

Agilent Technologies
87050A Option K12
User's and Service Guide

Agilent Technologies 87050A Option K12

Multiport Test Set User's and Service Guide

Use this manual with these documents:

**Agilent 8720D User's Guide
Part Number 08720-90288**

**Agilent 8720D Service Guide
Part Number 08720-90292**

**Agilent Technologies Part Number: 87050-90102
Printed in USA November 2000**

Notices

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Agilent Technologies, Inc. as governed by United States and international copyright laws.

Restricted Rights Legend

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

Warranty

The material contained in this document is subject to change without notice. Agilent Technologies makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Agilent Technologies, Inc.
1212 Valley House Drive
Rohnert Park, CA 94928-4999, U.S.A.

© Copyright 2000 Agilent Technologies, Inc.

1. Agilent Technologies

87050A Option K12 Overview

Description	1-2
-------------------	-----

2. Installation and Calibration

Introduction	2-2
Checking the Shipment	2-3
Meeting Electrical and Environmental Requirements	2-4
Connecting and Turning On the Test Set	2-8
Setting the Test Set Address Switch	2-9
Performing the Operator's Check	2-10

3. Controlling the Test Set and Making Measurements

Introduction	3-2
Commands	3-3
Calibrating the Test System	3-10
Example Setup	3-10
Making Measurements	3-12
Example Program	3-14
Control	3-14
The Control Program	3-15

4. Front and Rear Panels

Introduction	4-2
Front Panel	4-3
Rear Panel	4-5

5. Specifications and Characteristics

Performance Specifications and Characteristics	5-2
Environmental Characteristics	5-3
General Conditions	5-3
Operating Environment	5-3
Non-Operating Storage Conditions	5-3
Physical Dimensions	5-4
Weight	5-4
Cabinet Dimensions	5-4

6. Service

Introduction	6-2
Performance Tests	6-3
Equipment Required	6-3
Insertion Loss	6-4
Return Loss	6-5
Isolation	6-7
Performance Test Record	6-8
Replaceable Parts	6-19
Troubleshooting	6-21
General Troubleshooting Notes	6-21
Troubleshooting Power Supply Problems	6-21
Troubleshooting the Front Panel Display Board	6-22
Troubleshooting the Controller and Switch Driver Boards	6-22
Theory of Operation	6-24
System Theory	6-24
A1 Power Supply Theory	6-24
A2 Front Panel Display Theory	6-24
A3 Controller Board (Mother Board) and Switch Driver Board (Daughter Board) Theory	6-24

7. Safety and Regulatory Information

Introduction	7-2
Agilent Technologies Sales and Service Offices	7-3
Safety Information	7-4
Regulatory Information	7-7

1

Agilent Technologies
87050A Option K12 Overview

Description

The Agilent Technologies 87050A Option K12 multiport test set is designed for use with Agilent Technologies 50 Ω network analyzers such as the 8720D.

The multiport test set provides the ability to make single connection, multiple measurements of multiport devices such as distribution amplifiers, taps, switches, and couplers. These devices may have up to twelve ports. Throughput is increased by reducing the number of device reconnects the operator must perform. Switching is performed with mechanical switches.

The test set can be controlled by using an external GPIB controller, or parallel control.

NOTE

The *87050A Option K12 User's and Service Guide* documents the use of the test set with an 8720D network analyzer only.

Introduction

This chapter guides you through the steps necessary to correctly and safely install the multiport test set. The steps are

1. checking the shipment
2. meeting electrical and environmental requirements
3. connecting and turning on the test set
4. setting the test set address switch
5. performing the operator's check

Checking the Shipment

After the test set has been unpacked, it is recommended that the original packaging materials are kept so they may be used if the instrument should need to be transported.

Check the items received against Table to make sure that you have received everything.

Inspect the test set and all accessories for any signs of damage that may have occurred during shipment. If your test set or any accessories appear to be damaged or missing, call your nearest Agilent Technologies sales or service office (refer to page 7-3 for the nearest office).

Table 2-1 **87050A Option K12 Accessories Supplied**

Description	Part Number	Quantity
Power Cord	See Figure 4-3 on page 4-7	1
Front Handle Kit	5063-9228	1
Rack Mount Kit	5063-9235	1
Parallel Cable	8120-6818	1
RF Cable SMA (f) to SMA (m)	87050-20345	2
RF Cable N (m) to SMA (m)	87050-20346	2
User's and Service Guide	87050-90102	1

Meeting Electrical and Environmental Requirements

1. The line power module on your test set is an autoranging input. It is designed to be used with an ac power source with a nominal voltage of either 115 V or 230 V.
2. Ensure that the available ac power source meets the following requirements:
 - 90 to 250 Vac
 - 48 to 66 Hz
 - 40 watts

CAUTION

This product has an autoranging line voltage input. Be sure the supply voltage is within the specified range. If the ac line voltage does not fall within these ranges, an autotransformer that provides third wire continuity to earth ground should be used.

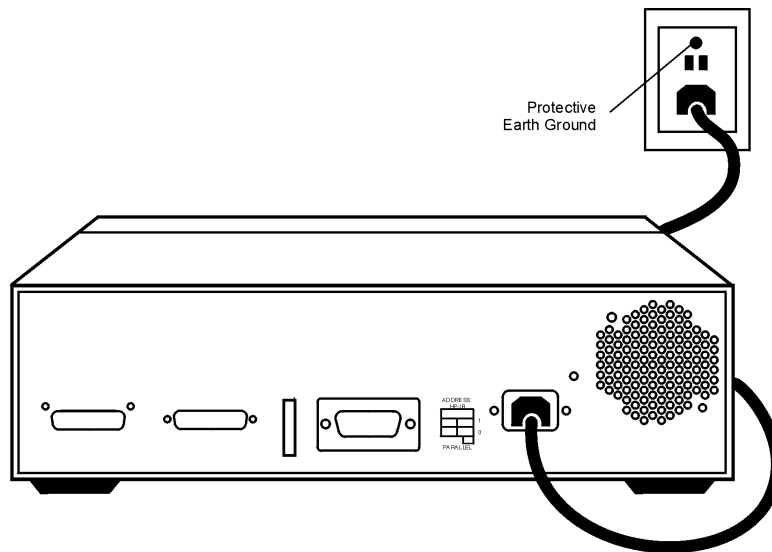
3. Ensure that the operating environment meets the following safety requirements for
 - indoor use
 - altitude up to 15,000 feet (4,572 meters)
 - temperature range of 0 °C to 55 °C
 - maximum relative humidity: 80% for temperatures up to 31 °C, decreasing linearly to 50% relative humidity
 - enclosure protection, IP 20, according to IEC 529

CAUTION

This product is designed for use in INSTALLATION CATEGORY II, and POLLUTION DEGREE 2, per IEC 101 and 664 respectively.

4. Verify that the power cable is not damaged, and that the power source outlet provides a protective earth ground contact. Note that the Figure 2-1 depicts only one type of power source outlet. Refer to Figure 4-3 on page 4-7 to see the different types of power cord plugs that can be used with your test set.

Figure 2-1 Protective Earth Ground

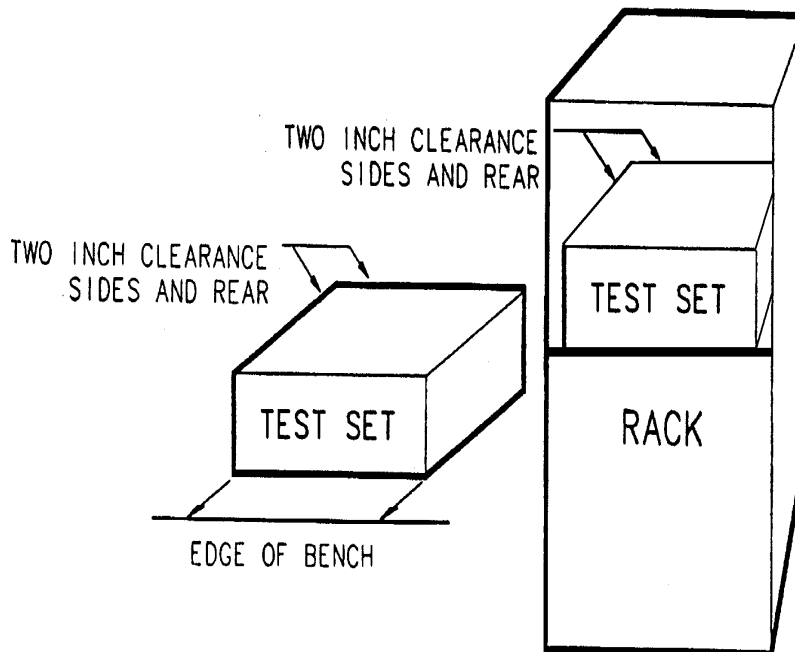


WARNING

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

5. If you are installing the test set into a cabinet, ensure there are at least two inches of clearance around the sides and back of the test set and the system cabinet. See Figure 2-2. The convection into and out of the test set must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the test set by 4 °C for every 100 watts dissipated in the cabinet.

Figure 2-2 Ventilation Clearance Requirements

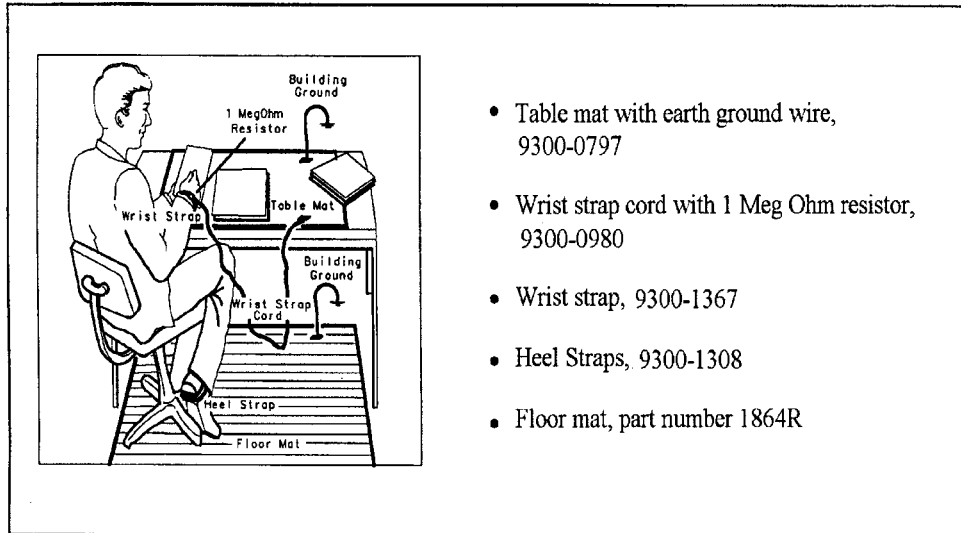


CAUTION

If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

6. Set up a static safe workstation. Electrostatic discharge (ESD) can damage or destroy components (refer to Figure 2-3).

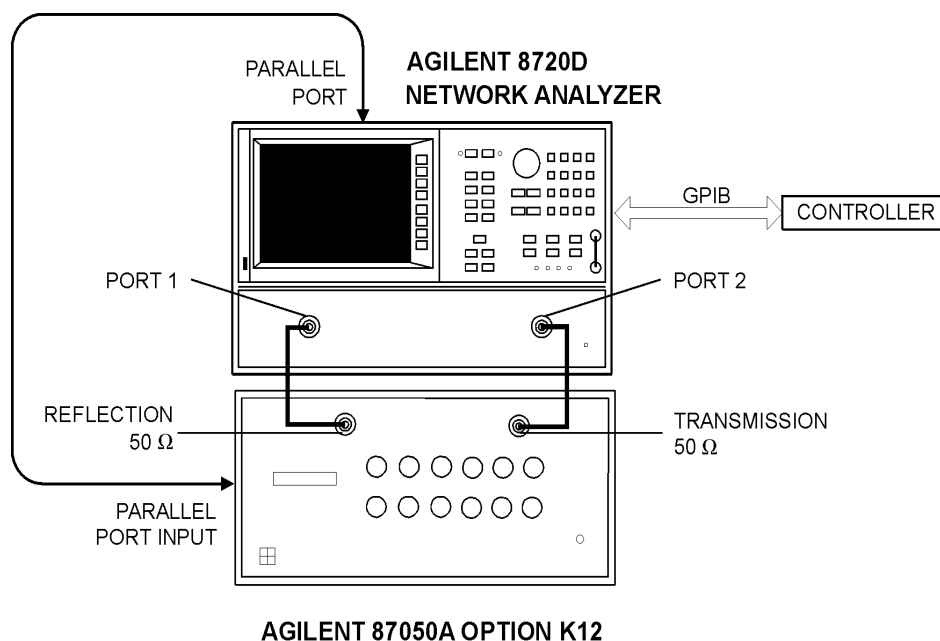
Figure 2-3 Example of an Antistatic Workstation



Connecting and Turning On the Test Set

The 87050A Option K12 test set is designed to be placed underneath the network analyzer, in a rack system or on a bench top, and connected as shown in Figure 2-4. Use the two APC 3.5 50 Ω jumper cables (5062-6682) that were shipped with the test set. See Table 2-1 on page 2-3 for a list of accessories supplied.

