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User's Guide

HP 86140A Series
Optical Spectrum Analyzer

HEWLETT® PACKARD

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This Hewlett-Packard instrument 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 Hewlett-Packard. Buyer shall prepay shipping charges to Hewlett-Packard and Hewlett-Packard shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Hewlett-Packard from another country.

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Safety Symbols.

CAUTION
The *caution* sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the product. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

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


The instruction manual symbol. The product is marked with this warning symbol when it is necessary for the user to refer to the instructions in the manual.


The laser radiation symbol. This warning symbol is marked on products which have a laser output.


The AC symbol is used to indicate the required nature of the line module input power.


The ON symbols are used to mark the positions of the instrument power line switch.


The OFF symbols are used to mark the positions of the instrument power line switch.


The CE mark is a registered trademark of the European Community.


The CSA mark is a registered trademark of the Canadian Standards Association.


The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.

ISM1-A
This text denotes the instrument is an Industrial Scientific and Medical Group 1 Class A product.

General Safety Considerations

This product has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Install the instrument according to the enclosure protection provided.
This instrument does not protect against the ingress of water.
This instrument protects against finger access to hazardous parts within the enclosure.

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

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

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

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

CAUTION Fiber-optic connectors are easily damaged when connected to dirty or damaged cables and accessories. The HP 86140 series's front-panel INPUT connector is no exception. When you use improper cleaning and handling techniques, you risk expensive instrument repairs, damaged cables, and compromised measurements. Before you connect any fiber-optic cable to the HP 86140 series, refer to "Cleaning Connections for Accurate Measurements" on page 6-10.

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

CAUTION Do not use too much liquid in cleaning the optical spectrum analyzer. Water can enter the front-panel keyboard, damaging sensitive electronic components.

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

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

CAUTION *Do not* connect ac power until you have verified the line voltage is correct as described in "Line Power Requirements" on page 1-7. Damage to the equipment could result.

CAUTION This instrument has autoranging line voltage input. Be sure the supply voltage is within the specified range.

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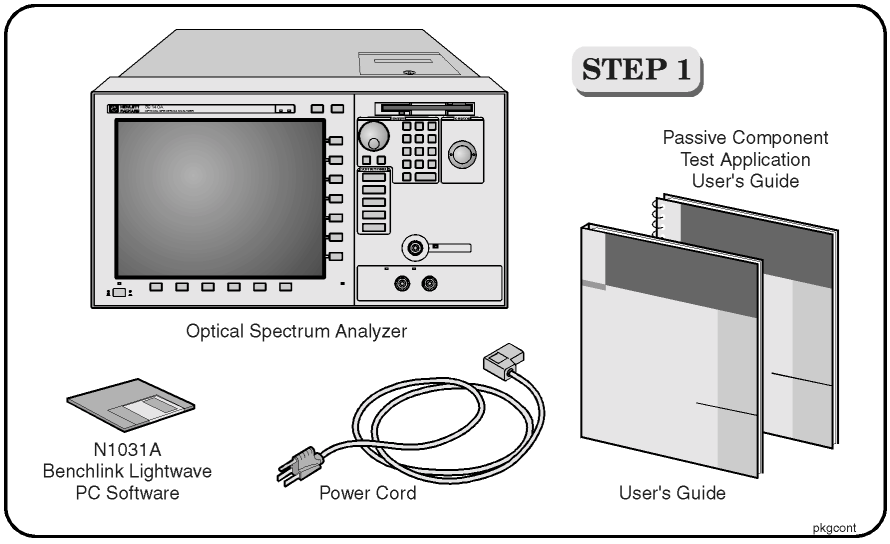
1

Setting Up the OSA

Setting Up the OSA

This chapter shows you how to set up your optical spectrum analyzer, connect power and accessories, and verify general operation. Although the pictures in this section show an HP 86140A or 86142A optical spectrum analyzer, setting up other HP 86140-series optical spectrum analyzers is very similar. Refer to Chapter 6, "Reference" for the following additional information:

- Tips on avoiding *costly* repairs by proper optical connection cleaning techniques.
- List of available options, accessories, and power cords.
- Instructions on returning your instrument to HP for service.
- HP Sales and Service Offices.



Package contents for HP 86140 series optical spectrum analyzers

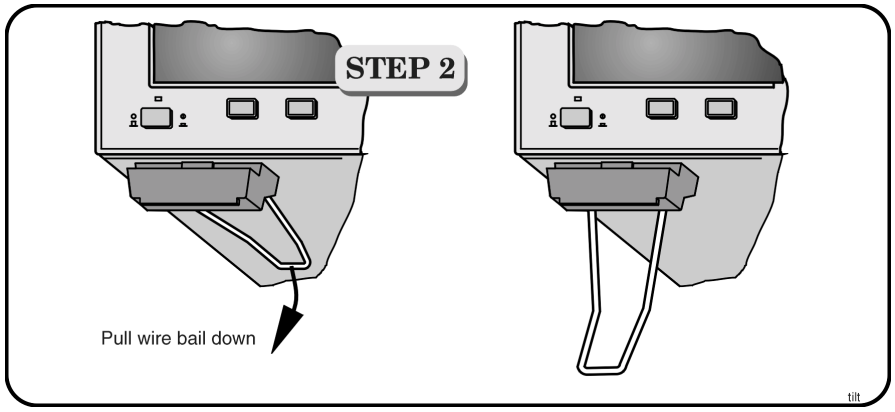
- ❒ Inspect the shipping container for damage.
- ❒ Inspect the instrument.
- ❒ Verify that you received the options and accessories you ordered.

Keep the shipping container and cushioning material until you have inspected the contents of the shipment for completeness and have checked the optical spectrum analyzer mechanically and electrically.

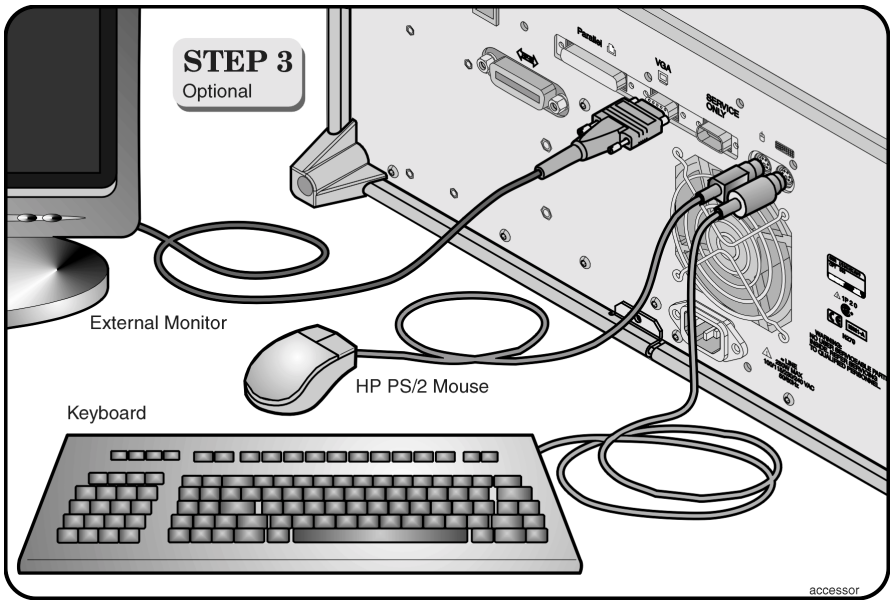
If anything is missing or defective, contact your nearest Hewlett-Packard Sales Office. If the shipment was damaged, contact the carrier, then contact the nearest Hewlett-Packard Sales Office. Keep the shipping materials for the carrier's inspection. The HP Sales Office will arrange for repair or replacement at Hewlett-Packard's option without waiting for claim settlement.

Note

The N1031A BenchLink software allows you to upload graphics and trace date to a personal computer for preparing a report, creating an analysis, or storing the waveforms for later use.



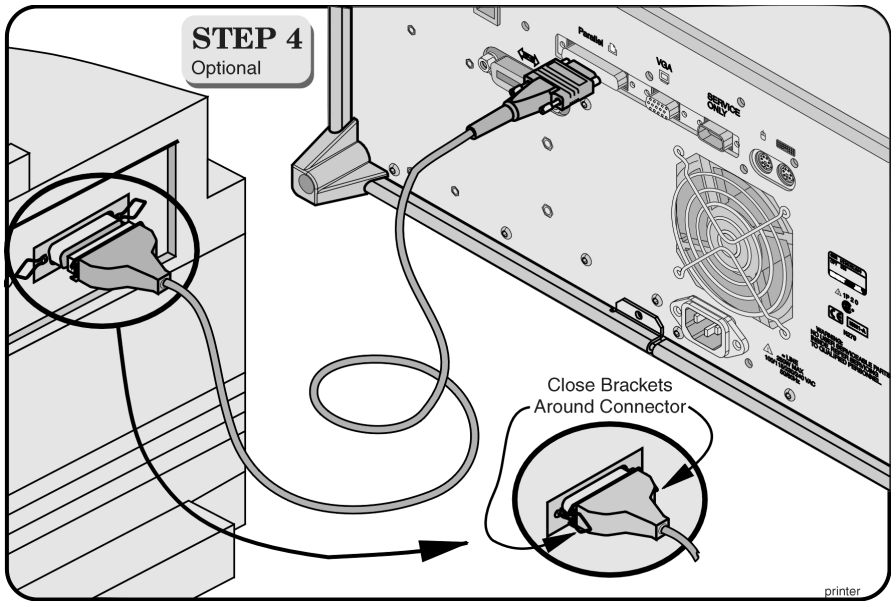
You can tilt your instrument upward for easier viewing. On the HP 86140A and 86142A instruments, lift up the front of the instrument, grasp one of the wire bails under the front corner, and pull it down and forward until it latches into place. Repeat for the other wire bail. On HP 86143A and 86145A instruments, pivot the handle to tilt the instrument.



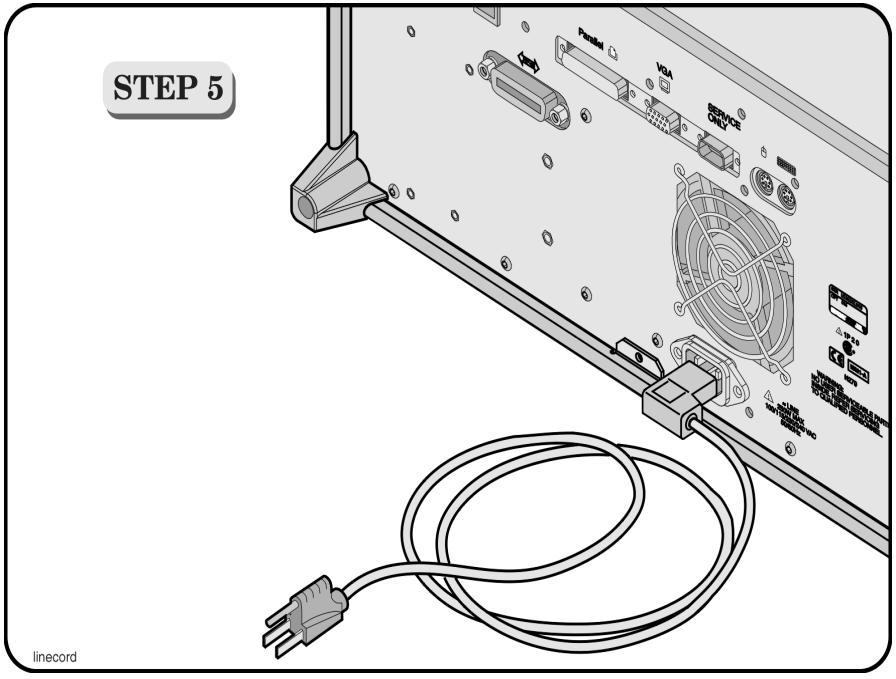
Although you can operate all instrument functions using only the front-panel keys and trackball, these accessories make your optical spectrum analyzer even easier to use! Connect any standard PC-compatible mouse (or other pointing device), keyboard, or external VGA-compatible display.

CAUTION

Do *not* stack other objects on the keyboard; this will cause self-test failures on power-on.



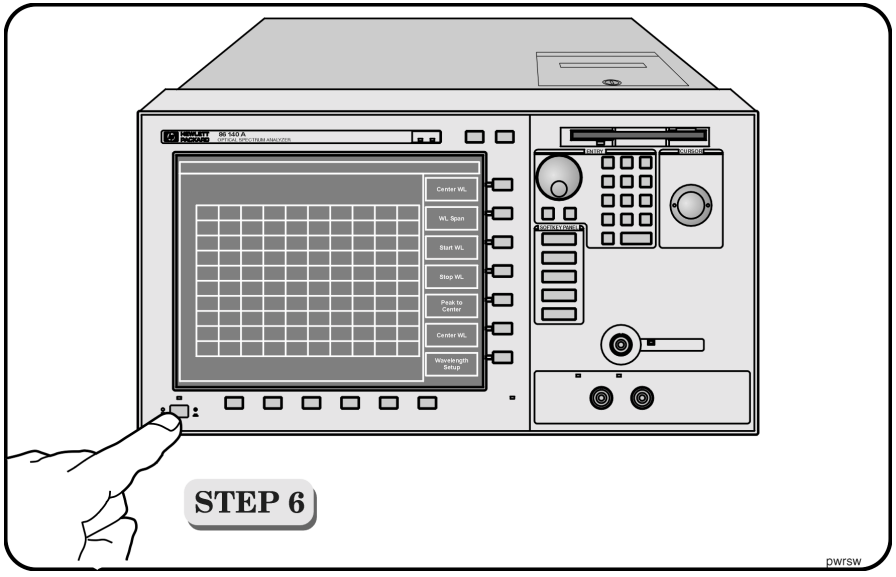
You can connect a PCL-language printer (for example, an HP LaserJet) to the instrument's rear panel Parallel connector. Use a parallel Centronics printer cable, such as an HP C2950A (2 m) or HP C2951A (3 m).



The optical spectrum analyzer automatically adjusts for line input voltages in the range of 100 to 240 VAC. There is no manual selection switch. The line cord provided is matched by HP to the country of origin of the order. Refer to "AC Line-Power Cords" on page 6-4.

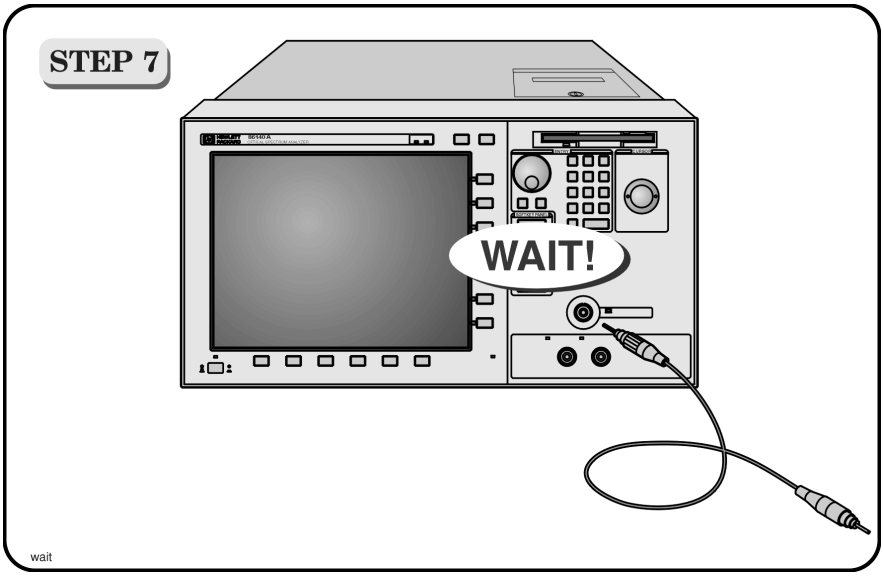
Line Power Requirements

Power	115 VAC: 110 VA MAX. / 60 WATTS MAX. / 1.1 A MAX. 230 VAC: 150 VA MAX. / 70 WATTS MAX. / 0.6 A MAX.
Voltage	nominal: 115 VAC / 230 VAC range 115 VAC: 90–132 V range 230 VAC: 198–254 V
Frequency	nominals: 50 Hz / 60 Hz range: 47–63 Hz



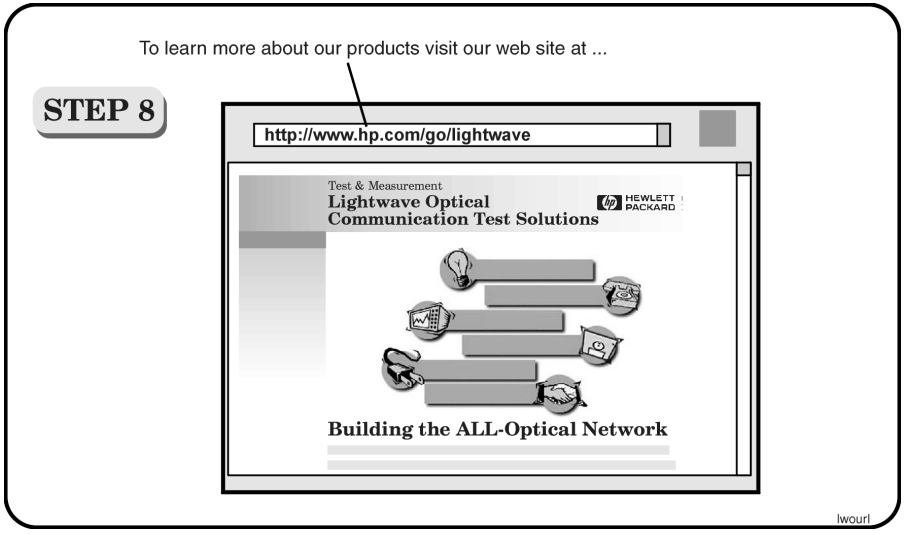
- Press the power switch at the lower left-hand corner of the front panel.

  After a short initialization period, the display will look similar to the picture on this page. The instrument is ready to use.



CAUTION

Fiber-optic connectors are easily damaged when connected to dirty or damaged cables and accessories. The HP 86140 series's front-panel INPUT connector is no exception. When you use improper cleaning and handling techniques, you risk expensive instrument repairs, damaged cables, and compromised measurements. Before you connect any fiber-optic cable to the HP 86140 series optical spectrum analyzer, refer to "Cleaning Connections for Accurate Measurements" on page 6-10.


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http://www.hp.com/go/lightwave
Test & Measurement
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Communication Test Solutions
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Building the ALL-Optical Network
lwourl

2

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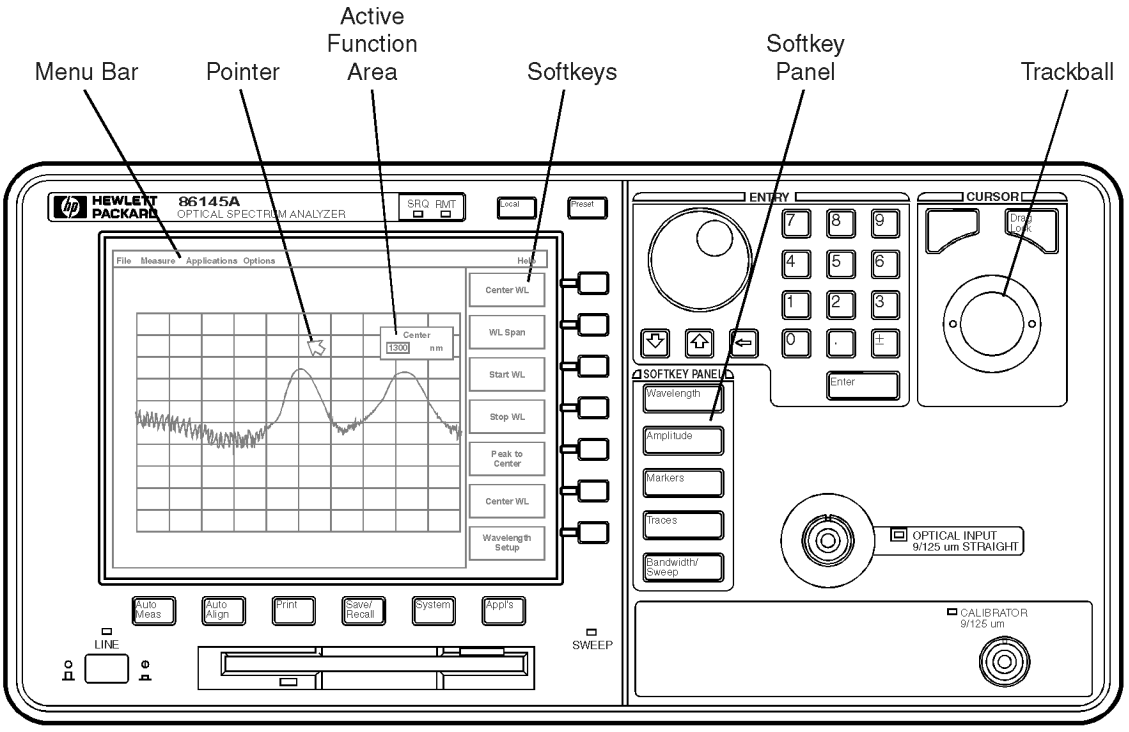
A Quick Tour

A Quick Tour

HP 86140A-series optical spectrum analyzers display input light spectra from 600 nm to 1700 nm. To change instrument settings use the softkeys. To display different softkeys use these items:

- Softkey panel and softkeys
- Print, Save/Recall, System, and Application keys
- Menu bar

The menu bar or keys can be used to access the same functions. Use the trackball or an optional pointing device to make menu and softkey selections.



All displayed wavelength values show values as measured in a vacuum. This default setting can be changed to show values as measured in air. See "To change the default wavelength settings" on page 3-63 for more information.

The OPTICAL INPUT connector on standard instrument versions uses *single mode fiber*. Connecting multi-mode fiber to these connectors results in large reflections and insertion loss.

Auto Align

To ensure maximum amplitude accuracy, connect an input signal to the instrument and then press Auto Align. This starts an automatic alignment procedure that should be performed whenever the instrument has been:

- moved,
- subjected to large temperature changes, or
- warmed up at the start of each day.

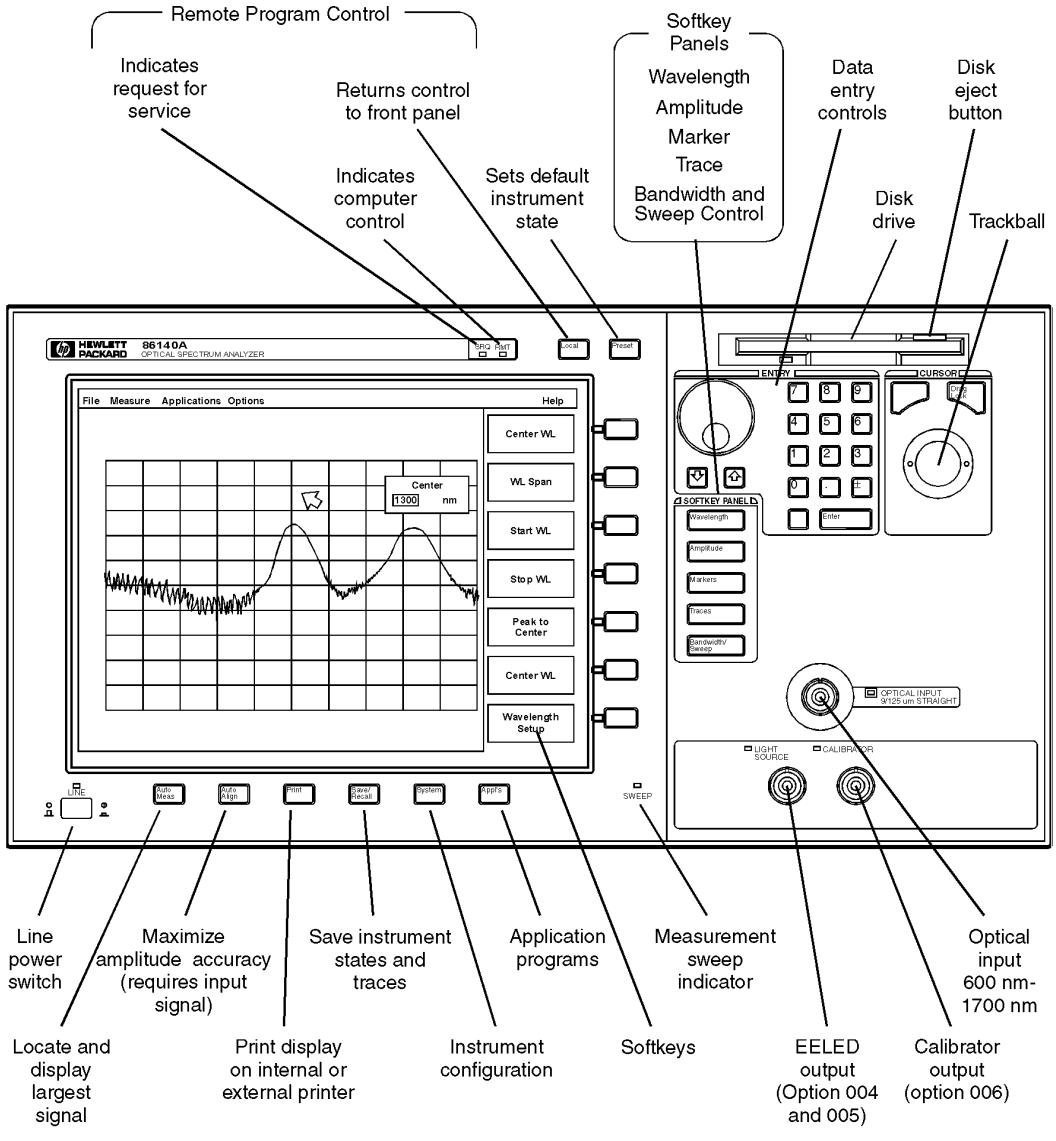
Auto Meas

Press the Auto Meas key to automatically locate the largest signal present at the input connector.

