User's and Service Guide

HP 87075C Multiport Test Set

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Key Conventions

This manual uses the following conventions:

(Front-Panel Key) : This represents a key physically located on the analyzer (a "hardkey").

Softkey : This indicates a "softkey": a key whose label is determined by the instrument's firmware, and is displayed on the right side of the instrument's screen next to the eight unlabeled keys.

Introduction

The HP 87075C is a multiport test set that is available with 2, 6, or 12 test ports.

Solid-state series/shunt PIN diode switching is used to route signals from and to the reflection and transmission ports to any of the test set ports.

The design of the multiport system supports an automatic multiport calibration technique called SelfCal. This technique requires that an open, short, load and thru (to one other port) be embedded behind each test set port. These calibration standards can be measured without removing any device under test.

See Chapter 4, "Test Set Cal and SelfCal," for more information on how the SelfCal feature works.

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1 Installation

This chapter will guide you through the steps necessary to correctly and safely install your multiport test set. The steps are:

1. Check the Shipment

2. Determine Network Analyzer Compatibility

3. Connect the Test Set to the Analyzer

4. Satisfy Electrical and Environmental Requirements

5. Activate the Test Set and Check the System Operation

6. Connect Peripheral Devices

Figure 1-1   **HP 87075C Multiport Test Set — Three Versions**

HP 87075C Option 002 — Two Port Test Set

pr64c
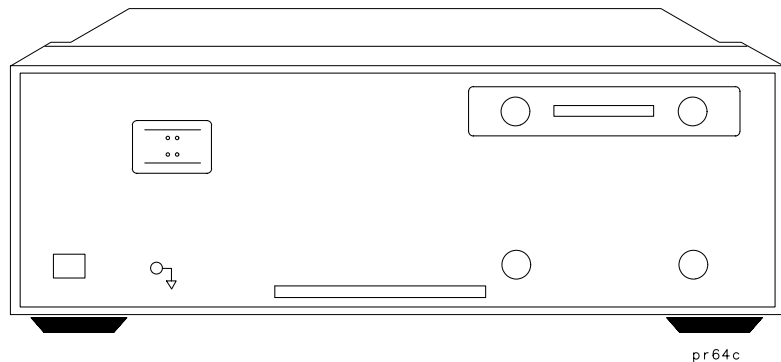
HP 87075C Option 006 — Six Port Test Set

pr65c
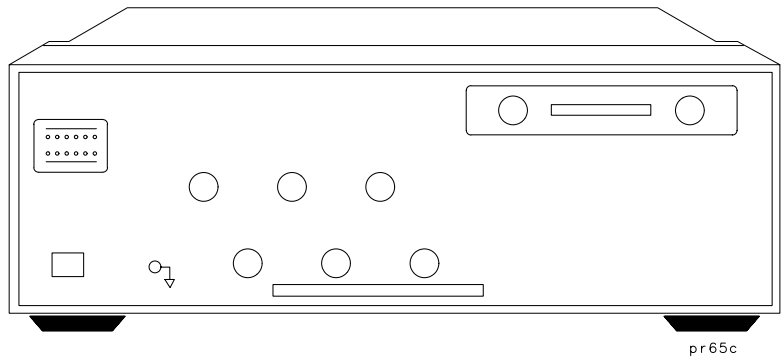
HP 87075C Option 012 — Twelve Port Test Set

pr66c
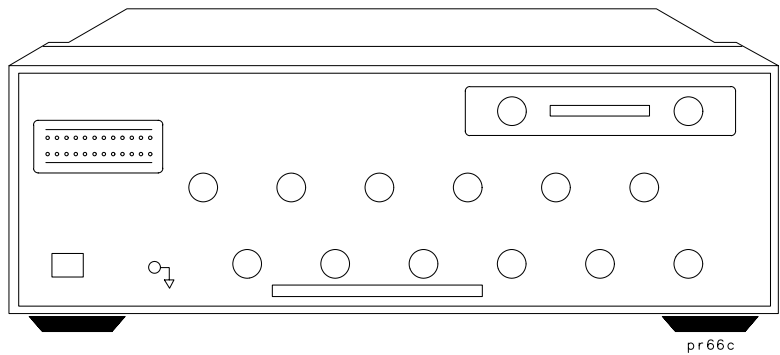
Step 1. Check the Shipment

After you have unpacked your test set, it is recommended that you keep the packaging materials so they may be used if your instrument should need to be returned for maintenance or repair.

Check the items received against Table 1-1 to make sure that you received everything.

Inspect the test set and all accessories for any signs of damage that may have occurred during shipment. If your test set or any accessories appear to be damaged or missing, call your nearest Hewlett-Packard sales or service office. Refer to Table 8-2 in Chapter 8 for the nearest office.

Table 1-1   **HP 87075C Accessories Supplied**

Item No.	Description	Quantity	HP Part Number
1	Power Cord	1	See Table 6-1
2	Type-N Cable (Reflection Port)[1]	1	87075-60026
3	Type-N Cable (Tranmission Port)[1]	1	87075-60028
4	Type-N Cable (Reflection Port)[2]	1	87075-60027
5	Type-N Cable (Tranmission Port)[2]	1	87075-60029
6	Parallel Port Interface Cable	1	8120-6818
7	HP 87075C User's and Service Guide	1	87075-90005
8	Test Set Calibration Disk	1	N/A

1. Not to be used with a rack-mounted system or if the analyzer has had its bottom feet removed. See Figure 1-6 to see how these cables are to be connected.
2. You will only receive these cables if you ordered Option 1CM (rack mount kit). Use these cables if you are rack-mounting your system, or if the bottom feet of the analyzer have been removed. See Figure 1-6 for information on how to connect these cables.

Figure 1-2   HP 87075C Accessories Supplied
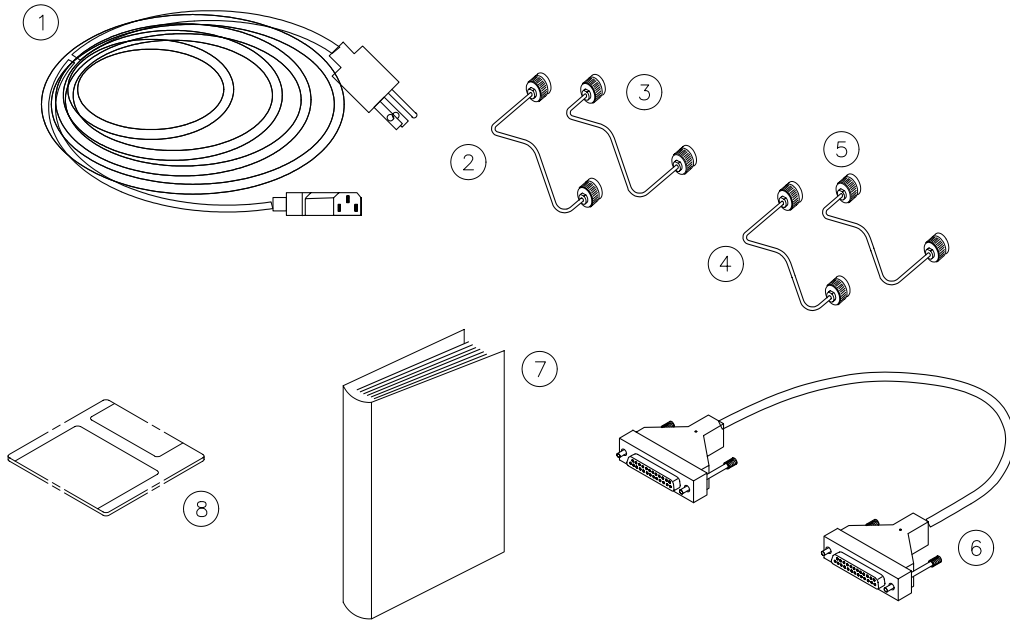
.pr623c

Step 2. Determine Network Analyzer Compatibility

The HP 87075C multiport test set is designed for use with an HP 8711C, HP 8712C, HP 8713C, or HP 8714C RF network analyzer.

IMPORTANT   Check the serial number on the rear panel of your analyzer; the serial number appears as xxyyyyzzzz, where "yyyy" is the serial number prefix. If the serial number prefix on your analyzer is 3737 or greater, then your analyzer is compatible and ready for use with your multiport test set. Proceed to "Step 3. Connect the Test Set to the Analyzer." If your analyzer has a serial number prefix *lower* than 3737, you should read the remainder of this section to determine if you need to upgrade your analyzer to be compatible with your multiport test set.

Check the Firmware Revision

The firmware in your analyzer must be revision C.04.50 or later. The firmware revision is displayed when you first power up the analyzer, and can also be viewed by pressing (SYSTEM OPTIONS) Service Instrument Info .

If your analyzer does not have a firmware revision of C.04.50 or later, then you must upgrade to the latest revision of firmware. To upgrade your firmware to the latest revision, order model number HP 86226C *or* HP part number 08712-60047. You can perform this upgrade yourself.

Check the Amount of DRAM

You should have 16 MBytes of DRAM installed. The amount of DRAM installed is displayed during the analyzer's power-up sequence, and can also be viewed by pressing (SYSTEM OPTIONS) Service Instrument Info .

If your analyzer does not have 16.0 MBytes of DRAM installed, then you should upgrade. To upgrade to 16 MBytes of DRAM, order the appropriate 16 MB SIMM (HP part number 1818-5621). The upgrade involves the removal of an 8 MByte SIMM from its socket on the A2 CPU board assembly and replacing it with the 16 MB SIMM. You can perform this upgrade yourself. (Refer to your analyzer's *Service Guide* for disassembly instructions and SIMM location.)

Check the Amount of Non-Volatile RAM

You should have 1 MB of non-volatile RAM in the analyzer. The amount of non-volatile RAM that the analyzer has can be determined by pressing (SAVE RECALL) Select Disk Non-Vol RAM Disk . The total amount of free memory will be displayed in the upper right corner of the display. Add this amount to the amount of RAM used by any files displayed on the screen.

If the total is approximately 920 KB, then no upgrade is required.

If the total is about 435 KB then an upgrade is required. Upgrading the non-volatile RAM involves soldering a large surface-mount IC (U330—HP part number 1818-5651), along with its associated bypass capacitors (C341 and C342—HP part number 0160-7798) to the A2 CPU assembly. This upgrade must only be done by qualified personnel.

NOTE   The HP 87075C multiport test set is warranted and specified with the use of all the upgrades mentioned previously. Using the test set with an analyzer that does not meet these conditions may result in improper results, or could cause the system to lock up. However, some limited functionality may be possible, depending upon installed options and assuming that large calibrations (large number of points and ports) are not made.

Step 3. Connect the Test Set to the Analyzer

For using your system on a bench, configure and connect the two instruments as shown in Figure 1-3. Use the parallel cable that was shipped with the multiport test set to connect to the analyzer as shown.

If you will be installing your system in a rack, read "Installing the System in a Rack," next in this section, before connecting the test set to the analyzer.

Figure 1-3   System Configuration
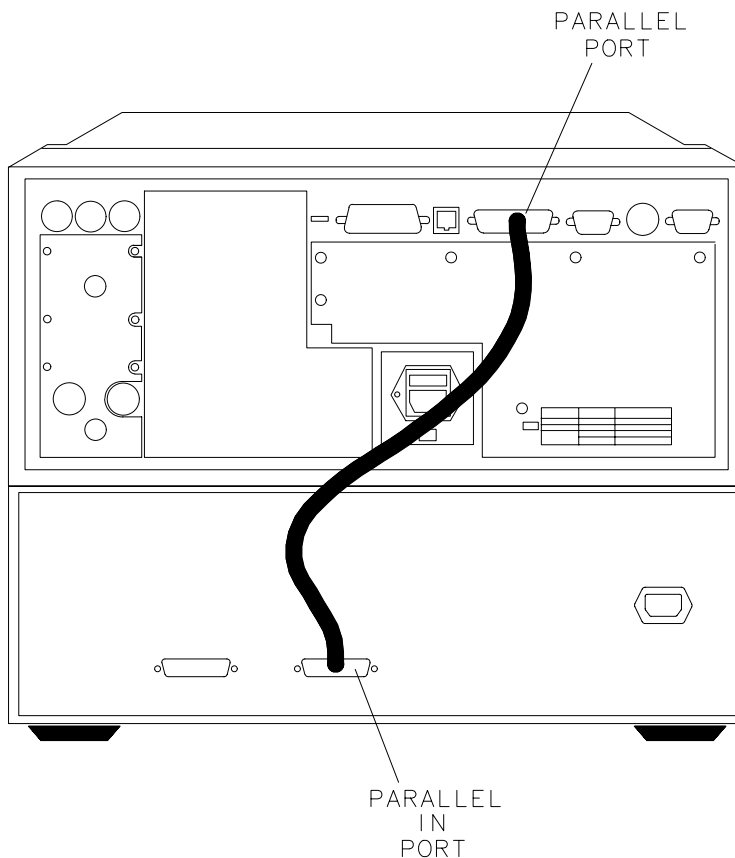
Installing the System in a Rack

Use only the recommended rack mount kit for the network analyzer (Option 1CM when ordered with the analyzer, or HP part number 08712-60036 when ordered separately): it needs side support rails. *Do not attempt to mount the analyzer by the front panel (handles) only.* The recommended rack mount kit allows you to mount the analyzer with or without handles.

The rack mount kit for the test set is Option 1CM when ordered with the test set, or HP part number 5063-9214 when ordered separately.

NOTE   There are special semi-rigid cables that should be used to connect the REFLECTION and TRANSMISSION ports of the analyzer and test set when used in a rack (or a bench configuration where the analyzer's bottom feet have been removed). These cables were shipped with your analyzer if you ordered Option 1CM. If you order the rack mount kit separately, you will need to order these special cables separately also. See Table 1-1 for part numbers.

To install your system in an HP 85043D rack, follow the instructions in the rack manual.

CAUTION   When installing your system in other racks, improper installation may cause shock hazards, overheating, dust contamination, and inferior system performance. Consult your HP customer engineer about installation, warranty, and support details.

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

Step 4. Satisfy Electrical and Environmental Requirements

NOTE

Refer to your network analyzer's *User's Guide* for information on electrical and environmental requirements for your network analyzer.

1. The line power module on your multiport 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 the available ac power source meets the following requirements:

Nominal	Range
Frequency: 50/60 Hz	47–63 Hz
Line Voltage: 100/115 V	90–132 V
Line Voltage: 230/240 V	198–254 V
Power	45 W max

CAUTION

This product has 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 the operating environment meets the following requirements for safety:

- indoor use
- altitude up to 15,000 feet (4,572 meters)
- 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

- use only in INSTALLATION CATEGORY II, and POLLUTION DEGREE 2, per IEC 1010 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 following illustration depicts only one type of power source outlet. Refer to Table 6-1 to see the different types of power cord plugs that can be used with your test set.

Figure 1-4   Protective Earth Ground
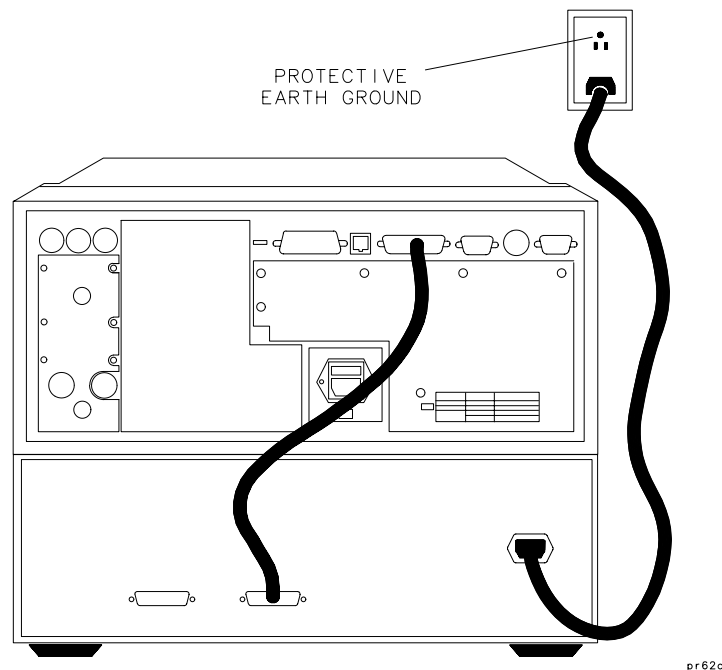
WARNING   **This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

5. Ensure there are at least two inches of clearance around the sides and back of the test set or the system cabinet.

Figure 1-5   Ventilation Clearance Requirements
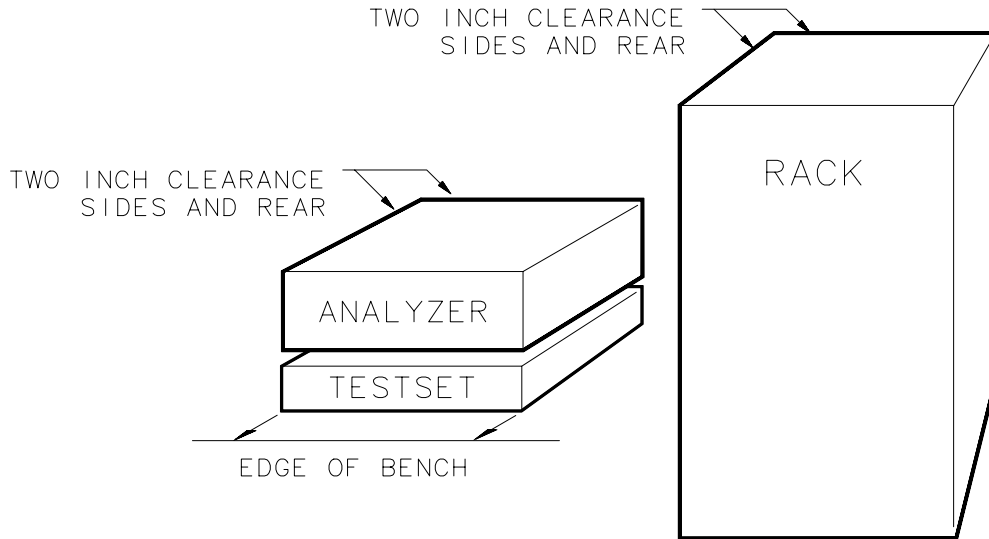
.ps64a

6. Set up a static-safe workstation. Electrostatic discharge (ESD) can damage or destroy components.

- table mat with earth ground wire: HP part number 9300-0797

- wrist-strap cord with 1 Meg Ohm resistor:
  HP part number 9300-0980

- wrist-strap:
  HP part number 9300-1367

- heel straps:
  HP part number 9300-1308

- floor mat:
  part number 1864R

Step 5. Activate the Test Set and Check the System Operation

1. Connect the semi-rigid cables that were shipped with your test set as shown in Figure 1-6. Check Table 1-1 to be sure that you are using the correct cables with your system configuration (the cables you use will be different depending on whether you are using a bench system configuration—as shown in Figure 1-6—or a rack configuration).

Figure 1-6   **Connect the Front Panel RF Cables**
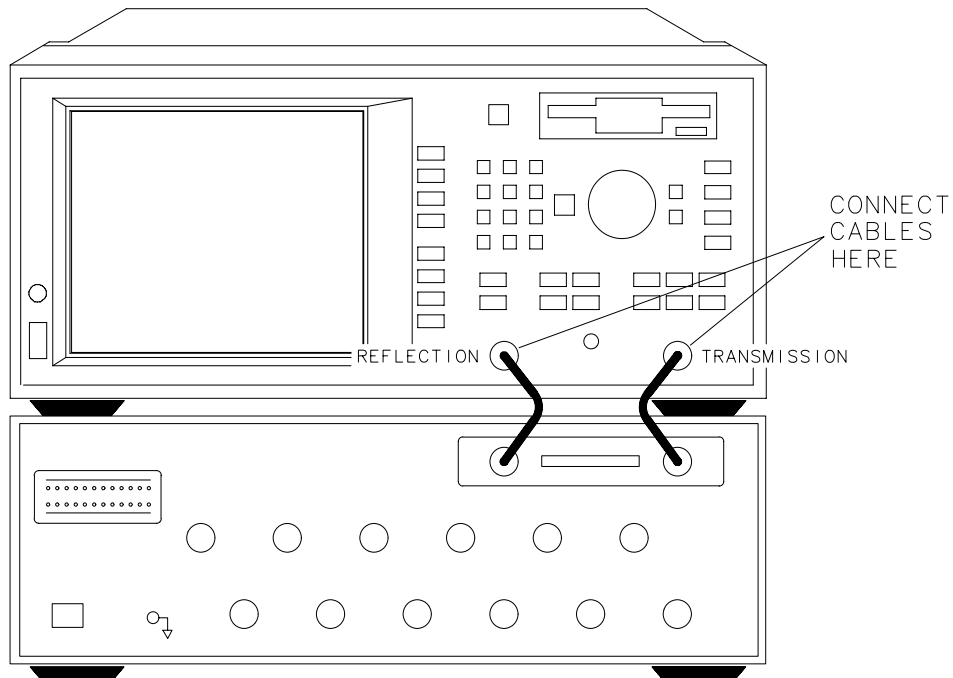
NOTE

The following step *must* be performed before you can use your network analyzer to control the multiport test set.

