OPERATING AND PROGRAMMING MANUAL

HP8152A OPTICAL AVERAGE POWER METER

SERIAL NUMBERS

This manual applies directly to instruments with serial number 2550G00101 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.

HERRENBERGER STR. 130, D-7030 BOBLINGEN
FEDERAL REPUBLIC OF GERMANY

MANUAL PART No. 08152-90001
MICROFICHE PART No. 08152-95001

PRINTED: MAY 1986

SAFETY

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded.

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

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

For warranty service or repair, this product must be returned to a service facility designated by HP. However, warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within the HP service travel area. 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.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

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. HP 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. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GENERAL – This is a Safety Class I instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

OPERATION – BEFORE APPLYING POWER comply with the installation section. Additionally, the following shall be observed:

Do not remove instrument covers when operating.

Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers and devices connected to it should be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation is present. Do not replace components with power cable connected.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

SAFETY SYMBOLS

The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Indicates dangerous voltages.

Earth terminal

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

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

WARNING

Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

5955-0713

HEWLETT PACKARD

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CONTENTS

CONTENTS (CONTD)

HP81000BS OPTICAL POWER SPLITTER

GENERAL INFORMATION

Specifications

The following specifications are measured at 1300nm with an LED source, CW.

Wavelength Range: 1200 - 1650 nm
Connector Types: Diamond® HMS-10/HP and DIN
Applicable Fiber Type: All fibers with ⩽ 0.3

Insertion Loss [IL]
(*Including coupling loss of connectors and excess loss of the splitter*)

	HMS-10/HP		DIN	
	SM/9µm	MM/50µm	SM/9µm	MM/50µm
Typical	2.0 dB	1.0 dB	2.5dB	1.0dB
Worst Case	4.0 dB	2.0 dB	5.0dB	2.0dB

Splitting Ratio [SR]
(Depends on actual insertion loss)

SM/9µm	10 dB +3 dB/-2 dB
MM/50µm	12.5 dB ± 1dB

Stability of Splitting Ratio within ± 2C Temperature Window

SM/9µm	⩽ ± 0.06 dB
MM/50µm	⩽ ± 0.01 dB

Supplementary Specifications

Thermal Stability of Splitting Ratio:

SM/9µm	⩽ 0.03 dB/°C
MM/50µm	⩽ 0.005 dB/°C

Polarization Sensitivity of Splitting Ratio (360°): ⩽ ± 4%
Not mode selective

Environmental

Storage Temperature: -40 to +75°C
Operating Temperature: 0 to +55°C

HEWLETT PACKARD

HERRENBERGER STR. 130, D-7030 BOEBLINGEN
FEDERAL REPUBLIC OF GERMANY

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General

The Model HP81000 BS Optical Power Splitter is used in combination with the HP8152A Optical Average Power Meter and Optical Heads in the wavelength range 1200 - 1650 nm. Designed for multimode and single-mode applications, it can accept all fibers with NA ⩽ 0.3.
Figure 1 shows how the splitter should be connected between an optical source and the HP8152A Optical Average Power Meter.

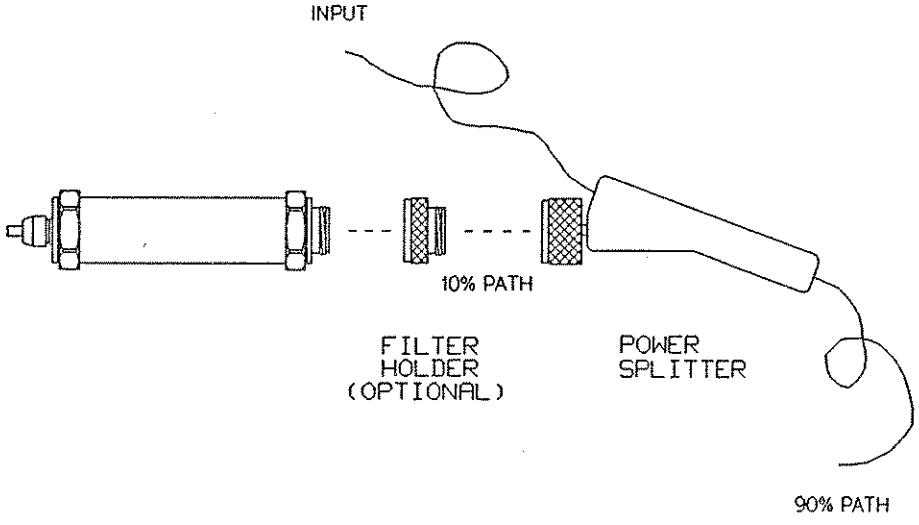

Figure 1

As can be seen from Figure 1, the optical source **must** be connected to the connector marked as "INPUT". The "90%" path is then via the connector marked as "OUTPUT"; the "10%" path is via the output marked as "OPTICAL HEAD", which enables the optical head to be attached directly.

NOTE: *When connecting an optical head to the "OPTICAL HEAD" output, ensure that there is no lens fitted to the optical head.*

The splitting ratio is calculated from the following formula:

SR = 10 log P(OUTPUT)/P(OPTICAL HEAD)

where P(OUTPUT) is the power at the "OUTPUT" connector and P(OPTICAL HEAD) is the power at the "OPTICAL HEAD" output.

NOTE

When the DIN connector, Opt.013, is used, make sure that the connection between the splitter and the cable is secure as the connector does not have a guiding key. If the connection is not correct then the splitter will not work to the specifications given.

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SECTION I

GENERAL INFORMATION

INTRODUCTION

This manual contains the information required to install, test, and operate the Hewlett-Packard Model 8152A Optical Average Power Meter and Model 81520 Series Optical Heads.

HOW TO USE THIS MANUAL

Operation of the HP8152A is dependent on the optical heads that are connected to the inputs. You can consider the HP8152A as a "mainframe" in a control function, and each optical head as a "plug-in" module which determines the measurement function. For this reason, this Operating and Programming Manual is provided in modular form so that it can be exactly tailored to the configuration you have ordered. The individual modules are as follows:

- The "mainframe" module for the HP8152A containing the first 4 Sections:

  SECTION I - GENERAL INFORMATION
  SECTION II - INSTALLATION
  SECTION III - OPERATING & POGRAMMING
  SECTION IV - PERFORMANCE TESTS

  In this module, general references are made to operation with an optical head, e.g., connection procedure, measurement making etc., but no information on a specific optical head is given. This module is always installed in the binder at delivery.

- An "appendix" module for each optical head in the HP81520 Series that you have ordered. The optical head determines the operating wavelength, sensitivity, etc., and this module therefore contains:

  General Information about the optical head
  Specifications of the optical head
  Performance Tests for the optical head

  This module is delivered as a separately bound package to be installed in your binder behind the "mainframe" module.

SPECIFICATIONS

Specifications of the HP8152A are given in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested.

SAFETY CONSIDERATIONS

The HP8152A is a Safety Class I 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 safe condition.

INSTRUMENTS COVERED BY THIS MANUAL

Each HP8152A 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 8152A. The contents of this manual apply directly to average optical power meters having the serial prefix 2550G.

DESCRIPTION

The HP8152A is a fully programmable, dual channel, optical average power meter designed for applications in the wavelength region 100-19999nm. The 2 channels can be operated independently at different wavelengths and power levels (useful in the evaluation of wavelength division multiplexers), or in combination for making power ratio measurements. Featuring ....

- autoranging for automatic selection of the best measurement range
- power-on selftest and error reporting
- microprocessor-driven menu concept that guides the user through the settings to be made for the current task
- power level display in relative or absolute values

... the user is assured of fast familiarization and minimum operating errors.

ACCESSORIES SUPPLIED

The HP8152A is supplied complete with the following accessories:

Item	HP Part No.
800 mA Fuse slow-blow (100/120V)*	2110-0020
400 mA Fuse slow-blow (220/240V)*	2110-0340
Power Cord	see Figure 2-2

* one fitted and one supplied

OPTIONS AVAILABLE

The following lists the options available for the HP8152A:

Option 907 Front Handle Kit
Option 908 Rack Flange Kit
Option 909 Combination Kit
Option 910 Additional Operating and Programming Manual (P/N 08152-90001)
P/N 5061-9701 Bail Handle Kit

Table 1-1. Specifications

Specifications describe the instrument's warranted performance.

Measurement Features and Operating Modes

Display: 4 1/2 digits, decimal point, polarity, units (dB, dBm, mW, uW, nW, pW, nm), HP-IB address, error conditions, status information (CAL<>0, REF<>0, HEAD), 3Hz refresh rate

Display Measurement Ranges: +30dBm (1000mW) to -80dBm (10pW))

Resolution: 0.01pW, 0.01dBm/dB, 1nm

Set Mode
All adjustable parameters are accessible (λ, CAL, REF). The last adjusted parameter will be displayed.

λ: Independent display and selection of wavelength for channel A and B (adjustable range depending on connected optical head). Correction factors are individually measured and stored in each head.
Cal: Independent entry of calibration factor for channel A and B. Range ± 199.99dB.
Ref: Independent entry of reference level setting for channel A and B. Range ± 199.99 dBm. In B/A mode, value in dB.

Measure Mode
AUTO, ZERO and FLTR function are available. Measured power of selected channel is displayed.

Auto: Automatically selects proper measurement range independently for channel A and B.
Zero: Automatic compensation of amplifier drifts, offsets and dark currents.
Fltr: Activates additional 2Hz lowpass filter for selected channel.

Channel Selection
A: Activates channel A. In measure mode measured power level is displayed
B: Activates channel B. In measure mode measured power level is displayed
B/A: Power level ratio of channel B to A is displayed in dB.

Clear: Clears calibration factors and reference settings for both channel A and B
Disp
→ Ref: Defines momentary power/power ratio reading as reference (power) level and sets the dB reading to 0dB
dB: Reading as ratio relative to selectable reference level setting
dBm: Logarithmic reading relative to 1mW=0dBm
Watt: Linear reading

Inputs and Outputs

A: Input connector for optical head
B: Input connector for optical head

Transducer Output
Output impedance: 600 Ohm typ.
Output voltage: 0 to 2V into open.
Max. input voltage: ± 10V
Bandwidth dependent on optical head.

General

Recalibration period: 1 year
Warm-up time: 15 min

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

Listen (time for HP 8152A to receive, verify and execute a message).
REF, CAL, λ: < 120 ms
ZERO (filter off): < 5s/channel
Receive time: < 1 ms/character

Talk (time for HP 8152A to transmit a message).
Learn mode, error condition, measured value, status: < 1ms/char

HP-IB Interface Function Code: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, 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: 100/120/220/240Vrms, +5%, -10%, 90VA max., 48-400Hz
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: 89mm H, 212.3mm W, 345mm D (3.5"x8.36"x13.6")
Weight: net 4.3 kg (9.5 lbs), shipping 8.6 kg (19 lbs)

For information on optical heads see individual manuals.

Data subject to change.

SECTION II

INSTALLATION

INTRODUCTION

This section provides installation instructions for the Model 8152A and its accessories. It also includes information about initial inspection and damage claims, preparation for use, packaging, storage and shipment.

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.

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.).

Power Requirements

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

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.

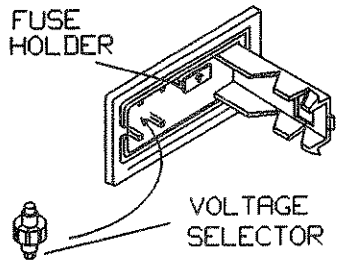


Figure 2-1. Line Voltage Switch Assembly.

The fuse values for the voltage settings are as follows:

VOLTAGE	100/120V	220/240V
FUSE	T 800mA	T 400mA

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.*

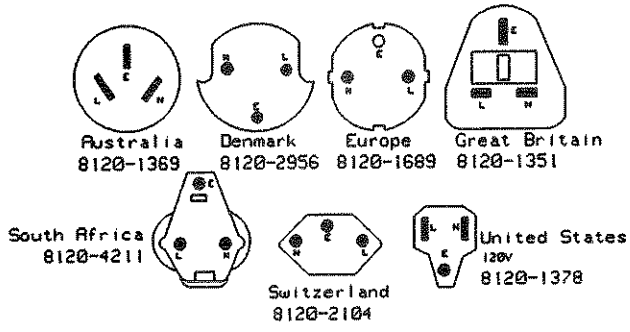


Figure 2-2. Power Cables - Plug Identification

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 colour coding used in the cable will depend on the cable supplied. 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.

Optical Connections

Each optical head that can be connected to the HP8152A is also equipped with various accessories to aid measurement. Depending on which accessories have been ordered, the following Figure 2-3 shows the sequence in which they are attached to the optical head.

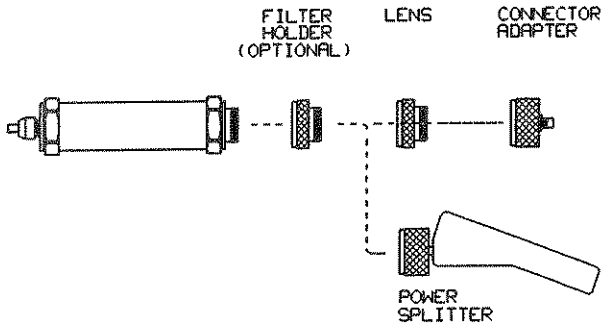


Figure 2-3. Optical Connections

Note that the optical head and its various accessories are marked with coloured dots to indicate wavelength and fiber type. The convention used is as follows:

Wavelength

- Brown $\lambda = 850nm$
- Red $\lambda = 1300nm$
- Orange $\lambda = 1550nm$

Fiber Type

- White single-mode (9 µm)
- Green Multimode (50 µm/125 µm GI)
- Blue Multimode (62.5 µm/125 µm GI)
- Violet Multimode (85 µm/125 µm GI)
- Grey Multimode (100 µm/140 µm SI)
- Black Multimode (> 200 µm SI)

HP-IB Connector

The rear panel HP-IB connector (Fig 2-4), 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.

HP-IB Logic Levels

The 8152A 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.

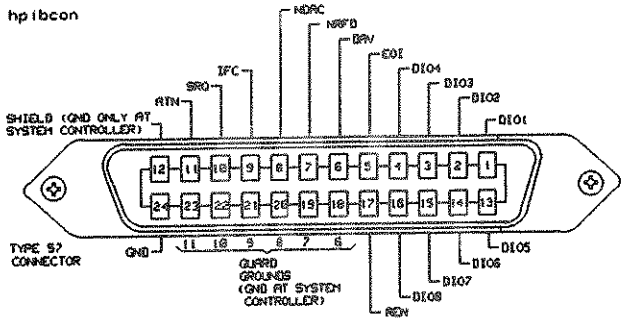


Figure 2-4. HB-IB Connector

OPERATING ENVIRONMENT

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

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.

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.

SECTION III

OPERATING AND PROGRAMMING

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.

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.

OPERATORS CHECKS

The HP8152A performs a self-test routine at power switch-on. At the start of this routine, all front panel LEDs and indicators should be momentarily lit. In the event of a fault being detected, an error code will appear 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 and optical head should be returned to the nearest Hewlett-Packard Service Office.

These error codes that indicate a serious fault are in the ranges E140 → E199 and E240 → E390. Any other error code appearing in the display during operation indicates a zero routine error. In this case, check that there is no light input to the optical head.