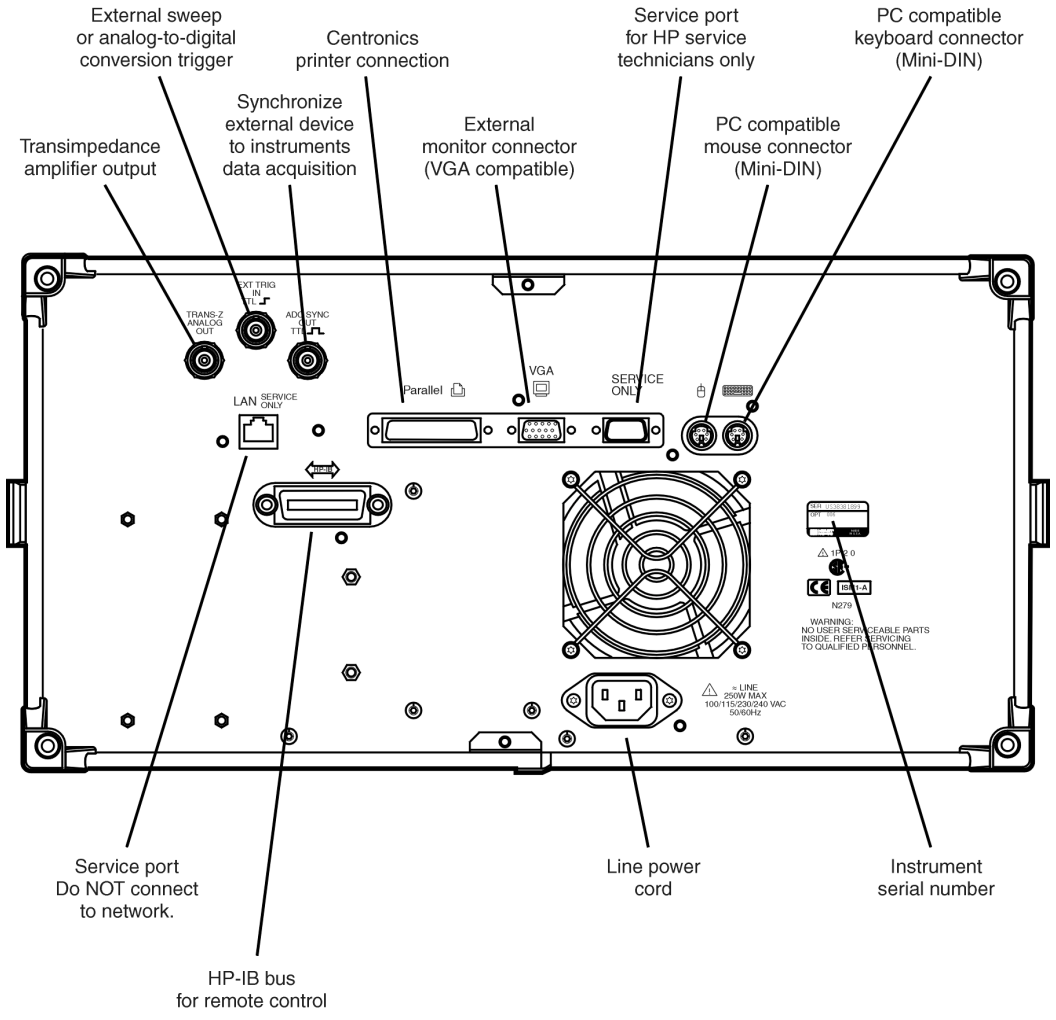
Appl's

Additional software applications can be purchased and installed in your optical spectrum analyzer. These applications automate and simplify your measurement tasks. Press this key to access your applications.

HP 86140/2 Front and Rear Panels

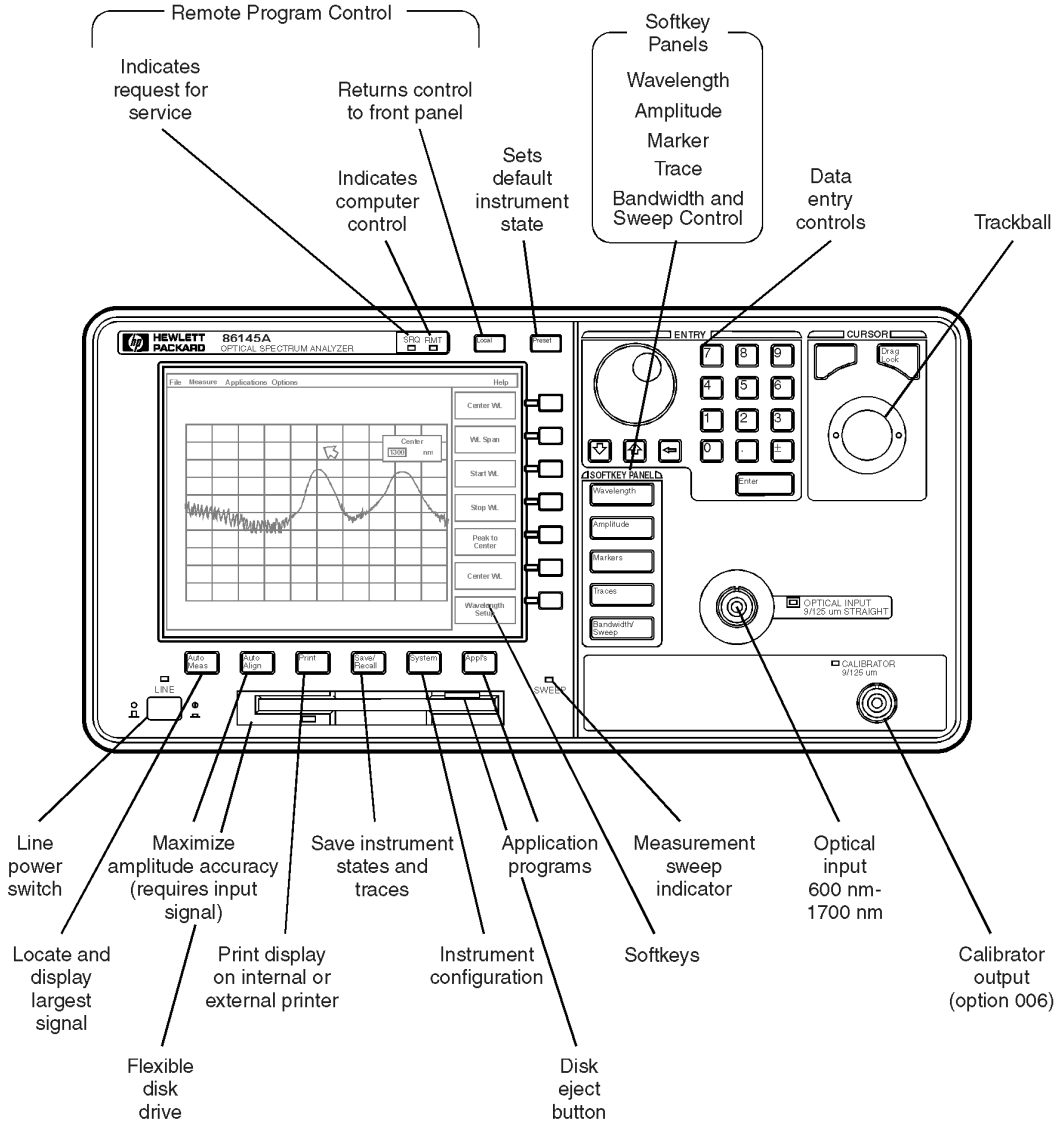


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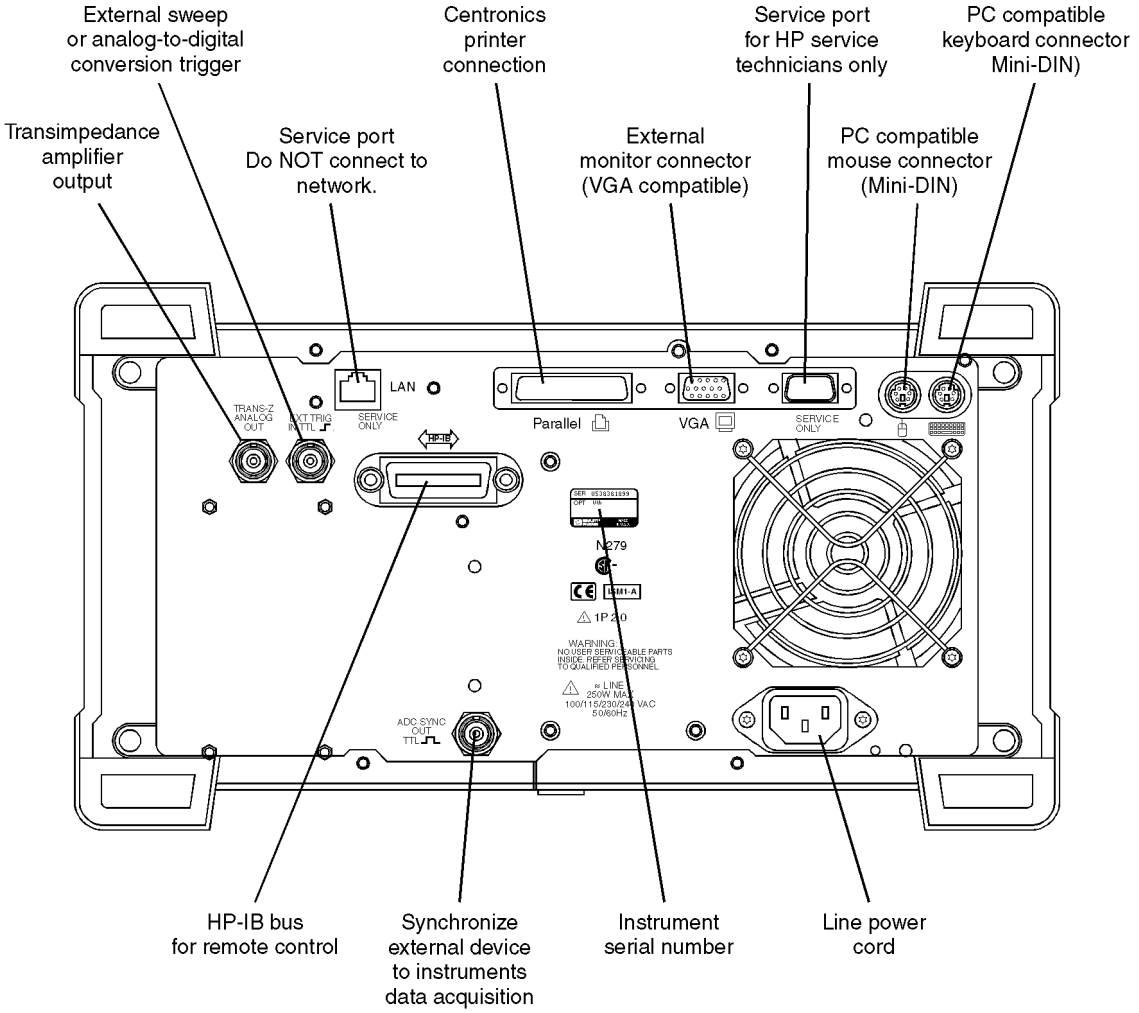

External sweep or analog-to-digital conversion trigger
Centronics printer connection
Service port for HP service technicians only
PC compatible keyboard connector (Mini-DIN)
Synchronize external device to instruments data acquisition
External monitor connector (VGA compatible)
PC compatible mouse connector (Mini-DIN)
Transimpedance amplifier output
EXT TRIG IN TTL
TRANS-Z ANALOG OUT
ADC SYNC OUT TTL
LAN
SERVICE ONLY
Parallel
VGA
SERVICE ONLY
LINE 250W MAX 100/115/230/240 VAC 50/60Hz
N279
WARNING: NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL.
Service port Do NOT connect to network.
HP-IB bus for remote control
Line power cord
Instrument serial number

rear140

HP 86143/5 Front and Rear Panels

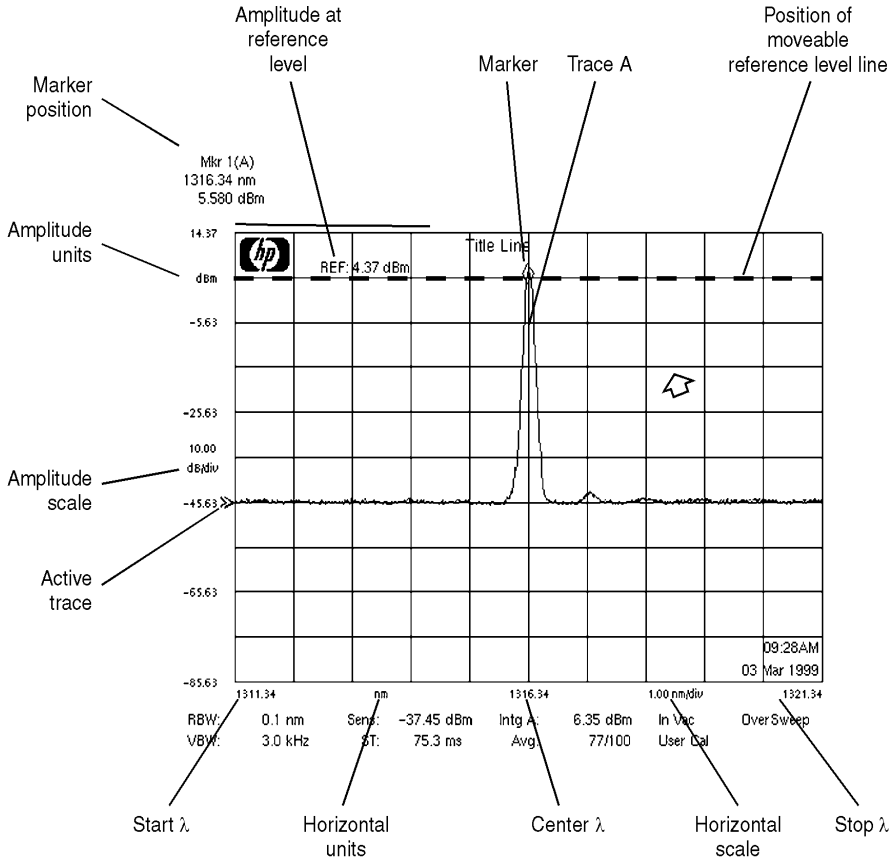


frnt145

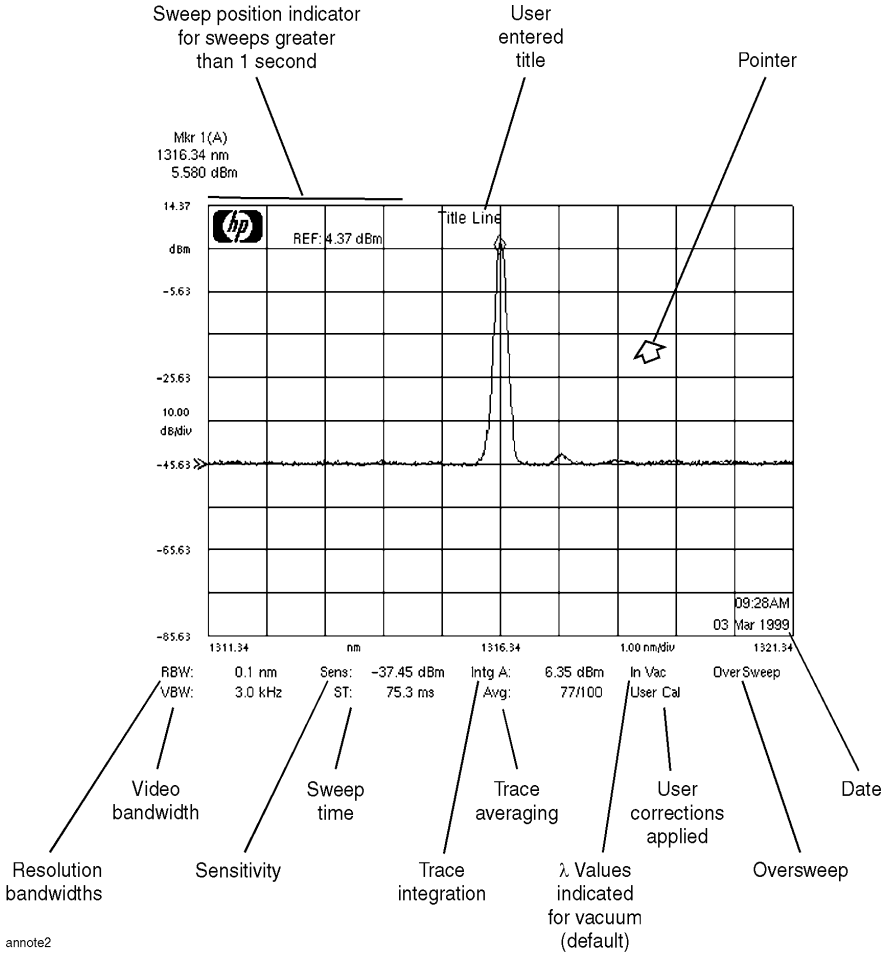

External sweep or analog-to-digital conversion trigger
Centronics printer connection
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PC compatible keyboard connector Mini-DIN)
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Service port Do NOT connect to network.
External monitor connector (VGA compatible)
PC compatible mouse connector (Mini-DIN)
LAN
Parallel
VGA
SERVICE ONLY
TRANS-Z ANALOG OUT
EXT TRIG IN TTL
HP-IB
N279
ADC SYNC OUT TTL
HP-IB bus for remote control
Synchronize external device to instruments data acquisition
Instrument serial number
Line power cord

rear145

Optical Spectrum Analyzer Display



annote1

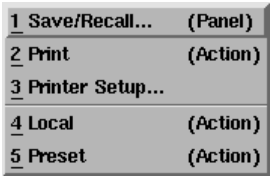

Sweep position indicator for sweeps greater than 1 second
User entered title
Pointer
Mkr 1(A)
1316.34 nm
5.580 dBm
14.37
dBm
-5.63
-25.63
10.00
dB/div
-45.63
-65.63
-85.63
Title Line
REF: 4.37 dBm
09:28AM
03 Mar 1999
1311.34
nm
1316.34
1.00 nm/div
1321.34
RBW: 0.1 nm
VBW: 3.0 kHz
Sens: -37.45 dBm
ST: 75.3 ms
Intg A: 6.35 dBm
Avg: 77/100
In Vac
User Cal
Over Sweep
Resolution bandwidths
Video bandwidth
Sensitivity
Sweep time
Trace integration
Trace averaging
λ Values indicated for vacuum (default)
User corrections applied
Oversweep
Date
annote2

The Menu Bar

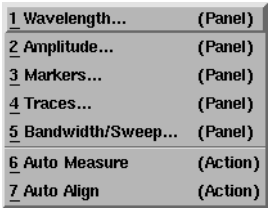
The Menu bar includes the File, Measure, Application, and Options drop-down menus. Each menu selection includes a descriptive label.

(Action)	Indicates the selection will perform an action such as making a measurement or printing the display.
(Panel)	Indicates the selection will open a softkey panel.

The File menu



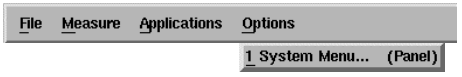
The Measure menu



The Applications menu



The Options menu



The Softkey Panels

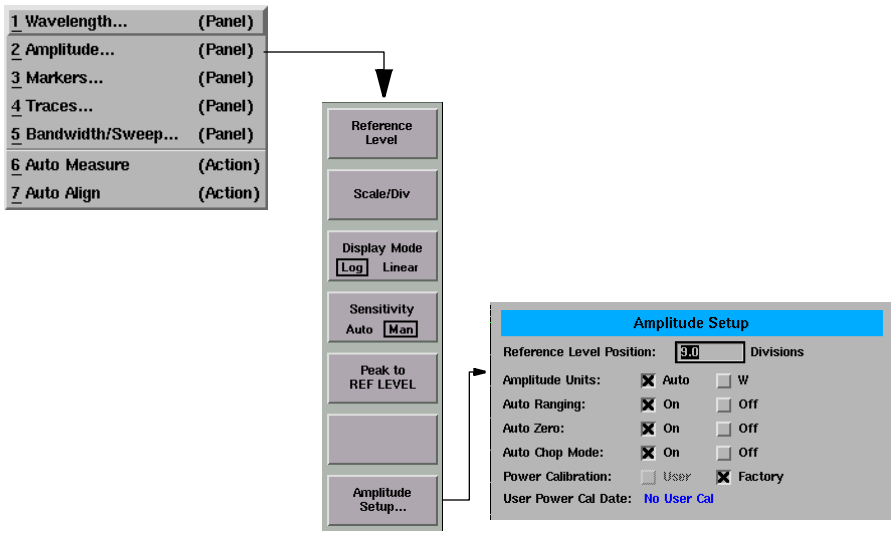
The softkey panels can be accessed using either the front-panel keys or the menu bar. This section includes brief descriptions of the following menus. See Chapter 3, “Using the Optical Spectrum Analyzer” for additional information on each of the OSA functions.

The Amplitude menus 2-12
The Applications menus 2-13
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The Amplitude menus

The Amplitude softkeys are accessed by using the front-panel Amplitude key or the Measure menu Amplitude selection on the menu bar.

The Measure menu

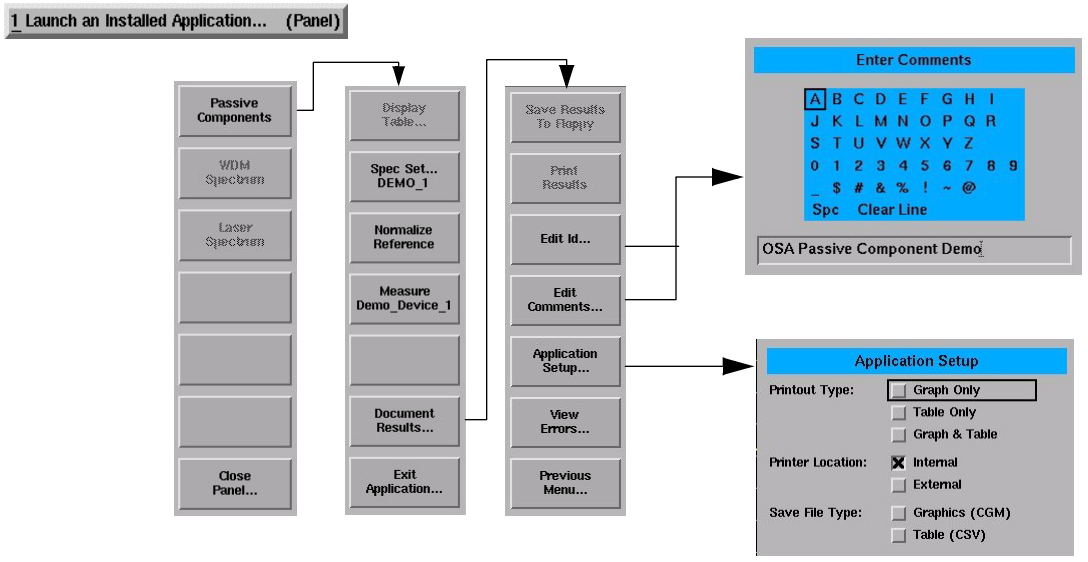


The Applications menus

The Applications (Appl's) softkeys are accessed by using the front-panel Appl's key or the Applications menu Launch an Installed Application.... selection on the menu bar.

For a complete description of the applications, refer to the manual that came with your software.

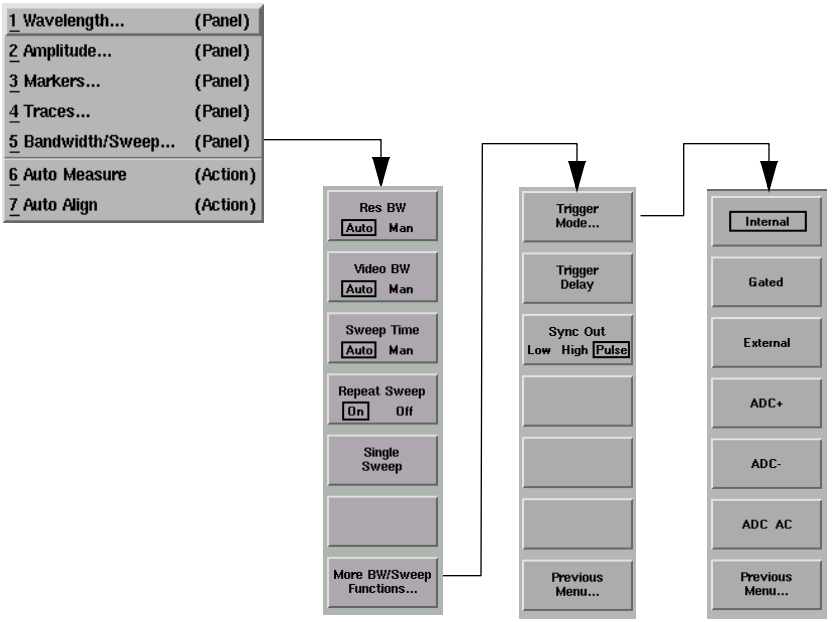
The Applications menu



The Bandwidth/Sweep menus

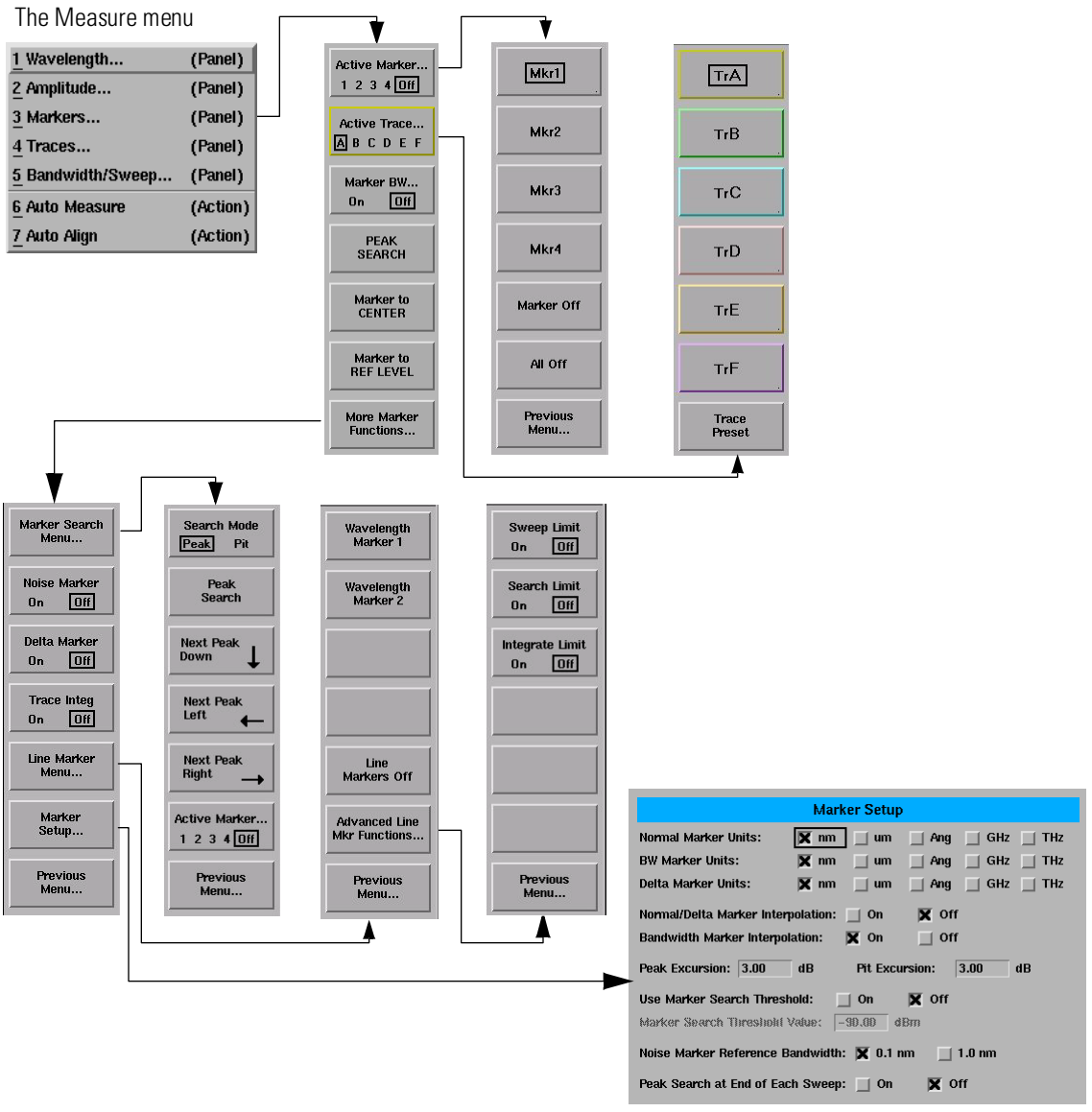
The Bandwidth/Sweep softkeys are accessed by using the front-panel Bandwidth/Sweep key or the Measure menu Bandwidth/Sweep selection on the menu bar.

