

Agilent Technologies 87050A Option K08

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

Agilent Technologies Part Number: 87050-90137

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WARNING	Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.
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CAUTION	Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.
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Definitions

Specifications describe the performance of parameters covered by the product warranty (temperature -0 to 55 °C, unless otherwise noted.)

- *Typical* describes additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80% of the units exhibit with a 95% confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.
- *Nominal* values indicate expected performance or describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- *Characteristic Performance* describes performance parameter that the product is expected to meet before it leaves the factory, but is not verified in the field and is not covered by the product warranty. A characteristic includes the same guard bands as a specification.

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Description

The Agilent Technologies 87050A Option K08 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 eight (8) 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 K08 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 safely and correctly install the multiport test set.

- [Verifying the Shipment](#)
- [Meeting Electrical and Environmental Requirements](#)
- [Connecting and Turning On the Test Set](#)
- [Setting the Test Set Address Switch](#)
- [Performing the Operators Check](#)

Verifying 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.

Verify the items received in [Table 1-1](#).

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, refer to [“Contacting Agilent” on page 6-8](#).

Table 1-1 87050A Option K08 Accessories Supplied

Description	Part Number	Quantity
Power Cord	See Figure 3-4 on page 3-8	1
Front Handle Kit	5063-9226	1
Rack Mount Kit	5063-9232	1
Parallel Cable	8120-6818	1
RF Cable SMA (m) to SMA (m)	5062-6681	2
Adapter APC 3.5 (f)	5061-5311	2
User's and Service Guide	87050-90137	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.

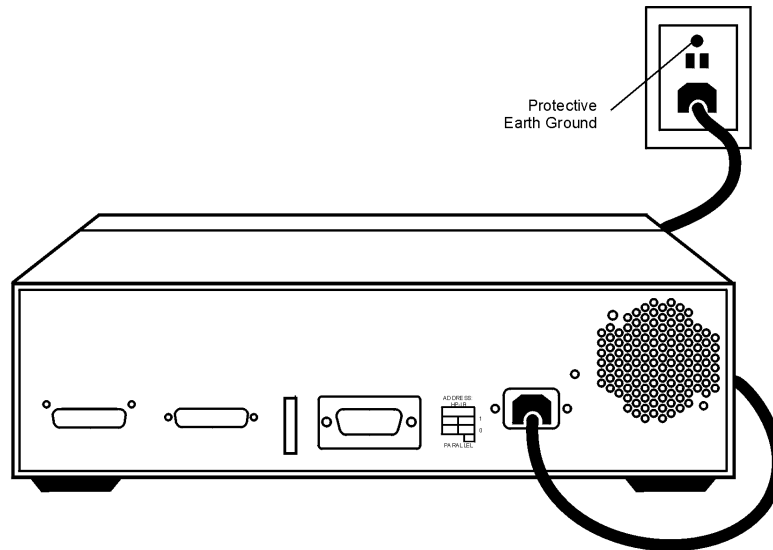
3. Ensure that the operating environment meets the following safety requirements for
 - indoor use
 - altitude up to 15,000 feet (4,572 meters)
 - temperature range of 0 °C to 55 °C
 - maximum relative humidity: 80% for temperatures up to 31 °C, decreasing linearly to 50% relative humidity
 - enclosure 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 1-1](#) depicts only one type of power source outlet. Refer to [Figure 3-4 on page 3-8](#) to see the different types of power cord plugs that can be used with your test set.

Figure 1-1 Protective Earth Ground

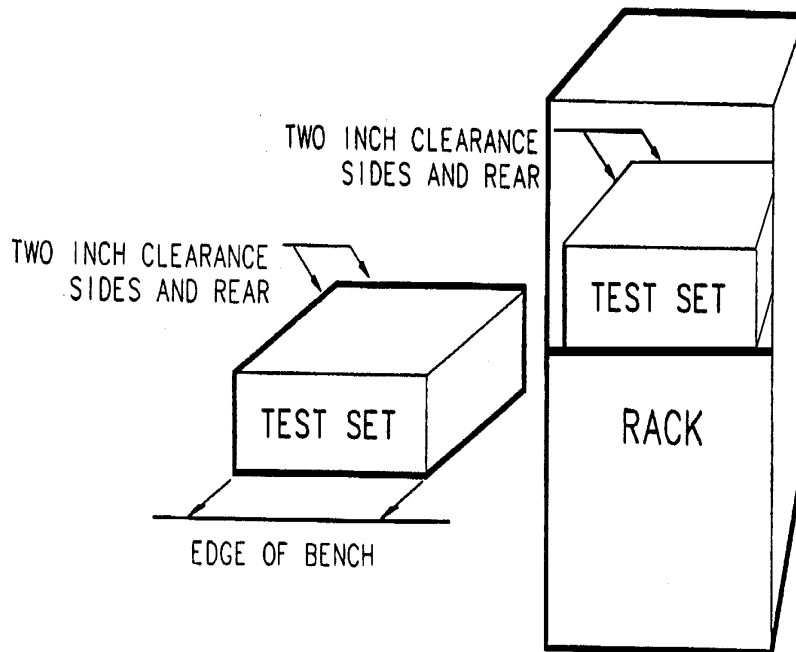


WARNING

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 1-2. 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 1-2 Ventilation Clearance Requirements

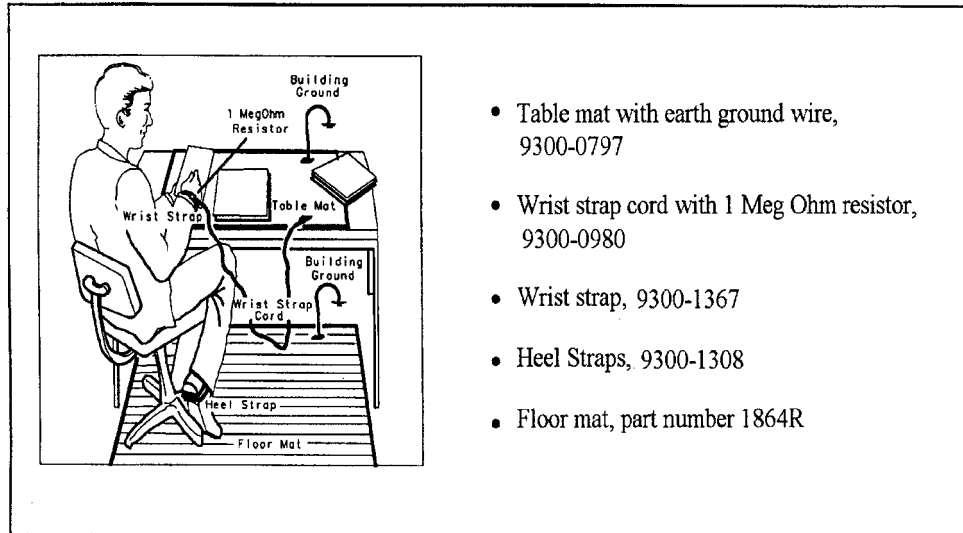


CAUTION

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 1-3](#)).

