

Agilent Technologies
87075C Option H12
User's and Service Guide Supplement

Agilent Technologies 87075C Option H12

User's and Service Guide Supplement

This Guide applies to 87075C instruments
with serial numbers greater than US37370244

Use this manual with the following documents:

87050E/75C User's Guide
Part Number 87050-90026
and
87050E/75C Addendum
Part number 87075-90021



Agilent Technologies

Manufacturing Part Number: 87075-90023

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- *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.

Safety Notes

The following safety notes are used throughout this manual. Familiarize yourself with each of the notes and its meaning before operating this instrument. All pertinent safety notes for using this product are located in Chapter 5, “Safety and Regulatory Information,” on page 50.

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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1 **General Information**

Description

The Agilent 87075C Option H12 multiport test set is designed for use with Agilent 75 Ω network analyzers such as the 8753C/D/E/ES/ET, the 8711B/C, the 8712B/C/ES/ET, the 8713B/C, and the 8714B/C/ES/ET.

The multiport test set provides the ability to make single connection, multiple measurements of multiport devices. Throughput is increased by reducing the number of device reconnects the operator must perform. Switching is performed with solid-state switches; no mechanical parts are used.

The test set can be controlled by using an external GPIB controller, by parallel control, or by the network analyzer's internal IBASIC capability (if available).

NOTE

The 87075C Option H12 User's and Service Guide documents the use of the test set with an 8753E/ET/ES Option 075 network analyzer only.

This User's and Service Guide Supplement is to be used in conjunction with the Agilent Technologies 87050E/75C User's and Service Guide, 87050-90026.

When necessary, part numbers will be provided in parentheses after the description of a part for clarification. Example: "Use any two Type-N 75 Ω jumper cables (8120-6995)...."

Verify the Shipment

After the test set has been unpacked, keep the original packaging materials so they can be used if you need to transport the instrument.

Verify that you have received the items listed below 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 54.

Table 1-1 **87075C Option H12 Accessories Supplied**

Description	Part Number	Quantity
Power Cord	See Figure 3-3 on page 34	1
Front Handle Kit	5063-9227	1
Type-N to Type-N Cable, 13 inch, 75 Ohm	8120-8624	2
Type-N Semi-Rigid Jumper Cable, 10 inch, 75 Ohm	8120-6983	2
Cal Constant Disk for Agilent 871x Self-Cal	08712-10016	1
Cable Assembly - Test Port	87075-60026	1
Cable Assembly - Test Port	87075-60028	1
87050E / 87075C User's and Service Guide	87050-90026	1
87075C Option H12 User's and Ser- vice Guide	87075-90023	1
Addendum to 87075C Option H12 User's and Service Guide	87075-90021	1

Specifications and Characteristics

Table 1-2

87075C Option H12 Performance Specifications

Parameter	Specification
Frequency Range	3 MHz to 1.3 GHz
Isolation ^a	>60 dB
Return Loss ^b	>15 dB
Insertion Loss	<6 dB ^c , <10 dB ^d
Input Power Damage Level	>+16 dBm

- a. Between any two non-connected signal paths
- b. When properly terminated in 75 Ω
- c. From any test port to the Reflection port
- d. From any test port to the Transmission port

Requirements

Electrical

The alternating-current (AC) power that is supplied to the test set must meet the following requirements:

Voltage: 90 to 250 Vac

Frequency: 48 to 66 Hz

Available power: 40 watts minimum

If the available AC line voltage is outside the 90 to 250 Vac range, an autotransformer that provides third wire continuity to earth ground may be used.

Environmental

Operating Environment

Indoor use only

Operating temperature: 0 to 55 °C

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

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

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.

Non-Operating Storage Conditions

Temperature: -40 °C to +70 °C

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

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

Weight

Net: Approximately 7 kg

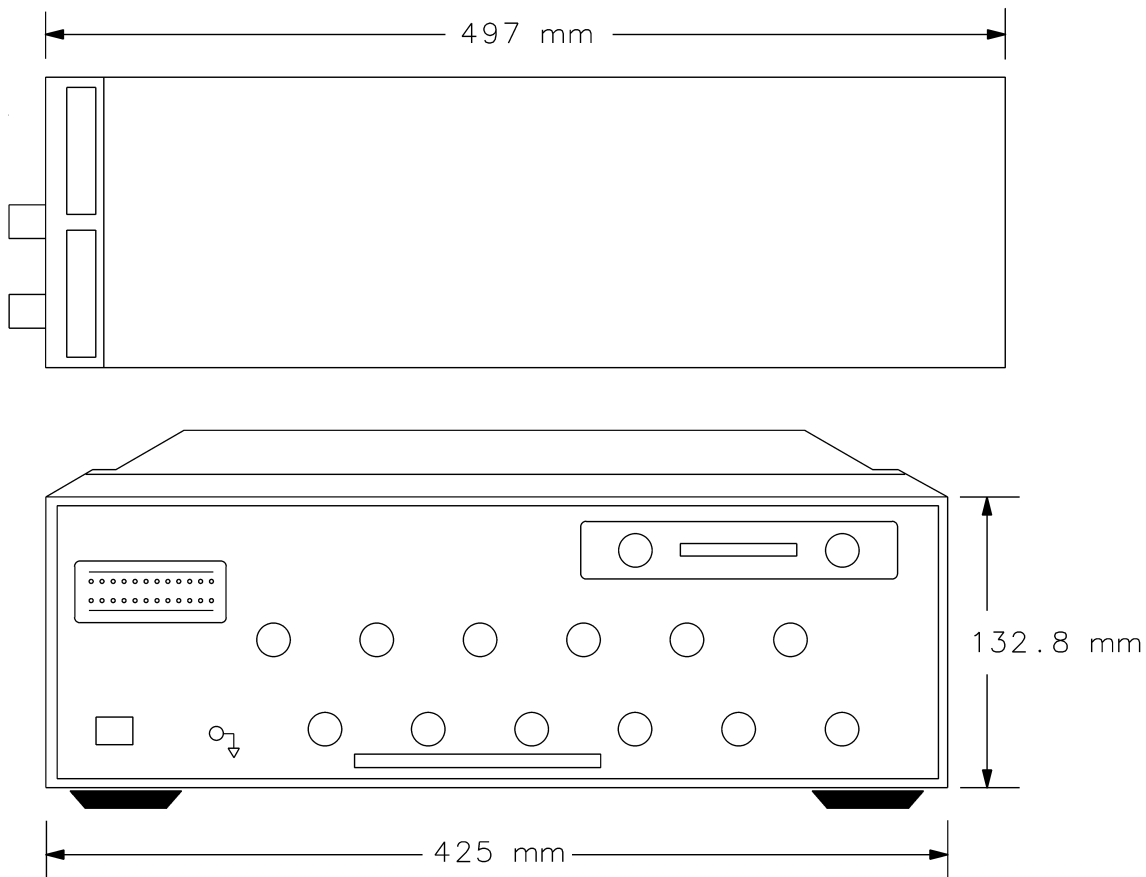
Shipping: Approximately 20 kg

Cabinet Dimensions

These dimensions exclude front and rear panel protrusions.

132.8 mm H by 425.0mm W by 497.0 mm L
(5.23 in by 16.75 in by 19.60 in)

Figure 1-1 Physical Dimensions



87075C Option H12 Options

UK6

Option UK6 provides a test data package for all critical specifications. A calibration and test data package is shipped with the test set when the UK6 Option is selected.