Figure 2-4 Connecting the Test Set to the Network Analyzer



Install the parallel cable (8120-6818) from the rear panel PARALLEL connector of the network analyzer to the rear panel PARALLEL INPUT connector of the test set.

Depending on how you will communicate with the test set (see Chapter 3, “Controlling the Test Set and Making Measurements”), connecting an GPIB cable from the controller to the rear panel of the network analyzer may also be necessary.

After the proper front and rear panel connections have been made, turn on the test set using the front panel line switch. The front panel line switch disconnects the mains circuits from the mains supply after the EMI filters and before other parts of the instrument.

NOTE For accurate, repeatable measurements, be sure to let the test set warm up for at least 2 hours. For the most stable and accurate measurements, leave the test set turned on at all times.

Setting the Test Set Address Switch

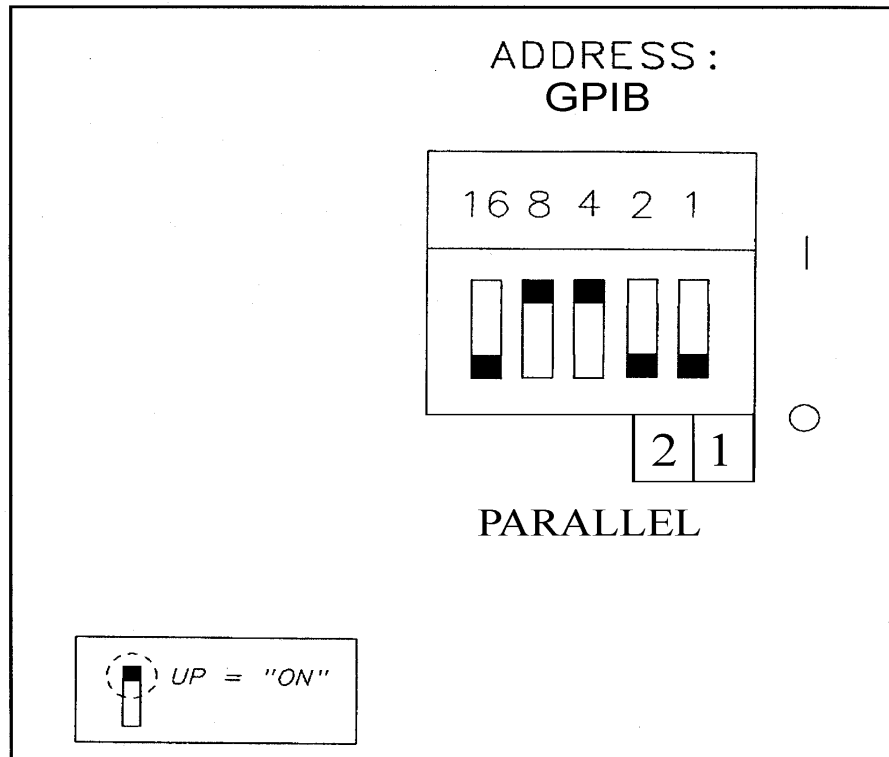
The test set is shipped with the GPIB address set to 12, which sets the parallel address to 0 as in Figure 2-5. Refer to Chapter 3, "Controlling the Test Set and Making Measurements," for the definition of the parallel address.

To set the GPIB address, set all five switches so that the sum of the switches in the on (or 1) position equal the desired address. In the example below, the two switches in the on position are 8 and 4, thus the GPIB address of 12.

To set the parallel address, use only the number 1 switch. Therefore, the possibilities for parallel port addressing are 0 or 1.

NOTE When GPIB is used, the parallel address is ignored.

Figure 2-5 The Test Set Address Switch



Performing the Operator's Check

For information on controlling the test set, refer to Chapter 3, "Controlling the Test Set and Making Measurements."

Description	The following operator's check is designed to provide you with a high degree of confidence that your test set is working properly. It is not designed to verify specifications. To verify specifications, refer to Chapter 6, "Service."
Procedure	This procedure is for performing a simple operator's check using a network analyzer of the proper frequency range and impedance.
Equipment Required	<ul style="list-style-type: none">• Network Analyzer, 50Ω impedance (8720D)• Cable, 50Ω, 3.5-mm (8120-4921 or equivalent), quantity 2• Calibration Kit, 50Ω, 3.5-mm (85052B)
Process	<ol style="list-style-type: none">1. Connect the 50Ω cable to PORT 1 of the analyzer.2. Perform a one-port reflection calibration at the end of the 50Ω cable over the frequency range of 50 MHz to 20 GHz on the analyzer. Verify that the calibration is active and that a cable terminated with a short displays a return loss of 0 ± 0.2 dB.3. Connect the cable (already connected to PORT 1 of the analyzer) to the REFLECTION port of the 87050A Option K12 test set.4. Measure the return loss of each path of the test set by selecting PORT 1 through PORT 12, one at a time, using the network analyzer. Terminate each port being tested with a 50Ω load (≥ -30 dB). The resulting return loss should be ≥ -12 dB (the absolute value should be greater than 12).5. Connect the cable (already connected to the REFLECTION port) to the TRANSMISSION port of the test set.6. Measure the return loss of each path of the test set by selecting PORT 1 through PORT 12, one at a time, using the network analyzer. Terminate each port being tested with a 50Ω load (≥ -30 dB). The resulting return loss should be greater than -12 dB (the absolute value should be greater than 12).

NOTE	This is an 80% confidence test only. A test set could pass this simple test and yet still not function properly. For more complete testing, see "Performance Tests", on page 6-3.
-------------	---

3 Controlling the Test Set and Making Measurements

Introduction

The 87050A Option K12 is a "slave" instrument: a controller must be used to control the test set. There are three ways in which the test set can be controlled:

1. The controller can talk to the network analyzer using GPIB, which then controls the test set via the parallel connection.
2. The controller can control the test set using GPIB commands via the GPIB connector.
3. A network analyzer equipped with a parallel connection can control the test set directly.

Commands

As mentioned earlier, the test set can be controlled in three ways. The first two involve the use of a separate computer. The third way uses the network analyzer manually. These methods of control are detailed on pages 3-3 through 3-5.

Computer Control

1. The first way to control the test set is to write GPIB commands to the network analyzer which then writes to the test set by way of the parallel port. See Figure 3-1 on page 3-4 for a diagram of connections for this type of control. The following examples use the variable [D] which is defined in Table 3-1 on page 3-6.

To use a parallel port connection with the 8720D, use a GPIB command to write bits on the parallel port. The following example assumes that the address of the network analyzer is 16.

```
OUTPUT 716;"PARALGPIO;"    Sets the parallel port for  
                             GPIO function
```

```
OUTPUT 716;"PARAOUT[D];"   Programs all GPIO output  
                             bits (0 to 256) at once
```

Be sure to use the ending semi-colon.

2. The second way to control the test set is to address the 87050A Option K12 test set directly over GPIB, using a controller to write directly to the test set's GPIB port. The following example assumes that the address of the test set is 12.

```
OUTPUT 712;"command$"
```

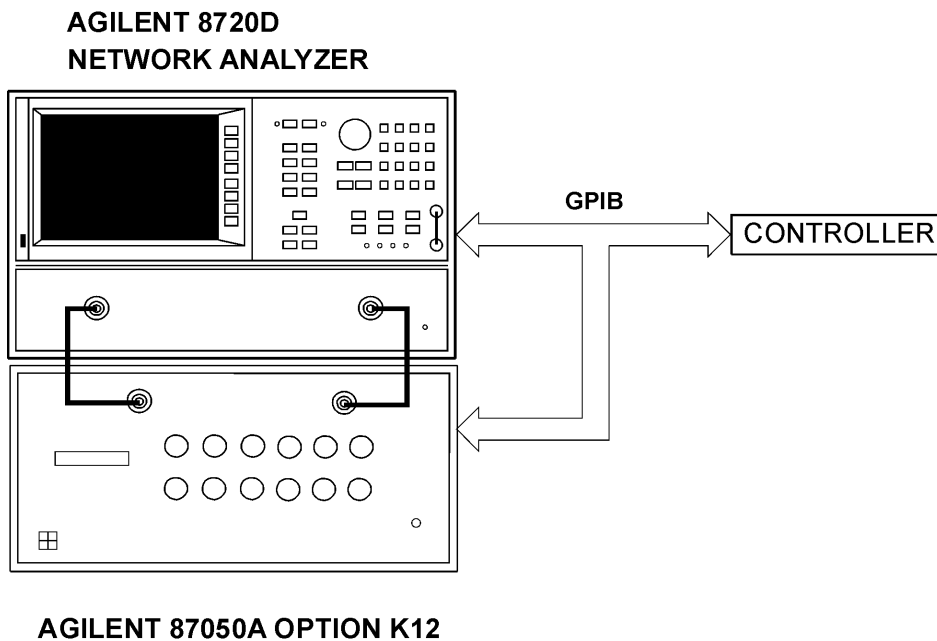
If using Quick Basic or Visual Basic, be sure to disable EOI and EOL before sending commands to the test set. Including the semicolon will not insure that these commands are disabled as would be the case in HP Basic/RMB. Using the 82335 GPIB Interface and Visual Basic, the following commands will disable the EOI, EOL, send the necessary data to the test set, and re-enable EOI and EOL. Be sure to re-enable EOI and EOL before sending data to another instrument.

```
HpibEoi(hHpib;7,0) 'disable EOI  
HpibEol(hHpib;7,"",0) 'disable EOL  
HpibOutput(hHpib;712,chr$([D])) 'send command to  
test set  
HpibEol(hHpib;7,chr$(13)+chr$(10),2) 're-enable EOL  
and set to'chr$(13)+chr$(10)  
HpibEoi(hHpib;7,1,) 're-enable EOI
```

where hHpib specifies the handle returned by HpibOpen.

For more information on the EOI and EOL commands, refer to the programming library manual supplied with the 82335 interface.

Figure 3-1 Controlling the Test Set over GPIB



NOTE Connection to the network analyzer is not required when controlling the test set over GPIB.

Network Analyzer Control

3. The third method of sending commands uses the network analyzer to control the test set directly. This method is performed with the standard setup of the network analyzer working with the test set. A parallel cable is connected from the network analyzer output to the test set input on both rear panels.

The following example for manual control, using the network analyzer, uses normal text in brackets to indicate hard keys and italicized text in brackets to indicated soft keys.

Press:

```
[Seq]  
[TTL I/O] [PARALLEL OUT ALL]
```

Use the arrow keys (↑ or ↓) to scroll to the desired test port address, or input the number directly using the hard keys [D] [x1], where D represents the decimal value of the test port address (see Table 3-1 on page 3-6).

Table 3-1 Test Port Addresses

Connection Path	Decimal [D]	Binary Equivalent	GPIB Command
Reflection to Port 1	0	00000000	refl_01
Reflection to Port 2	1	00000001	refl_02
Reflection to Port 3	2	00000010	refl_03
Reflection to Port 4	3	00000011	refl_04
Reflection to Port 5	4	00000100	refl_05
Reflection to Port 6	5	00000101	refl_06
Reflection to Port 7	6	00000110	refl_07
Reflection to Port 8	7	00000111	refl_08
Reflection to Port 9	8	00001000	refl_09
Reflection to Port 10	9	00001001	refl_10
Reflection to Port 11	10	00001010	refl_11
Reflection to Port 12	11	00001011	refl_12
Reflection Terminated	25	00011001	*r_term
Transmission to Port 1	26	00011010	tran_01
Transmission to Port 2	27	00011011	tran_02
Transmission to Port 3	28	00011100	tran_03
Transmission to Port 4	29	00011101	tran_04
Transmission to Port 5	30	00011110	tran_05
Transmission to Port 6	31	00011111	tran_06
Transmission to Port 7	32	00100000	tran_07
Transmission to Port 8	33	00100001	tran_08
Transmission to Port 9	34	00100010	tran_09
Transmission to Port 10	35	00100011	tran_10
Transmission to Port 11	36	00100100	tran_11
Transmission to Port 12	37	00100101	tran_12
Transmission Terminated	50	00110010	*t_term
All Ports Terminated	51	00110011	*all_term
Reset	52	00110100	*rst
Test Set Identification			idn?
Test Set Serial Number			sn?

To connect all ports to their internal 50Ω loads, send the following command by way of the parallel port:

```
OUTPUT 716;"PARALGPIO;"  
OUTPUT 716;"PARAOUT 51;"
```

When a test set port is not in use, it is terminated in 50Ω

If the 87050A Option K12 is being controlled by GPIB, you can identify the test set serial number by sending the following commands:

```
OUTPUT 712;"sn?"  
ENTER 712;Sn$  
DISP Sn$
```

NOTE This command may only be used with GPIB control.

Reset Command When the **Reset** command is sent, the test set is set to the default state where the REFLECTION port is directed to reflection PORT 1 and the TRANSMISSION port is directed to transmission PORT 2.

**Switch Count
Commands**

Reference the 87050A Option K12 block diagram, Figure 6-1 on page 6-29, for the switch paths.

To read the individual switch count, send the following command:

```
Output 712;"sw14?"
```

The above example shows the command for switch 14 only. This command returns a value which indicates the number of times the particular switch has been addressed and switched. To enter additional commands use Table 3-2.

