HP 8157A
OPTICAL ATTENUATOR
OPERATING AND PROGRAMMING MANUAL

HP 8157A OPTICAL ATTENUATOR

SERIAL NUMBERS

This manual applies directly to instruments with serial number 2720G00101 and higher. Any change made in instruments having serial numbers higher than the above number will be found in a "Manual Changes" supplement supplied with this manual. Be sure to examine the supplement for changes which apply to your instrument and record these changes in the manual.

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FEDERAL REPUBLIC OF GERMANY
CERTIFICATION

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allowed by the Bureau's calibration facility, and to the calibration facilities of other
International Standards Organization members.

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For warranty service or repair, this product must be returned to a service facility
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HP warrants that its software and firmware designated by HP for use with an instrument
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uninterrupted or error free.

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maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification
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are provided at the back of this manual.
LIST OF EFFECTIVE PAGES

The List of Effective Pages gives the date of the most recent version of each page in the manual. To verify that your manual contains the most current information, check the dates printed at the bottom of each page with those listed below. The date on the bottom of each page reflects the edition or subsequent update in which that page was printed.

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<td>October 1987</td>
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PRINTING HISTORY

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The date on the title page and back cover of the manual only changes when a new edition is published. When an edition is reprinted, all the prior updates to the edition are incorporated. No information is incorporated into a new edition unless it appears in a prior update.

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains the information required to install, test, and operate the Hewlett-Packard Model HP 8157A Optical Attenuator.

1.2 SPECIFICATIONS

Specifications of the Model HP 8157A are given in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested. The specifications are measured with Diamond® HMS-10/HP (Opt.011) connector interfaces and Diamond® HMS-10/HP connectors.

1.3 SAFETY CONSIDERATIONS

The Model HP 8157A is a Safety Class 1 instrument (instrument with an exposed metal chassis that is directly connected to earth via the power supply cable). The symbol used to indicate a protective earth terminal in the instrument is ♂.

Before operation, the instrument and manual, including the red safety page, should be reviewed for safety markings and instructions. These must then be followed to ensure safe operation and to maintain the instrument in a safe condition.

![CAUTION]

Every time that you connect a fiber to the HP 8157A, CLEAN the connectors. This is because any dirt particles on the ferrule of the HP 8157A connector will effect the return loss of the instrument and could also lead to permanent damage of the optical block.

DO NOT use index matching gel on the HP 8157A connectors, as this could damage the instrument. If you must improve connections, use only immersion oils.

Recommended Immersion Oils:

- R.P. Cargille Laboratories, INC
- Refractive Index Liquid, use one with the refractive index of glass.
- Zeiss Immersion Oil
- HP Part Number 6040-0648

![CAUTION]

If you wish to use a DIN multimode connector on this instrument, screw the connector onto the HP 8157A's connector interface very softly, otherwise permanent damage can be caused to the ferrule of the HP 8157A.

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1.4 INSTRUMENTS COVERED BY THIS MANUAL

Each Model HP 8157A has a two-part serial number. The first 4 digits and the letter comprise the serial number prefix; the last 5 digits a sequential suffix which is unique to each Model HP 8157A. The contents of this manual apply directly to optical attenuators having serial numbers above 2720G00101.

1.5 DESCRIPTION

The HP 8157A Optical Attenuator is precisely calibrated at 1300nm and 1550nm over the whole 60dB attenuation range. Because of the advanced optical system, including the lens design and coating, the attenuation can be easily corrected for other wavelengths in the respective ranges by simple entry of the desired wavelength into the instrument memory. This enables you to match the attenuator exactly to the center wavelength of your source, thus ensuring reliable measurement results. The following lists the features of the HP 8157A Optical Attenuator:

- designed for single-mode fibers
- full HP-IB programmability
- 60dB attenuation range, 0.01dB resolution and 0.04dB repeatability
- correction of attenuation between 1200nm and 1650nm

1.6 ACCESSORIES SUPPLIED

The Model HP 8157A is supplied complete with the following accessories:

<table>
<thead>
<tr>
<th>Item</th>
<th>HP Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 800mA, 250Vac Fuse (100/120V)*</td>
<td>2110-0020</td>
</tr>
<tr>
<td>T 400mA, 250Vac Fuse (220/240V)*</td>
<td>2110-0340</td>
</tr>
<tr>
<td>Power Cord</td>
<td>see Figure 2-2</td>
</tr>
</tbody>
</table>

* one fitted and one supplied

1.7 ACCESSORIES AVAILABLE

A number of interface cables are available for simplifying connection of the Model HP 8157A to various optical signal sources and receivers. For a list of these adapter cables and connectors, see the latest Ordering Guide. The following lists the company options available for the HP 8157A:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>907</td>
<td>Front Handle Kit</td>
</tr>
<tr>
<td>908</td>
<td>Rack Flange Kit</td>
</tr>
<tr>
<td>916</td>
<td>Additional Operating and Programming Manual</td>
</tr>
<tr>
<td>5061-9071</td>
<td>Bail Handle Kit</td>
</tr>
</tbody>
</table>

An additional accessory for the Model HP 8157A is the HP 15475A Cleaning Kit. This kit includes cleaning material (brush, tissue, tape, etc.) to clean optical surfaces such as connectors and is supplied in a plastic carrying case.

1-2  October 1987
Table 1-1. Specifications

Specifications describe the instrument’s warranted performance. They are measured with Diamond® HMS-10/HP connector interfaces (Opt.011) and Diamond® HMS-10/HP connectors, if not otherwise specified. The connectors must have Manufacturing Date Code 31-87 or higher to achieve the warranted return loss values.

**Optical Characteristics**

Specifications are measured at 1300nm and 1550nm using a CW laser diode source with constant output power and single-mode fibers with 9/125 μm (NA=0.1).

**Wavelength Range:**
1200nm to 1650nm

**Attenuation Range** (excl. insertion loss): 60.00dB

**Insertion Loss** (incl. both connectors)

<table>
<thead>
<tr>
<th></th>
<th>HMS-10/HP</th>
<th>FC/PC, DIN, ST</th>
</tr>
</thead>
<tbody>
<tr>
<td>worst case</td>
<td>&lt; 40dB</td>
<td>&lt; 60dB</td>
</tr>
<tr>
<td>typical</td>
<td>2.0dB</td>
<td>2.0dB</td>
</tr>
</tbody>
</table>

**Linearity:** ±0.20dB, typically 0.05dB

**Return Loss** (incl. two Diamond® HMS-10/HP connector interfaces and a terminated fiber end*): >33dB

**Typical Return Loss** (incl. two connector interfaces and a terminated fiber end*):

<table>
<thead>
<tr>
<th></th>
<th>PC</th>
<th>ST</th>
<th>DIN 47256</th>
<th>FC**</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMS-10/HP &gt; 36dB</td>
<td>&gt; 30dB</td>
<td>&gt; 20dB</td>
<td>&gt; 33dB</td>
<td>&lt; 14dB</td>
</tr>
</tbody>
</table>

* Far end of fiber connected to the output port is terminated reflection-free.

** Note: FC is not a physical contact connector, therefore return loss is < 14dB.

**Repeatability** (of attenuation after any parameter has been changed and reset): < ±0.04dB

**Display**

Display Range: 0.00 to 64.00dB
Display Resolution: 0.01dB (min. step size)
Supplementary Performance Characteristics
(Description of non-warranted typical performance parameters)

Repeatability (of attenuation after a max. of 6 matings of same connector pair): < 0.2 dB

Operating Modes
Output disable: Optical signal path interrupted.
λ: Entry of wavelength for automatic correction of attenuation using typical correction values
Att: Attenuation is displayed and can be varied
Cal: Entry of calibration factor to adjust display so that displayed value indicates actual power level at output connector of attenuator. Range: ±99.99 dB

General
Recalibration period: 1 year
No warm-up time required if previously stored within operating temperature range.

HP-IB Capability
All modes and parameters can be programmed.

Listen (time for HP 8157A to receive, verify and execute a message).
Output disable/enable, attenuation, λ: < 20 to 550 ms (depending on actual setting/programmed parameter)
Cal: < 5 ms

Talk (time for HP 8157A to transmit a message).
Query commands: < 1 ms/character

HP-IB Interface Function Code: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0

Environmental
Storage temperature: -40°C to +75°C
Operating temperature: 0°C to +55°C
Humidity: < 95% R.H. from 0°C to 40°C

Power: 100/120/220/240 Vrms, +5%, -10%, 90 VA max., 48-400 Hz

Battery back-up (for non-volatile memory): with instrument switched off all current modes and data will be maintained for at least 10 years after instrument delivery

Dimensions: 89 mm H, 212.3 mm W, 345 mm D (3.5" × 8.36" × 13.6")

Weight: net 6.3 kg (13.9 lbs), shipping 10.6 kg (23.4 lbs)

For adapter cables and other accessories see latest Ordering Guide.

Data subject to change.
SECTION II

INSTALLATION

2.1 INTRODUCTION

This section provides installation instructions for the Model HP 8157A and its accessories. It also includes information about initial inspection and damage claims, preparation for use, packaging, storage and shipment.

2.2 INITIAL INSPECTION

Inspect the shipping container for damage. If the container or cushioning is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been verified both mechanically and electrically.

