP 8510.

Other Connectors

RF IN/OUT Connector type: precision 2.4 mm female

LO Connector type: precision 3.5 mm female

Connector torque:

Precision 3.5 mm, 90 N-cm (8 in.-lb)

SMA, 56 N-cm (5 in.-lb)

RF Source power level:

Damage input level:>+13 dBm

Maximum input level:+5 dBm

Minimum input level:−2 dBm

LO Source power level:

Damage input level:>+13 dBm

Maximum input level:+3 dBm (+2 dBm recommended)

Minimum input level:0 dBm

HP 85105A Power Requirements and Physical Characteristics

Operating Temperature: ||

0°C to 55°C ||

Power: ||

110,120,220 or 240 ±10% Vac

48 to 66 Hz line frequency

270 VA maximum ||

Dimensions: ||

460 mm X 133 mm X 609 mm (18.1 X 5.25 X 24.0 inches) ||

Weight: ||

15 Kg, 35 lbs ||

TROUBLESHOOTING

The troubleshooting strategy for the HP 85105A is systematic. This information is used after system level troubleshooting has pinpointed the HP 85105A as the problem instrument. Use the following flowchart (Figure 7-6) to identify the faulty assembly. The flowchart is keyed to numbered, individual troubleshooting procedures. As you progress through the flowchart, perform the numbered procedure associated with each block. A block diagram is provided at the end of this section to assist in understanding the operation of the mm-wave controller.

THEORY OF OPERATION

The millimeter-wave controller, when used in conjunction with the HP U85104 test set provides all of the features and functions of a full S-parameter test set. Refer to the block diagram while reading the following description.

An LO signal is input to the rear panel of the mm-wave controller, divided and input to two identical 2-8 GHz leveling amplifier assemblies. The leveled LO signal is then output to ports 1 and 2 of the mm-wave controller. An RF signal is input to the rear panel of the mm-wave controller and then fed to a coax switch. If the mm-wave controller is the test set selected by the HP 8510, the RF will be routed through the coax switch to the RF leveling amplifier assembly and to a PIN switch where the RF will be routed to either port 1 or 2, whichever is active. If a coaxial test set is selected by the HP 8510, the RF is routed from the coax switch and back out to the rear panel of the mm-wave controller. Incident and reflected IF signals are input to the mm-wave controller from the highband test set via the module interface of the mm-wave controller. These signals are amplified and output to the analyzer to be processed and displayed. If the coaxial test set is selected by the HP 8510, the IF from the test set is routed through connectors J10 and J11 on the rear panel of the mm-wave controller and then to the HP 8510. When a highband test set is connected to the module interface of the mm-wave controller, a +5 Vdc level is input to pin 13 of the module interface. The result is that the ALC from the highband test set is routed through the mm-wave controller to the RF source. If the +5 Vdc is missing from this pin, the internal ALC of the mm-wave controller is routed from the RF leveling amplifier assembly to the RF source.

STATIC PRECAUTIONS

The assemblies in these procedures are very sensitive to damage by static electricity. They may not continue to function if subjected to an electro-static discharge. Their reliability will be impaired.

EQUIPMENT NEEDED BUT NOT SUPPLIED

The following equipment is needed to troubleshoot your instrument. It is not supplied.

1 point pozidriv (HP Part No. 8710-0899)

2 point pozidriv (HP Part No. 8710-0900)

Service Adapter (HP Part No. 85105-60210)

3.5 mm precision f to f adapter (HP Part No. 1250-1749)

5/16 in. Torque Wrench (HP Part No. 8710-1655) || HP 436A Power Meter

HP 8485A Power Sensor

HP 8473C Negative Detector

HP 1740A Oscilloscope

HP 8493C 10 dB fixed attenuator ||

TROUBLESHOOTING SEQUENCE

The following is a flowchart of the troubleshooting sequence. Use it to determine the faulty assembly.

Figure 7-6.Troubleshooting Flowchart

7-13/7-14

TROUBLESHOOTING PROCEDURES

PROCEDURE 1.>>A15 PRIMARY REGULATOR> > A6 SECONDARY REGULATOR> > HP-IB ADDRESS SWITCHES> > FUSE LOCATIONS

Figure 7-7.Power Supply Fuses and Test Points

A15 Primary Regulator Board Assembly> > A6 Secondary Regulator Board Assembly

Use a digital voltmeter to check the voltages and an oscilloscope to check the ripple in Table 7-1.

Table 7-1.Power Supply Voltages

Nominal Voltage ||

Test Point ||

Voltage Range ||

Maximum Ripple

Peak to Peak ||

+14.85 Vdc || A15TP3 || +14.10 TO +15.60 || 2 mv ||

−14.85 Vdc || A15TP4 || −14.10 TO −15.60 || 2 mv ||

+9.20 Vdc || A6TP1 || +9.10 TO +9.30 || 2 mv ||

+8.00 Vdc || A15TP2 || +7.60 TO +8.40 || 2 mv ||

+5.05 Vdc || A15TP1 || +4.75 TO +5.25 || 2 mv ||

HP-IB Address Switch

Set the switch as indicated in Figure 7-8 (the dark side of the switch is depressed). The HP-IB address switch is on the instrument rear panel. It is easy to access but need not be changed unless the error message “SYSTEM BUS ADDRESS ERROR” is displayed on the HP 8510 screen. Decimal twenty one, binary 10101 (on, off, on, off, on) is the default setting.