Table 3-2 Switch Count Commands

Switch Number	GPIB Command
SW11	sw11?
SW12	sw12?
SW14	sw14?
SW15	sw15?
SW16	sw16?
SW17	sw17?
SW50	sw50?
SW51	sw51?
SW52	sw52?
SW53	sw53?
SW54	sw54?
SW55	sw55?
SW56	sw56?
SW57	sw57?
SW58	sw58?
SW59	sw59?
SW60	sw60?
SW61	sw61?

Calibrating the Test System

After the test set has warmed up for two hours, it should be calibrated before making any measurements. Refer to the network analyzer user's guide to determine the type of calibration for the measurements you will be making.

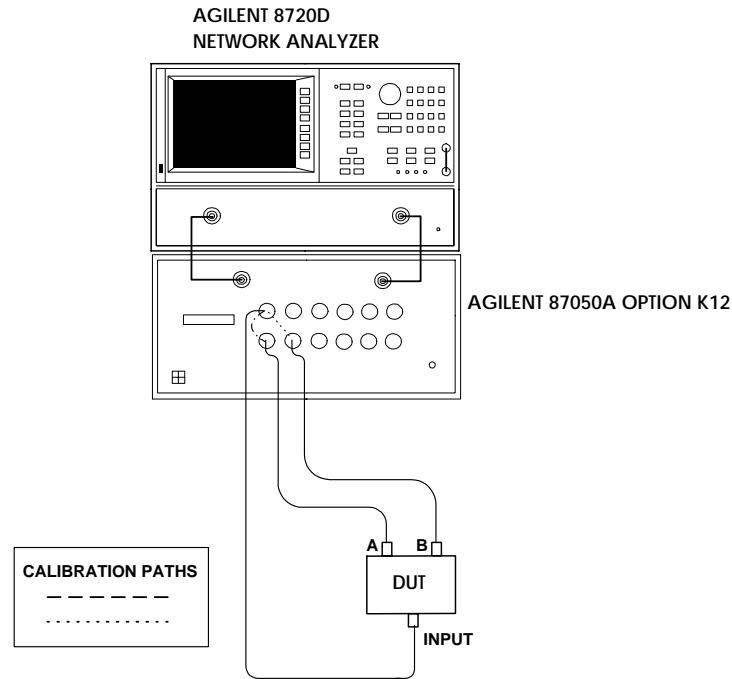
You will need to calibrate each measurement path separately and store the calibration as an instrument state in the network analyzer. Refer to your network analyzer's user's guide for information on how to calibrate and store instrument states. Refer to Figure 3-2 for an example of the setup.

Example Setup

In this setup example, the following tests will be made

- return loss on the DUT's input and 2 output ports (A and B)
- insertion loss (or gain) between the DUT's input and port A
- insertion loss (or gain) between the DUT's input and port B

Figure 3-2 **Calibrating the Test System**



For the best accuracy, you should perform a full two-port calibration between the test set PORT 1 and PORT 2, and again between PORT 1 and PORT 4. You need to save the calibrations as instrument states. See your analyzer user's guide for information on calibrations and saving instrument states.

NOTE

When performing a full two-port calibration and making subsequent measurements, you must use the transfer switch internal to the network analyzer to change the RF signal path direction. Do not use the test set to change the direction of the RF signal path when you are using a full two-port calibration. Doing so will render the calibration invalid.

Making Measurements

The following examples assume that you are using a parallel port connection with an 8720D, with the test set's parallel address set to 0. See "Setting the Test Set Address Switch" on page -9 for information on setting the test set's address.

Measuring Transmission

Refer to Figure 3-3 for the following discussion. With the 8720D set to measure forward transmission (S_{21}), the analyzer's RF source is being output through the analyzer's PORT 1, and PORT 2 is set to receive the RF signal.

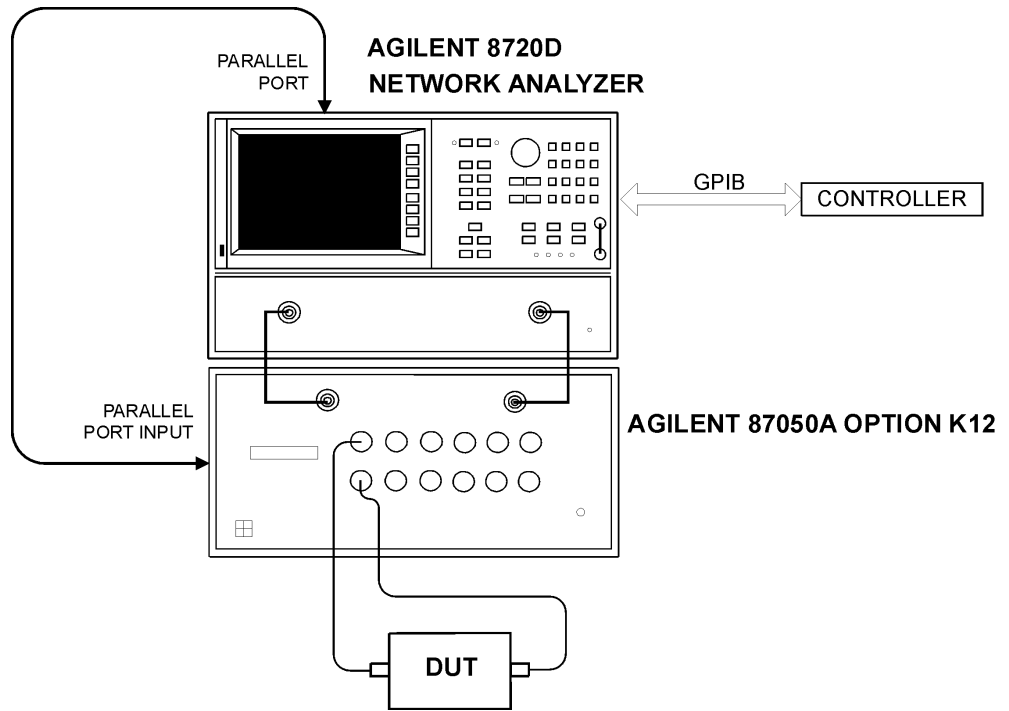
By using the following commands, you will connect PORT 1 of the test set to the REFLECTION port, and you will connect PORT 2 of the test set to the TRANSMISSION port. You will thus be measuring forward transmission through the device under test when measuring S_{21} . This will provide you with gain or insertion loss information.

```
OUTPUT 716;"PARALGPIO;"  
OUTPUT 716;"PARAOUT0;"  
  
OUTPUT 716;"PARALGPIO;"  
OUTPUT 716;"PARAOUT27;"
```

If directly controlling the test set by way of the GPIB interface, use the following GPIB commands:

```
OUTPUT 712;"ref1_01"  
OUTPUT 712;"tran_02"
```

Figure 3-3 Controlling the Test Set



Measuring Reflection

By leaving the DUT connected as in Figure 3-3 and setting the network analyzer to measure S_{11} , you can measure reflection or return loss.

Example Program

An example program is provided in this section to aid you in creating a program specific to your DUT. This program is written in HP BASIC and is for use with an HP 9000 series 200/300/700 computer. The program is briefly described below and listed following the description.

Control

This program demonstrates the control of the 87050A Option K12 via GPIB and/or the parallel port. This program can be used to manually select any port combination.

The Control program will first ask the user which method will be used to control the 87050A Option K12 either GPIB or parallel port. It will then ask which ports are to be enabled. The port entries are done in pairs (reflection/transmission), with the numbers in the pair separated by a comma. The numbers may range from 0 through 12 for the test ports. For example, the entry of "2,5" will connect the REFLECTION port to PORT 2 and the TRANSMISSION port to PORT 5. The program is a continuous loop. Press STOP to end program execution.

The Control Program

```
10      ! RE-SAVE "control"
20      ! CONTROL:  This example program allows "manual"
          control of the
30      !           87050A Option K12 via the parallel
          port of the
40      !           8720D network analyzer or via GPIB
          directly.
50      !
60      ! NOTE:    You MUST select either GPIB control or
          Parallel Port
70      !           control. If Parallel Port via the
          8720D is
80      !           selected, this program will return the
          analyzer to
90      !           LOCAL control after the switches are set.
100     !
110     !           Set the GPIB address as required below.
120     !
130     !           The 87050A Option K12 can be set to
          one of two
140     !           Parallel Port addresses.  This program (SUB
          Set_switches)
150     !           assumes it is set to address 00.
160     !
170     !           Copyright:  Agilent Technologies Inc.
          Palo Alto, CA 94304
180     !
190     !           Developed at Microwave Instruments Division
          Santa Rosa, CA
200     !           Revision A.01.00 19 January 2000 mf
210     Nwa_addr=716
220     Ts_addr=712
230     !
240     CLEAR SCREEN
250     PRINT USING "3/,K,/" ; "*****  DEMONSTRATION PROGRAM
          FOR 87050A-K12 MANUAL CONTROL  *****"
```

Controlling the Test Set and Making Measurements

Example Program

```
260 PRINT "Either direct GPIB control of the 87050A-K12
may be selected (h),"
270 PRINT "or indirect control via the Parallel Port (p)
of the 8720D"
280 REPEAT
290     Answ$="p"
300     OUTPUT 2;Answ$&CHR$(255)&"H";
310     BEEP 300,.1
320     INPUT "Select desired test-set control. GPIB or
Parallel Port? (Enter H or P)",Answ$
330     Answ$=UPC$(Answ$[1,1])
340 UNTIL Answ$="P" OR Answ$="H"
350 Controller$=Answ$
360 !
370 ABORT 7
380 CLEAR SCREEN
390 IF Controller$="P" THEN
400     Addr=Nwa_addr ! Assign address to the analyzer
410     PRINT "Test set is being controlled via Parallel
Port;8720D, address =";Addr
420 ELSE
430     Addr=Ts_addr
440     PRINT "Test set is being controlled directly via
GPIB. GPIB address =";Addr
450 END IF
460 Isc=Addr DIV 100 ! Interface Select Code
470 !
480 PRINT USING "/,K,/" ;RPT$("-",77)
490 PRINT "For manual operation of this switch box, enter
TWO numbers separated by"
500 PRINT "a comma (,). The two numbers represent the
port numbers directed to the"
510 PRINT "Reflection Port and Transmission Port,
respectively. Setting a port to"
520 PRINT "'0' will terminate the corresponding port."
530 PRINT "Unless both numbers are '0', the two values
cannot be the same."
```

```
540 PRINT "To terminate the program, press STOP or PAUSE."
550 PRINT
560 PRINT "Example: 1,2 sets the test set paths Port 1 to
Reflection Port and"
570 PRINT " Port 2 to Transmission Port."
580 PRINT " 10,1 sets the test set paths Port 10 to
Reflection Port and"
590 PRINT " Port 1 to Transmission Port."
600 PRINT " 0,5 sets the test set paths Reflection Port
terminated and"
610 PRINT "          Port 5 to Transmission Port."
620 PRINT " 0,0 sets the test set paths to
terminate both Reflection and"
630 PRINT " Transmission ports."
640 PRINT " all_term sets the test set paths to
terminate all ports"
650 PRINT " reset sets the test set to know paths,
i.e., Reflection Port"
660 PRINT " to Port 1 and Transmission Port to Port 2."
670 PRINT
680 PRINT "If you have selected GPIB you may also check
the model number of"
690 PRINT "the unit by typing 'model', or check the
number of times the switch"
700 PRINT "has switched by typing 'switch ##', where ## is
the number of the"
710 PRINT "desired switch."
720 LOOP
730     Refl=0
740     Trans=0
750     BEEP 500,.1
760     LINPUT "Enter the Reflection Port/Transmission Port
selections separated by commas:e.g. 1,2
",Command$
770     Current_pos=POS(Command$,"")
780     Command_length=LEN(Command$)
790     Counter=0
800     Cmd$=Command$
```

Controlling the Test Set and Making Measurements

Example Program

```
810      IF Current_pos>0 THEN
820          WHILE Current_pos>0
830              Command_length=LEN(Command$)
840              Current$=Command$[1,(Current_pos-1)]
850              Command$=Command$[(Current_pos+1),
                Command_length]
860              Current_pos=POS(Command$,"")
870              Set_no=VAL(Current$)
880              SELECT Counter
890              CASE 0
900                  Refl=Set_no
910              CASE ELSE
920                  PRINT TABXY(1,29),"Too many numbers
                entered. Try again! Entered ";Cmd$
930                  BEEP 500,.1
940                  WAIT 1
950              END SELECT
960              Counter=Counter+1
970          END WHILE
980          Set_no=VAL(Command$)
990          Trans=Set_no
1000         PRINT TABXY(1,29)," "
1010        IF NOT (((Refl<>Trans) OR (Refl=0 AND Trans=0)
                OR (Trans=12 AND Refl=12)) AND Refl<13 AND
                Trans<17 AND Refl>=0 AND Trans>=0) THEN
1020            DISP "Port selections MUST be different if
                non-zero; Range= 0 to 12. Entered
                ""&Current$&","&Command$&""
1030            BEEP 1500,.3
1040            WAIT 5
1050        ELSE
1060            Set_switches(Addr,"REFL",VAL$(Refl),
                Controller$)
1070            ! Sets Ports
1080            Set_switches(Addr,"TRANS",VAL$(Trans),
                Controller$)
1090            ! Sets Ports
```

```
1100         PRINT TABXY(1,28), " "
1110         PRINT TABXY(1,28), "Current Port = ";Refl;"
           to Reflection Port"
1120         PRINT TABXY(1,29), " "
1130         PRINT TABXY(1,29), "Current Port = ";Trans;"
           to Transmission Port"
1140     END IF
1150 ELSE
1160     SELECT UPC$(Command$)
1170     CASE "MODEL"
1180         OUTPUT 712;"idn?"
1190         ENTER 712;Model$
1200         PRINT TABXY(1,29), " "
1210         PRINT TABXY(1,29), "model number is ";Model$
1220     CASE "ALL_TERM"
1230         IF Controller$="H" THEN
1240             Output_cmd$="*all_term"
1250             OUTPUT Addr;Output_cmd$
1260         ELSE
1270             Output_cmd$="51"
1280             OUTPUT Addr;"PARALGPIO;"
1290             OUTPUT Addr;"PARAOUT"&Output_cmd$&" ";
1300         END IF
1310         PRINT TABXY(1,28), " "
1320         PRINT TABXY(1,29), " "
1330         PRINT TABXY(1,28), "All ports are terminated
           into 50 ohms."
1340     CASE "RESET"
1350         IF Controller$="H" THEN
1360             Output_cmd$="*rst"
1370             OUTPUT Addr;Output_cmd$           !
           sent via GPIB
1380         ELSE
1390             Output_cmd$="52"
1400             OUTPUT Addr;"PARALGPIO"
```