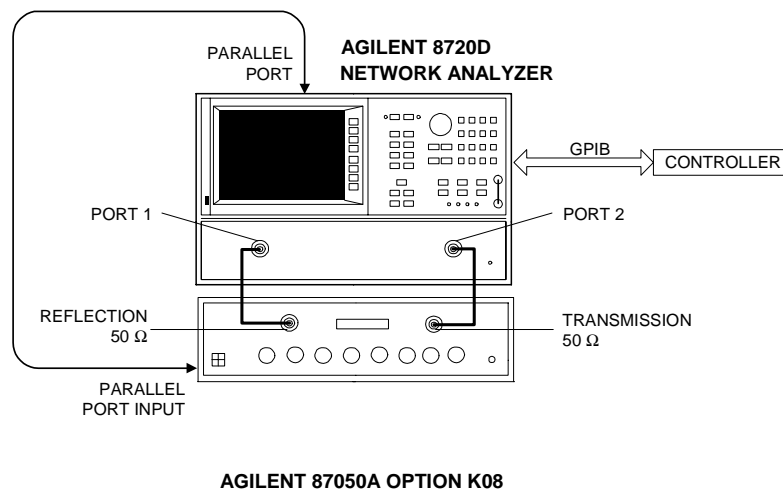
Figure 1-3 Example of an Antistatic Workstation



Connecting and Turning On the Test Set

The 87050A Option K08 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 1-4. Use the two APC 3.5 50 Ω jumper cables (5062-6681) and the two APC 3.5 Adapters (5061-5311) that were shipped with the test set. See Table 1-1 for a list of accessories supplied.

Figure 1-4 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

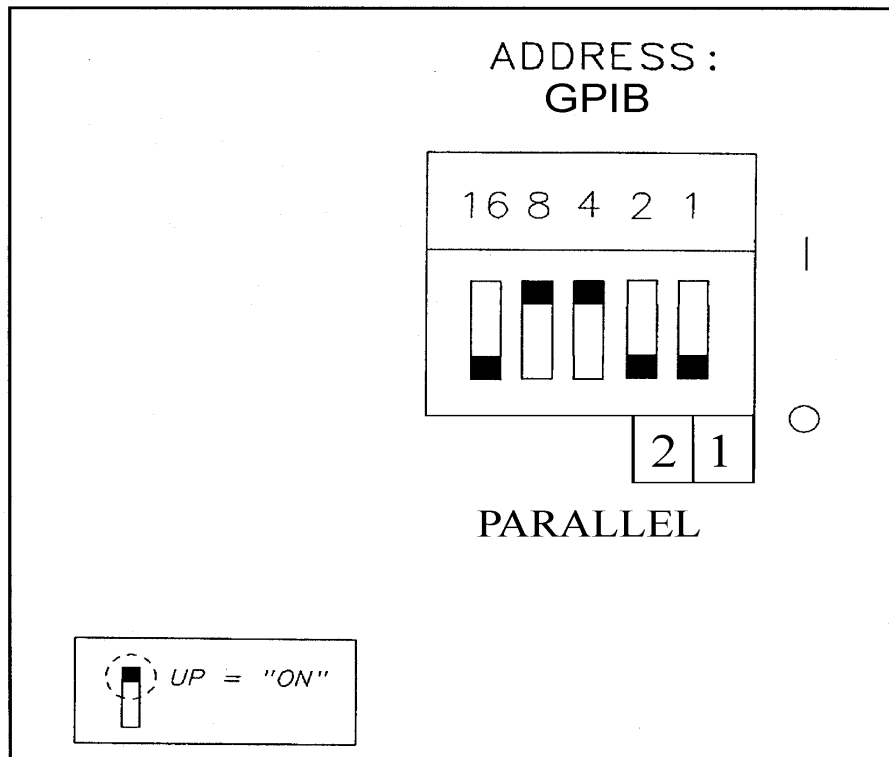
The test set is shipped with the GPIB address set to 12, which sets the parallel address to 0 as in [Figure 1-5](#). Refer to [Chapter 2, "Controlling the Test Set and Making Measurements,"](#) for the definition of the parallel address.

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 1-5 The Test Set Address Switch



Performing the Operators Check

For information on controlling the test set, refer to [Chapter 2, “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 5, “Service Information.”](#)

Procedure

This procedure performs a simple operator's check using the proper frequency range and impedance on the network analyzer.

Equipment Required

- Network Analyzer, 50 Ω impedance (8720D)
- Cable, 50 Ω , 3.5-mm (8120-4921 or equivalent), quantity 2
- Calibration Kit, 50 Ω , 3.5-mm (85052B)

Process

1. Connect the 50 Ω cable to PORT 1 of the analyzer.
2. Perform a one-port reflection calibration at the end of the 50 Ω cable over a frequency range of 50 MHz to 20 GHz. 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 K08 test set.
4. Measure the return loss of each path of the test set by selecting PORT 1 through PORT 8, one at a time, using the network analyzer. Terminate each port being tested with a 50 Ω load. 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 8, using the network analyzer. Terminate each port being tested with a 50 Ω load. 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 still not function properly. For more complete testing, see [“Performance Tests” on page 5-3.](#)

Installation and Calibration
Performing the Operators Check

Controlling the Test Set and Making Measurements

Introduction

The 87050A Option K08 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 the following pages.

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 2-1 on page 2-4](#) for a diagram of connections for this type of control. The following examples use the variable [D] which is defined in [Table 2-1 on page 2-5](#).