Figure 7-8.Instrument HP-IB Switch Setting

FUSES

The locations of the six fuses used in the HP 85105A are illustrated in Figure 7-7. The values of these fuses and their part numbers may be found in replaceable parts.

Refer to Figure 7-9 for information on how to set the voltage selector cam and replace the line fuse.

Figure 7-9.Power Line Module

PROCEDURE 2.>SELF-TEST INDICATORS

Figure 7-10.Location of Self-Test IndicatorsThe ACTIVE LED should always remain off until the HP 85105A is accessed by the HP 8510. Each time the test set is turned on, the Port 1 and Port 2 LEDs will light for approximately 2 seconds during the self test, and then turn off. To determine what part of the self-test has failed, note which LEDs on the A4 board are lit (Figure 7-10), as shown below:

Table 7-2.Self-Test Failure Indications

Self-test Indication

A4 HP-IB LEDs

||

LSN ||

TLK ||

SRQ ||

REM ||

Time (after turn-on)

PWON || ON || ON || ON || ON || 0 to 0.5 sec ||

Fail ROM Test || OFF || ON || ON || ON || on briefly ||

Pass ROM Test || OFF || OFF || ON || ON || 0.5 to 2.0 sec ||

Fail RAM Test || OFF || OFF || OFF || ON ||

Pass RAM Test || OFF || OFF || OFF || OFF || after 2 sec ||

If the Self-test Fails to Run

If the portion of memory which contains the self-test programming is faulty, the self-test will not run properly. The following conditions indicate that the self-test ROMs are most probably faulty.

* all LEDs flash briefly and go off

* all LEDs flash briefly and stay on

* ACTIVE LED goes on too soon

PROCEDURE 3.>RF AND LO OUTPUT POWER at REAR PANEL PORTS

Figure 7-11.Rear Panel RF and LO Ports1.

Run the system software and select the highband softkey to make the millimeter-wave controller active.

2. Choose a power meter that covers the 4-21 GHz frequency range of interest (HP 436A Meter and HP 8485A sensor). Calibrate the power meter and attach a 3.5 mm 10 dB fixed attenuator (8493C) and a female-to-female adapter to the sensor.

3. Attach the power sensor to the LO output on both ports 1 and 2. Select SINGLE-POINT MODE from the STIMULUS menu, then using the RPG knob, slowly scan over the frequency band. The power out should be +22 ±2 dBm.

4. Attach the power sensor to the RF output of the active port, measure the power out then select the other port and measure its RF output power. Select SINGLE-POINT MODE from the STIMULUSmenu, then using the RPG knob, slowly scan over the frequency band. The RF power out should be >+17 dBm for both ports (>+16 dBm 20 to 21 GHz).

PROCEDURE 4.LO INPUT at REAR PANEL

Figure 7-12.Rear Panel LO Input1.

Run the system software and select the highband softkey to make the millimeter-wave controller active.

2. Choose a power meter that covers the 4-6 GHz frequency range of interest (HP 436A Meter and HP 8485A Sensor). Calibrate the power meter and attach a 3.5 mm (f to f) adapter to the sensor.

3. Disconnect the LO source cable from the back of the instrument and attach the power sensor to the LO cable. Select SINGLE-POINT MODE from the STIMULUS menu, then using the RPG knob, slowly scan over the frequency band. The power level should be 0 to +2 dBm.

PROCEDURE 5.LO INPUT to LEVELING AMPLIFIERS

Figure 7-13.LO Input to Leveling Amplifiers

1. Run the system software and select the highband softkey to make the millimeter-wave controller active.

2. Choose a power meter that covers the 4-6 GHz frequency range of interest (HP 436A Meter and HP 8485A Sensor). Calibrate the power meter and attach a 3.5 mm (f to f) adapter to the sensor.

3. Loosen the end of the coaxial cable attached to the power divider and detach the coaxial cable from the leveling amplifier. Rotate the amplifier end of the coaxial cable so that it is easily accessible and then retighten the power divider end. When checking the input to the port 1 leveling amplifier it will be necessary to remove the coaxial cable connecting the RF leveling amplifier to the coax switch, rotate the cable for better access and then reconnect at the coax switch. Attach the power sensor to the cable. Select SINGLE-POINT MODE from the STIMULUS menu, then using the RPG knob, slowly scan over the frequency band. The power level should be -3 to $+0$ dBm.

PROCEDURE 6.LO ALC ADJUSTMENT

Figure 7-14.LO ALC Adjustment Points

1. Run the system software and select the highband softkey to make the millimeter-wave controller active.

2. Check the user parameter (a1 or a2) for the LO port in question. The trace should be -15 ± 2 dBm across the band as displayed on the HP 8510 CRT. If this is the case the LO ALC is adjusted properly. If the message "NO IF FOUND" is displayed and/or a trace is not observed at the level mentioned, the LO ALC adjustment needs to be made, continue with step 3.

NOTE:Step 3 should only be performed when an amplifier, coupler, or detector has been replaced.

3. Connect the oscilloscope and negative detector as shown in Figure 7-14. Turn the gain adjustment fully clockwise. Oscillations should be visible on the oscilloscope. Turn the gain adjustment counter clockwise until the oscillations just disappear. Recheck the user parameters in step 2 and then continue with step 4.