Controlling the Test Set and Making Measurements

Example Program

```
1410             OUTPUT Addr;"PARAOUT"&Output_cmd$&";!
                sent via Centronics Port

1420             END IF

1430             PRINT TABXY(1,28)," "

1440             PRINT TABXY(1,29)," "

1450             PRINT TABXY(1,28),"Test set reset; Port 1
                to REFL & Port 2 to TRANS."

1460             CASE ELSE

1470             Command$=UPC$(Command$)

1480             IF POS(Command$,"SWITCH") THEN

1490                 Nu$=TRIM$(Command$[8,Command_length])

1491                 SELECT Nu$

1492                 CASE
                    "11","12","14","15","16","17",
                    "50" TO "61"

1510                     OUTPUT 712;"sw"&Nu$;"?"

1520                     ENTER 712;Count$

1530                     PRINT TABXY(1,30)," "

1540                     PRINT TABXY(1,30),"switch number
                        ";Nu$;" has ";Count$

1550                 CASE ELSE

1560                     DISP "Installed switch numbers are
                        11, 12, 14, 15, 16, 17, 50
                        thru 61. Try again!
                        Entered ";Command$

1570                     BEEP 300,.1

1580                     WAIT 3

1590                 END SELECT

1600             ELSE

1610                 DISP "Unknown command """;Command$;""""

1620                 BEEP 300,.1

1630                 WAIT 3

1640             END IF

1650         END SELECT

1660     END IF

1670 END LOOP

1680 END
```

```
1690  !
1700  SUB Set_switches(Addr,First_parm$,Second_parm$,
      Controller$)
1710  !=====
1720  !  PURPOSE:  To set the 87050A Option K12
      switches.
1730  !-----
1740  !
1750  !  PARAMETERS:
1760  !
1770  !  Controller$: [P|H]  P=Parallel via 8720D or
      H=GPIB
1780  !  First_parm$: [REFL|TRANS]
1790  !  Second_parm$: [0|1|2|...16]
1800  !  Addr: GPIB addr of 8720D or          87050A-K12
      depending
1810  !                               on H or P above.
1820  !-----
1830  !
1840  !  DESCRIPTION:
1850  !
1860  !  Commands can be sent via Centronics (Parallel) port
      or via GPIB
1870  !  Choice depends upon variable Controller$ [P|H]
1880  !
1890  !=====
1900  Set_switches:  !
1910  !
1920      SELECT UPC$(TRIM$(First_parm$))
1930      CASE "REFL"
1940          SELECT UPC$(TRIM$(Second_parm$))
1950          CASE "0", "TERMINATE REFLECTION"
1960              Hswitch_code$="*r_term"
1970              Pswitch_code$="25"
1980          CASE "1", "PORT 1 TO REFLECTION"
1990              Hswitch_code$="refl_01"
```

Controlling the Test Set and Making Measurements

Example Program

```
2000         Pswitch_code$="0"
2010         CASE "2","PORT 2 TO REFLECTION"
2020         Hswitch_code$="refl_02"
2030         Pswitch_code$="1"
2040         CASE "3","PORT 3 TO REFLECTION"
2050         Hswitch_code$="refl_03"
2060         Pswitch_code$="2"
2070         CASE "4","PORT 4 TO REFLECTION"
2080         Hswitch_code$="refl_04"
2090         Pswitch_code$="3"
2100         CASE "5","PORT 5 TO REFLECTION"
2110         Hswitch_code$="refl_05"
2120         Pswitch_code$="4"
2130         CASE "6","PORT 6 TO REFLECTION"
2140         Hswitch_code$="refl_06"
2150         Pswitch_code$="5"
2160         CASE "7","PORT 7 TO REFLECTION"
2170         Hswitch_code$="refl_07"
2180         Pswitch_code$="6"
2190         CASE "8","PORT 8 TO REFLECTION"
2200         Hswitch_code$="refl_08"
2210         Pswitch_code$="7"
2220         CASE "9","PORT 9 TO REFLECTION"
2230         Hswitch_code$="refl_09"
2240         Pswitch_code$="8"
2250         CASE "10","PORT 10 TO REFLECTION"
2251         Hswitch_code$="refl_10"
2252         Pswitch_code$="9"
2255         CASE "11","PORT 11 TO REFLECTION"
2256         Hswitch_code$="refl_11"
2257         Pswitch_code$="10"
2260         CASE "12","PORT 12 TO REFLECTION"
2262         Hswitch_code$="refl_12"
2263         Pswitch_code$="11"
```



```
2287         CASE ELSE
2288             DISP "Unrecognized switched port
                parameters; ""&First_parm$&"" to
                ""&Second_parm$&"" "
2289             BEEP 1500,.1
2290             WAIT 2
2291         END SELECT
2292     CASE "TRANS"
2293         SELECT UPC$(TRIM$(Second_parm$))
2294         CASE "0","TERMINATE TRANSMISSION"
2295             Hswitch_code$="*t_term"
2296             Pswitch_code$="50"
2297         CASE "1","PORT 1 TO TRANSMISSION"
2298             Hswitch_code$="tran_01"
2299             Pswitch_code$="26"
2300         CASE "2","PORT 2 TO TRANSMISSION"
2301             Hswitch_code$="tran_02"
2302             Pswitch_code$="27"
2303         CASE "3","PORT 3 TO TRANSMISSION"
2304             Hswitch_code$="tran_03"
2305             Pswitch_code$="28"
2306         CASE "4","PORT 4 TO TRANSMISSION"
2307             Hswitch_code$="tran_04"
2308             Pswitch_code$="29"
2309         CASE "5","PORT 5 TO TRANSMISSION"
2310             Hswitch_code$="tran_05"
2311             Pswitch_code$="30"
2312         CASE "6","PORT 6 TO TRANSMISSION"
2313             Hswitch_code$="tran_06"
2314             Pswitch_code$="31"
2315         CASE "7","PORT 7 TO TRANSMISSION"
2316             Hswitch_code$="tran_07"
2317             Pswitch_code$="32"
2318         CASE "8","PORT 8 TO TRANSMISSION"
```

Controlling the Test Set and Making Measurements

Example Program

```
2319             Hswitch_code$="tran_08"
2320             Pswitch_code$="33"
2321             CASE "9","PORT 9 TO TRANSMISSION"
2322             Hswitch_code$="tran_09"
2323             Pswitch_code$="34"
2324             CASE "10","PORT 10 TO TRANSMISSION"
2325             Hswitch_code$="tran_10"
2326             Pswitch_code$="35"
2327             CASE "11","PORT 11 TO TRANSMISSION"
2328             Hswitch_code$="tran_11"
2329             Pswitch_code$="36"
2330             CASE "12","PORT 12 TO TRANSMISSION"
2331             Hswitch_code$="tran_12"
2332             Pswitch_code$="37"
2345             CASE ELSE
2346             DISP "Unrecognized switched port
                parameters; ""&First_parm$&"" to
                ""&Second_parm$&"""
2347             BEEP 300,.1
2348             WAIT 2
2349             END SELECT
2350         END SELECT
2351     !
2352     IF Controller$="H" THEN
2353         Output_cmd$=TRIM$(Hswitch_code$)
2354         OUTPUT Addr;Output_cmd$ ! sent via GPIB
2355     ELSE
2356         Output_cmd$=VAL$(VAL$(Pswitch_code$))
2357         OUTPUT Addr;"PARALGPIO;"
2358         OUTPUT Addr;"PARAOUT"&Output_cmd$&";"! sent
                via Centronics Port
2359     END IF
2360     WAIT .1
2361 SUBEND
```

4 **Front and Rear Panels**

Introduction

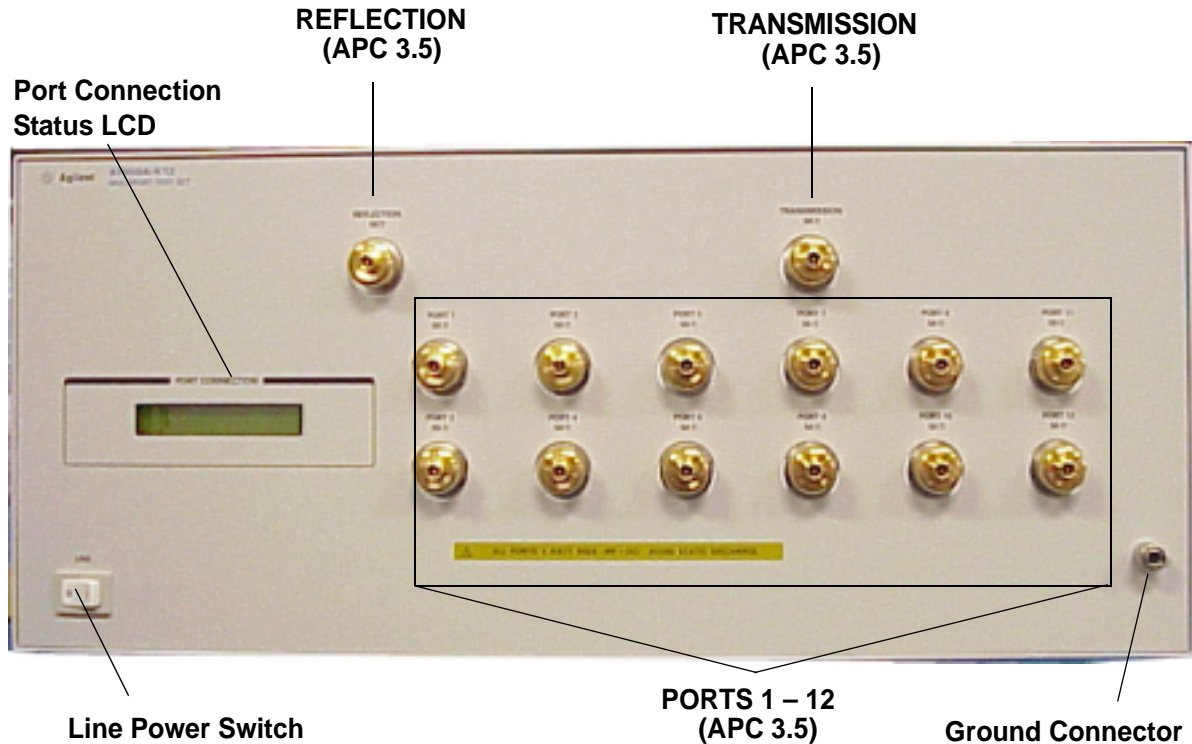
This chapter contains information on the ports and switches found on the front and rear panels of the test set.

This chapter is divided into two sections:

- Front Panel
- Rear Panel

Front Panel

Figure 4-1 Front Panel Features



The Port Connection Status LCD

The port connection status LCD provides visual feedback of which port(s) are connected to the REFLECTION and TRANSMISSION ports of the test set. When the LCD displays a path connection, all other corresponding test ports are internally terminated in 50Ω.

The REFLECTION and TRANSMISSION Ports

The REFLECTION and TRANSMISSION ports are 50Ω, 3.5-mm connectors. A 50Ω cable connects directly to the REFLECTION/TRANSMISSION port or PORT 1/PORT 2 of the network analyzer using the cables (5062-6682) that were shipped with your test set.

CAUTION

Check your analyzer's documentation for damage limits to the ports. Make sure that your test setup will not cause those limits to be exceeded.

Line Power Switch

The test set line power switch is located at the bottom left corner of the front panel. The line power switch turns the test set either on or off.

The line switch disconnects the mains circuits from the mains supply after the EMI filters and before other parts of the instrument.

PORTS 1 – 12

PORTS 1 through 12 are 50 Ω 3.5-mm connectors that are used to connect to the device under test.