GETTING TO KNOW YOUR INSTRUMENT

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

1. LINE switch. Power on/off switch.

2. LCL key. This key returns the 8152A to local manual operation when the instrument is under program control. Note that this return-to-local function is disabled when the LOCAL LOCKOUT command has been sent by the system controller to the instrument. In this case, pressing the key is the same as in local mode i.e. the currently selected HP-IB address is displayed.

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. Mode key and associated LEDs. Toggle key used to select SET mode or MEASure mode. Illuminated LED indicates the current selection. Operation in each mode is as follows:

SET mode	for entering parameter values prior to measuring the input power (λ, REFerence value, CAL factor)
MEASure mode	for making power measurements and selecting auxiliary measurement functions (AUTOranging, ZERO, FLTR)

5. Channel key and associated LEDs. Used to select single channels (A or B) for parameter settings and power measurements, or dual channel (B/A) for power ratio measurements. Illuminated LED indicates current selection.

Keys 6 to 9 in SET Mode

6. CLR key. Used to reset the currently displayed parameter (λ, CAL or REF). The reset values are as follows:

λ	Optical head dependent (850, 1300 or 1550nm)
CAL	0.00 dB
REF	0.00 dBm (1000 μW) with channel A or B selected 0.00 dB with B/A selected

   For each parameter, the reset value only applies to the currently selected channel.

   This key is also used to recall the standard parameter set by pressing the key for approximately 5 seconds. A list of the standard settings is given under 'STANDARD SETTINGS (LISTENER FUNCTION)' on the blue pages at the end of this section.

The following descriptions for keys 7 to 9 apply when the corresponding key LED is illuminated. In each case, the displayed parameter value can be changed via the VERNIER rocker keys.

7. λ key. Used to make λ settings for channel A or channel B (disabled if B/A selected by 5). Because the λ setting is dependent on the optical head, the following should be noted:

   - When an optical head is connected whose wavelength range covers the current λ setting, the λ setting remains active.

   - When an optical head is connected whose wavelength range does not cover the current λ setting, the λ setting is automatically changed to the default setting for that optical head.

8. CAL key. Used to enter the CAL factor for channel A or channel B.

9. REF key. Used to set a measurement REFerence value for channel A or channel B. In B/A operation, an entered REFerence value is treated as a ratio reference (not an absolute reference) e.g. for comparison of power splitter ratios.

Keys 6 to 9 in MEASure Mode

6. Not used.

7. When activated (key LED illuminated), autoranging is performed during the measurement cycle. This ensures that the measurement range with the best signal-to-noise ratio is automatically selected.

8. Used to activate zero-routine for the optical head. The head is then recalibrated to a ZERO reference. The key LED remains illuminated until the zero-routine ends.

9. When activated (key LED illuminated), a lowpass filter is switched into the signal path of the currently selected channel.

10. DISP → REF key. Used in MEASURE mode to set the current power measurement (shown in the display) as the new REFerence value. NOTE: In overrange or underrange conditions, DISP → REF operation is ignored.

11. dB key. Used in MEASURE mode to display the power measurements in dB's relative to the currently selected REF value.

12. dBm/WATT key. Used in MEASURE mode for channel A or channel B to display the power measurements as dBm or Watts (toggle function). If B/A operation is selected at (5), this key is disabled. In SET mode, this key can only be used in single channel operation for setting the REFerence value.

13. Status LEDs. When illuminated, they indicate the following:

CAL ≠ 0:	Indicates that a non-zero value is currently selected for the CAL factor
REF ≠ 0:	Indicates a non-zero REFerence value is currently selected. Only illuminated when dB's are the currently selected display units.
HEAD:	Indicates that no optical head is connected to the currently selected channel.

14. Value display. 4 1/2 digit display for settings and measurement values when dB, dBm or nm are the selected units; 3 1/2 digit display when WATT is selected. Overrange is indicated by "+1" appearing in this display; underrange is indicated by "-1".

15. Unit LEDs. Operate in conjunction with the value display (14) to indicate the base units of the currently selected parameter or measurement.

16. VERNIER rocker keys. In SET mode, used to vary parameter values. In MEASure mode, any of these keys can be used to display the current range selection. Pressing the upper half displays the channel A range selection; pressing the lower half displays the channel B range selection.

17. RANGE rocker key. In SET mode, used for range selection when setting the REF value in Watts for channel A or B. In MEASURE mode, used to select the display range for the current power measurement on channel A or B. In both modes, this key is disabled when B/A operation is selected.

18. Trend meter. Used to determine the optical coupling efficiency on channel B and aid the user to select the best measurement range.

19. XDCR OUT BNC connector. Channel B transducer output whose electrical signal level is proportional to the displayed optical power.

20. B INPUT connector. Channel B connector for signal from optical head.

21. Trend meter. Used to determine the optical coupling efficiency on channel A and aid the user to select the best measurement range.

22. XDCR OUT BNC connector. Channel A transducer output whose electrical signal level is proportional to the displayed optical power.

23. A INPUT connector. Channel A connector for signal from optical head.

Rearpanel Connectors

24. HP-IB address switch.

25. HP-IB connector.

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

POWER MEASUREMENTS

Basic Considerations

The HP8152A has 2 operating modes you can select via the front panel mode key (4):

SET mode	for entering parameter values prior to measuring the input power (λ, REFerence value, CAL factor).
MEASure mode	for making power measurements and selecting auxiliary measurement functions (AUTOranging, ZERO, FLTR).

Because the responsivity of the optical detector is different for each wavelength, correction factors for the entire wavelength range have been measured and stored in your optical head. Your first consideration is therefore the λ setting for each channel. This must correspond to the operating wavelength of the optical input signal to ensure measurement accuracy.

The next consideration is whether you want to make absolute or relative power measurements. These are detailed in the following using typical measurement setups to aid explanation.

Zero-Adjustment Before Measurement

In prolonged operation, measurement accuracy can be affected by dark currents and amplifier offsets in the optical head. It is therefore recommended that you initiate the zero routine at regular intervals by pressing ZERO key (8).

NOTE **Ensure that there is no light input to the optical head during zero routine**, e.g. by using the supplied protective cap. If any light is present at the optical input, either the head will not be properly zeroed or an error code will appear in the display. The zero routine must then be repeated with no light input.

MAKING ABSOLUTE POWER MEASUREMENTS

Consider the setup given in Figure 3-2. You have a calibrated optical source with - 20 dBm (10 μW) CW output power at 1300 nm. The output fiber and reference fiber are spliced, and you want to measure the power at the optical head. From this measurement, you could then determine the total loss of splice, reference fiber and optical head lens.

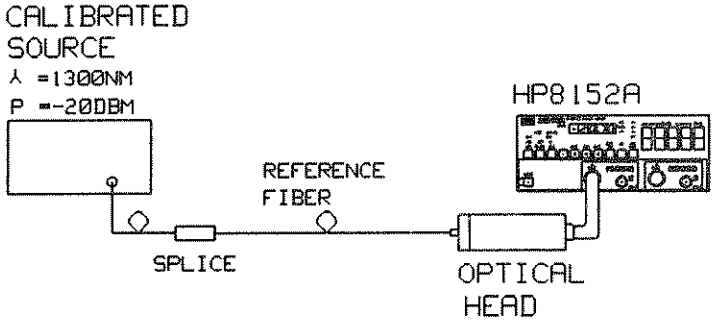


Figure 3-2

As can be seen from Figure 3-2, the fiber is connected to the channel A optical head of the HP8152A, so your setting procedure is as follows.

Settings

1. Select SET mode at key (4) and Channel A at key (5)

The parameter menu is now highlighted above keys (7) to (9), and the last parameter entry you made in single channel operation is displayed. Now make the following entries:

2. Press the λ key to display the current wavelength entry. This must correspond to the operating wavelength of the optical input i.e. 1300nm. If necessary, use the VERNIER rocker keys to change the entry.

3. Press the CAL key to display the current CAL factor entry. To measure the absolute power at the input to the optical head, the CAL factor must be set to 0.00 dB. If a non-zero value is displayed, simply press the CLR key.

As no further entries need to be made (the REF factor has no effect on absolute measurements), select MEASure mode at key (4) to begin measurement.

Measurements

In Measure mode, the HP8152A automatically begins measuring the input power on the selected channel. To get a fast, accurate measurement, do the following:

1. dBm or watts must be selected for absolute measurements. If the current display units are dB, press dBm/WATT key (12) once to select dBm, or twice to select watts. To aid explanation, it is assumed that dBm is now selected.

2. Activate the AUTOranging key (7). As measurement accuracy is dependent on range selection, this is the most convenient way of finding the optimum range.

You can now read the measured power in the display and thus determine the splice/fiber/lens loss.

Compensating for Known Losses With The CAL Key

Continuing with the previous measurement example, let us assume that the displayed reading is - 20.70 dBm. This would indicate a total loss of -0.70 dB. Knowing this loss, you can now enter a CAL factor, as follows, so that the displayed reading always corresponds to the output power of the source:

1. Select SET mode at key (4).

2. As the CAL factor was your last entry, 0.00 dB will now be displayed. Use the VERNIER keys to enter -0.70 dB.

3. Select MEASure mode again at key (4).

The reading in the display should now be -20.00 dBm. Note that the 'CAL ≠ 0' status LED is now illuminated. This informs you that the displayed reading has been corrected via the following formula to include the CAL factor:

Input (dBm) - CAL (dB) = Display Reading

Substituting the values in the example gives the following:

-20.70dBm - (-0.70 dB) = -20.00 dBm

MAKING RELATIVE POWER MEASUREMENTS

To make relative power measurements, you must select dB display units via key (11) in MEASure mode. Power is then displayed relative to the entered REFerence value which can be set as follows:

- in MEASure mode at any time by pressing the DISP → REF key. This sets the current power measurement (including CAL factor) as reference. NOTE: During relative power measurements (dB selected), pressing the DISP → REF sets the display to 0.00 dB.
- in SET mode as a REF value entry.

Both cases with typical examples are now explained in more detail.

... With Current Measurement Value as Reference

Again continuing with the measurement example in 'MAKING ABSOLUTE MEASUREMENTS', the current front panel display is as shown in Figure 3-3.

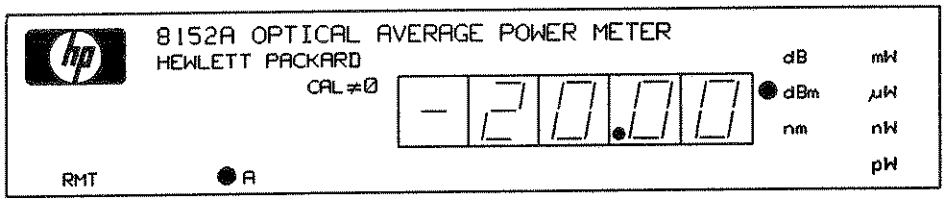


Figure 3-3

The -20 dBm reading includes the known splice/fiber loss, and can now be made the reference value by pressing DISP → REF key (10). Now press dB key (11) to make relative measurements. As there is no change in the optical connections, the initial display reading is 0.00 dB. Note that the REF ≠ 0 status LED is now illuminated. This informs you that the displayed reading has been corrected via the following formula to include the REFerence value:

Input (dBm) - CAL (dB) - REF (dBm) = Display Reading

Substituting the values in the example gives the following:

-20.7 dBm - (-0.70 dB) - (-20.00 dBm) = 0.00 dB

A typical development of the current setup would now be connector loss measurements as shown in Figure 3-4.

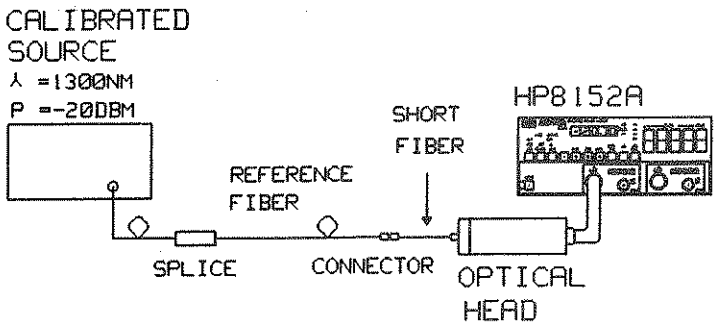


Figure 3-4

The connector-under-test, together with a short fiber of negligible loss, is inserted between the reference fiber and optical head. As measurements are now being performed relative to the original setup, your new display reading is the connector loss.

... With a Given Value as Reference

Another typical example of relative power measurements is the power budget verification on an optical link. Consider the situation where you know that -38 dBm is the minimum power requirement at the receiver end of the link. By entering -38 dBm as REFerence value, relative measurement at each stage in the link gives you a direct indication of where you are within the power budget.

This is illustrated in Figure 3-5, which is just a simple continuation of the previous measurement examples in this section.

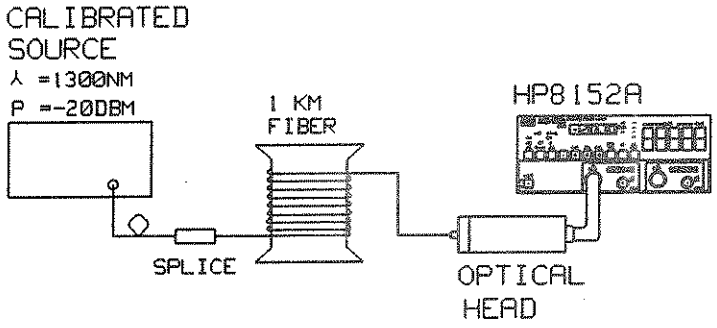


Figure 3-5

Assuming the spliced 1 km fiber represents the first stage in the link, you now make the following settings:

1. Select SET mode at key (4).

2. As the CAL factor was your last entry in previous examples, this is now displayed. Press CLR key (6) to set the CAL factor to 0.00 dB. (For this measurement, no loss compensation is required)

3. Press REF key (9) to display the current REFerence value. Use the VERNIER keys to change the value to -38.00 dBm.

Now select MEASure mode again to begin measurement. The displayed reading is a direct indication of how much power remains in your budget for the following stages in the link:

- A positive value indicates how much power is still available e.g. 11.00 dB reading indicates that the output power is still 11 dB above the minimum receiver requirement.

- A negative value indicates that the power is already below the minimum receiver requirement e.g. -2.00 dB reading indicates that the output power is already 2 dB below the minimum receiver requirement.

MAKING CHANNEL B/CHANNEL A RATIO MEASUREMENTS

A typical example of channel B/channel A ratio measurements is shown in Figure 3-6.

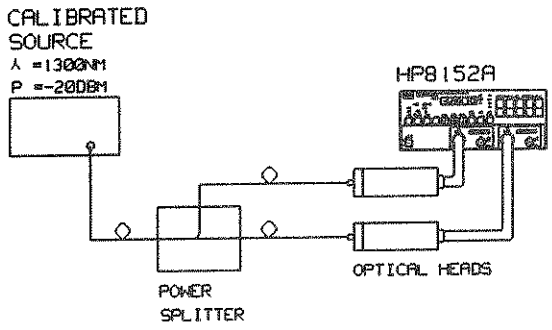


Figure 3-6

In this setup, you have a power splitting device and want to measure the total split ratio, including connectors and fibers. The result can then be taken into consideration for future measurements.