The Measure menu



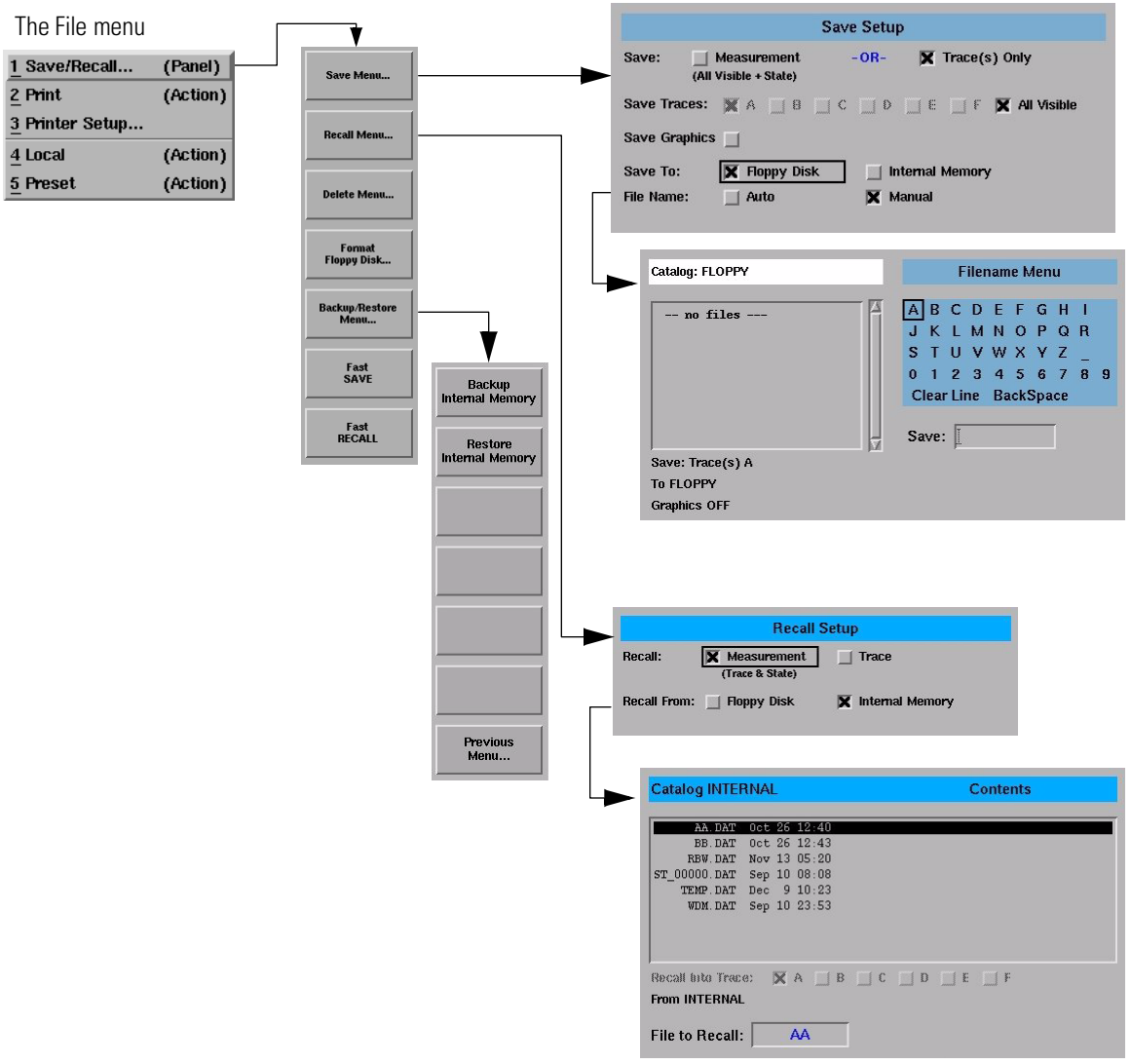
The Marker menus

The Markers softkeys are accessed using the front-panel Markers key or the Measure menu Markers selection on the menu bar.



The Save/Recall menus

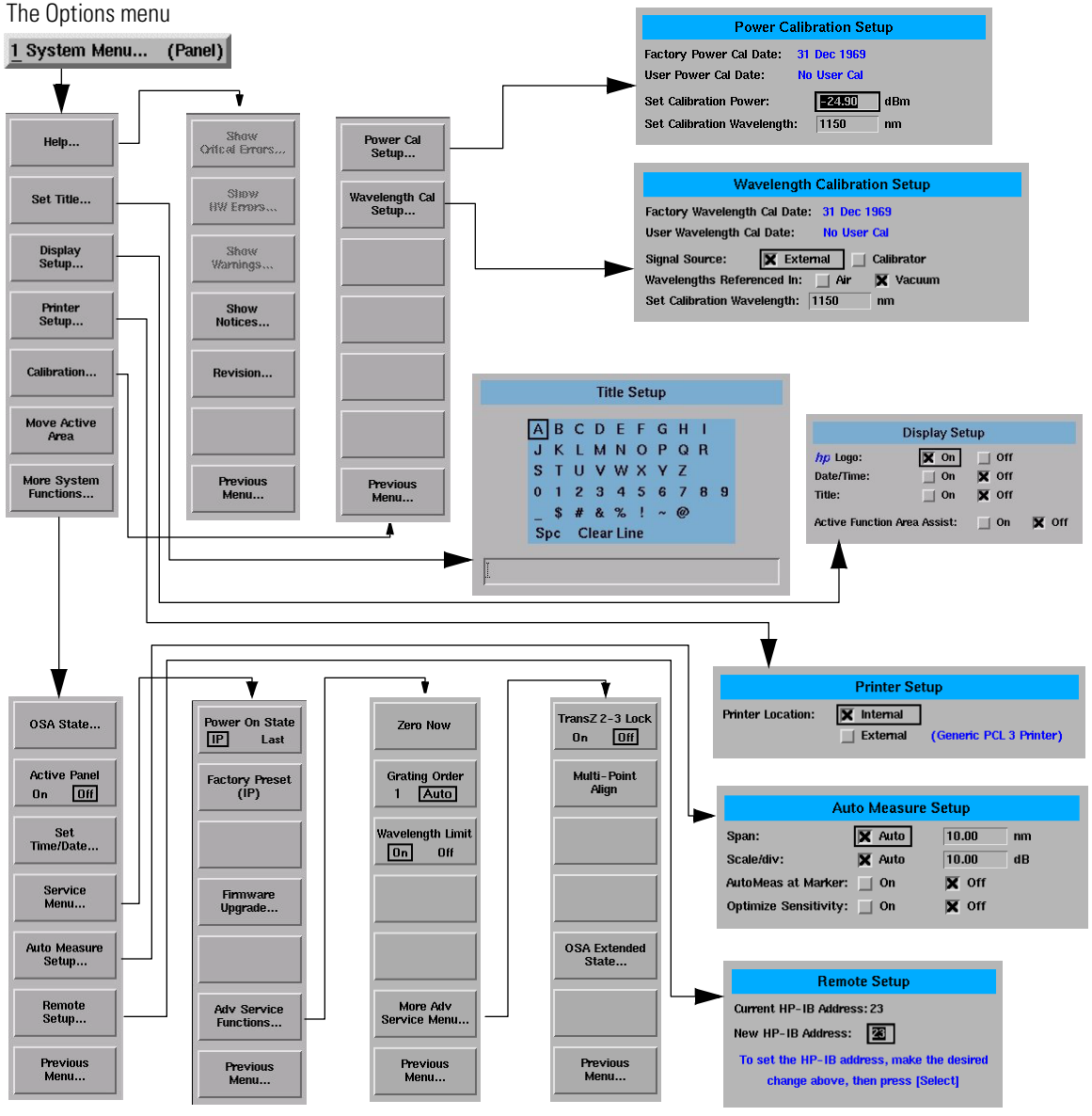
The Save/Recall softkeys and setup panels are accessed by using the drop-down File menu Save/Recall selection or the front-panel Save/Recall key. Use these functions to save, recall and print the measurement results.



The Systems menus

The System softkeys are accessed using the front-panel System key or the Options menu System selection on the menu bar.

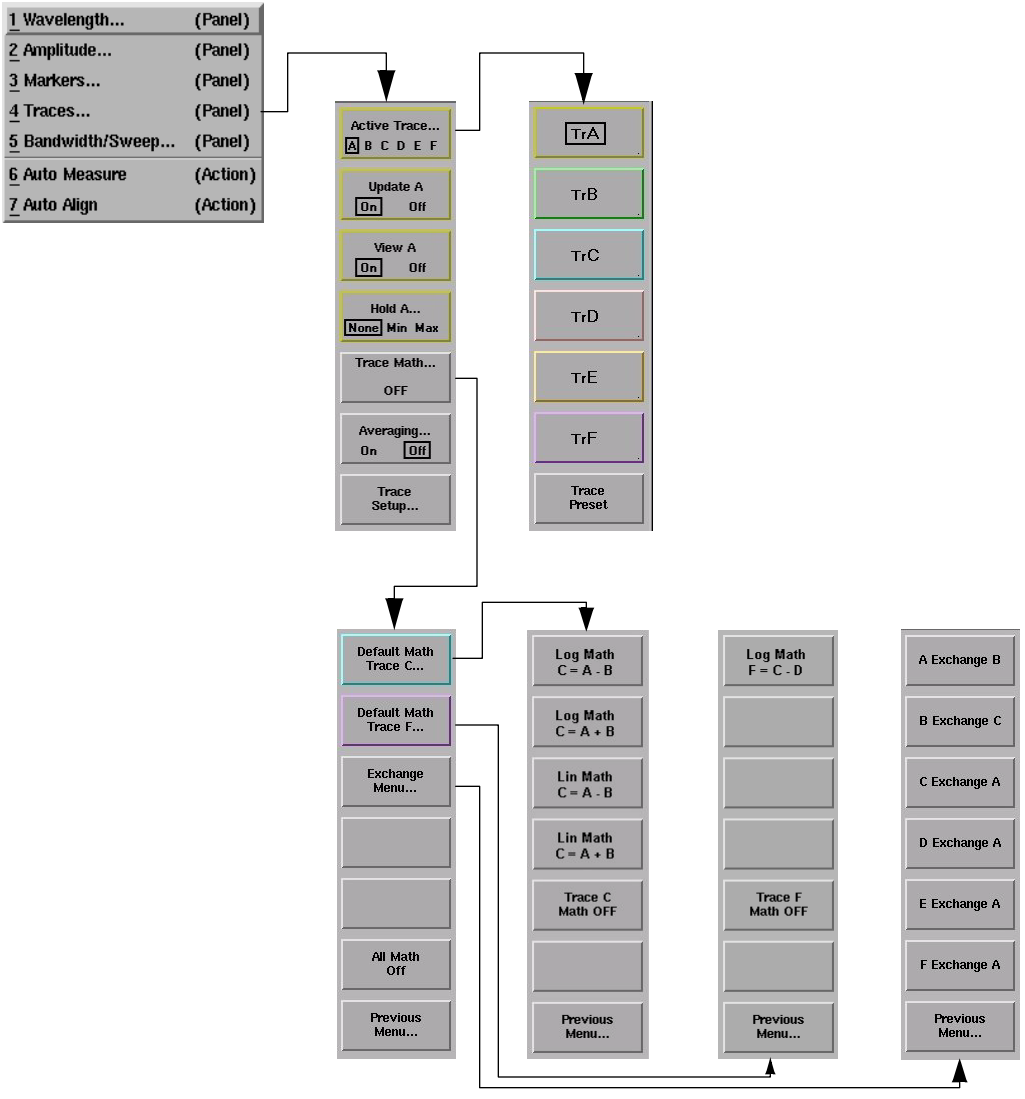
The Options menu



The Traces menus

The Traces softkeys are accessed by using the front-panel Traces key or the Measure menu Traces selection on the menu bar.

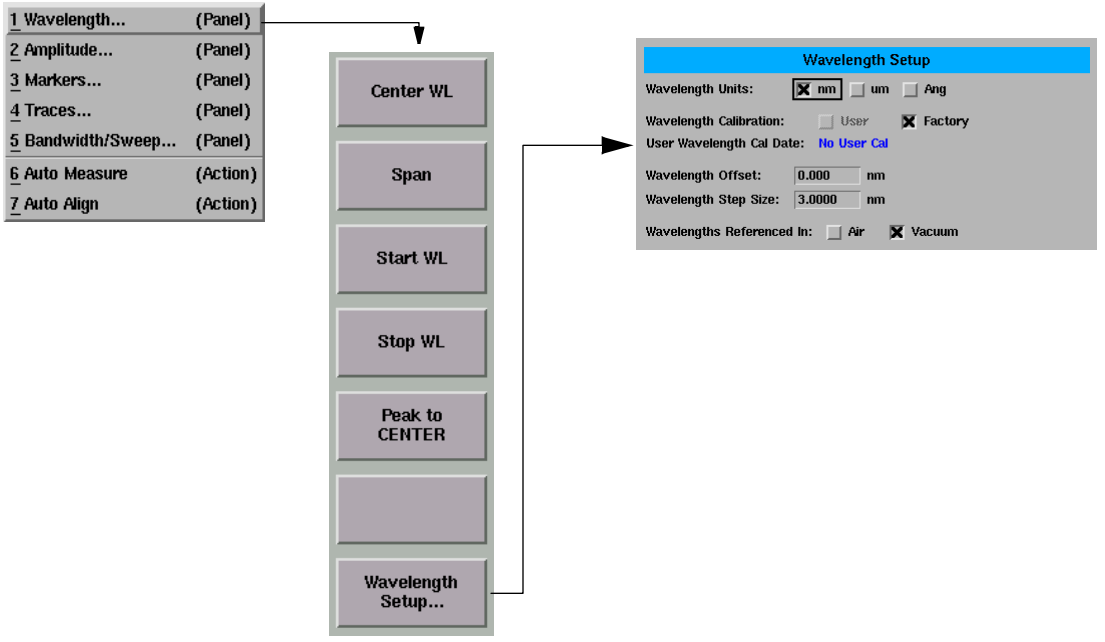
The Measure menu



The Wavelength menus

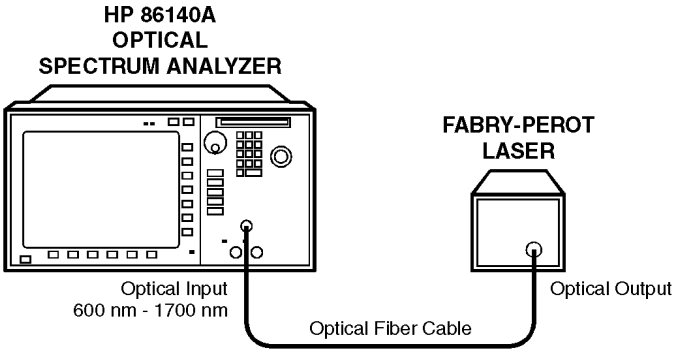
The Wavelength softkeys are accessed using the front-panel Wavelength key or the Measure menu Wavelength selection on the menu bar.

The Measure menu



Tutorial: Getting Started

This tutorial will introduce you to the HP 86140 series optical spectrum analyzer front panel controls. You will perform an auto alignment, perform a peak search, use a delta marker and print the display.



perlaser

Instrument setup

A source signal must be present at the input of the optical spectrum analyzer. In this tutorial a Fabry-Perot laser was used as the source. You can use another source or the optional 1310/1550 nm EELED. If another source is being used, the display will differ from those shown.

To set the OSA to a known state

1 Press the front-panel Preset key to set the instrument to a known state. For a complete description of preset conditions, see page 3-5.

To perform an Auto Align

For maximum amplitude accuracy, perform an automatic alignment whenever the optical spectrum analyzer has been moved, subjected to large temperature changes, or following warm-up. See "To perform an Automatic Alignment" on page 3-2 for more information.

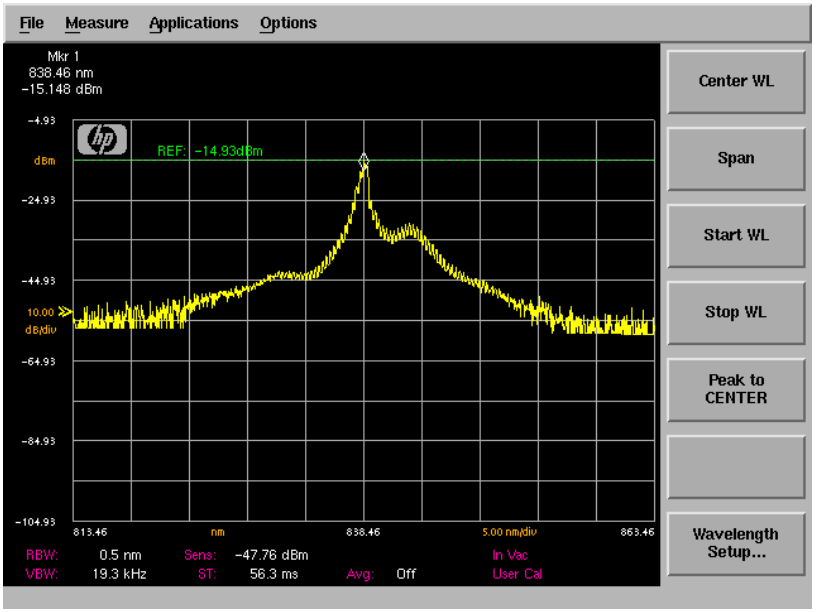
2 Connect a fiber from the source to the input connector of the optical spectrum analyzer. Be sure to follow the good connector practices described in "Cleaning Connections for Accurate Measurements" on page 6-10.

3 Enable the source.

4 Press the front-panel Auto Align key to optimize the detection of the incoming signal. This takes a few moments to complete.

To perform a peak search

5 Press the front-panel Auto Meas key to locate and zoom-in on the signal. Please wait until the Auto Measure routine is complete. A marker is placed on the peak of the displayed signal.



Trace with normal marker.

To zoom in on the signal

Press the *Span* softkey and then use the knob, step keys, or numeric keypad to zoom in on the signal.

Using the delta marker

The optical spectrum analyzer has four types of markers; normal markers, bandwidth markers, delta markers and noise markers. The marker currently being displayed is a normal marker. In the next step we will use it as a delta marker.

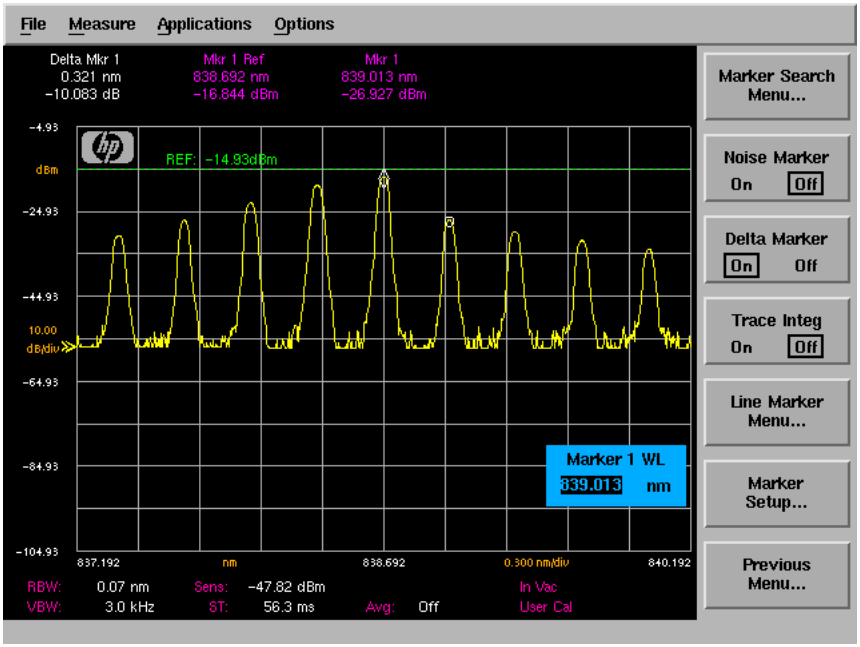
6 Press the front-panel Marker key.

7 Press the *More Marker Functions....* softkey.

8 Press the *Delta Marker* softkey to activate the delta marker and the active function area.

9 Use the knob, step keys or numeric entry pad to move the delta marker.

10 The reference marker remains stationary.

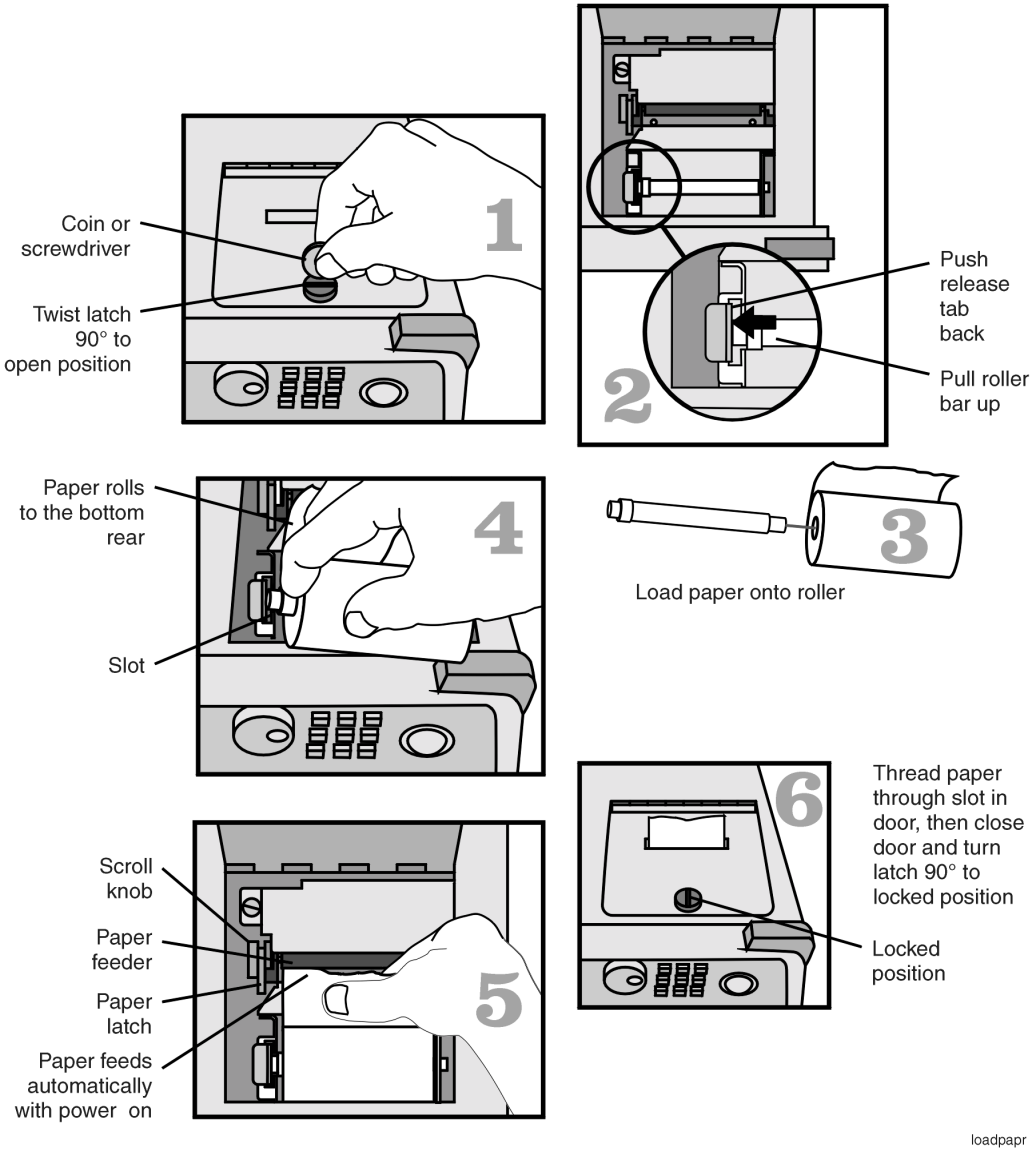


Trace with delta marker.

Printing the display

11 Press the Print key to print a copy of the display. The output will be sent to the internal or external printer, depending on the printer selected. For information on selecting the printer, see "To set up a printer" on page 3-44.

Changing the Printer Paper



CAUTION Avoid dropping the coin or screwdriver, used to open the printer door, into the printer assembly.

CAUTION Always use HP brand paper to ensure quality printing and long printer life. Order paper as HP part number 9270-1370.

CAUTION Never use the printer without printer paper as this can damage the printer head.