Procedures for checking the optical operation are given in Section 4. If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator’s checks, notify the nearest Hewlett-Packard office. Keep the shipping materials for carrier’s inspection. The HP office will arrange for repair or replacement without waiting settlement.

2.3 PREPARATION FOR USE

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, etc.).

When operating the HP 8157A in the vertical position i.e., standing on the rear panel feet, care should be taken to ensure the instrument does not fall over and cause operator injury.

2.4 Power Requirements

The instrument requires a power source of 100/120/220/240 Vrms (+10%, -5%) at a frequency of 48-400 Hz single phase. The maximum power consumption is 90 VA.
2.5 Line Voltage Selection

CAUTION

BEFORE SWITCHING ON THE INSTRUMENT, make sure that the instrument is set to the local line voltage.

The switch is combined with the power line voltage receptacle on the rear panel. If it is necessary to change the setting, THE POWER CORD MUST FIRST BE DISCONNECTED. Then insert a screwdriver into the recess at the left-hand side of the assembly and prise open the cover. Figure 2-1 shows the main details of the assembly. To change the voltage setting, the selector must be removed and then replaced with the new setting value displayed. If necessary, change the fuse in accordance with the new voltage setting.

![Fuse Holder and Voltage Selector Diagram]

Figure 2-1. Line Voltage Switch Assembly.

<table>
<thead>
<tr>
<th>VOLTAGE</th>
<th>100/120V</th>
<th>220/240V</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUSE</td>
<td>T 800mA, 250Vac</td>
<td>T 400mA, 250Vac</td>
</tr>
</tbody>
</table>
2.6 Power Cable

In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of the power cables available.

**WARNING**

To avoid the possibility of injury or death, the following precautions must be followed before the instrument is switched on.

a) If this instrument is to be energised via an autotransformer for voltage reduction, ensure that the Common terminal is connected to the grounded pole of the power source.

b) The power cable plug shall only be inserted into a socket outlet provided with a protective ground contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

c) Before switching on the instrument, the protective ground terminal of the instrument must be connected to a protective conductor. This is verified by using the power cord which is supplied with the instrument.

![Power Cable Plug Identification](image)

Figure 2-2. Power Cables - Plug Identification

The following work should be carried out by a qualified electrician - all local electrical codes being strictly observed. If the plug on the cable does not fit the power outlet, or the cable is to be attached to a terminal block, cut the cable at the plug end and re-wire it.

The color coding used in the cable will depend on the cable supplied (see Figure 2-2). If a new plug is to be connected, it should meet local safety requirements and include the following features:

- Adequate load-carrying capacity (see table of specifications in Section 1).
- Ground connection.
- Cable clamp.
2.7 HP-IB Connector

The rear panel HP-IB connector (Fig 2-3), is compatible with the connector on Cable Assemblies 10833A, B, C and D. If a cable is to be locally manufactured, use connector male, HP part number 1251-0293.

2.8 HP-IB Logic Levels

The HP 8157A HP-IB lines use standard TTL logic, the levels being as follows:

True = Low = digital ground or 0V dc to 0.4V dc,

False = High = open or 2.5V dc to 5V dc.

All HP-IB lines have LOW assertion states. High states are held at 3.0V d.c. by pull-ups within the instrument. When a line functions as an input, approximately 3.2mA of current is required to pull it low through a closure to digital ground. When a line functions as an output, it will sink up to 48mA in the low state and approximately 0.6mA in the high state.

NOTE: Isolation, the HP-IB line screens are not isolated from ground.

Figure 2-3. HB-IB Connector

2.9 OPERATING ENVIRONMENT

The operating temperature limits are 0°C to 55°C. The specifications also apply over this range.

2.10 CLAIMS AND REPACKAGING

If physical damage is evident or if the instrument does not meet specification when received, notify the carrier and the nearest Hewlett-Packard Service Office. The Sales/Service Office will arrange for repair or replacement of the unit without waiting for settlement of the claim against the carrier.
2.11 STORAGE AND SHIPMENT

The instrument can be stored or shipped at temperatures between minus 40 deg C and plus 75 deg C. The instrument should be protected from temperature extremes which may cause condensation within it.

If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office, attach a tag showing owner, return address, model number and full serial number and the type of service required.

The original shipping carton and packing material may be reusable, but the Hewlett-Packard Sales/Service Office will also provide information and recommendations on materials to be used if the original packing is no longer available or reusable. General instructions for repacking are as follows:

1. Wrap instrument in heavy paper or plastic.

2. Use strong shipping container. A double wall carton made of 350-pound test material is adequate.

3. Use enough shock-absorbing material (3 to 4 inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside container. Protect control panel with cardboard.

4. Seal shipping container securely.

5. Mark shipping container FRAGILE to encourage careful handling.

6. In any correspondence, refer to instrument by model number and serial number.
Figure 3-1. Front and Rear Panel

[Diagram showing the layout of the front and rear panels with various labeled components such as 'RMT', 'ROS', 'SPD', 'LCL', and 'CPL', along with a close-up view of a control panel with buttons and labels 'LINE 5', '50-60Hz', '100/120V', and '220/240V'.]
SECTION III

OPERATING AND PROGRAMMING

3.1 INTRODUCTION

This section explains the functions of controls, indicators and connectors, as well as providing operating and programming information. Figure 3-1 provides a numbered illustration of the front and rear panel controls, and should be folded out when reading the description "Getting to Know Your Instrument " on the following pages. This description should be read before continuing with the more detailed operating information. Programming information is located at the end of this section.

3.2 SPECIAL OPERATING CONSIDERATIONS

The following points should be noted before applying power to the instrument:

☐ Read the safety summary at the beginning of this manual.

☐ Ensure that the VOLTAGE SELECTOR switch on the rear panel is set for operation at the local line voltage.

If any change is made to the setting of the VOLTAGE SELECTOR switch, the fuse must also be changed. Before making either of these changes, switch the instrument off and disconnect the power cord.

WARNING

How to Avoid Potential Exposure to Radiation

When connecting the Model HP 8157A into the optical path between an optical source and optical receiver, complete the connection between the Model HP 8157A and receiver first. Then regarding the connection between Model HP 8157A and source, make the Model HP 8157A connection before the source connection. This avoids any potential exposure to radiation.

3.3 OPERATORS CHECKS

The HP 8157A performs a self-test routine at power switch-on. At the start of this routine, all front panel LEDs should be momentarily lit. In the event of a fault being detected, an error code will be presented in the digital display. The error codes and required action are listed as follows:

☐ Keyboard test failed. Check that no key is stuck in pressed position.

Exxx where xxx is a 3-digit number. Indicates a serious fault and instrument should be returned to the nearest Hewlett-Packard Service Office.
3.4 GETTING TO KNOW YOUR INSTRUMENT

The following should be read in conjunction with Figure 3-1 which can be folded out to aid understanding.

Frontpanel

1. LINE switch. Power on/off switch.

2. LCL key. This key returns the HP 8157A to local manual operation when the instrument is under program control. Note that this key is disabled when the LOCAL LOCKOUT command has been sent by the system controller to the instrument.

3. Program status LEDs. When illuminated, the following is indicated.
   - RMT: Indicates remote control. All front panel pushbuttons (except the LCL pushbutton) are disabled.
   - ADS: Indicates that the instrument is being addressed under program control, although the front panel pushbuttons may still be enabled depending on the status of the RMT LED.
   - SRQ: Indicates that a Service Request has been sent by the instrument to the controller.

4. CAL ≠ 0 LED. Indicates that a non-zero value is currently selected for the CAL factor (see description for CAL key 13). The difference between the displayed attenuation and actual attenuation = the CAL factor.

5. Digital display. Displays numerical value of currently selected parameter (wavelength, CAL-factor or attenuation).

6. Unit LEDs. Operate in conjunction with the digital display (6) to indicate the base units of the currently selected parameter.

7. VERNIER rocker keys. Used to vary parameter values.

8. DISABLE key. Used to enable/disable the optical output (10). When the key LED is illuminated, the optical output is disabled.

9. Connector for optical output.

10. Connector for optical input.

11. ATT key. Used to set the attenuation. When pressed, current attenuation is displayed and can be changed via VERNIER keys (8).

12. CAL key. Used to offset the displayed attenuation value (as set via key (12)). When pressed, current offset (CAL factor) is displayed and can be changed via VERNIER keys (8). NOTE: When CAL key is already active, i.e. key LED illuminated, holding the key down will display the insertion loss for the selected fiber mode.

13. λ key. Used for setting the wavelength. When pressed, the current wavelength is displayed and can be changed via VERNIER keys (8).
Rearpanel

14. HP-IB address switch.

15. HP-IB connector.

16. LINE connector assembly (including VOLTAGE SELECTOR switch). A three-pronged receptacle to provide chassis ground through the power cable for operator protection.

3.5 SETTING THE ATTENUATION

3.6 Basic Considerations

When you press the ATTenuation key on the HP 8157A front panel, the displayed setting automatically takes into consideration:

- The operating wavelength of the optical input. (Selected by λ key 13).