2. Turn on the analyzer and press (SYSTEM OPTIONS) System Config Switching Test Set Multiport ON .

3. Turn on the test set and then cycle the power on the analyzer.

4. The operator's check should be performed on the system to provide a high degree of confidence that the system is working properly. Refer to Chapter 2 for instructions on how to perform the operator's check.

5. After performing the operator's check, you should connect any peripheral devices you will be using with your system. Refer to "Step 6. Connect Peripheral Devices," next in this chapter.

Step 6. Connect Peripheral Devices

After you've performed the operator's check to ensure that your system is working properly, connect any peripherals that you intend to use with your system.

Connecting Peripherals and Controllers

Figure 1-7   **Network Analyzer and Multiport Test Set Rear Panel Connectors**
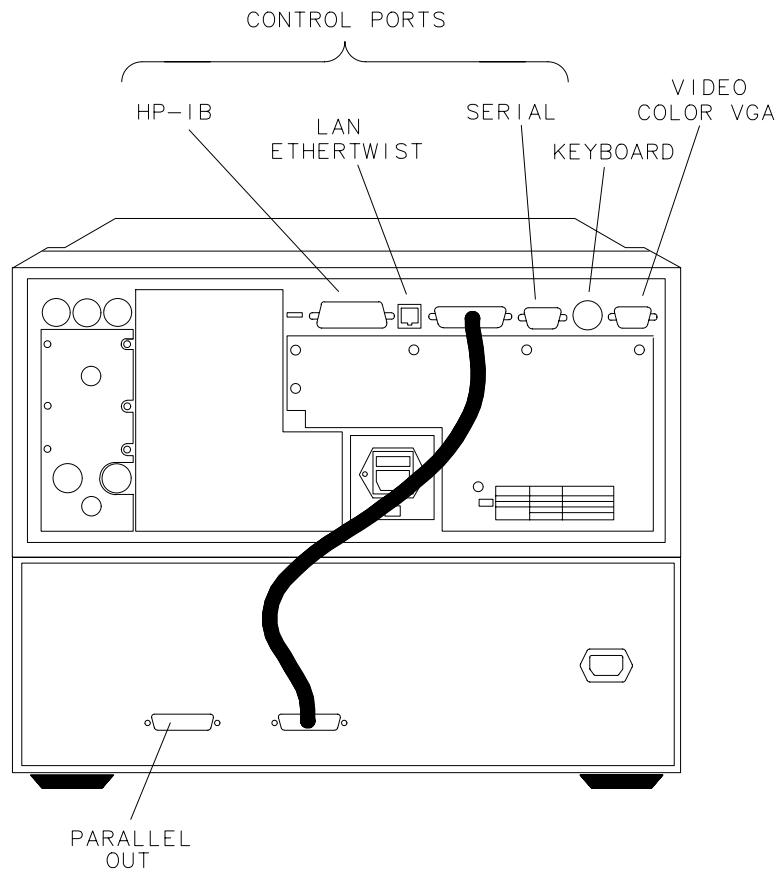
Refer to Figure 1-7:

> The HP-IB port on the analyzer is for use with computers and peripherals (printers, plotters, etc.).

> The PARALLEL PORT on the analyzer connects to the test set's PARALLEL IN port as shown with the interconnect cable that was shipped with your test set.

- The PARALLEL OUT port on the test set, and the analyzer's RS-232 (serial) port are for peripherals such as printers or plotters. With the IBASIC option (1C2), the serial port can also be programmed via IBASIC for general I/O control. See your analyzer's *HP Instrument BASIC User's Handbook* for information on using IBASIC.

- The VIDEO OUT COLOR VGA port on the analyzer allows you to connect a color VGA monitor for enhanced viewing. See "Using an External VGA Monitor" in Chapter 4 of your analyzer's *User's Guide* for more information.

- The LAN ETHERTWIST connector on the analyzer is for connecting your analyzer to a local area network (LAN) for control and access. You must have Option 1F7 to utilize this port. See the analyzer's *Option 1F7 User's Guide Supplement* for information on how to use your analyzer in a LAN.

- The DIN KEYBOARD connector can be used with an optional keyboard or bar code reader. See "Using a Keyboard" in Chapter 4 of your analyzer's *User's Guide* for more information.

NOTE   See your analyzer's *User's Guide* for more specific information on HP-IB connections, parallel and serial connections, and configuring peripheral settings.

Preventive Maintenance

Preventive maintenance consists of checking the front panel connectors. This should be done at least every six months — more often if the test set is used daily on a production line or in a harsh environment.

Visually inspect the front panel connectors. The most important connectors are those to which the DUT is connected. All connectors should be clean and the center pins centered. The fingers of female connectors should be unbroken and uniform in appearance. If you are unsure whether the connectors are good, gauge the connectors to confirm that their dimensions are correct.

Figure 1-8   **Maximum and Minimum Protrusion of Center Conductor From Mating Plane**

Mating plane

Max = 0.207 in.

Min = 0.204 in.
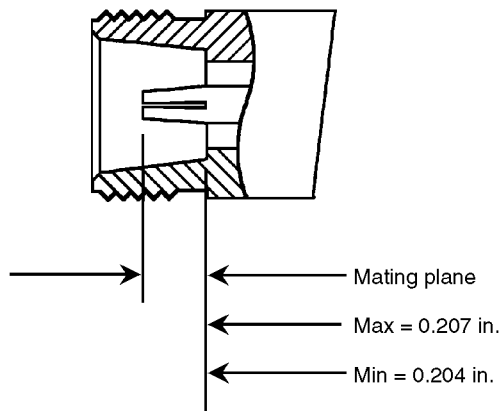
po644 b_c

CAUTION   Never connect 50 ohm cables to the front panel 75 ohm connectors of the analyzer or test set. Otherwise, *irreparable* connector damage will occur.

Cleaning the Test Set

Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

WARNING **To prevent electrical shock, disconnect the HP 87075C from mains before cleaning.**

2   Getting Started

This chapter provides a brief tour of the multiport system, pointing out some of the more important features you'll be using when making measurements. It also provides an operator's check that can be performed whenever you want a quick check of the system's integrity.

Brief Tour of System

Your multiport system will allow you to measure your multiport devices with maximum throughput by reducing the number of mechanical connections and by significantly reducing the amount of time spent on calibrations. Refer to Figure 2-1 where some of the main keys and features you'll most likely be using are pointed out. See Table 2-1 to find out where to go for more information on these features.

You should familiarize yourself with the analyzer's features by referring to its *User's Guide*.

Figure 2-1 **The Multiport System**
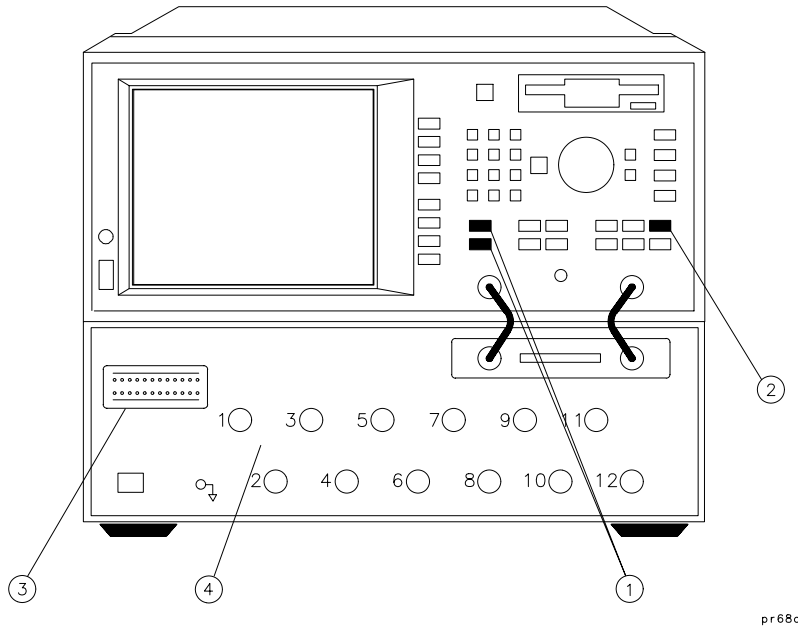
pr68c

Table 2-1 **Multiport System Features**

Item #	Description	For More Information
1	The (MEAS) keys: Use these keys to access measurement selection and test set port selection.	See "Port Control" in Chapter 3.
2	The (CAL) key: Use this key to access the Test Set Cal and SelfCal features.	See Chapter 4.
3	The port connection status display.	See "Port Control" in Chapter 3.
4	The test ports.	See Chapter 3.

Performing the Operator's Check

Description

The following operator's check is designed to provide you with greater than 85% confidence that your test set is functioning properly. It is *not* designed to verify specifications nor to check the validity of calibrations. To verify specifications, refer to "Manual Performance Tests" in Chapter 9. To check a calibration, refer to "Calibration Check" in Chapter 4.

NOTE   The operator's check for the test set assumes that the network analyzer is functioning properly and has a valid default calibration. Refer to your analyzer's *User's Guide* for information on performing the analyzer's operator's check.

Procedure

The quickest method for performing the operator's check is to use the "Op Verif" portion of the performance test software (see Chapter 9). This method will take approximately one minute to perform and no external connections to the test set's test ports are required. You'll need an external computer, or the IBASIC option (1C2) installed in your analyzer to use the software.

If you don't have access to the performance test software, the following procedure can be used instead.

Equipment Required

- HP 871xC network analyzer, 75 Ω impedance (Option 1EC)

- Cables, 75 Ω type-N, (shipped with the test set—see Table 1-1)

- 75 Ω type-N load (part of HP 85036B calibration kit)

- 75 Ω cable such as the one that was shipped with your analyzer (HP part number 8120-6468)

Process

Check Unterminated Return Loss.

1. Make sure the test set is properly connected to the analyzer using the parallel port interface cable and the front panel RF cables as described in Chapter 1.

2. Make sure that both instruments are turned on, and that the analyzer is configured for use with a multiport test set as described in "Step 5. Activate the Test Set and Check the System Operation" in Chapter 1.

3. Press (PRESET) (MEAS 1) Reflection to configure the analyzer to make a reflection measurement.

4. Press (FREQ) Start (3) MHz Stop (1300) MHz to set the analyzer to cover the frequency range of the test set.

5. Press (CAL) Restore Defaults to make sure the analyzer's default calibration is in place.

6. Press (MEAS 1) Multiport Selection Reflection Port Num (1) (ENTER).

7. Verify that the return loss of the selected port, with nothing connected, is between about −4 dB and −14 dB. See Figure 2-2 for an example measurement. Your results should be somewhat similar.

8. Repeat steps 6 and 7 for all the remaining ports on your test set.

Figure 2-2   **Operator's Check Unterminated Return Loss**
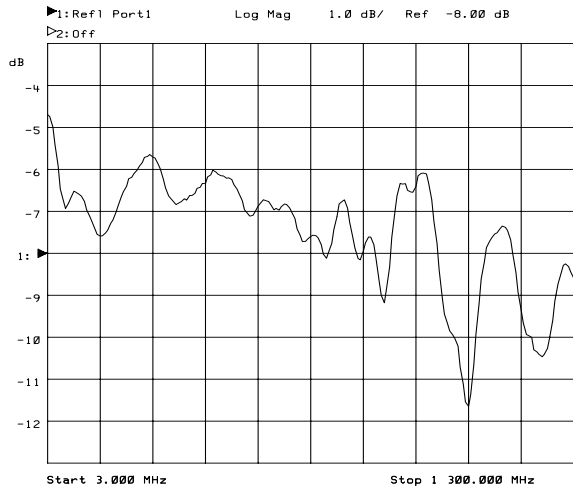
Check Terminated Return Loss.

9. Press (MEAS 1)   Multiport Selection   Reflection Port Num (1)
    (ENTER).

10. Connect a 75 Ω load to PORT 1 on the test set.

11. Verify that the return loss of the selected port is below −15 dB across
    the frequency range. See Figure 2-3 for an example measurement.
    Your results should be somewhat similar.

12. Repeat steps 2 through 4 for all the remaining ports on your test set.

Figure 2-3   **Operator's Check Terminated Return Loss**
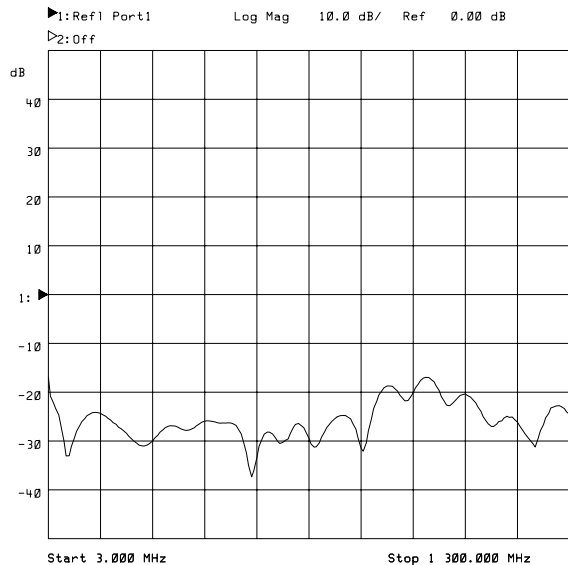
Check Transmission Measurement.

13. Press (MEAS 1) Transmissn (CAL) Restore Defaults .

14. Press (MEAS 1) Multiport Selection Reflection Port Num (1)
    (ENTER) Transmissn Port Num (2) (ENTER).

15. Connect a through cable between ports 1 and 2 on the test set.

16. Verify that the transmission measurement of the selected ports is
    between –7 db and –17 dB across the frequency range. See Figure 2-4
    for an example measurement. Your results should be somewhat
    similar.

Figure 2-4   **Operator's Check Transmission Measurement**
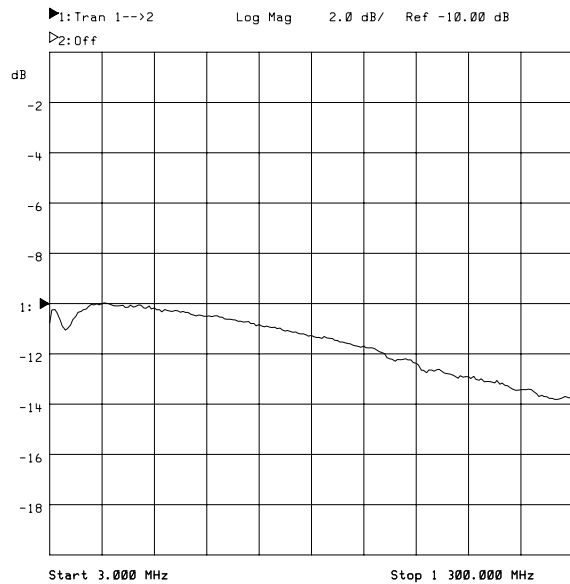
Load or Perform Test Set Cal

The Test Set Cal and SelfCal features of your multiport system allow you to make highly accurate measurements and also maximize throughput. To learn more about Test Set Cal and SelfCal, see Chapter 4.

A Test Set Cal is performed at the factory just prior to shipment of your multiport test set. The factory Test Set Cal is performed on all ports of your test set using the analyzer's preset condition over the full frequency range of the test set (3 MHz to 1300 MHz). This calibration and its associated instrument state are stored on a disk and shipped with the test set.

CAUTION   This calibration should only be used if you will be connecting test devices directly to the front panel connectors of the test set. Since most test setups consist of cables and/or test fixtures that are connected between the DUT and the test set, you should perform your own calibration using your specific operating parameters, mechanical standard type, and calibration reference plane.

To use the Test Set Cal that was shipped with your test set:

1. Insert the Test Set Cal disk into the analyzer's disk drive and press (SAVE RECALL) Select Disk   Internal 3.5" Disk .

2. Use the front panel knob to highlight the file called "DEFAULT.CAL".

3. Press Prior Menu   Recall State . The analyzer will copy the file into the analyzer's non-volatile memory. A message will appear that says the recalled Test Set Cal does not match current settings. This will be remedied by recalling the instrument state file from the disk as described in the next step.

4. Press (SAVE RECALL) and highlight the file called "DEFAULT.STA", and then press Recall State .

NOTE   The DEFAULT.STA file was created in the factory on an HP 8714C network analyzer. If your analyzer is not an HP 8714C, a message will appear warning you that some 8714C features are not available. However, there is nothing in the DEFAULT.STA file that will cause any problems on any HP 8711C, HP 8712C, or HP 8713C.

5. Press (CAL) Test Set Cal to invoke the calibration.

Cable and Test Fixture Considerations

For the most accurate, repeatable measurements, it is imperative that the cables and test fixtures that you use to test devices introduce as little drift as possible. Although the system's Test Set Cal feature can effectively calibrate out the effects of external cabling and fixtures, the drift-removing SelfCal feature can only remove subsequent drift internal to the system. It cannot compensate for subsequent drift associated with any external cabling or fixturing. See "Test Set Cal and SelfCal: The Details" in Chapter 4.

Drift can be minimized by using high quality connectors, semi-rigid cables, and fixturing that reduces cable movement to a minimum.

3   Making Measurements

Your multiport system allows you to measure both forward and reverse responses of a multiport device without having to manually change connections. This chapter explains how to control the test set port connections with the network analyzer and then walks through an example that performs the following three measurements on a single device.

- Insertion Loss

- Return Loss

- Isolation

NOTE   Although you may have a 2-port or a 6-port test set, the Option 012 12-port test set will most often be depicted and described here.

NOTE   For detailed information on how the analyzer detects signals, and how to interpret measurement responses, see your analyzer's *User's Guide*.

Port Control

If you have not yet activated the test set by pressing SYSTEM OPTIONS
  System Config   Switching Test Set   Multiport ON , you should do it now.

When your multiport test system is properly connected and configured as
described in Chapter 1, you have the ability to switch any of the
numbered ports on your test set to either the REFLECTION or
TRANSMISSION port on the analyzer. The analyzer controls the test set
through the rear panel parallel digital interface. The port connection
status is displayed on the test set's front panel and on the network
analyzer's display in the upper left-hand corner. See Figure 3-1, which
shows status indicator examples for a transmission measurement on the
left, and a reflection measurement on the right.

Figure 3-1   **Port Connection Status**
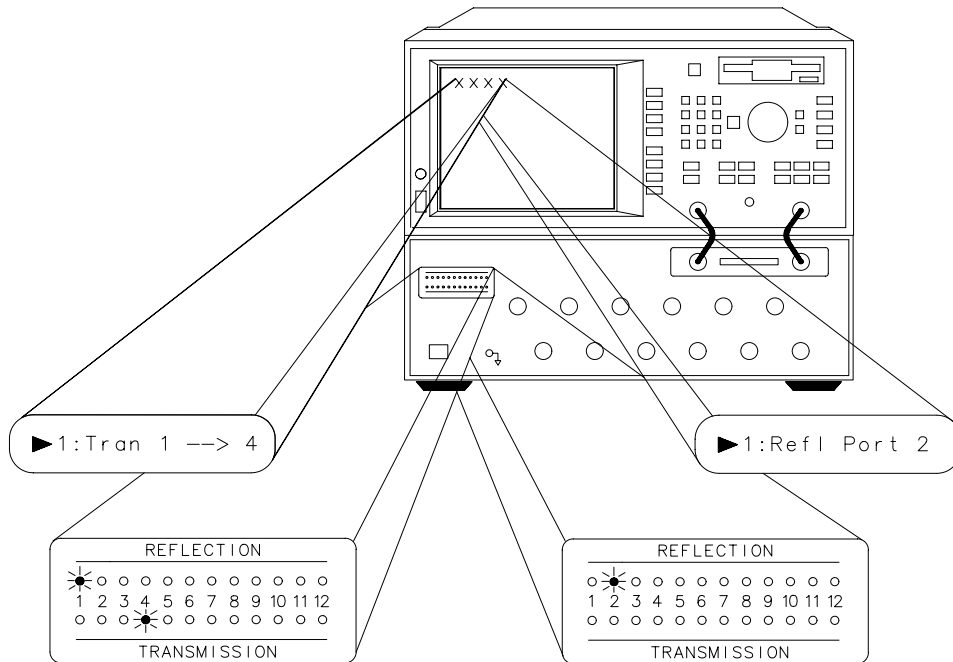
Transmission Measurements

During a transmission measurement, one test set port is connected to the analyzer's REFLECTION port and one test set port is connected to the analyzer's TRANSMISSION port. All other test set ports are terminated internally in 75 ohms. The diagram below shows port 3 connected to the REFLECTION port, port 4 connected to the TRANSMISSION port, and all other ports terminated in 75 ohms.