The HP8152A settings are then as follows:

1. Select SET mode and channel A at keys (4) and (5), respectively.

2. Press λ key (7) and CAL key (8), in turn, to display the current setting for each key. For this example, the settings are:

   λ = 1300 nm. Use the VERNIER rocker keys to make any necessary change.

   CAL factor = 0.00 dB. Press CLR key (6) if any other value is displayed.

3. Select channel B at key (5) and repeat step 2 using the same settings.

4. Select B/A operation at key (5) and check that the displayed REFerence value is 0.00 dB. Press CLR key (6) if any other value is displayed.

   NOTE: Once B/A operation is selected, only the REFerence value can be changed. The λ and CAL factor settings for each channel remain active.

When MEASure mode is now selected at key (4), measurement begins automatically so activate AUTO key (7) to ensure optimum range selection **on both channels**. The displayed value is the splitting ratio.

AUXILIARY FEATURES

Standard Parameter Set

The standard parameter set can be recalled in SET mode by pressing the CLR key for approximately 5 seconds. This provides a fast means of returning the HP8152A to a pre-defined state. A list of the standard settings is given under 'STANDARD SETTINGS (LISTENER FUNCTION)' on the blue pages at the end of this section.

Filter

When performing measurements with an unstabilized source, activating FLTR key (9) reduces the input bandwidth from 8Hz to 2 Hz on the selected channel for better averaging. The tradeoff is then slower response to any change on the input power level.

Transducer Outputs

Each channel is equipped with a transducer output which provides the electrical equivalent of low frequency optical inputs.

The wavelength correction factors stored in the optical head are also implemented for the transducer output.

Trend Meters for Manual Ranging

Each channel is equiped with a trend meter which provides analog level indication of the measured power within the currently selected range. This provides a visual aid for optimum range selection.

Overrange/Underrange Indicators

When making measurements, overrrange or underrange is indicated in the front panel display as follows:

'+1' is the **OVERRANGE** indicator. This appears when the optical signal is above the current range capability. All vertical bars on the trend meter will also be illuminated

'-1' is the **UNDERRANGE** indicator. When dB or dBm are the current display units, this indicates that the measured power is 0 or less (due to negative offset). If watts are the currently selected units, thisindicates that the negative offset exceeds -48 counts.

PROGRAMMING

WHAT YOU NEED TO KNOW . . . .

Programming information in this section is restricted to HP8152A 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 HP8152A programming commands, refer to the blue pages at the end of this section.

. . . About The HP8152A's HP-IB Capabilities

The HP8152A interfaces to the HP-IB as defined by the IEEE Standard 488-1978. The interface functional subset which the HP8152A implements is specified in Table 3-1.

Table 3-1. HP-IB Capabilities

MNEMONIC	INTERFACE FUNCTION NAME
SH1	SOURCE HANDSHAKE CAPABILITY
AH1	ACCEPTOR HANDSHAKE CAPABILITY
T6	BASIC TALKER, SERIAL POLL, UNADDRESSED IF MY LISTEN ADDRESS
L4	BASIC LISTENER, UNADDRESSED IF MY TALK ADDRESS
SR1	SERVICE REQUEST CAPABILITY
RL1	REMOTE/LOCAL CAPABILITY
PP0	NO PARALLEL POLL CAPABILITY
DC1	DEVICE CLEAR CAPABILITY
DT1	DEVICE TRIGGER CAPABILITY
C0	NO CONTROLLER CAPABILITY

. . . 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 HP8152A is set to HP-IB address 22 (factory setting)

. . . About the HP8152A's Command Syntax

The HP8152A has a flexible interpreter that simplifies program generation and allows you to use the data format you prefer. To aid explanation of the command syntax, consider the following programming example:

```
10 OUTPUT 722;"WVL1,1300 NM;caL 1,3.2;REf1,0dbm"
20 END
```

This sets the HP8152A's channel A parameter values: wavelength 1300nm, CAL factor 3.2dB and REFerence value 0 dBm. The points to note on the command "string" are as follows:

- Each command in the string must be terminated by a ";"
- Either upper or lower case may be selected (cal is the same as CAL)
- Any of 3 different data formats may be used. The following settings are equivalent and will be interpreted correctly:
  wvl1,1300 nm
  WVL1,1.3 um
  WVL1,1300 e-09 m
- For any parameter setting, the channel indicator must be separated from the parameter value by a ",". For example:

  WVL 1,1300nm - WVL is wavelength parameter; 1 is the channel A indicator; 1300nm the parameter value and units.

- If no unit is specified, then the default unit will be assumed. The default unit is **meter** for wavelength, **dB** for CAL factor, and watt or **dBm** for REFerence value **depending on the currently selected units.**

A complete list of commands is given on the blue pages at the end of this section.

GETTING STARTED

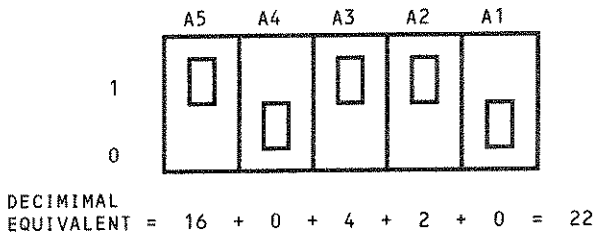
If this is the first time you are programming the HP8152A, the following gives you a few simple tasks to carry out prior to detailed program development. The benefits are twofold in that it gets you started on programming the HP8152A, at the same time checking remote operation of your instrument.

Setting the Address

Each instrument that you connect to the interface bus has a unique "address", and the HP8152A 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 HP8152A is preset at the factory to address 22 as shown in the following illustration of the rear panel address switch (you can check this by pressing the front panel LCL key to display the address). If you are satisfied with this address, then continue with the next task "Checking Remote Operation".



If you want to change the address, first ensure that the HP8152A 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 (24). Now press the front panel LCL key, and the new address will be activated and displayed.

Checking Remote Operation

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

```
10 DIM A$[11]
20 CLEAR 722                    -clears HP8152A's input/output buffers
30 OUTPUT 722; "WVL1,1300nm"    -sets wavelength of channel A to 1300nm
40 OUTPUT 722; "WVL?1"          -interrogates channel A wavelength setting
50 ENTER 722;A$
60 PRINT A$
70 END
```

The controller output should read "0.1300E-05" which indicates that both the Listener and Talker functions of the HP8152A are operating correctly.

SENDING DATA TO THE HP8152A (LISTENER FUNCTION)

The data that your program sends to the HP8152A falls into 2 categories:

- setting commands
- measurement commands

In contrast to local front panel operation, remote operation allows you to **access and change** any setting - **irrespective of the current operating mode (SET or MEASure) which remains unchanged.**

To make measurements, however, the HP8152A must be set to MEASure mode via the "M2" command:

e.g. OUTPUT 722;"M2;CH1" Selects MEASure mode and channel A

The HP8152A then performs measurements continuously, and the output register holding data for transfer to the controller is constantly updated. As update and transfer via the "ENTER" command is asynchronous in continuous operation, you can use the "T1" command (single cycle operation - HPIB only) to synchronize measurements with data transfer. This is illustrated as follows:

```
10  DIM A$[7]
20  OUTPUT 722;"WVL 1,1300NM;CAL 1,0;AR1;CH1;M2;U0;T1"
```

Comment: Sets channel A wavelength 1300nm, channel A CAL factor 0 dB, autoranging on, channel A, MEASure mode, units dBm, single cycle operation.

```
30  TRIGGER 722          - Triggers the HP8152A to make one measurement
40  ENTER 722;A$         - Transfer result to controller
50  PRINT A$             - Print result
60  END
```

When set to single cycle operation, the HP8152A will not respond to the "ENTER" command until the optimum range has been found and a measurement performed.

A complete list of commands is given on the blue pages at the end of this section.

RECEIVING DATA FROM THE HP8152A (TALKER FUNCTION)

Just as your program can send setting and measurement commands to the HP8152A, it can also receive data regarding:

- settings
- measurement results

Whereas settings can be interrogated at any time - irrespective of the current operating mode, measurement results can only be transferred in MEASure mode. A more detailed explanation is given in the following.

Settings

The settings can be interrogated either individually or as a complete set (learn string). From the programming example given in the previous sub-section, the channel A wavelength was set to 1300nm. If you now want to interrogate this setting, you could use the following simple program:

```
10 DIM A$[11]          -dimensions string A$ for 11 characters
20 OUTPUT 722;"WVL?1"  -interrogates the channel A wavelength setting
30 ENTER 722;A$        -transfer setting data to controller
40 PRINT A$            -prints the setting data
50 END                 Controller printout: 0.1300E-05 (with leading space)
```

Depending on which setting is being interrogated, the length of the character string returned to the controller varies from 1 to 35 characters. A complete list of the interrogating commands and the returned character strings is given on the blue pages at the end of this section.

You can also interrogate the complete settings using a single command as follows:

```
10 DIM A$[200]
20 OUTPUT 728;"LRN?"
30 ENTER 728;A$
40 PRINT A$
50 END
```

The Model 8152A then returns its settings as a 200 character string to the controller. The setting sequence is always the same and is listed on the blue pages at the end of this section.

Measurement Results

As already mentioned, the HP8152A must be in MEASure mode to transfer a measurement result to the controller. Transfer is then dependent on whether single cycle operation or continuous operation is selected:

Single cycle operation is selected by sending "T1" to the HP8152A.
e.g. OUTPUT 722;"T1"
In this case, the HP8152A must be triggered to make a measurement **before** the result can be transferred to the controller. A typical measurement program would be as follows, assuming parameters such as λ have already been set:

```
10 DIM A$[7]
20 OUTPUT 722;"M2;t1;ar1;u0"
30 TRIGGER 722
40 ENTER 722;A$
50 PRINT A$
60 END
```

Continuous operation is selected by sending "T0" to the HP8152A
e.g. OUTPUT 722;"T0"
In this case, measurements are performed continuously in MEASure mode, and the output register holding the measurement result is constantly updated. Resultant update and transfer via the "ENTER" command is therefore asynchronous.

In either case, the length of the character string transferred to the controller is:

7 characters floating point if dB or dBm are the currently selected units.
e.g. -20.68 (with leading space).
11 characters exponential if watts are the currently selected units.
e.g. 0.0008E-02 (with leading space).

NOTE: If **underrange** or **overrange** occurs during a measurement, one of the following strings will be returned to the controller when the measurement result is interrogated:

999.99	for overrange in dB or dBm
9.9999E+99	for overrange in watts
-999.99	for underrange in dB or dBm
-9.9999E-99	for underrange in watts

STATUS/ERROR REPORTING (TALKER FUNCTION)

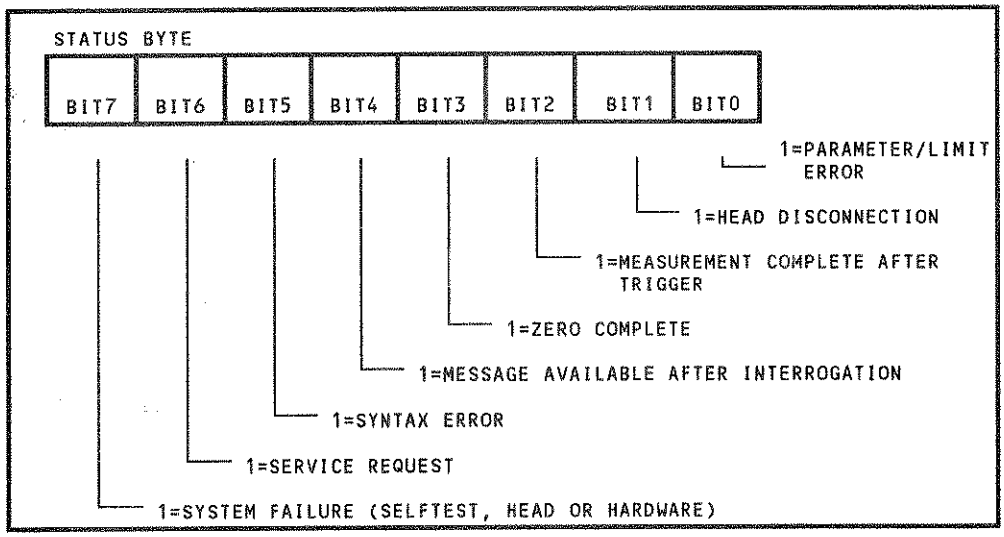
Another important feature of the HP8152A is that you can program it to interrupt the controller when certain status/error conditions are met. The Require Service (SRQ) message is used to implement this feature and is independent of all other HP-IB activity. However, the HP8152A **must be programmed** 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:

System Error.	If an error is detected by the self-test at power-on, or a head/mainframe error ocurs in normal operation.
Head Disconnection.	The head has been disconnected from the currently active channel.
Measurement Complete After Trigger.	In single cycle operation, measurement result is ready for transfer to the controller.
Parameter/Limit Error.	A wrong value has been set for a parameter.
Message Available.	When the HP8152A is ready to respond to an interrogation command.
Syntax Error.	An invalid instruction has been sent.
Zero Complete	The zero routine is completed.

These 7 interrupt conditions are monitored by an 8-bit **Status Register**, the content of this register being referred to as the **Status Byte**.

Status Register and Status Byte

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



When an interrupt condition is true, the corresponding bit in the status Register is set to 1 - **independent of the SRQ mask setting**. It is therefore possible for one or more bits of the Status Register to be true without the HP8152A 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 HP8152A 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:

```
10   DIM A$[7]                          - Dimension of A-string
20   CLEAR 722                          - Clears HP8152A's I/O buffers; SRQ mask = 000
30   OUTPUT 722;"CSB"                   - Clear status Byte
30   OUTPUT 722;"M2;CH1;AR1;T1;U0"      - MEASure mode;channel A; AUTOranging on; single cycle;
                                          units dBm
40   TRIGGER 722                        - Trigger HP8152A for one measurement
50   S=SPOLL(722)                       - Serial poll of HP8152A
60   IF BIT(S,2) = 0 THEN GOTO 50       - Check Status Byte; if Bit 2=0,repeat Serial poll; if Bit 2=1,
                                          measurement complete
70   ENTER 722;A$                       - Transfer measurement result to controller
80   PRINT A$                           - Print result
90   OUTPUT 722;"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 HP8152A as talker by using the Serial Poll command or "STB?" command:

```
10 A=SPOLL(722)                       - transfers Status Byte to variable "A"
20 PRINT A
30 END
```

or

```
10 OUTPUT 722;"STB?"                  - Interrogates the Status Byte
20 ENTER 722;A                        - transfers the Status Byte to variable "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.

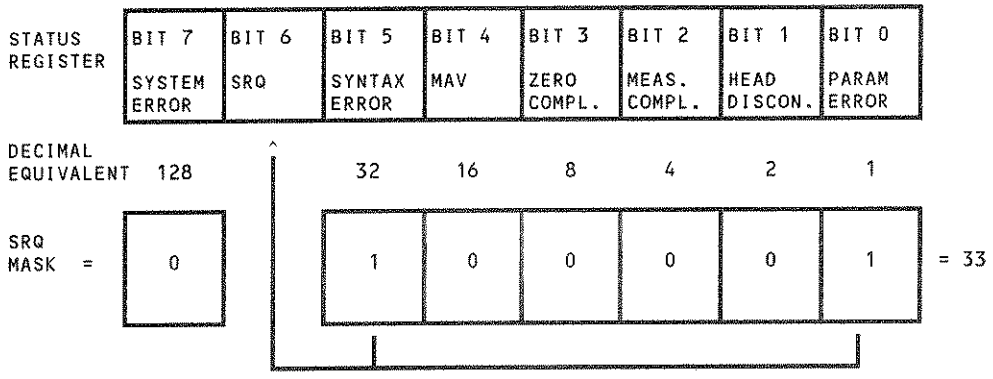
NOTES

- 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 HP8152A 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 HP8152A memory, and loaded simultaneously into the Status Register after it is cleared by a Serial Poll. If you have set more than one condition by the SRQ mask, therefore, your program should serial poll the HP8152A twice to ensure that the Status Register is cleared and SRQ set false.