4. Choose a power meter that covers the 4-6 GHz frequency range of interest (HP 436A Meter and HP 8485A Sensor). Calibrate the power meter and attach a 3.5 mm 10 dB fixed attenuator (8493C) and an adapter (f to f) to the sensor. Connect the sensor/attenuator to the LO output of the port in question. Turn the LO level adjustment so that +12 dBm is displayed on the power meter. The LO output is now set at +22 dBm. Select SINGLE-POINT MODE from the STIMULUS menu, then using the RPG knob, slowly scan over the frequency band.

Adjust the LEVEL pot over the full adjustment range to make sure there are no oscillations at any power level. Then turn the GAIN pot three additional turns.

PROCEDURE 7.RF AMPLIFIER OUTPUT

Figure 7-15.RF Amplifier Output

1. Run the system software and select the highband softkey to make the millimeter-wave controller active.

Make sure the highband test set is not connected to the module interface connectors.

2. Choose a power meter that covers the 13-22 GHz frequency range of interest (HP 436A Meter and HP 8485A sensor). Calibrate the power meter and attach a 3.5 mm 10 dB fixed attenuator (8493C) and a female to female adapter to the sensor.

3. Loosen the end of the coax cable attached to the output of the RF leveling amplifier coupler and detach the other end of the coax cable from the pin switch. Rotate the cable and attach the power meter sensor. Tighten the cable end attached to the RF leveling amplifier. Select SINGLE-POINT MODE from the STIMULUS menu, then using the RPG knob, slowly scan over the frequency band. The power level should be $+22 \pm 2$ dBm.

PROCEDURE 8.RF INPUT at REAR PANEL

Figure 7-16.Rear Panel RF Input

1. Run the system software and select the highband softkey to make the millimeter-wave controller active.

2. Choose a power meter that covers the 13-21 GHz frequency range of interest (HP 436A Meter and HP 8485A Sensor). Calibrate the power meter and attach a 3.5 mm (f) to 2.4 mm (f) adapter to the sensor.

3. Disconnect the RF source cable from the back of the instrument and attach the power sensor to the cable. Select SINGLE-POINT MODE from the STIMULUS menu, then using the RPG knob, slowly scan over the frequency band. The power level should be greater than +13 dBm.

Because the RF source is externally leveled, when the RF path is broken to measure the signal level the source will output its maximum power of greater than 13 dBm.

PROCEDURE 9.A24 COAX SWITCH VOLTAGES

Lowband OperationThe coax switch (Figure 7-19) routes the source RF through the HP 85105A and to the optional coax test set when HP-IB test set address 20 is selected on the HP 8510. At that time the bias voltages on the coax switch are as shown in Figure 7-17.

Figure 7-17.Switch Bias Voltages, Lowband OperationHighband-wave OperationThe coax switch (Figure 7-19) routes the source RF to the RF leveling amplifier when HP-IB test set address 21 is selected on the HP 8510. At that time the bias voltages on the coax switch are as shown in Figure 7-18.

Figure 7-18.Switch Bias Voltages, Highband Operation

Figure 7-19.A24 Coax Switch Location

PROCEDURE 10.A5 ATTENUATOR SWITCH DRIVER BOARD

Figure 7-20.Attenuator Switch Driver Board 1.

Remove cables W21 and W22 from the A5 attenuator switch driver board.

2. Switch the instrument to port 1. When port 1 is active, the port 1 indicator light on the A5 board will be green and the port 2 indicator light will be amber. The voltage measured at A5J1 is +15 ±1.5 Vdc and the voltage measured at A5J2 is −15 ±1.5 Vdc.

3. Switch the instrument to port 2. When port 2 is active, the port 2 indicator light on the A5 board will be green and the port 1 indicator light will be amber. The voltage measured at A5J1 is −15 ±1.5 Vdc and the voltage measured at A5J2 is +15 ±1.5 Vdc.

PROCEDURE 11.IF PATH, a1,a2,b1,b2

Figure 7-21.IF Inputs1.

Run the system software and select the highband softkey to make the millimeter-wave controller active.

2. Connect a BNC cable to the 20 MHz Out on the rear panel of the HP 85102 and to the service adapter (85102-60210). Connect the service adapter to the port 1 module interface.

3. A 20 MHz signal is routed from the 85102 through the service adapter and injected into the a1 and b1 inputs of the module interface, Figure 7-21. Check the a1 and b1 user parameters for port 1. The traces should be a flat lines approximately −5 dB across the band as displayed on th HP 8510 CRT.

4. Repeat steps 2 and 3 for the user parameters a2 and b2 at the module interface at port 2.

PROCEDURE 12.A2 IF MULTIPLEXER

Figure 7-22.Multiplexer Inputs1.

Switch the system to lowband operation by choosing test set address 20 for the coaxial test set.

2. Connect a BNC cable to the 20 MHz Out on the rear panel of the HP 85102 and to the service adapter (85102-60210). Connect the service adapter to the J10 TEST SET INTERCONNECT on the rear panel of the HP 85105A. A 20 MHz signal is routed from the 85102 through the service adapter and injected into the a1, a2, b1 and b2 inputs of the J10 TEST SET INTERCONNECT.

3. Check the a1, a2, b1, and b2 user parameters. The traces should be a flat lines approximately −28 dB across the band as displayed on the HP 8510 CRT.

Figure 7-23.HP 85105A Power Supply Block Diagram

Figure 7-24.Block Diagram

REPLACEABLE PARTS

This section contains information for ordering replaceable parts. The replaceable parts include major assemblies and chassis hardware, but not parts of major assemblies. Table 7-3 lists major reference designations and abbreviations used in the parts lists.