Due to the fact that attenuation is dependent on wavelength, you must first set the HP 8157A to the operating wavelength of the optical input to ensure attenuation accuracy. To make sure that you obtain the optimum performance from your optical system, use the center wavelength of your source. This can be found, for example, on the heatsink at the rear of the HP8154B. To set the wavelength, press λ key (13) and the current setting will be displayed. You can then change this setting via VERNIER keys (7), and the HP 8157A adjusts the attenuating filters automatically.

NOTE

Although instrument operation is specified for wavelengths 1300nm and 1550nm the setting range is 1200nm to 1650nm. For any setting other than that specified, the attenuation is based on a wavelength correction factor which is typically interpolated from the specified values.

With wavelength selected, the HP 8157A now performs automatic correction for any attenuation settings you make via the ATT key (11).
3.7 Optimize The Display With The CAL Key

The CAL key can be used to change the displayed attenuation setting without a corresponding change in actual attenuation at the output. Two examples of how this would be useful are as follows:

1. Making relative settings. If you want the displayed attenuation to be referenced to 20 dB, then entering -20 dB via the CAL key will set 20 dB actual attenuation to be the 0 dB displayed setting.

2. Adjusting the displayed attenuation to take known external losses into account. Consider the typical setup shown in the following figure 3-2.

<table>
<thead>
<tr>
<th>OPTICAL SOURCE</th>
<th>HP8157A</th>
<th>POWER METER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 dBm</td>
<td>10.00 dB</td>
<td>-14.00 dBm</td>
</tr>
</tbody>
</table>

Figure 3-2.

Total attenuation from source to power meter is 14 dB, although the HP 8157A's displayed attenuation setting is 10 dB. There are therefore 4 dB external losses. By entering 4 dB via the CAL key, the displayed attenuation setting will change to 14 dB to include the 4 dB external losses, thus corresponding to power meter reading. Note that the CAL ≠ 0 LED is now illuminated. This informs you that the displayed attenuation has been corrected via the following formula to include the CAL factor:

\[
\text{Actual attenuation + CAL factor} = \text{Displayed attenuation}
\]

Substituting the values in the example gives the following:

\[10\text{dB} + 4\text{dB} = 14\text{dB}\]
3.8 PROGRAMMING

3.9 WHAT YOU NEED TO KNOW . . . .

Programming information in this section is restricted to HP 8157A specifics, and assumes that you have a working knowledge of HP-IB intrinsics. If you are not familiar with HP-IB, then refer to the following publications:

- HP Publication 5952-0156, "Tutorial Description of HP-IB"
- ANSI/IEEE-488-1978, "Digital Interface for Programmable Instrumentation" published by the Institute of Electrical and Electronic Engineers

For a complete list of the HP 8157A programming commands, refer to the pages at the end of this section.

3.10 . . . About The HP 8157A's HP-IB Capabilities

The HP 8157A interfaces to the HP-IB as defined by the IEEE Standard 488-1978. The interface functional subset which the HP 8157A implements is specified in Table 3-1.

Table 3-1. HP-IB Capabilities

<table>
<thead>
<tr>
<th>MNEMONIC</th>
<th>INTERFACE FUNCTION NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH1</td>
<td>SOURCE HANDSHAKE CAPABILITY</td>
</tr>
<tr>
<td>AH1</td>
<td>ACCEPTOR HANDSHAKE CAPABILITY</td>
</tr>
<tr>
<td>T6</td>
<td>BASIC TALKER, SERIAL POLL, UNADDRESSED IF MY LISTEN ADDRESS</td>
</tr>
<tr>
<td>L4</td>
<td>BASIC LISTENER, UNADDRESSED IF MY TALK ADDRESS</td>
</tr>
<tr>
<td>SR1</td>
<td>SERVICE REQUEST CAPABILITY</td>
</tr>
<tr>
<td>RL1</td>
<td>REMOTE/LOCAL CAPABILITY</td>
</tr>
<tr>
<td>PP0</td>
<td>NO PARALLEL POLL CAPABILITY</td>
</tr>
<tr>
<td>DC1</td>
<td>DEVICE CLEAR CAPABILITY</td>
</tr>
<tr>
<td>DT0</td>
<td>NO DEVICE TRIGGER CAPABILITY</td>
</tr>
<tr>
<td>CO</td>
<td>NO CONTROLLER CAPABILITY</td>
</tr>
</tbody>
</table>

3.11 . . . About Programming Examples in This Section

Programming examples are given in this section to aid explanation. These examples assume the following:

- an HP9000, Series 200 or 300 Computer is controller
- that BASIC is the programming language
- the HP 8157A is set to HP-IB address 28 (factory setting)
3.12 GETTING STARTED

If this is the first time you are programming the HP 8157A, the following gives you a few simple tasks to carry out prior to detailed program development. The benefits are twofold in that it gets you started on programming the HP 8157A, at the same time checking remote operation of your instrument.

3.13 Setting the Address

Each instrument that you connect to the interface bus has a unique "address", and the HP 8157A is no different. The address used in a typical BASIC statement takes the form "7xx" where:

- **7** = the interface select code
- **xx** = the instrument address, which can be any integer from 00 to 30 (21 is usually reserved for the controller)

The HP 8157A is preset at the factory to address 28 as shown in the following illustration of the address switch (you can check this by pressing the front panel LCL key to display the address).

![Address Switch Illustration]

\[
\text{DECIMAL EQUIVALENT} = 16 + 8 + 4 + 0 + 0 = 28
\]

If you are satisfied with this address, then continue with the next task "Checking Remote Operation" (Note that all examples in this section assume the address is set to 28).

If you want to change the address, first ensure that the HP 8157A is in local mode and not addressed (i.e. the ADS and RMT LEDs (3) are not illuminated), then change the bit settings on rear panel address switch (16). Now press the front panel LCL key, and the new address will be activated and displayed.

3.14 Checking Remote Operation

You can now check remote operation using a few simple commands as follows:

```basic
10 DIM A$[7]
20 CLEAR 728
30 OUTPUT 728; "ATT 5.00 dB" - clears HP 8157A's input/output buffers
40 OUTPUT 728; "ATT?" - sets attenuation to 5.00 dB
50 ENTER 728; A$ - interrogates attenuation setting
60 PRINT A$ - transfers setting data to controller
70 END
```

The controller output should read " 5.00" which indicates that both the Listener and Talker functions of the HP 8157A are operating correctly.
3.15 SENDING DATA TO THE HP 8157A
(LISTENER FUNCTION)

All the settings you can make via front panel switches can also be programmed via HP-IB. To aid explanation, consider the following programming example:

10 OUTPUT 728;"WVL 1300 NM;Cal 0dB;D0;Att 3.2dB"
20 END

This sets the HP 8157A to a wavelength of 1300nm, attenuation 3.2dB, CAL factor 0.0dB and output ON. The points to note on the setting "string" are as follows:

- Each setting in the string must be terminated by a ","
- Either upper or lower case may be selected (D0 is the same as D0)
- Any of 3 different data formats may be used. The following settings are equivalent and will be interpreted correctly:
  - WVL 1300 nm
  - WVL 1.3 um
  - WVL 1300 e-09 m
  - WVL 1.3E-06
- If no unit is specified, then the default unit will be assumed. The default unit is dB for attenuation and CAL factor, and meter for wavelength

(A complete list of the setting commands is given at the end of this section).
3.16 RECEIVING DATA FROM THE HP 8157A
(TALKER FUNCTION)

Just as you can program all HP 8157A settings via HP-IB, you can also interrogate all settings - either individually or as a complete set (learn string). The HP 8157A can also send data regarding installed firmware, error and status reports. (A complete list of the interrogating commands is given on the blue pages at the end of this section).

From the programming example given in the previous sub-section, the wavelength was set to 1300nm. If you now want to interrogate this setting, you could use the following simple program:

```
10 DIM AS[11]
20 OUTPUT 728:"WVL?"
30 ENTER 728:AS
40 DISP AS
50 END
```

- dimensions string AS for 11 characters
- interrogates the wavelength setting
- transfer setting data to controller
- displays the setting data. (0.1300E-05)

Depending on which setting is being interrogated, the length of the character string returned to the controller is 1 to 11 characters long. You can also interrogate the complete settings using a single command. The following provides an example:

```
10 DIM AS[56]
20 OUTPUT 728:"LRN?"
30 ENTER 728:AS
40 PRINT AS
50 END
```

The Model HP 8157A then returns its settings as a 56-character string to the controller. The setting sequence is always the same and listed as follows:

- Fiber setting: 4 characters
- Output state: 4 characters
- SRQ mask: 8 characters
- CAL factor: 12 characters
- Attenuation: 12 characters
- Wavelength: 16 characters
3.17 STATUS/ERROR REPORTING (TALKER FUNCTION)

Another important feature of the HP 8157A is that you can program it to interrupt the controller when certain status/error conditions are met. The Require Service (SRQ) message is used to implement this feature and is independent of all other HP-IB activity. However, the HP 8157A must be programmed for the interrupt, via the SRQ mask, before the interrupt will take place. The possible interrupt conditions that can be programmed via the SRQ mask are listed as follows:

Self-Test Error     If an error is detected by the self-test at power-on, or via the "TST?" command (e.g. OUTPUT 728,"TST?").

Settled            When the HP 8157A's hardware has settled to the new setting values. (Hardware Ready).