Figure 3-2   **Transmission Measurement Port Connections**
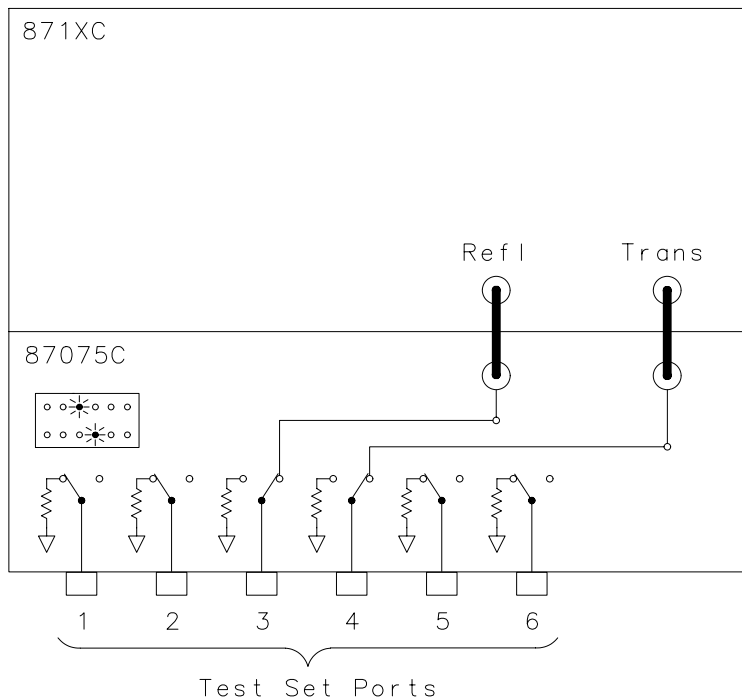
To make the connections as illustrated above, you would press the following keys on the analyzer: (MEAS 1) Transmissn Multiport Selection Reflection Port Num (3) (ENTER), Transmissn Port Num (4) (ENTER).

Reflection Measurements

During a reflection measurement, only one test set port is connected to the analyzer's reflection port. All other test ports are terminated internally in 75 ohms. The diagram below shows port 5 connected to the reflection port, and all other ports terminated in 75 ohms.

Figure 3-3   **Reflection Measurement Port Connection**
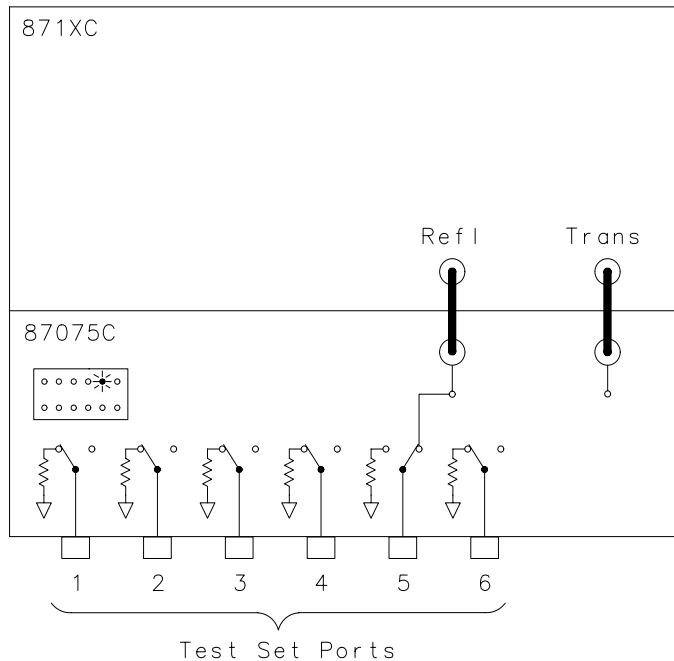
To make the connections as illustrated above, you would press the following keys on the analyzer: (MEAS 1) Reflection Multiport Selection Reflection Port Num (5) (ENTER). (You can also enter a transmission port number at this time, but it will not take effect until you leave reflection measurement mode.)

NOTE   Switching reflection or transmission to a port that is already selected will cause the analyzer to swap ports. For example, if you currently have Port 3 selected as the reflection port, and Port 4 selected as the transmission port (as in Figure 3-2), and you then select reflection to Port 4, transmission will automatically be switched over to Port 3.

Measuring a Multiport Device

The illustration below shows how with one mechanical set up (cables are represented by solid lines) you can make multiple measurements on one device simply by changing the port selections. Although you would most likely be making more than three measurements on a device like the one below, this example will show how to make three common measurements: insertion loss, return loss, and isolation.

Figure 3-4   **Measuring a Multiport Device — Three Measurements, One Test Setup**
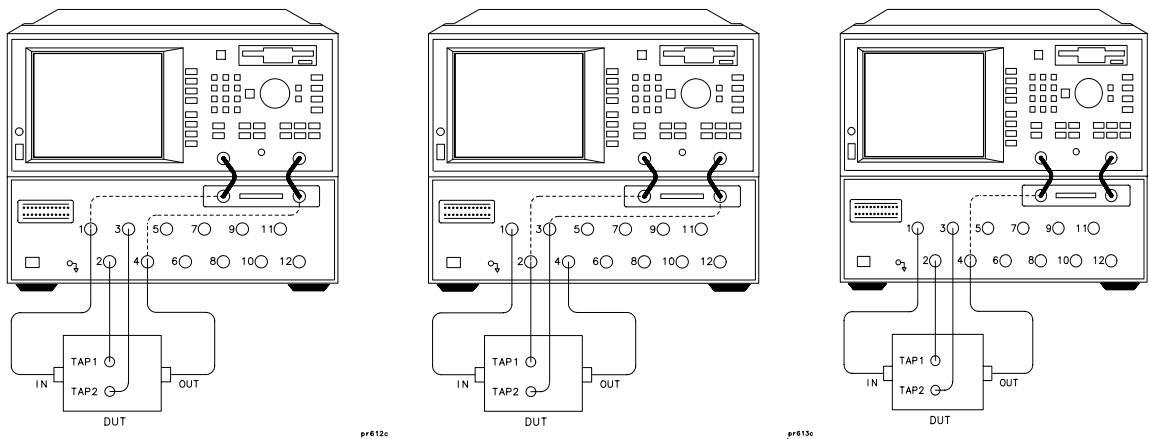
Insertion Loss	**Isolation**	**Return Loss**
IN to OUT	TAP 1 to TAP 2	OUT port
Tran 1– –>4	Tran 2– –>3	Refl Port 4

NOTE   Transmission and reflection responses of any multiport device can be affected by the load match presented to the unused ports. The effect of the test set load match on the measurements is device dependent and needs to be considered.

The first step before making any measurements is to calibrate your multiport system.

Calibrating the Multiport System

To properly calibrate your system for the most accurate measurements, you will need a set of mechanical standards called a calibration kit. You'll use the standards in the kit to perform a Test Set Cal. Follow along with the steps below to get an idea of how the complete measurement process works. For all the details on calibrating your test set, refer to Chapter 4.

For this particular example, you would do the following steps to perform the Test Set Cal and to set up the automated SelfCal:

1. Press (PRESET) (FREQ) Start (3) MHz Stop (1300) MHz .

2. Press (CAL) Test Set Cal .

CAUTION Every time you perform a Test Set Cal, the analyzer automatically stores the results in a file called "TSET_CAL.CAL" on the non-volatile RAM disk.

This file will be overwritten every time you perform a Test Set Cal. If you want to save the results of the current Test Set Cal, you must copy the current "TSET_CAL.CAL" file to another file. See "Saving the Test Set Cal" in Chapter 4.

3. Press Create "TSET_CAL" 4 Ports .

NOTE To save time when calibrating, calibrate the lowest number of ports necessary for your test setup. For this example we are only calibrating 4 of the available twelve ports. Since we won't be using ports 5 through 12 for this measurement example, there is no need to spend the time calibrating all twelve ports.

4. Follow the onscreen instructions for connecting the mechanical standards from the calibration kit.

5. When you have finished measuring all the opens, shorts, loads, and thrus, press All Stds Done .

6. Press Self Cal Timer and set the SelfCal interval to 60 minutes (the default interval). Then press Periodic SelfCal .

7. This completes the calibration process and activates the automated SelfCal.

Measuring Insertion Loss

Recall from Figure 3-4 that the insertion loss measurement setup looks like this:

Figure 3-5   **Insertion Loss Measurement Setup**
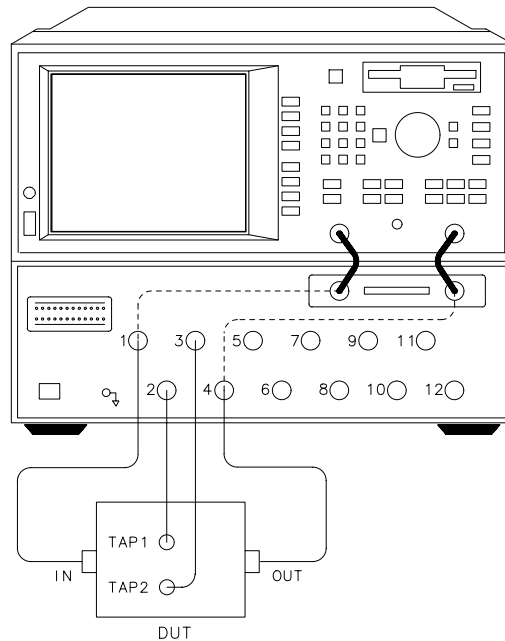
To perform the insertion loss measurement (measuring the loss from the IN port of the DUT to the OUT port of the DUT), do the following steps:

1. Press (MEAS 1) Transmissn to set up the analyzer for a transmission measurement.

2. Press Multiport Selection Reflection Port Num (1) (ENTER) to connect PORT 1 on the test set to the REFLECTION port of the analyzer.

3. Press Multiport Selection Transmissn Port Num (4) (ENTER) to connect PORT 4 on the test set to the TRANSMISSION port of the analyzer.

4. The response on the display will be the insertion loss from the input of the device to the output.

5. See your analyzer's *User's Guide* for example displays of insertion loss measurements and for information on using the analyzer's built-in features such as markers and limit lines to help interpret your measurements quickly and easily.

Measuring Isolation

Recall from Figure 3-4 that the isolation measurement setup looks like
this:

Figure 3-6   **Isolation Measurement Setup**
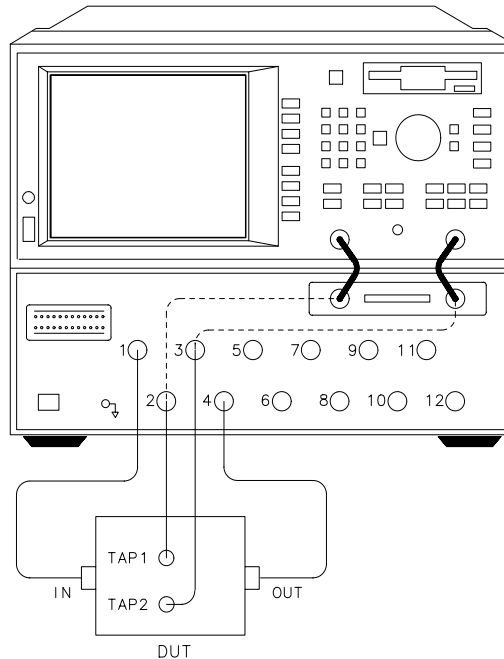
To perform the isolation measurement (a transmission measurement
from the TAP 1 port to the TAP 2 port on the DUT), do the following
steps:

1. Press $\boxed{\text{MEAS 1}}$ $\boxed{\text{Transmissn}}$ to set up the analyzer for a
   transmission measurement.

2. Press $\boxed{\text{Multiport Selection}}$ $\boxed{\text{Reflection Port Num}}$ $\boxed{2}$ $\boxed{\text{ENTER}}$ to
   connect PORT 2 on the test set to the REFLECTION port of the
   analyzer.

3. Press $\boxed{\text{Multiport Selection}}$ $\boxed{\text{Transmissn Port Num}}$ $\boxed{3}$ $\boxed{\text{ENTER}}$ to
   connect PORT 3 on the test set to the TRANSMISSION port of the
   analyzer.

4. The response on the display will be the isolation between the TAP 1
    and TAP 2 ports on the DUT.

5. See your analyzer's *User's Guide* for information on using the
    analyzer's built-in features such as markers and limit lines to help
    interpret your measurements quickly and easily.

Measuring Return Loss

Recall from Figure 3-4 that the return loss measurement setup looks like this:

Figure 3-7   **Return Loss Measurement Setup**
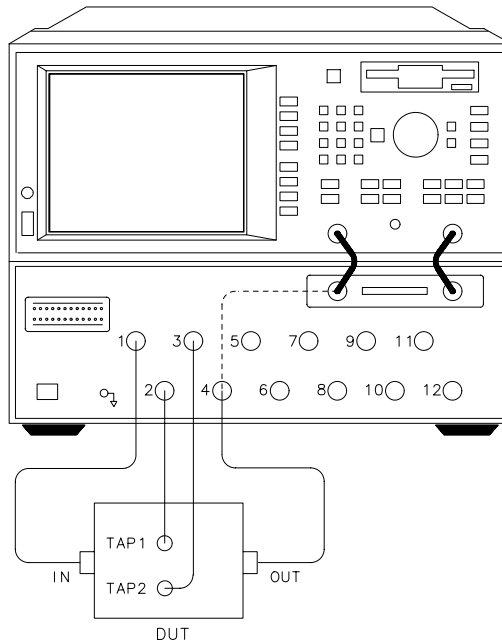
pr614c

To perform the return loss measurement on the output port of the DUT, do the following steps:

1. Press (MEAS 1) Reflection to set up the analyzer for a reflection measurement.

2. Press Multiport Selection   Reflection Port Num (4) (ENTER) to connect PORT 4 on the test set to the REFLECTION port of the analyzer.

3. The response on the display will be the return loss of the device.

4. See your analyzer's *User's Guide* for example displays of return loss measurements and for information on using the analyzer's built-in features such as markers and limit lines to help interpret your measurements quickly and easily.

Using Two Channels for Simultaneous Measurements

You can use both measurement channels on the network analyzer to view two different measurements simultaneously. For example, you can make a transmission measurement between two ports on your DUT and make a reflection measurement on one of those ports at the same time.

NOTE   Port selections cannot be made independently for each measurement channel.

Figure 3-8   **Simultaneous Measurements Example**


```
Meas1  — Transmission (Insertion Loss) --------
Meas2  — Reflection (Return Loss) ·················
```

pr615c
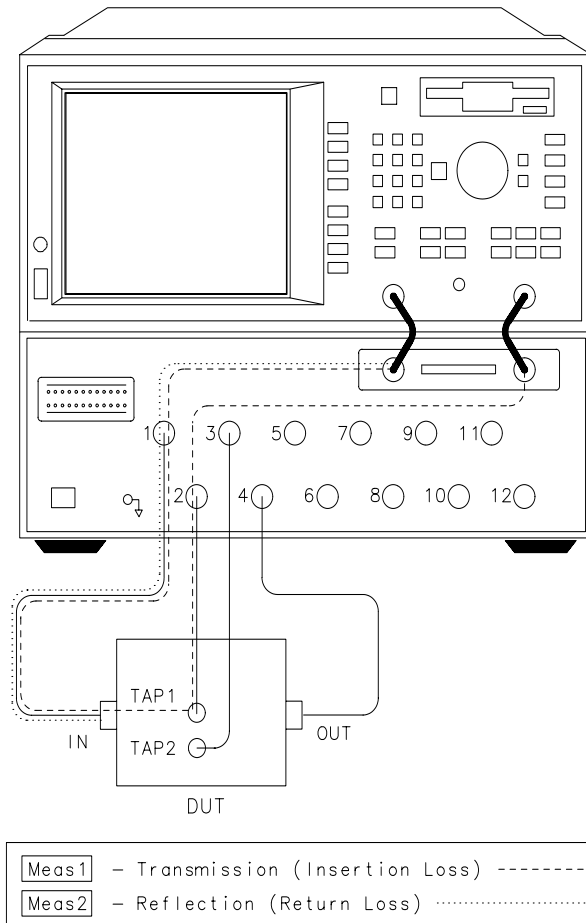
To set up the analyzer to make the transmission measurement on measurement channel 1, press (MEAS 1) Transmissn Multiport Selection Reflection Port Num (1) (ENTER), Transmissn Port Num (2) (ENTER). Now press (MEAS 2) Reflection to set up the analyzer to measure the return loss of the input port of the device on measurement channel 2.

When making dual measurements with alternate sweep off (both measurement channels sweeping simultaneously — the default mode for most types of measurements), it is important to note that the port connected to the analyzer's transmission port is terminated with the test set transmission path and network analyzer transmission input. It is *not* connected to the internal 75 ohm load. When the port is terminated using the internal load rather than the impedance of the test set, your reflection measurements will be more accurate.

To ensure that the transmission port is terminated by the internal load during the reflection measurement, turn alternate sweep on by pressing (SWEEP) Alt Sweep ON off . The analyzer will now sweep one measurement channel, then the other, which allows the transmission port to be properly terminated internally in 75 ohms during the reflection measurement. You can observe the transmission port LED (port 2 in this example) turning on and off with each sweep.

4   **Test Set Cal and SelfCal**

Introduction

Measurement calibration is a process that improves measurement accuracy by using error correction arrays to remove systematic measurement errors. By implementing the Test Set Cal and SelfCal features on your multiport system, you can increase the accuracy of your measurements *and* significantly increase the throughput of your multiport measurements by eliminating frequent and lengthy calibration procedures. A Test Set Cal is a calibration that should be performed when you first receive your test set and thereafter on a regular, but relatively infrequent basis (once a month is recommended). A Test Set Cal requires you to connect mechanical calibration standards to all of the ports you will be using for your measurements. The analyzer then makes some internal measurements, performs some calculations, and uses the results as a reference for subsequent SelfCals. The results of a completed Test Set Cal are always stored in the analyzer's non-volatile memory in a file call "TSET_CAL.CAL".

NOTE   During the analyzer's power-up sequence, it searches for this file in non-volatile memory. If it is not found, a message will be displayed indicating that the file was not found. If this happens you must either perform a new Test Set Cal or load one that has been saved on another disk.

A SelfCal is an automated internal system calibration that is set up to be performed on a regular, frequent basis (once per hour is recommended). A SelfCal does not require that you remove your DUT or that you make any mechanical connections. The SelfCal uses the results of the most recent Test Set Cal along with internal solid-state open, short, load and through transfer standards to remove the drift of the network analyzer and multiport test set due to environmental variations.

See "Test Set Cal and SelfCal: The Details" later in this chapter for detailed information on how the Test Set Cal and SelfCal work together.

See "Performing a Test Set Cal" to learn how to perform a Test Set Cal.

NOTE   Although HP recommends that you use the Test Set Cal and SelfCal features whenever you are using your multiport system, the traditional network analyzer calibrations are also available to you. Refer to your analyzer's *User's Guide* for information on these other calibrations.

Performing a Test Set Cal

To perform a Test Set Cal, the following steps are required, and are explained in detail in this section:

1. Set up measurement parameters, such as frequency range, power level, number of measurements points, etc.

2. Determine the calibration reference plane.

3. Determine the type of calibration standards you will need.

4. Perform the Test Set Cal.

5. Save the calibration, if desired.

6. Set up the SelfCal timer.

Setting up the measurement parameters

You will need to determine the measurement parameters under which you will perform your Test Set Cal by determining all the measurements you will be making on a particular device and setting your parameters accordingly. The analyzer will be able to accurately interpolate error correction when most parameters are changed. However, some special considerations are discussed below.

Frequency range

You should set your frequency range to the narrowest span possible that will cover all of the measurements you will be making. The analyzer uses a fixed number of frequency points during a calibration and interpolates as the frequency span is narrowed. Setting the analyzer to the narrowest span possible for your measurements will ensure the most accurate calibration. For example, if you will be measuring a device that requires three different measurements, set your start frequency to the lowest frequency used among the measurements and your stop frequency to the highest frequency used among the measurements. See Figure 4-1. The analyzer will interpolate between calibrated measurement points when the frequency span is narrowed. Widening the frequency span will invalidate the Test Set Cal and restore the default factory calibration.

Figure 4-1   **Frequency Range Example**
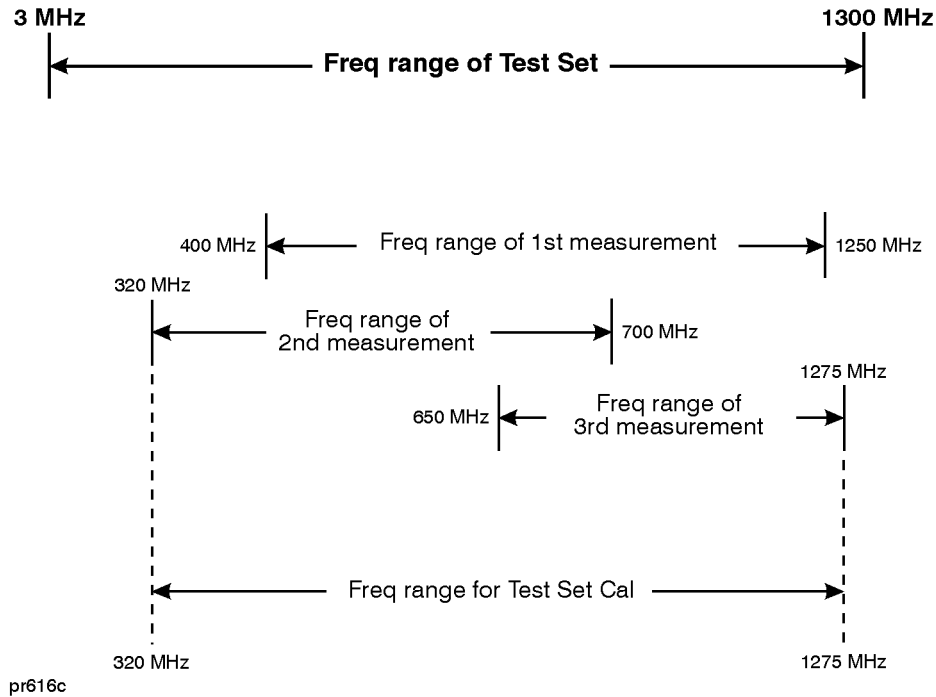
NOTE   If you are using an HP 8713C or HP 8714C with your test set, you must set your stop frequency to ≤ 1300 MHz.