R-E (REBUILT-EXCHANGE) ASSEMBLIES COST LESS

Some assemblies are available through the rebuilt-exchange program. These factory rebuilt (repaired and tested) assemblies meet all factory specifications required of a new assembly. They are offered on an exchange (trade-in) basis only. The defective assembly must be returned for credit. Figure 7-25 illustrates the procedure. The rest of the figures provide parts information. If you have any questions, contact your HP customer engineer.

REPLACEABLE PARTS LIST

The following figures assist in locating and identifying all replaceable parts, including corresponding lists that provide the following information:

1. Hewlett-Packard part number.

2. Part quantity as shown in the corresponding figure. There may or may not be more of the same part located elsewhere in the instrument.

3. Part description, using abbreviations in Table 7-3.

4. A typical manufacturer of the part in a five-digit code (refer to the Manufacturers Code list in Table 7-3).

5. The manufacturer's part number.

ORDERING INFORMATION

To order a part listed in the replaceable parts lists, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

To order a part that is not listed in the replaceable parts lists, include the instrument model number, complete instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

To Order Parts.... fast!

(800) 227-8164

Monday through Friday, 6 am to 5 pm (Pacific Standard Time)

The parts specialists have direct online access to replacement parts inventory corresponding to the replaceable parts list in this manual. There is a charge for hotline one day delivery, but four day delivery time is standard. After hours and holidays, call (415) 968-2347

This service applies to the United States only. Outside of the United States, contact your nearest HP office.

Table 7-3. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

AAssembly

CRDiode, Diode Thyristor,

Step Recovery Diode

(SCR), Varactor

DSAnnunciator, Lamp, Light

Emitting Diode (LED),

Signaling Device

FFuse || FLFilter

JElectrical Connector

(Stationary Portion), Jack

MPMiscellaneous

Mechanical Part

PElectrical Connector

(Movable Portion), Plug || QSilicon Controlled

Rectifier (SCR), Transistor,

Triode Thyristor

RResistor

SSwitch

TPTest Point

UIntegrated Circuit

WCable, Transmission

Path, Wire ||

ABBREVIATIONS

A

ADJAdjust, Adjustment

AMPAmplifier

ASSYAssembly

ATTNAttenuator

B

BDBoard

BNCType of Connector

C

CCapacitance, Capacitor

CBLCable

CHAMChamfer

CPUCentral Processing Unit

D

DDeep, Depletion, Depth, Diameter, Direct Current

DBDecibel, Double Break

DBLDouble

E

EXTExtended, Extension, External, Extinguish

F

FFahrenheit, Farad, Female, Film (Resistor), Fixed, Flange, Flint, Fluorine, Frequency

FLFlash, Flat, Fluid

FLTRFilter, Floater

G

GHZGigahertz ||

H

HDHand, Hard, Head, Heavy Duty

HEXHexadecimal, Hexagon, Hexagonal

I

IDIdentification, Inside Diameter

ININch, Indium

INTLInternal

K

KBKnob

L

LEDLight Emitting Diode

LGLength, Long

LKWRLockwasher

M

MACHMachine

MMMillimeter

MTLCMetallic

N

NEGNegative

O

ODOlive Drab, Outside Diameter

P

PAN-HDPan Head

PCPicocoulomb, Piece, Printed Circuit

PNLPanel

P/OPart of

PNPart Number ||

R

RRear

RFIRadio Frequency Interference

S

SAMPSampler

SCRScrew, Scrub, Silicon Controlled Rectifier

SHFT Shaft

SHLDR Shoulder

SKT Skirt, Socket

SLDR Solder

SMB Subminiature, B Type

(Snap-On Connector)

SST Stainless Steel

T

THD Thread, Threaded

THK Thick

V

VDC Volts, Direct Current

W

W Watt, Wattage, White, Wide, Width, Wire

X

XSTR Transistor

Y

YIG Yttrium-iron-garnet

Z

ZN-P Zinc Plate ||

Table 7-4.Manufacturer's Code List

Mfr. Code

Manufacturer Name

Address

Zip Code

00000 || Any Satisfactory Supplier ||

28480 || Hewlett-Packard Company Corp. Hq. || Palo Alto || CA || 94304 ||

55787 || Gas Spring Corp. || Montgomeryville || PA || 18936 ||

71400 || Cooper Industries Inc. || Houston || TX || 77210 ||

Table 7-5.Touch-up Paint

Color ||

Part Number

Applicable Use

Dove Grey || 6010-1146 || The frame around the front panel and painted portions of front handles. ||

French Grey || 6010-1147 || The side, top and bottom covers. ||

Parchment Grey || 6010-1148 || The rack mount flanges, rack support shelves and front panels. ||