Parameter Error    A wrong value has been set for a parameter.

Message Available  When the HP 8157A is ready to respond to an interrogation command.

Syntax Error       An invalid instruction has been sent.

These 6 interrupt conditions are monitored by an 8-bit Status Register, the content of this register being referred to as the Status Byte.

3.18 Status Register and Status Byte

The following shows which bit in the Status Register is allocated to which interrupt condition:

![Status Byte Diagram]

When an interrupt condition is true, the corresponding bit in the status Register is set to 1 - independent of the SRQ mask setting. However, an interrupt (SRQ) will only occur when the SRQ mask has been set for that condition. It is therefore possible for one or more bits of the Status Register to be true without the HP 8157A causing an interrupt - because the SRQ mask has not been set for these bits.
This is typically the case at power-on or after "Device Clear" - as the SRQ mask is then set to decimal 000 and all interrupts are disabled. If the HP 8157A is now serial polled or receives the "STB?" command, the decimal equivalent of the Status Byte is returned to the controller - but the Status Byte remains unchanged. To clear the Status Byte, the "CSB" (Clear Status Byte) command must be used. For example:

```
20 CLEAR 728    - Clears HP 8157A's I/O buffers; SRQ mask = 000
30 OUTPUT 728;"CSB"    - Clear Status Byte
40 OUTPUT 728;"wvl?"    - Interrogate wavelength setting.
50 S=SPOLL(728)    - Serial poll of HP 8157A
60 IF BIT(S,4) = 0 THEN GOTO 50    - Check Status Byte; if Bit 4=0, repeat serial poll; if Bit 4=1, message available
70 ENTER 728;A$    - Transfer wavelength setting to controller
80 PRINT A$       - Print result
90 OUTPUT 728;"CSB"    - Clear Status Byte
100 END
```

If the SRQ mask is set for certain conditions, and one of these conditions occur, bit 6 of the Status Register will go true ("1" state), the SRQ LED on the front panel will illuminate, and the HP-IB SRQ message will be sent. At this point, it will be necessary to address the HP 8157A as talker by using the Serial Poll command or "STB?" command:

```
10 A=SPOLL(728)    - Transfers Status Byte to variable "A"
20 PRINT A
30 END
or
10 OUTPUT 728;"STB?"    - Interrogates the Status Byte
20 ENTER 728;A
30 PRINT A
40 END
```

The Status Byte is returned to the controller as a decimal number which can be broken down into its 8 binary components to determine which bit has gone true. At the same time, the Status Register is cleared and SRQ set false.

**NOTES**

- Once SRQ is set true, the Status Byte remains unchanged until serial polled or interrogated via the "STB?" command. For any interrupt condition going true during this period, the corresponding bit in the Status Register will not be set. Instead, the "1" state will be held in HP 8157A memory and loaded into the Status Register after it is cleared e.g. by serial poll.

- For this reason, if several conditions are enabled by the SRQ mask and they all go true, only the condition that occurred first will have its bit set in the Status Register. The bit settings for the other conditions will be held in HP 8157A memory, and loaded simultaneously into the Status Register after it is cleared. If you have set more than one condition by the SRQ mask, therefore, your program should serial poll the HP 8157A twice to ensure that the Status Register is cleared and SRQ set false.
3.19 Setting the SRQ Mask

The SRQ mask can be set to mask bits 0-5 and bit 7 on the Status Register. Default mask value is 0 i.e. all interrupt conditions are disabled and no SRQ can be generated. To set the mask first determine which conditions you want to interrupt the controller, e.g., parameter error, syntax error, etc. Determine the decimal number (1-191) corresponding to those conditions. A "1" in the mask byte enables the corresponding interrupt condition. Then output the “SRE” instruction mnemonic followed by the decimal number. The following shows the Status Register and the SRQ mask set for bit 1 and bit 5, syntax error and parameter error. (OUTPUT 728;"SRE33").

<table>
<thead>
<tr>
<th>STATUS REGISTER</th>
<th>BIT 7</th>
<th>BIT 6</th>
<th>BIT 5</th>
<th>BIT 4</th>
<th>BIT 3</th>
<th>BIT 2</th>
<th>BIT 1</th>
<th>BIT 0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S_Err</td>
<td>SRQ</td>
<td>Syntax</td>
<td>Message</td>
<td>ALWAYS</td>
<td>SETTLED</td>
<td>ALWAYS</td>
<td>PARAM</td>
</tr>
<tr>
<td>DECIMAL EQUAL</td>
<td>128</td>
<td>32</td>
<td>16</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SRQ MASK</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

3.20 Condition Register

Whereas the Status Register monitors events, i.e. when an interrupt condition occurs, a bit is set and remains set until the register is cleared, the condition register monitors the current status regarding "settled" and "attenuation > display".

The bit allocation in the condition register is as follows:

When the condition register is interrogated via the “CNB?” command, the contents are returned to the controller as a decimal number. This number can then be broken down into its binary components to determine which bit has been set to "1".
## HP 8157A COMMAND SUMMARY

### SETTINGS (LISTENER FUNCTION)

<table>
<thead>
<tr>
<th>Parameter/Operation</th>
<th>Mnemonics</th>
<th>Data</th>
<th>Unit</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Single-Mode</td>
<td>F</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select Multimode</td>
<td>F</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enable Output</td>
<td>D</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disable Output</td>
<td>D</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set Wavelength</td>
<td>WVL</td>
<td>value</td>
<td>M</td>
<td>meter. Default if no unit defined</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MM</td>
<td>millimeter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>UM</td>
<td>micrometer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NM</td>
<td>nanometer</td>
</tr>
<tr>
<td>Set Attenuation</td>
<td>ATT</td>
<td>value</td>
<td>DB</td>
<td>Default is dB if no unit defined</td>
</tr>
<tr>
<td>Set CAL Factor</td>
<td>CAL</td>
<td>value</td>
<td>DB</td>
<td>Default is dB if no unit defined</td>
</tr>
<tr>
<td>Set SRQ Mask</td>
<td>SRE</td>
<td>value</td>
<td></td>
<td>value = decimal number (0-191). A &quot;1&quot; in the binary equivalent sets SRQ on this condition.</td>
</tr>
<tr>
<td>Clear Status Byte</td>
<td>CSB</td>
<td></td>
<td></td>
<td>Always clears Status Byte independent of SRQ state.</td>
</tr>
<tr>
<td>Clear Device</td>
<td>CLR</td>
<td></td>
<td></td>
<td>Clears all I/O buffers. Same as Universal Device Clear Command.</td>
</tr>
</tbody>
</table>

### INTERROGATING SETTINGS (TALKER FUNCTION)

<table>
<thead>
<tr>
<th>Parameter/Operation</th>
<th>Mnemonics</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn Mode</td>
<td>LRN?</td>
<td>Returns 56-character string detailing all settings.</td>
</tr>
<tr>
<td>Interrogate setting</td>
<td>F?</td>
<td>Always returns 1, i.e. single-mode.</td>
</tr>
<tr>
<td></td>
<td>WVL?</td>
<td>Returns 11-character string for ( \lambda ) setting. Always in meters.</td>
</tr>
<tr>
<td></td>
<td>CAL?</td>
<td>Returns 7-character string for CAL factor. Always in dB.</td>
</tr>
<tr>
<td></td>
<td>ATT?</td>
<td>Returns 7-character string for attenuation setting. Always in dB.</td>
</tr>
<tr>
<td></td>
<td>D?</td>
<td>Returns integer (0 or 1) for output off/on.</td>
</tr>
</tbody>
</table>
STATUS/ERROR REPORTING (TALKER FUNCTION)

<table>
<thead>
<tr>
<th>Interrogation</th>
<th>Mnemonics</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Byte</td>
<td>STB?</td>
<td>Returns 3-digit integer (000-191). With SRQ false, does not clear Status Byte.</td>
</tr>
<tr>
<td>Status Byte Mask</td>
<td>SRE?</td>
<td>Returns 3-digit integer (000-191)</td>
</tr>
<tr>
<td>Condition Byte</td>
<td>CNB?</td>
<td>Returns 2-digit integer (00-06)</td>
</tr>
<tr>
<td>Self-test</td>
<td>TST?</td>
<td>Executes self-test and returns 0 or 1 to indicate passed or failed</td>
</tr>
<tr>
<td>Error Number</td>
<td>ERR?</td>
<td>Returns 3-digit integer representing HP 8157A error code (details given in Service info). 000 means no error. An error code is only available if bit 7 (self-test) in the Status Byte has been set. Other error conditions in the Status Byte will not cause an error code. On readout, the error code is transferred to the 'Last Error Number' register.</td>
</tr>
<tr>
<td>Last Error Number</td>
<td>LERR?</td>
<td>Returns 3-digit integer for last active error. This is a destructive readout.</td>
</tr>
<tr>
<td>Operation Complete</td>
<td>OPC?</td>
<td>1 if no further command to interpret and execute in the input buffer. 0 if further commands in the input buffer.</td>
</tr>
<tr>
<td>Identifier</td>
<td>IDN?</td>
<td>Returns 40-character string identifying currently installed firmware and manufacturer model no.</td>
</tr>
</tbody>
</table>

UNIVERSAL COMMANDS

<table>
<thead>
<tr>
<th>Command</th>
<th>ASCII Character</th>
<th>Equivalent</th>
<th>Forms</th>
<th>Decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Clear</td>
<td>DC₄</td>
<td>00010100</td>
<td>024</td>
<td>20</td>
</tr>
<tr>
<td>Selected Device Clear</td>
<td>EOT</td>
<td>0000000100</td>
<td>004</td>
<td>4</td>
</tr>
</tbody>
</table>

Both "CLEAR" commands clear all input/output buffers, reset SRQ mask to all disabled and SRQ to false, but have no effect on HP 8157A mode/parameter settings.
SECTION IV

PERFORMANCE TESTS

4.1 INTRODUCTION

The procedures in this section test the optical performance of the instrument. The complete specifications to which the HP 8157A is tested are given in Table 1-1. All tests can be performed without access to the interior of the instrument.