Preparations

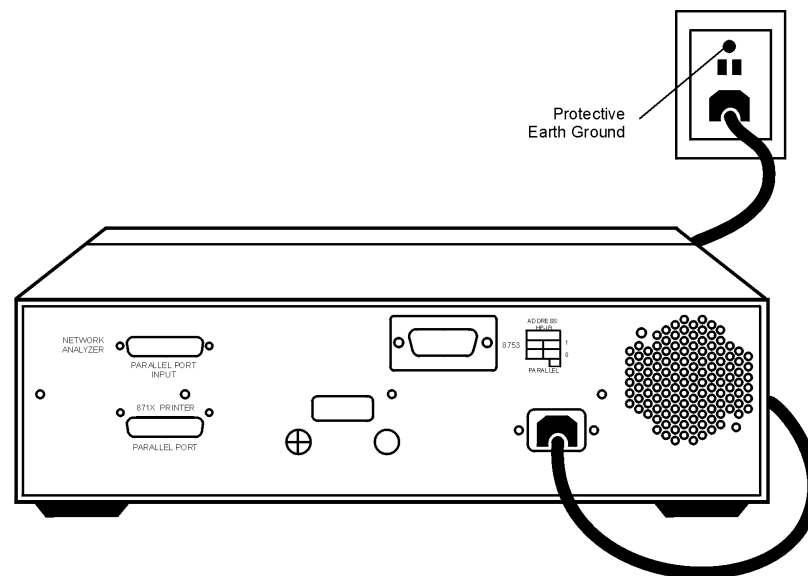
Electrical

1. Ensure that the “Requirements” on page 11 are met.
2. Verify that the power cable is not damaged and that the power source outlet provides a protective earth ground contact. Note that Figure 1-2 depicts only one type of power source outlet. Refer to Figure 3-3 on page 34 to see the different types of power cord plugs that can be used with your test set.

Cables are available in different lengths. For descriptions and part numbers of cables other than those described in Figure 3-3, Refer to “Contacting Agilent” on page 54.

3. 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.

Figure 1-2 Protective Earth Ground



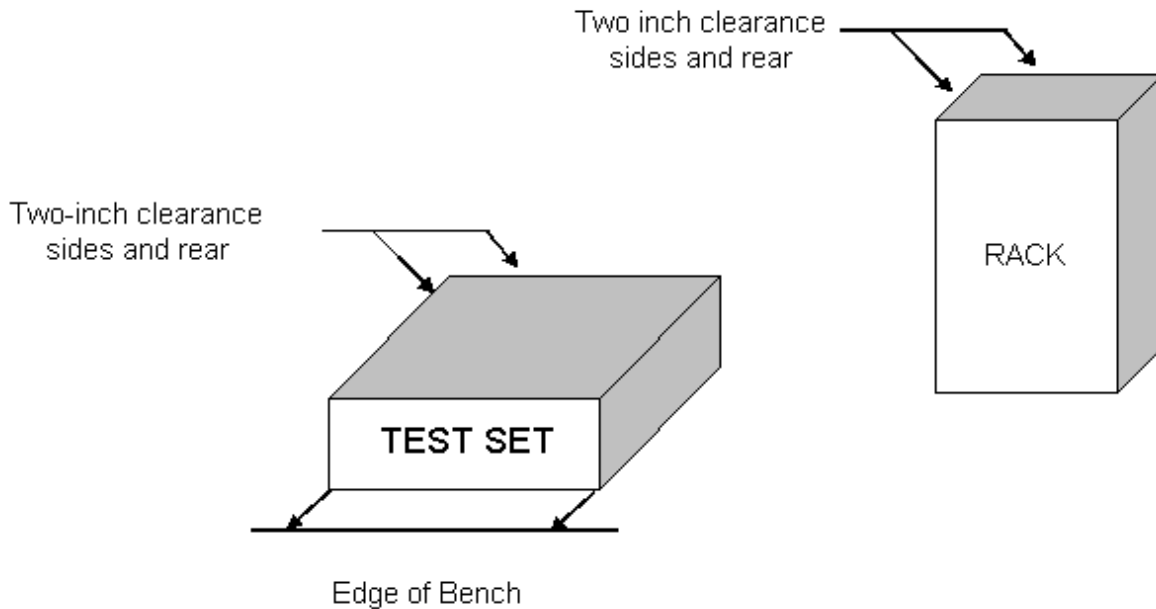
WARNING

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 into 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.

Environmental

1. Ensure that the “Requirements” on page 11 are met.
2. 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 1-3. 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 $4 \times C$ for every 100 watts dissipated in the cabinet.

Figure 1-3 Ventilation Clearance Requirements



CAUTION

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

Electrostatic Discharge Protection

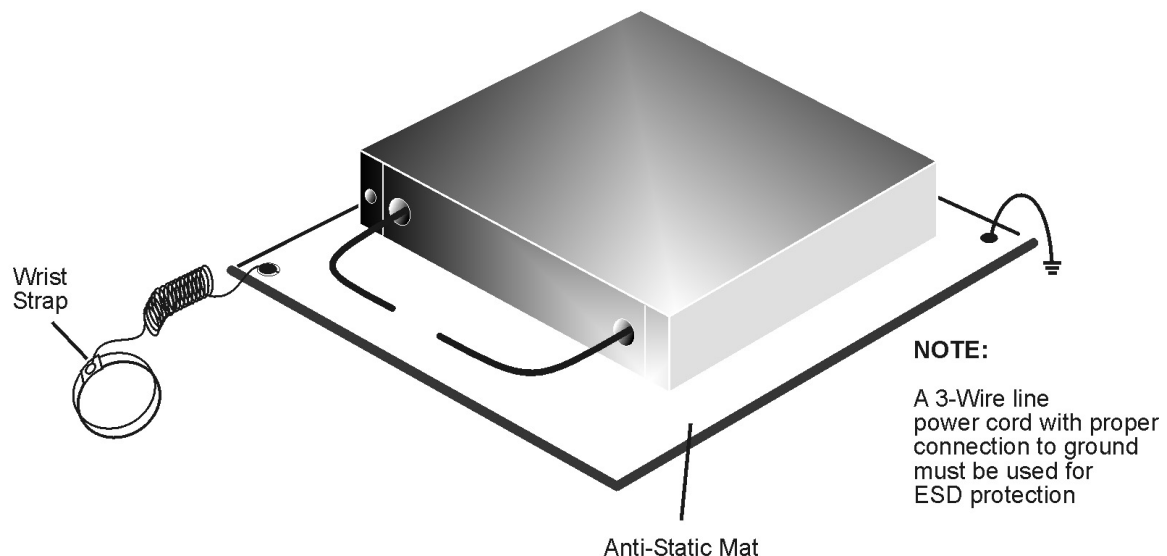
Protection against electrostatic discharge (ESD) is essential while removing or connecting cables or assemblies within the network analyzer or test set.

Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. To prevent damage to the instruments:

- *always* wear a grounded wrist strap having a 1 M Ω resistor in series with it when handling components and assemblies.
- *always* use a grounded, conductive table mat while working on the instrument.
- *always* wear a heel strap when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.

Figure 1-4 shows a typical ESD protection setup using a grounded mat and wrist strap.