SETTING THE SRQ MASK

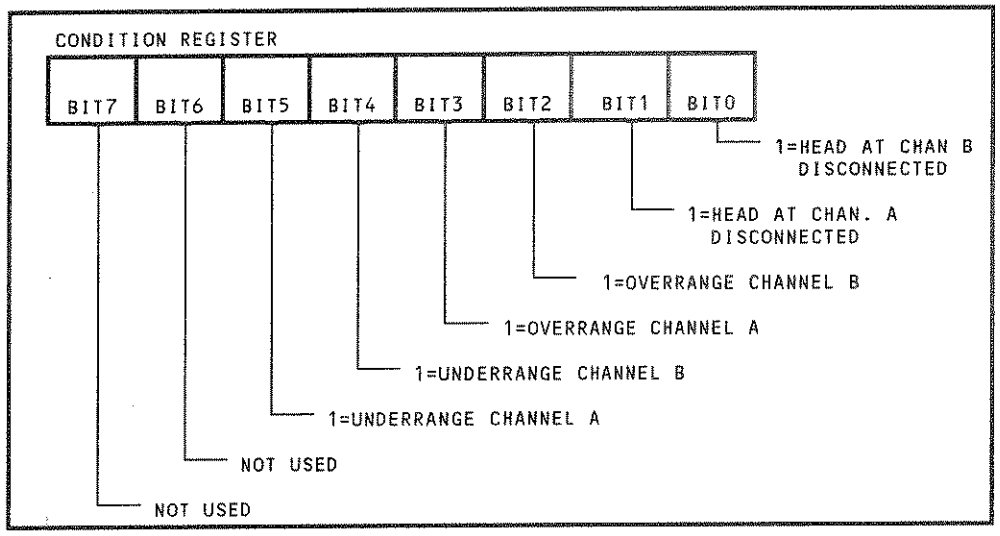
The SRQ mask can be set to mask bits 0-5 and bit 7 on the Status Register. Default mask value is 0 i.e. all interrupt conditions are disabled and no SRQ can be generated. To set the mask first determine which conditions you want to interrupt the controller, e.g., parameter error, syntax error, etc. Determine 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 722;"SRE33").



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 underrange, overrange and head connection.

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".

PROGRAMMING EXAMPLES

The following programming examples may help you to get started on programming the HP8152A. The programs are divided into functional blocks to aid understanding, each block being preceded by a comment line indicating the function.

Printout of Individual Settings in the Learn String

```
10  ! Task Callup From a Main Program
20  ! Calls a subprogram with parameter passing (by value).  In this case, the
30  ! HP-IB address of the HP8152A.
40  !
50  INTEGER Powermeter
60  Powermeter = 722
70  CALL Read_lrn(Powermeter)
80  END
90  !
100 !
110 !Subprogram for reading the learn string and providing a set of variables
120 !describing the complete settings of the power meter
130 !
140 SUB Read_lrn(INTEGER Pwmtr) ! 722 is passed to INTEGER Pwmtr
150 !
160 !Variable Declaration Section
170 DIM Mode$[3],Channel$[4]                                  !main keys
180 DIM Ranging$[4],Zeroing$[5],Filter$(1:3)[5],Unit$[3]      !measure keys
190 DIM Lambda$(1:2)[17],Cal$(1:2)[13],Ref$(1:3)[17]          !set keys
200 DIM Range$(1:2)[13]                                       !active range
210 DIM Trigger$[3],Srq_enable$[7]                            !HP-IB specials
220 DIM Lrn$[200]                                             !8152A response
230 DIM New_page$[2]                                          !printer control
240 INTEGER Printer                                           !device select
250 !
260 !Assign Constants
270 New_page$=CHR$(13)&CHR$(12)                               !formfeed
280 Printer=CRT                                               !output to CRT
290 !
300 !Start Program
310 OUTPUT Pwmtr;"LRN?"
320 ENTER Pwmtr;Lrn$
330 !
340 !Main Keys
350 Mode$=Lrn$[1;3]
360 Channel$=Lrn$[18;4]
370 !
380 !MEASure mode keys/functions
390 Ranging$=Lrn$[13;4]
400 Zeroing$=Lrn$[41;5]
410 Filter$(1)=Lrn$[23;5]
420 Filter$(2)=Lrn$[29;5]
430 Filter$(3)=Lrn$[35;5]
```

```
440  Unit$=Lrn$[9;3]
450  !
460  !Active measurement range
470  Range$(1)=Lrn$[55;13]
480  Range$(2)=Lrn$[69;13]
490  !
500  !SET mode keys/parameters
510  Lambda$(1)=Lrn$[165;17]
520  Lambda$(2)=Lrn$[183;17]
530  Cal$(1)=Lrn$[83;13]
540  Cal$(2)=Lrn$[97;13]
550  Ref$(1)=Lrn$[111;17]
560  Ref$(2)=Lrn$[129;17]
570  Ref$(3)=Lrn$[147;17]
580  !
590  !HP-IB specials
600  Trigger$=Lrn$[5;3]
610  Srq_enable$=Lrn$[47;7]
620  !
630  GOSUB Print_status
640  SUBEXIT                                              !skip subroutine
650  !
660  !Subroutine to print the 8152A settings
670  Print_status:
680       OUTPUT Printer;New_page$
690       OUTPUT Printer;"operating mode . . . . . :    ";Mode$
700       OUTPUT Printer;"active channel . . . . . :    ";Channel$
710       OUTPUT Printer;"AUTOranging . . . . . :       ";Ranging$
720       OUTPUT Printer;"range channel A . . . . . :   ";Range$(1)
730       OUTPUT Printer;"range channel B . . . . . :   ";Range$(2)
740       OUTPUT Printer;"ZERO status . . . . . :       ";Zeroing$
750       OUTPUT Printer;"filter channel A . . . . . :  ";Filter$(1)
760       OUTPUT Printer;"filter channel B . . . . . :  ";Filter$(2)
770       OUTPUT Printer;"filter channel B/A . . . . . :";Filter$(3)
780       OUTPUT Printer;"active display units . . . . . :";Units$
790       OUTPUT Printer;"_____________________________________________"
800       OUTPUT Printer;"wavelength channel A . . . . . :";Lambda$(1)
810       OUTPUT Printer;"wavelength channel B . . . . . :";Lambda$(2)
820       OUTPUT Printer;"CAL factor channel A . . . . . :";Cal$(1)
830       OUTPUT Printer;"CAL factor channel B . . . . . :";Cal$(2)
840       OUTPUT Printer;"reference channel A . . . . . :";Ref$(1)
850       OUTPUT Printer;"reference channel B . . . . . :";Ref$(2)
860       OUTPUT Printer;"reference channel B/A. . . . . :";Ref$(3)
870       OUTPUT Printer;"_____________________________________________"
890       OUTPUT Printer;"current trigger mode . . . . . :";Trigger$
900       OUTPUT Printer;"SRQ enable status . . . . . :";Srq_enable$
910  RETURN
920  !
930  SUBEND
```

Program to Perform the Front Panel DISP to REF Function and Check for Erroneous Measurements

```
1000 !Declare variables
1010 !
1020 INTEGER Powermeter                    ! HP-IB address of the 8152A
1030 INTEGER Message_device                ! Output device e.g. CRT or printer
1040 DIM Reference$(1:3)[22]               ! Reference values for channels A,B,B/A
1050 DIM Result$[43]                       ! Feedback for programming result
1060 DIM New_page$[2],New_line$[2]         ! Output device control
1070 !
1080 !Initialize variables and constants
1090 !
1100 Powermeter=722
1110 Message_device=CRT                    ! May also be a printer-address, e.g.701
1120 !
1130 New_page$=CHR$(13)&CHR$(12)           ! Carriage-return, form-feed
1140 New_line$=CHR$(13)&CHR$(10)           ! Carriage-return, line-feed
1150 !
1160 Reference$(1)=""
1170 Reference$(2)=""
1180 Reference$(3)=""
1190 Result$=""
1200 !
1210 !Start main program
1220 !
1230 CALL Disp_to_ref(Powermeter,Reference$(*),Result$)
1240 !
1250 !Report results
1260 !
1270 OUTPUT Message_device;New_page$
1280 OUTPUT Message_device;"********** reference status **********"
1290 OUTPUT Message_device;New_line$;
1300 OUTPUT Message_device;"result : ";Result$
1310 OUTPUT Message_device;New_line$;
1320 OUTPUT Message_device;"channel A ..... : ";Reference$(1)
1330 OUTPUT Message_device;"channel A ..... : ";Reference$(2)
1340 OUTPUT Message_device;"channel B/A ..... : ";Reference$(3)
1350 !
1360 END
1370 !
1380 SUB Disp_to_ref(INTEGER Pwmtr,Reference$(*),Success$)
1390 !
```

Comment: The following is a sub-program which performs the HP8152A DISP → REF front panel function. The advantage of this sub-program is that it allows any user-program to keep track of the actual reference values and possible error conditions. i.e. It ensures that no differences occur between what the user thinks is being performed and what is actually performed.

The sub-program is structured as follows:

Measure and check
If no error, then store to reference
Report status to caller

Input: HP-IB address of the HP8152A
Output: Reference values as given in the learn string.
Success reporting in "text"

```
1400 !Variable declaration section
1410 !
1420 DIM Mode$[3],Channel$[4]          ! Active operating parameters
1430 DIM Unit$[3]                      ! Active measurement unit
1440 DIM Lrn$[200]                     ! 8152A current setting
1450 DIM Channel_select$[1]            ! Selector for channel of REFERENCE
1460 DIM Setting$[20]                  ! Program string (to powermeter)
1470 DIM Power$[11]                    ! Result from power-measurement
1480 DIM Uf$[5]                        ! Unit suffix channel A and B (feedb.)
1490 DIM Us$[3]                        ! Unit suffix channel A and B (prog. )
1500 DIM Um$[3]                        ! Unit suffix for measurement (prog. )
1510 !
1520 INTEGER Set_new,False,True        ! Program control variables
1530 !
1540 !Assign constants
1550 !
1560 False=0
1570 True=1
1580 !
1590 !Start program
1600 !
1610 OUTPUT Pwmtr;"LRN?"               ! What's the current settings ?
1620 ENTER Pwmtr;Lrn$                  ! Enter the current setting
1630 !
1640 Mode$=Lrn$[1;3]                   ! Save current active mode
1650 Channel$=Lrn$[18;4]               ! Determine active channel
1660 Unit$=Lrn$[9;3]                   ! Save current active unit
1670 !
1680 !
1690 SELECT Unit$                      ! Determine active power unit
1700   CASE "U 0"                      ! dBm  is active
1710     Uf$="  dBm"                   ! Single channel unit feedback
1720     Um$="U 0"                     ! Measurement unit for ref
1730     Us$="dBm"                     ! Suffix for programming
1740     !
1750   CASE "U 2"                      ! dB   is active
1760     SELECT Channel$[4;1]          ! Determine active channel
1770       CASE "1","2"                ! Channel A or B
1780         Uf$="  dBm"               ! Single channel unit feedback
1790         Um$="U 0"                 ! Measurement unit for ref
1800         Us$="dBm"                 ! Suffix for programming
1810         !
1820       CASE ELSE                   ! Channel B/A
```

```
1830        Uf$="  dBm"                ! Single channel unit feedback
1840        Um$="U 0"                 ! Measurement unit for ref
1850        Us$="dB"                  ! Suffix for programming
1860      END SELECT                  ! End select channel
1870      !
1880    CASE ELSE                     ! Watt is active
1890      Uf$=" Watt"                 ! Single channel unit feedback
1900      Um$="U 1"                   ! Measurement unit for ref
1910      Us$="W"                     ! Suffix for programming
1920  END SELECT                      ! End select unit
1930  !
1940  !
1950  !Start measurement of reference value
1960  !
```

Comment: No need to check if the HP8152A is in an unfavorable mode. Just program the neccessary conditions to make a measurement, and restore the initial settings after measurement.

```
1970  Setting$="m2;"&Um$              ! Measure mode and valid reference unit
1980  OUTPUT Pwmtr;Setting$
1990  TRIGGER Pwmtr                   ! Ensures measurement independent of
2000                                  ! trigger mode setting
2010  ENTER Pwmtr;Power$              ! Get measurement result for your reference
2020  !
2030  !Restore initial settings
2040  !
2050  Setting$=Mode$&";"&Unit$
2060  OUTPUT Pwmtr;Setting$
2070  !
2080  !Test measurement result for validity
2090  !
```

Comment: The performance of this test check can be improved by using the 8152A's status byte, but for this example, a simple "demonstration" is chosen to show the principles of operation.

```
2100  SELECT Power$
2110    CASE "NO DATA"                ! May be no head or error occured
2120      Success$="no valid data"    ! No value to store to REF available
2130      Set_new=False               ! Suppress programming
2140      !
2150    CASE " 999.99","-999.99"      ! Overload or underrange if no watt
2160      Success$="power exceeds limits"
2170      Set_new=False               ! Suppress programming
2180      !
2190    CASE " 9.9999E+99","-9.9999E-99"  ! Overload or underrange in watt
2200      Success$="power exceeds limits"
2210      Set_new=False               ! Suppress programming
2220      !
2230    CASE ELSE
2240      IF Um$="U 1" THEN           ! If measurement in Watt then
2250        IF VAL(Power$)<=0 THEN    ! reference MUST always be > 0 Watt
2260          Success$="value =< 0 Watt"  ! Feedback to caller
2270          Set_new=False           ! Suppress programming
```

```
2280        ELSE
2390          Success$="reference is set"          ! Feedback to caller
2300          Set_new=True                         ! Allow programming
2310        END IF                                 ! End if test for power =< zero
2320      ELSE                                     ! Measurement in dBm or dB
2330        Success$="reference is set"            ! Valid measurement
2340        Set_new=True                           ! Allow programming
2350      END IF                                   ! End if test for watt
2360      !
2370  END SELECT
2380  !
2390  !Send reference to the power meter
2400  !
2410  IF Set_new THEN                              ! No error therefore set new reference
2420    Channel_select$=Channel$[4;1]              ! Select active channel
2430    Setting$="REF "&Channel_select$            ! Build command header
2440    Setting$=Setting$&","&Power$               ! Add data
2450    Setting$=Setting$&Us$                      ! Add suffix (e.g. dBm if dB is active)
2460    OUTPUT Pwmtr;Setting$                      ! Set new reference
2470    OUTPUT Pwmtr;"lrn?"                        ! Get new formatted data from the
2480    ENTER Pwmtr;Lrn$                           ! 8152A, which performs formatting!
2490  ELSE                                         ! Error condition, no programming
2500    Success$=Success$&", old REF still active!"
2510  END IF
2520  !
2530  !Return current reference to caller
2540  !
2550  Reference$(1)=Lrn$[111;17]&Uf$               ! Return channel A   data
2560  Reference$(2)=Lrn$[129;17]&Uf$               ! Return channel B   data
2570  Reference$(3)=Lrn$[147;17]&"   dB"           ! Return channel B/A data
2580  !
2590  SUBEND
```

HP8152A COMMAND SUMMARY

SETTINGS (LISTENER FUNCTION)

Parameter/Operation	Mnemonic	Data	Unit	Comment
Select SET Mode	M	1		
Select MEASure Mode	M	2		
Select Channel A	CH	1		
Select Channel B	CH	2		
Select B/A Operation	CH	3		
Autoranging Off	AR	0		
Autoranging On	AR	1		
Zero Off	ZER	0		
Zero On	ZER	1		
Filter Off Settings	F	1,0		for Channel A.
	F	2,0		for Channel B.
	F	3,0		for B/A operation.
Filter On Settings	F	1,1		for Channel A.
	F	2,1		for Channel B.
	F	3,1		for B/A operation.
Select dBm Units	U	0		
Select Watts	U	1		
Select dB Units	U	2		
Select Trigger Off	T	0		continuous operation.
Select Trigger On	T	1		single cycle operation.
Set Channel A Range	RNG	1,value	DBM or DB(MW)	value = +30,-90; head dependent.
Set Channel B Range	RNG	2,value	DBM or DB(MW)	value = +30,-90; head dependent.
Set Channel A λ	WVL	1,value	M	meter. Default if no unit defined.
			MM	millimeter
			UM	micrometer
			NM	nanometer
			PM	picometer
Set Channel B λ	WVL	2,value	M	meter. Default if no unit defined.
			MM	millimeter
			UM	micrometer
			NM	nanometer
			PM	picometer

SETTINGS (LISTENER FUNCTION) contd.