NOTE   Using this method of calibration will yield accurate measurements with optimum throughput. If your accuracy requirements are more important than your throughput requirements, you may want to perform a separate Test Set Cal for each measurement setup. This will eliminate the need for the analyzer to use interpolation, but will increase the amount of time needed for each measurement. See "Using Multiple Test Set Cals," later in this chapter for information on using more than one Test Set Cal.

Other parameters to consider

Changing the status of spur avoid options (MENU Spur Avoid Options)
after calibrating will invalidate the calibration and restore the analyzer's
default calibration. It is not recommended that the analyzer's default
calibration be used for multiport measurements. If you want to use any
spur avoid options with your measurements, be sure to select them *before*
you calibrate.

The following other parameters, if changed after calibrating, will not
invalidate the cal, but will cause the "C?" notation to appear, indicating
that an output parameter has been changed:

- Sweep time

- Number of points

- Power level

- System bandwidth

Determining your Calibration Reference Plane

For the most accurate calibrations and measurements it is important
that you calibrate at the appropriate reference plane. The reference
plane is where you will actually be connecting your DUT. Most often you
will not be connecting your DUT directly to the test set's front panel.
More likely, you will be connecting your DUT to a test fixture that is
connected to the test set. See Figure 4-2. It is important to calibrate out
the effects of the test fixture and its associated cables and hardware.
Whenever possible connect your calibration standards to the calibration
reference plane.

Figure 4-2   **The Calibration Reference Plane**
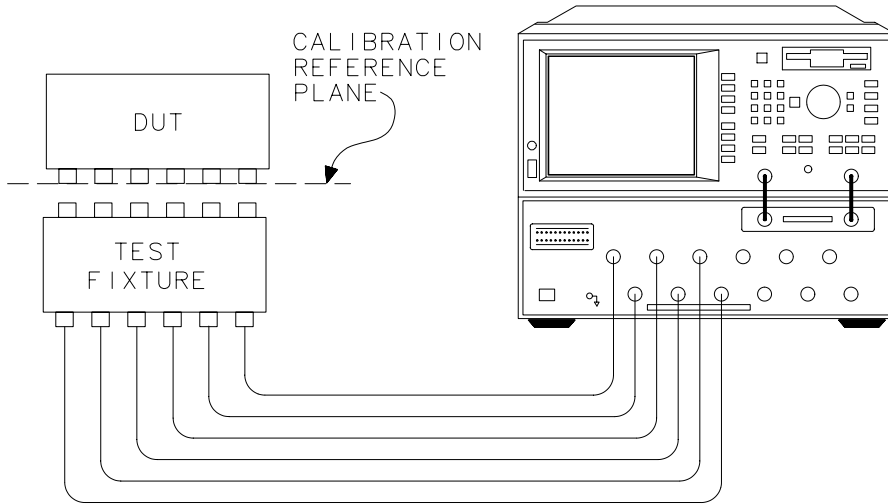
CAUTION   Although the Test Set Cal can calibrate out the effects of your external hardware, the drift-removing features of the SelfCal cannot remove drift associated with any external fixtures or cabling. See Figure 4-4.

Be sure that all external fixtures and cables are extremely stable. HP recommends the use of semi-rigid cabling external to your multiport test set. Design fixturing such that movement of all cables and connectors is minimized.

Determining the Type of Calibration Standards to Use

For the most accurate calibrations and measurements you should calibrate with mechanical standards of a type that match the connectors on your device or test fixture.

The following 75 ohm connector types have calibration kit definitions stored in the analyzer.

Connector Type	Cal Kit Model No.
Type-N	HP 85032B/E
Type-F	HP 85039B

NOTE   Often, multiport devices have more than one connector type. You must choose only one connector type with which to perform the Test Set Cal (and use adapters where necessary). An alternative is to perform a separate Test Set Cal for each connector type you will be using. However, this is *not* recommended, as switching between Test Set Cals during the measurement process will have a negative impact on throughput.

If you must sacrifice throughput for accuracy and use multiple Test Set Cals, see "Using Multiple Test Set Cals," later in this chapter.

Performing the Test Set Cal

HP recommends that you perform a Test Set Cal on a regular basis, about once a month. Your environmental conditions and accuracy requirements may dictate either a shorter interval or allow a longer interval.

Before you proceed with the following steps, be sure you have set up the analyzer with the required measurement parameters, determined your calibration reference plane, and selected your mechanical standards as described earlier in this chapter.

CAUTION   Every time you perform a Test Set Cal, the analyzer automatically stores the results in a file called "TSET_CAL.CAL" on the non-volatile RAM disk.

This file will be overwritten every time you perform a Test Set Cal. If you want to save the results of the current Test Set Cal, you must copy the current "TSET_CAL.CAL" file to another file. See "Saving the Test Set Cal" in this chapter.

1. Press (CAL) (More Cal if necessary) Cal Kit . Select the softkey that matches the type of mechanical standards you will be using. If the standards you are using are not listed in the analyzer's softkey menu, refer to the analyzer's *User's Guide* for information on performing a calibration with non-standard connectors.

NOTE   The calibration kit sex is defined to be the sex of the *test port* connector, not the sex of the calibration standard itself.

2. Press (CAL) Test Set Cal   Create "TSET_CAL" on the analyzer.

3. Select the number of ports.

    Decide how many of the ports you will be using on your multiport test set and select the number using the softkeys on the analyzer. If you need to use an odd number of ports, be sure to round *up* to the next even number.

NOTE   The number you select will determine the highest port number that gets calibrated. In other words, if you will be using 4 ports and want to just use ports 1 through 4, then select 4 Ports . But if you are using 4 of the ports, and want to use ports 1, 2, 4 and 6, you must choose 6 Ports so that ports 1 through 6 get calibrated.

NOTE   To save time, calibrate the lowest number of ports necessary for your test setup. For example, if your test setup requires the use of only 6 of the available twelve ports, calibrate for 6 ports; there is no need to spend the time to calibrate all twelve ports.

4. Follow the onscreen instructions to perform the calibration.

5. When the calibration is complete, the results are stored into a file called "TSET_CAL.CAL" in the analyzer's non-volatile memory.

Saving the Test Set Cal

It is a good idea to save the results of your Test Set Cal to a unique file. You can save the Test Set Cal to a floppy disk or to a unique filename on the analyzer's internal non-volatile RAM disk. The following examples describe how to save the file to a floppy disk and how to save the Test Set Cal to a unique filename in the analyzer's non-volatile memory. See your analyzer's *User's Guide* for more information on copying, saving, and recalling files.

Copy TSET_CAL.CAL to a floppy disk

1. Insert a DOS-formatted 3.5 inch floppy disk into the analyzer's disk drive. (If your disk is not formatted, you can use the (SAVE RECALL) File Utilities menu to format your disk. See your analyzer's *User's Guide* for more information.)

2. Press (SAVE RECALL) Define Save Tset Cal ON .

NOTE   When you use the Tset Cal ON key to define the contents of a save, the instrument state is *not* saved. Only the calibration data is saved. It is a good idea to also save the instrument state under which the calibration was performed. See your analyzer's *User's Guide* for more information on saving and recalling instrument states.

3. Press Prior Menu Select Disk Internal 3.5" Disk .

4. Press Prior Menu Save State .

5. You now have a copy of the TSET_CAL.CAL file on the floppy disk.

Copy TSET_CAL.CAL to a new filename

This procedure demonstrates how to make a copy of TSET_CAL.CAL with a unique filename in the analyzer's non-volatile memory.

1. Press (SAVE RECALL) Define Save Tset Cal ON .

2. Press Prior Menu Select Disk Non-Vol RAM Disk .

3. Press Prior Menu Re-Save State .

4. Use a keyboard connected to the analyzer's DIN KEYBOARD connector to enter the new filename. (If you don't have a keyboard, you can use the analyzer's front panel knob and the Select Char key to select and enter characters from the top of the analyzer's display. Press Enter when done.)

Setting the SelfCal Timer

The SelfCal timer feature allows you to set up your multiport system to automatically perform a SelfCal periodically at a user-defined interval. The default (and recommended) interval is 60 minutes (1 hour). Your environmental conditions and accuracy requirements may dictate either a shorter interval or allow a longer interval.

To set up the SelfCal timer:

1. Press (CAL) Test Set Cal   SelfCal Timer .

2. Select an interval by using the front panel keypad, knob or up/down
   arrow keys.

3. Press Periodic SelfCal .

Once you have done this, the system will automatically calibrate itself at
the interval you have chosen.

See "SelfCal Details," later in this chapter, for more information on the
timing of SelfCals.

Test Set Cal and SelfCal: The Details

Adding a multiport test set to the analyzer adds characteristics that affect raw performance as well as introducing drift. Vector error correction allows the system to achieve very good performance, but the drift of the test set would normally require recalibrations on a very frequent basis, thereby drastically reducing throughput.

Test Set Cal and SelfCal: Theory of Operation

A Test Set Cal is a calibration that is performed on a regular, but infrequent basis. The results of the Test Set Cal are used by the SelfCal feature to remove drift and return the multiport system to an accurately calibrated state. There are two steps to the Test Set Cal:

The first step requires you to connect known mechanical standards from a calibration kit to your calibration reference plane. This step is initiated by pressing (CAL) Test Set Cal Create "TSET_CAL" on the analyzer. Onscreen instructions lead you through this first part of the Test Set Cal. The analyzer measures the known mechanical reference standards and uses those measurements to compute error correction coefficients.

The second step occurs once you are done connecting the mechanical standards and have pressed the All Stds Done key. The HP 87075C multiport test set contains solid-state open, short, load, and through standards behind each port. (See Figure 4-3. This illustration depicts a two-port test set. The same solid-state standards are also included behind every port of your 6 or 12 port test set.) These standards are very stable, yet their calibration definitions are not known like the mechanical standards. During this second step, the analyzer makes a raw measurement of each internal standard and then, using the error coefficients that were computed from the measurements of the mechanical standards, derives a very accurate calibration definition for each internal standard. The results of the Test Set Cal are stored in a file called "TSET_CAL.CAL" on the analyzer's non-volatile RAM disk. Once this has been done, the internal standards act as "transfer standards" for future automatic calibrations called SelfCals.

Figure 4-3   **Internal Transfer Standards**
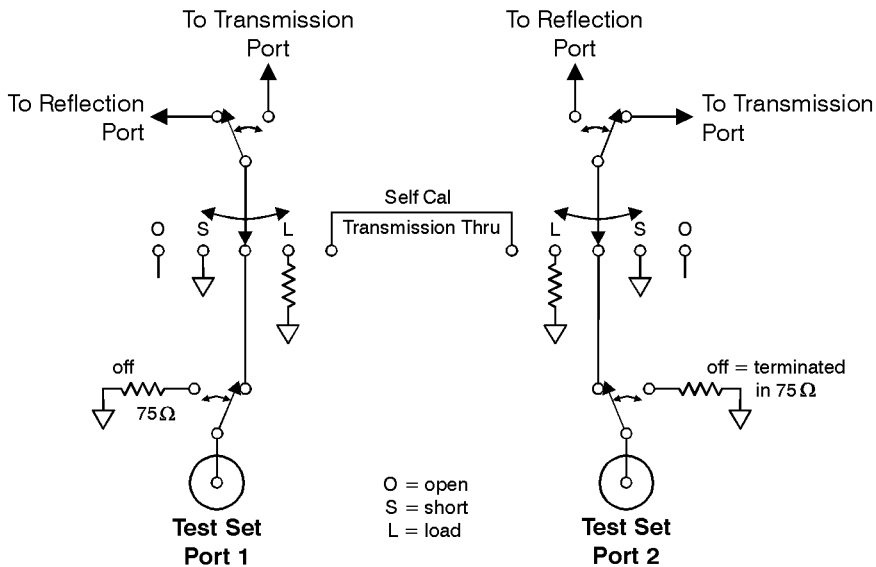
pr618c

A SelfCal is an automatic measurement of the test set's internal standards that allows the system to remove system drift that occurs with environmental changes such as temperature. A SelfCal can be initiated by pressing (CAL) Test Set Cal SelfCal Once , but it is recommended that you use the Periodic SelfCal and SelfCal Timer keys to set up the analyzer to automatically perform a SelfCal at regular, frequent intervals (a one hour interval is recommended).

During a SelfCal, the analyzer either first remeasures the internal solid-state standards, and then uses the derived calibration definitions from the second step of the Test Set Cal to compute new error correction coefficients. Or, depending upon the setting of the SelfCal timer, the SelfCal process may only include the computations, not the measurements. See "SelfCal Details" for more information on this subject.

SelfCal allows the multiport system to recalibrate itself without you having to disconnect your DUT or to connect any additional external standards or cables to the system.

CAUTION

Performing a Test Set Cal will effectively calibrate out the initial effects of any external cabling and/or test fixtures. However, it must be noted that although the SelfCal can remove drift internal to the measurement system, it *cannot* remove any drift associated with cables, test fixtures and connections beyond the internal transfer standards.

Refer to Figure 4-4: The Test Set Cal initially removes the effects of all hardware in the area designated by arrow "A." SelfCal can only remove the effects of drift from the area designated by arrow "B."

Drift can be minimized by controlling the environmental temperature and humidity, and by using high quality connectors, semi-rigid cables, and fixturing that reduces cable movement to a minimum.

Figure 4-4   **SelfCal Drift Removal**
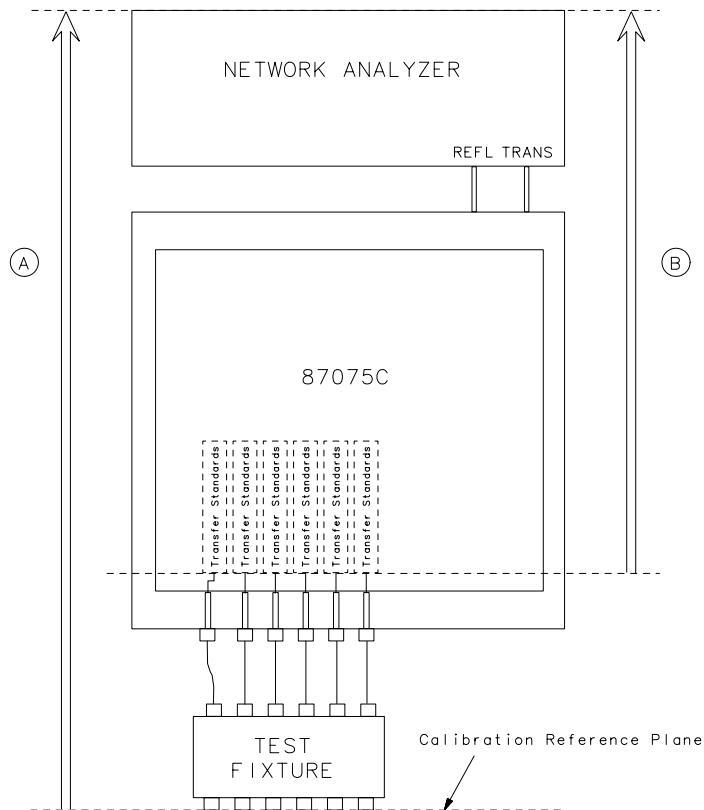
SelfCal Details

Whenever a valid TSET_CAL.CAL file exists in your analyzer's non-volatile memory, a SelfCal is initiated every time you change your port selection to a port that has been calibrated with a Test Set Cal. In order to further minimize the small delay in measurements that a SelfCal can introduce, the SelfCal that is performed can be one of the two processes listed below.

- A "full" SelfCal: remeasurement of the test set's internal standards *and* recomputation of the error coefficients based on those measurements, *or*

- A "quick" SelfCal: just a recomputation of the error coefficients based on data from the most recent internal standard measurement for that port.

The analyzer will automatically determine whether a quick SelfCal or a full SelfCal is necessary whenever SelfCal is invoked. The following sections, "Periodic SelfCal" and "User-Initiated SelfCals," describe when and how these two types of SelfCal are initiated.

NOTE   When the analyzer performs the first process above, and measures the internal standards, the data from the measurements and an associated time stamp are stored within the analyzer.

Periodic SelfCal

The following discussion describes how and when SelfCals are performed when you have enabled the SelfCal timer function using the Periodic SelfCal key.

Once you have set your SelfCal timer to the desired interval with the SelfCal Timer key and pressed the Periodic SelfCal key, the timer clock starts. For the following discussion, assume that you have successfully performed a Test Set Cal on ports 1 through 6, that you have set the timer to 60 minutes, and have just pressed the Periodic SelfCal key.

During the next 60 minutes, anytime you switch to a new port (1 through 6), you will notice the `SelfCal: calculating correction coefficients...` message appear briefly on the analyzer's display. When this happens, the analyzer checks the time stamp for the port you have just switched to, determines that the last internal standard

measurements were made within the timer interval of 60 minutes, so it just recalculates the error coefficients using the stored measurement data for that particular port.

When the 60 minute interval has lapsed, the analyzer will automatically initiate a full SelfCal (both measurements and recalculations), indicated by the onscreen message `SelfCal in progress...`, on the currently selected ports.

NOTE   SelfCals are *not* automatically initiated on currently unused ports. A port is never automatically calibrated unless it is selected -- even if the time interval has been exceeded.

NOTE   During a full SelfCal, the analyzer temporarily restores the instrument parameters that were set at the time of the Test Set Cal. The analyzer returns to the current measurement parameters as soon as the SelfCal is complete.

After the first 60 minute interval, whenever a new port selection is made, the analyzer checks the time stamp for the new port selection and either performs a quick SelfCal (recalculations only) or the full SelfCal (if the time stamp on the data is older than 60 minutes).

User-Initiated SelfCals

A full SelfCal (both measurements and recalculations) on the currently selected ports is immediately initiated when either of the following keys are pressed:

- Periodic SelfCal

- SelfCal Once

A full SelfCal of *all* ports that were calibrated for the current Test Set Cal is initiated with the SelfCal All Ports key.

NOTE   Pressing the SelfCal Once key turns off the SelfCal timer function, and all future SelfCals will only be quick SelfCals (recalculations only) until you press the Periodic SelfCal key (or the SelfCal Once key again).

Factory Test Set Cal

A Test Set Cal is performed at the factory just prior to shipment of your multiport test set. The factory Test Set Cal is performed on all ports of your test set using the analyzer's preset condition over the full frequency range of the test set (3 MHz to 1300 MHz). This calibration is stored on a disk and shipped with the test set. This calibration can be used, but it is recommended that you perform your own calibration using your specific operating parameters, mechanical standard type, and calibration reference plane.

Using Multiple Test Set Cals

Typically, you should not need to use more than one Test Set Cal, and you should be aware that using multiple Test Set Cals will degrade your throughput. However, there may be situations where it is desired or necessary. For example, you may have a device with two different kinds of connectors, and you would prefer to have separate calibrations using the two different types of mechanical standards.

The following example describes the steps you would take to use two different Test Set Cals during a measurement sequence.

1. Set up the analyzer's parameters and select the mechanical standards for the first Test Set Cal.

2. Perform the first Test Set Cal. The results of the cal will be stored in the analyzer on the non-volatile RAM disk as a file called "TSET_CAL.CAL".

3. You must now make a copy of this cal *before* performing your second Test Set Cal. You should copy this file to a uniquely-named file on either a floppy disk or the analyzer's internal non-volatile RAM disk. See "Saving the Test Set Cal," earlier in this chapter.

   For example, store this cal as a file called FIRST.CAL in the analyzer's non-volatile memory.

NOTE   It is not recommended that you use the analyzer's internal volatile RAM disk for storing this file. If you do, be aware that if you cycle the power on the analyzer, your file will be erased. If you do choose to use volatile RAM, you should make a copy of the file on either the non-volatile RAM disk, or a 3.5" floppy disk.

4. It would be a good idea to save the instrument state associated with your FIRST.CAL file as well. See "Saving and Recalling Measurement Results" in your analyzer's *User's Guide* for detailed information on saving the instrument state. (Hint: Use (SAVE RECALL) Define Save Inst State ON Save State .)

5. Now set up the analyzer's parameters and select the mechanical standards for the second Test Set Cal.

6. Perform the second Test Set Cal and save the new "TSET_CAL.CAL" file to another unique file such as SECOND.CAL. Also, save the instrument state associated with SECOND.CAL.