- If the instrument is on, the paper feeder automatically scrolls whenever paper is inserted into the feeder.
- Lift the paper latch to correct paper alignment problems. The scroll knob allows you to manually advance the paper.

CAUTION To avoid damage caused by losing parts and tools inside the instrument, always turn the instrument off *before* installing the printer paper.

3

To perform an Automatic Alignment 3-2
Front-Panel Keys 3-3
The Menus 3-7
The Amplitude Menus 3-8
The Bandwidth/Sweep Menus 3-14
The Markers Menus 3-21
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The Wavelength Menus 3-61
To Fill In a Setup Panel 3-65
To use the navigation softkeys 3-66

Using the Optical Spectrum Analyzer

Using the OSA

In this chapter, there are sections on both the menus and the front-panel keys.

Any of the instrument settings can be changed by using either the front-panel keys or the menu bar selections. Many of the menu selections and front-panel keys display a softkey panel. Settings in softkey panels are changed using the softkeys, data-entry keys, mouse, and trackball.

To perform an Automatic Alignment
For maximum amplitude accuracy, perform an automatic alignment whenever the optical spectrum analyzer has been moved, subjected to large temperature changes, or following warm-up. This function can also be accessed by choosing the Measure menu Auto Align selection on the menu bar. For a complete description of the Auto Align function, see the Auto Align section on the next page.

Front-Panel Keys

The optical spectrum analyzer has front-panel keys that perform a function when pressed.



For maximum amplitude accuracy, perform the automatic alignment whenever the optical spectrum analyzer has been moved, subjected to large temperature changes, or following warm-up. This function can also be accessed by choosing the Measure menu Auto Align selection on the menu bar.

Pressing the Auto Align button on the front panel of the OSA performs an automatic alignment of the instrument using the largest signal found in a full span sweep. This aligns the output of the monochromator with the photodetector for improved amplitude accuracy. You should use the Auto Align function whenever the OSA is bumped or physically moved to a new location.

The automatic alignment requires the connection of an external light source. This can be a broadband or narrowband source. If there is insufficient signal power, the automatic alignment will not be performed, and an error message will be reported.

The Auto Align function saves and restores the current instrument state. This allows the Auto Align function to be used in the middle of a measurement routine.

If markers are turned on, the Auto Align function attempts to do the automatic alignment at the wavelength of the active marker. If the instrument is in zero span, the alignment is performed at the center wavelength.

To perform an Auto Align function from the remote interface, see the descriptions of the following remote commands:

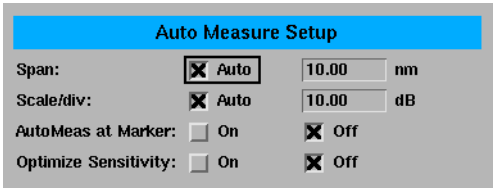
"CALibration:ALIGn" on page 4-68
"CALibration:ALIGn:MARKer[1|2|3|4]" on page 4-68



Pressing the Auto Meas button on the front panel of the OSA performs an automatic measurement of the largest signal found in a full span sweep and places a marker at the signal peak. Auto measure requires the connection of an external light source. This can be a broadband or narrowband source. If there is insufficient signal power, the automatic measurement will not be performed, and a warning message will be reported. This automatic measurement routine is normally the best way to adjust sensitivity while maintaining the fastest sweep rates.

The Auto Measure function uses trace A to perform the measurement. Since the Auto Measure function can alter the instrument state, we recommend that this operation be performed *before* a measurement sequence is started.

Using the Auto Measure Setup panel shown below, you can modify the automeasure span and the vertical scale, tune to the wavelength indicated by the marker and optimize the sensitivity. See "To change the automeasure defaults" on page 3-53 for more information.



To perform an Auto Measure from the remote interface, see the descriptions of the following remote commands:

"DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]" on page 4-71
"DISPlay[:WINDow[1]]:TRACe:X[:SCALe]:AUTO:SPAN <numeric_value>[M|NM|UM]" on page 4-74
"DISPlay[:WINDow[1]]:TRACe:X[:SCALe]:AUTO:SPAN:AUTO ON|OFF|1|0" on page 4-74
"DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:AUTO:PDIVision <numeric_value>[DB]" on page 4-74
"DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:AUTO:PDIVision:AUTO OFF|ON|0|1" on page 4-74
"DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]:MARKer OFF|ON|0|1" on page 4-73
"DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]:OPTimize OFF|ON|0|1" on page 4-73

Local

Places the optical spectrum analyzer under local control. Enables the front panel keys after the instrument has been under control with an external computer via HP-IB.

Preset

Sets the optical spectrum analyzer to a known state.

Function	Preset Value	Function	Preset Value
Start wavelength	600 nm	Stop wavelength	1700 nm
Wavelength offset	0	Wavelength step size	Auto
Resolution bandwidth	Auto	Resolution bandwidth to span ratio	0.01
Wavelength units	nm	Medium	Vacuum
Wavelength limit	On	Grating order	Auto
Power reference level	0 dBm	Power reference level position	9
Power scale	10 dB/div	Ratio reference level	0 dB
Ratio reference level position	5	Ratio scale	10 dB/div
Amplitude units	Auto	Ratio units[a]	Auto
Sensitivity	Auto	Video bandwidth	Auto
Auto range	On	Trans-Z lock	Off
Repetitive sweep	On	Sweep time	Auto
Auto chop	Off	Gated sweep	Off
Trigger mode	Normal	ADC trigger delay	10 µs
ADC sync out	Off	Sweep limit	Off
Trace length	1001	Current source pulse width	100 µs
Current source duty cycle	100%	Auto zero	On
User wavelength calibration	Enabled	User power calibration	Enabled
Graticule	On	Annotation	On
Current marker	MKR 1	Normal marker interpolation	Off
Bandwidth marker interpolation	On	Normal marker units	nm
Bandwidth marker units	nm	Peak search threshold	–90 dBm
Threshold enable	Off	Peak search excursion	3 dB
Pit search excursion	3 dB	Peak search on end-of-sweep	Off
Marker search limit	Off	Line markers	Off
Marker noise normalization bandwidth	1 nm		
Marker 1–4	Off	Marker 1–4 bandwidth	Off

Function	Preset Value	Function	Preset Value
Marker 1–4 bandwidth amplitude	–3 dB	Marker 1–4 delta	Off
Marker 1–4 noise	Off	Marker 1–4 delta marker units	nm
Current trace	TRA	Trace integration	Off
Trace integration limit	Off	Trace mean	Off
Trace mean limit	Off	Trace average count	100
Trace data format[a]	ASCII	TRA visibility	On
TRB–TRF visibility	Off	TRA update	On
TRB–TRF update	Off	TRA–TRF min hold	Off
TRA–TRF max hold	Off	TRA–TRF averaging	Off
TRA–TRF trace math	Off	TRB–TRF data	3-point dummy trace
Raw trace	3-point dummy trace		

a. Accessible only via the remote interface.

Print

Select this function to print a copy of the display. Using the Printer Setup menu selection, you can specify the printer as the built-in printer or a printer that is connected to the rear-panel parallel connector. See "To set up a printer" on page 3-44 for a complete description of this function.

The Menus

The front-panel menu keys are used to perform calibrations, setup measurements, set markers, save and recall data, set system preferences, and so forth. Pressing a front-panel menu key displays a softkey menu or setup panel.

The Amplitude Menus 3-8
The Bandwidth/Sweep Menus 3-14
The Markers Menus 3-21
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The Wavelength Menus 3-61

The Amplitude Menus

The Amplitude menus are accessed using the front-panel Amplitude key or the Measure menu Amplitude selection on the menu bar. If you wish to change amplitude settings, the following functions and setup panels are available:

Function	See....
Reference Level	"To change the reference level" on page 3-9
Scale/Division	"To change the value of the vertical amplitude scale" on page 3-9
Display Mode	"To change the display mode between log and linear" on page 3-10
Sensitivity	"To change the sensitivity" on page 3-10
Peak to Reference Level	"To set the reference level to the peak value" on page 3-11
Amplitude Setup....	"To change the default amplitude settings" on page 3-11

Note

Normally, the optical spectrum analyzer automatically selects the amplitude units according to whether the scale is logarithmic (dBm) or linear (watts). See "To change the default amplitude settings" on page 3-11.

Linear scale

In linear scale, the graticule is scaled in linear units, proportional to the input power. The bottom of the graticule line represents zero watts. The top of the graticule represents the reference level. Therefore, with 10 graticule lines, each division represents 10% of the input signal at the top of the screen.

Logarithmic scale

Logarithmic scales range from 0.01 to 20.00 decibels-per-division. The 10 dB-per-division scale is the default setting.

Using the Amplitude functions

To change the reference level

1. Press the front-panel Amplitude key.
2. Press the *Reference Level* softkey.
3. Use the knob, step keys or numeric entry pad to enter the desired value.

   The reference level value is the amplitude level shown at the reference level position. The reference level position is indicated on the display by a green line and the REF annotation on the display. The default position is one major graticule division from the top of the display. For the right vertical scale, the default position is midscreen. The reference level can be specified in dBm or watts.

Note

When using the step keys, the increment and decrement values are determined by the settings of the Scale/Division function. See "To change the value of the vertical amplitude scale" for more information.

Note

If both the left and right vertical scales are displayed, the reference level of the active trace is adjusted.

To change the value of the vertical amplitude scale

1. Press the front-panel Amplitude key.
2. Press the *Scale/Div* softkey.
3. Use the knob, step keys or numeric entry pad to enter the desired value.

Note

This function determines the amount the value increases or decreases when using the arrow keys to set the reference level. See "To change the reference level" for more information.

> **Note**
>
> If both the left and right vertical scales are displayed, the scale/division of the active trace is changed.

To change the display mode between log and linear

1. Press the front-panel Amplitude key.
2. Press the *Display Mode* softkey to toggle between Log and Linear data display.

To change the sensitivity

1. Press the front-panel Amplitude key.
2. Press the *Sensitivity* softkey to toggle between Auto and Manual modes.
3. Use the knob, step keys or numeric entry pad to enter the desired value.

   This key toggles the sensitivity between automatic and manual. The sensitivity setting indicates the smallest signal amplitude that will be displayed across the current wavelength range. Increasing sensitivity slows the sweep speed. An increase in sensitivity may also require a narrower video bandwidth, which will slow the sweep speed.

   Normally, the optical spectrum analyzer selects the greatest sensitivity possible that does not require amplification changes during the sweep. If you manually increase the sensitivity level, the sweep pauses to allow this change in gain.

   Automatic mode

   When in automatic mode, the analyzer selects the greatest sensitivity possible that does not require amplification changes during the sweep.

   Manual mode

   When sensitivity is increased manually, the sweep pauses to allow this change in gain.

> **Note**
>
> The settings for sensitivity, video bandwidth and sweep time interact. If the sensitivity is set to manual, the video bandwidth and sweep time may be forced to Auto mode. If the video bandwidth is set to manual, the sensitivity and sweep time may be forced to Auto. If the sweep speed is set to manual and is set too fast, the OVER SWEEP indicator will come on in the display area. Since these settings interact, it is recommended that only *one* of the settings be changed, whichever setting is most important to the measurement task being performed.

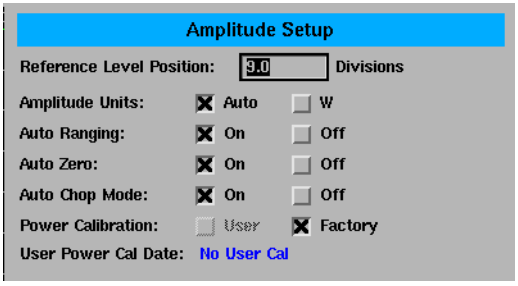
To set the reference level to the peak value

1. Press the front-panel Amplitude key.
2. Press the *Peak to REF LEVEL* softkey.

   The system sets the value of the reference level equal to the value of the highest point on the active trace.

To change the default amplitude settings

1. Press the front-panel Amplitude key.
2. Press the *Amplitude Setup....* softkey.
3. The Amplitude Setup panel opens. Refer to "To Fill In a Setup Panel" on page 3-65 for information on changing and selecting items in the setup panel.



The Amplitude Setup panel

Setup panel selections

Reference Level Position

The value selected for the Reference Level Position determines the position of the reference level on the graticule. Setting this value to zero divisions places the reference level on the very bottom of the grid. Setting the reference level to 10 divisions places the reference level at the top of the grid. Pressing the front-panel Preset key resets the reference level to 9.0 divisions.

Note

When using the knob or step keys, the value will automatically change. When using the numeric entry pad, a terminator must be selected from the softkey panel.

Amplitude Units

Selecting Auto for amplitude units allows power to be shown in dBm when using the logarithmic scale and in watts when using the linear scale. Selecting W forces the readout to be in watts, regardless of the amplitude scaling.

Auto Ranging

The Auto Range function allows the OSA to change the gain of the transimpedance amplifier during a sweep. This provides measurements to be made at the widest dynamic range and at the fastest sweep speed.

Pressing the front-panel Preset key turns Auto Ranging ON.

Note

It is recommended that Auto Ranging always be turned ON.

Auto Zero

Turns Auto Zero ON and OFF. Auto Zero ON enables the internal amplifiers to be zeroed between sweeps. Selecting OFF disables this feature. Pressing the front-panel Preset key resets this function to ON.

Note

Turning Auto Zero OFF allows the instrument to sweep faster, but results in less accuracy on low level signals.

Note

The optical spectrum analyzer performs a more complete zeroing when the instrument is first turned on. You can run this more complete routine anytime by pressing the *Zero Now* softkey. Refer to "To zero the instrument" on page 3-50 for more information.

Auto Chop Mode

Enables the spectrum analyzer chop mode. Chop mode increases dynamic range for long sweep times by subtracting ambient light. Subtracting the ambient light can improve sensitivity but slow down the sweep speed.

Pressing the front-panel Preset key turns this function OFF.

Note

Sweep times of 50 msec × the # of trace points, or longer, use a special "chop" mode. Chop mode increases dynamic range, stabilizes measurements against drift, and reduces effects of stray light. This special chop mode is enabled by setting the Auto Chop mode to ON.

Power Calibration

Power Calibration allows you to use amplitude correction factors either from the factory calibration or from the last successful user calibration. Pressing the front-panel Preset key resets this function to User. If a user calibration has not been performed, the factory calibration data is used.

User Power Cal Date

The User Power Cal Date displays the date of the last successful user-performed amplitude calibration. See "To perform a power calibration" on page 3-44 for information on performing an amplitude calibration.

The Bandwidth/Sweep Menus

The Bandwidth/Sweep softkeys are accessed by using the front-panel Bandwidth/Sweep key or the Measure menu Bandwidth/Sweep selection on the menu bar. If you wish to change bandwidth or sweep settings, the following functions and setup panels are available:

Function	**See....**
Resolution Bandwidth	"To change the resolution bandwidth" on page 3-15
Video Bandwidth	"To change the video bandwidth" on page 3-15
Sweep Time	"To change the sweep time" on page 3-16
Repeat Sweep	"To turn repeat sweep on and off" on page 3-17
Single Sweep	"To perform a single sweep" on page 3-17
Trigger Mode....	
Internal	"To select the internal trigger" on page 3-18
Gated	"To select a gated trigger" on page 3-18
External	"To select an external trigger" on page 3-19
ADC+, ADC–, and ADC AC	"To select the ADC trigger" on page 3-19
Trigger Delay	"To set the trigger delay" on page 3-20
Synch Out	"To select the synchronous output" on page 3-20

Using the Bandwidth/Sweep functions

To change the resolution bandwidth

The ability to display two closely spaced signals as two distinct responses is determined by resolution bandwidth.

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *Res BW* softkey.
3. Toggle between selecting the resolution bandwidth automatically or manually.
4. Use the knob, step keys or numeric entry pad to enter the desired value.

   The resolution bandwidth can be set to one of the following values: 0.07 (0.06 for the HP 86142A and 86145A), 0.1, 0.2, 0.5, 1, 2, 5, or 10 nm. Resolution bandwidth filtering occurs before detection of the light.

   In Auto mode, the resolution bandwidth is coupled to the span in a preset 0.01:1 ratio. This means that the optical spectrum analyzer attempts to set a bandwidth value that is 1% of the span setting. You can alter this behavior by manually setting the resolution bandwidth.

To change the video bandwidth

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *Video BW* softkey.
3. Toggle between selecting the video bandwidth automatically or manually.
4. Use the knob, step keys or numeric entry pad to enter the desired value.

   Video bandwidth filtering occurs after detection of the light. In the autocoupled mode, the video bandwidth has an extremely wide range. This allows the optical spectrum analyzer to avoid unnecessary filtering that would reduce the sweep speed more than required.

   Normally, the video bandwidth is coupled to the requested sensitivity. Manually entering a video bandwidth breaks this coupling. The video bandwidth can be manually set from 100 mHz to 3 kHz, or the bandwidth of the currently selected transimpedance amplifier, whichever is less.

The following functions affect video bandwidth:

- Changing the sensitivity value.
- Changing the reference level.
- Turning autoranging ON or OFF.

The range of video bandwidth available in Auto mode is much greater than can be set manually from the front panel. A lower video bandwidth value requires a longer sweep time. Because of the interdependence between the video bandwidth and sensitivity, it is recommended that either the sensitivity *or* the video bandwidth be changed, whichever is the most important to the measurement task being performed.

To change the sweep time

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *Sweep Time* softkey.
3. Toggle between selecting sweep time automatically or manually.
4. Use the knob, step keys or numeric entry pad to enter the desired value.

   The sweep time is the amount of time required for the optical spectrum analyzer to sweep the current measurement range. The optical spectrum analyzer automatically selects sweep times based on coupling of the following instrument settings:

   - Wavelength span
   - Resolution bandwidth
   - Video bandwidth
   - Sensitivity
   - Trace length
   - Power level

   Coupling of these parameters yields optimum amplitude accuracy. When coupled, the optical spectrum analyzer always uses the fastest sweep possible while still maintaining the specified accuracy. Coupled, sweep times range from 50 ms to a maximum value that depends on the number of trace points used to draw the trace. This relationship is shown in the following equation:

$$50\ ms \leq sweep\ time \leq (1s)(trace\ points)$$

   The default number of trace points is 1001, so the maximum sweep time is normally 100 seconds. When coupling is disabled, the sweep time can be set from 56.3 ms to a maximum of 1000 seconds. If you change the number of trace points, the maximum sweep time changes as well.

Manually setting the sweep time turns coupling off.

> **Note**
>
> If the sweep time is set too fast, an OVER SWEEP message appears indicating the display is no longer calibrated and that trace data may not meet specifications. Increase the sweep time until the OVER SWEEP message disappears. If the sweep time is set too slow, measurement times may be excessively long.

To turn repeat sweep on and off

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *Repeat Sweep* softkey to toggle this function ON or OFF.

To perform a single sweep

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *Single Sweep* softkey. The instrument will perform a single sweep and then stop.

   When first turned on, the optical spectrum analyzer uses free run triggering with continuous sweeps. Free run triggering ensures evenly timed sweeps for a stable display of the current tuning range. Sweeps continuously repeat as long as trigger conditions are met. The SWEEP indicator light on the front panel of the optical spectrum analyzer is on when the sweep is in progress. The indicator is off between sweeps.

> **Note**
>
> Single sweep mode is especially useful when programming the instrument. Use single sweeps for the following reasons:
>
> - Insure trace reflects current measurement range settings
> - Capture traces before processing them with math commands
> - Capture traces before positioning markers

To select the internal trigger

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *More BW/Sweep Functions....* softkey.
3. Press the *Trigger Mode....* softkey.
4. Press the *Internal* softkey.

   Internal triggering synchronizes the start of the sweep to an internally generated trigger signal. Internal triggering ensures continuously triggered sweeps with the shortest delay between sweeps.

To select a gated trigger

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *More BW/Sweep Functions....* softkey.
3. Press the *Trigger Mode....* softkey.
4. Press the *Gated* softkey.

   In some measurements, the spectrum at a particular time within the modulation period is more important than the average spectrum. Gated triggering can be used to synchronize the data acquisition portion of the OSA to a gating trigger connected to the rear-panel EXT TRIG IN connector. Gated triggering requires a TTL-compatible signal with a minimum of 0 Vdc and a maximum of +5 V.

   Gated triggering is used to select data samples containing valid information. When the gating signal is high, the data sample is accepted. When the gating signal is low, the data sample is replaced by a data point with a value of –200 dBm. The sweep time must be long enough to get data for each wavelength point, or else the Max Hold function must be used to complete a trace over several sweeps.

To select an external trigger

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *More BW/Sweep Functions....* softkey.
3. Press the *Trigger Mode....* softkey.
4. Press the *External* softkey.

   External triggering synchronizes the sweep with a signal connected to the rear-panel `EXT TRIG IN` connector. External triggering requires a TTL-compatible signal with a minimum of 0 V and a maximum of +5 V. There is a time delay between the external trigger signal and the data measurement that is set by the Trigger Delay value.

To select the ADC trigger

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *More BW/Sweep Functions....* softkey.
3. Press the *Trigger Mode....* softkey.
4. Press either the *ADC+*, *ADC–*, or *ADC AC* softkey.

   The softkeys in the menu select the type of triggering for the analog-to-digital converter in the data acquisition hardware of the OSA. The *ADC+* softkey triggers the OSA on the rising edge of the external trigger signal, and the *ADC–* softkey triggers it on the falling edge. The *ADC AC* softkey alternately triggers on the rising and falling edge of the external trigger signal. The amplitude measured on opposite edges are subtracted and the absolute value of the result becomes the trace amplitude value. The delay between the external trigger and the triggering of the analog-to-digital converter is set by the trigger delay value.

To set the trigger delay

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *More BW/Sweep Functions....* softkey.
3. Press the *Trigger Delay* softkey.
4. Use the knob, step keys or numeric entry pad to enter the desired value.
5. Use the *Trigger Delay* softkey to set the delay between the external trigger and the triggering of the analog-to-digital converter.

   The value you select is displayed in the Active Function Area.

To select the synchronous output

1. Press the front-panel Bandwidth/Sweep key.
2. Press the *More BW/Sweep Functions....* softkey.
3. Press the *Sync Out* softkey until the desired output is selected.

   The synchronous output allows external equipment to receive a sync signal at each sample point of the OSA sweep. When LOW is selected, the signal will be a TTL LOW. When HIGH is selected, the signal will be a TTL HIGH. When PULSE is specified, the signal will go HIGH when the external trigger is recognized and goes low when the analog-to-digital converter is triggered. The width of the synchronous output pulse is equal to the trigger delay.

The Markers Menus

The Markers softkeys are accessed using the front-panel Markers key or the Measure menu Markers selection on the menu bar. If you wish to change marker settings, the following functions and setup panels are available:

Function	**See....**
Active Marker....	"To select the active marker" on page 3-23
Marker Trace....	"To set the active trace" on page 3-23 (Marker key)
Marker Bandwidth....	"To set markers to measure bandwidth" on page 3-24
–3 dB, –6 dB, –10 dB, –20 dB Marker Bandwidth Off	"To set markers to measure bandwidth" on page 3-24
Peak Search	"To perform a peak search" on page 3-25 "To perform a peak search using a marker" on page 3-24
Marker to Center	"To change the center wavelength with a marker" on page 3-24
Marker to Reference Level	"To change the reference level with a marker" on page 3-25
More Marker Functions....	
Marker Search Menu....	
Search Mode	"To perform a peak search" on page 3-25 "To perform a pit search" on page 3-26
Noise Marker	"To set the noise marker function" on page 3-27
Delta Marker	"To set the delta marker function" on page 3-28
Trace Integration	"To calculate the total power under a trace" on page 3-28
Line Marker Menu....	
Wavelength Marker 1	"To set the wavelength line markers" on page 3-28

Function	See....
Wavelength Marker 2	"To set the wavelength line markers" on page 3-28
All Line Markers Off	"To turn off all line makers and line marker functions" on page 3-29
Advanced Line Marker Functions....	
Sweep Limit	"To sweep between line markers" on page 3-29
Search Limit	"To search between line markers" on page 3-29
Integrate Limit	"To integrate between line markers" on page 3-30
Marker Setup....	"To change the default marker settings" on page 3-30

Using the Marker functions

To select the active marker

1. Press the front-panel Markers key.
2. Press the *Active Marker....* softkey.
3. Select the appropriate marker to activate, deactivate, or turn all markers off.

   Selecting a marker always places that marker on the currently selected Active trace at the center wavelength. Turning a marker OFF will turn off any marker function that was on for that particular marker. When the marker is turned ON again, all the marker functions for that marker will be off.

To set the active trace

1. Press the front-panel Markers key.
2. Press the *Active Trace....* softkey.
3. Select the trace to activate.

or

1. Press the front-panel Traces key.
2. Press the *Active Trace....* softkey.
3. Select the trace to activate.

> **Note**
>
> The active trace is designated by a double arrow (>>) on either the right or left side of the display.

To set markers to measure bandwidth

1. Press the front-panel Markers key.
2. Select an active marker.
3. Place the marker on the peak of the signal to be measured by pressing the *PEAK SEARCH* softkey.
4. Press the *Marker BW....* softkey.
5. Select a pre-defined bandwidth or use the knob, step keys, or numeric entry pad to enter the active marker bandwidth amplitude for the active marker.

   If a peak search is not performed, then pressing the *Marker BW....* softkey finds the bandwidth around the currently active marker. If the bandwidth markers cannot be placed at the selected value, an error message, such as "`BW not found`" will be displayed.

To perform a peak search using a marker

1. Press the front-panel Markers key.
2. Select an active marker.
3. Press the *PEAK SEARCH* softkey.

   The active marker is placed on the highest point of the active trace. If no marker is ON, Marker #1 will be turned ON and placed on the highest point of the active trace.

To change the center wavelength with a marker

1. Press the front-panel Markers key.
2. Place a marker on the trace to be centered.
3. Press the *Marker to CENTER* softkey.

   The center wavelength is set to the wavelength value of the active marker.

To change the reference level with a marker

1. Press the front-panel Markers key.
2. Place a marker on the trace at the level you want moved to the reference level position.
3. Press the *Marker to REF LEVEL* softkey.

   The reference level is set to the amplitude of the active marker.

To perform a peak search

1. Press the front-panel Markers key.
2. Select an active marker.
3. Press the *PEAK SEARCH* softkey.

   or

1. Press the front-panel Markers key.
2. Select an active marker.
3. Press the *More Marker Functions....* softkey.
4. Press the *Marker Search Menu....* softkey.
5. Press the *Search Mode....* softkey and toggle to select Peak search mode.
6. Press the *Peak Search* softkey. Select from the following options:

   Next Peak Down

   Places the marker on the next highest peak from the current marker amplitude. This next highest peak must meet the peak excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search for the next maximum will begin from that point.