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
```

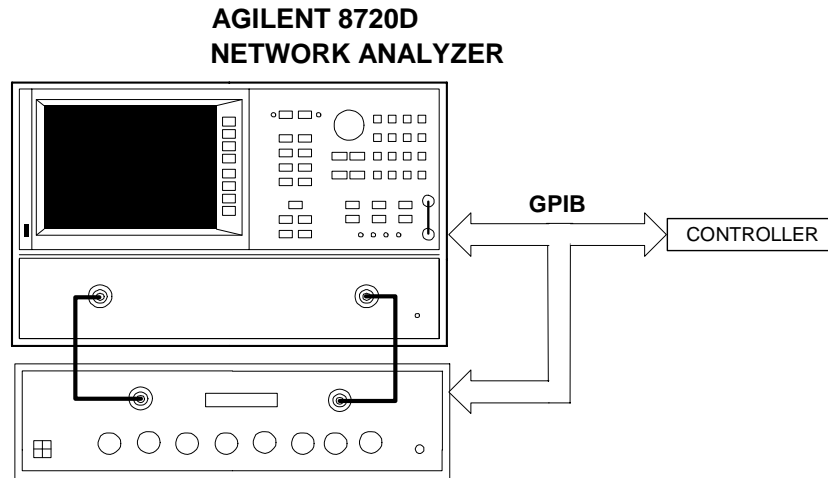
```
OUTPUT 716;"PARAOUT[D];"   Programs all GPIO output  
                             bits (0 to 256) at once
```

Be sure to use the ending semi-colon.

2. The second way to control the test set is to address the 87050A Option K08 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$"
```

Figure 2-1 Controlling the Test Set over GPIB



AGILENT 87050A OPTION K08

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 2-1 on page 2-5](#)).

Table 2-1 Test Port Addresses

Connection Path	Decimal [D]	Binary Equivalent	GPIB Command
Reflection to Port 1	1	00000001	refl_01
Reflection to Port 2	2	00000010	refl_02
Reflection to Port 3	3	00000011	refl_03
Reflection to Port 4	4	00000100	refl_04
Reflection to Port 5	5	00000101	refl_05
Reflection to Port 6	6	00000110	refl_06
Reflection to Port 7	7	00000111	refl_07
Reflection to Port 8	8	00001000	refl_08
Reflection Terminated	18	00010010	*r_term
Transmission to Port 1	9	00001001	tran_01
Transmission to Port 2	10	00001010	tran_02
Transmission to Port 3	11	00001011	tran_03
Transmission to Port 4	12	00001100	tran_04
Transmission to Port 5	13	00001101	tran_05
Transmission to Port 6	14	00001110	tran_06
Transmission to Port 7	15	00001111	tran_07
Transmission to Port 8	16	00010000	tran_08
Transmission Terminated	19	00010011	*t_term
All Ports Terminated	17	00010001	*all_term
Reset	0	00000000	*rst

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 8.

GPIB Queries

When an external computer is used to control the test set, the computer can use all of the commands listed in [Table 2-2](#). In addition, the computer can use GPIB queries that are not available when the network analyzer is used to control the test set.

Table 2-2 GPIB Queries

Query	Test Set Response
id?	Test Set ID
sw10?	Number of times Switch #10 has operated
sw11?	Number of times Switch #11 has operated
sw12?	Number of times Switch #12 has operated
sw13?	Number of times Switch #13 has operated
sw14?	Number of times Switch #14 has operated
sw15?	Number of times Switch #15 has operated
sw50?	Number of times Switch #50 has operated
sw51?	Number of times Switch #51 has operated
sw52?	Number of times Switch #52 has operated
sw53?	Number of times Switch #53 has operated
sw54?	Number of times Switch #54 has operated
sw55?	Number of times Switch #55 has operated
sw56?	Number of times Switch #56 has operated
sw57?	Number of times Switch #57 has operated

Box Identification

To read the Box Identification, first query the test set for its ID, then read back the ID from the test set. For example, if the GPIB address of the test set is 12, send the following commands:

```
OUTPUT 712;"id?"  
ENTER 712;Box_id$
```

Switch Count

The Switch Count is the number of times a switch has been operated. To read the Switch Count for a particular switch, first query the switch and then read back the count. For example, if the test set has an address of 12, the following two commands will read the Switch Count for switch #10:

```
OUTPUT 712;"sw10?"  
ENTER 712;Count$
```

Languages

Using Rocky Mountain Basic (RMB)

To address the 87050A Option K08 test set directly over GPIB, use 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. (Note the semi-colon ";".)

Write Commands:

```
OUTPUT 712;"STRING$;" ! Output Command
```

Read Commands:

```
OUTPUT 712;"STRING$;" ! Output Command  
ENTER 712;String$ ! Enter Command
```

Using Quick Basic or Visual Basic

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

NOTE

Be sure to re-enable EOI and EOL before sending data to another instrument.

Write Commands:

```
info$="refl_01" 'command for reflection to port 1  
length%=len(info$) 'length of command  
HpibEoi(hHpib;7,0) 'disable EOI  
HpibEol(hHpib;7,"",0) 'disable EOL  
HpibOutputs (hHpib;712,info$,length%) 'send command to test set  
HpibEol(hHpib;7,chr$(13)+chr$(10),2) 're-enable EOL and set to  
chr$(13)+chr$(10)  
HpibEoi(hHpib;7,1,) 're-enable EOI hHpib specifies the handle  
returned byHpibOpen.
```

Read Commands:

```
info$="id?" `command for test set identification.
length%=len(info$) `length of command
max.len% = 10 `max length data from id? or swxx? function.
infi$ = space$(max.len%)
HpiBEoi(hHpiB;7,0) `disable EOI.
HpiBEol(hHpiB;7,"",0) `disable EOL
HpiBOutputs (hHpiB;712,info$,length%) `send command to test set.
HpiBEnters(hHpiB%,712,infi$,max.len%) `get data from test set.
HpiBEol(hHpiB;7,chr$(13)+chr$(10),2) `re-enable EOL and set to
chr$(13)+chr$(10).
HpiBEoi(hHpiB;7,1,) `re-enable EOI hHpiB specifies the handle
returned byHpiBOpen.
```

NOTE

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

Using HPVVEE

If you are using HPVVEE, be sure to set the Direct I/O in the Advance Device Configuration so the Read Terminator and Write EOL Sequence is set to "\n". In the I/O Transaction make sure the EOL is ON.

Using National Instruments VISA

If you are using National Instruments VISA, be sure to set the following variables as follows:

`VI_ATTR_SEND_END = VI_FALSE` ` This specifies whether to assert END during the transfer of the last byte of the buffer

`VI_ATTR_TERMCHAR = 0x0A` ` This is the termination character. When the termination character is read and `VI_ATTR_TERMCHAR_EN` is enabled during a read operation, the read operation terminates.

`VI_ATTR_TERMCHAR_EN = VI_TRUE` ` This is a flag that determines whether the read operation should terminate when a termination character is received.