Figure 1-4 ESD Protection Setup



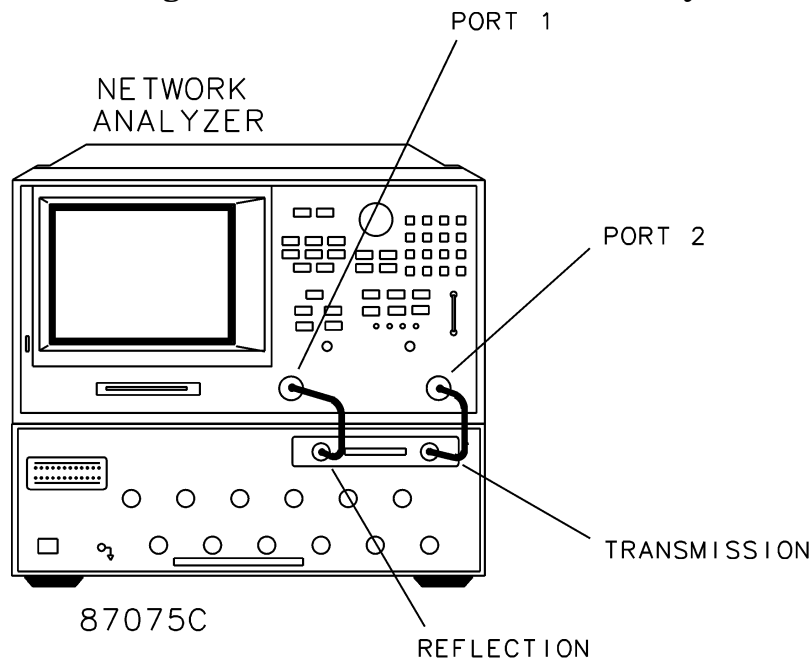
Getting Started

Connecting and Turning On the Test Set

The 87075C Option H12 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 1-5. Use the two Type N 75 Ω jumper cables (Agilent Part No. 8120-6983) that were shipped with the test set. See Table 1-1 on page 9 for a list of accessories supplied.

Figure 1-5

Connecting the Test Set to the Network Analyzer



CAUTION

Never connect 50 Ω cables to the test set or network analyzer. Otherwise, connector damage will occur.

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.

CAUTION

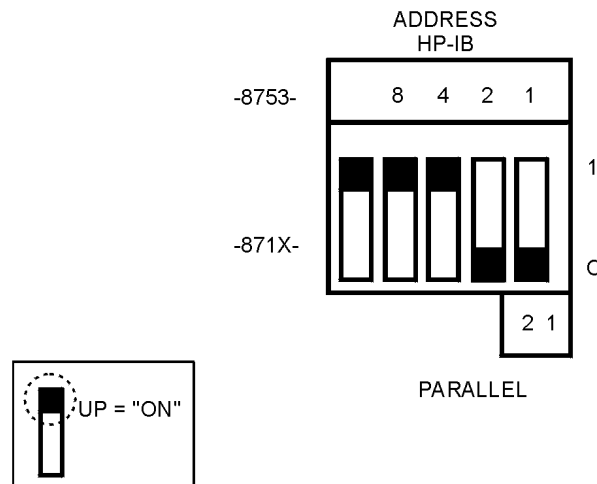
For accurate, repeatable measurements, be sure to let the test set warm up for at least two hours. It is recommended that the test set not be turned Off on a regular basis. For the most stable and accurate measurements, leave the test set turned On at all times.

Setting the Test Set Address Switch

The test set is shipped with the GPIB address set to 12, which sets the parallel address to 00 as in Figure 1-6. The left most switch is also shown in the up, or “On”, position which is required for operation with the Agilent 8753 series network analyzer or GPIB operation of the test set. Refer to Chapter 2, “Controlling the Test Set and Making Measurements,” on page 21, for the definition of the parallel address.

To set the parallel address use only the number 1 and 2 switches. The possibilities for parallel port addressing are an address of 0, 1, 2, or 3. When GPIB is used, the parallel address is ignored.

Figure 1-6 **The Test Set Address Switch**



CAUTION Make sure the test set is turned Off before you change the position of any address switch.

NOTE The left most switch is used to specify whether the test set will work with an Agilent 8753 or an Agilent 871X. When the switch is up, the test set will work with an Agilent 8753 and behaves as indicated in Chapter 3. When the switch is down, the test set will work with an Agilent 871X. Refer to the 87075C User’s and Service Guide (Agilent Part No. 87075-90005) for operating instructions.

The last switch is used to specify whether the test set will work with an 8753ET/ES or an 8712/14ET/ES. When the switch is up, the test set will work with an 8753ET/ES and behaves as indicated in Chapter 2, “Controlling the Test Set and Making Measurements.” When the switch is down, the test set will work with 8712/14ET/ES. Refer to the standard 87050E/75C User’s and Service Guide (87050-90026) for operating instructions.

Performing the Operator's Check

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 4, "Service," on page 35. In the event that your test set is not working properly, it must be returned to Agilent for servicing. Contact the nearest sales or service office for instructions on returning the test set to Agilent. See "Contacting Agilent" on page 54.

For information on how to control the test set, refer to page 21.

Equipment Required

- Network Analyzer, 75 Ω impedance (8753)
- Computer (Agilent 9000 series 200/300/700)
- Cable, 75 Ω , Type N, (8120-2408 or equivalent)
- Calibration Kit, 75 Ω , Type N (85036B)

Procedure

This procedure is for performing a simple operator's check using a network analyzer of the proper frequency range and impedance.

1. Connect the 75 Ω cable to the Reflection port of the analyzer.
2. Perform a one-port reflection calibration at the end of the 75 Ω cable over the frequency range of 3 MHz to 1.3 GHz on the analyzer. Verify that the calibration is active and that a cable terminated with a short displays a return loss of 0 dB \pm 0.2 dB.
3. Connect the cable (already connected to the Reflection port of the analyzer) to the Reflection port of the 87075C Option H12 test set.
4. Measure the return loss of each path of the test set by selecting Ports 1 through 12, one at a time, viewing the display on the network analyzer. All twelve ports should be either unterminated or shorted.
5. The return loss value should be a maximum of 14 dB. This accounts for the maximum of 6 dB loss each way, plus a 2 dB margin of error to account for source match errors. Typically the return loss for each port will be about 4 dB to 8 dB, depending upon frequency, and all ports should look approximately the same.
6. Better accuracy can be obtained by averaging two measurements: one taken with a short attached and one taken with an open attached.

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 37.

If a more complete test is desired, repeat the above procedure, but this time terminate each port being tested with a known good 75 Ω load (with a return loss of better than 40 dB). The resulting return loss should be a maximum of 15 dB.

General Information
Performing the Operator's Check

2

Controlling the Test Set and Making Measurements

Introduction

The 87075C Option H12 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:

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

The next three sections discuss the three methods of control.

Commands

As previously mentioned, there are three ways to control the test set. The first two involve the use of a separate computer. The third way uses the network analyzer manually. These methods of control are detailed in the following sections.

Computer Control via Network Analyzer

One way to control the test set is to write GPIB commands to the 8753ES/ET network analyzer which then writes to the test set by way of the parallel port. See Figure 2-1 on page 24 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 25.

To use a parallel port connection with the 8753ET/ES analyzer, 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*

NOTE

Be sure to use the ending semi-colon.

Direct Computer Control

The second way to control the test set is to address the 87075C Option H12 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.

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 Basic/RMB. Using the Agilent 82335 GPIB Interface and Visual Basic, the following commands will disable the EOI and EOL, send the necessary data to the test set, and re-enable EOI and EOL. Be sure to re-enable the EOI and EOL before sending data to another instrument.