Table 7-6.Power Cable and Plug Part Numbers

Figure 7-25.The Low-cost Rebuilt-Exchange Procedure

A108513-600051 FRONT PANEL INTERFACE BOARD ASSEMBLY2848008513-60005

A2 || 08513-60004 || 1 || IF MULTIPLEXER BOARD ASSEMBLY || 28480 || 08513-60004

A2 || 08513-69004 || 1 || IF MULTIPLEXER BOARD ASSEMBLY %BF(R-E)%MF || 28480 || 08513-69004

A3 || 85105-60016 || 1 || VTO SUMMING AMPLIFIER BOARD ASSEMBLY || 28480 || 85105-60016

A3 || 85105-69016 || 1 || VTO SUMMING AMPLIFIER BOARD ASSEMBLY %BF(R-E)%MF || 28480 || 85105-69016

A4 || 85105-60014 || 1 || HP-IB BOARD ASSEMBLY || 28480 || 85105-60014

A5 || 85105-60003 || 1 || ATTENUATOR/SWITCH DRIVER BOARD ASSEMBLY || 28480 || 85105-60003

A6 || 85105-60006 || 1 || SECONDARY REGULATOR BOARD ASSEMBLY 9 Vdc || 28480 || 85105-60006

A7-10 || || || NOT ASSIGNED || ||

A11 || 85105-60011 || 1 || IF AMPLIFIER ASSEMBLY || 28480 || 85105-60011

A12-14 || || || NOT ASSIGNED || ||

A15 || 85105-60002 || 1 || PRIMARY REGULATOR BOARD ASSEMBLY +5, +8, $PM15 Vdc || 28480 || 85105-60002

A16-A17 || 85105-60008 || 1 || LO LEVELING AMPLIFIER ASSEMBLY, PORT 1%BF %MFAND 2 || 28480 || 85105-60008

A18 || 85105-60009 || 1 || RF LEVELING AMPLIFIER ASSEMBLY || 28480 || 85105-60009

A19 || 85105-60012 || 1 || PIN SWITCH, 21 GHz || 28480 || 85105-60012

A20 || 08513-60006 || 1 || HP-IB INTERFACE BOARD ASSEMBLY || 28480 || 08513-60006

A21-23 || || || NOT ASSIGNED || ||

A24 || 85105-60018 || 1 || COAXIAL RF SWITCH || 28480 || 85105-60018

A25 || 0955-0264 || 1 || POWER DIVIDER 2-8 GHZ || 28480 || 0955-0264

B1 || 08513-20031 || 1 || FAN-TBAX 34-CFM 115V 50/60 HZ 1.5KVDIEL || 28480 || 08513-20031

T1 || 5181-0161 || 1 || POWER TRANSFORMER || 28480 || 5181-0161

T2 || 5181-0178 || 1 || POWER TRANSFORMER || 28480 || 5181-0178

Figure 7-26.Major Assemblies

W4885105-200501 SEMI-RIGID RF CABLE A19J1 TO A18 COUPLER2848085105-20050

W49 || 85105-20033 || 1 || SEMI-RIGID RF CABLE A25 TO REAR PNL LO INPUT || 28480 || 85105-20033

W51 || 85105-20035 || 1 || SEMI-RIGID RF CABLE A24 TO REAR PNL RF OUTPUT || 28480 || 85105-20035

W53 || 85105-20037 || 1 || SEMI-RIGID RF CABLE A25 TO A16 MOD AMP || 28480 || 85105-20037

W54 || 85105-20038 || 1 || SEMI-RIGID RF CABLE A25 TO A17 MOD AMP || 28480 || 85105-20038

W73 || 85105-60045 || 1 || SEMI-RIGID RF CABLE A16 COUPLER TO REAR PNL J2 || 28480 || 85105-60045

W72 || 85105-60046 || 1 || SEMI-RIGID RF CABLE A17 COUPLER TO REAR PNL J4 || 28480 || 85105-60046

W70 || 85105-60047 || 1 || SEMI-RIGID RF CABLE A19 TO REAR PNL J1 || 28480 || 85105-60047

W71 || 85105-60048 || 1 || SEMI-RIGID RF CABLE A19 TO REAR PNL J3 || 28480 || 85105-60048

W76 || 85105-20018 || 1 || SEMI-RIGID RF CABLE A24 TO REAR PANEL RF INPUT || 28480 || 85105-20018

W77 || 85105-20019 || 1 || SEMI-RIGID RF CABLE A24 TO REAR PANEL RF OUTPUT || 28480 || 85105-20019

W78 || 85105-20020 || 1 || SEMI-RIGID RF CABLE A24 TO A18 MOD AMP || 28480 || 85105-20020

Figure 7-27.Semi-rigid RF Cables

Figure 7-28.Flexible RF Cables (1 of 2)