Parameter/Operation	Mnemonic	Data	Unit	Comment
Set CAL for Channel A	CAL	1,value	DB	default is dB if no units defined
Set CAL for Channel B	CAL	2,value	DB	default is dB if no units defined
Set REF for Channel A	REF	1,value	DBM or DB(MW) W MW UM NM PM	watts milliwatts microwatts nanowatts picowatts If no units defined, default is determined by the "U" setting
Set REF for Channel B	REF	2,value	"	"
Set REF for B/A Mode	REF	3,value	DB	default is dB if no units defined
Set SRQ Mask	SRE	value		value = decimal number (0-191). A "1" in the binary equivalent sets SRQ on this condition.
Clear Status Byte	CSB			Always clears Status Byte independent of SRQ state
Clear Device	CLR			Clears all I/O buffers. Same as Universal Device Clear Command.
Trigger	TRG			Perform one measurement in single cycle operation

STANDARD PARAMETER SET (LISTENER FUNCTION)

Parameter/Operation	Mnemonics	Comment
Recall Standard Parameter Set	RST	The settings are as follows: Measure mode Channel A AUTOranging on ZERO off Filter off Units dBm Range 0 dBm REFerence value 0 dB/1 mW CAL factor 0 dB λ - head dependent

INTERROGATING SETTINGS (TALKER FUNCTION)

Parameter/Operation	Mnemonics	Comment
Learn Mode	LRN?	Returns 200-character string detailing all settings. Setting sequence is always the same and listed as follows:

Setting	Byte Position	Length
Mode	1-4	4
Trigger	5-8	4
Units	9-12	4
AUTOranging	13-17	5
Channel	18-22	5
Filter A, B and B/A	23-28,29-34,35-40	6,6,6
Zero	41-46	6
SRQ mask	47-54	8
Range A and B	55-68,69-82	14,14
CAL factors A and B	83-96,97-110	14,14
REF values A, B and B/A	111-128,129-146, 147-164	18,18, 18
λ A and B	165-182,183-200	18,18

Interrogate setting	M?	Returns integer (1 or 2) for mode setting
	CH?	Returns integer (1,2 or 3) for channel setting
	AR?	Returns integer (0 or 1) for autorange off/on
	ZER?	Returns integer (0 or 1) for zero off/on
	U?	Returns integer (0,1 or 2) for current units
	T?	Returns integer (0 or 1) for trigger off/on
	F? 1,2 or 3	Returns integer (0 or 1) for filter off/on for the selected channel (A,B or B/A)
	F?	Returns 3 integers separated by commas to indicate all 3 filter settings
	RNG? 1 or 2	Returns 7-character string for range selection on the selected channel (A or B)
	RNG?	Returns 15-character string to indicate range selections of both channels
	WVL? 1 or 2	Returns 11-character string for λ setting on the selected channel (A or B). Always in meters.
	WVL?	Returns 23-character string for λ settings of both channels. Always in meters.
	CAL? 1 or 2	Returns 7-character string for CAL setting of selected channel (A or B). Always in dB.
	CAL?	Returns 15-character string for CAL settings of both channels. Always in dB.
	REF?1,2 or 3	Returns 7-character string for REF setting of the selected channel (A,B or B/A) if dB or dBm are the current units. Returns 11-character string if watts are current units.
	REF?	Returns 23-character string for all REF settings (A,B,B/A) if dB or dBm are the current units. Returns 31-character string if watts are the current units.

STATUS/ERROR REPORTING (TALKER FUNCTION)

Interrogation	Mnemonics	Comment
Status Byte	STB?	Returns 3-digit integer (000-191). With SRQ false, does not clear Status Byte.
Status Byte Mask	SRE?	Returns 3-digit integer (000-191).
Condition Byte	CNB?	Returns 2-digit integer (00-63).
Self-test	TST?	Executes self-test and returns 0 or 1 to indicate passed or failed.
Error Number	ERR?	Returns 3-digit integer representing HP8152A error code (details given in Service info). 000 means no error. An error code is only available if bit 7 (System Error) 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.
Last Error Number	LERR?	Returns 3-digit integer for last active error. This is a destructive readout.
Operation Complete	OPC?	1 if no further command to interpret and execute in the input buffer. 0 if further commands in the input buffer.
Identifier	IDN?	Returns 56-character string identifying currently installed firmware, manufacturer model no. and serial number.
	IDN?1 or 2	Returns 26-character string indentifying currently installed firmware, manufacturer model no. and serial number of channel A or B optical head.

UNIVERSAL COMMANDS

Command	ASCII Character	Equivalent Forms Binary	Octal	Decimal
Device Clear	DC_4	00010100	024	20
Selected Device Clear	EOT	00000100	004	4
Group Execute Trigger	BS	00001000	010	8

Both "CLEAR" commands clear all input/output buffers, reset SRQ mask to all disabled and SRQ to false, but have no effect on HP8158B mode/parameter settings.

The HP8152A performs one measurement in response to the trigger command in single cycle operation. The measurement result overwrites any pending response to an interrogation command.

SECTION IV

FUNCTION TESTS

4-1 INTRODUCTION

4-2 The procedures in this section test the electrical performance of the instrument.The complete specifications to which the HP8152A is tested are given in Table 1-1. All tests can be performed without access to the interior of the instrument.

4-3 EQUIPMENT REQUIRED

4-4 Equipment required for the function 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

Instrument/Accesory	Rec. Model	Critical Specification
Test Box	HP8100AT	
Test Cable	HP15414-61603	
BNC to BNC cable	HP15402A	
Digital Voltmeter	HP3466A	0.01mV Resolution
BNC (f) Dual Banana Adapter	HP1251-2277	
DC Standard		Accuracy 50ppm ±20uV

4-5 TEST RECORD

4-6 Results of the function 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.

4-7 TEST FAILURE

4-8 If the HP8152A fails any function test, return the instrument to the nearest Hewlett-Packard Sales/Service Office for repair.

4-9 INSTRUMENTS SPECIFICATION

4-10 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 HP8152A can be tested. Table 1-1 also lists some supplemental characteristics of the HP8152A and should be considered as additional information.

4-11 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 supersede any previously published.

4-12 FUNCTION TESTS

4-13 The function tests given in this section are separated into Function Test without Optical Head and Voltage Status and Accuracy Test. Perform each step in the tests in the order they are given using the corresponding test equipment.

4-14 8152A FUNCTION AND ACCURACY TEST

Equipment required:
81000AT Test Box
15414-61603 Test Cable
10502A BNC to BNC cable
DC Standard
Digital Voltmeter
1251-2277 BNC (f) Dual Banana Adapter

8152A Function Test without Optical Heads connected.

1. Turn the 8152A on and check that all LEDs and are on for approx. 0.5 seconds.

2. Press the LCL key and check that the selected HP-IB address is displayed.

3. Set the 8152A to SET mode and select input A.

4. Press the λ key and using the VERNIER keys check that λ can be set from 100nm to 19999nm. Then press CLR and 1300nm should be displayed.

5. Press the CAL key and using the VERNIER check that the CAL factor can be set from -199.99dB to 199.99dB. Press CLR and the display should show 0.00dB.

6. Press REF, select display in dBm and check that the REF value can be set from 199.99dBm to -199.99dBm. Press CLR and 0.00dBm should be displayed.

7. Press WATT and using the RANGE rocker key, check that following ranges can be selected:

1000	mW	1000	pW
100.0	mW	100.0	pW
10.00	mW	10.00	pW
1000	uW	1.00	pW
100.0	uW	0.10	pW
10.00	uW	0.01	pW
1000	nW		
100.0	nW		
10.00	nW		

8. Select B/A and check that the display can be set from 199.99dB to -199.99dB and then press CLR to get a 0.00dB display.

Voltage, Status and Accuracy Test.

1. Connect the equipment as shown in Figure 4-1 and set the toggle switch on the 81000AT Test Box to NO position.

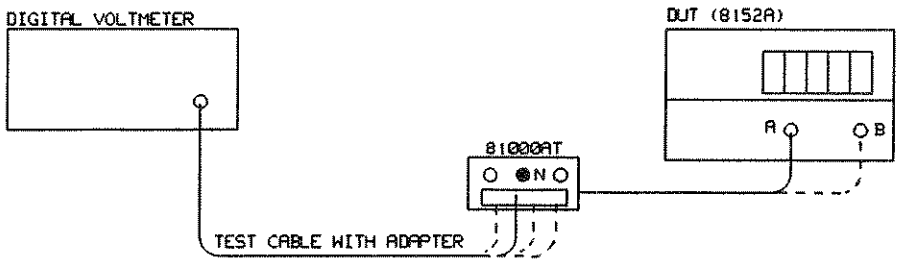


Figure 4-1

2. Set the 8152A to MEASure, select INPUT A and display in dBm.

3. Using the Test Cable measure first the following DC levels and states.

ON/OFF	+ 5 Volt	±0.5 Volt
+ 15 V	+ 15 Volt	±0.8 Volt
- 15 V	- 15 volt	±0.8 Volt
MODE 0	Low	
MODE 1	Low	
RANGE 0	High in the 30dBm to -30dBm ranges Low in the -40dBm to -90dBm ranges	
RANGE 1	High in the 30dBm to -10dBm ranges Low in the -20dBm to -90dBm ranges	
STATUS	High	
CLOCK	High	

4. Set the DC Standard to +0.000 Volt and connect the equipment as shown in Figure 4-2.

CAUTION: Check polarity of DC Standard connection.

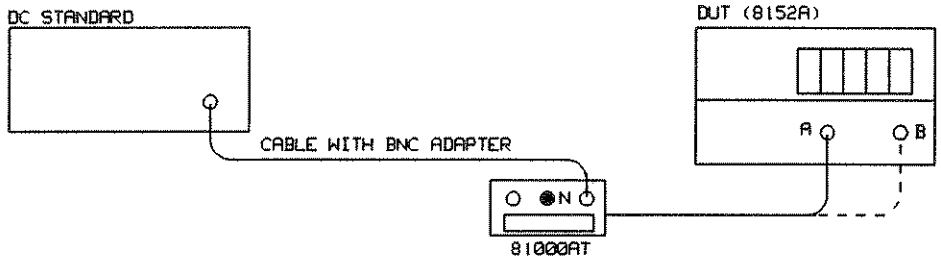


Figure 4-2

5. Select the 0dBm Range display in uW and switch AUTOrange off. Press the ZERO key and check the 8152A display readings at following DC Standard settings:

	DC Standard Setting	8152A Reading (±4 counts)
	0.000 Volt	0 uW
+	0.100 Volt	100 uW
+	0.300 Volt	300 uW
+	0.500 Volt	500 uW
+	0.700 Volt	700 uW
+	0.900 Volt	900 uW
+	1.000 Volt	1000 uW
+	1.100 Volt	1100 uW
+	1.300 Volt	1300 uW
+	1.500 Volt	1500 uW
+	1.700 Volt	1700 uW
+	1.900 Volt	1900 uW
+	1.990 Volt	1990 uW

6. Set the DC Standard to 0.010 Volt and check the 8152A display with the -50dBm range and then with the -60dBm range selected.

   -50dBm range = 1.00nW ±4 counts, -60dBm range = 1000pW ±4 counts.