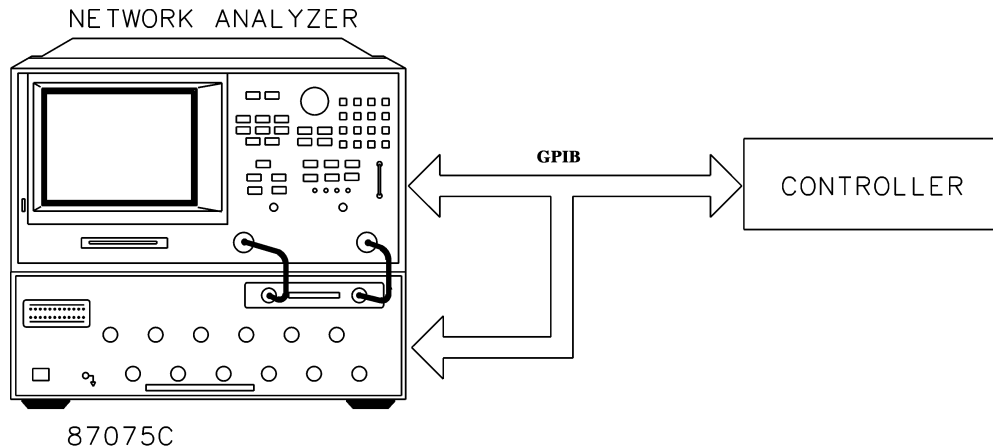
```
HpibEoi(hHpib;7,0) 'disable EOI
HpibEol(hHpib;7,"",0) 'disable EOL
HpibOutput(hHpib;712,chr$([D])) 'send command to
test set
HpibEol(hHpib;7,chr$(13)+chr$(10),2) 're-enable EOL
and set to'chr$(13)+chr$(10)
HpibEoi(hHpib;7,1,) 're-enable EOI
```

where Hpib specifies the handle returned by HpibOpen.

Commands

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

Figure 2-1 Controlling the Test Set Over GPIB

**NOTE**

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

Manual Control via Network Analyzer

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 (\uparrow or \downarrow) 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 25).

Table 2-1 Test Port Addresses

Connection Path	Decimal [D]	Binary Equivalent
Reflection to Port 1	0	00000000
Reflection to Port 2	1	00000001
Reflection to Port 3	2	00000010
Reflection to Port 4	3	00000011
Reflection to Port 5	4	00000100
Reflection to Port 6	5	00000101
Reflection to Port 7	6	00000110
Reflection to Port 8	7	00000111
Reflection to Port 9	8	00001000
Reflection to Port 10	9	00001001
Reflection to Port 11	10	00001010
Reflection to Port 12	11	00001011
All Reflection Ports Terminated	13	00001101
Transmission to Port 1	16	00010000
Transmission to Port 2	17	00010001
Transmission to Port 3	18	00010010
Transmission to Port 4	19	00010011
Transmission to Port 5	20	00010100
Transmission to Port 6	21	00010101
Transmission to Port 7	22	00010110
Transmission to Port 8	23	00010111
Transmission to Port 9	24	00011000
Transmission to Port 10	25	00011001
Transmission to Port 11	26	00011010
Transmission to Port 12	27	00011011
All Transmission Ports Terminated	28	00011100

An easy way to remember these numbers is:

Reflection = Port Number - 1

Transmission = Port Number + 15

For example, to connect Port 8 to Reflection, the “D” number is 7, (8 - 1). To connect Port 8 to Transmission, the “D” number is 23, (8 + 15).

To connect all eight of the test port to their internal 75 Ω loads, send the following commands:

```
OUTPUT 716;" PARALGPIO;"
```

```
OUTPUT 716;" PARAOUT13;"
```

```
OUTPUT 716;" PARALGPIO;"
```

```
OUTPUT 716;" PARAOUT28;"
```

or

```
OUTPUT 712;CHR$(13);
```

```
OUTPUT 712;CHR$(28);
```

NOTE

When a test set port is not in use (not connected to transmission or reflection) it is terminated in 75 Ω

Calibrating the Test System

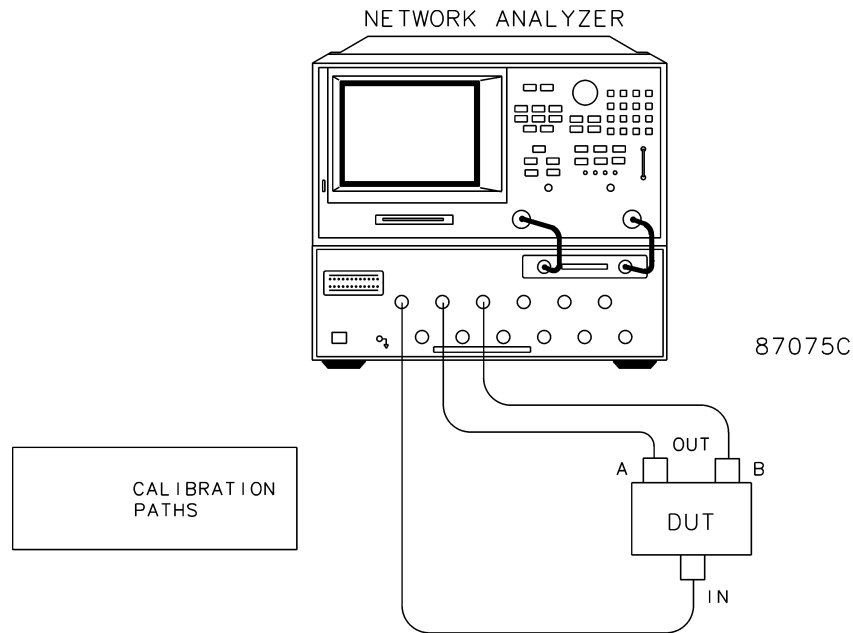
After the test set has warmed up for two hours, it should be calibrated before making any measurements. Refer to the network analyzer's user's guide to determine the type of calibration needed for the measurements you will be making.

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. See Figure 2-2 on page 27 for an example of the setup.

In this example setup the following tests will be made:

- Return Loss on the DUT's (device under test) input and two 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 perform a full two-port calibration between the test set PORT 1 and PORT 3, and again between PORT 1 and PORT 5. Save the calibrations as instrument states. Refer to the network analyzer user's guide for information on calibrations and saving instrument states.

CAUTION

When performing a full two-port calibration and making subsequent measurements, you must use the transfer switch internal to the 8753ET/ES analyzer to change the RF signal path direction. Do not use the test set to change the RF signal path direction when you are entering a full two-port calibration. Doing so will render the calibration invalid.

NOTE

The SelfCal feature (described in the 87050E /87075C User's and Service Guide) is not available when using the Option H12 with the 8753D/E/ET/ES analyzer.

Making Measurements

The following examples assume that you are using a parallel port connection with an 8753E, with the test set's parallel address set to "0". See "Setting the Test Set Address Switch" on page 17 for information on setting the test set's address.

Measuring Transmission

Refer to Figure 2-3. With the 8753E/ES/ET 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 3 of the test set to the REFLECTION port, and you will connect PORT 8 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.