W185105-601111FLEXIBLE RF CABLE A2J1 TO A11A12848085105-60111

W2 || 85105-60111 || 1 || FLEXIBLE RF CABLE A2J4 TO A11B1 || 28480 || 85105-60111

W3 || 85105-60111 || 1 || FLEXIBLE RF CABLE A2J7 TO A11A2 || 28480 || 85105-60111

W4 || 85105-60111 || 1 || FLEXIBLE RF CABLE A2J10 TO A11B2 || 28480 || 85105-60111

W5 || 08513-60125 || 1 || FLEXIBLE RF CABLE A2J2 TO J11A1 || 28480 || 08513-60125

W6 || 08513-60126 || 1 || FLEXIBLE RF CABLE A2J8 TO J11A4 || 28480 || 08513-60126

W7 || 08513-60127 || 1 || FLEXIBLE RF CABLE A2J5 TO J11A2 || 28480 || 08513-60127

W8 || 08513-60128 || 1 || FLEXIBLE RF CABLE A2J11 TO J11A3 || 28480 || 08513-60128

W9 || 08513-60129 || 1 || FLEXIBLE RF CABLE A2J3 TO J10A1 || 28480 || 08513-60129

W10 || 08513-60130 || 1 || FLEXIBLE RF CABLE A2J9 TO J10A4 || 28480 || 08513-60130

W11 || 08513-60131 || 1 || FLEXIBLE RF CABLE A2J6 TO J10A2 || 28480 || 08513-60131

W12 || 08513-60132 || 1 || FLEXIBLE RF CABLE A2J12 TO J10A3 || 28480 || 08513-60132

W13 || || || NOT ASSIGNED || ||

W14 || 08513-60134 || 1 || FLEXIBLE RF CABLE A3J2 TO J11A7 || 28480 || 08513-60134

W15 || 08513-60135 || 1 || FLEXIBLE RF CABLE A3J3 TO J10A7 || 28480 || 08513-60135

W16 || 08513-60136 || 1 || FLEXIBLE RF CABLE A3J5 TO J11A5 || 28480 || 08513-60136

W17 || 08513-60137 || 1 || FLEXIBLE RF CABLE A3J6 TO J10A5 || 28480 || 08513-60137

W18 || 08513-60138 || 1 || FLEXIBLE RF CABLE A3J7 TO J11A6 || 28480 || 08513-60138

W19 || 08513-60139 || 1 || FLEXIBLE RF CABLE A3J8 TO J10A6 || 28480 || 08513-60139

W20 || || || NOT ASSIGNED || ||

W21 || 85105-60101 || 1 || FLEXIBLE RF CABLE A5J3 TO A19B2 || 28480 || 85105-60101

W22 || 85105-60102 || 1 || FLEXIBLE RF CABLE A5J1 TO A18 || 28480 || 85105-60102

W23 || 85105-60103 || 1 || FLEXIBLE RF CABLE A18J4 TO A19B1 || 28480 || 85105-60103

W24 || 85105-60104 || 1 || FLEXIBLE RF CABLE A18 TO J5A4 || 28480 || 85105-60104

W25 || 85105-60105 || 1 || FLEXIBLE RF CABLE A18 TO J6A4 || 28480 || 85105-60105

W66 || 85105-60125 || 1 || FLEXIBLE RF CABLE A11A1 TO J5A2 || 28480 || 85105-60125

W68 || 85105-60127 || 1 || FLEXIBLE RF CABLE A11B1 TO J5A6 || 28480 || 85105-60127

W67 || 85105-60126 || 1 || FLEXIBLE RF CABLE A11A2 TO J6A2 || 28480 || 85105-60126

W69 || 85105-60128 || 1 || FLEXIBLE RF CABLE A11B2 TO J6A6 || 28480 || 85105-60128

W30 || 85105-60121 || 1 || RIBBON CABLE A15 TO A18 || 28480 || 85105-60121

W31 || 85105-60110 || 1 || FLEXIBLE RF CABLE A18 TO REAR PNL ALC || 28480 || 85105-60110

W40 || 08513-60013 || 1 || RIBBON CABLE A1 TO A10 || 28480 || 08513-60013

W41 || 08513-60036 || 1 || RIBBON CABLE A4 TO A20 || 28480 || 08513-60036

W74 || 85105-60133 || 1 || FLEXIBLE RF CABLE A3J1 TO REAR PANEL TEST SET MODE SWITCH || 28480 || 85105-61033

W75 || 85105-61034 || 1 || FLEXIBLE RF CABLE A3J4 TO REAR PANEL TEST SET MODE SWITCH || 28480 || 85105-61034

Figure 7-28.Flexible RF and Ribbon Cables (2 of 2)