7. **Repeat steps 2 to 6 for INPUT B.**

Hewlett-Packard Model 8152A

Optical Average Power Meter

Serial Number _____

Test Performed By _____

Date _____

Comments _____

4-14 FUNCTION AND ACCURACY TEST

Test Condition: Function Test without Optical Heads connected

Step	Description	Test Pass	Test Fail
1.	All LED's and Displays on for approx. 0.5 sec.	____	____
2.	HP-IB address displayed when pressing LCL key	____	____
4	Lambda selectable from 100nm to 19999nm	____	____
	Lambda CLR function (1300nm)	____	____
5.	CAL setting -199.99dB to 199.99dB	____	____
	CAL CLR function	____	____
6.	REF setting from 199.99dB to -199.99dB	____	____
	REF CLR function	____	____
7.	RANGE selection		
	1000 mW / 100.0 mW / 10.00 mW / 1000 uW / 100.0 uW / 10.00 uW / 1000 nW / 100.0 nW / 10.00 nW	____	____
	1000 pW / 100.0 pW / 10.00 pW / 1.00 pW / 0.10 pW / 0.01 pW		
8.	B/A display setting from 199.00dB to -199.99dB	____	____
	B/A CLR function	____	____

Hewlett-Packard Model 8152A

Optical Average Power Meter

Serial Number _____

Test Performed By _____

Date _____

Comments _____

4-14 FUNCTION AND ACCURACY TEST INPUT A

Test Condition: Function Test with HP81000AT connected

Step	Description			Test Pass	Test Fail
	Voltage, Status and Accuracy Iest				
4.	ON / OFF	+ 5 Volt +/- 0.5 Volt		____	____
	+ 15 Volt	+ 15 Volt +/- 0.8 Volt		____	____
	- 15 Volt	- 15 Volt +/- 0.8 Volt		____	____
	MODE 0	Low		____	____
	MODE 1	Low		____	____
	RANGE 0	High in the 30dBm to -30dBm ranges		____	____
		Low in the -40dBm to -90dBm ranges		____	____
	RANGE 1	High in the 30dBm to -10dBm ranges		____	____
		Low in the -20dBm to -90dBm ranges		____	____
	STATUS	High		____	____
	CLOCK	High		____	____
6.	DC Standard Setting	8152A Reading (+/-4 counts)			
	0.000 Volt	0 uW		____	____
	+ 0.100 Volt	100 uW		____	____
	+ 0.300 Volt	300 uW		____	____
	+ 0.500 Volt	500 uW		____	____
	+ 0.700 Volt	700 uW		____	____
	+ 0.900 Volt	900 uW		____	____
	+ 1.000 Volt	1000 uW		____	____
	+ 1.100 Volt	1100 uW		____	____
	+ 1.300 Volt	1300 uW		____	____
	+ 1.500 Volt	1500 uW		____	____
	+ 1.700 Volt	1700 uW		____	____
	+ 1.900 Volt	1900 uW		____	____
	+ 1.990 Volt	1990 uW		____	____
7.	+ 0.010 Volt	-50dBm range	1.00 nW (+/-4 counts)	____	____
	+ 0.010 Volt	-60dBm range	1000 pW (+/-4 counts)	____	____

Hewlett-Packard Model 8152A

Optical Average Power Meter

Serial Number _____

Test Performed By _____

Date _____

Comments _____

4-14 FUNCTION AND ACCURACY TEST INPUT B

Test Condition: Function Test with HP81000AT connected

Step	Description			Test Pass	Test Fail
	Voltage, Status and Accuracy Iest				
4.	ON / OFF	+ 5 Volt +/- 0.5 Volt		____	____
	+ 15 Volt	+ 15 Volt +/- 0.8 Volt		____	____
	- 15 Volt	- 15 Volt +/- 0.8 Volt		____	____
	MODE 0	Low		____	____
	MODE 1	Low		____	____
	RANGE 0	High in the 30dBm to -30dBm ranges		____	____
		Low in the -40dBm to -90dBm ranges		____	____
	RANGE 1	High in the 30dBm to -10dBm ranges		____	____
		Low in the -20dBm to -90dBm ranges		____	____
	STATUS	High		____	____
	CLOCK	High		____	____
6.	DC Standard Setting	8152A Reading (+/-4 counts)			
	0.000 Volt	0 uW		____	____
	+ 0.100 Volt	100 uW		____	____
	+ 0.300 Volt	300 uW		____	____
	+ 0.500 Volt	500 uW		____	____
	+ 0.700 Volt	700 uW		____	____
	+ 0.900 Volt	900 uW		____	____
	+ 1.000 Volt	1000 uW		____	____
	+ 1.100 Volt	1100 uW		____	____
	+ 1.300 Volt	1300 uW		____	____
	+ 1.500 Volt	1500 uW		____	____
	+ 1.700 Volt	1700 uW		____	____
	+ 1.900 Volt	1900 uW		____	____
	+ 1.990 Volt	1990 uW		____	____
7.	+ 0.010 Volt	-50dBm range	1.00 nW (+/-4 counts)	____	____
	+ 0.010 Volt	-60dBm range	1000 pW (+/-4 counts)	____	____

OPERATING MANUAL

HP81521B OPTICAL HEAD 850nm to 1700nm

SERIAL NUMBERS

This manual applies directly to instruments with serial number 2602G00101 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.

HERRENBERGER STR. 130, D-7030 BOBLINGEN
FEDERAL REPUBLIC OF GERMANY

MANUAL PART No. 81521-90011
MICROFICHE PART No. 81521-95011

PRINTED: MAY 1986

SAFETY

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded.

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

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

For warranty service or repair, this product must be returned to a service facility designated by HP. However, warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within the HP service travel area. 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.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

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. HP 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. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GENERAL – This is a Safety Class I instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

OPERATION – BEFORE APPLYING POWER comply with the installation section. Additionally, the following shall be observed:

Do not remove instrument covers when operating.

Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers and devices connected to it should be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation is present. Do not replace components with power cable connected.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

SAFETY SYMBOLS

The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Indicates dangerous voltages.

Earth terminal

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

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

WARNING

Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

5955-0713

HEWLETT PACKARD

Publication:
Hewlett-Packard GmbH, Böblingen, Dec. 1979

Printed in the Federal Republic of Germany

CONTENTS

SECTION A-1

GENERAL INFORMATION

INTRODUCTION

This appendix provides the supplementary information required when an HP81521B Optical Head is connected to the HP8152A Optical Average Power Meter. The information is HP81521B specific and covers installation, operation and performance tests.

SPECIFICATIONS

Specifications of the HP81521B are given in Table A-1. These specifications are the performance standards or limits against which the optical head is tested.

SAFETY CONSIDERATIONS

CAUTION

Before connecting the optical head to the HP8152A, ensure that the HP8152A is connected to protective (earth) ground.

OPTICAL HEADS COVERED BY THIS APPENDIX

Each optical head has a two-part serial number. The first 4 digits and the letter comprise the serial prefix; the last 5 digits a sequential suffix which is unique to each HP81521B. The contents of this appendix apply directly to optical heads having the serial prefix 2602G.

DESCRIPTION

The HP81521B is the standard optical head for the HP8152A Optical Average Power Meter when operating in the wavelength range 850nm → 1700nm. This head covers single- and multimode fibers up to 100 μm core diameter.

At the factory, correction factors over the entire wavelength range are individually measured and stored in each optical head. This ensures precise power measurements, even when the source-under-test has an operating wavelength other than 1300nm. The dynamic range is +3 → -80dBm with the noise floor being well below -70dBm to provide the sensitivity needed for a wide range of applications.

A large variety of optical adapters is available to simplify connection of the HP81521B to the device-under-test. If it is necessary to measure power levels above +3dBm, fixed attenuation filters can be easily inserted into an optional filter holder.

ACCESSORIES AVAILABLE

A number of accessories are available to aid measurement and simplify connection to either bare or terminated fibers. The accessories are listed as follows:

- **CONNECTOR ADAPTERS**

81000AA	for connection with Diamond HMS-10/HP connector
81000BA	for connection with bare fiber (125 µm cladding)
81000FA	for connection with FC or PC connectors
81000GA	for connection with NEC D4 connector
81000JA	for connection with AMP SMA or Amphenol 906 connectors
81000LA	for connection with F & G 3702 connector
81000NA	for connection with Stratos 430 connector
81000WA	for connection with Biconic connector
81000YA	for connection with Diamond HFS-1 connector
81000ZA	blank adapter for connection with any other connectors

- **LENSES**

81010BL	lens for 1300nm, 1550nm, and 9/125µm or 10/125µm fiber.
81050BL	lens for 1300nm, 1550nm, and 50/125µm or 62.5/125µm fiber

- **FILTERHOLDER**

81000AF	filterholder for filters with 1-inch diameter

- **POWER SPLITTER**

81000BS	10:1 power splitter for single- and multimode; fiber core diameters from 9µm to 85µm (NA $\leq$ 0.3).

An additional accessory for the HP81521B is the HP15475A 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.

Table A-1. Specifications

Specifications describe the instrument's warranted performance. They apply to optical input signals transmitted in parallel beam. Use appropriate lenses and connector adapters for the optical head to accomodate light emerging from optical fibers.

Optical Characteristics

Wavelength Range: 850nm to 1700nm, actual wavelength user-selectable. Each optical head is individually calibrated over wavelength between 850nm and 1700nm. Correction factors are stored in its non-volatile memory.

Sensor Element: Cooled Ge PIN diode
Sensor Diameter: 5mm
Maximum Power Density: 10mW/mm^2

Power Measurements

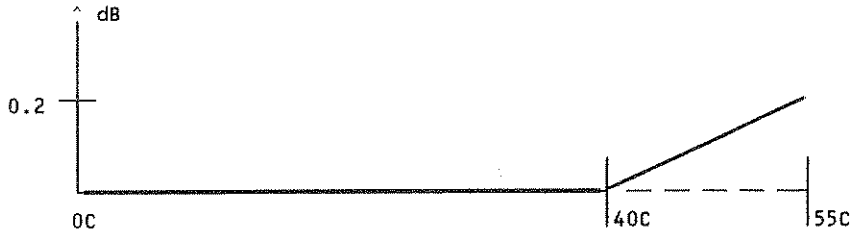
Accuracy specifications measured at DC power levels and "Zero" enabled prior to measurement. They are valid between 1000nm and 1600nm.

Measurement Range: 3dBm to -80dBm
Resolution: 4 1/2 digits, 0.01dB, 10pW best case

Accuracy
Traceable calibration accuracy: ±5%
Accuracy (rel. to calibration at 1300nm and -20dBm log. reading, 0 to 40°C ambient temp., 10 to 100% full scale, -50dBm range 100pW to 100%):

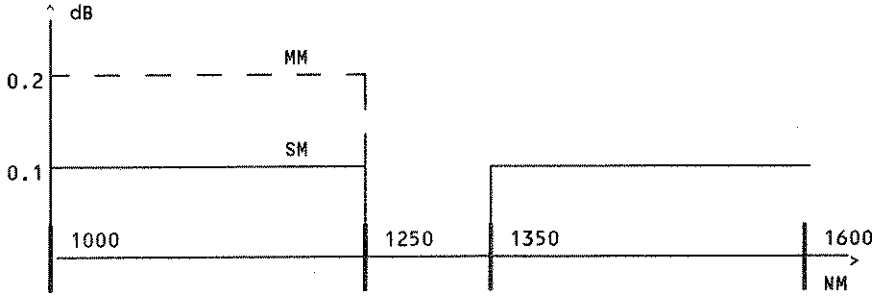
Range [dBm]	Average Power ±(of read + Watts)
0	0.15dB
-10	0.15dB
-20	0.15dB
-30	0.15dB
-40	0.15dB
-50	0.15dB + 100pW

Accuracy derating factor over temperature:



Accuracy at 25°C±5°C between 3dBm and -60dBm: typ.<±0.05dB

Accuracy of lens coating over wavelength (typical):



General

Recalibration period: 1 year
Warm-up time: 5 minutes

Bandwidth (-3dB) at XDCR OUT of 8152A: typ. 700Hz

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

Dimensions: 37.7mm diameter, 140mm length (1.5"x5.5")

Weight: net 0.45kg (1lbs), shipping 1kg (2.2lbs)

SECTION A-2

INSTALLATION

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 optical head has been verified both mechanically and optically.

Procedures for checking the optical operation are given in Section A-4. If the contents are incomplete, mechanical damage or defect is apparent, or if an optical head 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.

HANDLING PRECAUTION

CAUTION

Do not drop or otherwise mechanically damage the optical head.
Do not install the optical head in an environment where strong vibrations or self-heating may occur.

OPTICAL CONNECTIONS

For each optical head, various accessories can be ordered that aid measurement as well as connection to bare or terminated fibers. Depending on which accessories have been ordered, the following Figure A-1 shows the sequence in which they are attached to the optical head.

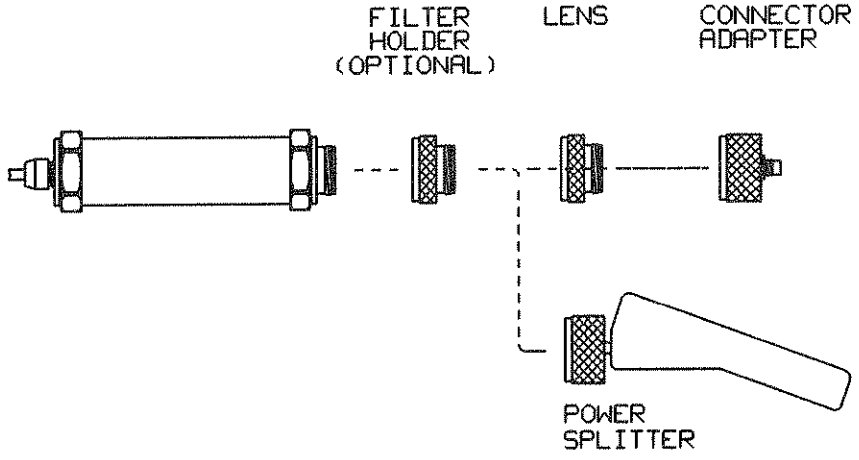


Figure A-1. Optical Connections

Note that the optical head and its various accessories are marked with coloured dots to indicate wavelength and fiber type. The convention used is as follows:

Note that the optical head and its various accessories are marked with coloured dots to indicate wavelength and fiber type. The convention used is as follows:

Wavelength

- Red — 2nd λ-window (1300nm)
- Orange — 3rd λ-window (1550nm)

Fiber Type

- White — single-mode (9 μm)
- Green — Multimode (50 μm/125 μm GI)
- Blue — Multimode (62.5 μm/125 μm GI)
- Violet — Multimode (85 μm/125 μm GI)
- Grey — Multimode (100 μm/140 μm SI)
- Black — Multimode (> 200 μm SI)

STORAGE AND SHIPMENT ENVIRONMENT

The optical head should be stored in a clean, dry, vibration-free environmment. The following limitations apply to both storage and shipment:

- Temperature: -40°C to +70°C
- Humidity: <95% R.H. from 0°C to 40°C

RETURN SHIPMENTS TO HEWLETT-PACKARD

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.

NOTE: **When returning the optical head to Hewlett-Packard for service or damage claim, your Model 8152A should also be returned. A second tag showing owner and return address should be attached to the Model 8152A.**

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.

SECTION A-3

OPERATION

SPECIAL OPERATING CONSIDERATIONS

WARNING

How To Avoid Potential Exposure To Radiation

When connecting a fiber between the optical head and an optical source, make the optical head connection before the source connection. This avoids any potential exposure to radiation.

COMPENSATING FOR LENS LOSS

The HP81521B specifications apply to a parallel beam incident at the detector window. If the HP81521B is being used with a fiber, then a lens must be inserted between the connector adapter and detector window to convert the divergent light from the fiber into a parallel beam. For any lens that you order with the HP81521B, the attenuation loss has been individually measured at the factory to within 0.01dB. The measured value has then been marked on the lens casing as a 'CAL' factor, e.g. CAL -.19dB.

As explained in the HP8152A manual, you can make CAL factor entries to compensate for any known losses. If you want to compensate for the lens attenuation in your measurement, the entry procedure is as follows:

1. Select SET mode at key **(4)**, and the channel to which the optical head is connected at key **(5)**

The parameter menu is now highlighted above keys **(7)** to **(9)**, and the last parameter entry you made in single channel operation is displayed. Now make the following entry:

2. Press the CAL key to display the current CAL factor entry. Use the VERNIER rocker keys to enter the value marked on the lens casing, e.g. if -.19dB is marked, then enter -0.19dB.

No further key operation is required as the CAL factor is now automatically stored and activated.

CLEANING THE LENS

CAUTION

The lens must not be cleaned via ultra-sonic bath or immersion in a fluid. Only wipe-clean is allowed to ensure optical specifications.

For lens cleaning, especially the multimode lens, it is recommended that you carry out the following procedure in which the HP Model 15457A Cleaning Kit is used.

1. Unscrew the lens from the optical head.

2. Hold the lens so that the **surface to be cleaned is facing downwards**. For multimode lenses in which a two-lens construction is used, this is critical as it ensures that no cleaning fluid can leak into the cavity between the two lenses.

3. Apply a small amount of the Head Cleaner to a Q-tip and carefully clean the lens surface. Wait until the lens surface is dry.