   Next Peak Left

   Places the marker on the next peak located at a shorter wavelength than the current marker wavelength position. This next peak must meet the peak excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search to the left will begin from that point.

Next Peak Right

Places the marker on the next peak located at a longer wavelength than the current marker wavelength position. This next peak must meet the peak excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search to the right will begin from that point.

Active Marker....

Turns a particular marker ON or OFF. Turning a marker OFF will turn off any marker function that was on for that particular marker. When the marker is turned ON again, all the marker functions for that marker will be off.

Note

For addition information on setting the peak and pit excursion criteria, see "Peak Excursion" and "Pit Excursion" on page 3-32.

To perform a pit search

1. Press the front-panel Markers key.
2. Select an active marker.
3. Press the *More Marker Functions....* softkey.
4. Press the *Marker Search Menu....* softkey.
5. Press the *Search Mode....* softkey and toggle to select Pit search mode.
6. Press the *Pit Search* softkey. Select from the following options:

Next Pit Up

Places the marker on the next lowest pit from the current marker amplitude. This next highest pit must meet the peak excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search for the next minimum will begin from that point.

Next Pit Left

Places the marker on the next pit located at a shorter wavelength than the current marker wavelength position. This next pit must meet the pit excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search to the left will begin from that point.

Next Pit Right

Places the marker on the next pit located at a longer wavelength than the current marker wavelength position. This next pit must meet the pit excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search to the right will begin from that point.

Active Marker....

Turns a particular marker ON or OFF. Turning a marker OFF will turn off any marker function that was on for that particular marker. When the marker is turned ON again, all the marker functions for that marker will be off.

Note

For addition information on setting the peak and pit excursion criteria, see "Peak Excursion" and "Pit Excursion" on page 3-32.

To set the noise marker function

1. Press the front-panel Markers key.
2. Select an active marker.
3. Press the *More Marker Functions....* softkey.
4. Press the *Noise Marker* softkey.
5. Toggle the noise marker ON or OFF.

   The noise marker measures the spectral power density at the position of the active marker. The measurement is referenced to a 0.1 nm or 1 nm resolution bandwidth. The reference bandwidth used to normalize the noise is selected on the Marker setup panel. See "To change the default marker settings" on page 3-30 for additional information.

To set the delta marker function

1. Place the marker to be used as a reference on the desired trace and at the desired wavelength.
2. Press the front-panel Markers key.
3. Press the *More Marker Functions....* softkey.
4. Press the *Delta Marker* softkey.

   To fix the position of the reference marker and activate the delta marker, toggle the delta marker ON. Use the front-panel knob or keypad to move the delta marker to the desired location. If the delta function is turned ON and no marker is active, Marker #1 will be turned ON, placed at the center wavelength, and the delta function will be turned ON.

To calculate the total power under a trace

1. Press the front-panel Markers key.
2. Press the *More Marker Functions....* softkey.
3. Use the *Trace Integ* softkey to turn trace integration on.

   Only one total power calculation can be turned on at a time. For example, if a total power calculation is being performed on trace A, turning a total power calculation for trace B ON will turn the calculation for trace A OFF.

To set the wavelength line markers

1. Press the front-panel Markers key.
2. Press the *More Marker Functions....* softkey.
3. Press the *Line Marker Menu....* softkey.
4. Press the *Wavelength Marker 1* or *Wavelength Marker 2* softkey.
5. Position the line markers using the knob, step keys, or numeric entry pad.

   Line markers let you perform sweeps, searches and integrations over a reduced section of the selected wavelength range. Wavelength Marker 1 is always to the left of Wavelength Marker 2.

To turn off all line makers and line marker functions

1. Press the front-panel Markers key.
2. Press the *More Marker Functions....* softkey.
3. Press the *Line Marker Menu....* softkey.
4. Press the *Line Markers Off* softkey.

To sweep between line markers

1. Press the front-panel Markers key.
2. Press the *More Marker Functions....* softkey.
3. Press the *Line Marker Menu....* softkey.
4. Select and set Wavelength Marker 1 and 2 to the desired wavelength sweep limits.
5. Press the *Advanced Line Mkr Functions....* softkey.
6. Press the *Sweep Limit* softkey to toggle this function ON or OFF.

   When the sweep limit is ON, the instrument will only sweep between Wavelength Marker 1 and Wavelength Marker 2.

To search between line markers

1. Press the front-panel Markers key.
2. Press the *More Marker Functions....* softkey.
3. Press the *Line Marker Menu....* softkey.
4. Select and set Wavelength Marker 1 and 2 to the desired wavelength search limits.
5. Press the *Advanced Line Mkr Functions....* softkey.
6. Press the *Search Limit* softkey to toggle this function ON or OFF.

   When the search limit is ON, all the marker peak/pit searches will be between Wavelength Marker 1 and Wavelength Marker 2.

To integrate between line markers

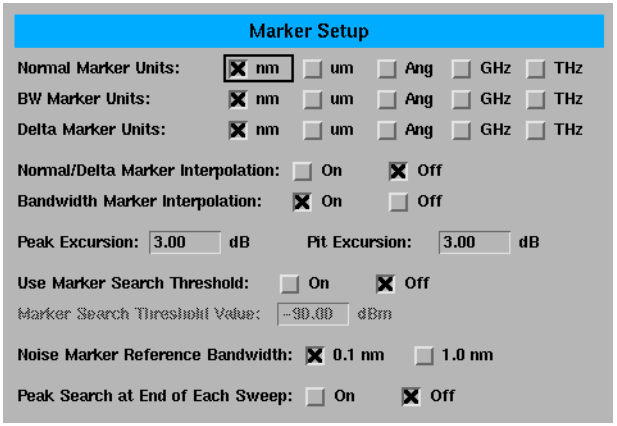
1. Press the front-panel Markers key.
2. Press the *More Marker Functions....* softkey.
3. Press the *Line Marker Menu....* softkey.
4. Select and set Wavelength Marker 1 and 2 to the desired integration limits.
5. Press the A*dvanced Line Mkr Functions....* softkey.
6. Press the *Integrate Limit* softkey to toggle this function ON or OFF.

   Turning the integration limit ON will calculate the power between Wavelength Marker 1 and Wavelength Marker 2 when the Trace Integration function in ON. See "To calculate the total power under a trace" on page 3-28.

> **Note**
>
> Although there is a single range controlling the total power integration, the marker search range, and the wavelength sweep range, there are three independent state settings for limiting the total power integration, the marker search, and the wavelength sweep to the range.

To change the default marker settings

1. Press the front-panel Markers key.
2. Press the *More Marker Functions....* softkey.
3. Press the *Marker Setup....* softkey.
4. The Marker Setup panel opens. Refer to "To Fill In a Setup Panel" on page 3-65 for information on changing and selecting items in the setup panel.



The Marker Setup panel

Setup panel selections

Normal Marker Units

Sets the X-axis readout for frequency or wavelength when the instrument is in a non-zero span. This setting controls only the normal marker X-axis and the delta reference readout. This setting controls all four normal markers. The bandwidth and delta offset markers have their own settings.

Bandwidth Marker Units

Sets the bandwidth marker X-axis readout for frequency or wavelength when the instrument is in a non-zero span. The delta markers have their own setting. This setting controls all four bandwidth markers.

Delta Marker Units

Sets the delta marker X-axis readout for frequency or wavelength when the instrument is in a non-zero span. The bandwidth markers have their own setting. This setting controls all four delta markers.

Normal/Delta Marker Interpolation

Turns the normal/delta marker interpolation ON or OFF. When interpolation is ON, the normal/delta markers will be placed at the exact wavelength or frequency value selected if it is within the trace range. The marker will linearly interpolate between two trace data points. The default state is OFF.

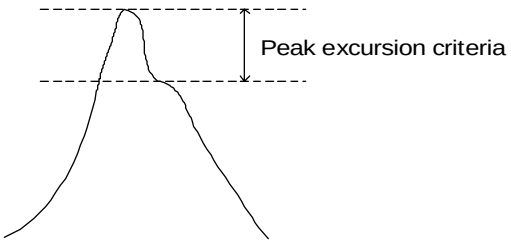
This setting controls the interpolation state for all four markers when in the normal or delta mode.

Bandwidth Marker Interpolation

Turns the bandwidth marker interpolation ON or OFF. When interpolation is ON, the bandwidth markers will be placed at the exact number of dB (NDB) from the normal marker if within the trace range. The position of the marker will be linearly interpolated between two trace data points. The default state is ON. If interpolate is OFF, for negative NDB values, the bandwidth markers will be at values closest to and more negative than the NDB value. For positive NDB values, the bandwidth markers will be at values closest to and more positive than the NDB values. This will typically result in a wider bandwidth measurement.

Peak Excursion

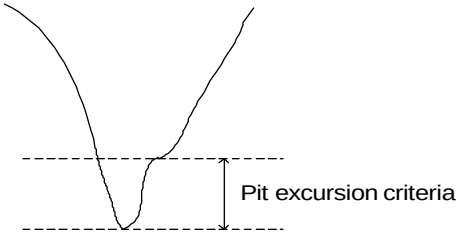
Sets the peak excursion value for the marker search routines.



The peak excursion value is used to determine whether or not a local maximum in the trace is to be considered a peak. To qualify as a peak, both sides of the local maximum must fall by at least the peak excursion value.

Pit Excursion

Sets the pit excursion value for the marker search routines.



The pit excursion value is used to determine whether or not a local minimum in the trace is to be considered a pit. To qualify as a pit, both sides of the local minimum must rise by at least the pit excursion value.

Use Marker Search Threshold

This limits the marker search function to data points above the selected threshold level.

Marker Search Threshold Value

Selects the amplitude threshold value used for limiting the marker search function. When Marker Search Threshold is ON, a dotted line is shown on the display at the threshold level.

Noise Marker Reference Bandwidth

Sets the normalization bandwidth for the noise marker. There are two allowable settings: 1 nm and 0.1 nm.

> **Note**
>
> Changing this value will change the value of the noise marker by 10 dB.

Peak Search at End of Each Sweep

Finds the peak value of the trace and moves the marker to the peak at the end of each sweep. This function operates on the active marker. This function operates on normal, delta, bandwidth and noise markers.

The Save/Recall Menus

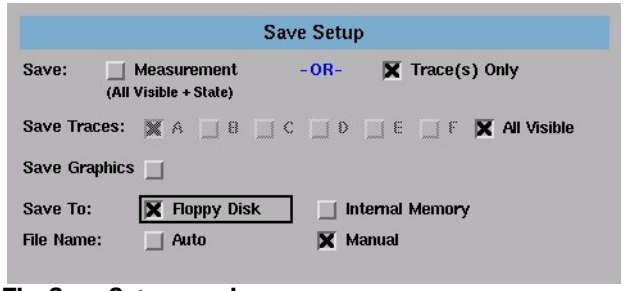
The Save/Recall softkeys are accessed by using the front-panel Save/Recall key or the File menu Save/Recall selection on the menu bar. If you wish to change save or recall settings, the following functions are available:

Function	See....
Save Menu....	"To save measurement and trace data" on page 3-35
Recall Menu....	"To recall measurement and trace data" on page 3-37 "To select a file from the catalog" on page 3-37
Delete Menu....	"To delete a file from internal memory or a floppy disk" on page 3-38
Format Floppy Disk....	"To format a floppy disk" on page 3-39
Backup/Restore Menu....	
Backup Internal Memory	"To backup or restore the internal memory" on page 3-39
Restore Internal Memory	"To backup or restore the internal memory" on page 3-39
Fast Save	"To save in Fast Save mode" on page 3-39
Fast Recall	"To recall in Fast Recall mode" on page 3-39

Using the Save/Recall functions

To save measurement and trace data

1. Press the front-panel Save/Recall key.
2. Press the *Save Menu...* softkey.
3. The Save Setup panel opens. Refer to "To Fill In a Setup Panel" on page 3-65 for information on changing and selecting items in the setup panel.



The Save Setup panel

Setup panel selections

Save

Saves the measurement data in a binary format (*.dat* file). This includes the traces and all measurement conditions. When the file is recalled, the instrument state will be set to the same state as when the file was saved. The Trace(s) Only option creates an ASCII (*.csv*) file. When the file is recalled, the trace data will be displayed *under the current instrument settings.* Refer to "To display the OSA State information panel" on page 3-47 for a description of the OSA state information.

Save Traces

Selects the traces to be saved.

Save Graphics

Saves graphic data when selected. The graphic data is stored in Computer Graphics Metafile (CGM) format. This is a vector graphics format that describes pictures and graphical elements in geometric terms. This selection is valid only when saving to the floppy drive.

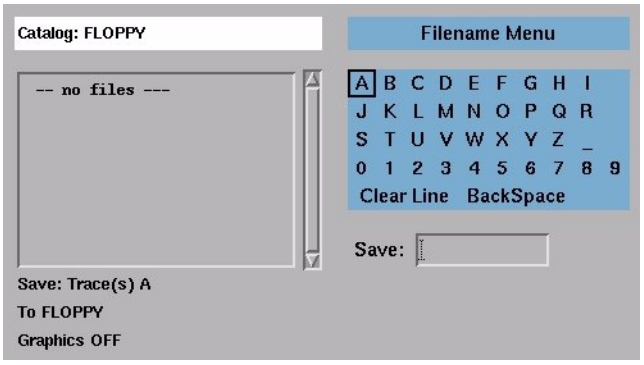
Save to

Selects saving data to a floppy disk or to internal memory.

File Name

Selects manual or automatic mode for choosing a file name.

4 When you are satisfied with your selections, press the *Choose File to Save* softkey. The Filename Menu setup panel opens.



The Filename Menu setup panel

To enter a filename using the arrow keys

1 Use the front-panel step keys (⇑ and ⇓) and the arrow softkeys (→ and ←) to highlight each letter of the filename.

2 When the desired letter or function is selected, press the *Select* softkey.

3 Select the BackSpace function to delete individual letters.

4 Select the Clear Line function to delete the entire filename.

5 When you finish entering the filename, press the *SAVE FILE* softkey.

To enter a filename using a trackball or mouse

1 Use the pointing device to place the cursor on a letter of the filename. Click on the character to select it.

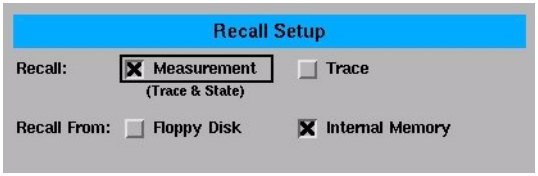
2 Click the BackSpace function to delete individual letters.

3 Click the Clear Line function to delete the entire filename.

4 When you finish entering the filename, click the *SAVE FILE* softkey.

To recall measurement and trace data

1. Press the front-panel Save/Recall key.
2. Press the *Recall Menu....* softkey.
3. The Recall Setup panel opens.



The Recall Menu setup panel

Setup panel selections

Recall

Selects whether a measurement or trace will be recalled.

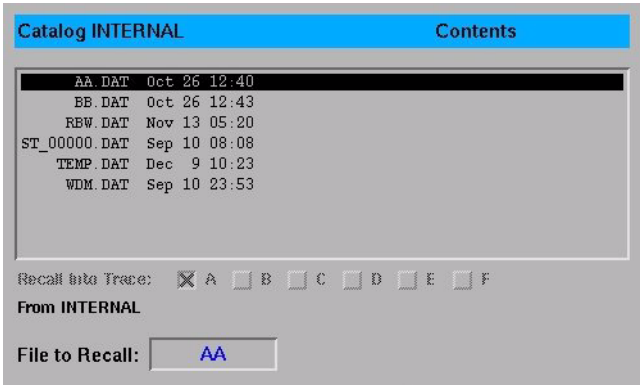
Recall From

Selects whether to recall from a floppy disk or from internal memory.

4. When you are satisfied with your selections, press the *Choose File to Recall* softkey. The Catalog panel opens. See "To select a file from the catalog" on page 3-37.

To select a file from the catalog

1. Press the front-panel Save/Recall key.
2. Press the *Recall Menu....* or *Delete Menu....* softkey.
3. Press the *Choose File to Recall* or *Choose File to Delete* softkey.
4. Make the desired selections on the setup panel. Refer to "To Fill In a Setup Panel" on page 3-65 for information on changing and selecting items in the setup panel.
5. When you are satisfied with your selections, press Enter. The Catalog panel opens.



The Catalog setup panel

6 Use the arrow keys to highlight the next five previous file softkeys, or click on the desired filename using a trackball or mouse. Press Enter to recall or delete the selected file.

To delete a file from internal memory or a floppy disk

1 Press the front-panel Save/Recall key.

2 Press the *Delete Menu....* softkey.



The Delete Setup panel

Setup panel selections

Delete File From:

Selects whether to delete from a floppy disk or from internal memory.

Press the *Choose File to Delete* softkey to open the Catalog window. See "To select a file from the catalog" on page 3-37 for information on selecting the file to delete.

To format a floppy disk

1. Press the front-panel Save/Recall key.
2. Press the *Format Floppy Disk....* softkey.
3. Press the *Format* softkey to format the 3.5 floppy disk. Press the *Cancel* softkey to stop the format action and return to the previous screen.

To backup or restore the internal memory

1. Press the front-panel Save/Recall key.
2. Press the *Backup/Restore Menu....* softkey.

Softkey panel selections

Backup Internal Memory

An OSA Backup Utility screen appears asking you to insert a formatted floppy disk in the external drive.

Restore Internal Memory

An OSA Restore Utility screen appears. This operation will remove all files from internal memory and replace them with files from backup floppy disks.

To save in Fast Save mode

1. Press the front-panel Save/Recall key.
2. Press the *Fast SAVE* softkey.
3. The instrument saves the measurement to internal memory.

To recall in Fast Recall mode

1. Press the front-panel Save/Recall key.
2. Press the *Fast RECALL* softkey.
3. The instrument recalls the measurement saved previously by the Fast Save function.

The System Menus

The System softkeys are accessed using the front-panel System key or the Options menu System selection on the menu bar. If you wish to change system settings, the front-panel System key provides access to the following functions and setup panels:

Function	See....
Help....	
Show Critical Errors....	"To display notices, bandwidth errors, critical errors and warnings" on page 3-42
Show BW Errors....	"To display notices, bandwidth errors, critical errors and warnings" on page 3-42
Show Warnings....	"To display notices, bandwidth errors, critical errors and warnings" on page 3-42
Show Notices....	"To display notices, bandwidth errors, critical errors and warnings" on page 3-42
Revision....	"To display the firmware revision" on page 3-42
Set Title....	"To add a title to the display" on page 3-42
Display Setup....	"To change the display setup" on page 3-43
Printer Setup....	"To set up a printer" on page 3-44
Calibration....	
Power Cal Setup....	"To perform a power calibration" on page 3-44
Wavelength Cal Setup....	"To perform a wavelength calibration" on page 3-45
Move Active Area	"To move the active function area" on page 3-47

Function	See....
More System Functions....	
OSA State....	"To display the OSA State information panel" on page 3-47
Active Panel	"To display the Active Function Area" on page 3-48
Set Time/Date....	"To change the time and date" on page 3-48
Service Menu....	
Power On State	"To select the power-on state" on page 3-48
Factory Preset (IP)	"To perform a factory preset (IP)" on page 3-49
Firmware Upgrade	"To upgrade the firmware" on page 3-50
Adv Service Functions....	
Zero Now	"To zero the instrument" on page 3-50
Grating Order	"To set the grating order mode" on page 3-51
Wavelength Limit	"To set the wavelength limit" on page 3-51
More Adv Service Functions....	
TransZ 2-3 Lock	"To set the TransZ 2 - 3 Lock" on page 3-52
Multi-Point Align	"To set multi-point alignment" on page 3-52
OSA Extended State....	"To display the OSA Extended State information panel" on page 3-53
Auto Measure Setup....	"To change the automeasure defaults" on page 3-53
Remote Setup....	"To set the HP-IB address" on page 3-55

Using the System functions

To display notices, bandwidth errors, critical errors and warnings

> **Note**
>
> The Show Notices...., Show BW Errors...., Show Critical Errors...., and Show Warnings.... functions are only available if a notice, bandwidth error, critical error, or warning has been generated by the system. If no notices, bandwidth errors, critical errors, or warnings have been generated, these functions will be grayed out.

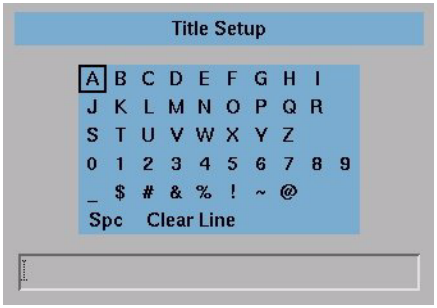
1. Press the front-panel System key.
2. Press the *Help....* softkey.
3. Press the S*how Notices....*, *Show BW Errors....*, *Show Critical Errors....* or *Show Warnings....*softkey. A window opens displaying the notice, bandwidth error, critical error or warning. You can print the queue, clear the queue, or page up and down to view the information.

To display the firmware revision

1. Press the front-panel System key.
2. Press the *Help....* softkey.
3. Press the *Revision....* softkey. A display appears showing the firmware revision information.

To add a title to the display

1. Press the front-panel System key.
2. Press the *Set Title....* softkey. The Title Setup panel appears.

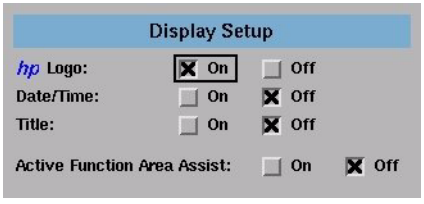


The Title Setup panel

Refer to "To Fill In a Setup Panel" on page 3-65 for information on changing and selecting items in the setup panel.

To change the display setup

1. Press the front-panel System key.
2. Press the *Display Setup...* softkey. The Display Setup panel appears.



The Display Setup panel

Setup panel selections

HP Logo

When this function is ON, the HP logo is shown on the display and printouts.

Date/Time

Turns the date and time ON or OFF on the display.

Title

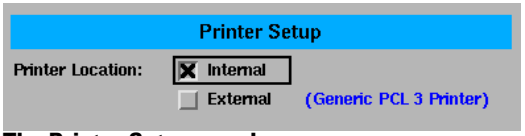
Turns the title ON or OFF on the display.

Active Function Area Assist

When this function is ON, the function set in the Active Function Area is automatically set to the first, or top, softkey function. For example, when you press the front-panel Bandwidth/Sweep key, the Active Function Area Assist function will set the Active Function Area to resolution bandwidth. This means you can immediately enter the desired resolution bandwidth. There is no need to press the *Res BW* softkey.

To set up a printer

1. Press the front-panel System key.
2. Press the *Printer Setup....* softkey. The Printer Setup panel appears.



The Printer Setup panel

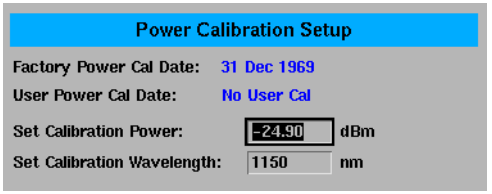
Setup panel selections

Printer Location

Selects either the internal printer or an external printer as the print destination.

To perform a power calibration

1. Press the front-panel System key.
2. Press the *Calibration....* softkey.
3. Press the *Power Cal Setup....* softkey. The Power Calibration Setup panel appears.



The Power Calibration setup panel

Setup panel selections

Factory Power Cal Date

Shows the date of the last factory-performed power calibration.

User Power Cal Date

Shows the date of the last successful user-performed power calibration.

Set Calibration Power

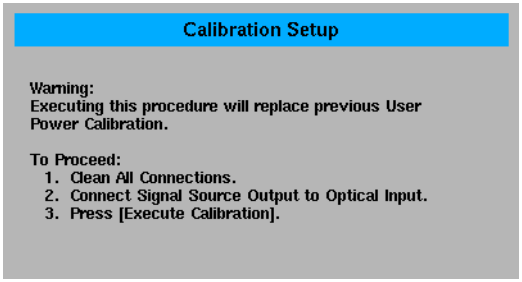
This is the exact amplitude of the calibration source that will be used for the next power calibration. The power entered must be within +10 dB and –3 dB of the amplitude measured using the factory calibration.

Set Calibration Wavelength

This is the approximate wavelength of the calibration source that will be used for the next user power calibration. The wavelength entered must be within 2.5 nm of the wavelength measured using the factory calibration.

4 Enter the power and wavelength of the calibration signal.

5 Press the *Perform Calibration....* softkey.



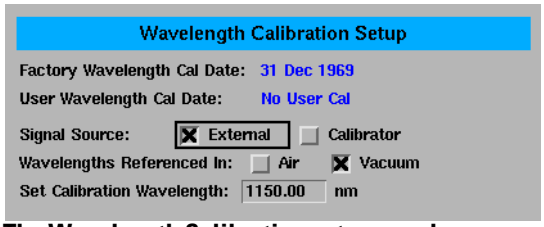
6 Follow the on-screen instructions and then press *Execute Calibration*.

To perform a wavelength calibration

1 Press the front-panel System key.

2 Press the *Calibration....* softkey.

3 Press the *Wavelength Cal Setup....* softkey. The Wavelength Calibration Setup panel appears.



The Wavelength Calibration setup panel

Setup panel selections

Factory Wavelength Cal Date

Shows the date of the last factory-performed wavelength calibration.

User Wavelength Cal Date

Shows the date of the last successful user-performed wavelength calibration.

Signal Source

Select either an external single wavelength signal source or the internal calibrator as the wavelength calibration source.

Wavelength Referenced In (for external calibration source only)

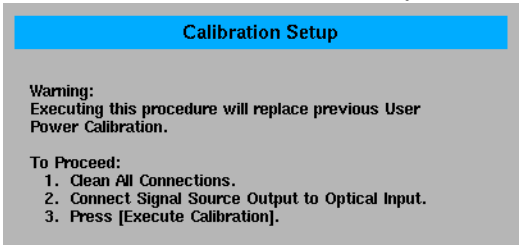
Selects air or vacuum for the calibration. If the internal calibrator is selected, this selection will not be available.

Set Calibration Wavelength (for external calibration source only)

This is the exact wavelength of the calibration source that will be used for the next user wavelength calibration. The wavelength entered must be within 2.5 nm of the wavelength measured using the factory calibration. If the internal calibrator is selected, this selection will not be available.

4 If you are using an external calibration source, enter the signal source and wavelength of the calibration signal and whether the calibration is referenced in air or vacuum. If you are using an internal calibration source, continue with Step 5.