CAUTION

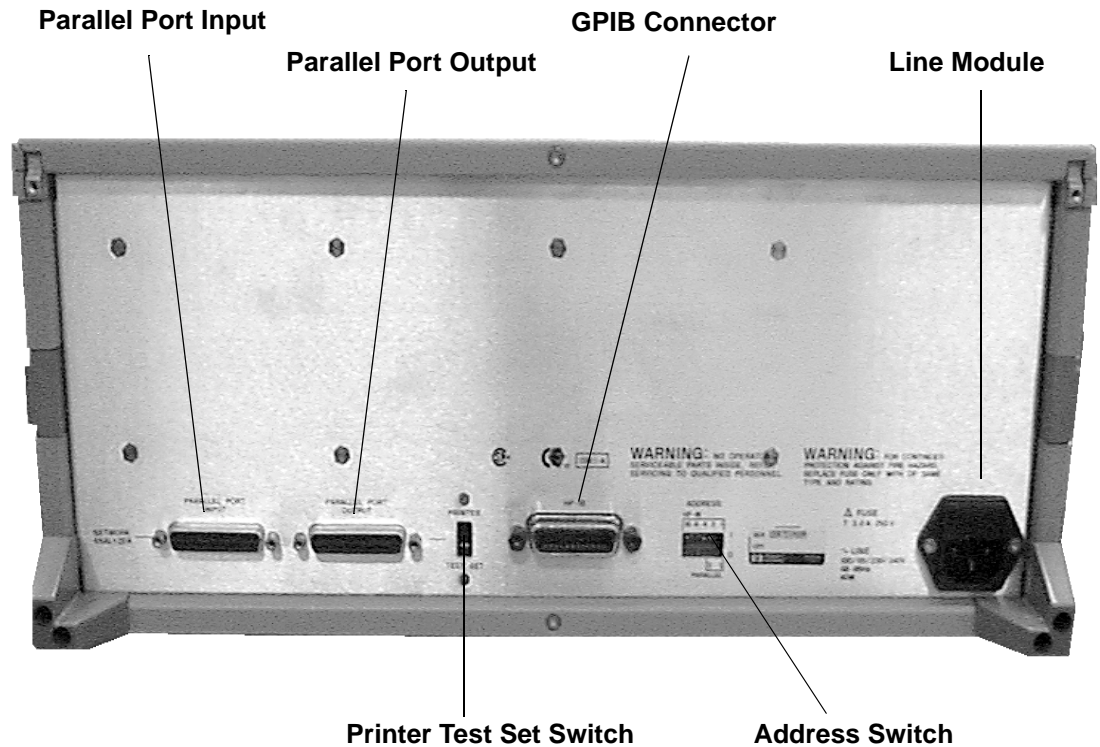
Do not input more than 1 watt (RF and dc combined) to these ports, or damage to the internal RF switches or the analyzer may occur.

The Ground Connector

The ground connector provides a convenient front panel ground connection for a standard banana plug.

Rear Panel

Figure 4-2 Rear Panel Features



The Parallel Port Input Connector

This input port is connected to the parallel port of the network analyzer. The analyzer provides control signals that drive the switches inside the test set. In pass-through mode, it also accepts signals required to drive a printer.

The Parallel Port Output Connector

The output from this connector is used to either control another test set, or to control a printer, depending upon how the Printer/Test Set switch is set.

The Printer/Test Set Switch

This switch determines the function of the Parallel Port Output connector. When switched to Printer, the Parallel Port Output will pass-through printer driver signals. When switched to Test Set, an additional test set can be controlled from the Parallel Port Output connector.

GPIB Connector

This connector allows the test set to be connected directly to a controller. See Figure 3-3 on page 3-12.

Address Switch

The address switch sets the GPIB and/or parallel address of the test set. See “Setting the Test Set Address Switch” on page -9 for information.

Line Module

The line module contains the power cable receptacle and the line fuse. The line module is an autoranging input and is designed to be used with an ac power source with a nominal voltage of either 115 V or 230 V.

Power Cables

The line power cable is supplied in one of several configurations, depending on the destination of the original shipment.

Each instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument chassis. The type of power cable shipped with each instrument depends on the country of destination. See Figure 4-3 on page 4-7 for the part numbers of these power cables. Cables are available in different lengths. Check with your nearest Agilent Technologies service center for descriptions and part numbers of cables other than those described in Figure 4-3. A list of Agilent Technologies sales or service offices is located on page 7-3.

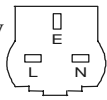
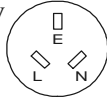

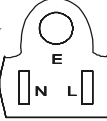
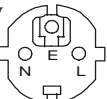
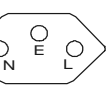

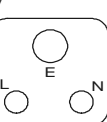
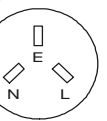
CAUTION

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

WARNING

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

Figure 4-3 Power Cable and Line (Mains) Plug Part Numbers

Plug Type ^a	Cable Part Number	Plug ^b Description	Length cm (in.)	Cable Color	For Use in Country
250V 	8120-8705	Straight BS 1363A	229 (90)	Mint Gray	Option 900 United Kingdom, Hong Kong, Cyprus, Nigeria, Singapore, Zimbabwe
	8120-8709	90°	229 (90)	Mint Gray	
250V 	8120-1369	Straight AS 3112	210 (79)	Gray	Option 901 Argentina, Australia, New Zealand, Mainland China
	8120-0696	90°	200 (78)	Gray	
125V 	8120-1378	Straight NEMA 5-15P	203 (80)	Jade Gray	Option 903 United States, Canada, Brazil, Colombia, Mexico, Philippines, Saudi Arabia, Taiwan
	8120-1521	90°	203 (80)	Jade Gray	
125V 	8120-4753	Straight NEMA 5-15P	229 (90)	Gray	Option 918 Japan
	8120-4754	90°	229 (90)	Gray	
250V 	8120-1689	Straight CEE 7/VII	200 (78)	Mint Gray	Option 902 Continental Europe, Central African Republic, United Arab Republic
	8120-1692	90°	200 (78)	Mint Gray	
230V 	8120-2104	Straight SEV Type 12	200 (78)	Gray	Option 906 Switzerland
	8120-2296	90°	200 (78)	Gray	
220V 	8120-2956	Straight SR 107-2-D	200 (78)	Gray	Option 912 Denmark
	8120-2957	90°	200 (78)	Gray	
250V 	8120-4211	Straight IEC 83-B1	200 (78)	Mint Gray	Option 917 South Africa, India
	8120-4600	90°	200 (78)	Mint Gray	
250V 	8120-5182	Straight SI 32	200 (78)	Jade Gray	Option 919 Israel
	8120-5181	90°	200 (78)	Jade Gray	

a. E =earth ground, L = line, and N = neutral.

b. Plug identifier numbers describe the plug only. The Agilent Technologies part number is for the complete cable assembly.

The Line Fuse

The line fuse, as well as a spare, reside within the line module. Figure 4-4 illustrates where the fuses are and how to access them.

Available Fuses

United States (115 V orientation)

Fuse (F 3 A/250 V, 2110-0780) U.L. listed and CSA certified

Europe (230 V orientation)

Fuse (F 3.15 A/250 V, 2110-0655) IEC certified and U.L. recognized

Figure 4-4 **Location of Line Fuses**



5 **Specifications and Characteristics**

Performance Specifications and Characteristics

Table 5-1

Option K12 Performance Specifications and Characteristics

Parameter	Specification
Frequency Range	50 MHz to 20 GHz
Isolation ^a	
500 MHz up to 20.0 GHz	≥100 dB
Return Loss (Switch Path ON)	
50.0 MHz up to 3.0 GHz	≥18 dB
3.0 GHz to 12.4 GHz	≥12 dB
12.4 GHz to 20 GHz	≥10 dB
Return Loss (Switch Path OFF)	
50.0 MHz up to 3.0 GHz	≥22 dB (Typical)
3.0 GHz to 12.4 GHz	≥14 dB (Typical)
12.4 GHz to 20 GHz	≥12 dB (Typical)
Insertion Loss	
50 MHz up to 3.0 GHz	≤2.0 dB
3.0 GHz to 6.0 GHz	≤3.0 dB
6.0 GHz to 12.4 GHz	≤4.0 dB
12.4 GHz to 20 GHz	≤5.0 dB
Phase Deviation	
Reflection Port to Ports 1–12	±15 ° @6 GHz (Typical) ±40 ° @20 GHz (Typical)
Transmission Port to Ports 1–12	±15 ° @6 GHz (Typical) ±40 ° @20 GHz (Typical)
Input Power Damage Level	>1 watt (RF + dc)

a. From Port-to-Port (1 through 12). Due to the limitations of the 8720D network analyzer, isolation is measured from 500 MHz to 20 GHz.

Environmental Characteristics

General Conditions	ESD (electrostatic discharge) must be eliminated by use of static-safe work procedures and an anti-static bench mat (such as a 92175T). Refer to Figure 2-3 on page 2-7.
Operating Environment	<p>For indoor use only</p> <p>Altitude: Up to 15,000 feet (4,572 meters)</p> <p>Operating temperature: 0 °C to 55 °C</p> <p>Maximum relative humidity: 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C</p> <p>Enclosure protection IP 20, according to IEC 529</p> <p>This product is designed for use in INSTALLATION CATEGORY II, and POLLUTION DEGREE 2, per IEC 101 and 664 respectively.</p>
Non-Operating Storage Conditions	<p>Temperature: -40 °C to 70 °C</p> <p>Humidity: 0 to 90% relative at 65 °C (non-condensing)</p> <p>Altitude: 0 to 15,240 meters (50,000 feet)</p>

Physical Dimensions

Weight

Net: Approximately 9 kg (19.85 pounds)

Shipping: Approximately 20 kg (44.10 pounds)

Cabinet Dimensions

These dimensions exclude front and rear panel protrusions.

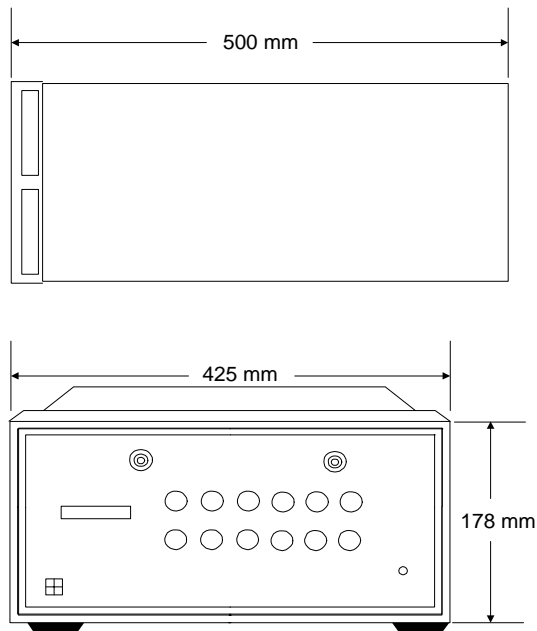
Height: 178 mm (7.02 inches)

Width: 425 mm (16.75 inches)

Depth: 500 mm (19.7 inches)

These dimensions are illustrated in Figure 5-1.

Figure 5-1 87050A Option K12 Physical Dimensions



If you should need technical assistance, contact the nearest Agilent Technologies sales or service office. A listing is located on page 7-3.

6 **Service**

Introduction

This chapter contains information on the theory of operation, how to verify the performance of your test set, how to troubleshoot it if necessary, and a block diagram.

NOTE

Please read all applicable safety warnings and cautions in Chapter 7, “Safety and Regulatory Information” before servicing the test set.

Performance Tests

Performance testing consists of measuring insertion loss, return loss, and isolation between all ports. For the most accurate measurements, the use of an 8720D 50 Ω network analyzer is recommended and its use is assumed in these notes. Familiarity with RF/microwave measurements is also assumed. The use of adapters may be required and their effects should be accounted within the measurements.

Equipment Required

- 8720D Network Analyzer
- Test Port Extension Cables and Adapters
- 85052B Calibration Kit (50 Ω , 3.5-mm)
- 909D or 00909-60006, 50 Ω Load

NOTE Make a photocopy of the performance test record (later in this chapter) to record the results of the performance tests.

There are no adjustments required for the 87050A Option K12 test set.

Set up the network analyzer with the following:

1. Number of points to 401
2. IF Bandwidth to 30 Hz

Perform a full two-port calibration from 50 MHz to 20 GHz at the ends of two cables attached to the two test ports of the 8720D. The cable on PORT 1 of the network analyzer should interface with the TRANSMISSION or REFLECTION ports on the front panel of the test set, and the cable on PORT 2 of the analyzer should interface with the test ports (1 through 12) on the front panel of the test set.

NOTE The isolation calibration routine is done with 16 averages.

NOTE Throughout this manual, the following conventions are observed:
[Hardkeys] are labeled, front panel keys.

Softkeys are display-defined keys (in the menus).

- Insertion Loss**
1. Connect the cable attached to PORT 1 of the network analyzer to the TRANSMISSION port of the test set.
 2. Connect the cable from PORT 2 of the network analyzer to PORT 1 of the test set.
 3. Select the `all_term` command using the network analyzer by pressing:
`[SEQ] > [TTL I/O] > Parallel All Out > [51] > [X1]`
This command will ensure that no conflicts will occur when selecting the test set ports.
For complete information on controlling the test set, refer to Chapter 3, “Controlling the Test Set and Making Measurements”, in this manual.

NOTE Reflection and transmission cannot be directed to the same port. If the test set does not switch to the port you have selected, switch the other port to either 1 or 4.