`VI_ATTR_SUPPRESS_END_EN = VI_FALSE` ` Specifies whether to suppress the END bit termination. If this attribute is set to `VI_TRUE`, the END bit does not terminate read operations. If this attribute is set to `VI_FALSE`, the END bit terminates read operations.

Write Commands:

Append all commands with "\n," for example, `*rst\n`.

Read Commands:

The 87050A Option K08 returns data terminated by `\r\n`.

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.

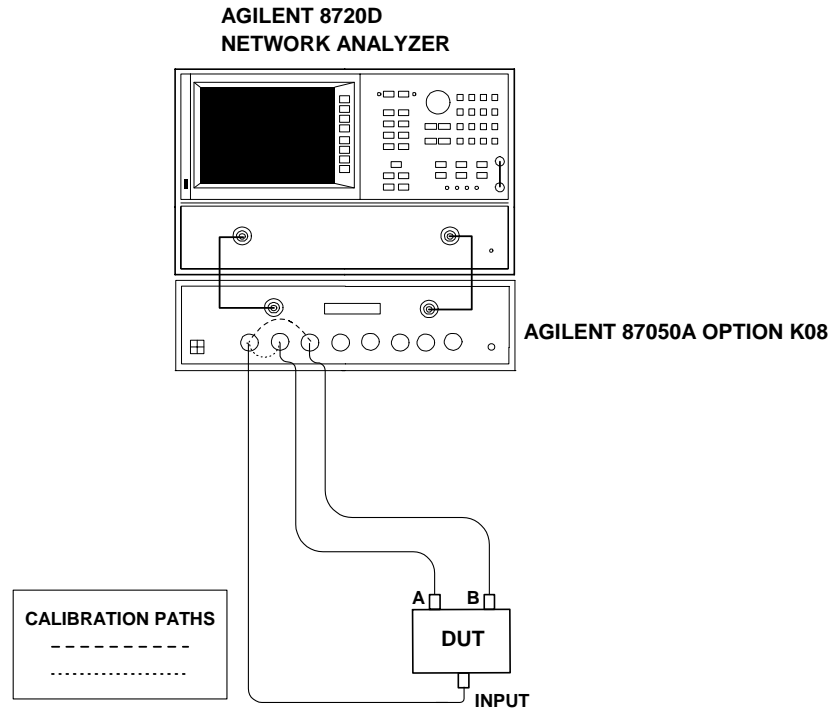
You will need to calibrate each measurement path separately and store the calibration as an instrument state in the network analyzer. Refer to your network analyzer's user's guide for information on how to calibrate and store instrument states. Refer to [Figure 2-2](#) for an example of the setup.

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 2-2 **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 3. 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 1-9](#) for information on setting the test set's address.

Measuring Transmission

Refer to [Figure 2-3](#) 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.

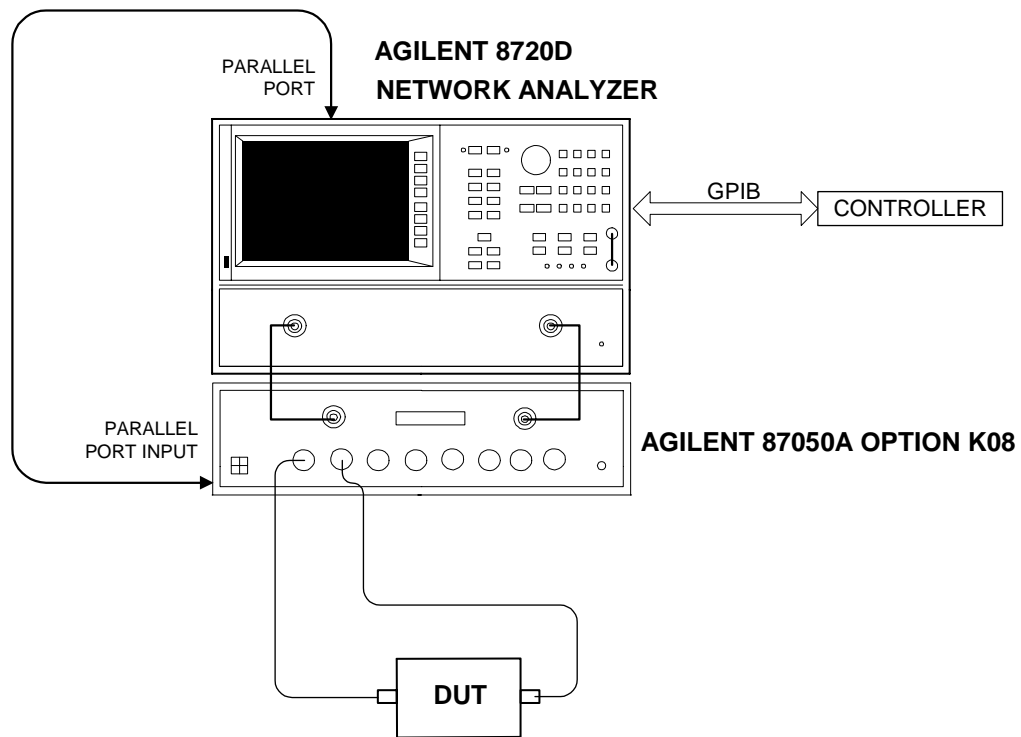
By using the following commands, you will connect PORT 1 of the test set to the REFLECTION port, and you will connect PORT 2 of the test set to the TRANSMISSION port. You will thus be measuring forward transmission through the device under test when measuring S_{21} . This will provide you with gain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

```
OUTPUT 716;"PARALGPIO;"  
OUTPUT 716;"PARAOUT1;"  
  
OUTPUT 716;"PARALGPIO;"  
OUTPUT 716;"PARAOUT9;"
```

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

```
OUTPUT 712;"refl_01"  
OUTPUT 712;"tran_02"
```

Figure 2-3 **Controlling the Test Set**



Measuring Reflection

By leaving the DUT connected as in [Figure 2-3](#) and setting the network analyzer to measure S_{11} , you can measure reflection or return loss.