5 Press the *Perform Calibration....* softkey.



6 Follow the on-screen instructions and then press *Execute Calibration*.

To move the active function area

1 Press the front-panel System key.

2 Press the *Move Active Area* softkey. Each press of the softkey moves the active function area to one of eight on-screen locations.

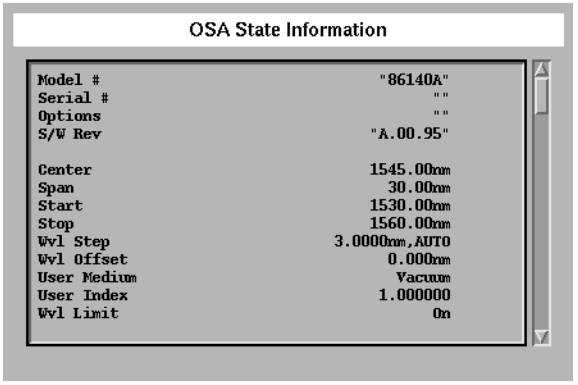
To display the OSA State information panel

1 Press the front-panel System key.

2 Press the *More System Functions....* softkey.

3 Press the *OSA State....* softkey.

4 The OSA State Information display panel opens and can be printed.



The OSA State information panel

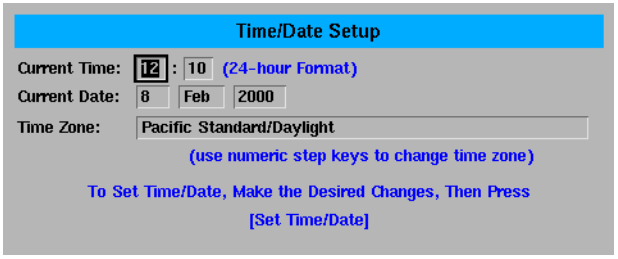
To display the Active Function Area

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Active Panel* softkey to toggle the display of the Active Function Area ON or OFF.

To change the time and date

NOTE Changing the time, date, or time zone causes the instrument to reboot.

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Set Time/Date....* softkey. The Time/Date Setup panel appears.



4. Use the navigation keys to set the date, time and time zone that are correct for your location.
5. Press the *Set Time/Date* softkey when you are satisfied with your selections.

To select the power-on state

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Service Menu....* softkey.
4. Press the *Power On State* softkey. Toggle to select IP or Last.

The IP function is the same as the front-panel Preset key. For a complete list of the Preset conditions, see page 3-5. When Last is selected the instrument will power-on in the same state it was in when last powered-off.

To perform a factory preset (IP)

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Service Menu....* softkey.
4. Press the *Factory Preset (IP)* softkey.

The factory preset function restarts the instrument and sets it to the same states as the front-panel Preset key. See "SYSTem:PRESet" on page 4-93 for a complete list of the preset conditions. In addition, it also sets the following functions.

Function	Factory Preset Value
Wavelength functions	
User wavelength calibration date	None
User wavelength calibration source	None
User wavelength calibration wavelength	0 nm
Wavelength for next wavelength calibration	1150 nm
Wavelength for next amplitude calibration	1150 nm
User wavelength calibration correction	Zero
Amplitude functions	
User amplitude calibration date	None
User amplitude calibration source	None
User amplitude calibration wavelength	0 nm
User amplitude calibration amplitude	–300 dBm
Amplitude for next amplitude calibration	0 dBm
User amplitude calibration correction	Zero
Auto Measure functions	
Auto-Measure optimize sensitivity	Off
Auto-Measure auto span	On
Auto-Measure Manual span	10 nm
Auto-Measure dB/div auto	On
Auto-Measure manual dB/division	10 dB/division

Function	Factory Preset Value
Miscellaneous functions	
Power-on in last state	Off
HP-IB address	23
Time display	On
HP logo display	On
Active function area assist	On
Active function area location	Upper right
Printer interface	Internal

To upgrade the firmware

To upgrade the firmware you must have the firmware upgrade disk set from HP.

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Service Menu....* softkey.
4. Press the *Firmware Upgrade....* softkey.
5. You are prompted for each disk in the firmware upgrade set. When the last disk has been copied, the instrument will finish the installation process and restart.

To zero the instrument

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Service Menu....* softkey.
4. Press the *Adv Service Functions....* softkey.
5. Press the *Zero Now* softkey.

   The Zero Now function causes the auto zero function to run immediately. This allows you to manually zero the instrument when the Auto Zero function is off. The dark current of the photodetector is measured one time, and then the resulting correction is applied to all subsequent measurements, for improved amplitude accuracy.

> **Note**
>
> The optical spectrum analyzer compensates for temperature-related current drift between each sweep. Although this "zeroing" increases amplitude accuracy, it increases the time between sweeps. If amplitude accuracy is not critical to your measurement, you can turn off zeroing. Refer to "Auto Zero" on page 3-12 for additional information.
>
> The optical spectrum analyzer performs a more complete zeroing when the instrument is first turned on. You can run this more complete routine anytime by pressing the ZERO NOW softkey.

To set the grating order mode

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Service Menu....* softkey.
4. Press the *Adv Service Functions....* softkey.
5. Press the *Grating Order* softkey.
6. Toggle between 1 and AUTO.

   The Grating Order function lets you choose between 1st order grating only and the Automatic setting. The Automatic mode selects 2nd order mode if the stop wavelength is less than 900 nm. The 2nd order grating mode provides a slightly higher measurement sensitivity. Note that the 10 nm resolution bandwidth is not available when using the 2nd order grating mode. The grating order is listed in the OSA State Information. See "To display the OSA State information panel" on page 3-47 for more information.

To set the wavelength limit

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Service Menu....* softkey.
4. Press the *Adv Service Functions....* softkey.

5 Press the *Wavelength Limit* softkey. Toggle ON to limit the span to the specified range of 600 to 1700 nm. When this function is OFF, the start wavelength of the OSA can be tuned down to 350 nm, and the stop wavelength can be tuned up to 2000 nm.

> **Note**
>
> The performance of the OSA is not specified and the amplitude is not calibrated outside the 600–1700 nm range.

To set the TransZ 2 - 3 Lock

1 Press the front-panel System key.

2 Press the *More System Functions....* softkey.

3 Press the *Service Menu....* softkey.

4 Press the *Adv Service Functions....* softkey.

5 Press the *More Adv Service Menu....* softkey.

6 Press the *TransZ 2 - 3 Lock* softkey.

Setting the TransZ 2-3 Lock to ON prohibits the instrument from using a transimpedance gain higher than 10k ohms. This ensures that there is sufficient video bandwidth for making accurate pulsed measurements. This is useful for EDFA pulsed testing. The Preset state for TransZ 2-3 Lock is OFF.

To set multi-point alignment

1 Press the front-panel System key.

2 Press the *More System Functions....* softkey.

3 Press the *Service Menu....* softkey.

4 Press the *Adv Service Functions....* softkey.

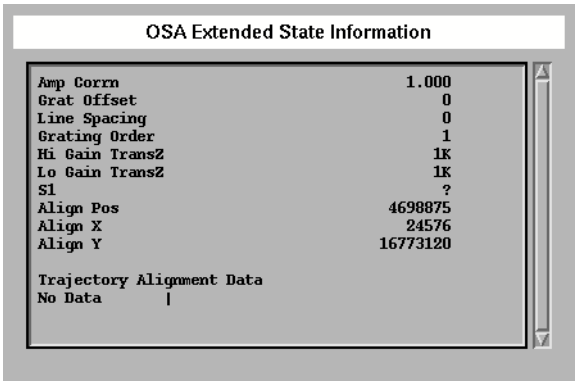
5 Press the *More Adv Service Menu....* softkey.

6 Press the *Multi-Point Align* softkey.

Multi-Point Align is an advanced service function that requires a broadband white light source. This function is to be used by HP service personnel.

To display the OSA Extended State information panel

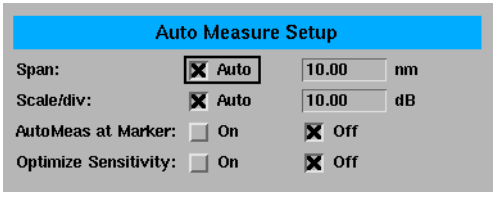
1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Service Menu....* softkey.
4. Press the *Adv Service Functions....* softkey.
5. Press the *More Adv Service Menu....* softkey.
6. Press the *OSA Extended State....* softkey. The OSA Extended State Information panel is displayed and can be printed.



The OSA Extended State function provides information useful to HP service personnel.

To change the automeasure defaults

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Auto Measure Setup....* softkey. The Automeasure Setup panel appears.



4 Use the arrow keys or the numeric entry pad to set the wavelength span manually or automatically. Refer to "To Fill In a Setup Panel" on page 3-65 for information on changing and selecting items in the setup panel.

Setup panel selections

Span

This function selects the wavelength span for viewing the signal located by the auto measure function. If Auto is specified, the span is set wide enough to display most of the signal. If a particular span is desired, deselect Auto and put the desired span in the nm dialog box. The default selection for Span is Auto.

Note

If the span is set too narrow, the auto measure operation may not complete successfully. If this happens a warning message is displayed.

Scale/Div

The dB/div selection sets the vertical scale to be used after performing the auto measure function. If Auto is specified, the measurement function sets the vertical scale to a value based on the dynamic range of the signal. If a particular vertical scale is desired, deselect Auto and put the desired dB/div in the dB dialog box. The default selection for dB/div is Auto.

AutoMeas at Marker

Selecting the ON state for AutoMeas at Marker causes the auto measure function to perform its operation at the wavelength of the active marker. This allows you to measure a signal other than the largest one found in a full span sweep. The default selection for Automeasure at Marker is OFF.

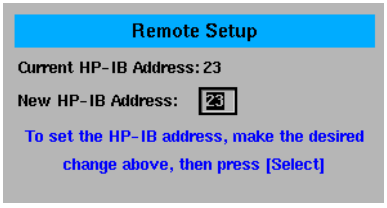
Optimize Sensitivity

Selecting the ON state for Optimize Sensitivity causes the auto measure function to set the sensitivity so the resulting measurement has a minimal amount of noise. It does this by finding the minimum in the measurement trace and comparing this value to the known sensitivity of the instrument at that wavelength. Sensitivity is then reduced until the signal is close to this minimum sensitivity or the sweep time becomes too long. The Optimize Sensitivity function is useful when viewing high dynamic range signals. The drawback to turning this function ON is that it generally requires a longer sweep time to get better sensitivity. The default selection for Optimize Sensitivity: is OFF.

> **Note**
>
> None of the Automeasure Setup parameters are affected by the front-panel Preset key. They are not saved as part of the measurement setup.

To set the HP-IB address

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Remote Setup....* softkey. The Remote Setup panel appears.
4. The Current HPIB Address information shows the HP-IB address currently being used. To change the address, use the numerical entry pad or knob to change the New HPIB Address information. Press the *Defaults* softkey to reset the address to factory preset defaults. Refer to "To Fill In a Setup Panel" on page 3-65 for information on changing and selecting items in the setup panel.
5. Press the *Set HPIB Address* softkey if changes were made.



The Remote Setup panel

Setup panel selections

Current HPIB Address

Shows the HP-IB address currently being used.

New HPIB Address

Enter the new HP-IB address in the text box using the number keys or knob.

The Traces Menus

The Traces softkeys are accessed by using the front-panel Traces key or the Measure menu Traces selection on the menu bar. If you wish to change trace settings, the front-panel Traces key provides access to the following functions and setup panels:

Function	**See....**
Active Trace....	"To set the active trace" on page 3-57
Update *<trace>*	"To set the update function for the trace" on page 3-57
View *<trace>*	"To set the display function for the trace" on page 3-57
Hold *<trace>*....	"To set the Hold.... function" on page 3-58
Trace Math....	
Default Math Trace C....	"To set the trace math for trace C" on page 3-58
Default Math Trace F....	"To set the trace math for trace F" on page 3-59
Exchange Menu....	"To exchange both the X-axis and Y-axis data of two traces" on page 3-59
All Math Off	"To turn all math functions off" on page 3-59
Averaging....	"To set up averaging" on page 3-60
Trace Setup....	"To set the number of points in a sweep" on page 3-60

Using the Traces functions

To set the active trace

1. Press the front-panel Traces key.
2. Press the *Active Trace....* softkey.
3. Use the arrow keys or knob to select the active trace.

   or

1. Press the front-panel Markers key.
2. Press the *Active Trace....* softkey.
3. Use the arrow keys or knob to select the active trace.

   To put a marker on a trace, or to make changes to a trace, it must be the active trace. The active trace is designated by the double-arrows at either the left or right edge of the graticule.

To set the update function for the trace

1. Press the front-panel Traces key.
2. Select the trace to be changed.
3. Press the *Update <trace>* softkey.
4. Use the arrow keys or knob to select ON or OFF.

   When ON, the trace always accepts data when data is available.

   When OFF, the trace will not be updated.

To set the display function for the trace

1. Press the front-panel Traces key.
2. Select the trace to be changed.
3. Press the *View <trace>* softkey to turn the display of the selected trace ON or OFF.

To set the Hold.... function

1. Press the front-panel Traces key.
2. Press the *Hold <trace>....* softkey to select None, Min or Max.

   None turns the Hold function off.

   The maximum hold function compares the current amplitude value of each point on a trace in the current sweep to the corresponding point detected during the previous sweep, then displays the maximum value.

   The minimum hold function compares the current amplitude value of each point on a trace in the current sweep to the corresponding point detected during the previous sweep, then displays the minimum value.

   Pressing the *Max/Min Reset* softkey resets the hold function to the last acquired trace. Subsequent traces are accumulated in the hold sequence.

To set the trace math for trace C

1. Press the front-panel Traces key.
2. Press the *Trace Math....* softkey.
3. Press the *Default Math Trace C....* softkey to define the math expression to be used when the math operations are turned on. The result is placed in Trace C.
4. Select the appropriate softkey to define the math expression.

   C*=A_{LOG}–*B*, *C*=A_{LOG}+*B*, *C*=A_{LIN}–*B*, *C*=A_{LIN}+*B

   Defines the math expression to be used and turns the math operation ON. The math operation is performed in linear units.

   Trace C Math Off

   Determines whether or not math processing is performed.

To set the trace math for trace F

1. Press the front-panel Traces key.
2. Press the *Trace Math....* softkey.
3. Press the *Default Math Trace F....* softkey. The result is placed in trace F.
4. Select the appropriate softkey to define the math expression.

   F=C*$_{LOG}$*–D

   Defines the math expression to be used and turns the math operation ON. The math operation is performed in linear units.

   Trace F Math Off

   Determines whether or not math processing is done.

To exchange both the X-axis and Y-axis data of two traces

1. Press the front-panel Traces key.
2. Press the *Trace Math....* softkey.
3. Press the *Exchange Menu....* softkey.
4. Select the two traces to be exchanged for both the X- and Y-axis.

To turn all math functions off

1. Press the front-panel Traces key.
2. Press the *Trace Math....* softkey.
3. Press the *All Math Off* softkey.

To set up averaging

1. Press the front-panel Traces key.
2. Press the *Averaging....* softkey.
3. Toggle averaging ON or OFF. If averaging is on, softkeys appear to select the number of measurements to be averaged.

   Use the keys to select the number of measurements to be averaged. When the number of measurements taken is less than the count, the following formula is used to calculate the data:

$$AVG = \frac{sum\ of\ all\ measurements}{number\ of\ measurements}$$

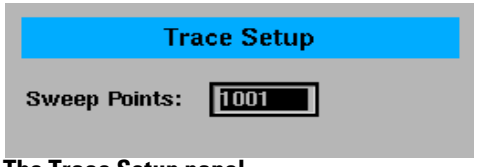
   If the number of measurements is greater than or equal to the count, the following formula is used to calculate the data:

$$New\ average = \frac{count - 1}{count} \times last\ average + \frac{new\ measurement}{count}$$

   Averaging values other than those displayed can be entered by using the numeric keypad or the knob when the Avg Count active function area is displayed.

To set the number of points in a sweep

1. Press the front-panel Traces key.
2. Press the *Trace Setup....* softkey. The Trace Setup panel will appear.



The Trace Setup panel

3. Enter the desired sweep length in the setup panel. The minimum sweep length is three points. The maximum sweep length is 10,001 points. Refer to "To Fill In a Setup Panel" on page 3-65 for information on changing and selecting items in the setup panel.

The Wavelength Menus

The Wavelength softkeys are accessed using the front-panel Wavelength key or the Measure menu Wavelength selection on the menu bar. If you wish to change the wavelength settings, the front-panel Wavelength key provides access to the following functions and setup panels:

Function	**See....**
Center Wavelength	"To set the center wavelength" on page 3-62
Span	"To set the wavelength span" on page 3-62
Start Wavelength	"To set the start wavelength" on page 3-62
Stop Wavelength	"To set the stop wavelength" on page 3-62
Peak to Center	"To set the peak to the center of the display" on page 3-63
Wavelength Setup....	"To change the default wavelength settings" on page 3-63

Note

When the optical spectrum analyzer is first turned on, the wavelength range is set to the full 1100 nm span (600 nm to 1700 nm). Sweeps begin at the shortest wavelength (start) and end at the longest wavelength (stop). You can set the center, stop, start, and span wavelength values. The span is set symmetrically about the center wavelength.

Using the Wavelength functions

To set the center wavelength

1. Press the front-panel Wavelength key.
2. Press the *Center WL* softkey.
3. Use the knob, step keys or numeric entry pad to enter the desired value.

To set the wavelength span

1. Press the front-panel Wavelength key.
2. Press the *Span* softkey.
3. Use the knob, step keys or numeric entry pad to enter the desired value.

   The span is set symmetrically about the center wavelength. When the span is set to 0 nm, the display's horizontal axis represents time instead of wavelength. A span of 0 nm (called zero span mode) configures the optical spectrum analyzer as a fixed tuned receiver.

To set the start wavelength

1. Press the front-panel Wavelength key.
2. Press the *Start WL* softkey.
3. Use the knob, step keys or numeric entry pad to enter the desired value.

To set the stop wavelength

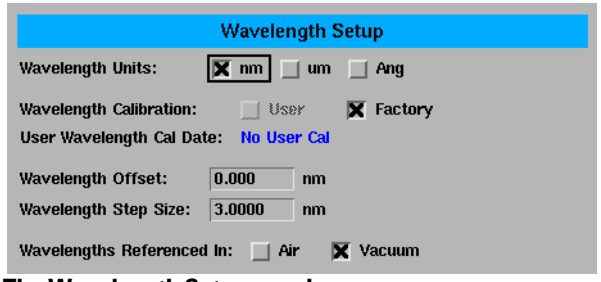
1. Press the front-panel Wavelength key.
2. Press the *Stop WL* softkey.
3. Use the knob, step keys or numeric entry pad to enter the desired value.

To set the peak to the center of the display

1. Press the front-panel Wavelength key.
2. Press the *Peak to CENTER* softkey to move the peak to the center of the display.

To change the default wavelength settings

1. Press the front-panel Wavelength key.
2. Press the *Wavelength Setup....* softkey. The Wavelength Setup panel opens.



The Wavelength Setup panel

Setup panel selections

Wavelength Units

Sets the wavelength units to nm, um, or Ang.

Wavelength Calibration

The wavelength calibration is not a simple offset applied to all wavelengths, but uses the trigonometric diffraction grating equation to correct all wavelengths in a calculated manner. The power offset is a simple offset applied equally to all wavelengths. It is good measurement practice to calibrate the optical spectrum analyzer as close as possible to the wavelength where you plan to make your measurements.

User Wavelength Cal Date

Shows the date of the last successful user-performed wavelength calibration.

Wavelength Offset

Specifies the wavelength offset. This is an offset between the measured wavelength and the displayed wavelength.

Wavelength Step Size

Specifies the center wavelength step size.

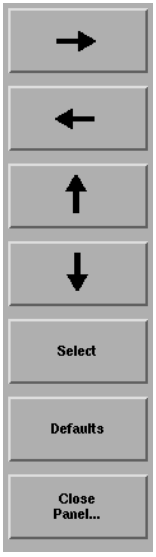
Wavelengths Referenced In

Specifies if the displayed wavelengths show values as measured in air or in vacuum. Pressing the front-panel Preset key sets this value to Vacuum. See page 3-5 for more information on the Preset states.

To Fill In a Setup Panel

Setup panels allow you to adjust setup conditions which are not frequently changed.

Using the softkeys



The arrow softkeys

Allow the user to navigate from field to field in the dialog box. The highlighted parameter can be changed.

The Select softkey

Selects or deselects the highlighted parameter.

The Defaults softkey

Resets the parameters to their default condition.

Close Panel.... softkey

Saves the current setup and returns the user to the previous menu.

The front-panel number keys, step keys, and knob

Allows the user to enter a numeric value in the highlighted field.

To use the navigation softkeys

1. Use the arrow softkeys to highlight the settings on the setup panel.
2. Use the *Select* softkey to toggle the selection boxes on and off.
3. Enter values in the numeric fields using the front-panel knob or numeric entry pad.
4. To return the setup values to the instrument's preset settings, press the *Defaults* softkey.
5. When you are satisfied with your selections, press the *Close Panel....* softkey to enter your selections and close the setup panel.

4

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Remote Operation

Remote Operation

This chapter provides information on remote programming of the HP 86140-series optical spectrum analyzers. The easiest way to program the instrument is by using the VXI*plug&play* universal instrument drivers. The VXI-*plug&play* universal instrument drivers allow you to develop programs using the following applications: HP VEE, LabVIEW[1], LabWindows/CVI, C, C++, and Microsoft®[2] Visual Basic[3].

If you desire more control of the instrument, you can use the HP-IB programming commands that are documented in this chapter. The programming commands are compatible with the Standard Commands for Programmable Instruments (SCPI) standard. For more detailed information regarding the HP-IB, the IEEE 488.2 standard, or the SCPI standard, refer to the following books:

SCPI Consortium. *SCPI—Standard Commands for Programmable Instruments,* 1997.

International Institute of Electrical and Electronics Engineers. *IEEE Standard 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation.* New York, NY, 1987.

International Institute of Electrical and Electronics Engineers. *IEEE Standard 488.2-1987, IEEE Standard Codes, Formats, Protocols and Common commands For Use with ANSI/IEEE Std 488.1-1987.* New York, NY, 1987.

For situations where all you need to accomplish is capturing the instrument's display or returning trace data values to the computer, consider using the HP N1031A BenchLink software that was shipped with the instrument.

1. LabVIEW and LabWindows/CVI are products of National Instruments Corporation.
2. Microsoft® is a U.S. registered trademark of Microsoft Corp.
3. Microsoft Visual Basic is a product of Microsoft Corp.

Table 4-1. Front-Panel Features

RMT	Indicates that the instrument is operating under HP-IB control.
SRQ	Indicates that the instrument has requested service from the computer. Refer to "Monitoring the Instrument" on page 4-11.
Local	Pressing this button activates the front-panel keys after a computer has had control of the instrument.

Getting Started

One of the easiest ways to learn how to write programs to control the instrument is to look at simple examples. In "Example Programs" on page 4-16, you'll find several useful example programs. Although they are written using the HP BASIC language, you can easily convert them to the language that you are using. The HP 86140 series' HP-IB address is configured at the factory to a value of 23. You must set the output and input functions of your programming language to send the commands to this address. Pressing the green Preset key does not change the HP-IB address.

To change the HP-IB address

1. Press the front-panel System key.
2. Press the *More System Functions....* softkey.
3. Press the *Remote Setup....* softkey, and change the HP-IB address.

Remote mode and front-panel lockout

Whenever the instrument is in Remote mode, the RMT message is displayed on the instrument's screen and all keys are disabled except for the front-panel LOCAL key. This key can be pressed by the user to restore front-panel control of the instrument.

You can specify a local lockout mode that de-activates the front-panel LOCAL key. If the instrument is in local lockout mode, all the front-panel keys are disabled.

Consult the documentation for your programming environment to determine which commands are used to put an instrument in the remote and local lockout modes. These are not HP 86140 series commands; they control HP-IB control lines and do not send any characters to the instrument.

Remote command buffering

The OSA accepts serial data via HP-IB, testing each byte. Once a complete command is received and interpreted, the HP-IB handshake is held until the command operation is completed. Once completed, the next command byte is read by the analyzer. If several commands are included in a single output statement, the computer will not be able to complete the controller output operation until the OSA has executed all of the commands. This process can hold the HP-IB interface, or program control, past a timeout cycle.

For this reason, send individual commands rather than combining them. After the command is correctly interpreted, the bus is held until the command execution is complete. If there are no other commands pending, the interface bus is released and the controller can perform other tasks while the OSA is completing the operation.

Command buffering provides an automatic synchronization between the program sending the commands and the analyzer operation. Each command will be executed before another command is recognized. There is no danger of reading or interpreting trace data in an indeterminate state, such as before a sweep has completed.

Controlling the sweep

Placing the optical spectrum analyzer in remote mode and sending the DISP:WIND:TRAC:ALL:SCAL:AUTO command finds the largest signal and optimizes the analyzer settings. This command also sets single sweep mode on the analyzer. If the DISP:WIND:TRAC:ALL:SCAL:AUTO command is not used, single sweep can be set using the INIT:CONT OFF command. The trace data present in the analyzer must be updated by taking a sweep when appropriate using the INIT:IMM command. Use this command to update the sweep after changing settings.

This mode of operation allows the program to control the sweep and ensure that data read from, or operated on in the analyzer, is updated correctly. Controlling the sweep also minimizes the amount of time the analyzer spends sweeping. At high sensitivity and high resolution settings, sweeps can take a significant amount of time. Controlling the sweep ensures that the amount of time spent acquiring data is optimized and that the data being displayed is valid for the current settings.

Syntax notation conventions

The following information applies to the common and instrument-specific commands listed in this chapter. All measurement values and parameters are sent and received as ASCII strings with the exception of the following commands. These commands send and receive floating point binary data in IEEE 488.2 indefinite or definite length blocks:

HCOPy:DATA?
MMEMory:DATA
TRACe:DATA:Y:POWER
TRACe:DATA:Y:RATio
TRACe:DATA:Y?
MEMory:STATe:EXTended?

Uppercase lettering indicates that the uppercase portion of the command is the short form of the command. For example, in the command WAVelength, WAV is the short form.