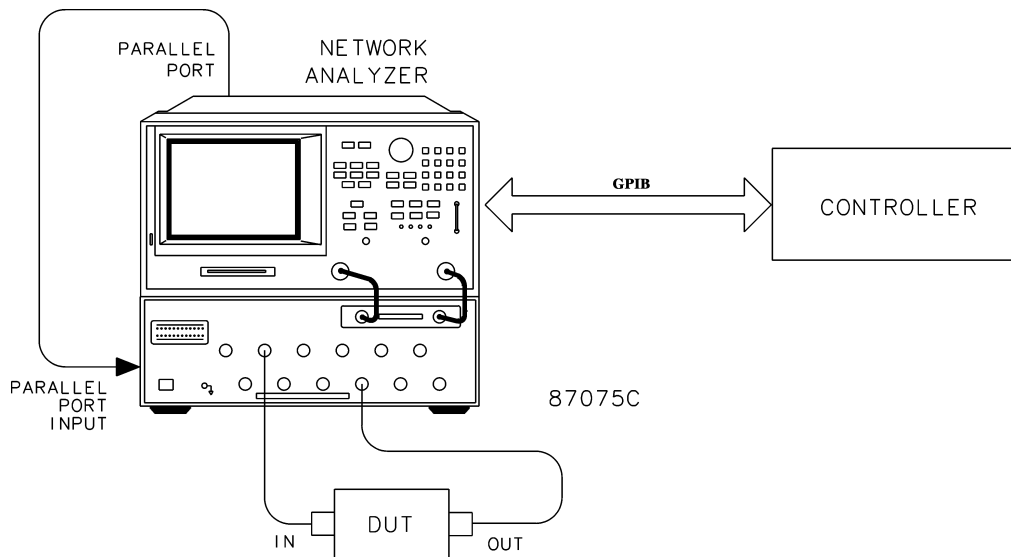
```
OUTPUT 716;"PARALGPIO;"  
OUTPUT 716;"PARAOUT2;"
```

```
OUTPUT 716;"PARALGPIO;"  
OUTPUT 716;"PARAOUT23;"
```

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.

Figure 2-3 A Transmission Measurement

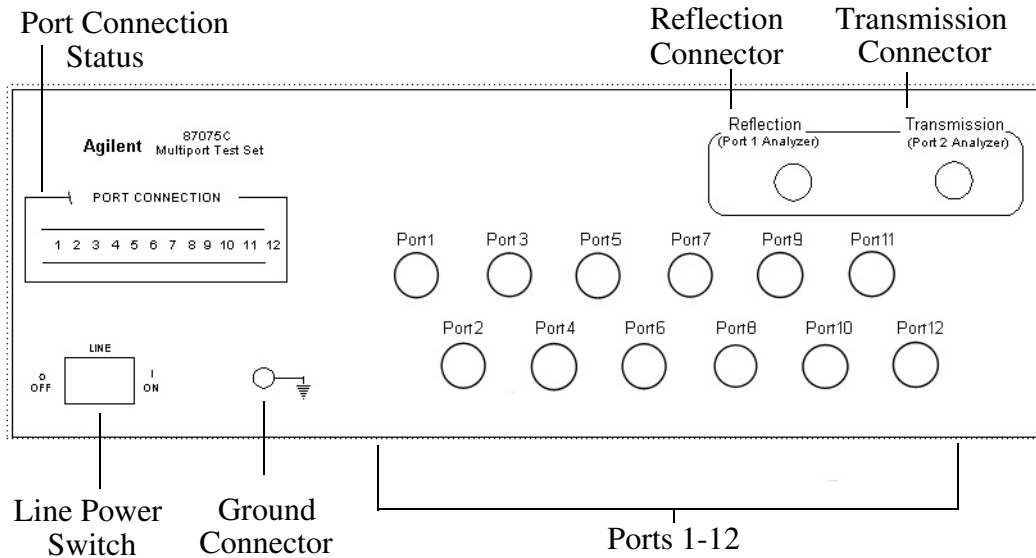


3

Front/Rear Panel

Front Panel

Figure 3-1 Front Panel Features



Line Power Switch

The test set line power switch is located at the bottom left corner of the front panel. See Figure 3-1. The line power switch turns the power to the test set either On (|) or Off (O).

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

Ports 1—12

PORTS 1 through 12 are female Type-N 75 Ω connectors that are used to connect to the device under test.

CAUTION

Never attempt to use 50 Ω Type-N cables, connectors, or devices with a female Type-N 75 Ω connector. Irreparable damage *will* occur.

CAUTION

Do not input more than +20 dBm or 25 Vdc to these ports or damage to the internal RF switches or the analyzer may occur.

The REFLECTION Connector

The REFLECTION Connector is a female Type-N 75 Ω connector that connects directly to the PORT 1 port of the network analyzer using the semi-rigid cable (Agilent Part No. 8120-6983) that was shipped with your test set.

CAUTION

Check your analyzer's documentation for damage limits to Port 1. Make sure that your test setup will not cause those limits to be exceeded.

The TRANSMISSION Connector

The TRANSMISSION Connector is a female Type-N 75 Ω connector that connects directly to the PORT 2 port of the network analyzer using the semi-rigid cable (Agilent Part No. 8120-6983) that was shipped with your test set.

CAUTION

Check your analyzer's documentation for damage limits to Port 2. Make sure that your test setup will not cause those limits to be exceeded.

The GROUND Connector

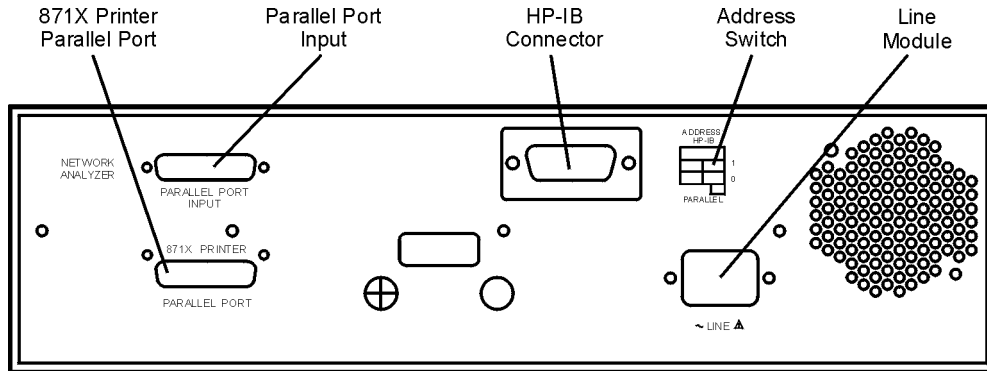
The GROUND connector provides a convenient front panel ground connection for a standard banana plug.

The PORT CONNECTION Status LEDs

The port connection status LEDs provide visual feedback of which port(s) are connected to the REFLECTION and TRANSMISSION ports of the test set. When neither LED is lit, the corresponding test port is internally terminated in 75 Ω .

Rear Panel

Figure 3-2 Rear Panel Features



The Parallel Port Input Connector

This input is connected to 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 871X Printer Parallel Port Connector

The output from this connector is provided to control a printer.

GPIB Connector (Agilent 8753ET/ES only)

This connector allows the test set to be connected directly to a controller.

Address Switch

The address switch sets the GPIB or parallel address of the test set. For more information refer to, “Setting the Test Set Address Switch” on page 17.

Line Module

The line module contains the power cable receptacle and the line fuse.

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 3-3, “Power Cable and Line (Mains) Plug Part Numbers” on page 34 for the part numbers of the power cables. Cables are available in different lengths. Use “Contacting Agilent” on page 54 for descriptions and part numbers of cables other than those described in Figure 3-3.