3 **Front and Rear Panels**

Introduction

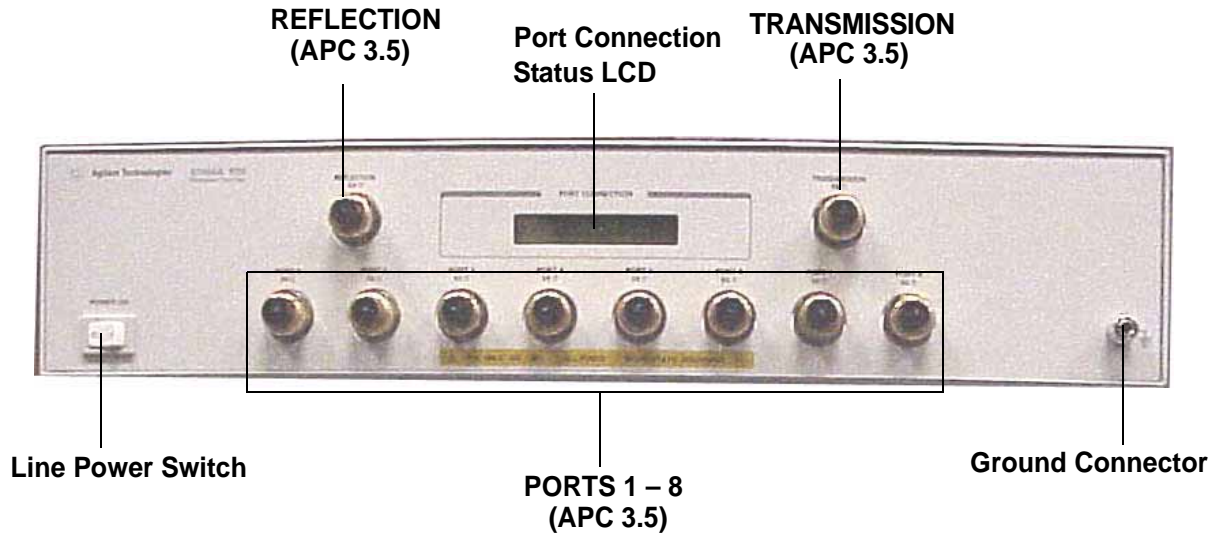
This chapter contains information on the ports and switches found on the front and rear panels of the test set.

This chapter is divided into two sections:

- [Front Panel](#)
- [Rear Panel](#)

Front Panel

Figure 3-1 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 50 Ω .

The REFLECTION and TRANSMISSION Ports

The REFLECTION and TRANSMISSION ports are 50 Ω , 3.5-mm connectors. A 50 Ω cable connects directly to the REFLECTION/TRANSMISSION port or PORT 1/PORT 2 of the network analyzer using the cables (5062-6681) 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 1-8

PORTS 1 through 8 are 50 Ω 3.5-mm connectors that are used to connect to the device under test.

CAUTION

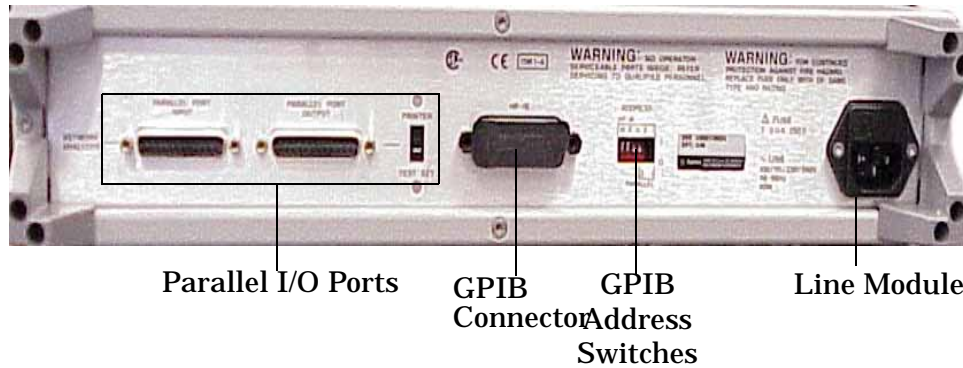
Do not input more than 1 watt (RF and dc combined) to these ports, or damage to the internal RF switches or the analyzer may occur.

The Ground Connector

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

Rear Panel

Figure 3-2 Rear Panel Features



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.

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.

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 2-1 on page 2-4](#).

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 1-9](#) for more 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 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 3-4 on page 3-8](#) for the part numbers of these power cables. Refer to [“Contacting Agilent” on page 6-8](#) for cables that are available in different lengths.

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.

Line Fuse

The line fuse, as well as a spare, reside within the line module. [Figure 3-3](#) 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 3-3 **Location of Line Fuses**

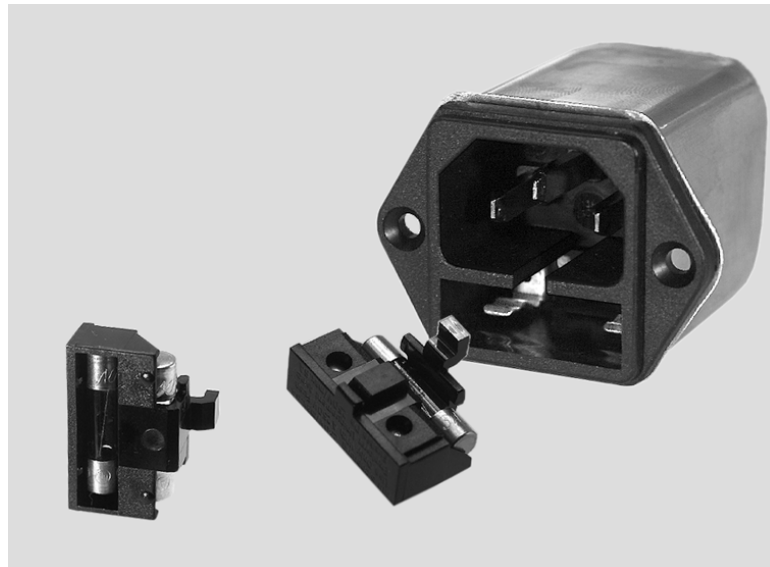
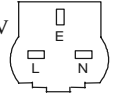
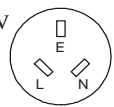
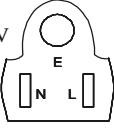
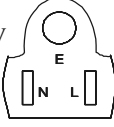
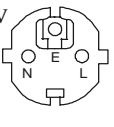
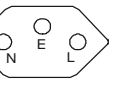

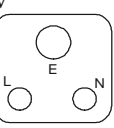
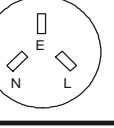


Figure 3-4 Power Cable and Line (Mains) Plug Part Numbers

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.