7. When making measurements that require the first Test Set Cal, you will need to recall the contents of the file FIRST.CAL to the TSET_CAL.CAL file before proceeding. And similarly, before making measurements that require the second Test Set Cal, you will need to recall the contents of the file SECOND.CAL to the TSET_CAL.CAL file.

8. For example, to recall FIRST.CAL into the TSET_CAL.CAL file, press (SAVE RECALL) Select Disk Non-Vol RAM Disk Prior Menu .

   Now use the analyzer's front panel knob to highlight the FIRST.CAL file. Press Recall State . The contents of FIRST.CAL will be written into the TSET_CAL.CAL file. To ensure you are using the same parameters under which the calibration was performed, you should also restore the instrument state associated with the FIRST.CAL file.

Calibration Check

The analyzer has a calibration check feature that can compute and display corrected measurement uncertainties (residual errors) that apply to your current instrument settings and calibrations. Your analyzer's *User's Guide* describes this feature in detail in Chapter 6, in the section titled "Check the Calibration."

When used with the multiport system, the calibration check feature can be very useful for determining:

- the validity of your current measurements

- the correct SelfCal timer interval for your measurements

- the stability of your external cabling and fixturing

Perform a Calibration Check

Performing a calibration check consists of following the analyzer's prompts to connect mechanical standards to the currently used ports on the test set.

1. To initiate a calibration check, press CAL Cal Check Do Cal Check .

2. Connect the standards as prompted. Be sure to connect the standards to your calibration reference plane (the same plane you used for the Test Set Cal).

CAUTION   It is recommended that you use a *different* set of calibration standards for the calibration check than you used to perform the initial calibration.

3. After you have connected all the required standards, the analyzer computes the residual errors for the measurement.

4. Now you can use the selections under the View Cal Check key to view the residual errors.

Interpret the Results

Refer to your analyzer's *User's Guide* for illustrations of some typical error plots, or refer to the table below for typical values.

Error Term	Typical Value[1]
Directivity	< –40 dB
Source Match (corrected)	< –30 dB
Source Match (uncorrected)	< –15 dB
Load Match	< –10 dB
Transmission Tracking	+ 0.1 to –0.1 dB
Isolation	–100 to –70 dBm
Reflection Tracking	+ 0.05 to –0.5 dB

1. Typical values include cables and fixtures. Your results will vary depending upon your cables, fixturing, and connector type.

If your error plots are similar to those in the analyzer's *User's Guide* and/or they fall into the typical values noted above, your calibration is probably good and valid. If your data looks bad or questionable, refer to "If the Calibration Check Data Is Bad," later in this chapter.

TIP   For the best indication on whether your calibration is still valid, it is a good idea to perform a calibration check immediately after you perform a Test Set Cal. Save the data from this initial calibration check to compare against future calibration checks. Comparing your own calibration checks against each other will give you a more accurate view of any drift that may be occurring, and can help you determine the best SelfCal timing interval, as well as the best Test Set Cal interval.

CAUTION   Be aware that periodic SelfCals may affect the results of a calibration check. For example, if your system performs an automatic full SelfCal just prior to a "good" calibration check, it is possible that measurements

made before the SelfCal was triggered were "bad" if your SelfCal timer interval is set too high. See "Using the Calibration Check to Determine Calibration Intervals."

Using the Calibration Check to Determine Calibration Intervals

The calibration check feature can help you determine the best SelfCal and Test Set Cal intervals for your measurement environment.

Determine the Best SelfCal Interval

The default and recommended SelfCal timer interval is 60 minutes. However, your test setup and environment may dictate a shorter interval or allow a longer one. To determine the best SelfCal interval for your measurements:

1. Perform a Test Set Cal and then a calibration check. Save the data from the calibration check for future comparisons.

2. Turn the SelfCal timer off by pressing (CAL) Test Set Cal SelfCal Once .

3. Periodically perform calibration checks and compare the results to those obtained in step 1. Keep track of the time that elapsed from the SelfCal performed in step 2.

4. Note the time when the calibration check data has drifted beyond what is acceptable for your measurements.

5. To verify that a SelfCal will remove the drift noted in step 4, do a SelfCal Once or SelfCal All Ports and then do another calibration check. The SelfCal should have removed the unacceptable drift. If it didn't, refer to "If the Calibration Check Data Is Bad," otherwise continue with step 6.

6. Use the (CAL) Test Set Cal SelfCal Timer keys to set your SelfCal interval to a value less than the time noted here.

7. Now turn the SelfCal timer on by pressing (CAL) Test Set Cal Periodic SelfCal to enable the automatic SelfCal at the best interval for your measurements. It is a good idea to check your calibrations periodically to ensure that you are making good measurements.

Determine the Best Test Set Cal Interval

The default and recommended Test Set Cal interval is 1 month. However, your test setup and environment may dictate a shorter interval or allow a longer one. To determine the best Test Set Cal interval for your measurements:

1. Perform a Test Set Cal and then a calibration check. Save the data from the calibration check for future comparisons.

2. Periodically perform calibration checks and compare the results to those obtained in step 1. Keep track of the time that elapsed from the Test Set Cal performed in step 1.

   a. When performing a calibration check in this case, always do a SelfCal Once first to ensure that just the accuracy of the Test Set Cal is being observed.

   b. Be sure to select Periodic SelfCal again after performing the calibration check.

3. If the data is bad, it may be an indication of what the proper Test Set Cal interval is for your measurement environment. See "If the Calibration Check Data Is Bad" for other reasons that the calibration check data may be bad.

If the Calibration Check Data Is Bad

CAUTION   When you encounter a calibration check with bad results, you should note that the accuracy of measurements made prior to the check is questionable. There is no way to tell exactly when a calibration drifted from the last good calibration check.

When you perform a calibration check and the results are bad, use the following troubleshooting procedure to help you identify the problem.

1. Initiate a SelfCal by pressing the SelfCal Once key.

2. Perform the calibration check again. If the results are now good, then the SelfCal timer may not have been on, or the interval may have been set too long. See "Determine the Best SelfCal Interval" for more information.

3. If the results from step 2 are still bad, then it probably means that the Test Set Cal was either originally bad, has drifted because of time or temperature, or has drifted due to external hardware that has been moved or flexed.

4. Redo the Test Set Cal and then redo the calibration check. If the results are good, then:

   • You may need to redetermine your Test Set Cal interval. See "Determine the Best Test Set Cal Interval" for more information.

   • Your external hardware, such as cables and fixturing, may not be stable enough. You can check this by performing a Test Set Cal, doing a calibration check, flexing or moving your external hardware, and then performing another calibration check for comparison.

   • Environmental parameters such as temperature and humidity may have affected your calibration. These parameters can have a detrimental effect on the stability of your calibrations. The SelfCal feature can remove drift due to temperature and humidity changes within the multiport system (analyzer + test set), but SelfCal cannot remove drift of any external hardware, such as cables and fixtures. See Figure 4-4.

5. If the results from step 4 are still bad, then:

   • Have your calibration standards checked. If you are using the recommended procedure of using a different set of standards for the Test Set Cal and the calibration check, and the calibration check is always bad, you may have some faulty standards.

   • If you continue to experience calibration check problems, you should perform the operator's checks on both the analyzer and test set to see if they are performing as expected.

   • Contact the nearest Hewlett-Packard sales or service office for assistance if you are unable to identify the problem. (See Table 8-2.)

5   **Automating Measurements**

This chapter contains a table of SCPI commands that are specifically related to the multiport test set. These commands, as well as the commands for controlling the network analyzer functions, are fully documented in your analyzer's *Programmer's Guide*.

Introduction

The multiport test set is controlled by the network analyzer via the rear panel parallel interface. You can control the system (including the test set) by using the analyzer's internal IBASIC Option (1C2), by sending commands over a LAN (Option 1F7) to the analyzer, or by using an external controller connected to the analyzer's HP-IB port.

For detailed information on automating measurements and programming for the analyzer, refer to the following documents:

Table 5-1　　　　　**Programming Reference Materials**

Title of Document	HP Part Number	Revision Date[1]
HP 8711C/13C RF Network Analyzer's User's Guide	08711-90071	Oct 1997 or later
HP 8712C/14C RF Network Analyzer's User's Guide	08712-90056	Oct 1997 or later
HP 8711C/12C/13C/14C RF Network Analyzers Programmer's Guide	08712-90057	Oct 1997 or later
HP Instrument BASIC User's Handbook[2]	08712-90045	Oct 1996 or later
HP 8711C/12C/13C/14C/30A Option 1F7 LAN[3] Interface User's Guide Supplement	08712-90062	Oct 1997 or later

1. Earlier versions of these manuals may be sufficient to help you successfully program your system. However, they will not contain information specifically related to the multiport test set or the most recent revision of analyzer firmware.
2. For use with analyzers with Option 1C2 only.
3. For use with analyzers with Option 1F7 only.

Multiport Test Set SCPI Commands

The test set is controlled remotely by sending the appropriate commands to the analyzer. The following table lists the commands that are associated specifically with the test set.

Table 5-2   **Multiport Test Set SCPI Command**

SCPI Command	Description
`CALibration:SELF <ON|OFF|ONCE>`[1]	Initiates a SelfCal on the currently selected ports and selects Periodic SelfCal (`ON`) or SelfCal Once (`OFF` or `ONCE`).
`CALibration:SELF:ALL`[1]	Initiates a SelfCal on all ports that were calibrated during the Test Set Cal.
`CALibration:SELF:TIMer <num>`	Sets the time interval for automatic SelfCals.
`MMEMory:STORe:STATe:TSCal <ON|OFF>`	When ON, saved state will be test set cal only.
`ROUTe[1|2]:PATH:DEFine:PORT <num1>, <num2>`[1]	Selects the measurement ports on the test set. `num1` is the test set port connected to the REFLECTION port, and `num2` is the test set port connected to the TRANSMISION port.
`ROUTe[1|2]:PATH:DEFine:PORT?`[1]	Returns the currently selected port pair, `num1, num2`.
`ROUTe[1|2]:REFLection:PATH:DEFine:PORT <num>`[1]	Selects which port of the test set is connected to the REFLECTION port.
`ROUTe[1|2]:REFLection:PATH:DEFine:PORT?`[1]	Returns which port of the test set is currently connected to the REFLECTION port.

SCPI Command	Description
`ROUTe[1|2]:TRANsmission:PATH:DEFine:PORT <num>`[1]	Selects which port of the test set is connected to the TRANSMISSION port.
`ROUTe[1|2]:TRANsmission:PATH:DEFine: PORT?`[1]	Returns which port of the test set is currently connected to the TRANSMISSION port.
`SENSe[1|2]:CORRection:COLLect:METHod TESTset`	Selects the type of calibration to be Test Set Cal.
`SENSe[1|2]:CORRection:COLLect:MP:LOAD <STANdard1|STANdard2|...|STANdard12>`	For the test set cal process, measures a load on the port selected with `STANdard1` through `STANdard12`
`SENSe[1|2]:CORRection:COLLect:MP:OPEN <STANdard1|STANdard2|...|STANdard12>`	For the test set cal process, measures an open on the port selected with `STANdard1` through `STANdard12`
`SENSe[1|2]:CORRection:COLLect:MP:SHORT <STANdard1|STANdard2|...|STANdard12>`	For the test set cal process, measures a short on the port selected with `STANdard1` through `STANdard12`
`SENSe[1|2]:CORRection:COLLect:MP:THRU <STANdard1|STANdard2|...|STANdard6>`	For the test set cal process, measures a thru on the ports selected with `STANdard1` through `STANdard6`
`SENSe[1|2]:CORRection:COLLect:PORTs <2|4|6|8|10|12>`	Selects the number of ports to perform the Test Set Cal on.

SCPI Command	Description

`SENSe[1|2]:CORRection:COLLect:VERify:`
`REFLection`
`<STANdard1|STANdard2|...|STANdard12>`
	For Cal Check measurement of standards (reflection measurements).

`SENSe[1|2]:CORRection:COLLect:VERify:`
`TRANsmission`
`<STANdard1|STANdard2|...|STANdard12>`
	For Cal Check measurement of standards (transmission measurements).

`SENSe[1|2]:CORRection:TESTset`	Sets cal to Test Set Cal if a valid Test Set Cal file exists.

1. Use *OPC synchronization with this command. See "Usage of *OPC?" later in this chapter.

Usage of *OPC

The *OPC query and command should be used whenever you send a command that initiates a SelfCal. A SelfCal is initiated with any of the following commands:

```
CAL:SELF <ON|OFF|ONCE>
CAL:SELF:ALL
ROUTe[1|2]:PATH:DEF:PORT <num1>, <num2>
ROUTe[1|2]:REFL:DEF:PORT <num>
ROUTe[1|2]:TRAN:DEF:PORT <num>
```

Using the *OPC query and command will ensure synchronization of overlapped and sequential commands.

```
10  !
20  ! Example shows port pair selection with selfcal
30  ASSIGN @Rfna TO 800
40  !
50  ! Enable Periodic SELF CAL and selfcal with new port
selection
60  OUTPUT @Rfna;"CAL:SELF ON;*OPC?"
70  ENTER  @Rfna;Opc_done
80  !
90  ! Select calibrated port 3 as reflection and port
5 as transmission
100 OUTPUT @Rfna;"ROUT:PATH:DEF:PORT 3,5;*OPC?"
110 ENTER @Rfna;Opc_done
```

```
120 !
130 END




10  !
20  ! Example use of port pair selection wihout selfcal
30  ASSIGN @Rfna TO 800
40  !
50  ! Disable Periodic SELF CAL.  Delay Port
calibrations until requested.
60  OUTPUT @Rfna;"CAL:SELF OFF;*OPC?"
70  ENTER  @Rfna;Opc_done
80  !
90  ! Select port 3 as reflection and port 5 as
transmission
100 OUTPUT @Rfna;"ROUT:PATH:DEF:PORT 3,5;*OPC?"
110 ENTER @Rfna;Opc_done
120 !
130 ! Initiate port calibrations for all ports now.
140 OUTPUT @Rfna;"CAL:SELF ALL;*OPC?"
150 ENTER @Rfna:Opc_done
160 !
170 END
```

6 Front/Rear Panel

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

Front Panel

Figure 6-1   **Front Panel Features**
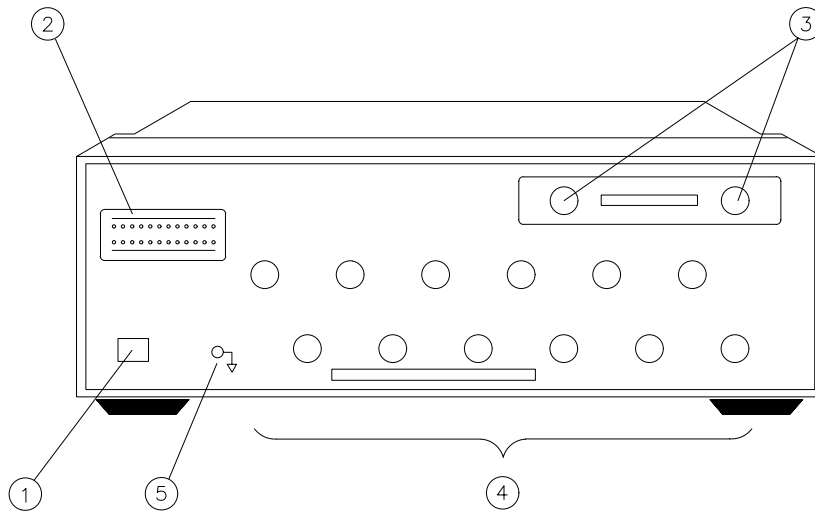
pr619c

Item	Description
1	Line Power Switch
2	Port Connection Status LEDs
3	Reflection and Transmission Connectors
4	Test Ports
5	Chassis Ground Connector

Line Power Switch

The test set line POWER switch is located at the bottom left corner of the front panel. See Figure 6-1. The line POWER switch turns the power to the test set to either on or off.

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

Test Ports

The front panel test ports are female 75 Ω connectors that are used to connect to the device under test.

Figure 6-2   **Physical Description of Type-N Connector**

Mating plane

Max = 0.207 in.

Min = 0.204 in.
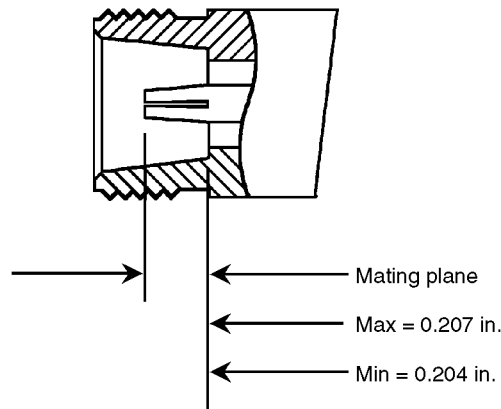
po644 b_c

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.

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

The REFLECTION Connector

The REFLECTION connector is a female type-N 75 Ω connector that connects directly to the REFLECTION (RF OUT) port of the network analyzer using a semi-rigid cable that was shipped with your test set.

CAUTION   Check your analyzer's documentation for damage limits to the RF OUT port. 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 TRANSMISSION (RF IN) port of the network analyzer using a semi-rigid cable that was shipped with your test set.

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

The Chassis Ground Connector

The chassis 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 ohms. See "Port Control" in Chapter 3 for more information.

Rear Panel

Figure 6-3   **Rear Panel Features**
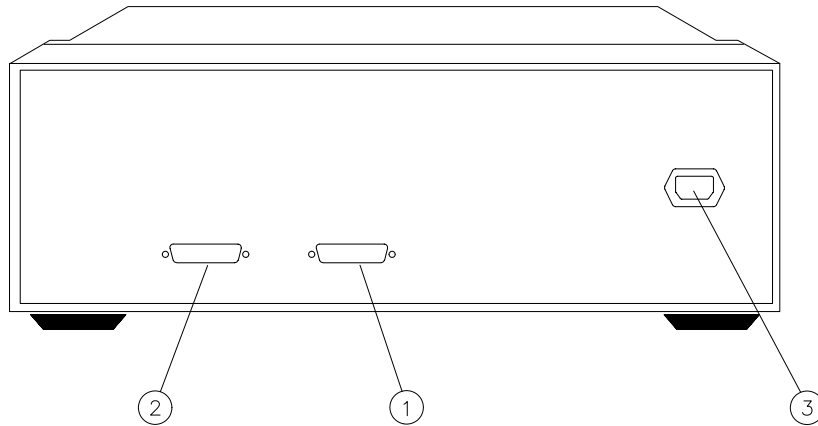
pr620c

| Item	Description
1	Parallel In Connector
2	Parallel Out Connector
3	Line Module

The PARALLEL IN Connector

This female DB-25 connector input is always connected to the network analyzer. The analyzer provides control of the test set through this cable as well as passing through any printer control signals to the test set's PARALLEL OUT connector.

The PARALLEL OUT Connector

This rear panel connector is used with peripherals with a parallel
interface such as printers and plotters. The pin-out is standard IBM PC
compatible Centronics interface, using a female DB-25 connector, as
shown in Figure 6-4.

Figure 6-4   **Parallel Port Pinouts**
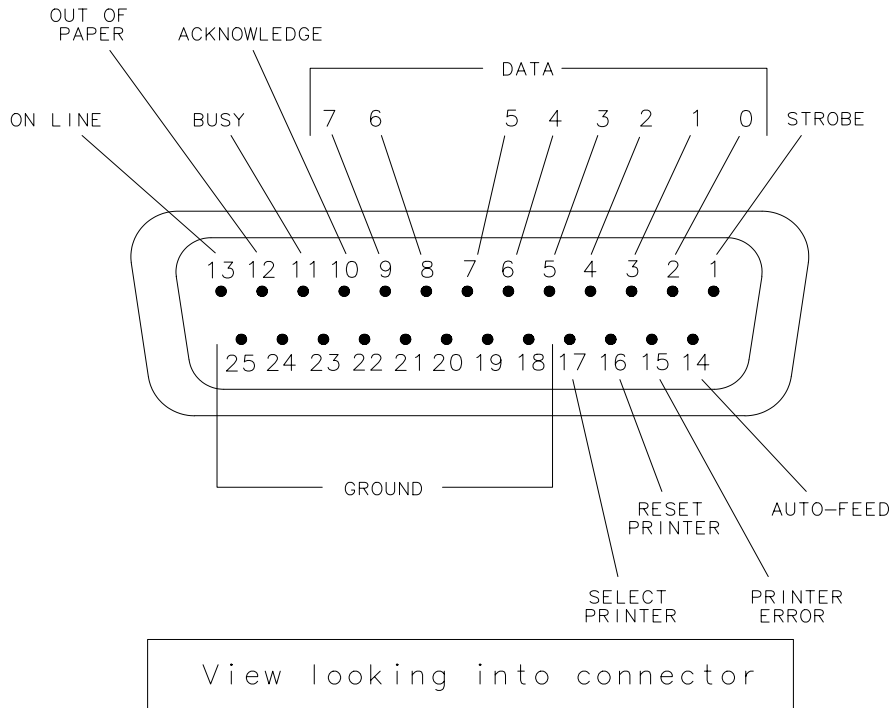
Line Module

The line module contains the power cable receptacle. See "Step 4. Satisfy
Electrical and Environmental Requirements" in Chapter 1 for power
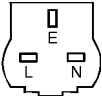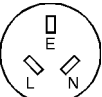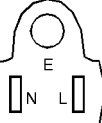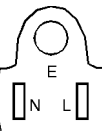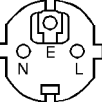supply requirements.