W3585105-601131CABLE ASSEMBLY A16 ALC TO BIAS BOARD2848085105-60113

W36 || 85105-60113 || 1 || CABLE ASSEMBLY A17 ALC TO BIAS BOARD || 28480 || 85105-60113

W63 || 85105-60122 || || CABLE ASSEMBLY A10J3 TO REAR PNL J5 & J6, A18 & REAR PNL .5V GHZ || 28480 || 85105-60122

W38 || 85105-60115 || 1 || CABLE ASSEMBLY A6 TO A18 AND A17 || 28480 || 85105-60115

W39 || 85105-60116 || 1 || CABLE ASSEMBLY A6 TO A16 AND A11 || 28480 || 85105-60116

W44 || 85105-60118 || 1 || CABLE ASSEMBLY A16 ALC BOARD TO A17 ALC BOARD || 28480 || 85105-60118

W45 || 08513-60014 || 1 || CABLE ASSEMBLY J10 AND J11 TO J7 MOTHERBOARD || 28480 || 08513-60014

W59 || 85102-60226 || 1 || CABLE ASSEMBLY LINE SWITCH || 28480 || 85102-60226

W60 || 85105-60119 || 1 || CABLE ASSEMBLY A18 ALC TO BIAS BOARD || 28480 || 85105-60119

W61 || 85105-60120 || 1 || CABLE ASSEMBLY J3 MOTHER BOARD TO A24 || 28480 || 85105-60120

W62 || || || NOT ASSIGNED || ||

Figure 7-29.Wire Harnesses

185105-000101FRONT PANEL DRESS2848085105-00010

2 || 85105-00002 || 1 || SUB PANEL || 28480 || 85105-00002

3 || 1990-0858 || 1 || LED-LAMP 25 MA MAX || 28480 || 1990-0858

1450-06151RETAINER LED284801450-0615

08340-400021LED MOUNT2848008340-40002

4 || 1510-0038 || 1 || BINDING POST ASSEMBLY || 28480 || 1510-0038

2190-00671LOCK WASHER .25 IN 284802190-0067

2950-00061HEX NUT DOUBLE CHAM 1/4-32284802950-0006

5 || 5021-8747 || 1 || FRONT BEZEL || 28480 || 5021-8747

W59SEE FIGURE 7-29

Figure 7-30.Front Panel Miscellaneous Parts

12510-02701MACHINE SCREW 8-32 3.25 IN284802510-0270

3050-01391FLAT WASHER MTLC NO.8284803050-0139

2190-00171LOCK WASHER NO.10284802190-0017

2950-00011HEX NUT DBL-CHAM 3/8-32284802950-0001

0380-00101ROUND SPACER .625-IN-LG284800380-0010

2 || 85105-00014 || 1 || REAR PANEL || 28480 || 85105-00014

3 || 3160-0309 || 1 || FINGER GUARD || 28480 || 3160-0309

4 || 0400-0002 || 1 || GROMMET-RND || 28480 || 0400-0002

0590-09261THREADED INSERT STANDOFF284800590-0926

2360-01231MACHINE SCREW 6-32284802360-0123

2420-00011HEX NUT 3-32284802420-0001

3050-02271FLAT WASHER NO.6284803050-0227

5 || 1251-7812 || 1 || CONNECTOR JACKSCREW || 28480 || 1251-7812

0590-06631HEX NUT 4/40284800590-0663

6 || 0380-0643 || 1 || STANDOFF HEX || 28480 || 0380-0643

7 || 5001-3907 || 1 || LINE MODULE RETAINER CLIPS || 28480 || 5001-3907

J1-4 || 5061-5316 || 1 || 3.5 MM CONNECTOR ASSEMBLY || 28480 || 5061-5316

2190-01041LOCK WASHER284802190-0104

2950-01321HEX NUT284802950-0132

J5-6 || 1251-2197 || 1 || 24 PIN CONNECTOR FEMALE || 28480 || 1251-2197

J7-9 || 08513-20016 || 1 || GOLD NOSE CONNECTOR || 28480 || 08513-20016

5061-53941PIN AND BEAD ASSEMBLY284805061-5394

08513-200171BULKHEAD CONNECTOR2848008513-20017

2190-01041LOCK WASHER 7/16284802190-0104

2950-01321HEX NUT 7/16284802950-0132

J13-14 || 1250-0083 || 1 || BNC CONNECTOR FEMALE 50 OHM || 28480 || 1250-0083

2190-00161LOCK WASHER 3/8 IN284802190-0016

2950-00011HEX NUT 3/8284802950-0001

FL1 || 9135-0217 || 1 || LINE MODULE-FILTERED || 28480 || 9135-0217

Figure 7-31.Rear Panel Miscellaneous Parts

REAR-RF INPUT CONNECTOR

HARDWARE STACK-UP _ TRANSFORMER

HARDWARE STACKUP FAN

HARDWARE STACK-UP REAR PANEL CABLE CONNECTORS

Figure 7-32.Detailed Views

A6F12110-00031FUSE 4A 250V284802110-0003

A15F1 || 2110-0003 || 1 || FUSE 4A 250V || 28480 || 2110-0003

A15F2 || 2110-0003 || 1 || FUSE 4A 250V || 28480 || 2110-0003

A15F3 || 2110-0043 || 1 || FUSE 2A 250V || 28480 || 2110-0043

A15F4 || 2110-0001 || 1 || FUSE 1A 250V || 28480 || 2110-0001

FL1F1 || 2110-0003 || 1 || FUSE 3A 250V MAIN LINE || 28480 || 2110-0003

Figure 7-33.Fuse Locations and Values

18120-13481POWER CORD U.S.A.284808120-1348

2 || 8120-3445 || 1 || HP-IB CABLE || 28480 || 8120-3445

3 || 08510-60106 || 1 || TEST SET INTERFACE CABLE || 28480 || 08510-60106

4 || 8120-1840 || 2 || BNC CABLES || 28480 || 8120-1840

5 || 85100-60002 || 1 || FLEX SOURCE CABLE 30 IN. || 28480 || 85100-60002

6 || 1250-1894 || 2 || ADAPTER MALE N TO MALE SMA || 28480 || 1250-1894

7 || 5062-4071 || 1 || RACK MOUNT KIT || 28480 || 5062-4071

8 || 8120-4396 || 4 || FLEXIBLE SOURCE CABLE 18“|| 28480 || 8120-4396”

9 || 08510-10033 || 1 || SPECIFICATION AND PERFORMANCE VERIFICATION SOFTWARE PROGRAM AND DATA DISK || 28480 || 08510-10033

10 || 1250-1159 || 1 || ADAPTER MALE SMA TO MALE SMA || 28480 || 1250-1159

11 || 85105-20053 || 1 || RF CABLE, SOURCE TO HP 85105A OPT. 054 || 28480 || 85105-20053

12 || 1250-2188 || 1 || ADAPTER, 2.4 MM (F) TO (F) || 28480 || 1250-2188

13 || 85105-20054 || 1 || SEMI-RIGID 2.4 MM CABLE HP 85105 TO COAX TEST SET || 28480 || 85105-20054

Figure 7-34.Accessories

15062-37351TOP COVER284805062-3735

2 || 08513-00041 || 1 || SIDE COVER PERF || 28480 || 08513-00041

3 || 5021-8403 || 1 || FRONT FRAME || 28480 || 5021-8403

4 || 5040-7201 || 1 || FRONT FOOT || 28480 || 5040-7201

5 || 5062-3747 || 1 || BOTTOM COVER || 28480 || 5062-3747

6 || 5062-3799 || 1 || HANDLE ASSEMBLY || 28480 || 5062-3799

7 || 5020-8896 || 1 || TRIM FRONT HANDLE || 28480 || 5020-8896

8 || 5040-7221 || 1 || REAR FOOT || 28480 || 5040-7221

9 || 5062-3757 || 1 || SIDE COVER || 28480 || 5062-3757

10 || 5021-5837 || 1 || 18“CORNER STRUT || 28480 || 5021-5837”