4 Specifications and Characteristics

Table 4-1

Performance Specifications and Characteristics
Option K08 Performance Specifications and Characteristics

Parameter	Specification
Frequency Range	50 MHz to 20 GHz
Isolation: ^a	
500 MHz up to 20.0 GHz	≥90 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 1–8	±15 ° @6 GHz (Typical) ±40 ° @20 GHz (Typical)
Transmission Port to Ports 1–8	±15 ° @6 GHz (Typical) ±40 ° @20 GHz (Typical)
Input Power Damage Level	>1 watt (RF + dc)

a. From Port-to-Port (1 through 8). 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 1-3 on page 1-7](#).

Operating Environment

For indoor use only

Altitude: Up to 15,000 feet (4,572 meters)

Operating temperature: 0 °C to 55 °C

Maximum relative humidity: 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C

Enclosure protection IP 20, according to IEC 529

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

Non-Operating Storage Conditions

Temperature: -40 °C to 70 °C

Humidity: 0 to 90% relative at 65 °C (non-condensing)

Altitude: 0 to 15,240 meters (50,000 feet)

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: 89.9 mm (3.50 inches)

Width: 425 mm (16.75 inches)

Depth: 500 mm (19.7 inches)

If you should need technical assistance, contact the nearest [“Contacting Agilent” on page 6-8](#).

Specifications and Characteristics
Environmental Characteristics

5 **Service Information**

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 6, “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 50Ω 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 (50Ω 3.5-mm)
- 909D or 00909-60006, 50Ω 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 K08 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 8) 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 2, “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 ([Table 2-1 on page 2-5](#)) 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”](#) beginning on [page 5-7](#) for the port being measured.
9. Repeat steps 5 through 8 for the remaining test ports (2 through 8) listed in the [“Performance Test Record”](#) beginning on [page 5-7](#).
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 [step 4](#) through [step 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 50Ω load.

1. Connect the cable attached to PORT 1 of the analyzer to PORT 1 of the test set.
2. Connect a 50Ω 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 ([Table 2-1 on page 2-5](#)) 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 minimum value in the “[Performance Test Record](#)” beginning on [page 5-7](#) for the port being measured, under “Switch Path ON.”
9. Repeat the previous two steps (7 and 8) for the remaining ports in the “[Performance Test Record](#)” beginning on [page 5-7](#), 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” beginning on page 5-7 for the port being measured, under “Switch Path OFF.”
13. Repeat the previous two steps (11 and 12) for the remaining ports in “Performance Test Record” beginning on page 5-7, under “Switch Path OFF.”
14. After all the transmission ports have been measured, move the 50Ω 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 (Table 2-1 on page 2-5) 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” beginning on page 5-7 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 7 and 8.

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 K08 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 K08 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
	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	

87050A Option K08 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
	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	
Insertion Loss 6.0 GHz up to 12.4 GHz	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
	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	

87050A Option K08 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	
		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		

87050A Option K08 Return Loss Test Record (Sw. Path ON)

Test Description	Port	Specification	Measured Results	Measurement Uncertainty
Return Loss 50.0 MHz up to 3.0 GHz Switch Path ON	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
	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	
Return Loss 3.0 GHz up to 12.4 GHz Switch Path ON	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
	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	

87050A Option K08 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
	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	

87050A Option K08 Return Loss Test Record (Sw. Path OFF)

Test Description	Port	Specification (Typical)	Measured Results	Measurement Uncertainty
Return Loss 50.0 MHz up to 3.0 GHz Switch Path OFF	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
	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	
Return Loss 3.0 GHz up to 12.4 GHz Switch Path OFF	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
	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	

87050A Option K08 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
	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	