Power Cables

The line power cable is supplied in one of several configurations, depending on the destination of the original shipment.
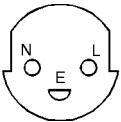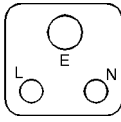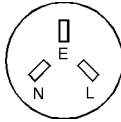
Each instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument chassis. The type of power cable shipped with each instrument depends on the country of destination. See Table 6-1, "Power Cable and Line (Mains) Plug Part Numbers," for the part numbers of these power cables. Cables are available in different lengths. Check with your nearest Hewlett-Packard service center for descriptions and part numbers of cables other than those described in Table 6-1.

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.

Table 6-1 **Power Cables**

Plug Type [a]	HP Cable Part Number	Plug [b] Description	Length cm (in.)	Cable Color	For Use in Country
250V	8120-1351	Straight BS 1363A	229 (90)	Mint Gray	Option 900 United Kingdom, Hong Kong, Cyprus, Nigeria, Singapore, Zimbabwe
	8120-1703	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	

Plug Type [a]	HP Cable Part Number	Plug [b] Description	Length cm (in.)	Cable Color	For Use in Country
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 HP part number is for the complete cable assembly.

7   Key Reference

This chapter contains an alphabetical reference of the network analyzer keys that are used exclusively for the multiport test set. It also contains entries for some of the network analyzer keys that are likely to be used while making measurements with your multiport test set. For a complete reference of network analyzer keys, see your analyzer's *User's Guide*.

Alphabetical Key Reference

2 Ports Softkey in the number of ports to cal menu. Use this key to select the number of ports to include in a Test Set Cal.

See "Performing a Test Set Cal" in Chapter 4 for more information.

Access Keys: (CAL) Test Set Cal Create "TSET_CAL"

4 Ports *(Options 006 and 012 only)* Softkey in the number of ports to cal menu. Use this key to select the number of ports to include in a Test Set Cal.

See "Performing a Test Set Cal" in Chapter 4 for more information.

Access Keys: (CAL) Test Set Cal Create "TSET_CAL"

6 Ports *(Options 006 and 012 only)* Softkey in the number of ports to cal menu. Use this key to select the number of ports to include in a Test Set Cal.

See "Performing a Test Set Cal" in Chapter 4 for more information.

Access Keys: (CAL) Test Set Cal Create "TSET_CAL"

8 Ports *(Option 012 only)* Softkey in the number of ports to cal menu. Use this key to select the number of ports to include in a Test Set Cal.

See "Performing a Test Set Cal" in Chapter 4 for more information.

Access Keys: (CAL) Test Set Cal Create "TSET_CAL"

10 Ports *(Option 012 only)* Softkey in the number of ports to cal menu. Use this key to select the number of ports to include in a Test Set Cal.

See "Performing a Test Set Cal" in Chapter 4 for more information.

Access Keys: (CAL) Test Set Cal Create "TSET_CAL"

12 Ports   *(Option 012 only)* Softkey in the number of ports to cal menu. Use this key to select the number of ports to include in a Test Set Cal.

See "Performing a Test Set Cal" in Chapter 4 for more information.

Access Keys: (CAL)   Test Set Cal   Create "TSET_CAL"

All Stds
Done   Softkey in create "TSET_CAL" menu. This key is pressed after all mechanical standards have been connected and measured.

See Chapter 4, "Test Set Cal and SelfCal," for more information.

Access Keys: (CAL)   Test Set Cal   Create "TSET_CAL"

(AVG)   Front panel hardkey. Displays the menu that allows selection of the averaging feature as well as system bandwidth options.

See your analyzer's *User's Guide* for more information.

(CAL)   Front panel hardkey. Displays the calibration menu options for the current measurement mode.

See Chapter 4, "Test Set Cal and SelfCal," for information on Test Set Cal, and see your analyzer's *User's Guide* for information on other calibrations.

Create
"TSET_CAL"   Softkey in Test Set Cal menu. Use this key to start the Test Set Cal process. After pressing this key, you will need to select the number of ports to calibrate.

See Chapter 4, "Test Set Cal and SelfCal," for more information.

Access Keys: (CAL)   Test Set Cal

Define
Save   Softkey in (SAVE RECALL) menu. Displays the menu to define the contents of a saved state.

See your analyzer's *User's Guide* for more information.

(DISPLAY)   Front panel hardkey. Displays menu with selections concerning type of
              data to be displayed, split or full screen, title and limit lines.

              See your analyzer's *User's Guide* for more information.

(FORMAT)   Front panel hardkey. Pressing this key displays a menus of choices for
              the display format of your measurement.

              See your analyzer's *User's Guide* for more information.

(FREQ)   Front panel hardkey. Displays the frequency menu which allows you to
              enter the frequency range for your measurements.

              See your analyzer's *User's Guide* for more information.

(HARD COPY)   Front panel hardkey. Displays the menu to initiate prints or plots, set
              up printers and plotters, and define the appearance of the output.

              See your analyzer's *User's Guide* for more information.

(MARKER)   Front panel hardkey. Pressing this key turns on marker 1 and displays
              the main marker menu. There are many marker features that can help
              you quickly interpret your measurement results.

              See your analyzer's *User's Guide* for more information.

(MEAS 1)   Front panel hardkeys. Selecting (MEAS 1) makes measurement
(MEAS 2)   channel 1 the active measurement channel and also displays the menu
              where measurement type and port selections are made.

              Selecting (MEAS 2) turns on measurement channel 2 (it is off in the
              default condition) and allows you to select the measurement type for
              that channel.

              You can select different measurement types for each measurement
              channel, but you cannot make different port selections.

              See Chapter 3, "Making Measurements," and your analyzer's *User's
              Guide* for more information.

Measure
Loads

Softkey in create "TSET_CAL" menu. Press this key when you are ready to measure the mechanical loads as part of the Test Set Cal process.

See Chapter 4, "Test Set Cal and SelfCal," for more information on performing a Test Set Cal.

Access Keys: (CAL)   Test Set Cal   Create "TSET_CAL"

Measure
Opens

Softkey in create "TSET_CAL" menu. Press this key when you are ready to measure the mechanical opens as part of the Test Set Cal process.

See Chapter 4, "Test Set Cal and SelfCal," for more information on performing a Test Set Cal.

Access Keys: (CAL)   Test Set Cal   Create "TSET_CAL"

Measure
Shorts

Softkey in create "TSET_CAL" menu. Press this key when you are ready to measure the mechanical shorts as part of the Test Set Cal process.

See Chapter 4, "Test Set Cal and SelfCal," for more information on performing a Test Set Cal.

Access Keys: (CAL)   Test Set Cal   Create "TSET_CAL"

Measure
Thrus

Softkey in create "TSET_CAL" menu. Press this key when you are ready to measure the mechanical thrus as part of the Test Set Cal process. You must have completed measuring the opens, shorts and loads before pressing this key.

See Chapter 4, "Test Set Cal and SelfCal," for more information on performing a Test Set Cal.

Access Keys: (CAL)   Test Set Cal   Create "TSET_CAL"

MENU Front panel hardkey. Displays menu with source settings selections: trigger functions, number of measurement points, external reference, and spur avoid features.

Softkey in create "TSET_CAL" menu. Press this key when you are ready to measure the mechanical loads as part of the Test Set Cal process.

See your analyzer's *User's Guide* for more information.

Multiport ON off Softkey in switching test set menu. When ON, configures the analyzer for use with the multiport test set.

See "Step 5. Activate the Test Set and Check the System Operation" in Chapter 1 for more information.

Access Keys: SYSTEM OPTIONS System Config Switching Test Set

Multiport Selection Softkey in MEAS 1 / MEAS 2 menus. Accesses port selection menu where you can choose which ports of the test set are connected to REFLECTION and TRANSMISSION.

See "Port Control" in Chapter 3 for more information.

Periodic SelfCal Softkey in Test Set Cal menu. Pressing this key initiates a SelfCal on the currently selected ports and turns on the automatic SelfCal feature.

See "SelfCal Details" in Chapter 4 for more information.

Access Keys: CAL Test Set Cal

POWER Front panel hardkey. Displays menu to set the power level of the internal RF source and turn it on or off. Also allows you to choose what power level will be in effect after the PRESET key is pressed.

See your analyzer's *User's Guide* for more information.

PRESET   Front panel hardkey. Pressing this key returns the analyzer to a
predetermined state. Chapter 12 in your analyzer's *User's Guide*
contains the complete listing of preset state default parameters.

Pressing PRESET will not change your current multiport test set
port selections.

NOTE   PRESET can also be used in the event that your
system locks up, or you receive an "Unrecoverable
error." If this should happen, cycle the power on
the analyzer, and press the PRESET key several
times while the analyzer is booting up. (You must
press it at least twice after you hear the double
beep.) Then follow the onscreen instructions.

Re-measure   Softkey in create "TSET_CAL" menu. This key appears after you have
Loads   connected and measured the loads on all the ports requested for your
Test Set Cal. Use this key if you want to remeasure the loads before
finishing the calibration process.

If you remeasure the loads after you have already measured the thrus,
you will also have to remeasure the thrus.

Access Keys: CAL   Test Set Cal   Create "TSET_CAL"

Re-measure   Softkey in create "TSET_CAL" menu. This key appears after you have
Opens   connected and measured the opens on all the ports requested for your
Test Set Cal. Use this key if you want to remeasure the opens before
finishing the calibration process.

If you remeasure the opens after you have already measured the thrus,
you will also have to remeasure the thrus.

Access Keys: CAL   Test Set Cal   Create "TSET_CAL"

Re-measure Shorts	Softkey in create "TSET_CAL" menu. This key appears after you have connected and measured the shorts on all the ports requested for your Test Set Cal. Use this key if you want to remeasure the shorts before finishing the calibration process.

If you remeasure the shorts after you have already measured the thrus, you will also have to remeasure the thrus.

Access Keys: (CAL)   Test Set Cal   Create "TSET_CAL"

Re-measure Thrus	Softkey in create "TSET_CAL" menu. This key appears after you have connected and measured the thrus on all the ports requested for your Test Set Cal. Use this key if you want to remeasure the thrus before finishing the calibration process.

Access Keys: (CAL)   Test Set Cal   Create "TSET_CAL"

Reflection Port Num	Softkey in multiport selection menu. Use this key to designate which port on your multiport test set will be connected to the REFLECTION port of the system.

See "Port Control" in Chapter 3 for more information.

Access Keys: (MEAS 1) or (MEAS 2)   Multiport Selection

(SAVE RECALL)	Front panel hardkey. Displays menus to save, title, define, and recall states, calibrations, and programs; rename, delete, and copy files; and select, configure, and format disks.

See "Saving the Test Set Cal" in Chapter 4 for information on saving a Test Set Cal, and see your analyzer's *User's Guide* for detailed information on the other save/recall features of your system.

(SCALE)	Front panel hardkey. Allow changing of scale per division, and reference level and position for optimum viewing of measurement results. Also accesses reference tracking function.

See your analyzer's *User's Guide* for more information.

SelfCal All Ports	Softkey in Test Set Cal menu. Initiates a full SelfCal on all ports that were calibrated during the currently active Test Set Cal.

See "SelfCal Details" in Chapter 4 for more information.

Access Keys: (CAL) Test Set Cal

SelfCal Once	Softkey in Test Set Cal menu. Initiates a full SelfCal on the currently selected ports and disables automatic SelfCals until Periodic SelfCal is pressed.

See "SelfCal Details" in Chapter 4 for more information.

Access Keys: (CAL) Test Set Cal

SelfCal Timer	Softkey in Test Set Cal menu. Use this key to input the interval of time desired between automatic SelfCals.

See "SelfCal Details" in Chapter 4 for more information.

Access Keys: (CAL) Test Set Cal

(SWEEP)	Front panel hardkey. Displays menu to select automatic sweep time (fastest possible), manual sweep time, alternate sweep, or power sweep.

See "Using Two Channels for Simultaneous Measurements" in Chapter 3 for information about using alternate sweep mode. Also, refer to your analyzer's *User's Guide* for more information on alternate sweep and other sweep functions.

Switching Test Set	Softkey in system config menu. Displays the menu where you configure the analyzer for use with your multiport test set.

See "Step 5. Activate the Test Set and Check the System Operation" in Chapter 1 for more information.

Access Keys: (SYSTEM OPTIONS) System Config

(SYSTEM OPTIONS) Front panel hardkey. Displays menu with system configuration options such as IBASIC, LAN, and HP-IB. Use this key to access the menu to configure the analyzer for operation with the multiport test set.

See your analyzer's *User's Guide* for more information.

Test Set   Softkey in (CAL) menu. Displays menu of Test Set Cal and SelfCal
Cal   functions and features.

See Chapter 4, "Test Set Cal and SelfCal," for more information.

Transmissn   Softkey in multiport selection menu. Use this key to designate which
Port Num   port on your multiport test set will be connected to the
             TRANSMISSION port of the system.

See "Port Control" in Chapter 3 for more information.

Access Keys: (MEAS 1) or (MEAS 2) Multiport Selection

Tset Cal   Softkey in define save menu. When this key is toggled to ON, and you
on OFF   use the Save State or Re-Save State keys, you can save the currently
            active Test Set Cal to a file. Note that the instrument state is *not* saved
            along with the calibration data.

See Chapter 4, "Test Set Cal and SelfCal," for more information.

8   Specifications and Characteristics

Specifications and Characteristics

The specifications and characteristics in this chapter describe the performance of the multiport test set at the test ports under the following conditions:

- The test set must be used with an HP 8711C/12C/13C/14C network analyzer (with 1 MB SRAM, 16 MB DRAM, firmware revision C.04.50 or later, and Option 1EC (75 Ω impedance) installed). See "Step 2. Determine Network Analyzer Compatibility" in Chapter 1 for information on determining whether or not your analyzer meets these conditions.

- The test set and the analyzer must both have currently (within one year) had their performance verified.

- Both instruments must have warmed up for at least 30 minutes after turn-on.

- A valid Test Set Cal must have been performed on the system within the last 30 days using valid mechanical standards (such as those from an HP 85036B/E calibration kit) at a temperature that was within 5 ˚C of the current temperature.

- A SelfCal must have been performed by the system within the last 60 minutes.

Specifications describe the test set's warranted performance over the temperature range of 20 to 30 ˚C unless otherwise stated.

Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.

Typical performance describes additional product performance information that is not covered by the product warranty. It is performance beyond the indicated specification that most test sets will exhibit.

Nominal values indicate the expected, but not warranted, value of a parameter.

Table 8-1 **HP 87075C Specifications**

Parameter	Specification	Supplemental Information
Frequency Range	3–1300 MHz	
Connector Type		Type-N female 75 ohm, nominal
Number of Switching Ports Option 002 Option 006 Option 012	 2 6 12	
Maximum Test Port Power Measurement level Damage level	 +16 dBm 	 +20 dBm, characteristic
Noise Floor Fine bandwidth	 < −84 dBm	
Receiver Dynamic Range	> 100 dB	noise floor to maximum measured power level
Measurement Dynamic Range	> 60 dB	limited by port-to-port isolation
Port-to-Port Isolation	> 60 dB	
Port-to-Port Insertion Loss REFLECTION to PORT X PORT X to TRANSMISSION		 < 6 dB, characteristic < 10 dB, characteristic
System Residuals Transmission measurement Source match Transmission tracking Load match[1] Load match[2] Reflection measurement Directivity Source match Reflection tracking Load match	 < −30 dB < 0.1 dB < −16 dB < −40 dB < −30 dB < 0.1 dB < −20 dB	 < −18 dB, characteristic

Parameter	Specification	Supplemental Information
Uncorrected Source Match		< −14 dB, characteristic
Port Switching Time Reflection Transmission		(assumes a new SelfCal is not needed) 1 sec, characteristic 2 sec, characteristic
SelfCal Calibration Time Reflection Transmission		(assumes 201 pts, medium-wide BW) 2 sec, characteristic 4 sec, characteristic

1. Test set TRANSMISSION port terminated with a type-N 75 Ω load from an HP 85036B/E calibration kit.
2. Test set TRANSMISSION port connected to HP 871xC network analyzer.

General Characteristics

Environmental Characteristics

General Conditions   ESD (electrostatic discharge): must be eliminated by use of static-safe work procedures and an antistatic bench mat.

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)

Non-Operating Storage Conditions   Temperature: –40 °C to +70 °C

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

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

Weight   Net: approximately 17 pounds (8 kg)

Shipping: approximately 25 pounds (11 kg)

Figure 8-1   Physical Dimensions
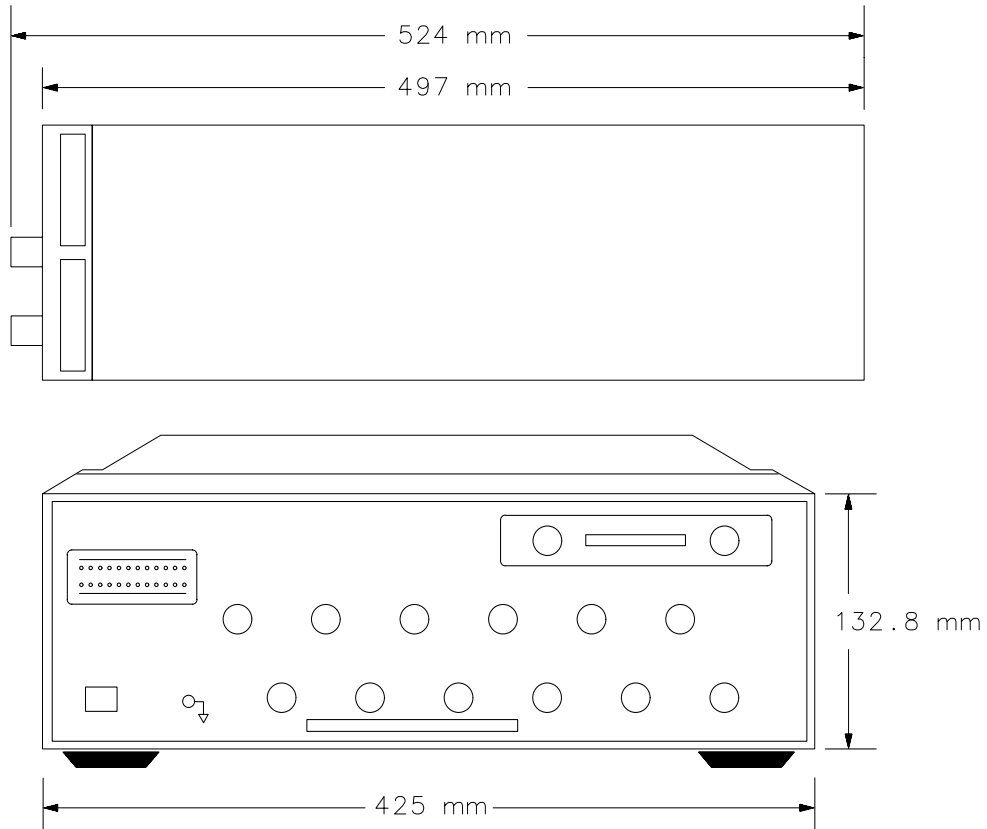
pr621c

Warranty

NOTE   The actual warranty on your instrument depends on the date it was
ordered as well as whether or not any warranty options were purchased
at that time. To determine the exact warranty on your instrument,
contact the nearest Hewlett-Packard sales or service office with the
model and serial number of your instrument. See Table 8-2 for a list of
sales and service offices.

This Hewlett-Packard instrument product is warranted against defects
in material and workmanship for the warranty period. During the
warranty period, Hewlett-Packard Company will, at its option, either
repair or replace products which prove to be defective.

If the warranty covers repair or service to be performed at Buyer's
facility, then the service or repair will be performed at the Buyer's facility
at no charge within HP service travel areas. Outside HP service travel
areas, warranty service will be performed at Buyer's facility only upon
HP's prior agreement, and Buyer shall pay HP's round-trip travel
expenses. In all other areas, products must be returned to a service
facility designated by HP.

If the product is to be returned to Hewlett-Packard for service or repair,
it must be returned to a service facility designated by Hewlett-Packard.
Buyer shall prepay shipping charges to Hewlett-Packard and
Hewlett-Packard shall pay shipping charges to return the product to
Buyer. However, Buyer shall pay all shipping charges, duties, and taxes
for products returned to Hewlett-Packard from another country.