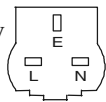
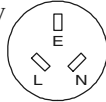
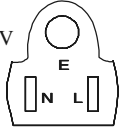
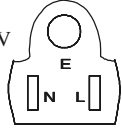
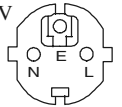
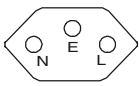

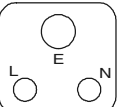
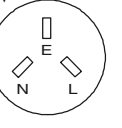
CAUTION

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 into 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.

Figure 3-3 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.

4 **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 5 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 8753E/ES/ET 75 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 for within the measurements.

Equipment Required

- 8753E/ES/ET Option 075 Network Analyzer
- 11857B Test Port Extension Cables
- 85036B Calibration Kit (75 Ω , Type-N)
- 75 Ω Load (Agilent Model 909E Option 040 or Agilent Part No. 00909-60019)

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 87075C Option H12 test set.

Insertion Loss

1. Perform a full two-port calibration from 3 MHz to 1.3 GHz at the ends of two cables attached to the two test ports of the Agilent 8753E. Make sure the calibration is active.
2. Connect the cable that is attached to PORT 1 of the 8753E/ES/ET to the Reflection port of the 87075C Option H12.
3. Connect the cable from PORT 2 of the analyzer to PORT 1 of the 87075C Option H12. Select reflection port 1. (the selected transmission port does not matter). Verify less than 6 dB of insertion loss. See Table 1-2 on page 10.
4. Repeat step 3 for each of the remaining test ports 2 through 12.
5. Repeat steps 2 through 4, but connect the cable in step 2 to the Transmission port of the 87075C Option H12. Verify in step 3 that the insertion loss is less than 10 dB. Also in step 3, select only the transmission port instead of the reflection port by specifying (for instance) "0,1".
6. Verify less than 10 dB of insertion loss. See Table 1-2 on page 10.

Return Loss

This test will check both the internal termination load of each port and the through match when the appropriate input port is terminated with a 75 Ω load.

1. Perform a one-port reflection calibration at the end of a 75 Ω cable over the frequency range of 3 MHz to 1.3 GHz on the network analyzer. Verify that the calibration is active and that the terminated cable displays a return loss of 0 dB \pm 0.2 dB.
2. Connect the cable (already connected to the Reflection measurement port of the analyzer) to PORT 1 of the 87075C Option H12. Connect a high-quality 75 Ω load to the Reflection port of the 87075C Option H12. Measure the return loss of PORT 1 by selecting port 1 (viewing the display on the analyzer).
3. Repeat this measurement again, but this time select no active port. No LEDs will be lit. This will test the internal load for the port.
4. Move the cable to PORT 2 and repeat steps 2 and 3, selecting PORT 2. Repeat steps 2 and 3 for the remaining ports.

The return loss specification for any input match when properly terminated is >15 dB.

Isolation

NOTE

Isolation needs to only be measured on adjacent ports. Two 75 Ω loads are required for this test.

1. Perform a full two-port calibration from 3 MHz to 1.3 GHz at the ends of two cables attached to the two test ports of the network analyzer. Make sure the calibration is active.
2. Connect a 75 Ω load to both the Reflection and Transmission ports of the 87075C Option H12.
3. Connect the two cables that are attached to the network analyzer, to ports 1 and 2 of the 87075C Option H12. The exact order doesn't matter.
4. Select reflection port 1 and transmission port 2. Set the 8753E/ES/ET to measure transmission. Verify >60 dB of isolation.
5. Repeat steps 3 and 4 for the next two adjacent ports (2 and 3). Repeat again for ports 3 and 4, then 4 and 5, and so on, ending with ports 11 and 12.

Performance Test Record

The following pages (Performance Test Record) are designed to be duplicated and used as templates for the performance tests (Insertion Loss, Return Loss, and Isolation). At the top of each page, write the test date.

87075C Option H12 Test Record

87075C Option H12 Insertion Loss Test Record

Test Description	Port	Specification	Measured Results	Measurement Uncertainty
Insertion Loss to Reflection Port	Port 1	≤6 dB	_____	±0.1 dB
	Port 2	≤6 dB	_____	±0.1 dB
	Port 3	≤6 dB	_____	±0.1 dB
	Port 4	≤6 dB	_____	±0.1 dB
	Port 5	≤6 dB	_____	±0.1 dB
	Port 6	≤6 dB	_____	±0.1 dB
	Port 7	≤6 dB	_____	±0.1 dB
	Port 8	≤6 dB	_____	±0.1 dB
	Port 9	≤6 dB	_____	±0.1 dB
	Port 10	≤6 dB	_____	±0.1 dB
	Port 11	≤6 dB	_____	±0.1 dB
	Port 12	≤6 dB	_____	±0.1 dB
Insertion Loss to Transmission Port	Port 1	≤10 dB	_____	±0.1 dB
	Port 2	≤10 dB	_____	±0.1 dB
	Port 3	≤10 dB	_____	±0.1 dB
	Port 4	≤10 dB	_____	±0.1 dB
	Port 5	≤10 dB	_____	±0.1 dB
	Port 6	≤10 dB	_____	±0.1 dB
	Port 7	≤10 dB	_____	±0.1 dB
	Port 8	≤10 dB	_____	±0.1 dB
	Port 9	≤10 dB	_____	±0.1 dB
	Port 10	≤10 dB	_____	±0.1 dB
	Port 11	≤10 dB	_____	±0.1 dB
	Port 12	≤10 dB	_____	±0.1 dB

87075C Option H12 Return Loss and Isolation Test Record

Test Description	Port	Specification	Measured Results	Measurement Uncertainty
Return Loss	Port 1	≥15 dB	_____	±0.5 dB
	Port 2	≥15 dB	_____	±0.5 dB
	Port 3	≥15 dB	_____	±0.5 dB
	Port 4	≥15 dB	_____	±0.5 dB
	Port 5	≥15 dB	_____	±0.5 dB
	Port 6	≥15 dB	_____	±0.5 dB
	Port 7	≥15 dB	_____	±0.5 dB
	Port 8	≥15 dB	_____	±0.5 dB
	Port 9	≥15 dB	_____	±0.5 dB
	Port 10	≥15 dB	_____	±0.5 dB
	Port 11	≥15 dB	_____	±0.5 dB
	Port 12	≥15 dB	_____	±0.5 dB
	Transmission Reflection	≥15 dB	_____	±0.5 dB
	Isolation	Port 1 to 2	≥60 dB	_____
Port 2 to 3		≥60 dB	_____	±1.0 dB
Port 3 to 4		≥60 dB	_____	±1.0 dB
Port 4 to 5		≥60 dB	_____	±1.0 dB
Port 5 to 6		≥60 dB	_____	±1.0 dB
Port 6 to 7		≥60 dB	_____	±1.0 dB
Port 7 to 8		≥60 dB	_____	±1.0 dB
Port 8 to 9		≥60 dB	_____	±1.0 dB
Port 9 to 10		≥60 dB	_____	±1.0 dB
Port 10 to 11		≥60 dB	_____	±1.0 dB
Port 11 to 12		≥60 dB	_____	±1.0 dB

Replaceable Parts

The following table contains the list of replaceable parts for the 87075C Option H12 multiport test set. If any of these parts or assemblies are replaced, you must run all performance tests to verify conformance to specifications.