4. Select `Transmission Port 1` by pressing:
`[SEQ] > [TTL I/O] > Parallel All Out > [51] > [X1]`
Enter the decimal value (D in Table 3-1, on page 3-6) to select the port, then press:
`[x1]`
5. Check the status LCD on the test set to verify the port has been selected.
6. On the network analyzer, press:
`[MENU] > Trigger Menu > Single`
Wait until the analyzer is finished taking a sweep, then press:
`[SCALE REF] > Auto Scale > [MARKER]`

7. Using the front panel knob, locate the minimum value of the data trace for the following frequency ranges:
 - 50.0 MHz to 6.0 GHz
 - 6.0 GHz to 12.4 GHz
 - 12.4 GHz to 20.0 GHz
8. Write the minimum value in the Performance Test Record, on pages 6-10 through 6-14, for the port being measured.
9. Repeat steps 5 through 8 for the remaining test ports (2 through 12) listed in the Performance Test Record, on pages 6-10 through 6-14.
10. After all transmission ports have been measured, move the cable attached to the TRANSMISSION port to the REFLECTION port on the test set. Repeat steps 4 through 9, but select the reflection ports instead of the transmission ports.

Return Loss

This test will check the internal termination load of each port, and the through match when the appropriate input port is terminated with a 50 Ω load.

1. Connect the cable attached to PORT 1 of the analyzer to PORT 1 of the test set.
2. Connect a 50 Ω load to the TRANSMISSION port of the test set.
3. Select the `all_term` command using the network analyzer by pressing:
[SEQ] > [TTL I/O] > Parallel All Out > [51] > [X1]
This command will ensure that no conflicts will occur when selecting the test set ports.
4. Select `Transmission Port 1` on the network analyzer by pressing:
[SEQ] > [TTL I/O] > Parallel All Out
This will turn the switching path on.
Enter the decimal value (D in Table 3-1, on page 3-6) to select the port, then press:
[x1]
5. Check the status LCD to verify the port has been selected.
6. On the network analyzer press:
[MENU] > Trigger > Single
Wait until the analyzer is finished taking a sweep, then press:
[SCALE REF] > Auto Scale > [MARKER]

7. Using the front panel knob, locate the maximum value of the data trace for the following frequency ranges:
 - 50.0 MHz to 3.0 GHz
 - 3.0 GHz to 12.4 GHz
 - 12.4 GHz to 20.0 GHz
8. Write the value in the Performance Test Record (pages 6-15 through 6-18) for the port being measured, under “Switch Path ON.”
9. Repeat the previous two steps (7 and 8) for the remaining ports listed on pages 6-15 through 6-18 in the Performance Test Record, under “Switch Path ON.”
10. Turn the switching path off by pressing:
[SEQ] > [TTL I/O] > Parallel Out All > [51] > [X1]
11. Using the front panel knob, locate the maximum value of the data trace for the following frequency ranges:
 - 50.0 MHz to 3.0 GHz
 - 3.0 GHz to 12.4 GHz
 - 12.4 GHz to 20.0 GHz
12. Write the value in the Performance Test Record, (pages 6-19 through 6-22) for the port being measured, under “Switch Path OFF.”
13. Repeat the previous two steps (11 and 12) for the remaining ports listed on pages 6-19 through 6-22 in the Performance Test Record, under “Switch Path OFF.”
14. After all the transmission ports have been measured, move the 50 Ω load to the REFLECTION port on the test set. Repeat steps 3 through 13, but select the reflection ports instead of the transmission ports.

Isolation

NOTE

Isolation needs to only be measured on adjacent ports. Two 50Ω loads are required for this test.

1. Connect two (2) 50Ω loads to both the TRANSMISSION and REFLECTION ports on the test set.
2. Turn the averaging on by pressing:
[AVG] > Averaging On
3. Connect the two cables (attached to the network analyzer) to PORT 1 and PORT 2 of the test set. The exact order does not matter.
4. Select Reflection Port 1 on the network analyzer by pressing:
[SEQ] > [TTL I/O] > Parallel All Out
Enter the decimal value (D in Table 3-1, on page 3-6) to select the port, then press:
[x1]
5. Repeat step 4, but select Transmission Port 2 on the network analyzer. Check the status LCD on the test set for the port selected.
6. On the network analyzer, press:
[MENU] > Trigger Menu > Number of Groups > [16] > [X1]
Wait until the analyzer is finished making the measurement, then press:
[SCALE REF] > Auto Scale > [MARKER]
7. Using the front panel knob, locate the maximum value of the data trace for the 500 MHz to 20.0 GHz frequency range.
8. Write the maximum value in the Performance Test Record, on page 6-23, for the ports being measured.
9. Repeat steps 5 through 8 for the next two adjacent ports, 2 and 3. Repeat again for ports 3 and 4, and then for ports 4 and 5, and so on until you have tested ports 11 and 12.
This completes the Performance Testing instructions.

Performance Test Record

The following pages (Performance Test Record) are designed to be duplicated and used as a template for either of the Transmission or Reflection Ports during each of the performance tests (Insertion Loss, Return Loss, and Isolation). At the top of each page, circle the appropriate input port, Transmission or Reflection, and write in the test date.

87050A Option K12 Test Record

Test Facility _____	Report Number _____		
_____	Date _____		
_____	Date of Last System Calibration _____		
_____	_____		
Tested by _____	Customer _____		
Model _____	Serial Number _____		
Ambient Temperature _____ °C	Relative Humidity _____ %		
Test Equipment Used	Model Number	Trace Number	Cal Due Date
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
Special Notes:			

87050A Option K12 Insertion Loss Test Record

Test Description	Port	Specification	Measured Results	Measurement Uncertainty	
Insertion Loss 50.0 MHz up to 3.0 GHz	Transmission				
	Port 1	≤ 2.00 dB	_____	± 0.3 dB	
	Port 2	≤ 2.00 dB	_____	± 0.3 dB	
	Port 3	≤ 2.00 dB	_____	± 0.3 dB	
	Port 4	≤ 2.00 dB	_____	± 0.3 dB	
	Port 5	≤ 2.00 dB	_____	± 0.3 dB	
	Port 6	≤ 2.00 dB	_____	± 0.3 dB	
	Port 7	≤ 2.00 dB	_____	± 0.3 dB	
	Port 8	≤ 2.00 dB	_____	± 0.3 dB	
	Port 9	≤ 2.00 dB	_____	± 0.3 dB	
	Port 10	≤ 2.00 dB	_____	± 0.3 dB	
	Port 11	≤ 2.00 dB	_____	± 0.3 dB	
	Port 12	≤ 2.00 dB	_____	± 0.3 dB	
	Reflection				
	Port 1	≤ 2.00 dB	_____	± 0.3 dB	
	Port 2	≤ 2.00 dB	_____	± 0.3 dB	
	Port 3	≤ 2.00 dB	_____	± 0.3 dB	
	Port 4	≤ 2.00 dB	_____	± 0.3 dB	
	Port 5	≤ 2.00 dB	_____	± 0.3 dB	
	Port 6	≤ 2.00 dB	_____	± 0.3 dB	
	Port 7	≤ 2.00 dB	_____	± 0.3 dB	
	Port 8	≤ 2.00 dB	_____	± 0.3 dB	
	Port 9	≤ 2.00 dB	_____	± 0.3 dB	
	Port 10	≤ 2.00 dB	_____	± 0.3 dB	
Port 11	≤ 2.00 dB	_____	± 0.3 dB		
Port 12	≤ 2.00 dB	_____	± 0.3 dB		

87050A Option K12 Insertion Loss Test Record

Test Description	Port	Specification	Measured Results	Measurement Uncertainty
Insertion Loss 3.0 GHz up to 6.0 GHz	Transmission			
	Port 1	≤3.00 dB	_____	±0.3 dB
	Port 2	≤3.00 dB	_____	±0.3 dB
	Port 3	≤3.00 dB	_____	±0.3 dB
	Port 4	≤3.00 dB	_____	±0.3 dB
	Port 5	≤3.00 dB	_____	±0.3 dB
	Port 6	≤3.00 dB	_____	±0.3 dB
	Port 7	≤3.00 dB	_____	±0.3 dB
	Port 8	≤3.00 dB	_____	±0.3 dB
	Port 9	≤3.00 dB	_____	±0.3 dB
	Port 10	≤3.00 dB	_____	±0.3 dB
	Port 11	≤3.00 dB	_____	±0.3 dB
	Port 12	≤3.00 dB	_____	±0.3 dB
	Reflection			
	Port 1	≤3.00 dB	_____	±0.3 dB
	Port 2	≤3.00 dB	_____	±0.3 dB
	Port 3	≤3.00 dB	_____	±0.3 dB
	Port 4	≤3.00 dB	_____	±0.3 dB
	Port 5	≤3.00 dB	_____	±0.3 dB
	Port 6	≤3.00 dB	_____	±0.3 dB
	Port 7	≤3.00 dB	_____	±0.3 dB
	Port 8	≤3.00 dB	_____	±0.3 dB
	Port 9	≤3.00 dB	_____	±0.3 dB
	Port 10	≤3.00 dB	_____	±0.3 dB
Port 11	≤3.00 dB	_____	±0.3 dB	
Port 12	≤3.00 dB	_____	±0.3 dB	

87050A Option K12 Insertion Loss Test Record

Test Description	Port	Specification	Measured Results	Measurement Uncertainty
<p style="text-align: center;">Insertion Loss 6.0 GHz up to 12.4 GHz</p>	Transmission			
	Port 1	≤4.00 dB	_____	±0.3 dB
	Port 2	≤4.00 dB	_____	±0.3 dB
	Port 3	≤4.00 dB	_____	±0.3 dB
	Port 4	≤4.00 dB	_____	±0.3 dB
	Port 5	≤4.00 dB	_____	±0.3 dB
	Port 6	≤4.00 dB	_____	±0.3 dB
	Port 7	≤4.00 dB	_____	±0.3 dB
	Port 8	≤4.00 dB	_____	±0.3 dB
	Port 9	≤4.00 dB	_____	±0.3 dB
	Port 10	≤4.00 dB	_____	±0.3 dB
	Port 11	≤4.00 dB	_____	±0.3 dB
	Port 12	≤4.00 dB	_____	±0.3 dB
	Reflection			
	Port 1	≤4.00 dB	_____	±0.3 dB
	Port 2	≤4.00 dB	_____	±0.3 dB
	Port 3	≤4.00 dB	_____	±0.3 dB
	Port 4	≤4.00 dB	_____	±0.3 dB
	Port 5	≤4.00 dB	_____	±0.3 dB
	Port 6	≤4.00 dB	_____	±0.3 dB
	Port 7	≤4.00 dB	_____	±0.3 dB
	Port 8	≤4.00 dB	_____	±0.3 dB
	Port 9	≤4.00 dB	_____	±0.3 dB
	Port 10	≤4.00 dB	_____	±0.3 dB
Port 11	≤4.00 dB	_____	±0.3 dB	
Port 12	≤4.00 dB	_____	±0.3 dB	

87050A Option K12 Insertion Loss Test Record

Test Description	Port	Specification	Measured Results	Measurement Uncertainty
Insertion Loss 12.4 GHz up to 20.0 GHz	Transmission			
	Port 1	≤5.00 dB	_____	±0.3 dB
	Port 2	≤5.00 dB	_____	±0.3 dB
	Port 3	≤5.00 dB	_____	±0.3 dB
	Port 4	≤5.00 dB	_____	±0.3 dB
	Port 5	≤5.00 dB	_____	±0.3 dB
	Port 6	≤5.00 dB	_____	±0.3 dB
	Port 7	≤5.00 dB	_____	±0.3 dB
	Port 8	≤5.00 dB	_____	±0.3 dB
	Port 9	≤5.00 dB	_____	±0.3 dB
	Port 10	≤5.00 dB	_____	±0.3 dB
	Port 11	≤5.00 dB	_____	±0.3 dB
	Port 12	≤5.00 dB	_____	±0.3 dB
	Reflection			
	Port 1	≤5.00 dB	_____	±0.3 dB
	Port 2	≤5.00 dB	_____	±0.3 dB
	Port 3	≤5.00 dB	_____	±0.3 dB
	Port 4	≤5.00 dB	_____	±0.3 dB
	Port 5	≤5.00 dB	_____	±0.3 dB
	Port 6	≤5.00 dB	_____	±0.3 dB
	Port 7	≤5.00 dB	_____	±0.3 dB
	Port 8	≤5.00 dB	_____	±0.3 dB
	Port 9	≤5.00 dB	_____	±0.3 dB
	Port 10	≤5.00 dB	_____	±0.3 dB
Port 11	≤5.00 dB	_____	±0.3 dB	
Port 12	≤5.00 dB	_____	±0.3 dB	

87050A Option K12 Return Loss Test Record (Sw. Path ON)