4. Repeat steps 2 and 3 for the opposite lens surface using a new Q-tip.

6. Rescrew the lens onto the optical head.

NOTE: **Never use abrasive materials to clean the lens. The use of such materials can damage the lens and drastically affect the performance of an optical system. Use only the cleaning agent supplied with the kit, or a similar product.**

TRANSDUCER OUTPUTS

The XDCR output for each channel on the mainframe HP8152A provide the electrical equivalent of low frequency inputs to the HP81521B on that channel. The $3dB_{elec}$ cutoff frequency is 700Hz.

NOTE: Since the output voltage represents input power, there is a conversion factor of 2 from dB_{opt} to dB_{elec}. The $3dB_{opt}$ frequency ($6dB_{elec}$) is 1.2kHz.

SECTION A-4

PERFORMANCE TESTS

4-1 INTRODUCTION

4-2 The procedures in this section test the optical performance of the instrument.The complete specifications to which the HP81521B is tested are given in Table A-1. All tests can be performed without access to the interior of the instrument.

4-3 EQUIPMENT REQUIRED

4-4 Equipment required for the performance test is listed in Table A-2. Recommended Test Equipment. Any equipment which satisfies the critical specifications given in the table may be substituted for recommended models.

Table A-2. Recommended Test Equipment

Instrument/Accesory	Rec. Model	Critical Specification
Power Meter Standard	HP8152A 81521B	Accuracy < 2%
Optical Attenuator	HP8158B	0.01dB Resolution
Lens Adapter for single-mode	HP81010BL	
Connector Adapter	HP81000AA	
Single-Mode Fiber	HP81101AC	
13000 nm Laser Source		0dBm into single-mode fiber
Single-Mode Fiber	HP81101xx	Source dependent
Cleaning Kit	HP15475A	

4-5 TEST RECORD

4-6 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.

4-7 TEST FAILURE

4-8 If the HP81521B fails any performance test, return the instrument to the nearest Hewlett-Packard Sales/Service Office for repair.

4-9 INSTRUMENTS SPECIFICATION

4-10 Specifications are the performance characteristics of the instrument which are certified. These specifications, listed in Table A-1 are the performance standards or limits against which the HP81521B can be tested. Table A-1 also lists some supplemental characteristics of the HP81521B and should be considered as additional information.

4-11 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 supersede any previously published.

4-12 PERFORMANCE TEST

4-13 The performance tests given in this section are separated into Accuracy Test and Linearity 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.

The Optical Cables from the Laser Source to and from the 8158B Attenuator to the Power Meter must be fixed on the table to ensure minimum cable movement during the tests.

4-14 81521B ACCURACY and LINEARITY TEST

Equipment required:

Power Meter Standard HP8152A with 81521B Optical Head
Optical Attenuator HP8158B
Lens Adapter for single-mode HP81010BL
Connector Adapter HP81000AA
Single-Mode Fiber HP81101AC
13000 nm Laser Source (0dBm into single mode fiber)
Single-Mode Fiber HP8181101xx (Source dependent)

Specifications:

Traceable accuracy: ± 5%
Accuracy (rel. to calibration at 1300nm and -20dBm) in the 0dBm, -10dBm, -20dBm, -30dBm and -40dBm Range : ± 0.15dB of reading
-50dBm Range : ± 0.15dB + 100pW.

CALIBRATION ACCURACY TEST

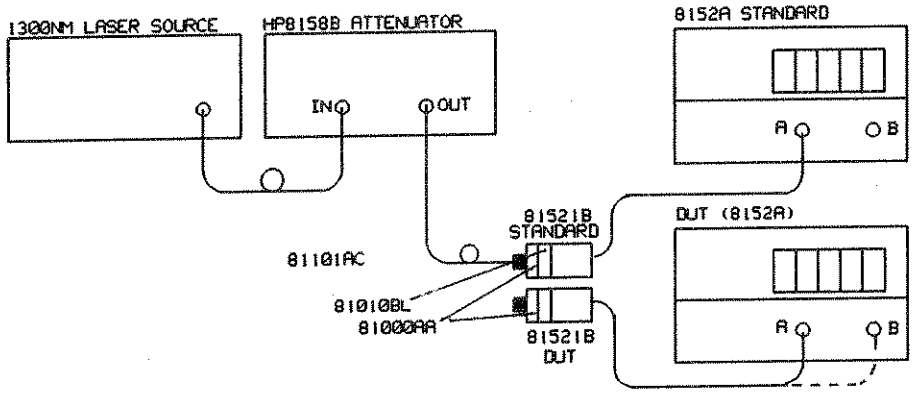


Figure A-2

1. Make sure that cable connectors, lenses and detector windows are clean.

2. Connect the equipment as shown in Figure A-2. Ensure that the cables to and from the Attenuator are fixed on the table and both optical heads (Standard and DUT) are close together so that minimum cable movement is achieved when connecting the cable to the Standard Head or to the DUT Head.

3. Turn the instruments on and allow to warm up for at least 30 minutes.

4. Set the CAL factor of both instruments to the lens calibration factor marked on the corresponding 81010BL lens.

5. Set the WAVELENGTH of both instruments to the wavelength of the Laser Source.

6. Set both instruments to MEASure, switch AUTOrange off and select the -20dBm range.

7. Disable the 8158B output and ZERO the Power Meter Standard.

8. Enable the 8158B output and change the attenuation until the Power Meter Standard displays -20.00 dBm.

9. Disable the 8158B output and connect the cable to the DUT.

10. ZERO the DUT, enable the 8158B output and check that the DUT display is between -19.79dBm and -20.22dBm.

LINEARITY TEST

11. Select display in dB on the DUT and set DISPlay to REFerence.

12. Reconnect the 8158B output cable to the Power Meter Standard, select display in dB and set DISPlay to REFerence on the Standard too.

13. Set the Power Meter Standard and the DUT to the 0dBm range and using the attenuator adjust the power level so that the Standard displays 16.50dB.

14. Connect the 8158B output cable to the DUT and check that the DUT display reading is between 16.65 dB and 16.35 dB.

15. Repeat the level comparison as described in steps 13 and 14 at following range and level settings:

Standard and DUT Range	Power Level set on Standard	DUT Reading max.	DUT Reading min.
0dBm	12.50dB	12.65dB	12.35dB
-10dBm	12.50dB	12.65dB	12.35dB
	10.00dB	10.15dB	9.85dB
	3.00dB	3.15dB	2.85dB
-20dBm	2.50dB	2.65dB	2.35dB
	0.00dB	0.15dB	-0.85dB
	-7.00dB	-6.85db	-7.15dB
-30dBm	-7.50dB	-7.35dB	-7.65dB
	-10.00dB	-9.85dB	-10.15dB
	-17.00dB	-16.85dB	-17.15dB
-40dBm	-17.50dB	-17.35dB	-17.65dB
	-20.00dB	-19.85dB	-20.15dB
	-27.00dB	-26.85dB	-27.15dB
-50dBm	-27.50dB	-27.33dB	-27.67dB
	-30.00dB	-29.81dB	-30.19dB
	-37.00dB	-36.64dB	-37.36dB

Hewlett-Packard Model 81521B | Test Performed By _____

Optical Optical Head | Date _____

Serial Number _____ | Comments _____

4-14 ACCURACY AND LINEARITY TEST

Test Condition: 1300nm wavelength with single-mode fibers

Step	Description				Test Pass	Test Fail
	Accuracy Test					
	Standard and DUT Range	Power Level set on Standard	DUT reading in dBm max.	DUT reading in dBm act.	DUT reading in dBm min.	
8-10.	-20dBm	-20.00dBm	-19.79	_____	-20.22	____ ____
	Linearity Test					
	Standard and DUT Range	Power Level set on Standard	DUT reading in dB max.	DUT reading in dB act.	DUT reading in dB min.	
15.	0dBm	12.50dB	12.65	_____	12.35	____ ____
	-10dBm	12.50dB	12.65	_____	12.35	____ ____
		10.00dB	10.15	_____	9.85	____ ____
		3.00dB	3.15	_____	2.85	____ ____
	-20dBm	2.50dB	2.65	_____	2.35	____ ____
		0.00dB	0.15	_____	-0.85	____ ____
		-7.00dB	-6.85	_____	-7.15	____ ____
	-30dBm	-7.50dB	-7.35	_____	-7.65	____ ____
		-10.00dB	-9.85	_____	-10.15	____ ____
		-17.00dB	-16.85	_____	-17.15	____ ____
	-40dBm	-17.50dB	-17.35	_____	-17.65	____ ____
		-20.00dB	-19.85	_____	-20.15	____ ____
		-27.00dB	-26.85	_____	-27.15	____ ____
	-50dBm	-27.50dB	-27.33	_____	-27.67	____ ____
		-30.00dB	-29.81	_____	-30.19	____ ____
		-37.00dB	-36.64	_____	-37.36	____ ____

OPERATING MANUAL

HP81521B OPTICAL HEAD 850nm to 1700nm

SERIAL NUMBERS

This manual applies directly to instruments with serial number 2602G00101 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.

HERRENBERGER STR. 130, D-7030 BOBLINGEN
FEDERAL REPUBLIC OF GERMANY

MANUAL PART No. 81521-90011
MICROFICHE PART No. 81521-95011

PRINTED: MAY 1986

SAFETY

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded.

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

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

For warranty service or repair, this product must be returned to a service facility designated by HP. However, warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within the HP service travel area. 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.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

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. HP 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. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GENERAL – This is a Safety Class I instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

OPERATION – BEFORE APPLYING POWER comply with the installation section. Additionally, the following shall be observed:

Do not remove instrument covers when operating.

Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers and devices connected to it should be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation is present. Do not replace components with power cable connected.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

SAFETY SYMBOLS

The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Indicates dangerous voltages.

Earth terminal

WARNING

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

CAUTION

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

WARNING

Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

5955-0713

HEWLETT PACKARD

Publication:
Hewlett-Packard GmbH, Böblingen, Dec. 1979

Printed in the Federal Republic of Germany

SAFETY SUMMARY

CONTENTS

SECTION A-1

GENERAL INFORMATION

INTRODUCTION

This appendix provides the supplementary information required when an HP81521B Optical Head is connected to the HP8152A Optical Average Power Meter. The information is HP81521B specific and covers installation, operation and performance tests.

SPECIFICATIONS

Specifications of the HP81521B are given in Table A-1. These specifications are the performance standards or limits against which the optical head is tested.

SAFETY CONSIDERATIONS

CAUTION

Before connecting the optical head to the HP8152A, ensure that the HP8152A is connected to protective (earth) ground.

OPTICAL HEADS COVERED BY THIS APPENDIX

Each optical head has a two-part serial number. The first 4 digits and the letter comprise the serial prefix; the last 5 digits a sequential suffix which is unique to each HP81521B. The contents of this appendix apply directly to optical heads having the serial prefix 2602G.

DESCRIPTION

The HP81521B is the standard optical head for the HP8152A Optical Average Power Meter when operating in the wavelength range 850nm → 1700nm. This head covers single- and multimode fibers up to 100 μm core diameter.

At the factory, correction factors over the entire wavelength range are individually measured and stored in each optical head. This ensures precise power measurements, even when the source-under-test has an operating wavelength other than 1300nm. The dynamic range is +3 → -80dBm with the noise floor being well below -70dBm to provide the sensitivity needed for a wide range of applications.

A large variety of optical adapters is available to simplify connection of the HP81521B to the device-under-test. If it is necessary to measure power levels above +3dBm, fixed attenuation filters can be easily inserted into an optional filter holder.

ACCESSORIES AVAILABLE

A number of accessories are available to aid measurement and simplify connection to either bare or terminated fibers. The accessories are listed as follows:

- **CONNECTOR ADAPTERS**

81000AA	for connection with Diamond HMS-10/HP connector
81000BA	for connection with bare fiber (125 µm cladding)
81000FA	for connection with FC or PC connectors
81000GA	for connection with NEC D4 connector
81000JA	for connection with AMP SMA or Amphenol 906 connectors
81000LA	for connection with F & G 3702 connector
81000NA	for connection with Stratos 430 connector
81000WA	for connection with Biconic connector
81000YA	for connection with Diamond HFS-1 connector
81000ZA	blank adapter for connection with any other connectors

- **LENSES**

81010BL	lens for 1300nm, 1550nm, and 9/125µm or 10/125µm fiber.
81050BL	lens for 1300nm, 1550nm, and 50/125µm or 62.5/125µm fiber

- **FILTERHOLDER**

81000AF	filterholder for filters with 1-inch diameter

- **POWER SPLITTER**

81000BS	10:1 power splitter for single- and multimode; fiber core diameters from 9µm to 85µm (NA $\leqslant$ 0.3).

An additional accessory for the HP81521B is the HP15475A 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.

Table A-1. Specifications

Specifications describe the instrument's warranted performance. They apply to optical input signals transmitted in parallel beam. Use appropriate lenses and connector adapters for the optical head to accomodate light emerging from optical fibers.

Optical Characteristics

Wavelength Range: 850nm to 1700nm, actual wavelength user-selectable. Each optical head is individually calibrated over wavelength between 850nm and 1700nm. Correction factors are stored in its non-volatile memory.

Sensor Element: Cooled Ge PIN diode
Sensor Diameter: 5mm
Maximum Power Density: $10mW/mm^2$

Power Measurements

Accuracy specifications measured at DC power levels and "Zero" enabled prior to measurement. They are valid between 1000nm and 1600nm.

Measurement Range: 3dBm to -80dBm
Resolution: 4 1/2 digits, 0.01dB, 10pW best case

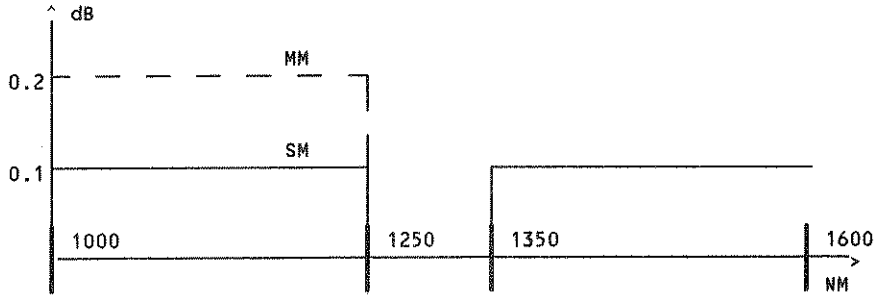
Accuracy
Traceable calibration accuracy: ±5%
Accuracy (rel. to calibration at 1300nm and -20dBm log. reading, 0 to 40°C ambient temp., 10 to 100% full scale, -50dBm range 100pW to 100%):

Range [dBm]	Average Power ±(of read + Watts)
0	0.15dB
-10	0.15dB
-20	0.15dB
-30	0.15dB
-40	0.15dB
-50	0.15dB + 100pW

Accuracy derating factor over temperature:

Accuracy at 25°C±5°C between 3dBm and -60dBm: typ.<±0.05dB

Accuracy of lens coating over wavelength (typical):



General

Recalibration period: 1 year
Warm-up time: 5 minutes

Bandwidth (-3dB) at XDCR OUT of 8152A: typ. 700Hz

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

Dimensions: 37.7mm diameter, 140mm length (1.5"x5.5")

Weight: net 0.45kg (1lbs), shipping 1kg (2.2lbs)

SECTION A-2

INSTALLATION

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 optical head has been verified both mechanically and optically.

Procedures for checking the optical operation are given in Section A-4. If the contents are incomplete, mechanical damage or defect is apparent, or if an optical head 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.