Table 4-2. Syntax Notation Conventions

Convention	Description
::=	Means *is defined as*.
|	Indicates a choice of one element from a list. For example, A | B indicates A or B, but not both.
[ ]	Indicates the enclosed item is optional.
{ }	Indicates the enclosed item can be incorporated in the command several times, once, or not at all.
<file_name>	File names must conform to standard MS-DOS®[a] file naming conventions.
<trace_name>	TRA, TRB, TRC, TRD, TRE, TRF
<data_block>	This parameter represents the arbitrary block program data as defined by IEEE 488.2. Arbitrary block program data allows any 8-bit bytes to be transmitted. This includes extended ASCII control codes and symbols. Two types of data blocks are defined: definite-length blocks and indefinite-length blocks. The **definite-length block** consists of a "#" character, followed by one digit (in ASCII) specifying the number of length bytes to follow, followed by the length (in ASCII), followed by length bytes of binary data. For example, two bytes of binary data would be sent as follows: **#12<8 bit data byte><8 bit data byte>** The **indefinite-length block** consists of a "#" character, followed by a "0" character (in ASCII), followed by any number of bytes of binary data. The data stream is terminated by a new line character with EOI set. For example, two bytes of binary data would be sent as follows: **#0<8 bit data byte><8 bit data byte>NL^EOI**

a. MS-DOS is a U.S. registered trademark of Microsoft Corporation.

SCPI command are grouped in subsytems
In accordance with IEEE 488.2, the instrument's commands are grouped into "subsystems." Commands in each subsystem perform similar tasks. The first page of this chapter lists where each subsystem is documented.

Sending a command
It's easy to send a command to the instrument. Simply create a command string from the commands listed in this book, and place the string in your program language's output statement. For example, the following string places marker1 on the peak of the active trace:

```
OUTPUT 723;"CALC:MARK1:MAX"
```

Use either short or long forms
Commands and queries may be sent in either long form (complete spelling) or short form (abbreviated spelling). The description of each command in this manual shows both versions; the extra characters for the long form are shown in lowercase. The following is a long form of a command:

```
OUTPUT 723;":SENSe:WAVelength:STARt?"
```

And this is the short form of the same command:

```
OUTPUT 723;":SENS:WAV:STAR?"
```

You can use upper or lowercase letters
Program headers can be sent using any combination of uppercase or lowercase ASCII characters. Instrument responses, however, are always returned in uppercase.

Combine commands in the same subsystem
You can combine commands from the same subsystem provided that they are both on the same level in the subsystem's hierarchy; simply separate the commands with a semi-colon (;). For example, the following two lines,

```
OUTPUT 723;":SENS:WAV:STAR 1300NM"
OUTPUT 723;":SENS:WAV:STOP 1400NM"
```

can be combined into one line:

```
OUTPUT 723;":SENS:WAV:STAR 1300NM;STOP 1400NM"
```

The semicolon separates the two functions.

Combine commands from different subsystems

You can send commands and program queries from different subsystems on the same line; simply precede the new subsystem by a semicolon followed by a colon. In the following example, the colon and semicolon pair before CALC allows you to send a command from another subsystem.

```
OUTPUT 723;":SENS:WAV:SPAN:FULL;:CALC:MARK1:MAX"
```

Sending common commands

If a subsystem has been selected and a common command is received by the instrument, the instrument remains in the selected subsystem. For example, if the command

```
OUTPUT 723;":SENS:WAV:STAR 1300NM;*CLS;STOP 1400NM"
```

is sent to the instrument, the Sense subsystem remains selected. If some other type of command is received within a program message, you must reenter the original subsystem after the command.

Adding parameters to a command

Many commands have parameters that specify an option. Use a space character to separate the parameter from the command, as shown in the following line:

```
OUTPUT 723;":SENS:BWID:RES 0.1NM"
```

Separate multiple parameters with a comma (,). Spaces can be added around the commas to improve readability.

```
OUTPUT 723;":DISP:WIND:TRAC:STAT TRB, ON"
```

White space

White space is defined to be one or more characters from the ASCII set of 0 through 32 decimal, excluding 10 (NL). White space is usually optional, and can be used to increase the readability of a program.

Numbers

All numbers are expected to be strings of ASCII characters. Thus, when sending the number 9, you would send a byte representing the ASCII code for the character "9" (which is 57). A three-digit number like 102 would take up three bytes (ASCII codes 49, 48, and 50). This is taken care of automatically when you include the entire instruction in a string. Several representations of a number are possible. For example, the following numbers are all equal: 28, 0.28E2 and 280E-1.

If a measurement cannot be made, no response is given and an error is placed into the error queue. For example,

```
*RST
:CALC1:MARK1:X?
```

will timeout the controller and place a *Settings conflict* error in the error queue.

Table 4-3. Suffix Multipliers

Multiplier	Mnemonic	Multiplier	Mnemonic
1E18	EX	1E-3	M
1E15	PE	1E-6	U
1E12	T	1E-9	N
1E9	G	1E-12	P
1E6	MA	1E-15	F
1E3	K	1E-18	A

Program message terminator

The string of instructions sent to the instrument is executed after the instruction terminator is received. The terminator may be either a new-line (NL) character, the End-Or-Identify (EOI) line asserted, or a combination of the two. All three ways are equivalent. Asserting the EOI sets the EOI control line low on the last byte of the data message. The NL character is an ASCII line-feed (decimal 10). The NL terminator has the same function as an EOS (End Of String) and EOT (End Of Text) terminator.

Querying data

Data is requested from the instrument using a query. Queries can be used to find out how the instrument is currently configured. They are also used to obtain results of measurements made by the instrument, with the query actually activating the measurement. String responses are returned as uppercase letters.

Queries usually take the form of a command followed by a question mark (?). After receiving a query, the instrument places the answer in its output queue. The answer remains in the output queue until it is read or another command is issued. For example, the query

```
OUTPUT 723;":CALC:MARK1:X?"
```

places the wavelength of marker 1 in the output queue. In HP BASIC, the controller input statement

```
ENTER 720;Range
```

passes the value across the bus to the controller and places it in the variable Range. Sending another command or query before reading the result of a query causes the output queue to be cleared and the current response to be lost. This also generates an error in the error queue. The output of the instrument may be numeric or character data depending on what is queried. Refer to the specific commands for the formats and types of data returned from queries. You can send multiple queries to the instrument within a single program message, but you must also read them back within a single program message. This can be accomplished by either reading them back into a string variable or into multiple numeric variables. When you read the result of multiple queries into string variables, each response is separated by a semicolon.

Monitoring the Instrument

Your programs can monitor the HP 86140 series for its operating status, including querying execution or command errors and determining whether or not measurements have been completed. Several status registers and queues are provided to accomplish these tasks as shown in Figure 4-1 on page 4-12. The status structures shown in the figure consist of condition registers, event registers, event enable registers, and, in the case of the Operation Status Structure, transition filters. For example, there exists the Standard Status *Condition* Register, the Standard Status *Event* Register, and the Standard Status *Event Enable* Register. Condition registers show the *current* condition of the status lines. Event registers show that an event has occurred. Once latched, these registers stay set until cleared. Event enable registers are masks that you can use to enable or disable the reporting of individual bits from an event register. For example, you can disable the reporting of the Sweeping bit in the Operation Status structure so that, even though it goes high in the registers, it can never set the summary bit 7 in the Status Byte high.

Querying a register always returns the value as a decimal-weighted sum of all set bits. Refer to Table 4-4 on page 4-11. For example, if the value returned was 528, this would indicate that bits 4 and 9 were set. Mask registers are set using these same values. For example, the *ESE 60 command sets bits 2 through 5 of the Standard Status Event Enable Register. Whenever any one of bits 2 through 5 of the Standard Status Event Register goes high, bit 5 of the status byte will be set.

Table 4-4. Decimal Values of Event Enable Register Bits

Bit	Decimal Value	Bit	Decimal Value	Bit	Decimal Value	Bit	Decimal Value
0	1	4	16	8	256	12	4096
1	2	5	32	9	512	13	8192
2	4	6	64	10	1024	14	16,384
3	8	7	128	11	2048	15	32,768

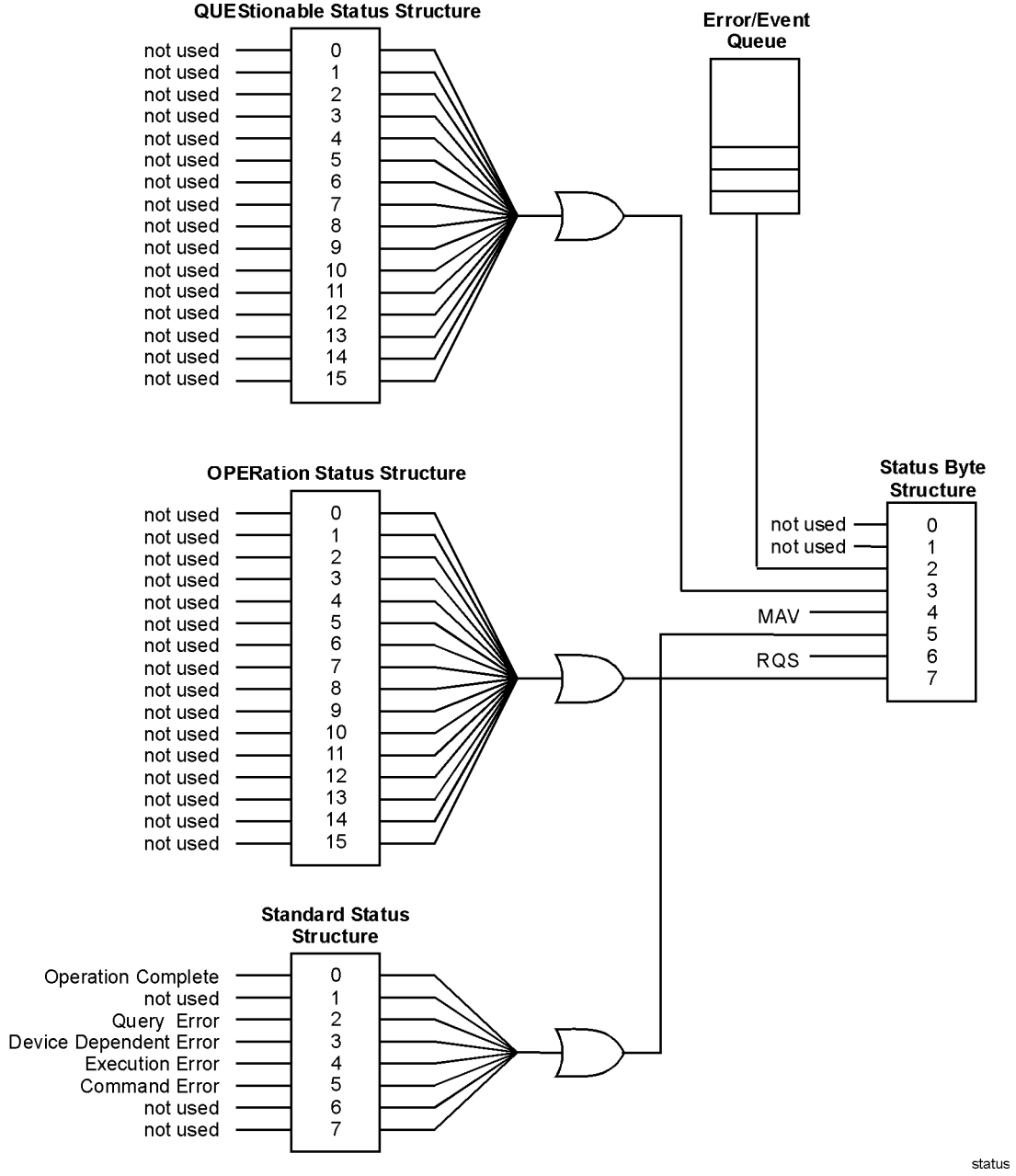


Figure 4-1. Status Registers

The STATus:PRESet command clears all event registers and sets all bits in the event enable registers. Use the *CLS common command to clear all event registers and all queues except the output queue. If *CLS is sent immediately following a program message terminator, the output queue is also cleared. In addition, the request for the *OPC bit is also cleared.

For an example program using the status registers, refer to "Example 9. Monitoring the status registers" on page 4-29.

Status Byte

The Status Byte contains summary bits that monitor activity in the other status registers and queues. The register's bits are set and cleared by summary bits from other registers or queues. If a bit in the Status Byte goes high, query the value of the source register to determine the cause.

Command	Use
HP-IB serial poll command	Returns the status byte value. Reads bit 6 as the Request Service (RQS) bit and clears the bit which clears the SRQ interrupt.
*STB? common command	Returns the status byte value. Reads bit 6 as the Master Summary Status (MSS) and does not clear the bit or have any effect on the SRQ interrupt.
*SRE common command	Sets or reads the event enable register value (mask).

Standard Status Structure

The Standard Status Structure monitors the following instrument status events: operation complete, query error, device dependent error, execution error, and command error. When one of these events occurs, the event sets the corresponding bit in the register.

Command	Use
*ESR? common command	Returns and clears the value of the event register.
*OPC common command	When all operations have finished, sets bit 0 of the event register. The query returns a 1 when all operations have finished.
*ESE common command	Sets or returns the value of the event enable register (mask).

Operation Status Structure

Contains bits that report on the instrument's normal operation. Additional transition filters give you the ability to select the logic transitions which set the event register bits. For example, you can define the Measuring bit of the Operation Status Structure to be set when a status line transitions from false to true. This is a positive transition. You can also specify a negative transition where bits are set when a status line transitions from true to false.

Command	Use
STAT:OPER:COND?	Returns the value of the condition register.
STAT:OPER:EVEN?	Returns the value of the event register.
STAT:OPER:ENAB	Sets or returns the value of the event enable register (mask).
STAT:OPER:NTR	Sets or returns the value of the negative transition register.
STAT:OPER:PTR	Sets or returns the value of the positive transition register.

Table 4-5. Bits in Operation Status Structure

Bit	Definition
0–15	not used

Questionable Status Structure

Contains bits that report on several questionable instruments conditions.

Command	Use
STAT:QUES:COND?	Returns the value of the condition register.
STAT:QUES:EVEN?	Returns the value of the event register.
STAT:QUES:ENAB	Sets or returns the value of the event enable register (mask).

Table 4-6. Bits in Questionable Status Structure

Bit	Definition
0–15	not used

Output Queue

The output queue stores the instrument responses that are generated by certain commands and queries that you send to the instrument. The output queue generates the Message Available Summary bit when the output queue contains one or more bytes. This summary bit sets the MAV bit (bit 4) in the Status Byte. The method used to read the output queue depends upon the programming language and environment. For example, with HP Basic, the output queue may be read using the ENTER statement.

Error Queue

As errors are detected, they are placed in an error queue. Instrument specific errors are indicated by positive values. General errors have negative values. You can clear the error queue by reading its contents, sending the *CLS command, or by cycling the instrument's power. The error queue is first in, first out. If the error queue overflows, the last error in the queue is replaced with error -350, "Queue overflow." Any time the queue overflows, the least recent errors remain in the queue, and the most recent error is discarded. The length of the instrument's error queue is 30 (29 positions for the error messages, and 1 position for the "Queue overflow" message). Querying errors removes the oldest error from the head of the queue, which opens a position at the tail of the queue for a new error. When all the errors have been read from the queue, subsequent error queries return 0, "No error."

Command	Use
*CLS common command	Clears the error queue (and all event registers).
SYSTem:ERRor?	Returns and removes the oldest error from the head of the queue.

Example Programs

These programs are provided to give you examples of using HP 86140 series remote programming commands in typical applications. They are not meant to teach general programming techniques or provide ready-to-use solutions. They should allow you to see how measurements are performed and how to return data to the computer. The programs are written in HP BASIC for Windows.

The following example programs are provided in this section:

Example 1. Initialization and a simple measurement 4-17
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Example 1. Initialization and a simple measurement

Description

This program provides the basic building block for beginning development of a measurement routine. The *RST common command resets the instrument to predetermined settings to provide a common starting point. The automeasure function locates the largest signal in the spectrum and optimizes the display of the signal. The maximum signal is located and a marker placed on the signal. This signal is then used for the autoalign function. Autoalign aligns the internal components of the OSA to compensate for any effects of handling, temperature, and humidity. This operation should be performed whenever the instrument is moved or the environmental conditions change. It should be performed after the instrument is at operating temperature. Periodic use of autoalign assures optimum performance. The program sets the start and stop wavelength and the amplitude sensitivity.

Program

```
PRINT "Single Measurement Example"
OUTPUT 723;"disp:wind:text:data 'Single Measurement'"
!
!********************** Initialization Routine ******************
!
PRINT
OUTPUT 723;"*rst"                                   ! Preset the instrument
PRINT "Presetting the instrument"
!
PRINT
OUTPUT 723;"disp:wind:trac:all:scal:auto"           ! Automeasure
PRINT "Performing Automeasure"
!
PRINT
OUTPUT 723;"cal:alig:mark1"                         ! Perform an autoalignment
PRINT "Performing Autoalign"
!*************************************************************************
PRINT
! Next line is the operation complete query used so that the text is not printed
!   until after the Autoalign is complete
OUTPUT 723;"*opc?"
ENTER 723;Dum
PRINT " ... measurement begins"
!
OUTPUT 723;"sens:wav:star 1314nm"                   ! Set start wavelength
OUTPUT 723;"sens:wav:stop 1316nm"                   ! Set stop wavelength
OUTPUT 723;"sens:pow:dc:rang:low -70dbm"            ! Set ampl sensitivity
OUTPUT 723;"sens:bwid:res 0.1 nm"                   ! Set the res bandwidth
OUTPUT 723;"init:imm"                               ! Take a sweep
OUTPUT 723;"calc:mark1:max"                         ! Locate max signal
OUTPUT 723;"calc:mark1:scen"                        ! Marker to center
OUTPUT 723;"init:imm"                               ! Take a sweep
!
LOCAL 723                                           ! Return to local operation
END
```

Example 2. Locating the largest signal

Description

This program finds the largest signal, zooms to a narrow span, and then uses markers to return signal wavelength and amplitude to the computer.

Program

```
PRINT "OSA Zoom Example"
OUTPUT 723;"disp:wind:text:data 'Display the largest Signal'"
!
PRINT
OUTPUT 723;"*rst"                                   ! Preset the instrument
PRINT "Presetting the instrument"
!
PRINT
OUTPUT 723;"disp:wind:trac:all:scal:auto"           ! Automeasure
PRINT "Performing Automeasure"
!
!
PRINT
OUTPUT 723;"cal:alig:mark1"                          ! Perform an autoalignment
PRINT "Performing Autoalign"
!
PRINT
! Next line is the operation complete query used so that the text is not printed
!   until after the Autoalign is complete
OUTPUT 723;"*opc?"
ENTER 723;Dum
PRINT "...measurement begins"
!
OUTPUT 723;"init:imm"                               ! Take a single sweep
OUTPUT 723;"calc1:mark1:max"                         ! Marker to peak
OUTPUT 723;"calc1:mark1:scen"                        ! Marker to center
OUTPUT 723;"sens:wav:span 10 nm"                     ! Set span
!
OUTPUT 723;"init:imm"                                ! Take a single sweep
OUTPUT 723;"calc1:mark1:max"                         ! Marker to peak
OUTPUT 723;"calc1:mark1:scen"                        ! Marker to center
!
OUTPUT 723;"init:imm"                               ! Take a single sweep
!
OUTPUT 723;"calc1:mark1:x?"                          ! Read marker wavelength
ENTER 723;Markwl
!
OUTPUT 723;"calc1:mark1:y?"                          ! Read marker amplitude
ENTER 723;Markamp
!
PRINT "        Marker values"
PRINT
Markwl=Markwl*1.E+9                                  ! Convert to nm
PRINT Markwl;"nm",Markamp;"dBm"
!
LOCAL 723
END
```

Example 3. Bandwidth

Description

The 20 dB marker BW function is used to determine the bandwidth of the signal. The program assumes a narrowband signal as an input.

Program

```
PRINT
PRINT "20 dB Bandwidth example"
OUTPUT 723;"disp:wind:text:data 'Signal Bandwidth Measurement'"
!
PRINT
PRINT "Presetting the instrument"
OUTPUT 723;"*rst"                                   ! Preset the instrument
!
PRINT
OUTPUT 723;"disp:wind:trac:all:scal:auto"           ! Automeasure
PRINT "Performing Automeasure"
!
PRINT
OUTPUT 723;"cal:alig:mark1"                         ! Perform an autoalign
PRINT "Performing Autoalign"
!
! Next line is the operation complete query used so that the text is not printed
!   until after the Autoalign is complete
OUTPUT 723;"*opc?"
ENTER 723;Dum
PRINT " ...measurement begins"
PRINT
!
OUTPUT 723;"sens:wav:span 10 nm"                    ! Set span
!
OUTPUT 723;"init:imm"                               ! Take a sweep
OUTPUT 723;"calc1:mark1:max"                        ! Marker to peak
OUTPUT 723;"calc1:mark1:scen"                       ! Marker to center
!
OUTPUT 723;"calc1:mark1:x?"                         ! Read marker wavelength
ENTER 723;Markwl
OUTPUT 723;"calc1:mark1:y?"                         ! Read marker amplitude
ENTER 723;Markamp
! Convert to standard measurement units (nm)
Markwl=Markwl*1.E+9
PRINT "Marker wavelength";Markwl;"nm"
PRINT "Marker amplitude";Markamp;"dBm"
PRINT
!
OUTPUT 723;"sens:bwid:res 0.1 nm"                   ! Set resolution bandwidth to min
OUTPUT 723;"sens:wav:span 2 nm"                     ! Set span to higher resolution
OUTPUT 723;"init:imm"                               ! Take a single sweep
!
OUTPUT 723;"calc1:mark1:max"                        ! Marker to peak for reference point
!
OUTPUT 723;"calc1:mark1:func:bwid:ndb -20.0 db"     ! Selects db down where bw is calculated
OUTPUT 723;"calc1:mark1:func:bwid:int on"           ! Enable bw marker interpolation
```

```
OUTPUT 723;"calc1:mark1:func:bwid:read wav"     ! Sets the BW unit of measure to WL
OUTPUT 723;"calc1:mark1:func:bwid:stat on"      ! Enable bandwidth marker
!
OUTPUT 723;"calc1:mark1:func:bwid:res?"         ! Returns X axis values between markers
ENTER 723;Rbw
IF Rbw<9.E+37 THEN Cnt                          ! Test for valid result
PRINT " BW not found"
STOP
Cnt:                                            ! BW was determined
!
OUTPUT 723;"calc1:mark1:func:bwid:x:left?"      ! Read left BW marker X axis value
ENTER 723;Markleft
OUTPUT 723;"calc1:mark1:func:bwid:x:righ?"      ! Read right BW marker X axis value
ENTER 723;Markright
!
! Convert to standard measurement units (nm)
Rbw=Rbw*1.E+9
Markleft=Markleft*1.E+9
Markright=Markright*1.E+9
!
PRINT "20 dB Marker bandwidth";Rbw;"nm"
PRINT "Left marker";Markleft;"nm"
PRINT "Right marker";Markright;"nm"
PRINT "Center";Rbw/2+Markleft;"nm"
!
LOCAL 723;
END
```

Example 4. Maximum and minimum amplitude values

Description

The marker delta function is used to find the maximum and minimum (peak and pit) values of the signal.

Program

```
PRINT "Peak to Pit Example"
OUTPUT 723;"disp:wind:text:data 'Minimum & Maximum Signals'"
!
PRINT
OUTPUT 723;"*rst"                                   ! Preset the instrument
PRINT "Presetting the instrument"
!
PRINT
OUTPUT 723;"disp:wind:trac:all:scal:auto"           ! Automeasure
PRINT "Performing Automeasure"
!
PRINT
OUTPUT 723;"cal:alig:mark1"                         ! Perform an autoalignment
PRINT "Performing Autoalign"
!
PRINT
! Next line is the operation complete query used so that the text is not printed
!   until after the Autoalign is complete
OUTPUT 723;"*opc?"
ENTER 723;Dum
PRINT "...measurement begins"
!
OUTPUT 723;"sens:wav:span 10 nm"                    ! Set span
!
OUTPUT 723;"init:imm"                               ! Take a single sweep
OUTPUT 723;"calc1:mark1:max"                        ! Marker to peak
OUTPUT 723;"calc1:mark1:scen"                       ! Marker to center
!
OUTPUT 723;"sens:pow:dc:rang:low -60dBm"            ! Set sensitivity
OUTPUT 723;"init:imm"                               ! Take a single sweep
!
OUTPUT 723;"calc1:mark1:max"                        ! Marker to peak
OUTPUT 723;"calc1:mark1:x?"                         ! Read marker wavelength
ENTER 723;Markwl
OUTPUT 723;"calc1:mark1:y?"                         ! Read marker amplitude
ENTER 723;Markamp
!
! Turn on marker delta
OUTPUT 723;"calc1:mark1:func:delt:stat on"
!
OUTPUT 723;"calc1:mark1:min"                        ! Marker to pit
!
OUTPUT 723;"calc1:mark1:func:delt:y:offs?"          ! Read Delta Y Marker
ENTER 723;Markdelty
OUTPUT 723;"calc1:mark1:func:delt:x:offs?"          ! Read the x delta marker
ENTER 723;Markdeltx
!
```

```
PRINT "        Marker values"
PRINT
Markwl=Markwl*1.E+9                          ! Convert to nm
PRINT Markwl;"nm",Markamp;"dBm"
!
Markdeltx=Markdeltx*1.E+9                    ! Convert to nm
PRINT
PRINT "Marker Delta Values"
PRINT
PRINT Markdeltx;"nm",Markdelty;"dBm"
!
LOCAL 723                                    ! Return control to local
END
```

Example 5. Maximum and minimum values over time

Description

This program locates the largest signal using automeasure, and adjusts the center wavelength, span, and sensitivity settings. Trace B is then viewed and updated and set to maximum hold. Trace C is then viewed, updated, and set to minimum hold. Signal variations with time can now be monitored.