Test Description	Port	Specification	Measured Results	Measurement Uncertainty	
<p style="text-align: center;">Return Loss 50.0 MHz up to 3.0 GHz Switch Path ON</p>	Transmission				
	Port 1	≥18 dB	_____	±1.5 dB	
	Port 2	≥18 dB	_____	±1.5 dB	
	Port 3	≥18 dB	_____	±1.5 dB	
	Port 4	≥18 dB	_____	±1.5 dB	
	Port 5	≥18 dB	_____	±1.5 dB	
	Port 6	≥18 dB	_____	±1.5 dB	
	Port 7	≥18 dB	_____	±1.5 dB	
	Port 8	≥18 dB	_____	±1.5 dB	
	Port 9	≥18 dB	_____	±1.5 dB	
	Port 10	≥18 dB	_____	±1.5 dB	
	Port 11	≥18 dB	_____	±1.5 dB	
	Port 12	≥18 dB	_____	±1.5 dB	
		Reflection			
	Port 1	≥18 dB	_____	±1.5 dB	
	Port 2	≥18 dB	_____	±1.5 dB	
	Port 3	≥18 dB	_____	±1.5 dB	
	Port 4	≥18 dB	_____	±1.5 dB	
	Port 5	≥18 dB	_____	±1.5 dB	
	Port 6	≥18 dB	_____	±1.5 dB	
	Port 7	≥18 dB	_____	±1.5 dB	
	Port 8	≥18 dB	_____	±1.5 dB	
	Port 9	≥18 dB	_____	±1.5 dB	
	Port 10	≥18 dB	_____	±1.5 dB	
Port 11	≥18 dB	_____	±1.5 dB		
Port 12	≥18 dB	_____	±1.5 dB		

87050A Option K12 Return Loss Test Record (Sw. Path ON)

Test Description	Port	Specification	Measured Results	Measurement Uncertainty
<p>Return Loss 3.0 GHz up to 12.4 GHz Switch Path ON</p>	Transmission			
	Port 1	≥12 dB	_____	±0.6 dB
	Port 2	≥12 dB	_____	±0.6 dB
	Port 3	≥12 dB	_____	±0.6 dB
	Port 4	≥12 dB	_____	±0.6 dB
	Port 5	≥12 dB	_____	±0.6 dB
	Port 6	≥12 dB	_____	±0.6 dB
	Port 7	≥12 dB	_____	±0.6 dB
	Port 8	≥12 dB	_____	±0.6 dB
	Port 9	≥12 dB	_____	±0.6 dB
	Port 10	≥12 dB	_____	±0.6 dB
	Port 11	≥12 dB	_____	±0.6 dB
	Port 12	≥12 dB	_____	±0.6 dB
	Reflection			
	Port 1	≥12 dB	_____	±0.6 dB
	Port 2	≥12 dB	_____	±0.6 dB
	Port 3	≥12 dB	_____	±0.6 dB
	Port 4	≥12 dB	_____	±0.6 dB
	Port 5	≥12 dB	_____	±0.6 dB
	Port 6	≥12 dB	_____	±0.6 dB
	Port 7	≥12 dB	_____	±0.6 dB
	Port 8	≥12 dB	_____	±0.6 dB
	Port 9	≥12 dB	_____	±0.6 dB
	Port 10	≥12 dB	_____	±0.6 dB
Port 11	≥12 dB	_____	±0.6 dB	
Port 12	≥12 dB	_____	±0.6 dB	

87050A Option K12 Return Loss Test Record (Sw. Path ON)

Test Description	Port	Specification	Measured Results	Measurement Uncertainty	
Return Loss 12.4 GHz up to 20.0 GHz Switch Path ON	Transmission				
	Port 1	≥10 dB	_____	±0.6 dB	
	Port 2	≥10 dB	_____	±0.6 dB	
	Port 3	≥10 dB	_____	±0.6 dB	
	Port 4	≥10 dB	_____	±0.6 dB	
	Port 5	≥10 dB	_____	±0.6 dB	
	Port 6	≥10 dB	_____	±0.6 dB	
	Port 7	≥10 dB	_____	±0.6 dB	
	Port 8	≥10 dB	_____	±0.6 dB	
	Port 9	≥10 dB	_____	±0.6 dB	
	Port 10	≥10 dB	_____	±0.6 dB	
	Port 11	≥10 dB	_____	±0.6 dB	
	Port 12	≥10 dB	_____	±0.6 dB	
	Reflection				
	Port 1	≥10 dB	_____	±0.6 dB	
	Port 2	≥10 dB	_____	±0.6 dB	
	Port 3	≥10 dB	_____	±0.6 dB	
	Port 4	≥10 dB	_____	±0.6 dB	
	Port 5	≥10 dB	_____	±0.6 dB	
	Port 6	≥10 dB	_____	±0.6 dB	
	Port 7	≥10 dB	_____	±0.6 dB	
	Port 8	≥10 dB	_____	±0.6 dB	
	Port 9	≥10 dB	_____	±0.6 dB	
	Port 10	≥10 dB	_____	±0.6 dB	
Port 11	≥10 dB	_____	±0.6 dB		
Port 12	≥10 dB	_____	±0.6 dB		

87050A Option K12 Return Loss Test Record (Sw. Path OFF)

Test Description	Port	Specification (Typical)	Measured Results	Measurement Uncertainty
<p>Return Loss 50.0 MHz up to 3.0 GHz Switch Path OFF</p>	Transmission			
	Port 1	≥22 dB	_____	±1.5 dB
	Port 2	≥22 dB	_____	±1.5 dB
	Port 3	≥22 dB	_____	±1.5 dB
	Port 4	≥22 dB	_____	±1.5 dB
	Port 5	≥22 dB	_____	±1.5 dB
	Port 6	≥22 dB	_____	±1.5 dB
	Port 7	≥22 dB	_____	±1.5 dB
	Port 8	≥22 dB	_____	±1.5 dB
	Port 9	≥22 dB	_____	±1.5 dB
	Port 10	≥22 dB	_____	±1.5 dB
	Port 11	≥22 dB	_____	±1.5 dB
	Port 12	≥22 dB	_____	±1.5 dB
	Reflection			
	Port 1	≥22 dB	_____	±1.5 dB
	Port 2	≥22 dB	_____	±1.5 dB
	Port 3	≥22 dB	_____	±1.5 dB
	Port 4	≥22 dB	_____	±1.5 dB
	Port 5	≥22 dB	_____	±1.5 dB
	Port 6	≥22 dB	_____	±1.5 dB
	Port 7	≥22 dB	_____	±1.5 dB
	Port 8	≥22 dB	_____	±1.5 dB
	Port 9	≥22 dB	_____	±1.5 dB
	Port 10	≥22 dB	_____	±1.5 dB
Port 11	≥22 dB	_____	±1.5 dB	
Port 12	≥22 dB	_____	±1.5 dB	

87050A Option K12 Return Loss Test Record (Sw. Path OFF)

Test Description	Port	Specification (Typical)	Measured Results	Measurement Uncertainty	
<p style="text-align: center;">Return Loss 3.0 GHz up to 12.4 GHz Switch Path OFF</p>	Transmission				
	Port 1	≥14 dB	_____	±0.6 dB	
	Port 2	≥14 dB	_____	±0.6 dB	
	Port 3	≥14 dB	_____	±0.6 dB	
	Port 4	≥14 dB	_____	±0.6 dB	
	Port 5	≥14 dB	_____	±0.6 dB	
	Port 6	≥14 dB	_____	±0.6 dB	
	Port 7	≥14 dB	_____	±0.6 dB	
	Port 8	≥14 dB	_____	±0.6 dB	
	Port 9	≥14 dB	_____	±0.6 dB	
	Port 10	≥14 dB	_____	±0.6 dB	
	Port 11	≥14 dB	_____	±0.6 dB	
	Port 12	≥14 dB	_____	±0.6 dB	
		Reflection			
	Port 1	≥14 dB	_____	±0.6 dB	
	Port 2	≥14 dB	_____	±0.6 dB	
	Port 3	≥14 dB	_____	±0.6 dB	
	Port 4	≥14 dB	_____	±0.6 dB	
	Port 5	≥14 dB	_____	±0.6 dB	
	Port 6	≥14 dB	_____	±0.6 dB	
	Port 7	≥14 dB	_____	±0.6 dB	
	Port 8	≥14 dB	_____	±0.6 dB	
	Port 9	≥14 dB	_____	±0.6 dB	
	Port 10	≥14 dB	_____	±0.6 dB	
Port 11	≥14 dB	_____	±0.6 dB		
Port 12	≥14 dB	_____	±0.6 dB		

87050A Option K12 Return Loss Test Record (Sw. Path OFF)

Test Description	Port	Specification (Typical)	Measured Results	Measurement Uncertainty
Return Loss 12.4 GHz up to 20.0 GHz Switch Path OFF	Transmission			
	Port 1	≥12 dB	_____	±0.6 dB
	Port 2	≥12 dB	_____	±0.6 dB
	Port 3	≥12 dB	_____	±0.6 dB
	Port 4	≥12 dB	_____	±0.6 dB
	Port 5	≥12 dB	_____	±0.6 dB
	Port 6	≥12 dB	_____	±0.6 dB
	Port 7	≥12 dB	_____	±0.6 dB
	Port 8	≥12 dB	_____	±0.6 dB
	Port 9	≥12 dB	_____	±0.6 dB
	Port 10	≥12 dB	_____	±0.6 dB
	Port 11	≥12 dB	_____	±0.6 dB
	Port 12	≥12 dB	_____	±0.6 dB
	Reflection			
	Port 1	≥12 dB	_____	±0.6 dB
	Port 2	≥12 dB	_____	±0.6 dB
	Port 3	≥12 dB	_____	±0.6 dB
	Port 4	≥12 dB	_____	±0.6 dB
	Port 5	≥12 dB	_____	±0.6 dB
	Port 6	≥12 dB	_____	±0.6 dB
	Port 7	≥12 dB	_____	±0.6 dB
	Port 8	≥12 dB	_____	±0.6 dB
	Port 9	≥12 dB	_____	±0.6 dB
	Port 10	≥12 dB	_____	±0.6 dB
Port 11	≥12 dB	_____	±0.6 dB	
Port 12	≥12 dB	_____	±0.6 dB	

87050A Option K12 Isolation Test Record

Test Description	Port	Specification	Measured Results	Measurement Uncertainty
Isolation 500.0 MHz up to 20.0 GHz	Port 1-2	≥100 dB	_____	±5 dB
	Port 2-3	≥100 dB	_____	±5 dB
	Port 3-4	≥100 dB	_____	±5 dB
	Port 4-5	≥100 dB	_____	±5 dB
	Port 5-6	≥100 dB	_____	±5 dB
	Port 6-7	≥100 dB	_____	±5 dB
	Port 7-8	≥100 dB	_____	±5 dB
	Port 8-9	≥100 dB	_____	±5 dB
	Port 9-10	≥100 dB	_____	±5 dB
	Port 10-11	≥100 dB	_____	±5 dB
	Port 11-12	≥100 dB	_____	±5 dB

Replaceable Parts

The following table contains the list of replaceable parts for the 87050A Option K12 multipoint test set. If any of these parts or assemblies are replaced, you must run all performance tests to verify conformance to specifications.

Table 6-1 Replaceable Parts

Replacement Part	Part Number	Quantity
Power Supply, 110W	0950-2252	1
Feet, Spring	1460-1345	2
Fuse, daughter control board	2110-0518	1
Fuse, 3A 250V (f), ac line module	2110-0780	2
Switch Assembly, 33314-024	33314-60012	12
Cover, top	5002-1047	1
Cover, bottom	5002-1088	1
Cover, side	5002-3985	2
Shield, power supply	5002-4017	1
Frame, rear	5021-5806	1
Strut, side	5021-5837	4
Frame, front	5022-1189	1
Foot	5041-9167	4
Trim, front frame side	5041-9173	2
Trim, top	5041-9176	1
Front Cap, strap handle	5041-9186	2
Rear Cap, strap handle	5041-9187	2
Standoff, rear panel	5041-9188	4
Handle, Strap	5063-9210	2
Front Handle Kit	5063-9228	1
Rack Mount Kit	5063-9235	1
Parallel Cable	8120-6818	1
Jumper Cable	5062-6682	2
LCD Cable	8120-8794	1
Assembly, switch	08711-60129	1
Rear Panel	08720-00102	1
Bracket, switch	08720-00103	3
RF Cable J53(59)-1	08720-20189	2
RF Cable J51(57)-2	08720-20194	2
RF Cable J12-2 to J11-6	08720-20206	1
RF Cable J12-6 to J11-2	08720-20207	1
RF Cable Odd FP Ports	08720-20235	6
Wire Harness, multipoint*	08720-60191	1
Switch Support, 12 sw	87050-00020	1
Deck	87050-00021	1

Table 6-1 **Replaceable Parts (Continued)**

Replacement Part	Part Number	Quantity
RF Cable, J50(56)-1*	87050-20131	2
RF Cable, J51(57)-1*	87050-20132	2
RF Cable, J52(58)-1*	87050-20133	2
RF Cable, J54(60)-1*	87050-20134	2
RF Cable, J55(61)-1*	87050-20135	2
RF Cable, J50(56)-2*	87050-20136	2
RF Cable, J52(58)-2*	87050-20137	2
RF Cable, J53(59)-2*	87050-20138	2
RF Cable, J54(60)-2*	87050-20139	2
RF Cable, J55(61)-2*	87050-20140	2
RF Cable, Reflection Port*	87050-20141	1
RF Cable, Transmission Port*	87050-20142	1
RF Cable, SW10-1 to SW50-2, SW11-1 to SW56-2*	87050-20145	4
RF Cable, SMA (f) to SMA (m)	87050-20345	2
RF Cable, N (m) to SMA (m)	87050-20346	2
RF Cable Even FP Ports	87050-20347	6
Wire Harness, 04c, 0.3m, 13f-06f	87130-60021	1
Wire Harness, 04c, 0.13m, 04f-04f	87050-60022	1
Wire Harness, 40c, 0.09m, 40f-40f	87050-60023	3
Fan Assembly 5 cfm	87050-60027	1
Daughter Control Board	87050-60324	1
Ribbon Cable, 16c 16f/16f	87050-60055	8
Controller Mother Board *	87050-60175	1
Front Panel Subassembly*	87050-60179	1
User's and Service Guide*	87050-90102	1
Bracket, fan	87075-00005	1
Switch, 1p4t 26.5	87104-60001	2
Switch, 1p6t 26.5	87106-60009	6
Cable Assembly, ac line	87130-60007	1
Power Cord	See Figure 4-3	1

NOTE The parts indicated (*) are unique to this special option. To order replacement parts, please contact the Component Test PGU at (707) 577-6802 with the part number, module/model number and option number. If ordering parts through your local Agilent Technologies sales or service office, specify that they are ordered through the Component Test PGU.