4.2 EQUIPMENT REQUIRED

Equipment required for the performance test is listed in Table 4-1. Recommended Test Equipment. Any equipment which satisfies the critical specifications given in the table may be substituted for recommended models.

Table 4-1. Recommended Test Equipment

<table>
<thead>
<tr>
<th>Instrument/Accessory</th>
<th>Rec. Model</th>
<th>Critical Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Meter Standard</td>
<td>HP8152A</td>
<td>Accuracy: &lt; 2%, Dynamic Range &gt;60dB, Accuracy (rel) &lt;0.15dB</td>
</tr>
<tr>
<td></td>
<td>HP81521B</td>
<td></td>
</tr>
<tr>
<td>Lens Adapter</td>
<td>HP81010BL</td>
<td></td>
</tr>
<tr>
<td>Connector Adapter</td>
<td>HP81000AA</td>
<td></td>
</tr>
<tr>
<td>Single-Mode Fibers</td>
<td>HP81101AC 2 off</td>
<td>Date code 31-87 and higher.</td>
</tr>
<tr>
<td>Laser Source</td>
<td>HP8155A Opt.002/011 1300nm -3dBm into single-mode fiber</td>
<td></td>
</tr>
<tr>
<td>CW Laser Source</td>
<td>HP8155A Opt.003/011 1550nm -3dBm into single-mode fiber</td>
<td></td>
</tr>
<tr>
<td>OTDR</td>
<td>HP8145A Opt.002/011 or Opt.003/011</td>
<td></td>
</tr>
<tr>
<td>Optical Attenuator</td>
<td>HP8158B Opt.002/011 or HP8157A Opt.011</td>
<td></td>
</tr>
<tr>
<td>Single-Mode Fiber</td>
<td>≥0.5Km length with 2 Diamond HMS-10/HP connectors</td>
<td></td>
</tr>
<tr>
<td>Connector Adapters</td>
<td>P/N 08154-61701 (Opt 011), if required</td>
<td></td>
</tr>
<tr>
<td>Cleaning Kit</td>
<td>HP15475A</td>
<td></td>
</tr>
</tbody>
</table>
TEST RECORD

Results of the performance test may be tabulated on the Test Record provided at the end of the test procedures. It is recommended that you fill out the Test Record and refer to it while doing the test. Since the test limits and setup information are printed on the Test Record for easy reference, the record can be also be used as an abbreviated test procedure (if you are familiar with test procedures). The Test Record can also be used as a permanent record and may be reproduced without written permission from Hewlett-Packard.

TEST FAILURE

If the HP 8157A fails any performance test, return the instrument to the nearest Hewlett-Packard Sales/Service Office for repair.

INSTRUMENTS SPECIFICATION

Specifications are the performance characteristics of the instrument which are certified. These specifications, listed in Table 1-1, are the performance standards or limits against which the HP 8157A can be tested. Table 1-1 also lists some supplementary characteristics of the HP 8157A and should be considered as additional information.

Any changes in the specifications due to manufacturing changes, design, or traceability to the National Bureau of Standards will be covered in a manual change supplement or revised manual. The specifications listed here supercede any previously published.

PERFORMANCE TEST

The performance tests given in this section are separated into Total Insertion Loss Test, Attenuation Accuracy Test, Attenuation Repeatability Test and Return Loss Test. Perform each step in the tests in the order they are given using the corresponding test equipment.

NOTE

Make sure that all optical connections of the test setups given in the procedure are dry and clean. For cleaning use accessory kit Model HP15475A. DO NOT USE INDEX MATCHING GEL.

The Optical Cables from the Laser Source to the HP 8157A and from the Attenuator to the Power Meter must be fixed on the table to ensure minimum cable movement during the tests.

All tests and equipment mentioned in the Performance Test section refer to tests carried out with the Diamond® HMS-10/HP connectors with date codes 31-87 and higher.
4.7 TOTAL INSERTION LOSS TEST

Specification:

Insertion loss (including both connectors) < 4.0 dB with single-mode fiber 9 um.

Equipment required:

1300nm single-mode tests

HP8155A Opt.002/011 Laser Source with constant output power 1300nm wavelength.
Power Meter Standard with Optical Head, connector adapter and lens adapter
for single-mode fiber. (8152A; 81521B; 81010BL; 81000AA)
Optical Cable (9 um) HP81101AC
Optical Cable (9 um) HP81101AC

1550nm single-mode tests

HP8155A Opt.003/011 Laser Source with constant output power 1550nm wavelength.
Power Meter Standard with Optical Head, connector adapter and lens adapter
for single-mode fiber. (8152A; 81521B; 81010BL; 81000AA)
Optical Cable (9 um) HP81101AC
Optical Cable (9 um) HP81101AC

Carry out the following TOTAL INSERTION LOSS test for 1300nm or 1550nm single-mode, using the equipment listed above.

1. Using the VERNIER rocker keys set the HP 8157A attenuation to 0000 dB.

2. Connect the equipment as shown in Figure 4-1

3. Set the Average Power Meter to Autorange. Display [dB].

4. Set DISPlay to REFerence on the power meter 8152A.
5. Connect the equipment as shown in Figure 4-2.

![Figure 4-2. Total Insertion Loss Test Set-up](image)

6. Enable the HP 8157A attenuator output and record the power meter reading (in dB) on the Test Record and check that it is within specifications.
4.8 ATTENUATION ACCURACY

Specifications:

Linearity for single-mode, ±0.2 dB.

Equipment required:

1300nm single-mode tests

HP8155A Opt.002/011 Laser Source with constant output power 1300nm wavelength.
Power Meter Standard with Optical Head, connector adapter and lens adapter
for single-mode fiber. (8152A; 81521B; 81010BL; 81000AA)
Optical Cable (9 um) HP81101AC
Optical Cable (9 um) HP81101AC

1550nm single-mode tests

HP8155A Opt.003/011 Laser Source with constant output power 1550nm wavelength.
Power Meter Standard with Optical Head, connector adapter and lens adapter
for single-mode fiber. (8152A; 81521B; 81010BL; 81000AA)
Optical Cable (9 um) HP81101AC
Optical Cable (9 um) HP81101AC

Carry out the following ATTENUATION ACCURACY tests for 1300nm single-mode and 1550nm single-mode using the equipment listed above.

1. Set HP 8157A as follows:

   \( \lambda \) as required

   CAL to 0.00 dB.

   ATT to 0.00 dB

2. Connect equipment as shown in Figure 4-3.

![Figure 4-3. Attenuation Accuracy Test Set-up](image)

October 1987
3. Set HP 8157A output power level as 0.00 dB reference level on the Average Power Meter and check the following attenuation settings for ± 0.2 dB accuracy.

<table>
<thead>
<tr>
<th>0.00 dB = Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 dB</td>
</tr>
<tr>
<td>2 dB</td>
</tr>
<tr>
<td>3 dB</td>
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<tr>
<td>4 dB</td>
</tr>
<tr>
<td>5 dB</td>
</tr>
<tr>
<td>6 dB</td>
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<tr>
<td>7 dB</td>
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<tr>
<td>8 dB</td>
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<tr>
<td>9 dB</td>
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<tr>
<td>10 dB</td>
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<tr>
<td>11 dB</td>
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<tr>
<td>12 dB</td>
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<tr>
<td>13 dB</td>
</tr>
<tr>
<td>14 dB</td>
</tr>
<tr>
<td>24 dB</td>
</tr>
<tr>
<td>34 dB</td>
</tr>
<tr>
<td>44 dB</td>
</tr>
<tr>
<td>54 dB</td>
</tr>
</tbody>
</table>
4.9 ATTENUATOR REPEATABILITY

Specifications:

Repeatability after any parameter has been changed and reset $< \pm 0.04$ dB.

Equipment required:

Use the same equipment, test set-up and HP 8157A settings as used for the ATTENUATION ACCURACY test (either for 1300nm or 1550nm wavelength).

1. Set the HP8157A attenuation to the values shown in step 3 and note the AVG Power Meter reading in the Test Record.

2. Set the HP8157A attenuation to any other value (e.g., 0.00dB) and then back to the previous value. Note the AVG Power Meter reading in the Test Record and check that the second reading is within $\pm 0.04$dB of the first reading.