Table 4-1 **Replaceable Parts**

Replacement Part	Part Number
Power Supply	0950-2023
Main Switch Board	87075-60013
Driver Board	87050-60007*
SRF Cables	87075-20053*
SRF Cables	87075-20054*
Port 1	87075-20055*
Port 2	87075-20056*
Port 3	87075-20057*
Port 4	87075-20058*
Port 5	87075-20059*
Port 6	87075-20060*
Port 7	87075-20061*
Port 8	87075-20062*
Port 9	87075-20063*
Port 10	87075-20064*
Port 11	87075-20065*
Port 12	87075-20066*
Front Panel Subassembly	87075-60006
Front Panel Display Board	87075-60014
Front Panel Assembly	87075-60017*
Front Panel Overlay	87075-60022

NOTE The parts indicated (*) are unique to this special option. To order replacement parts, please contact the MID NA 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 or service office, specify that they are ordered through the MID NA Support Group.

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

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 needs 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 46.

General Troubleshooting Notes

WARNING	<i>Always</i> 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 to prevent damage from electrostatic discharge (ESD). See “ESD Protection Setup” on page 15.
NOTE	Before replacing an assembly or board, inspect for obvious, easily repaired defects such as bent pins on ICs or cold solder joints.

Troubleshooting Power Supply Problems

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

1. If the LED is off, check the main fuse located in the power supply filter at the rear of the instrument.
2. If the fuse is in working order and the LED 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 LED is still off, there is still a possibility that the power supply is not supplying the necessary +15 V, -15 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 +15 V, -15 V, and +5 V. If not, replace the power supply.

Troubleshooting the Front Panel Board

Turn the instrument power on and check the following:

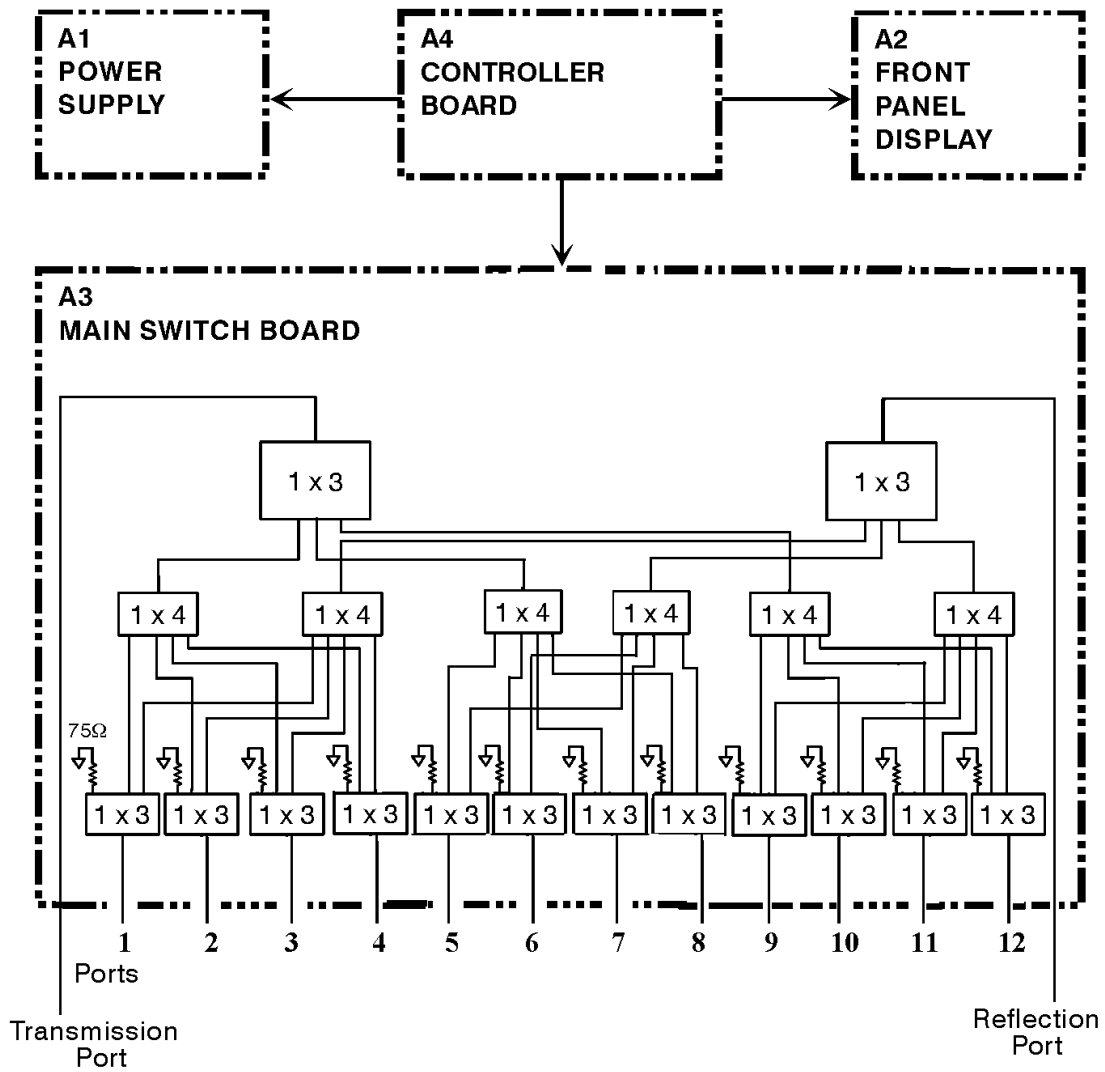
1. Check the condition of each of the switching paths by issuing commands to switch each of the paths to either the reflection or the transmission path. Ensure that the LED indicates the appropriate path.
2. If the LED indicates a wrong path, the problem can lie with either the front panel board or the main switch board. Determine where the problem is by measuring the RF path.
3. If the LED 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.
4. Ensure that the front panel washers between the board and the front panel assembly are present. Missing washers can cause erratic LED behavior.

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 reflection or the transmission path. Check each of the RF paths for connection. If an RF path is not connected to the necessary port or terminated in 75 Ω , replace the controller and switch driver board.

Refer to Figure 4-1 on page 45 for a block diagram of the major components and the switching paths of the 87075C Option H12.

Figure 4-1 87075C Option H12 Block Diagram



Theory of Operation

The theory of operation begins with a general description of the 87075C Option H12 multiport test set. This is followed by more detailed operating theory. The operation of each group is described briefly but only to the assembly level. Detailed component level circuit theory is not provided.

System Theory

The test set consists of four main components: a power supply, a controller board, a front panel display, and a main switch board. The purpose of the power supply is to provide power to the other three assemblies. The front panel display serves to indicate the switching paths to the user. The main switch board contains the switches and RF cabling. Finally, the controller 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: +15 V, -15 V, and +5 V.

A2 Front Panel Display Theory

The front panel display consists of 24 LEDs. Each test port has two LEDs associated with it: one for reflection and one for transmission. Control signals and DC power are provided by a cable connected to the main switch board.

A3 Main Switch Board Theory

Refer to Figure 4-1 for the following discussion.

The main switch board contains all of the switches. A particular test port (1 through 12) can be in one of three states. The three states are:

1. switched to the reflection port
2. switched to the transmission port
3. terminated in 75 Ω

When a port is not connected to either the transmission port or the reflection port, it is automatically terminated in $75\ \Omega$. Only one port can be connected to the transmission port and only one port can be connected to the reflection port at any given time.

The test set consists of fourteen (14) 1-by-3 switches and six (6) 1-by-4 switches. The 1-by-3 switches divide each of the input ports (1 through 12) into three separate paths. One path is terminated into $75\ \Omega$. The other two are the reflection and transmission paths.