11 || 5021-5804 || 1 || REAR FRAME || 28480 || 5021-5804

12 || 5040-7202 || 1 || TRIM STRIP || 28480 || 5040-7202

Figure 7-35.Cabinet Parts

Contents

1

Section 8.Test Port Combiner

The test port combiner enables an HP 8510 system to provide a single RF connection to a device under test from 0.045 to 62.5 GHz. In the HP 85109 on-wafer system, for example, the test port combiner combines the RF test ports from the two test sets used in the system. Through its DC-to-50 GHz input, the combiner also provides a DC path for biasing on-wafer devices.

Figure 8-1.Test Port Combiner

Typical Performance Characteristics

The characteristics below are intended to provide information useful in applying the combiner by giving typical but non-warranted performance parameters. They are not specifications.

Port

Frequency

Range

(GHz) ||

Connector

Type

Port Match

Insertion Loss to Port 3

DC to

50 GHz ||

40 to

62.5 GHz || DC to

50 GHz ||

40 to

62.5 GHz ||

1 ||

DC to 50 Input || 2.4 mm (f) || 9.7 dB || _ || 3.5 dB || _ || ||

2 || 40 to 62.5 Input || 1.85 mm (f) || _ || 6.8 dB || _ || 5.5 dB ||

3 || DC to 62.5

Output || 1.85 mm (f) || 14.0 dB || 10.0 dB || _ || _ ||

Pin Depth1 (all three ports)1: || 0.0001 to 0.00022 inch

(0.0025 to 0.0056 mm) ||

Maximum Power: || 1W ||

DC Current Limit: || 2A ||

DC Voltage Limit ||

100V ||

DC Series Resistance of Bias Path: || Typically 1 ||

Size: || 2.5 cm x 3.0 cm x 1.3 cm ||

Weight: || 71g (2.5 oz) ||

Service

Return all test port combiners to Hewlett-Packard for service or replacement. The replacement part number is 85109-60002.

1. Hewlett-Packard 2.4 mm gauges are compatible with 1.85 mm connectors.

Contents

1

Appendix A.HP 85109 Hardware and Instrument States

INTRODUCTION

This section contains information on:

HP-IB addresses of all HP 85109 system instruments.

Hardware states specific to the HP 85109 system.

Instrument states specific to the HP 85109 system.

Multiple source operating frequencies for highband operation.

HP-IB Addresses

Table A-1 lists the HP-IB address of each instrument in the HP 85109 system.

Table A-1.HP 85109 System HP-IB Addresses

HP 8510

System Bus

HP-IB Addresses

During Lowband Operation

(45 MHz — 40 GHz)

During Highband Operation

(40 — 60 GHz)

Address of 8510 || 16

System bus || 17

Source #11 || 19 || Same ||

||

Source #22 || 18 ||

Test Set || 203 || 214 ||

Plotter || 5 ||

||

Printer || 1 ||

||

Disk Drive || 0 || Same ||

||

Pass-thru || 31 ||

||

RF switch || 31 ||

1. RF source.

2. LO source.

3. Address of coaxial test set (HP 8516A).

4. Address of millimeter-wave controller (HP 85105A).

Hardware States

Table A-2 lists the hardware states that are specific to the HP 85109 system.

Table A-2.Hardware States Specific to the HP 85109 System

System Parameter

During Lowband Operation

(45 MHz — 40 GHz) ||

During Highband Operation

(40 — 60 GHz)

System Phaselock || Int. || None1 ||

Mult. Source || Off || On ||

Leveling Source #1 || Int. || Ext. ||

Leveling Source #2 || Int. || Int. ||

1. System must be set to “external” if the source is an HP 8350B.

Instrument States

Table A-3 lists the instrument states that are specific to the HP 85109 system.

Table A-3.Instrument States Specific to the HP 85109 System

System Parameter

During Lowband Operation

(45 MHz — 40 GHz) ||

During Highband Operation

(40 — 60 GHz)

Unit

Power Source #1 || +10 || −20 || dBm ||

Power Source #2 || N/A || +3 || dBm ||

Z0 || 50 || 501 || Ohm ||

Delay || coaxial || coaxial || _ ||

1. Z0 set to one Ohm during Highband performance verification in WR-19 waveguide.

NOTE:Instrument states may be changed if the PRESET key on the HP 8510 is pressed.

Multiple Source Operating Frequencies

Table A-4 lists the multiple source operating frequencies of the HP 85109 system for highband operation.

Table A-4.Multiple Source Operating Frequencies for Highband Operation

||

Values

Frequency

Mult. ||

Offset Freq.

(GHz) || Start

(GHz) ||

Stop

(GHz) ||

Source #1 ||

1/3 || 0.000000000

Source #2 ||

1/10 || 0.020000000 || 40.0 || 60.0

Receiver:Constant Frequency = 0.020000000 GHz.

NOTE:The exact start and stop frequencies set by the source may be slightly different depending on the source model.