Hewlett-Packard warrants that its software and firmware designated by
Hewlett-Packard for use with an instrument will execute its
programming instructions when properly installed on that instrument.
Hewlett-Packard does not warrant that the operation of the instrument,
or software, or firmware will be uninterrupted or error-free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from
improper or inadequate maintenance by Buyer, Buyer-supplied software
or interfacing, unauthorized modification or misuse, operation outside of
the environmental specifications for the product, or improper site
preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HEWLETT- PACKARD SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Exclusive Remedies

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Hewlett-Packard Sales and Service Offices

If you should need technical assistance, contact the nearest Hewlett-Packard sales or service office. See Table 8-2 on the next page.

Table 8-2   Hewlett-Packard Sales and Service Offices

UNITED STATES

Instrument Support Center
Hewlett-Packard Company
(800) 403-0801

EUROPEAN FIELD OPERATIONS		
Headquarters Hewlett-Packard S.A. 150, Route du Nant-d'Avril 1217 Meyrin 2/ Geneva Switzerland (41 22) 780.8111	**France** Hewlett-Packard France 1 Avenue Du Canada Zone D'Activite De Courtaboeuf F-91947 Les Ulis Cedex France (33 1) 69 82 60 60	**Germany** Hewlett-Packard GmbH Hewlett-Packard Strasse 61352 Bad Homburg v.d.H Germany (49 6172) 16-0
Great Britain Hewlett-Packard Ltd. Eskdale Road, Winnersh Triangle Wokingham, Berkshire RG41 5DZ England (44 734) 696622		

INTERCON FIELD OPERATIONS		
Headquarters Hewlett-Packard Company 3495 Deer Creek Rd. Palo Alto, CA 94304-1316 USA (415) 857-5027	**Australia** Hewlett-Packard Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130 (61 3) 895-2895	**Canada** Hewlett-Packard (Canada) Ltd. 17500 South Service Road Trans-Canada Highway Kirkland, Quebec H9J 2X8 Canada (514) 697-4232
Japan Hewlett-Packard Japan, Ltd. 9-1 Takakura-Cho, Hachioji Tokyo 192, Japan (81 426) 60-2111	**Singapore** Hewlett-Packard Singapore (Pte.) Ltd. 150 Beach Road #29-00 Gateway West Singapore 0718 (65) 291-9088	**Taiwan** Hewlett-Packard Taiwan 8th Floor, H-P Building 337 Fu Hsing North Road Taipei, Taiwan (886 2) 712-0404
China China Hewlett-Packard Co. 38 Bei San Huan X1 Road Shuang Yu Shu Hai Dian District Beijing, China (86 1) 256-6888		

9 Service

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

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.**

Automated Performance Tests

The preferred method of performing the operator's check and the performance verification tests is to use the automated test software. This software is included with the 871xC family performance test software (see part lists).   The program, which comes in two versions (DOS format or LIF), can be run on one of 3 platforms:

- An HP workstation such as a Series 200, 300 or 700 (use LIF format)

- A PC running HP BASIC for Windows®[1] (use DOS format)

- An HP 871xC network analyzer with IBASIC (Option 1C2) (use either format)

Note that utilities exist to convert one format to the other. Because the program is stored as ASCII text, both the DOS and LIF versions of the programs are identical.

The program file name is "CAL_TSET". Loading the program depends upon the platform used. For the internal IBASIC platform, insert the disk and press (SAVE RECALL). If necessary, select the 3.5 inch floppy drive. Scroll the highlight bar to the program file name and press   Programs   Recall Program . When finished, press RUN .

Test Equipment Required

- HP 85036B 75 Ω type-N calibration kit

- high-quality 75 Ω cable (such as HP part number 8120-2408)

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1. Windows® is a registered trademark of Microsoft Corporation.

Program Overview

IMPORTANT

For full performance verification, both the operator's check (Op Verif) and the performance tests (PerfTest) must be done.

An informational screen is presented when you start the program. Press RESUME to reach the main menu. The choices in the main menu are:

Op Verif   Pressing this key will run the automated operator's check. Assuming the test mode has remained as "Standard" (see "CONFIG"), this test takes less than one minute to perform on a full 12-port system and provides greater than 85% confidence that the test set hardware is functioning normally. Follow the simple instructions on the screen.

If the "Enhanced" mode of operation is chosen, some standards, adapters, and flexible cables will be needed. The test times will still be less than a few minutes. While the standard test method is acceptable in most cases, the enhanced method is more accurate and should be used if there is any doubt about the accuracy of the measurement.

PerfTest   The performance test will check the nominal insertion loss of each through path (a non-warranted characteristic) along with the following three warranted specifications:

• Reflection load match

• Transmission load match

• Port-to-port isolation

PRINT   Displays or prints the test results. (Printer configuration is done in the "CONFIG" area.)

Rd Info   Displays the current configuration of the test set.

HELP   Displays additional information that may be helpful when doing performance testing.

CONFIG   This selection allows you to specify several user and hardware options. Selection is via the softkeys. See "Configure for Performance Testing," next, in this section.

Configure for Performance Testing

f1 HP 871x HP-IB address specifies the analyzer's HP-IB address. This value is not used if you are running the program from the internal IBASIC feature. The default address is 16.

f2 Type of printer used specifies what type printer is to be used for data output. The four choices are HP-IB, Parallel, Serial, or Windows. Generally, if running the program from an external computer rather than from the internal IBASIC, only the HP-IB selection is valid. However, if you are using HP BASIC for Windows as the operating platform, then selecting Windows will direct the output to whatever is defined as the default Windows printer. The default selection is HP-IB.

f3 Printer HP-IB address specifies the printer's HP-IB address. This value is only used if an HP-IB printer is selected. The default address is 01.

f4 Test method specifies the program's mode of operation: standard or enhanced. In standard mode the default calibration of the analyzer is assumed to be accurate and the use of the provided interconnect cables is assumed. The standard method is much faster and simpler to perform and is usually sufficient.

If there is any question about the performance of the test set, then the enhanced mode should be used. This will take more time but will compensate for many sources of error such as cable loss and match. This is the definitive test, and the uncertainties listed assume this mode of operation. In general, assuming the use of good cables, the difference between the two methods should be well under 1dB. The default mode is Standard.

f5 Display messages allows you to turn on/off error and prompting messages on the screen of the analyzer. The display messages are most useful during troubleshooting. The use of display messages during a normal verification (where no problems are anticipated) may be distracting. The default is OFF.

f6 871X controlling another 871x? allows one to use an HP 871x that has the IBASIC option installed to control another HP 871xC that may not have the IBASIC option, but is connected to the Multiport Test Set. In other words, the controlling analyzer is only being used as a computer. It may even be an HP 8711A or 871xB. Since control is via HP-IB, the controlling analyzer will use the specified analyzer HP-IB address above. Make sure the controlling analyzer and the analyzer under test do not have the same HP-IB address. Default is NO.

Test Results Explanation

Test results are displayed and printed with a very short description due to screen and space limitations. This section lists the test names along with more descriptive information.

Voltages/Temperature

AGND	Measured voltage of ground
P5VF	Measured voltage of the +5 volt supply
P15VF	Measured voltage of the +15 volt supply
N15VF	Measured voltage of the −15 volt supply
TEMP	Measured temperature of the main board in ˚C

Diode Bias Voltages

BIAS On REFL X	**BIAS Off REFL X**
BIAS On TRAN X	**BIAS Off TRAN X**
STND On SHORT	**STND Off SHORT**
STND On LOAD	**STND Off LOAD**
STND On THRU	**STND Off THRU**

All these tests report the measured diode bias voltage for various switches on port X or the specified standard. All bias voltages shown are relative to the positive or negative power supply voltages, so a typical result will be ±1 volt or less. The actual bias voltages are about ±14 volts.

Other Tests

MIN RL PORT X

MAX RL PORT X   These display the measured minimum and maximum return loss (in dB) of each port when left unterminated. Leaving a cable or device connected to any port will make this test fail.

RL IntLoad P X   This displays the measured minimum (worst case) return loss of the internal load (the SelfCal load) for port X.

INT THRU P X-X   This displays the maximum insertion loss of port pairs (in dB) when using the internal through path. A port pair is ports 1&2, 3&4, 5&6, etc. Normally, maximum insertion loss occurs at the highest frequency.

O/S DEG Diff P X   This displays the difference, in phase degrees, of the measured reflection from the internal short versus the internal open. The nominal difference should equal 180 degrees, but in practice, the exact difference is not important; stability over time is more important than the exact difference.

LOSS PORTS X-X   This displays the loss of the through connection (in dB) between a port pair. This will include the loss of the connecting cable. However a fixed value of 0.5 dB is subtracted out as a typical value for a short cable at 1300 MHz.

ISOL PORTS X-X   This represents the isolation of any port pair (in dB) between a through connection made with a cable and a "through" measurement made with two loads attached. (This is the warranted parameter, "port-to-port isolation.")

RL EXT PORT X   This is the input return loss of the specified port when connected to the Transmission port of the multiport test set. The Transmission port must be terminated in a known good load. (This is the warranted parameter, "transmission load match.")

RL INT PORT X   This is the input return loss of the specified port when connected to the internal termination load. This is what a device would "see" if the specified port were set to "Off." (This is the warranted parameter, "reflection load match.")

Manual Performance Tests

The preferred method for doing a performance test is to use the performance test software. See the parts list later in this chapter for ordering information, and see "Automated Performance Tests," earlier in this chapter for information on using the software.

If the performance test software is not available, the following list of manual tests should be performed. The procedures for these tests assume that you are familiar with network analysis measurements. Keystroke sequences may vary slightly depending upon the model number and options installed in your analyzer. The results of these tests do not depend upon any user or test set calibration, however the analyzer is assumed to be functioning properly and has currently (within one year) had its performance verified.

- Operator's check (see "Performing the Operator's Check" in Chapter 2 for instructions)

- Isolation (instructions follow)

- Match (instructions follow)

Port-to-Port Isolation

Equipment Required

- high-quality 75 Ω cable (such as HP part number 8120-2408)

- high-quality 75 Ω male loads (2) (such as from calibration kit model number HP 85036B)

NOTE   If you do not have two male loads, you can substitute the female load and the male-to-male adapter from the HP 85036B calibration kit.

Equipment Setup

Figure 9-1   **Port-to-Port Isolation Performance Test Setup**
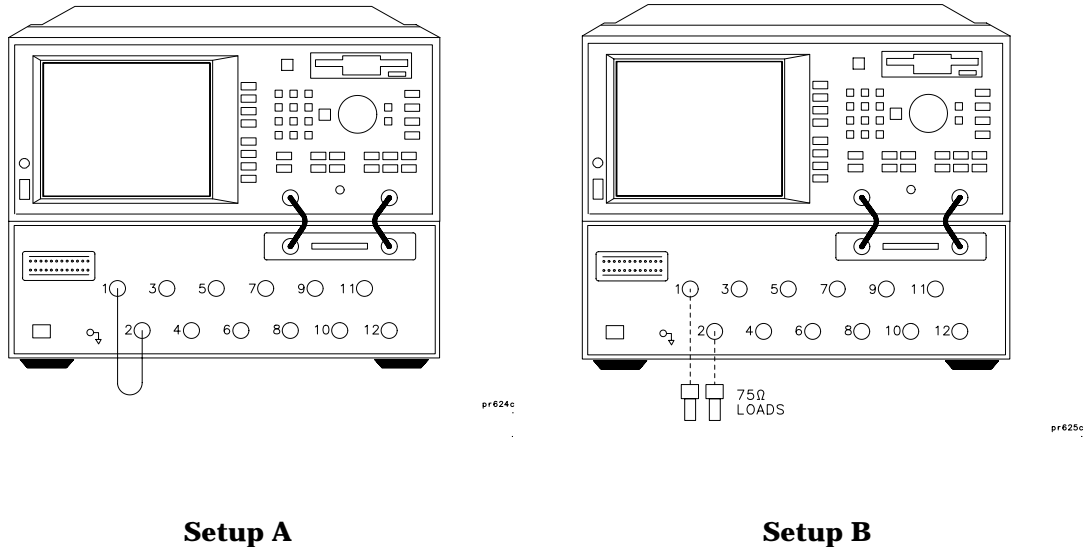
Setup A   Setup B

Procedure

1. Press (PRESET) (MEAS 1) Transmissn (FREQ) Start (3) MHz Stop (1300) MHz (CAL) Restore Defaults .

2. Press (SCALE) Reference Position (9) (ENTER) (AVG) System Bandwidth Narrow .

3. Press (MEAS 1) Multiport Selection Reflection Port Num (1) (ENTER) Transmissn Port Num (2) (ENTER). Connect the cable between these two ports as shown in "Setup A."

4. Press (CAL) Response Measure Standard . When the calibration is complete, remove the cable and attach a load to each of the two ports selected as shown in "Setup B."

5. Press (MARKER) Marker Search Max Search to find the worst case isolation. Record this measurement on the test record card.

6. Repeat steps 3 through 5 for remaining test port pairs. (Test port pairs are ports 1 and 2, 3 and 4, 5 and 6, 7 and 8, 9 and 10, 11 and 12.)

Load Match

Equipment Required

- high-quality 75 Ω cable (such as HP part number 8120-2408)
- calibration kit model number HP 85036B

Equipment Setup

Figure 9-2   **Load Match Performance Test Setup**
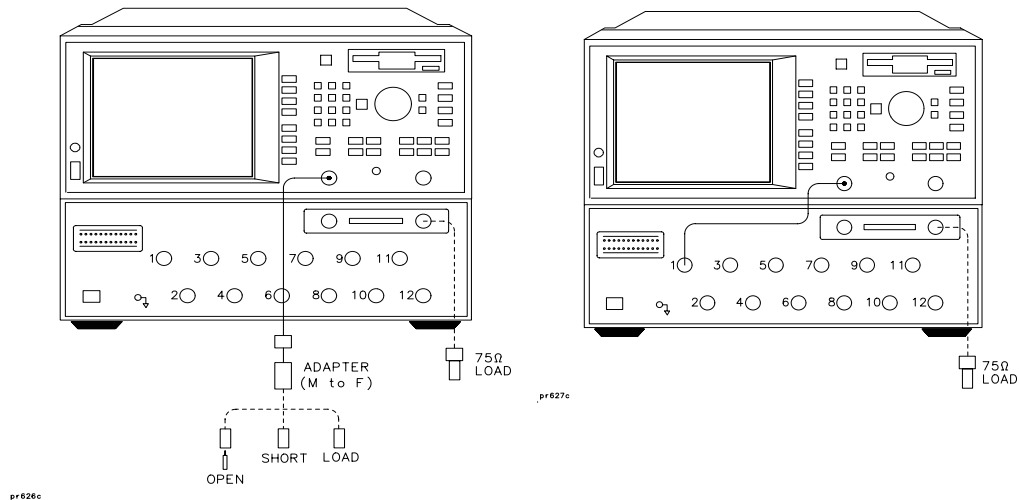
Setup A   **Setup B**

Procedure

1. Connect the high-quality cable and the female-to-male adapter from the calibration kit to the REFLECTION port of the analyzer. Connect a known good load to the test set's TRANSMISSION port. See "Setup A."

2. Press (PRESET) (MEAS 1) Reflection (FREQ) Start (3) MHz Stop (1300) MHz .

3. Press (CAL) (More Cal if necessary) Cal Kit Type-N(m) to select
   the proper calibration kit. Then press (CAL) One Port and follow
   the analyzer prompts to perform a one port calibration at the end of
   the cable. See "Setup A." Be sure to use the female standards from the
   calibration kit and be sure to use the center conductor extender when
   connecting the female open device.

4. When the calibration is complete, connect the cable to PORT 1 of the
   test set. See "Setup B."

5. Press (MEAS 1) Transmissn Multiport Selection
   Transmissn Port Num (1) Enter (MEAS 1) Reflection .

6. Press (SYSTEM OPTIONS) Service Service Utilities Next Menu
   Multiport Tset Ctrl PORT 1 OFF .

7. The resulting trace shows the transmission measurement load match.
   Record the worst case (highest) value on the test record card as the
   "Internal Load Match."

8. Press EXT . The resulting trace shows the reflection measurement
   load match. Record the worst case (highest) value on the test record
   card as the "External Load Match."

9. Move the cable to the next available test set port and repeat steps 5
   through 8, being sure to select the appropriate port number in steps 5
   and 6.

Performance Test Record Card

HP 87075C Serial Number_____ Date_____			
Test Description	**Specification**	**Results**	**Uncertainty**
Port 1 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 1 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 2 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 2 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 1 to Port 2 Isolation	> −60 dB		±0.5 dB
Port 3 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 3 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 4 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 4 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 3 to Port 4 Isolation	> −60 dB		±0.5 dB
Port 5 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 5 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 6 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 6 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 5 to Port 6 Isolation	> −60 dB		±0.5 dB
Port 7 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 7 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 8 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 8 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 7 to Port 8 Isolation	> −60 dB		±0.5 dB
Port 9 Transmission Load Match	< −16 dB		+1, −1.1 dB

HP 87075C Serial Number_____ Date_____			
Test Description	**Specification**	**Results**	**Uncertainty**
Port 9 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 10 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 10 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 9 to Port 10 Isolation	> −60 dB		±0.5 dB
Port 11 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 11 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 12 Transmission Load Match	< −16 dB		+1, −1.1 dB
Port 12 Reflection Load Match	< −20 dB		+1.3, −1.5 dB
Port 11 to Port 12 Isolation	> −60 dB		±0.5 dB

Adjustments

There are no adjustments for this instrument. Any drift in components can be compensated for with the SelfCal feature. Any failure will require the replacement of an assembly.

Troubleshooting

Refer to Chapter 1, "Installation," to make sure the test set is connected properly to the analyzer and that the analyzer has been configured for use with the multiport test set.

Troubleshooting consists of isolating the cause of any problem to an individual assembly. The HP 87075C has three main assemblies:

- power supply
- LED display board
- main switch board assembly

WARNING   **Line voltage may be present on exposed metal heat-sinks and other components contained on the power supply. Observe all safety precautions.**

The Power Supply

WARNING   **For continued protection against fire hazard, replace fuse only with same type and ratings (H 3.15 A, 250 VAC). The use of other fuses or materials is prohibited.**

The line fuse is located on the power supply assembly. See the parts list (later in this chapter) for the fuse part number. The power supply is autoranging and will accept from 90 to 254 volts AC. The power supply provides ±15 volts and +5 volts to the main board assembly via a four wire cable assembly. The pin-out is as follows:

Pin #	Voltage	Wire Color	LED Ref. Designator
1	+15 volts	brown	DS701
3	+5 volts	orange	DS700
4	ground	yellow	N/A
6	−15 volts	blue	DS702

If the power supply voltage is measured while the cable is disconnected from the main board assembly, the 5 volt supply may not function. It requires a load of at least 0.5 amps to operate properly. This can be simulated with any 10 ohm, 5 watt resistor.

The LEDs on the main board assembly indicate that power is being received. The fan operates from +12 volts and has its own regulator derived from the +15 volt supply. If the fan does not operate, check the +12 volt supply at test point TP706.

The LED Display Board

If all performance tests pass, but the LED indicators on the front panel do not operate, then the most likely cause of failure is the LED display board assembly or its associated ribbon cable.

The Main Switch Board Assembly

If any of the performance tests fail and the cause is not obvious, such as a bad power supply, damaged or loose connector, etc., then the recommended course of action is to replace the main board assembly.

IMPORTANT   If the main board assembly is replaced, it is critical that the socketed ID ROM (U801) be transferred from the old board assembly to the new one. The replacement board assembly will *not* contain an ID ROM when purchased, and will not function properly without this ROM. In the unlikely case that this ROM should fail, contact the nearest HP office for instructions. See Table 8-2 for a list of Hewlett-Packard sales and service offices.

Post-Repair Procedure

If the main board assembly or power supply is replaced, a complete performance test should be performed. A Test Set Cal should be performed also (see Chapter 4) and stored on a disk for usage by the end user.