3. Repeat steps 1 and 2 for following attenuation settings:

   5dB
   12dB
   24dB
   36dB
   48dB
   50dB
   53dB
4.10 ATTENUATOR RETURN LOSS

Specifications:

Return Loss > 33 dB

Equipment required:

Return Loss Test

Single-Mode Fiber with 2 HMS10/HP Connectors (>0.5km)
HP8157A or HP8158B Opt.002/011 Attenuator
2 off HP81101AC Single-Mode Fibers
15475-68701 Adhesive Tape Kit (Part of HP15475A Cleaning Kit) to terminate the HP8157A output.

1. Make sure that all optical connectors are cleaned carefully.

2. Connect equipment as shown in Figure 4-4

![Figure 4-4. Return Loss Set-up](image)

3. Set the 8158B (or HP 8157A) to min. attenuation and enable the output.

4. Set the HP8145A as follows:

   Press RCL 0 ENTER and then START.
   Select span and move the end-reflection of the connected fiber to the center of the screen.
   Next press the center position softkey.

STOP measurement.

Change the HP8145A as follows:

- vertical offset to: 7dB
- vertical scale to: 2.5dB
- span to: 1Km
- measurement mode to: fast refresh
5. Press MEASUREMENT START. The displayed end-reflection signal shows that the receiver is in saturation. Therefore increase the attenuation of the HP8158B (HP 8157A) until the displayed end-reflection shows only one peak which should be approx. one minor division below saturation.

6. Using vertical offset move the peak (fresnel reflection of 4%) to the upper graticule line as reference (14 dB).

7. Check the dynamic range by pressing the open fiber connector slightly against a piece of adhesive tape supplied with the HP15475A Cleaning Kit. The end-reflection signal should decrease by at least 5 divisions. If the end-reflection is higher, clean the connectors again.

8. Connect the open fiber connector to the input of the HP8157A DUT, set CAL and ATT to 0.00 and enable the output.

9. Terminate the output cable of the HP8157A DUT by pressing the open connector slightly against the piece of adhesive tape and check that the end-reflection decreases below to the center horizontal graticule line. Note the reading in dB, multiply by 2 and add 14 dB. Note the result in the Performance Test Record.

NOTE: The HP8145A OTDR displays the measurement results only for one way in the fiber, therefore the displayed results must be multiplied by 2. The measurement results are referenced to 14dB fresnel reflection which must be added.
TOTAL INSERTION LOSS TEST
Test Conditions; 1300nm with single-mode fibers
1550nm with single-mode fibers
with Diamond HMS-10/HP connectors

<table>
<thead>
<tr>
<th>Description</th>
<th>Test</th>
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</thead>
<tbody>
<tr>
<td>1300nm with single-mode fibers &lt; 4.0dB</td>
<td></td>
</tr>
<tr>
<td>Output via 8157A (min. ATT.)</td>
<td></td>
</tr>
<tr>
<td>Total Insertion Loss = _____ dB</td>
<td></td>
</tr>
<tr>
<td>1550nm with single-mode fibers &lt; 4.0dB</td>
<td></td>
</tr>
<tr>
<td>Output via 8157A (min. ATT.)</td>
<td></td>
</tr>
<tr>
<td>Total Insertion Loss = _____ dB</td>
<td></td>
</tr>
</tbody>
</table>
PERFORMANCE TEST RECORD FOR HP 8157A OPT.011

Hewlett-Packard Model 8157A  Test Performed By________________
Optical Attenuator  Date_____________________________
Serial Number __________  Comments____________________

ATTENUATION ACCURACY TEST

Test Condition: 1300nm with single-mode fibers
with Diamond HMS-10/HP connectors

<table>
<thead>
<tr>
<th>Attenuation Setting</th>
<th>Power Meter Reading</th>
<th>Test Pass</th>
<th>Test Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>act.</td>
<td>max.</td>
</tr>
<tr>
<td>0 dB</td>
<td>0.00</td>
<td>dB</td>
<td>dB</td>
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<td>0.8</td>
<td>dB</td>
<td>1.2</td>
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<td>1.8</td>
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<td>54 dB</td>
<td>53.8</td>
<td>dB</td>
<td>54.2</td>
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</table>
# PERFORMANCE TEST RECORD FOR HP 8157A OPT.011

Hewlett-Packard Model 8157A  
Optical Attenuator  
Serial Number  

Test Performed By  
Date  
Comments  

## ATTENUATION ACCURACY TEST

Test Condition: 1550nm with single-mode fibers with Diamond HMS-10/HP connectors

<table>
<thead>
<tr>
<th>Attenuation Setting</th>
<th>Power Meter Reading</th>
<th>Test</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>act.</td>
<td>max.</td>
</tr>
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<td>0 dB</td>
<td>0.00 dB Reference</td>
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</tr>
<tr>
<td>34 dB</td>
<td>33.8dB</td>
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<tr>
<td>44 dB</td>
<td>43.8dB</td>
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</tr>
<tr>
<td>54 dB</td>
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<td></td>
<td>54.2dB</td>
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</table>

## ATTENUATOR REPEATABILITY TEST

Test Condition: 1300nm or 1550nm with single-mode fibers with Diamond HMS-10/HP connectors

<table>
<thead>
<tr>
<th>Attenuation Setting</th>
<th>Power Meter Reading 1</th>
<th>Power Meter Reading 2</th>
<th>Power Meter Reading 1-2</th>
<th>Spec.</th>
<th>Test Pass</th>
<th>Test Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>+/-0.04dB</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>12 dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>+/-0.04dB</td>
<td>____</td>
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<tr>
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<td>____ dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>+/-0.04dB</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>36 dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>+/-0.04dB</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>48 dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>+/-0.04dB</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>53 dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>____ dB</td>
<td>+/-0.04dB</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>Hewlett-Packard Model 8157A</td>
<td>Test Performed By ___________________________</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-----------------------------</td>
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<tr>
<td>Optical Attenuator</td>
<td>Date ___________________________</td>
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<tr>
<td>Serial Number</td>
<td>Comments ______________________________________</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### RETURN LOSS TEST

Test Condition: 1300nm or 1550nm with single-mode fibers with Diamond HMS-10/HP connectors

<table>
<thead>
<tr>
<th>Specification</th>
<th>&gt;33 dB</th>
</tr>
</thead>
</table>

Actual Return Loss Measured _____ dB
SALES & SUPPORT OFFICES
Arranged alphabetically by country

Product Line Sales/Support Key
Key Product Line
A Analytical
CM Components
C Computer Systems
E Electronic Instruments & Measurement Systems
M Medical Products
P Personal Communication Products
* Sales only for specific product line
** Support only for specific product line

IMPORTANT: These symbols designate general product line capability. They do not insure sales or support availability for all products within a line, at all locations. Contact your local sales office for information regarding locations where HP support is available for specific products.

HEADQUARTERS OFFICES
If there is no sales office listed for your area, contact one of these headquarters offices

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Bernal, Olav
BUENOS AIRES
Tel: 252-3958, 252-3951

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JAMISON, A.C.T. 2614
Telex: 62850
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Telex: 31-024
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Tel: (02) 22-761-31-11
Telex: 234049 newhpac
A,C,C.M,E.P.

BERMUDA
Applied Computer Technologies
Atlantic House Building
P.O. Box HM 2091
Par-La-Ville Road
HAMILTON 5
Tel: 295-1616
Telex: 380-3589/ACT BA P

BOLIVIA
Arrellano Ltda
Av 20 de Octubre #2/225
Casilla 1393
LA PAZ
Tel: 368541

BRAZIL
Hewlett-Packard do Brasil S.A
Alameda Rio Negro, 750-41
ALPHAVILLE
06400 Barueri SP
Tel: (011) 241 1311
Telex: (011) 71301 HP BR
Cable: HEWPACF Sao Paulo
C.M.E.

Hewlett-Packard do Brasil S.A
Praia de Botafogo 228-A-414
5 0 AND-COR 212
Edition Argentina - Aia A
22250 RIO DE JANEIRO, RJ
Tel: (022) 552-6422
Telex: 21995 HPBR BR
Cable: HEWPAC Rio de Janeiro

E. Van Den Cetina Ltda
Rua Jose Bonfim, 458
Todos os Santos
20771 RIO DE JANEIRO, RJ
Tel: (021) 552-8220
Telex: 33497 EGBL BR
A

ANAMEDIC E I Ltda
Rua Vergueiro, 360
04012 SAO PAULO, SP
Tel: (011) 572-1106
Telex: 24720 HPBR BR
M

Datatronix Electronica Ltda
Av. Pamphulha, 746-C
SÃO PAULO, SP
Tel: (11) 2601111
CM
SALES & SUPPORT OFFICES
Arranged alphabetically by country

FRANCE (Cont’d)
Hewlett-Packard France
28 Rue de la République
Boîte Postale 563
75020 BÉNÉCOURT CEDEX, FRANCE
Tel: (33) 01-80-18-99-99
Telex: 366957 C.E.M

Hewlett-Packard France
4, Rue Thomas-Mann
Boîte Postale 56
76033 STRASBOURG Cedex
Tel: (88) 28-56-46
Telex: 890141 C.E.M

Hewlett-Packard France
Le Pélerin III
3, Chemin du Pigeonnier de la Capelière
31081 TOULOUSE Cedex
Tel: 33-61-40-11-12
Telex: 531363 F
A.C.E.M.