HANDLING PRECAUTION

CAUTION

Do not drop or otherwise mechanically damage the optical head.
Do not install the optical head in an environment where strong vibrations or self-heating may occur.

OPTICAL CONNECTIONS

For each optical head, various accessories can be ordered that aid measurement as well as connection to bare or terminated fibers. Depending on which accessories have been ordered, the following Figure A-1 shows the sequence in which they are attached to the optical head.

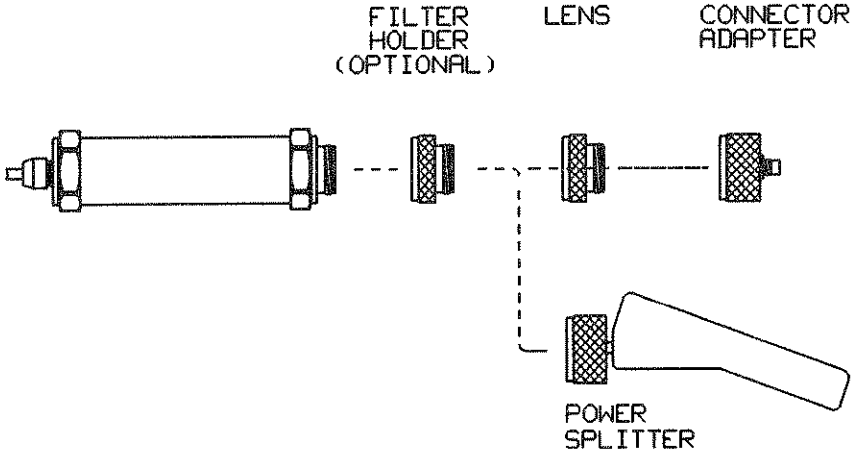


Figure A-1. Optical Connections

Note that the optical head and its various accessories are marked with coloured dots to indicate wavelength and fiber type. The convention used is as follows:

Note that the optical head and its various accessories are marked with coloured dots to indicate wavelength and fiber type. The convention used is as follows:

Wavelength

- Red — 2nd λ-window (1300nm)
- Orange — 3rd λ-window (1550nm)

Fiber Type

- White — single-mode (9 μm)
- Green — Multimode (50 μm/125 μm GI)
- Blue — Multimode (62.5 μm/125 μm GI)
- Violet — Multimode (85 μm/125 μm GI)
- Grey — Multimode (100 μm/140 μm SI)
- Black — Multimode (> 200 μm SI)

STORAGE AND SHIPMENT ENVIRONMENT

The optical head should be stored in a clean, dry, vibration-free environmment. The following limitations apply to both storage and shipment:

- Temperature: -40°C to +70°C
- Humidity: <95% R.H. from 0°C to 40°C

RETURN SHIPMENTS TO HEWLETT-PACKARD

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.

NOTE: **When returning the optical head to Hewlett-Packard for service or damage claim, your Model 8152A should also be returned. A second tag showing owner and return address should be attached to the Model 8152A.**

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.

SECTION A-3

OPERATION

SPECIAL OPERATING CONSIDERATIONS

WARNING

How To Avoid Potential Exposure To Radiation

When connecting a fiber between the optical head and an optical source, make the optical head connection before the source connection. This avoids any potential exposure to radiation.

COMPENSATING FOR LENS LOSS

The HP81521B specifications apply to a parallel beam incident at the detector window. If the HP81521B is being used with a fiber, then a lens must be inserted between the connector adapter and detector window to convert the divergent light from the fiber into a parallel beam. For any lens that you order with the HP81521B, the attenuation loss has been individually measured at the factory to within 0.01dB. The measured value has then been marked on the lens casing as a 'CAL' factor, e.g. CAL -.19dB.

As explained in the HP8152A manual, you can make CAL factor entries to compensate for any known losses. If you want to compensate for the lens attenuation in your measurement, the entry procedure is as follows:

1. Select SET mode at key (4), and the channel to which the optical head is connected at key (5)

The parameter menu is now highlighted above keys (7) to (9), and the last parameter entry you made in single channel operation is displayed. Now make the following entry:

2. Press the CAL key to display the current CAL factor entry. Use the VERNIER rocker keys to enter the value marked on the lens casing, e.g. if -.19dB is marked, then enter -0.19dB.

No further key operation is required as the CAL factor is now automatically stored and activated.

CLEANING THE LENS

CAUTION

The lens must not be cleaned via ultra-sonic bath or immersion in a fluid. Only wipe-clean is allowed to ensure optical specifications.

For lens cleaning, especially the multimode lens, it is recommended that you carry out the following procedure in which the HP Model 15457A Cleaning Kit is used.

1. Unscrew the lens from the optical head.

2. Hold the lens so that the **surface to be cleaned is facing downwards.** For multimode lenses in which a two-lens construction is used, this is critical as it ensures that no cleaning fluid can leak into the cavity between the two lenses.

3. Apply a small amount of the Head Cleaner to a Q-tip and carefully clean the lens surface. Wait until the lens surface is dry.

4. Repeat steps 2 and 3 for the opposite lens surface using a new Q-tip.

6. Rescrew the lens onto the optical head.

NOTE: **Never use abrasive materials to clean the lens. The use of such materials can damage the lens and drastically affect the performance of an optical system. Use only the cleaning agent supplied with the kit, or a similar product.**

TRANSDUCER OUTPUTS

The XDCR output for each channel on the mainframe HP8152A provide the electrical equivalent of low frequency inputs to the HP81521B on that channel. The $3dB_{elec}$ cutoff frequency is 700Hz.

NOTE: Since the output voltage represents input power, there is a conversion factor of 2 from dB_{opt} to dB_{elec}. The $3dB_{opt}$ frequency ($6dB_{elec}$) is 1.2kHz.

SECTION A-4

PERFORMANCE TESTS

4-1 INTRODUCTION

4-2 The procedures in this section test the optical performance of the instrument.The complete specifications to which the HP81521B is tested are given in Table A-1. All tests can be performed without access to the interior of the instrument.

4-3 EQUIPMENT REQUIRED

4-4 Equipment required for the performance test is listed in Table A-2. Recommended Test Equipment. Any equipment which satisfies the critical specifications given in the table may be substituted for recommended models.

Table A-2. Recommended Test Equipment

Instrument/Accesory	Rec. Model	Critical Specification
Power Meter Standard	HP8152A 81521B	Accuracy < 2%
Optical Attenuator	HP8158B	0.01dB Resolution
Lens Adapter for single-mode	HP81010BL	
Connector Adapter	HP81000AA	
Single-Mode Fiber	HP81101AC	
13000 nm Laser Source		0dBm into single-mode fiber
Single-Mode Fiber	HP81101xx	Source dependent
Cleaning Kit	HP15475A	

4-5 TEST RECORD

4-6 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.

4-7 TEST FAILURE

4-8 If the HP81521B fails any performance test, return the instrument to the nearest Hewlett-Packard Sales/Service Office for repair.

4-9 INSTRUMENTS SPECIFICATION

4-10 Specifications are the performance characteristics of the instrument which are certified. These specifications, listed in Table A-1 are the performance standards or limits against which the HP81521B can be tested. Table A-1 also lists some supplemental characteristics of the HP81521B and should be considered as additional information.

4-11 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 supersede any previously published.

4-12 PERFORMANCE TEST

4-13 The performance tests given in this section are separated into Accuracy Test and Linearity 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.

The Optical Cables from the Laser Source to and from the 8158B Attenuator to the Power Meter must be fixed on the table to ensure minimum cable movement during the tests.

4-14 81521B ACCURACY and LINEARITY TEST

Equipment required:

Power Meter Standard HP8152A with 81521B Optical Head
Optical Attenuator HP8158B
Lens Adapter for single-mode HP81010BL
Connector Adapter HP81000AA
Single-Mode Fiber HP81101AC
13000 nm Laser Source (0dBm into single mode fiber)
Single-Mode Fiber HP8181101xx (Source dependent)

Specifications:

Traceable accuracy: ± 5%
Accuracy (rel. to calibration at 1300nm and -20dBm) in the 0dBm, -10dBm, -20dBm, -30dBm and -40dBm Range : ± 0.15dB of reading
-50dBm Range : ± 0.15dB + 100pW.

CALIBRATION ACCURACY TEST

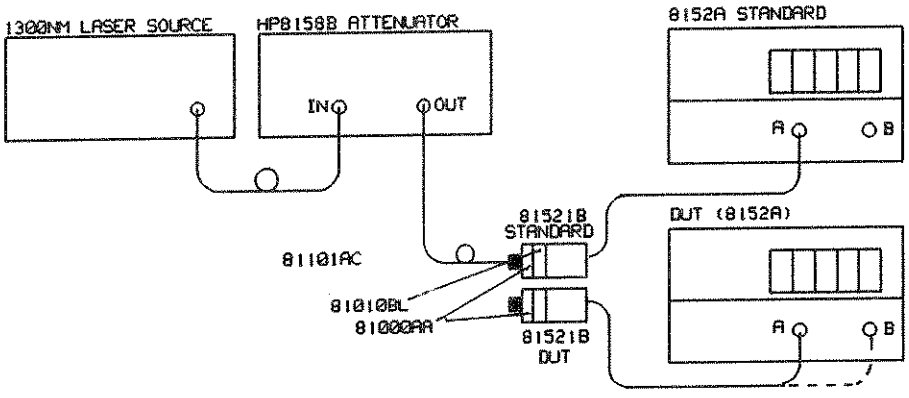


Figure A-2

1. Make sure that cable connectors, lenses and detector windows are clean.

2. Connect the equipment as shown in Figure A-2. Ensure that the cables to and from the Attenuator are fixed on the table and both optical heads (Standard and DUT) are close together so that minimum cable movement is achieved when connecting the cable to the Standard Head or to the DUT Head.

3. Turn the instruments on and allow to warm up for at least 30 minutes.

4. Set the CAL factor of both instruments to the lens calibration factor marked on the corresponding 81010BL lens.

5. Set the WAVELENGTH of both instruments to the wavelength of the Laser Source.

6. Set both instruments to MEASure, switch AUTOrange off and select the -20dBm range.

7. Disable the 8158B output and ZERO the Power Meter Standard.

8. Enable the 8158B output and change the attenuation until the Power Meter Standard displays -20.00 dBm.

9. Disable the 8158B output and connect the cable to the DUT.

10. ZERO the DUT, enable the 8158B output and check that the DUT display is between -19.79dBm and -20.22dBm.

LINEARITY TEST

11. Select display in dB on the DUT and set DISPlay to REFerence.

12. Reconnect the 8158B output cable to the Power Meter Standard, select display in dB and set DISPlay to REFerence on the Standard too.

13. Set the Power Meter Standard and the DUT to the 0dBm range and using the attenuator adjust the power level so that the Standard displays 16.50dB.

14. Connect the 8158B output cable to the DUT and check that the DUT display reading is between 16.65 dB and 16.35 dB.

15. Repeat the level comparison as described in steps 13 and 14 at following range and level settings:

Standard and DUT Range	Power Level set on Standard	DUT Reading max.	DUT Reading min.
0dBm	12.50dB	12.65dB	12.35dB
-10dBm	12.50dB	12.65dB	12.35dB
	10.00dB	10.15dB	9.85dB
	3.00dB	3.15dB	2.85dB
-20dBm	2.50dB	2.65dB	2.35dB
	0.00dB	0.15dB	-0.85dB
	-7.00dB	-6.85db	-7.15dB
-30dBm	-7.50dB	-7.35dB	-7.65dB
	-10.00dB	-9.85dB	-10.15dB
	-17.00dB	-16.85dB	-17.15dB
-40dBm	-17.50dB	-17.35dB	-17.65dB
	-20.00dB	-19.85dB	-20.15dB
	-27.00dB	-26.85dB	-27.15dB
-50dBm	-27.50dB	-27.33dB	-27.67dB
	-30.00dB	-29.81dB	-30.19dB
	-37.00dB	-36.64dB	-37.36dB

Hewlett-Packard Model 81521B | Test Performed By _____

Optical Optical Head | Date _____

Serial Number _____ | Comments _____

4-14 ACCURACY AND LINEARITY TEST

Test Condition: 1300nm wavelength with single-mode fibers

Step	Description				Test Pass	Test Fail
	Accuracy Test					
	Standard and DUT Range	Power Level set on Standard	DUT reading in dBm max.	DUT reading in dBm act.	DUT reading in dBm min.	
8-10.	-20dBm	-20.00dBm	-19.79	_____	-20.22	____ ____
	Linearity Test					
	Standard and DUT Range	Power Level set on Standard	DUT reading in dB max.	DUT reading in dB act.	DUT reading in dB min.	
15.	0dBm	12.50dB	12.65	_____	12.35	____ ____
	-10dBm	12.50dB	12.65	_____	12.35	____ ____
		10.00dB	10.15	_____	9.85	____ ____
		3.00dB	3.15	_____	2.85	____ ____
	-20dBm	2.50dB	2.65	_____	2.35	____ ____
		0.00dB	0.15	_____	-0.85	____ ____
		-7.00dB	-6.85	_____	-7.15	____ ____
	-30dBm	-7.50dB	-7.35	_____	-7.65	____ ____
		-10.00dB	-9.85	_____	-10.15	____ ____
		-17.00dB	-16.85	_____	-17.15	____ ____
	-40dBm	-17.50dB	-17.35	_____	-17.65	____ ____
		-20.00dB	-19.85	_____	-20.15	____ ____
		-27.00dB	-26.85	_____	-27.15	____ ____
	-50dBm	-27.50dB	-27.33	_____	-27.67	____ ____
		-30.00dB	-29.81	_____	-30.19	____ ____
		-37.00dB	-36.64	_____	-37.36	____ ____

Product Line Sales/Support Key

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A Analytical
CM Components
C Computer Systems
E Electronic Instruments & Measurement Systems
M Medical Products
P Personal Computation 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.

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

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Eldan Electronic Instrument Ltd.
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11 Masad Street
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TEL-AVIV
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Suhail & Saud Bahwan
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Imtac LLC
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Telex: 5304
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Telex: 22561 CARTEL WG
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Telex: 3000 POSTLX WG, ACCT LOO9O AGENCY 1264
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Feral Assoc.
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Telex: 22432 FERALCO
Cable: FERALCO
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Telex: 13238
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Mediha Eldem Sokak No. 41/6
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SEPT. 1985

SALES & SUPPORT OFFICES
Arranged alphabetically by country

OPERATING AND PROGRAMMING MANUAL SUPPLEMENT

MODEL No. 81521B
SPECIAL No. # H01

This special option provides a 4 m connecting cord mounted on the HP 81521B Optical Head, instead of the standard 1 m cable.

MATERIAL LIST

Description	Part-Number	Qty	Comment
Tubing-Flexible	0890-1687	-1.20 MT	Delete
Tubing-Flexible	0890-1687	+4.20 MT	Add
Cbl Ay Plug, 1 MT	81521-61602	-1	Delete
Cbl Ay Plug, 4 MT	81521-61603	+1	Add

Note: If the unit is returned to Hewlett-Packard for any reason, please make sure that this Operating and Programming Manual Supplement is also returned with it.

Date: Sept. 1988

Hewlett-Packard GmbH Herrenberger Strasse 130, D-7030 Boeblingen, West Germany

HEWLETT PACKARD