NOTE Special options are built to order, therefore long lead times may be encountered when ordering replacement parts.

NOTE Before replacing an assembly or board, inspect for obvious, easily repaired defects such as bent pins on ICs or cold solder joints.

Troubleshooting

This section contains information on troubleshooting the test set to the assembly level only. By following these procedures you should be able to determine whether the power supply, front panel, or main switch board need replacing. A block diagram is included at the end of this section as an aid in troubleshooting.

The theory of operation information can be found starting on page 6-24.

General Troubleshooting Notes

WARNING

Always turn the instrument power off before removing or installing an assembly.

NOTE

If you need to disassemble the instrument, be sure to work at an antistatic workstation and use a grounded wrist strap to prevent damage from electrostatic discharge (ESD). See Figure 2-3 on page 2-7.

Troubleshooting Power Supply Problems

Turn the instrument on. Check the condition of the LCD on the front panel:

1. If the LCD is off, check the main fuse located in the power supply filter at the rear of the instrument. Refer to Figure 4-4 on page 4-8.
2. If the fuse is in working order and the LCD is still off, check the cable and connections between the main board and front panel board.
3. If the cable and connections are working and the LCD is still off, there is still a possibility that the power supply is not supplying the necessary +24 V, +12 V, and +5 V to the main board.

Disconnect the dc power cable from the power supply to the main switch board and measure the voltages. They should be +24 V, +12 V, and +5 V. If not, replace the power supply.

Troubleshooting the Front Panel Display Board

Turn the instrument power on and check the following:

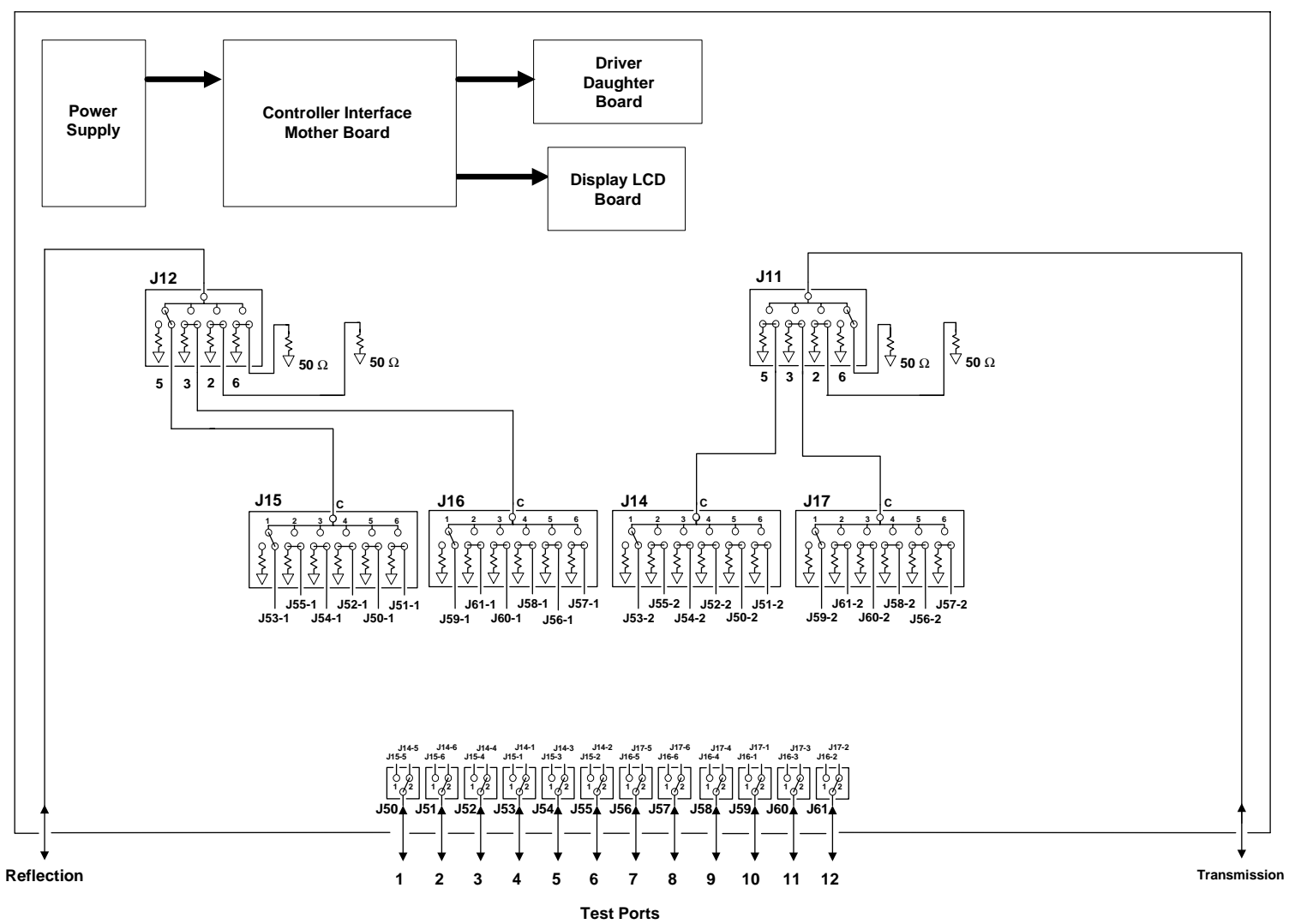
1. Check the condition of each of the switching paths by issuing commands to switch each of the paths to either the transmission or reflection path. Ensure that the LCD indicates the appropriate path.
2. If the LCD indicates a wrong path, the problem can lie with either the daughter board or the main switch board. Determine where the problem is by measuring the RF path and the +24 V control voltage.
3. If the LCD does not display the proper path, check to see if the RF path has been switched. If the problem lies with the daughter board, replace it.

Troubleshooting the Controller and Switch Driver Boards

Turn the instrument power on. Check the condition of each of the switching paths by issuing commands to switch each of the paths to either the transmission or reflection path. Check each of the RF paths for connection. If an RF path is not connected to the necessary port or terminated in 50Ω , replace the controller and switch driver board.

Refer to Figure 6-1 for a block diagram of the major components and the switching paths of the 87050A Option K12.

Figure 6-1 87050A Option K12 Block Diagram



Theory of Operation

The theory of operation begins with a general description of the 87050A Option K12 multiport test set. This is followed by more detailed operating theory. The operation of each group is described briefly, to the assembly level only. Detailed component level circuit theory is not provided.

System Theory

The test set consists of three main components: a power supply, a front panel display, and a controller interface mother board. The purpose of the power supply is to provide power to both the front panel display and the main switch board. The front panel display serves to indicate the switching paths to the user. Finally, the controller interface mother board does the actual switching between the different ports.

A1 Power Supply Theory

The switching power supply provides regulated dc voltages to power all assemblies in the test set. A dc cable provides power to the main switch board. A connector from the main switch board to the front panel display provides dc power and control signals to the front panel. The power supply provides the following supplies: +24 V, +12 V, and +5 V.

A2 Front Panel Display Theory

The front panel display consists of an LCD. The LCD is divided into a reflection line and a transmission line. The reflection line indicates which one of the sixteen ports is connected to the REFLECTION port. The transmission line indicates which one of the sixteen ports is connected to the TRANSMISSION port. Control signals and dc power are provided by a cable connected to the main switch board.

A3 Controller Board (Mother Board) and Switch Driver Board (Daughter Board) Theory

Refer to Figure 6-1, on page 6-24, for the following discussion.

The mother and daughter boards provide the bias for the switching paths for the various test ports to the TRANSMISSION and REFLECTION ports. The front panel display contains an LCD that indicates the switched ports. A particular test port (1 through 12) can be in one of three states. The three states are

1. switched to the forward path
2. switched to the reverse path
3. terminated in 50Ω

When a port is not connected, it is automatically terminated in 50Ω .

The test set consists of twelve (12) 1-by-2 switches, four (4) 1-by-6 switches, and two (2) 1-by-4 switches. The 1-by-2 switches divide each of the input ports (1 through 12) into two separate paths, the transmission path or the reflection path.

Each path, transmission or reflection, is routed to a bank of two (2) 1-by-6 switches. Each bank of switches is routed to a single 1-by-4 switch, where it becomes either the TRANSMISSION port or the REFLECTION port.

All switches are mechanical and are biased according to the necessary switching path. A user interface, through the GPIB and parallel ports, converts the necessary input signals to the control signals, which then control the switching paths.

7 **Safety and Regulatory Information**

Introduction

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

Cleaning Instructions

Clean the cabinet using a damp cloth only.

Shipping Instructions

Always transport or ship the instrument using the original packaging if possible. If not, comparable packaging must be used.

Agilent Technologies Sales and Service Offices

UNITED STATES		
Instrument Support Center Agilent Technologies (800) 403-0801		
EUROPEAN FIELD OPERATIONS		
Headquarters Agilent Technologies S.A. 150, Route du Nant-d'Avril 1217 Meyrin 2/ Geneva Switzerland (41 22) 780.8111	France Agilent Technologies France 1 Avenue Du Canada Zone D'Activite De Courtaboeuf F-91947 Les Ulis Cedex France (33 1) 69 82 60 60	Germany Agilent Technologies GmbH Agilent Technologies Strasse 61352 Bad Homburg v.d.H Germany (49 6172) 16-0
Great Britain Agilent Technologies Ltd. Eskdale Road, Winnersh Triangle Wokingham, Berkshire RG41 5DZ England (44 118) 9696622		
INTERCON FIELD OPERATIONS		
Headquarters Agilent Technologies 3495 Deer Creek Rd. Palo Alto, CA 94304-1316 USA (415) 857-5027	Australia Agilent Technologies Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130 (61 3) 895-2895	Canada Agilent Technologies (Canada) Ltd. 17500 South Service Road Trans-Canada Highway Kirkland, Quebec H9J 2X8 Canada (514) 697-4232
Japan Agilent Technologies Japan, Ltd. Measurement Assistance Center 9-1, Takakura-Cho, Hachioji-Shi, Tokyo 192-8510, Japan TEL (81) -426-56-7832 FAX (81) -426-56-7840	Singapore Agilent Technologies Singapore (Pte.) Ltd. 150 Beach Road #29-00 Gateway West Singapore 0718 (65) 291-9088	Taiwan Agilent Technologies Taiwan 8th Floor, H-P Building 337 Fu Hsing North Road Taipei, Taiwan (886 2) 712-0404
China China Agilent Technologies 38 Bei San Huan X1 Road Shuang Yu Shu Hai Dian District Beijing, China (86 1) 256-6888		

Safety Information

Warnings

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

Warnings applicable to this instrument are:

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

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

WARNING For continued protection against fire hazard replace line fuse only with same type and rating:

- United States—F 3A/250V, 2110-0780
- Europe—F 3.15A/250V, 2110-0655

The use of other fuses or material is prohibited.

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

WARNING The power cord is connected to internal capacitors that may remain live for 5 seconds after disconnecting the plug from its power supply.

WARNING These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

WARNING **The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.**

Cautions

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

Cautions applicable to this instrument are:

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

CAUTION This instrument has autoranging line voltage input; be sure the supply voltage is within the specified range

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

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

Instrument Markings



When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.



This symbol indicates hazardous voltages.



The laser radiation symbol is marked on products that have a laser output.



This symbol indicates that the instrument requires alternating current (ac) input.



The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.



The CSA mark is a registered trademark of the Canadian Standards Association.

ISM1-A

This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).



This symbol indicates that the power line switch is ON.



This symbol indicates that the power line switch is OFF or in STANDBY position.



This symbol indicates the product meets the Australian Standards.

**Safety
Earth
Ground**



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

**Before Applying
Power**

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

Regulatory Information

Statement of Compliance

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

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration Machines (Laermangabe nach der Maschinenlaermrrerordnung -3.GSGV Deutschland).

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

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: Microwave Instruments Division
1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

declares that the products

Product Name: Switching Test Set

Model Number: HP 87050A, HP 87050B

Product Options: This declaration covers all options of the above products.

conform to the following Product specifications:

Safety: IEC 1010-1:1990+A1 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

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


IEC 1000-3-2:1995/EN 61000-3-2:1995
IEC 1000-3-3:1994/EN 61000-3-2:1995

Supplementary Information:

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

This product was tested for use with the HP 8711, HP 8712, HP 8713, and HP 8714 family of network analyzers.

Santa Rosa, California, USA 26 Dec. 1996


John Hiatt/Quality Engineering Manager

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