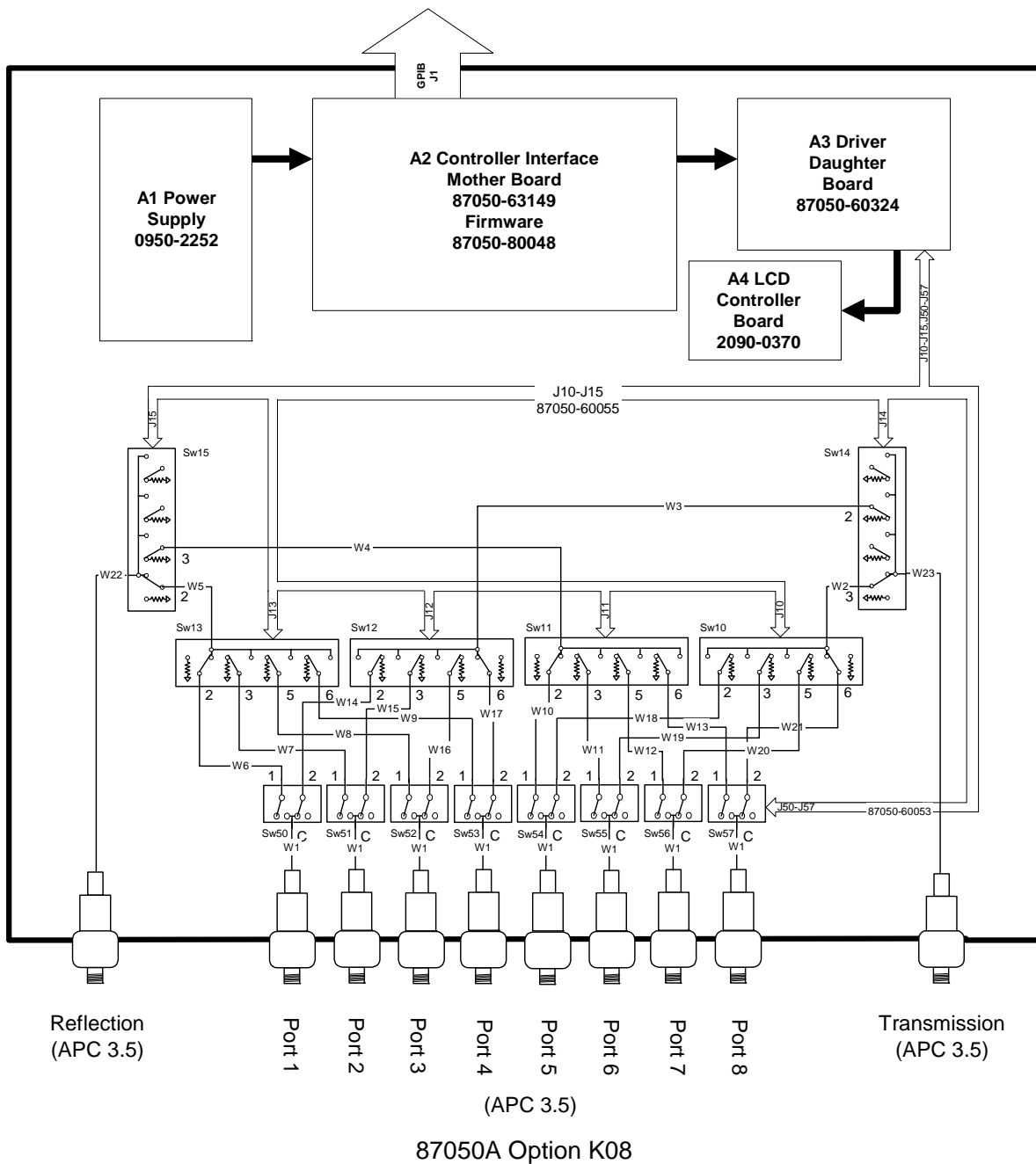
87050A Option K08 Isolation Test Record

Test Description	Port	Specification	Measured Results	Measurement Uncertainty
Isolation 500.0 MHz up to 20.0 GHz	Port 1-2	≥90 dB	_____	±5 dB
	Port 2-3	≥90 dB	_____	±5 dB
	Port 3-4	≥90 dB	_____	±5 dB
	Port 4-5	≥90 dB	_____	±5 dB
	Port 5-6	≥90 dB	_____	±5 dB
	Port 6-7	≥90 dB	_____	±5 dB
	Port 7-8	≥90 dB	_____	±5 dB

Adjustments

There are no adjustments for the test set.

Figure 5-1 87050A Option K08 Block Diagram



Theory of Operation

The theory of operation begins with a general description of the 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

Refer to [Figure 5-1](#). The test set consists of three main components: a power supply, front panel display, and main switch board. The purpose of the power supply is to supply 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 main switch 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, +5 V.

The power LED on the front panel indicates that the instrument is on and that the power supply is providing power.

A2 Controller and A3 Switch Driver Board Theory

The mother and daughter boards provide the bias for the switching paths for the various ports to the Reflection or Transmission ports. The front panel display contains an LCD that indicates the switched ports. A particular test port (1 through 8) can be in one of three states. The three states are:

- Switched to the forward path
- Switched to the reverse path
- Terminated in 50 Ω

When a port is not connected, it is automatically terminated in 50 Ω . Only one test port can be connected to any one reflection port and only one test port can be connected to any transmission port at any given time.

The test set consists of eight 1x2 switches and six 1x4 switches. The 1x2 switches divide each of the input ports (1 through 8) into two separate paths.

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

A4 Front Panel Display Theory

The front panel display consists of an LCD. The LCD is divided into two lines of text. The first line indicates which of the eight ports are connected to the forward path. The second line indicates which of the eight ports are connected to the reverse path. Control signals and DC power are provided by a cable connected to the main switch board.

Connector Replacement

The 50 Ω APC 3.5 connectors are available separately. It is possible to replace them in the field.

Troubleshooting

This section contains procedures for troubleshooting the test set to assembly level only. These procedures should enable you to determine whether the power supply, front panel, or main switch board needs replacing. Refer to the system block diagram [Figure 5-1 on page 5-15](#) as an aid in troubleshooting.

General Troubleshooting Notes

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

WARNING Some parts in the instrument have sharp edges. Work carefully to avoid injury.

CAUTION If you need to disassemble the instrument, be sure to work at an antistatic workstation and use a grounded wrist strap. This will protect the instrument from electrostatic discharges (ESD) that could damage the instrument.

CAUTION After identifying a defective assembly or board, inspect it for obvious, easy-to-fix defects such as bent pins on ICs or cold solder joints. Repair of these defects by qualified personnel will restore the instrument to normal operation much more rapidly than ordering a replacement assembly or board.

Power Supply Problems

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

- If it is off, there is still a possibility that the power supply is not supplying the necessary +24V, +12V, and +5V to the main board.
- If the LCD is off, check the main fuse located in the power supply filter at the rear of the instrument.
- If the LCD is still off, check the cable between the main board and front panel board.
- Finally, disconnect the DC power cable from the power supply to the main switch board and measure the voltages. They should be +15V, +12V, and +5V. If not, replace the power supply.

Front Panel Board

Turn the instrument power on and check the following:

- 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.
- If the LCD indicates a wrong path, the problem can lie with either the front panel board or the main switch board. Measure the RF path to determine where the problem is.
- Ensure that the front panel washers between the board and front panel assembly are present. Missing washers can cause erratic LCD behavior.
- If the LCD does not display the proper path, check to see if the RF path has indeed been switched. If the problem lies with the front panel board, replace it.

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 Reflection or Transmission path. Check each of the RF paths for connection. If an RF path is not connected to the necessary port or terminated in 50 Ω , replace the controller and switch driver board.

List of Replaceable Parts

The following table contains the list of replaceable parts for the test set. If any of these parts or assemblies is replaced, you must perform all performance tests to verify conformance to specifications

Table 5-1 Replaceable Parts for 87050A Option K08

Reference Designator	Description	Agilent Part Number	Quantity
A1	24 Volt Power Supply	0950-2252	1
A4	2x16 LCD	2090-0370	1
Sw50-Sw57	1P2T Switch 26.5 GHz	33314C	8
W5	RF Cable	87050-20017	1
W9	RF Cable	87050-20024	1
	J50-J57 CA AY	87050-60053	1
	J10-J15 CA AY	87050-60055	6
A3	Driver PCB	87050-60324	1
Sw10-Sw15	1P4T Switch 26.5 GHz	87104C	6
	Connector APC 3.5 (F)	5062-6618	10
W1	RF Cable	Z5623-20027	8
W2	RF Cable	Z5623-20028	1
W3	RF Cable	Z5623-20029	1
W4	RF Cable	Z5623-20030	1
W6	RF Cable	Z5623-20031	1
W7	RF Cable	Z5623-20032	1
W8	RF Cable	Z5623-20033	1
W10	RF Cable	Z5623-20034	1
W11	RF Cable	Z5623-20035	1
W12	RF Cable	Z5623-20036	1
W13	RF Cable	Z5623-20037	1
W14	RF Cable	Z5623-20038	1
W15	RF Cable	Z5623-20039	1
W16	RF Cable	Z5623-20040	1

Table 5-2 Replaceable Parts for 87050A Option K08

Reference Designator	Description	Agilent Part Number	Quantity
W17	RF Cable	Z5623-20041	1
W18	RF Cable	Z5623-20042	1
W19	RF Cable	Z5623-20043	1
W20	RF Cable	Z5623-20044	1
W21	RF Cable	Z5623-20045	1
W22	RF Cable	Z5623-20046	1
W23	RF Cable	Z5623-20047	1
A2	Control Mother PCB	87050-63149	1

NOTE The above parts are unique to this special option. To order replacement parts, please contact the Component Test / Product Generation Unit (CT / PGU) Support Group at (707) 577-6802 with the part number, module/model number, and option number. If ordering parts through your local Agilent Technologies Sales and Service Office, specify that they are ordered through the Component Test PGU Support Group.