Hewlett-Packard France
Les Cardinaux
Batiment B2
Route des Dolines
Parc d’activité de Valbonne
Sophia Antipolis
06560 VALBONNE (Nice)
Tel: 63-55-39-40
C.

Hewlett-Packard France
9, Rue Baudin
26000 VALENCE
Tel: 33-75-47-76-76
C.

Hewlett-Packard France
Carolus
ZAC de Bons Brard
57650 VIGY (Metz)
Tel: 61-71-20-22
C.

Hewlett-Packard France
Parc d’activité des Prés 1
Rue Papin Cedex
65685 VILLENEUVE D’ASCQ
Tel: 33-29-91-41-25
Telex: 160124 C.E.M

Hewlett-Packard France
47, Rue de Châtillon
11000 Toulouse
Tel: 33-26-86-6919
C.

Hewlett-Packard France
33-35-53-57-56
Telex: 1703595 F
A.C.E.M.

Hewlett-Packard France
9 Avenue de Belgique
76100 ROUEN
Telex: 1703595 F
A.C.E.M.

Hewlett-Packard GmbH
Verbindungsstele Bonn
Friedrich-Ebert-Allee 26
5300 BONN
Tel: (0228) 234001
Telex: 8589421

Hewlett-Packard GmbH
Vertriebszentrum Südwest
Schloß-Straße 2
D-70300 BÖBLINGEN
Postfach 1427
Tel: (07031) 845-0
Telex: 7255739 hgp

Hewlett-Packard GmbH
Zentralbereich MKtg
Herrenberger Straße 130
D-70300 BÖBLINGEN
Tel: (07031) 14-0
Telex: 7255739 hgp

Hewlett-Packard GmbH
Geschäftsstelle
Schloßstrasse 2a
D-6600 DORTMUND-41
Tel: (0231) 45051
Telex: 822858 heppod
A.C.E.

Hewlett-Packard GmbH
Reparaturzentrum Frankfurt
Berliner Straße 111
6000 FRANKFURT/MAIN 60
Tel: (069) 500001-0
Telex: 413249 hfpf

Hewlett-Packard GmbH
Vertriebsbereich Nord
Kapstädter Straße 5
D-4000 HAMBURG 60
Tel: 49-40-63-804-0
Telex: 021 63 032 hpph d
A.C.E.M.

Hewlett-Packard GmbH
Geschäftsstelle
Heidering 37-39
D-3000 HANNOVER 61
Tel: (0511) 7507-0
Telex: 092 2209 hphann
A.C.E.M.

Hewlett-Packard GmbH
Geschäftsstelle
Rossleuer Weg 2-4
D-6600 MANNHEIM
Tel: 06221-70-65-0
Telex: 0462163 hpphann
A.C.E.

Hewlett-Packard GmbH
Geschäftsstelle
Messerschmittstraße 7
D-79110 NEUDECK
Tel: 07122-73-73-0
Telex: 0712816 HP ULM D
A.C.E.

Hewlett-Packard GmbH
Geschäftsstelle
Emil-Kolben-Straße 15
D-3800 NÜRNBERG 10
Tel: (0911) 5205-0
Telex: 0523 860 hpphann
C.E.M.

GABON
Shei Gabon
P.O. Box 89
LIBREVILLE
Tel: 721 484
Telex: 5220

GERMAN FEDERAL REPUBLIC
Hewlett-Packard GmbH
Vertriebszentrum Mitte
Hewlett-Packard-Strasse
D-6380 BAD HOMBURG
Tel: (06172) 450-0
Telex: 410 844 hpphann
A.C.E.

Hewlett-Packard GmbH
Geschäftsstelle
Kehrwiederstraße 2-4
D-1000 BERLIN 50
Tel: (030) 21 99 04-0
Telex: 518 2405 hpphann
A.C.E.

Hewlett-Packard GmbH
Verbindungsstele Bonn
Friedrich-Ebert-Allee 26
5300 BONN
Tel: (0228) 234001
Telex: 8589421

Hewlett-Packard GmbH
Vertriebszentrum Südwest
Schloß-Straße 2
D-70300 BÖBLINGEN
Postfach 1427
Tel: (07031) 845-0
Telex: 7255739 hgp

Hewlett-Packard GmbH
Zentralbereich MKtg
Herrenberger Straße 130
D-70300 BÖBLINGEN
Tel: (07031) 14-0
Telex: 7255739 hgp

Hewlett-Packard GmbH
Geschäftsstelle
Schloßstrasse 2a
D-6600 DORTMUND-41
Tel: (0231) 45051
Telex: 822858 heppod
A.C.E.

Hewlett-Packard GmbH
Reparaturzentrum Frankfurt
Berliner Straße 111
6000 FRANKFURT/MAIN 60
Tel: (069) 500001-0
Telex: 413249 hfpf

Hewlett-Packard GmbH
Vertriebsbereich Nord
Kapstädter Straße 5
D-4000 HAMBURG 60
Tel: 49-40-63-804-0
Telex: 021 63 032 hpph d
A.C.E.M.

Hewlett-Packard GmbH
Geschäftsstelle
Heidering 37-39
D-3000 HANNOVER 61
Tel: (0511) 7507-0
Telex: 092 2209 hphann
A.C.E.M.

Hewlett-Packard GmbH
Geschäftsstelle
Rossleuer Weg 2-4
D-6600 MANNHEIM
Tel: 06221-70-65-0
Telex: 0462163 hpphann
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Hewlett-Packard GmbH
Geschäftsstelle
Messerschmittstraße 7
D-79110 NEUDECK
Tel: 07122-73-73-0
Telex: 0712816 HP ULM D
A.C.E.

Hewlett-Packard GmbH
Geschäftsstelle
Emil-Kolben-Straße 15
D-3800 NÜRNBERG 10
Tel: (0911) 5205-0
Telex: 0523 860 hpphann
C.E.M.

Hewlett-Packard GmbH
Vertriebszentrum Ratingen
Berlin-Straße 111
D-4030 RATINGEN 4
Postfach 31 12
Tel: (02102) 494-0
Telex: 538 070 hpard
A.C.E.M.

Hewlett-Packard GmbH
Vertriebszentrum Munchen
Eschenstrasse 5
D-8028 TAUPIKIRCHEN
Tel: 49-89-51-2070
Telex: 0524585 hpm
A.C.E.M.

Hewlett-Packard GmbH
Geschäftsstelle
Emrištalska
7517 WILDBORHORN
Postfach 1251
Tel: (07243) 602-0
Telex: 782 538 hpph
A.C.E.

GREAT BRITAIN

Hewlett-Packard (GB) Limited
178, Kiftsias Avenue
6th Floor
Harlandi-ATHENS
Greece
Tel: 3011167230, 3011167260 090
Telex: 221 286 HPDRLG
A.C.E.M.

Kostas Karanitsis S A
5, Omiou Street
ATHENS 133
Tel: 32 33 303, 33 37 371
Telex: 215562 KGRK AR
A.C.E.

Impexim
Intelekt Diw
209 Mesogon
11525 ATHENS
Tel: 6474481/2
Telex: 216286

PA
Hani Company
38, Makharopoulu
ATHENS 512
Tel: 2759277
Telex: 218677

Hellenic P.O. Box 87526
18507 PIRAEUS
Tel: 482741
Telex: 241441

GUATEMALA
IPESA DE GUATEMALA
Avenida Reforma 24-50, Zona 9
GUATEMALA CITY
Tel: 316627, 317855, 846771/5
9-01-502-2-316827
Tel: 3005785 IPESU GA
A.C.E.M.

A.C.E.M.
JAPAN (Cont’d)
Yokogawa-Hewlett-Packard Ltd
Chuo Bldg, 5-4-20 Nihonbashi
Chuo-ku, Tokyo 103
Tel: 435-12-9220
Telex: V24725 HP JAPAN
C M E P

JORDAN
Scientific and Medical Supplies Co
P O Box 1367
AMMAN
Tel: 24587, 391577
Telex: 21456 SABCO JO
C M E P

KENYA
AGCOM Ltd, Inc, Kenya
P O Box 30070
NAIROBI
Tel: 3941155
Telex: 22839 E M

KOREA
Samsung Hewlett-Packard Co Ltd
Dongbong Yeoeuido Building
16-16th Floors
36-1 Yeoeuido-Dong
Yongdungpo-Ku
SEOUL
Tel: 794-1666, 784-2666
Fax: 25-1666 SAMSAN K
C M E P
Young In Scientific Co, Ltd
Youngna Building
547 Shinna Dong, Kangnam-Ku
SEOUL 115
Tel: 194-7711
Fax: 2114257 GINSCO
A

KUWAIT
Al-Halayda Trading & Contracting
P O Box 830
SAFAF
Tel: 2343391, 417126
Telex: 224815 VISCOM K T
C M E P
Gulf Computing Systems
P O Box 30125
SAFAF
Tel: 453969
Fax: 334684
P

MALAISIA
Hewlett-Packard Sales (Malaysia)
Sdn Bhd
9th Floor
Chung Khaw Bank Building
46, Jalan Raja Laut
50230 KUALA LUMPUR, MALAYSIA
Tel: 03-2968955
Fax: 301111 HPMS MA
A C M E P
Protel Engineering
P O Box 1917
Lot 6024, Section 64
23/4 Pending Road
Kuching, SARAWAK
Tel: 362999
Fax: 362999
PRIMA PRO, MALIA
Cable: PROTEKENG
A F M