Block Diagram

Figure 9-3   **Block Diagram**
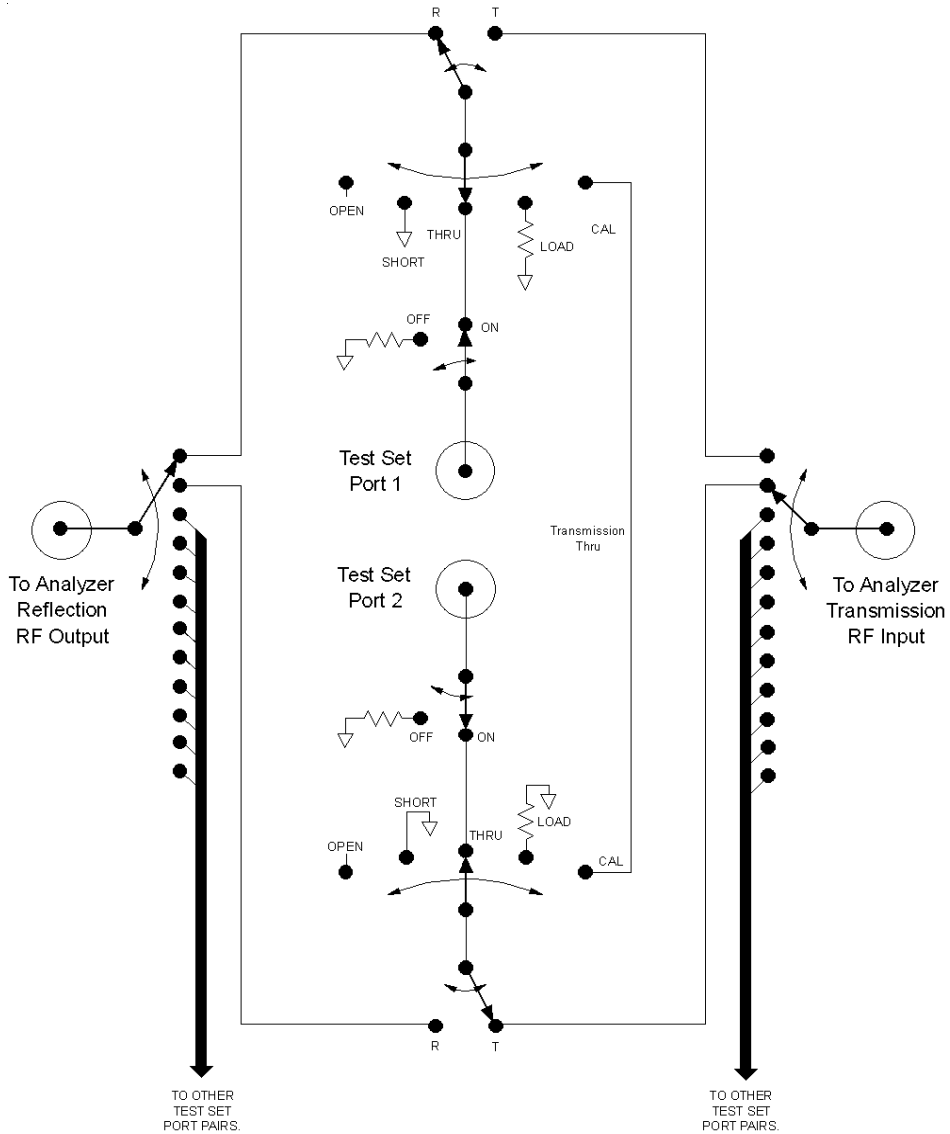
Parts List

This chapter provides ordering information and lists the part numbers for the various replaceable parts, kits, and accessories for your multiport test set.

Ordering Information

To order a part listed in the replaceable parts lists:

1. Determine the part number and quantity required.

2. Mail the information to the nearest Hewlett-Packard office or, in the U.S., call the hotline number listed in the following section.

To order a part *not* listed in the replaceable parts lists:

1. Note the instrument model number, serial number and options (see the rear panel of the test set).

2. Describe the part and its function.

3. Determine the quantity required.

4. Mail the information to the nearest Hewlett-Packard office or, in the U.S., call the hotline number listed in the following section.

Call (800) 227-8164 to Order Parts Fast (U.S. Only)

When you have gathered the information required to place an order, contact Hewlett-Packard's direct ordering team by calling the toll-free hotline number shown above. Orders may be placed Monday through Friday, 6 AM to 5 PM (Pacific Standard Time).

The parts specialists have direct online access to replacement parts inventory corresponding to the replaceable parts lists in this manual. Four day delivery time is standard; there is a charge for hotline one-day delivery.

This information applies to the United States only. Outside the United States, you must contact the nearest HP sales and service office. (Refer to Table 8-2.)

Rebuilt-Exchange Assemblies

Under the rebuilt-exchange assembly program, certain factory-repaired and tested assemblies are available on a trade-in basis. These assemblies cost less than a new assembly, and meet all factory specifications required of a new assembly.

The defective assembly must be returned for credit under the terms of the rebuilt-exchange assembly program.

Shipping the Defective Assembly Back to Hewlett-Packard

1. When the rebuilt assembly is received, be careful not to damage the box in which it was shipped. You will use that box to return the defective assembly. The box you receive will contain the following:

   - The rebuilt assembly

   - An exchange assembly failure report

   - A return address label

2. Complete the failure report.

3. Place the failure report and the defective assembly in the box. Be sure to remove the enclosed return address label.

4. Seal the box with tape.

   If you are inside the United States, stick the preprinted return address label over the label that is already on the box and return box to HP. (HP pays postage on boxes mailed within the United States.)

   If you are outside the USA, do not use the return address label; instead, address box to the nearest HP sales or service office. (Refer to Table 8-2.)

Major Parts and Assemblies

Table 9-1   **Major Parts and Assemblies**

Item #	HP Part Number	Qty	Description
1	87075-60013	1	Main board assembly
1	87075-69013	1	Rebuilt-exchange main board
2	87030-60008	14[1]	Type-N connectors, 75 Ω
3	1510-0038	1	Ground connector
4	3101-3008	1	Line switch
5	87075-60014	1	Board assembly, LED display
6	87075-60018	1	Line module cable assembly
7	2110-0957	1	Fuse H 3.15 A, 250 VAC
8	0950-2023	1	Power supply assembly
9	87075-60019	1	Power supply cable assembly
10	87075-60018	1	Line module
11	87075-60021	1	Fan assembly
12	87075-60020	1	Ribbon cable

1. Quantity 14 is for Option 012 only. Options 006 and 002 have quantities 8 and 4, respectively.

Figure 9-4   **Major Parts and Assemblies**
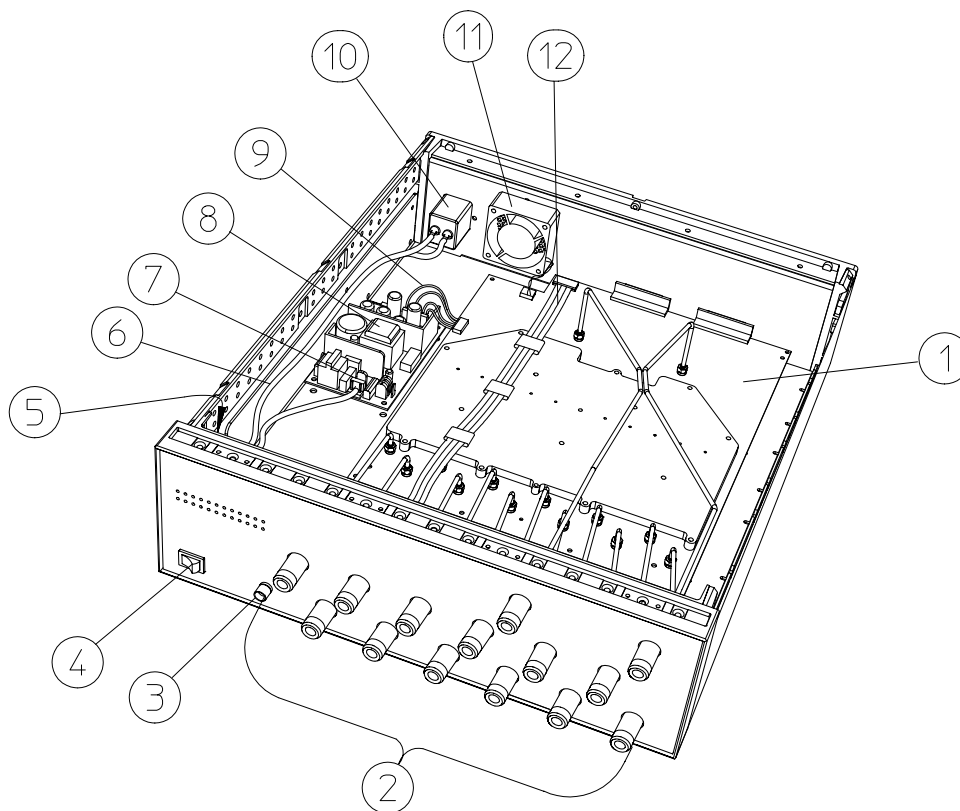
pr629c

Front Panel and Cables — Option 012

Table 9-2 **Front Panel and Cables — Option 012**

Item #	HP Part Number	Qty	Description
1	87075-20034	1	Semi-rigid cable, reflection port
2	87075-20035	1	Semi-rigid cable, transmission port
3	87075-20036	1	Semi-rigid cable, test port 1
4	87075-20037	1	Semi-rigid cable, test port 2
5	87075-20038	1	Semi-rigid cable, test port 3
6	87075-20039	1	Semi-rigid cable, test port 4
7	87075-20040	1	Semi-rigid cable, test port 5
8	87075-20041	1	Semi-rigid cable, test port 6
9	87075-20042	1	Semi-rigid cable, test port 7
10	87075-20043	1	Semi-rigid cable, test port 8
11	87075-20044	1	Semi-rigid cable, test port 9
12	87075-20045	1	Semi-rigid cable, test port 10
13	87075-20046	1	Semi-rigid cable, test port 11
14	87075-20047	1	Semi-rigid cable, test port 12
15	87075-60023	1	Front dress panel

Figure 9-5   Front Panel and Cables — Option 012
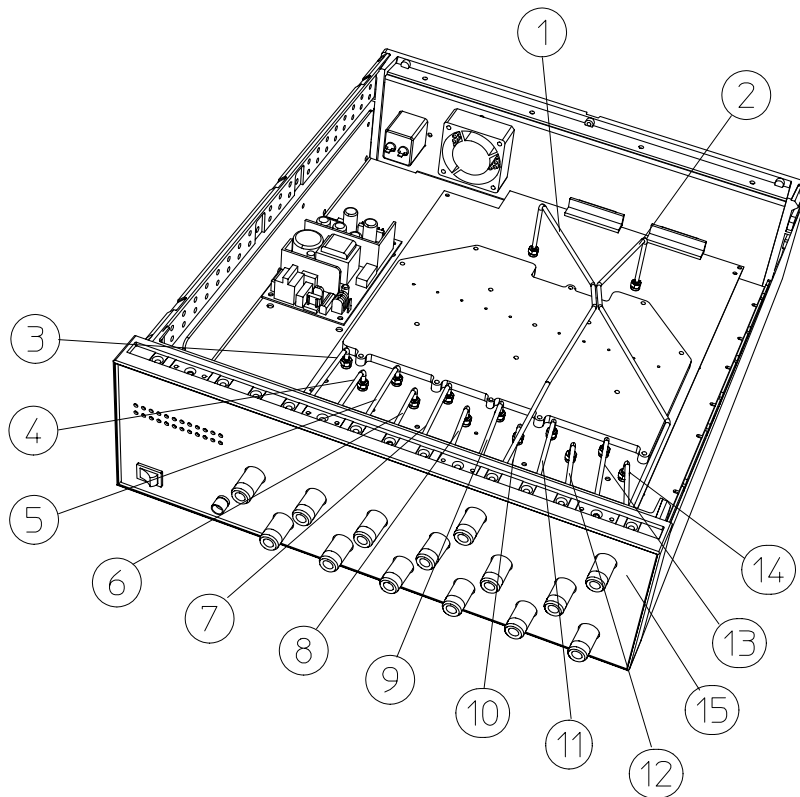
pr632c

Front Panel and Cables — Option 006

Table 9-3   **Front Panel and Cables — Option 006**

Item #	HP Part Number	Qty	Description
1	87075-20034	1	Semi-rigid cable, reflection port
2	87075-20035	1	Semi-rigid cable, transmission port
3	87075-20036	1	Semi-rigid cable, test port 1
4	87075-20037	1	Semi-rigid cable, test port 2
5	87075-20038	1	Semi-rigid cable, test port 3
6	87075-20039	1	Semi-rigid cable, test port 4
7	87075-20040	1	Semi-rigid cable, test port 5
8	87075-20041	1	Semi-rigid cable, test port 6
9	87075-60024	1	Front dress panel

Figure 9-6   **Front Panel and Cables — Option 006**
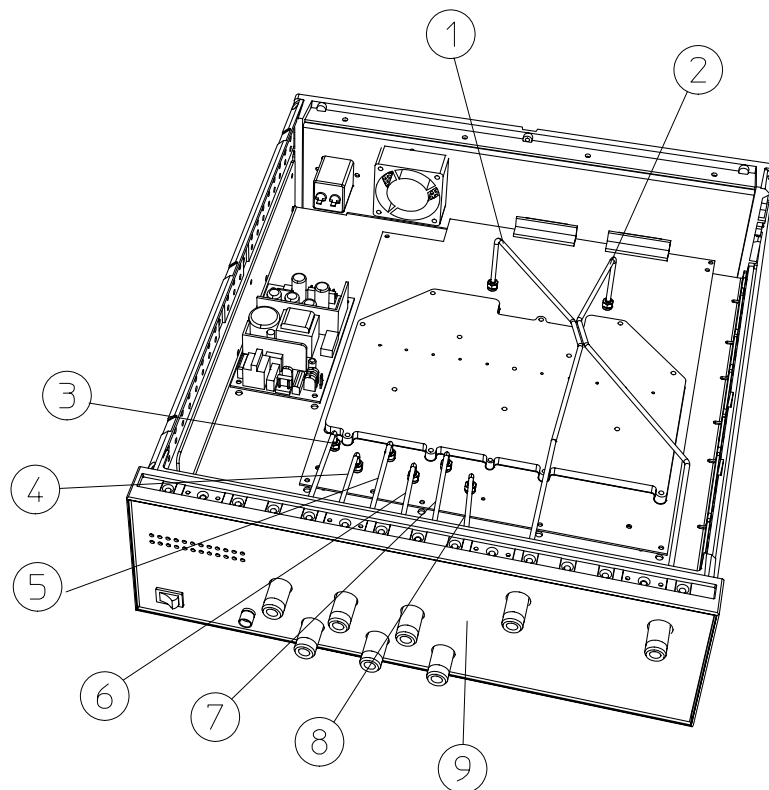
pr631c

Front Panel and Cables — Option 002

Table 9-4   **Front Panel and Cables — Option 002**

Item #	HP Part Number	Qty	Description
1	87075-20034	1	Semi-rigid cable, reflection port
2	87075-20035	1	Semi-rigid cable, transmission port
3	87075-20047	1	Semi-rigid cable, test port 1
4	87075-20048	1	Semi-rigid cable, test port 2
5	87075-60025	1	Front dress panel

Figure 9-7 **Front Panel and Cables — Option 002**
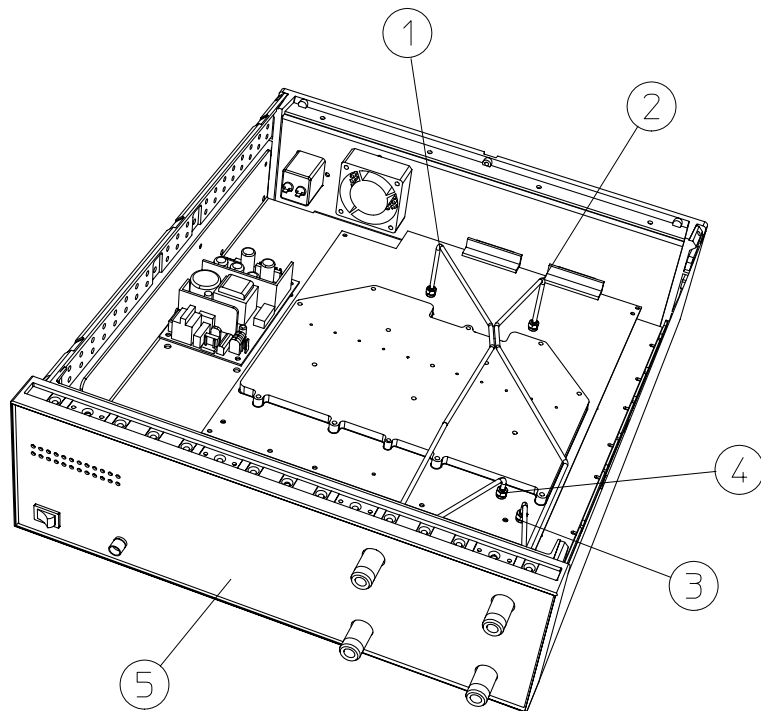
pr630c

Instrument Covers and Associated Parts

Table 9-5   **Instrument Covers and Associated Parts**

Item #	HP Part Number	Qty	Description
1	5002-3964	2	Side cover
2	5002-1088	1	Bottom cover
3	5041-9171	2	Side trim
4	5041-9167	4	Feet
5	1460-1345	2	Tilt-up foot wire
6	5041-9176	1	Top trim
7	5002-1047	1	Top cover

Figure 9-8 **Instrument Covers and Associated Parts**
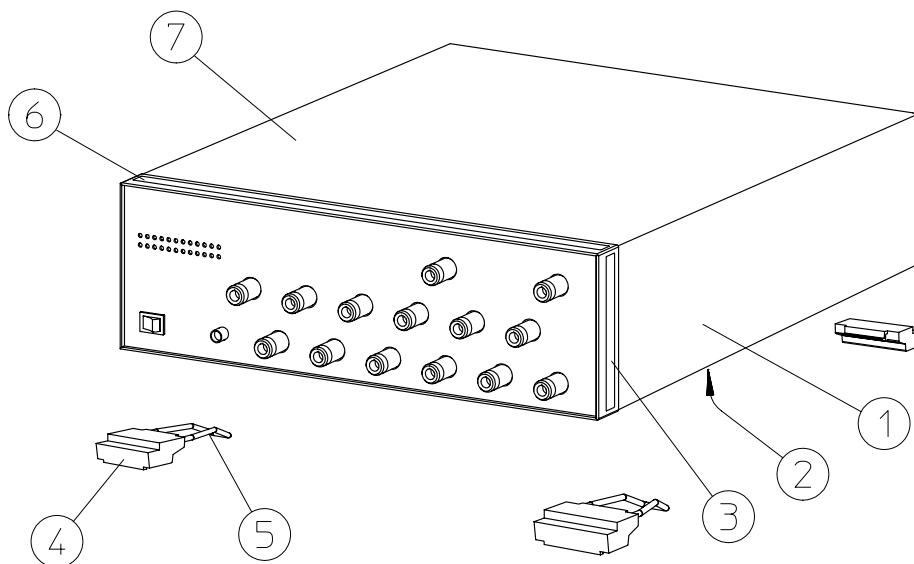
pr628c

Accessories

Table 9-6   **Accessories**

HP Part or Model Number	Description
HP 85036B/E	Type-N 75 Ω calibration kit
HP 85039B	Type-F calibration kit
8120-6818	Parallel port interface cable
87075-60026	Type-N front panel interconnect cable (REFL)[1]
87075-60028	Type-N front panel interconnect cable (REFL)[1]
87075-60027	Type-N front panel interconnect cable (TRANS)[1]
87075-60029	Type-N front panel interconnect cable (TRANS)[1]
08712-10017	Performance test programs (LIF format)
08712-10018	Performance test programs (DOS format)

1. See Table 1-1 for more information on these cables.

Documentation

Table 9-7   **Documentation**

HP Part Number	Description
87075-90005	HP 87075C User's and Service Guide
08711-90071	HP 8711C/13C User's Guide
08712-90056	HP 8712C/14C User's Guide
08712-90059	HP 8711C/12C/13C/14C/30A Service Guide
08712-90057	HP 8711C/12C/13C/14C Programmer's Guide
08712-90045	HP 8711C/12C/13C/14C/30A IBASIC Guide

10   Safety and Regulatory Information

This chapter contains required safety and regulatory information that is not included elsewhere in the manual.

Safety Information

Much of the required safety information is distributed throughout this manual in appropriate places. This section contains all required safety information that is not included elsewhere in this manual.

Warnings

IMPORTANT

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

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

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 Definition
Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, would 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.

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 °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.

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.

Cleaning Instructions

WARNING **To prevent electrical shock, disconnect the test set 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.**

Shipping Instructions

Always transport or ship the instrument using the original packaging or comparable.

Instrument Markings
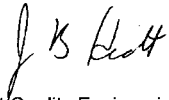
⚠	The instruction manual symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the manual.
CE	The CE mark shows compliance with European Community. (If accompanied by a year, it is the year when the design was proven.)
CSA	The CSA mark is the Canadian Standards Association safety mark.
I	This symbol is used to mark the ON position of the power line switch.
O	This symbol is used to mark the OFF position of the power line switch.
~	This symbol indicates that the input power required is ac.
ISM 1-A	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.

Regulatory Information

Notice for Germany: Noise Declaration

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrerordnung –3.GSGV Deutschland).	
Acoustic Noise Emission/Geraeuschemission	
LpA < 70 dB	LpA < 70 dB
Operator position	am Arbeitsplatz
Normal position	normaler Betrieb
per ISO 7779	nach DIN 45635 t. 19

Declaration of Conformity

DECLARATION OF CONFORMITY
according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	Hewlett-Packard Co.
Manufacturer's Address:	Microwave Instruments Division 1400 Fountaingrove Parkway Santa Rosa, CA 95403-1799 USA

declares that the product

Product Name:	Multiport Test Set
Model Number:	HP 87075C
Product Options:	This declaration covers all options of the above product.

conforms to the following Product specifications:

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

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

IEC 555-2:1982 + A1:1985/EN 60555-2:1987
IEC 555-3:1982 + A1:1990/EN 60555-3:1987 + A1:1991

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE-marking accordingly.

Santa Rosa, California, USA 5 Aug. 1997

John Hiatt/Quality Engineering Manager

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

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