The six 1-by-4 switches combine each of the twelve 1-by-3 switches into six banks. These six banks are divided into three for the transmission port and three for the reflection port. Finally, the two 1-by-three switches recombine the four banks into either the transmission port or reflection port.

All switches are solid-state PIN diodes which are biased 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.

A4 Controller Board Theory

The controller board provides the biases that control the states of the switches on the main switch board. The controller board also provides signals to the front panel display that indicate which switching paths have been activated.

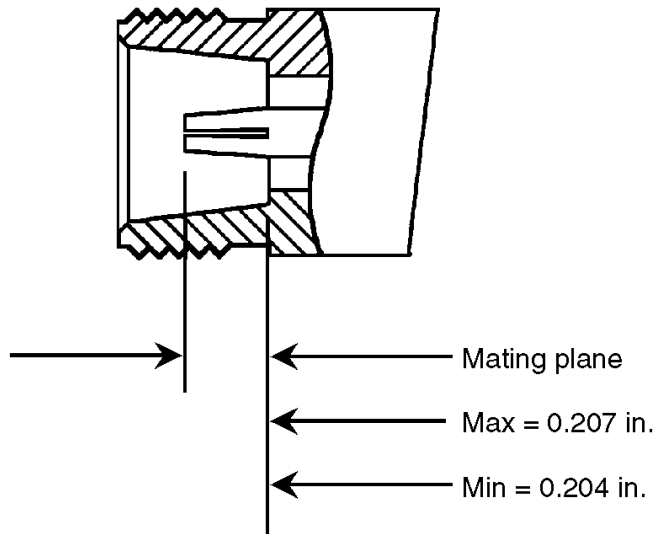
Connector Replacement

Experience has shown that the female 75 Ω Type-N connectors on the front panel are subject to damage due to inadvertent mating of 50 Ω devices. These 75 Ω connectors are available separately as Agilent part number 08752-60009. However, they are designed to be press-fit into the aluminum front panel. It is generally not possible to do this in the field, since a special press is required. A possible alternative to replacing a damaged connector would be to just replace the center pin components. The three required components are:

Component	Agilent Part Number
Insulator, 75 Ω	5020-8593
Contact, RF Connector, 75 Ω	5021-0912
Center Conductor, 75 Ω	08752-20009

The three components should be connected together using a liquid thread-locking adhesive such as Agilent part number 0470-1590. Re-use any shims and spacers from the connector being replaced. For best results, use a connector gauge to verify pin depth. See Figure 4-2 for proper pin depth. Add or subtract spacers as required. Spacers and shims are also available from Agilent.

Figure 4-2 Physical Description of Type-N Connector



5 **Safety and Regulatory
Information**

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.

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 54. 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.

Statement of Compliance

This instrument has been designed and tested in accordance with IEC Publication 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Warnings

WARNING **“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.

Warnings applicable to this instrument are:

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

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

WARNING **For continued protection against fire hazard, replace line fuse only with same type and rating (H 3.15 A/250 Vac, part number 2110-0957). The use of other fuses or materials 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 into 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 product from all voltage sources while it is being opened.**

WARNING **To prevent electrical shock, disconnect the Agilent Technologies model 87075C Option H12 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.**

Cautions

CAUTION 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 product. Do not proceed beyond a caution sign 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 This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

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 $4 \times C$ 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.

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 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.
	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.

Contacting Agilent

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

This information supersedes all prior HP contact information.			
Online assistance: www.agilent.com/find/assist			
Americas			
Brazil (tel) (+55) 11 3351 7012 (fax) (+55) 11 3351 7024	Canada (tel) +1 877 894 4414 (fax) +1 303 662 3369	Mexico (tel) 1 800 254 2440 (fax) 1 800 254 4222	United States (tel) 800 829 4444 (alt) (+1) 303 662 3998 (fax) 800 829 4433
Asia Pacific and Japan			
Australia (tel) 1 800 225 574 (fax) 1 800 681 776 (fax) 1 800 225 539	China (tel) 800 810 0508 (alt) 800 810 0510 (fax) 800 810 0507 (fax) 800 810 0362	Hong Kong (tel) 800 933 229 (fax) 800 900 701	India (tel) 1600 112 626 (fax) 1600 112 727 (fax) 1600 113 040
Japan (Bench) (tel) 0120 32 0119 (alt) (+81) 426 56 7799 (fax) 0120 01 2144	Japan (On-Site) (tel) 0120 802 363 (alt) (+81) 426 56 7498 (fax) (+81) 426 60 8953	Singapore (tel) 1 800 275 0880 (fax) (+65) 6755 1235 (fax) (+65) 6755 1214	South Korea (tel) 080 778 0011 (fax) 080 778 0013
Taiwan (tel) 0800 047 669 (fax) 0800 047 667 (fax) 886 3492 0779	Thailand (tel) 1 800 2758 5822 (alt) (+66) 2267 5913 (fax) 1 800 656 336	Malaysia (tel) 1800 880 399 (fax) 1800 801 054	
Europe			
Austria (tel) 0820 87 44 11* (fax) 0820 87 44 22	Belgium (tel) (+32) (0)2 404 9340 (alt) (+32) (0)2 404 9000 (fax) (+32) (0)2 404 9395	Denmark (tel) (+45) 7013 1515 (alt) (+45) 7013 7313 (fax) (+45) 7013 1555	Finland (tel) (+358) 10 855 2100 (fax) (+358) (0) 10 855 2923
France (tel) 0825 010 700* (alt) (+33) (0)1 6453 5623 (fax) 0825 010 701*	Germany (tel) 01805 24 6333* (alt) 01805 24 6330* (fax) 01805 24 6336*	Ireland (tel) (+353) (0)1 890 924 204 (alt) (+353) (0)1 890 924 206 (fax) (+353) (0)1 890 924 024	Israel (tel) (+972) 3 9288 500 (fax) (+972) 3 9288 501
Italy (tel) (+39) (0)2 9260 8484 (fax) (+39) (0)2 9544 1175	Luxemburg (tel) (+32) (0)2 404 9340 (alt) (+32) (0)2 404 9000 (fax) (+32) (0)2 404 9395	Netherlands (tel) (+31) (0)20 547 2111 (alt) (+31) (0)20 547 2000 (fax) (+31) (0)20 547 2190	Russia (tel) (+7) 095 797 3963 (alt) (+7) 095 797 3900 (fax) (+7) 095 797 3901
Spain (tel) (+34) 91 631 3300 (alt) (+34) 91 631 3000 (fax) (+34) 91 631 3301	Sweden (tel) 0200 88 22 55* (alt) (+46) (0)8 5064 8686 (fax) 020 120 2266*	Switzerland (French) (tel) 0800 80 5353 opt. 2* (alt) (+33) (0)1 6453 5623 (fax) (+41) (0)22 567 5313	Switzerland (German) (tel) 0800 80 5353 opt. 1* (alt) (+49) (0)7031 464 6333 (fax) (+41) (0)1 272 7373
Switzerland (Italian) (tel) 0800 80 5353 opt. 3* (alt) (+39) (0)2 9260 8484 (fax) (+41) (0)22 567 5314	United Kingdom (tel) (+44) (0)7004 666666 (alt) (+44) (0)7004 123123 (fax) (+44) (0)7004 444555		
(tel) = primary telephone number; (alt) = alternate telephone number; (fax) = FAX number; * = in country number 11/16/04			