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

Service Information
List of Replaceable Parts

6 Safety and Regulatory Information

Introduction

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Connector Care and Cleaning

If alcohol is used to clean the connectors, the power cord to the instrument must be removed. All cleaning should take place in a well ventilated area. Allow adequate time for the fumes to disperse and moist alcohol to evaporate prior to energizing the instrument.

WARNING

To prevent electrical shock, disconnect the Agilent Technologies model product from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

Before Applying Power

Verify that the product is configured to match the available main power source. 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.

Shipping Instructions

You must always call the Agilent Technologies Instrument Support Center to initiate service before retuning your instrument to a service office. See [“Contacting Agilent” on page 6-8](#). Always transport or ship the instrument using the original packaging if possible. If not, comparable packaging must be used. Attach a complete description of the failure symptoms.

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:









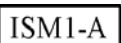



CAUTION Always use the three-prong ac power cord supplied with this instrument. Failure to ensure adequate earth grounding by not using this cord may cause instrument damage

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.
	This symbol indicates the product meets the Australian Standards.
	This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).
	This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPR 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.
	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.

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 Canadian EMC Requirements

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme a la norme NMB du Canada.

Compliance with German Noise Requirements

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

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

Contacting Agilent

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

This information supersedes all prior contact information.			
Online assistance: www.agilent.com/find/assist			
Americas			
Brazil <i>(tel)</i> (+55) 11 3351 7012 <i>(fax)</i> (+55) 11 3351 7024	Canada <i>(tel)</i> +1 877 894 4414 <i>(alt)</i> +1 303 662 3369 <i>(fax)</i> +1 800 746 4866	Mexico <i>(tel)</i> 1800 254 2440 Ext 2703 <i>(alt)</i> from USA 18008374039 <i>(fax)</i> 1 800 254 422	United States <i>(tel)</i> 800 829 4444 <i>(alt)</i> (+1) 303 662 3998 <i>(fax)</i> 800 829 4433
Asia Pacific and Japan			
Australia <i>(tel)</i> 1 800 225 574 <i>(fax)</i> 1 800 681 776 <i>(fax)</i> 1 800 225 539	China <i>(tel)</i> 800 810 0189 <i>(fax)</i> 800 820 2816	Hong Kong <i>(tel)</i> 800 933 229 <i>(fax)</i> 800 900 701	India <i>(tel)</i> 1600 112 626 <i>(alt)</i> +65 6275 0800 <i>(fax)</i> 1600 113 040
Japan (Bench) <i>(tel)</i> 0120 421 345 <i>(alt)</i> (+81) 426 56 7832 <i>(fax)</i> 0120 01 2144	Japan (On-Site) <i>(tel)</i> 0120 421 345 <i>(alt)</i> (+81) 426 56 7832 <i>(fax)</i> 0120 012 114	Malaysia <i>(tel)</i> 1800 880 399 <i>(fax)</i> 1800 801 054	New Zealand <i>(tel)</i> +64 4 939 0635 <i>(alt)</i> 0800 738 378 <i>(fax)</i> +64 4 972 5364
Singapore <i>(tel)</i> 1 800 275 0880 <i>(fax)</i> (+65) 6755 1214	South Korea <i>(tel)</i> 080 778 0011 <i>(fax)</i> 080 778 0013	Taiwan <i>(tel)</i> 0800 047 669 <i>(fax)</i> 0800 047 667 <i>(fax)</i> +886 3492 0779	Thailand <i>(tel)</i> +66 2 267 5913 <i>(tel)</i> 1 800 2758 5822 <i>(fax)</i> 1 800 653 336
Europe			
Austria <i>(tel)</i> 0820 87 44 11* <i>(fax)</i> 0820 87 44 22	Belgium <i>(tel)</i> (+32) (0)2 404 9340 <i>(fax)</i> (+32) (0)2 404 9395	Denmark <i>(tel)</i> (+45) 7013 1515 <i>(fax)</i> (+45) 7013 1555	Finland <i>(tel)</i> (+358) (0) 10 855 2100 <i>(fax)</i> (+358) (0) 10 855 2923
France <i>(tel)</i> 0825 010 700* <i>(fax)</i> 0825 010 701*	Germany <i>(tel)</i> 01805 24 6333* <i>(fax)</i> 01805 24 6336*	Ireland <i>(tel)</i> (+353) 1 890 924 204 <i>(fax)</i> 1 890 924 024	Israel <i>(tel)</i> (+972) 3 9288 504 <i>(alt)</i> (+972) 3 9288 544 <i>(fax)</i> (+972) 3 9288 520
Italy <i>(tel)</i> (+39) (0)2 9260 8484 <i>(fax)</i> (+39) (0)2 9544 1175	Luxemburg <i>(tel)</i> (+32) (0)2 404 9340 <i>(fax)</i> (+32) (0)2 404 9395	Netherlands <i>(tel)</i> (+31) (0)20 547 2111 <i>(fax)</i> (+31) (0)20 547 2190	Russia <i>(tel)</i> (+7) 095 797 3963 <i>(alt)</i> (+7) 095 797 3900 <i>(fax)</i> (+7) 095 797 3901
Spain <i>(tel)</i> (+34) 91 631 3300 <i>(fax)</i> (+34) 91 631 3301	Sweden <i>(tel)</i> 0200 88 22 55* <i>(alt)</i> (+46) (0)8 5064 8686 <i>(fax)</i> 020 120 2266*	Switzerland (French) <i>(tel)</i> 0800 80 5353 opt. 2* <i>(fax)</i> (0) 22 567 5313	Switzerland (German) <i>(tel)</i> 0800 80 5353 opt. 1* <i>(fax)</i> 0 44 272 7373
Switzerland (Italian) <i>(tel)</i> 0800 80 5353 opt. 3* <i>(fax)</i> (0) 22 567 5314	United Kingdom <i>(tel)</i> (+44) (0)7004 666666 <i>(fax)</i> (+44) (0)7004 444555		
<i>(tel)</i> = primary telephone number; <i>(alt)</i> = alternate telephone number; <i>(fax)</i> = FAX number; * = in country number 8/10/05			

Safety and Regulatory Information
Contacting Agilent