MALTA
Philip Toledo Ltd
Kirkikara P O Box 11
Notable Rd
MELLIEA
Tel: 447 47, 455 66, 457 25
Telex: Media MW 469
E M P

MAURITIUS
Blanche Birtie Co Ltd
18, Jules Koenig Street
PORT LOUIS
Tel: 39258
Fax: 4256
P

MEXICO
Hewlett-Packard de Mexico, S A de C V
Rio No 4043 Des 12
Francisco R de Cede
JUAREZ
Tel: 16-3-15-62
P

LEBANON
Computer Information Systems S A L
Chamoun Building
P O Box 11-6274 Dora
BEIRUT
Tel: 89 40 73
Fax: 412030 chaos le
C M E P

LIBERIA
Unichemicals Inc
P O Box 4509
MONROVIA
Tel: 228228
Telex: 4509 E

LUXEMBOURG
Hewlett-Packard Belgium S A IN V
Bvdu de la Woluwe, 100
Woluwedal
B-1200 BRUSSELS
Tel: 02926-32-00
Fax: 23-2349 paloten brus
A C M E P

MADAGASCAR
Technie de Precision
12, rue de Nice
P O Box 1227
ANTANANARIVO
Tel: 22600
Fax: 22255

MOROCCO
Etablissement Habib Diboue & Fils
83, rue Ksar el Kebir
B P 11133
CASABLANCA
Tel: 3041-82, 3968-38
Telex: 22351, 22022
E Gerep
2, rue Agadir
Boite Postale 156
CASABLANCA 01
Tel: 3170333, 270335
Fax: 22 7328
P

NETHERLANDS
Hewlett-Packard Nederland B V
Startbaan 16
NL-1187 XZ AMSTELVEEN
P O Box 566
NL-1180 AR AMSTELVEEN
Tel: 020-547-6911
Fax: 13 216 HEPA NL
A C M E P

Nepal
Hewlett-Packard Nederland B V
Bongerd 2
P O Box 41
NL 2900AA CAPELLE A/D IJSSEL
Tel: 31-20-51-4443
Fax: 21261 HEPA NL
C E P

NEW ZEALAND
Hewlett-Packard (N Z) Ltd
5 Owens Road
P O Box 28-189
Epson AUCKLAND
Tel: 64-9-687-159
Fax: 342410 HPMAY
C

INFOLGICAS Y SISTEMAS
del Noreste, S A
Rio Orinoco #1171 Oriente
Despacho 2001
Colonia Del Valle
MONTERREY
Tel: 555-4415, 555-3837
Fax: 453184
A E

Hewlett-Packard de Mexico, S A de C V
Bvd Independencia No 2000 Col Estrella
TORREON, COAH
Tel: 17-1-18-21-99
P

NORTH AMERICA

OSAKA, 532
Tel: (06) 304-6021
Telex: YHPOSA 532-3647
C M E P

Pokhara
You hewlett-packard Ltd
8-29-21 Takada-Higashi, 3 Chome Suginami-ku
TOKYO 168
Tel: 303-311-6111
Telex: 232-2092 HYHOK
C M E P

Yokogawa-Hewlett Packard Ltd
Shinjuku Daiichi Seimei Bldg
2-1-7 Nishi-Shinjuku
Shinjuku-ku, TOKYO 163
Tel: 03-348-4611
C M E P

Yokogawa-Hewlett Packard Ltd
9-1, Takakura-cho
Hachioji-shi, TOKYO, 192
Tel: 81-426-42-1231
C E

Yokogawa-Hewlett Packard Ltd
3-29-21 Takada-Higashi, 3 Chome Suginami-ku
TOKYO 168
Tel: 303-311-6111
Telex: 232-2092 HYHOK
C M E P

Yokogawa-Hewlett Packard Ltd
Shinjuku-Nishi Bldg
10F
4-1 Nishi-Shinjuku 2-Chome
Shinjuku-ku
TOKYO, 163
Tel: (03) 349-1859
Telex: 227584
A

Yokogawa-Hewlett Packard Ltd
Meji-Seimei
Utsonomiyato Odori Building 1-1 Odori 2 Chome
UTSONOMIYA, Tochigi 320
Tel: (0288) 33-1153
C E

Yokogawa-Hewlett Packard Ltd
Yasuda Seimei Nishiguchi Bldg
30 4 Taruoya-cho, 3 Chome
Kanagawa-ku, TOKYO 221
Tel: (045) 312-1992
C M E P
### SALES & SUPPORT OFFICES

**Arranged alphabetically by country**

<table>
<thead>
<tr>
<th>Country</th>
<th>City</th>
<th>Address/Location Details</th>
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<tbody>
<tr>
<td><strong>SWITZERLAND</strong> (Cont'd)</td>
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<tr>
<td>TOGO</td>
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<tr>
<td><strong>SYRIA</strong></td>
<td>General Electric Inc</td>
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<tr>
<td></td>
<td>Nuri Basha Alnn Ebn Keys Street</td>
<td>1035 J какой</td>
</tr>
<tr>
<td></td>
<td>P.O. Box 5781</td>
<td></td>
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<tr>
<td><strong>TAIWAN</strong></td>
<td>Hewlett-Packard Taiwan Ltd</td>
<td></td>
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<tr>
<td></td>
<td>THOM Office</td>
<td></td>
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<tr>
<td></td>
<td>2, Huan Nan Road</td>
<td></td>
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<tr>
<td></td>
<td>CHUNG LI, Taoyuan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P.O. Box 3966</td>
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<td></td>
<td>Hewlett-Packard Taiwan Ltd</td>
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<tr>
<td><strong>TUNISIA</strong></td>
<td>Tunisie Electronique S A R L</td>
<td>31 Avenue de la Liberté</td>
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<tr>
<td></td>
<td>31 Avenue de la Liberté</td>
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<td></td>
<td>TUNIS</td>
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<td></td>
<td>Tunisie Electronique S A R L</td>
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<tr>
<td></td>
<td>94 Av. Judruga, Mutuelville</td>
<td></td>
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<tr>
<td></td>
<td>1002 TUNIS BELVedere</td>
<td></td>
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<td>28014</td>
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<tr>
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<td>C.E.P</td>
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<td></td>
<td>Corema S A</td>
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<td></td>
<td>1er Av. de Carthage</td>
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<td>TUNIS</td>
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<tr>
<td></td>
<td>255-212</td>
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<tr>
<td></td>
<td>1210 CAIRAN Tn</td>
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<tr>
<td><strong>TURKEY</strong></td>
<td>E.M.A.</td>
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<tr>
<td></td>
<td>Medha Eldem Svak No 4/16</td>
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<td>Tencel Industrial</td>
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<td>ANKARA</td>
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<tr>
<td></td>
<td>319-175</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tel: 43211 KTHM TR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Email: ETMATEX ANKARA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teknim Company Ltd</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iran Caddesi No 7</td>
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<td></td>
<td>Karakidere</td>
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<td></td>
<td>278000</td>
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<tr>
<td></td>
<td>Tel: 4215 TKNM TR</td>
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<td>C.E.P</td>
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<td>Kurt &amp; Kurt A S</td>
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<td>Mihlatapsa Caddeesi No 75</td>
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<td>Kat 4 Kizilay</td>
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<td>ANKARA</td>
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<td>518975/07/10</td>
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<td>Tel: 42650 MES TR</td>
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<tr>
<td><strong>SOUTH AFRICA</strong></td>
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<tr>
<td><strong>SOUTH AMERICA</strong></td>
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<tr>
<td><strong>SPAIN</strong></td>
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<tr>
<td><strong>SWITZERLAND</strong> (Cont'd)</td>
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<tr>
<td><strong>UNITED STATES</strong></td>
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<td><strong>UNITED STATES</strong></td>
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</tr>
</tbody>
</table>

SALES & SUPPORT OFFICES
Arranged alphabetically by country

UNITED STATES (Cont'd)

Hewlett-Packard Co
6555 South Lewis, Suite 105
TULSA, OK 74135
Tel: (918) 418-6700
A**, C,E,M,P

Oregon
Hewlett-Packard Co
2955 S W, Pioneer Court WILSONVILLE, OR 97070
Tel: (503) 682-8000
A,C,E,M

Pennsylvania
Hewlett-Packard Co
Heatherwood Industrial Park
50 Dorchester Rd
Route 22 HARRISBURG, PA 17112-2799
Tel: (717) 657-5900
C

Hewlett-Packard Co
117 Zeta Drive PITTSBURGH, PA 15238
Tel: (412) 782-0400
A,C,E,M

Hewlett-Packard Co
2150 Monroe Boulevard VALLEY FORGE, PA 19482
Tel: (215) 666-9000
A,C,D,M,E,M

South Carolina
Hewlett-Packard Co
Brookside Park, Suite 122
1 Harbison Way COLUMBIA, SC 29212
Tel: (803) 712-0400
C,M

Hewlett-Packard Co
545 N Pleasantburg Dr
Suite 101 GREENVILLE, SC 29607
Tel: (863) 232-8000
C

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