Program

```
PRINT "OSA Min/Max Hold Example"
OUTPUT 723;"disp:wind:text:data 'OSA Min/Max Hold Example'"
!
PRINT
OUTPUT 723;"*rst"                                   ! Preset the instrument
PRINT "Presetting the instrument"
!
PRINT
OUTPUT 723;"disp:wind:trac:all:scal:auto"           ! Automeasure
PRINT "Performing Automeasure"
!
PRINT
OUTPUT 723;"cal:alig:mark1"                         ! Perform an autoalignment
PRINT "Performing Autoalign"
!
PRINT
! Next line is the operation complete query used so that the text is not printed
!   until after the Autoalign is complete
OUTPUT 723;"*opc?"
ENTER 723;Dum
PRINT "... measurement begins"
!
! Set up and display the signal
!
OUTPUT 723;"sens:wav:cent 1315nm"                   ! Set the center wavelength
OUTPUT 723;"sens:wav:span 20nm"                     ! Set the wavelength span
OUTPUT 723;"sens:pow:dc:rang:low -65dBm"            ! Set the sensitivity
!
! Update and view trace B and set it to max hold
!
OUTPUT 723;"disp:wind:trac:stat trB, on"            ! View trace B
OUTPUT 723;"trac:feed:cont trB, Alw"                ! Update trace B
OUTPUT 723;"calc2:max:stat on"                      ! Set trace B to max hold
!
! Update and view trace C and set it to min hold
!
OUTPUT 723;"disp:wind:trac:stat trC, on"            ! View trace C
OUTPUT 723;"trac:feed:cont trC, Alw"                ! Update trace C
OUTPUT 723;"calc3:min:stat on"                      ! Set trace C to min hold
!
OUTPUT 723;"init:cont on"                           ! Turn continuous sweep on
!
LOCAL 723                                           ! Return control to local
END
```

Example 6. Returning trace data

Description

This program locates the largest signal and then zooms to a narrow span. The trace length is changed to 101 points and the entire trace data is read in and printed on the display.

Program

```
PRINT "OSA Trace Example"
OUTPUT 723;"disp:wind:text:data 'Trace Readout'"
!
DIM Tdata(1:101)                                    ! Create a trace array
DIM Wdata(1:101)                                    ! Wavelength data
!
PRINT "Presetting the instrument"
PRINT
OUTPUT 723;"*rst"                                   ! Preset the instrument
!
OUTPUT 723;"disp:wind:trac:all:scal:auto"           ! Automeasure
PRINT "Performing Automeasure"
PRINT
!
OUTPUT 723;"cal:alig:mark1"                         ! Perform an autoalignment
PRINT "Performing Autoalign"
PRINT
!
PRINT
! Next line is the operation complete query used so that the text is not printed
!   until after the Autoalign is complete
OUTPUT 723;"*opc?"
ENTER 723;Dum
PRINT "...measurement begins"
PRINT
!
OUTPUT 723;"sens:wav:span 10 nm"                    ! Set span
!
OUTPUT 723;"init:imm"                               ! Take a single sweep
OUTPUT 723;"calc1:mark1:max"                        ! Marker to peak
OUTPUT 723;"calc1:mark1:scen"                       ! Marker to center
!
OUTPUT 723;"init:imm"                               ! Take a single sweep
!
! Read in the trace data
OUTPUT 723;"sens:swe:poin 101"                      ! Set trace length to 101
OUTPUT 723;"init:imm"                               ! Take a single sweep
!
OUTPUT 723;"form ascii"                             ! Set data format to ASCII
OUTPUT 723;"trac:data:y? tra"                       ! Request data
ENTER 723;Tdata(*)                                  ! Read data trace
!
! Read start, stop and trace length
!
OUTPUT 723;"sens:wav:star?"                         ! Read start wavelength
```

```
ENTER 723;Startw
OUTPUT 723;"sens:wav:stop?"                    ! Read stop wavelength
ENTER 723;Stopw
OUTPUT 723;"sens:swe:poin?"                    ! Read trace length
ENTER 723;Tlength
Bucket=(Stopw-Startw)/(Tlength-1)              ! Calculate bucket length
PRINT "Data Point Size",Bucket;"nm"
!
PRINT "Point"," Wavelength","Amplitude"
!
! The following lines calculate the wavelength value of each point
!    of the trace.  Note that wavelength values of a trace cannot
!    be directly queried.
!
FOR I=1 TO 101
Wlength=Startw+(Bucket*(I-1))                  ! Calculate point wavelength
Wlength=Wlength*1.E+9                          ! Convert to nm
PRINT I,Wlength,Tdata(I)
NEXT I
!
LOCAL 723                                      ! Return to local operation
END
```

Example 7. Trace normalization

Description

This program demonstrates trace normalization. Normalization is used to observe changes to a displayed response. For example, run the program and then bend the fiber to observe the change in signal level across the spectrum. Trace C displays the difference between trace A and trace B.

Program

```
PRINT "OSA Normalization Example"
OUTPUT 723;"disp:wind:text:data 'OSA Normalization Example'"
!
!************************ Initialization Routine *******************
!
PRINT
OUTPUT 723;"*rst"                                   ! Preset the instrument
PRINT "Presetting the instrument"
!
PRINT
OUTPUT 723;"disp:wind:trac:all:scal:auto"           ! Automeasure
PRINT "Performing Automeasure"
!
PRINT
OUTPUT 723;"cal:alig:mark1"                         ! Perform an autoalignment
PRINT "Performing Autoalign"
!
!*****************************************************************
!
PRINT
! Next line is the operation complete query used so that the text is not printed
!   until after the Autoalign is complete
OUTPUT 723;"*opc?"
ENTER 723;Dum
PRINT "... measurement begins"
!
OUTPUT 723;"Sens:Wav:Cent 1315 nm"
OUTPUT 723;"Sense:bwid:res 10nm"                    ! Fix resolution bw
!
OUTPUT 723;"Init:Imm"
!
! Trace A is the active trace
OUTPUT 723;"Disp:Wind:Trac:Stat TrA,On"             ! Turn on Trace A
OUTPUT 723;"Trac:Feed:Cont TrA, Alw"
!
! Trace B is the reference trace
OUTPUT 723;"Disp:Wind:Trac:Stat TrB,On"             ! Turn on Trace B
OUTPUT 723;"Trac:Feed:Cont TrB, Alw"
!
! Trace C displays the difference between A & B
OUTPUT 723;"Disp:Wind:Trac:Stat TrC,On"             ! Turn on Trace C
OUTPUT 723;"Trac:Feed:Cont TrC, Alw"
!
OUTPUT 723;"Trac:Feed:Cont TrB,Nev"                 ! Stop updating B
```

```
!
OUTPUT 723;"Init:Cont On"                    ! Set continuous sweep
!
!  Trace math function Log Math C=A-B
OUTPUT 723;"Calc3:Math:Expr (TRA / TRB)"     ! Normalize Trace A to B
OUTPUT 723;"Calc3:Math:Stat On"              ! Turn on normalization
!
LOCAL 723                                    ! Return to local operation
END
```

Example 8. Total power measurement

Description

This program demonstrates the total power function. The ASE broadband noise power of an EDFA source is measured. Two sweeps are taken, one of the entire trace and then another of just the noise hump. The total power of the two different traces are displayed.

Program

```
OUTPUT 723;"*rst"                                   ! Preset the instrument
OUTPUT 723;"disp:wind:trac:all:scal:auto"           ! Perform automeasure
!
OUTPUT 723;"sens:wav:span 10nm"                     ! Set the span
OUTPUT 723;"sens:bwid:res 5nm"                      ! Set resolution bandwidth
!
OUTPUT 723;"init:imm"                               ! Take a single sweep
!
OUTPUT 723;"calc1:tpow:stat 1"                      ! Turn the tpower state on
OUTPUT 723;"calc1:tpow:data?"                       ! Query the total power
!
ENTER 723;Tpower
PRINT "Entire Trace:";Tpower                        ! Print the total power
PRINT
!
! Select portion of trace
OUTPUT 723;"calc1:tpow:iran:low 1547.6nm"           ! Set the upper & lower
OUTPUT 723;"calc1:tpow:iran:upp 1552.6nm"           ! total power limits for the calculated range.
!
OUTPUT 723;"calc1:tpow:data?"                       ! Query the total power
!
ENTER 723;Tpower
PRINT "Portion of trace:";Tpower                    ! Print the total power
!
LOCAL 723                                           ! Return to local operation
!
END
```

Example 9. Monitoring the status registers

Description

This program presets the analyzer and then selects the largest signal using automeasure. This program demonstrates the use of status registers to detect programming errors. A serial poll is performed to read the instrument status byte. The same status byte is read with *STB?. The internal error register is also read and displayed. The error queue is queried to display the error condition.

Program

```
PRINT "OSA Status Byte Example"
OUTPUT 723;"disp:wind:text:data 'OSA Status Byte Example'"
!
!****************** Initialization routine ******************************
!
PRINT
OUTPUT 723;"*rst"                                    ! Preset the analyzer
PRINT "Presetting the analyzer"
!
PRINT
OUTPUT 723;"disp:wind:trac:all:scal:auto"            ! Automeasure
PRINT "Performing Automeasure"
!
!*************************************************************************
!
PRINT
! Next line is the operation complete query used so that the text is not printed
!   until after the Automeasure is complete
OUTPUT 723;"*opc?"
ENTER 723;Dum
PRINT "... measurement begins"
!
OUTPUT 723;"*CLS"                                    ! Clear Error Queue
!
OUTPUT 723;"*ESE 32"                                 ! Set Standard Event Enable bit 5(32)
!
OUTPUT 723;"init:imm"                                ! Take a sweep
! Next line is the operation complete query used so that the text is not printed
!   until after the Autoalign is complete
OUTPUT 723;"*opc?"
ENTER 723;Dum
!
Sbyte=SPOLL(723)                                     ! Read serial poll status byte
PRINT
PRINT "Serial Poll Status Byte:";Sbyte
PRINT
!
OUTPUT 723;"*stb?"                                   ! Read the Status Byte Register
ENTER 723;Stat
PRINT "Status Byte Register:";Stat
PRINT
```

```
!
OUTPUT 723;"*esr?"                          ! Read & clear the Std Event Status Register
ENTER 723;Stat
PRINT "Standard Event Status Register Byte:";Stat
PRINT
!
REPEAT
OUTPUT 723;"system:error?"                  ! Query error queue entries
ENTER 723;Errno;Error$
PRINT "Error Queue";Errno;Error$
UNTIL Errno=0                               ! Test for no error message in queue
!
LOCAL 723
END
```

Front Panel Functions to Remote Commands

This is a table of the front-panel functions of the HP 86140 series and the corresponding remote commands.

Table 4-7. Front Panel Function to Remote Command for the HP 86140 Series (1 of 6)

Front Panel Function	Remote Command
Amplitude	
Amplitude Setup	
Amplitude Units	UNITs:POWer
Auto Chop Mode	SENSe:CHOP:STATe
Auto Ranging	SENSe:POWer:DC:RANGe:AUTO
Auto Zero	CALibration:ZERO:AUTO
Power Calibration User	CALibration:POWer:STATe ON
Power Calibration Factory	CALibration:POWer:STATe OFF
Reference Level Position	DISPlay:WINDow:TRACe:Y:SCALe:RLPOS
Display Mode Log | Linear	DISPlay:WINDow:TRACe:Y:SCALe:SPACing LINear DISPlay:WINDow:TRACe:Y:SCALe:SPACing LOGarithmic
Peak to Reference Level	CALCulate:MARKer:MAXimum CALCulate:MARKer:SRLevel
Reference Level	DISPlay:WINDow:TRACe:Y:SCALe:RLEVel
Scale/Div	DISPlay:WINDow:TRACe:Y:SCALe:PDIVision
Sensitivity Auto | Man	Automatic: SENSe:POWer:DC:RANGe:LOWer:AUTO Manual: SENSe:POWer:DC:RANGe:LOWer
Applications	
Launch an Installed Application	None
Auto Align	CALibration:ALIGn:AUTO
Auto Measure	DISPlay:WINDow:TRACe:ALL:SCALe:AUTO
Bandwidth/Sweep	
Repeat. Sweep On | Off	INITiate:CONTinuous

Table 4-7. Front Panel Function to Remote Command for the HP 86140 Series (2 of 6)

Front Panel Function	Remote Command
Res BW Auto | Man	SENSe:BANDwidth:RESolution:AUTO SENSe:BANDwidth|BWIDth:RESolution
Single Sweep	INITiate:IMMediate
Sweep Time Auto | Man	SENSe:SWEep:TIME:AUTO SENSe:SWEep:TIME
Sync Out Low | Pulse | High Trigger Delay	TRIGger[:SEQuence]:OUTPut TRIGger[:SEQuence]:DELay
Trigger Mode	TRIGger[:SEQuence]:SLOPe TRIGger[:SEQuence]:SOURce
Video BW Auto | Man	SENSe:BANDwidth|BWIDth:VIDeo:AUTO SENSe:BANDwidth|BWIDth:VIDeo
Local	Local operation
Marker	
Active Marker 1 | 2 | 3 | 4 | Off	CALCulate:MARKer:STATe CALCulate:MARKer:AOFF
Delta Marker On | Off	CALCulate:MARKer:FUNCtion:DELTa:STATe
Line Marker Menu	
All Line Markers Off	
Advanced Line Marker Functions	
Integrate Limit On | Off	CALCulate:TPOWer:IRANge:STATe
Search Limit On | Off	CALCulate:MARKer:SRANge:STATe
Sweep Limit On | Off	SENSe:WAVelength:SRANge:STATe
Trace Integ On | Off	CALCulate:TPOWer:STATe
Wavelength Marker 1	Integration Limit:CALCulate:TPOWer:IRANge:LOWer Search Limit: CALCulate:MARKer:SRANge:LOWer Sweep Limit: SENSe:WAVelength:SRANge:LOWer
Wavelength Marker 2	Integration Limit:CALCulate:TPOWer:IRANge:UPPer Search Limit: CALCulate:MARKer:SRANge:UPPer Sweep Limit: SENSe:WAVelength:SRANge:UPPer
Marker BW On | Off	CALCulate:MARKer:FUNCtion:BANDwidth:STATe
Marker Search Menu	
Search Mode Peak	
Active Marker 1 | 2 | 3 | 4 | Off	CALCulate:MARKer:STATe CALCulate:MARKer:AOFF
Next Peak Down ↓	CALCulate:MARKer:MAXimum:NEXT
Next Peak Left ←	CALCulate:MARKer:MAXimum:LEFT
Next Peak Right →	CALCulate:MARKer:MAXimum:RIGHt

Table 4-7. Front Panel Function to Remote Command for the HP 86140 Series (3 of 6)

Front Panel Function	Remote Command
Peak Search	CALCulate:MARKer:MAXimum
Search Mode Pit	
Active Marker 1 | 2 | 3 | 4 | Off	CALCulate:MARKer:STATe CALCulate:MARKer:AOFF
Next Pit Up ↑	CALCulate:MARKer:MINimum:NEXT
Next Pit Left ←	CALCulate:MARKer:MINimum:LEFT
Next Pit Right →	CALCulate:MARKer:MINimum:RIGHt
Pit Search	CALCulate:MARKer:MINimum
Marker Setup	
Bandwidth/Marker Interpolation On | Off	CALCulate:MARKer:FUNCtion:BANDwidth:INTerpolation
BW Marker Units	CALCulate:MARKer:FUNCtion:BANDwidth:READout
Normal/Delta Marker Interpolation On | Off	CALCulate:MARKer:INTerpolation
Normal Marker Units	CALCulate:MARKer:X:READout
Peak Excursion ### dB	CALCulate:MARKer:PEXCursion:PEAK
Pit Excursion ### dB	CALCulate:MARKer:PEXCursion:PIT
Noise Marker Reference Bandwidth	CALCulate:MARKer:FUNCtion:NOISe:BANDwidth
Threshold Value ### pW	CALCulate:THReshold
Use Threshold On | Off	CALCulate:THReshold:STATe
Marker to CENTER	CALCulate:MARKer:SCENter
Marker to REF LEVEL	CALCulate:MARKer:SRLEVel
Marker Trace A | B | C | D | E | F	CALCulate:MARKer:TRACe
Noise Marker On | Off	CALCulate:MARKer:FUNCtion:NOISe:STATe
Peak Search	CALCulate:MARKer:MAXimum
Preset	SYSTem:PRESet
Print	HCOPy:IMMediate
Save/Recall	
Backup/Restore Menu	
Delete Menu	MMEMory:DELete
Fast Meas SAVE	
Fast Meas RECALL	
Format Floppy Disk	MMEMory:INITialize
Recall Menu	
Measurement	*RCL
Recall From	FLOPpy | INTernal

Table 4-7. Front Panel Function to Remote Command for the HP 86140 Series (4 of 6)

Front Panel Function	Remote Command
Trace	MMEMory:LOAD:TRACe
Save Menu	
File Name	<file_name>
Measurement	*SAV
Save Graphics	
Save To	FLOPpy | INTernal
Trace Only	MMEMory:STORe:TRACe
System	
Calibration	
Power Cal Setup	
Execute Calibration	CALibration:POWer
Set Calibration Power	CALibration:POWer:VALue
Set Calibration Wavelength	CALibration:POWer:WAVelength
Wavelength Calibration Setup	
Execute Calibration	CALibration:WAVelength
Calibration Wavelength measured in	SENSe:CORRection:RVELocity:MEDium
Set Calibration Wavelength	CALibration:WAVelength:VALue
Help	
Revision	*IDN?
Show Critical Errors	SYSTem:ERRor?
Show BW Errors	SYSTem:ERRor?
Show Notices	
Show Warnings	SYSTem:ERRor?
More System Functions	
Active Panel	
Auto Measure Setup	
Auto Meas at Marker	DISPlay:WINDow:TRACe:ALL:SCALe:AUTO:MARKer
Scale/div	DISPlay:WINDow:TRACe:Y:SCALe:AUTO:PDIVision
Auto	DISPlay:WINDow:TRACe:Y:SCALe:AUTO:PDIVision:AUTO
Optimize Sensitivity	DISPlay:WINDow:TRACe:ALL:SCALe:AUTO:OPTimize
Span	DISPlay:WINDow:TRACe:X:SCALe:AUTO:SPAN
Auto	DISPlay:WINDow:TRACe:X:SCALe:AUTO:SPAN:AUTO
Display Setup	
Remote Setup Service Functions	
Adv Service Functions	

Table 4-7. Front Panel Function to Remote Command for the HP 86140 Series (5 of 6)

Front Panel Function	Remote Command
Grating Order	SENSe:GORDer:AUTO
More Adv Service Menu	
Power ON State	SYSTem:PON:TYPE
TransZ 2 - 3 Lock	
Multi-Point Align	CALibration:ALIGn:EXTernal
Wavelength Limit	SENSe:WAVelength:LIMit
Zero Now	CALibration:ZERO:AUTO ONCE
Factory Preset	
Move Active Area	
Printer Setup	
Printer Location	HCOPy:DESTination
Set Title	DISPlay:WINDow:TEXT:DATA
Traces	
Active Trace A | B | C | D | E | F	Update and view commands below may affect active trace
Averaging Menu...	
Averaging On | Off	CALCulate:AVERage:COUNt CALCulate:AVERage:STATe OFF
Hold A None | Max | Min	CALCulate1-6:MAXimum:STATe ON CALCulate1-6:MINimum:STATe ON CALCulate1-6:MAXimum:STATe OFF CALCulate1-6:MINimum:STATe OFF
Reset Min/Max Hold	CALCulate1-6:MAXimum:CLEar CALCulate1-6:MINimum:CLEar
Trace Math Off	CALCulate:MATH:STATe
Default Math...	CALCulate:MATH:EXPRession:DEFine
Exchange Math	TRACe:EXCHange
Trace Setup...	
Sweep ### Points	SENSe:SWEep:POINts
Update A... On | Off	TRACe:FEED:CONTrol TRA-TRF,ALWays TRACe:FEED:CONTrol TRA-TRF,NEVer
View A On | Off	DISPlay:WINDow:TRACe:STATe
Wavelength	
Center Wavelength	SENSe:WAVelength:CENTer
Peak to Center	CALCulate:MARK:SCENter
Start Wavelength	SENSe:WAVelength:STARt
Stop Wavelength	SENSe:WAVelength:STOP
Wavelength Setup	

Table 4-7. Front Panel Function to Remote Command for the HP 86140 Series (6 of 6)

Front Panel Function	Remote Command
Wavelength Referenced In	SENSe:CORRection:RVELocity:MEDium
Wavelength Units	
Wavelength Calibration User	CALibrate:WAVelength:STATe ON
Wavelength Calibration Factory	CALibrate:WAVelength:STATe OFF
Wavelength Offset	SENSe:WAVelength:OFFSet
Wavelength Step Size	SENse:WAVelength:CENTer:STEP:INCRement
Wavelength Span	SENSe:WAVelength:SPAN

Command Trees

Common Commands

```
*CLS
*ESE <numeric_value>
*ESR?
*IDN?
*OPC
*OPT?
*RCL <numeric_value>|<file_name>[INTernal|FLOPpy]
*RST
*SAV <numeric_value>|<file_name>[INTernal|FLOPpy]
*SRE <numeric_value>
*STB?
*TST?
*WAI
```

CALCulate

```
:AVERage
    :CLEar
    :COUNt <numeric_value>
    [:STATe]  OFF|ON|0|1
:MARKer[1|2|3|4]
    :AOFF
    :FUNCtion
        :BWIDth|BANDwidth
            :INTerpolate OFF|ON|0|1
            :NDB <param>
            :READout FREQuency|WAVelength|TIME
            :RESult?
            [:STATe] OFF|ON|0|1
            :X:CENTer?
            :X:LEFT?
            :X:RIGHt?
        :DELTa
            :RESet
            [:STATe] OFF|ON|0|1
            :X:OFFSet?
                :FREQuency <param>
                :TIME <param>
                [:WAVelength] <param>
            :X:READout FREQuency|WAVelength|TIME
            :X:REFerence?
            :Y:OFFSet?
            :Y:REFerence?
        :NOISe
            :BWIDth|BANDwidth <param>
            :RESult?
            [:STATe] OFF|ON|0|1
        :PRESet
    :INTerpolate OFF|ON|0|1
    :MAXimum
```

```
            :LEFT
            :NEXT
            :RIGHt
      :MINimum
            :LEFT
            :NEXT
            :RIGHt
      :PEXCursion
            [:PEAK] <param>
            PIT <param>
      :SCENter
      :SRANge
            :LOWer?
                  :FREQuency <param>
                  :TIME <param>
                  [:WAVelength] <param>
            [:STATe] OFF|ON|0|1
            :UPPer?
                  :FREQuency <param>
                  :TIME <param>
                  [:WAVelength] <param>
      :SRLevel
      [:STATe] OFF|ON|0|1
      :TRACe TRA|TRB|TRC|TRD|TRE|TRF
      :X?
            :FREQuency <param>
            :READout FREQuency|WAVelength|TIME
            :TIME <param>
            [:WAVelength] <param>
      :Y?
:MATH
      [:EXPRession][:DEFine] <expression>
      :STATe OFF|ON|0|1
:MAXimum
      :CLEar
      [:STATe] ON|OFF|1|0
:MEAN
      [:DATA]?
      :STATe ON|OFF|1|0
      :RANGe
            :LOWer?
                  :FREQuency <param>
                  :TIME <param>
                  [:WAVelength] <param>
            [:STATe] ON|OFF|1|0
            :UPPer?
                  :FREQuency <param>
                  :TIME <param>
                  [:WAVelength] <param>
:MINimum
      :CLEar
      [:STATe] ON|OFF|1|0
:THReshold <param>
      :STATe ON|OFF|1|0
:TPOWer
      [:DATA]?
```

```
    :STATe ON|OFF|1|0
    :IRANge
        :LOWer <param>
        [:STATe] ON|OFF|1|0
        :UPPer <param>
```

CALibration

```
:ALIGn
    [:AUTO]
        :MARKer[1|2|3|4]
    :EXTernal
    :PRESet
:DATE?
:POWer
    :DATE?
    :STATe OFF|ON|0|1
    :VALue <param>
    :WAVelength <param>
:PRESet
:STATe OFF|ON|0|1
:WAVelength
    :DATE?
    :MARKer[1|2|3|4]
    :STATe OFF|ON|0|1
    :VALue <param>
:ZERO[:AUTO] OFF|ON|0|1|ONCE
```

DISPlay

```
[:WINDow[1]]
    :ANNotation[:ALL] ON|OFF|0|1
    :TEXT
        :CLEar
        :DATA <string> | <data_block>
    :TRACe
        :ALL[:SCALe][:AUTO]
            :MARKer OFF|ON|0|1
            :OPTimize OFF|ON|0|1
        :GRATicule:GRID[:STATe] OFF|ON|0|1
        [:STATe] <trace_name>, OFF|ON|0|1
        :X[:SCALe]:AUTO:SPAN <numeric_value>[M|NM|UM]
        :X[:SCALe]:AUTO:SPAN:AUTO OFF|ON|0|1
        :Y[:SCALE]
            :AUTO:PDIVision <numeric_value>[DB]
            AUTO:PDIVision :AUTO OFF|ON|0|1
            [1|2]:LINear OFF|ON|0|1
            :PDIVision <numeric_value>[DB]
            :RLEVel <numeric_value>[DBM]
            :RPOSition <numeric_value>
            :SPACing [LINear|LOGarithmic]
```

FORMat

```
[:DATA] <param>
```

HCOPy

```
:DATA?
:DESTination <data_handle>
[:IMMediate]
```

INITiate

```
:CONTinuous OFF|ON|0|1
[:IMMediate]
```

MEMory

```
:STATe:[EXTended]?
```

MMEMory

```
:CATalog? [INTernal|FLOPpy]
:DATA <file_name>, <data_block>
:DELete <file_name>[,INTernal|FLOPpy]
:INITialize [FLOPpy]
:LOAD:TRACe <trace_name>,<file_name>[,INTernal|FLOPpy]
:STORe:TRACe <trace_name>,<file_name>[,INTernal|FLOPpy]
```

SENSe

```
:BANDwidth|BWIDth
    [:RESolution] <param>
        :AUTO OFF|ON|0|1
        :RATio <numeric_value>
    :VIDeo <numeric_value>
        :AUTO OFF|ON|0|1
:CHOP[:STATe] OFF|ON|0|1
:CORRection
    :RVELocity:MEDium AIR|VACuum
:GORDer[:AUTO] OFF|ON|0|1
:POWer[:DC]:RANGe
    :AUTO OFF|ON|0|1
    :LOCK OFF|ON|0|1
    :LOWer <numeric_value>|<step>
    :LOWer :AUTO OFF|ON|0|1
    :DETector
:SWEep
    :POINts <numeric_value>
    :TIME <param>
        :AUTO OFF|ON|0|1
:WAVelength
    :CENTer <numeric_value>
        :STEP:AUTO OFF|ON|0|1
        :STEP[:INCRement] <numeric_value>
    :LIMit OFF|ON|0|1
    :OFFSet <param>
    :SPAN <numeric_value>
        :FULL
    :SRANge
        :LOWer <param>
        [:STATe] OFF|ON|0|1
        UPPer <param>
    :STARt <numeric_value>
    :STOP <numeric_value>
```

SOURce[n]

```
:PULSe
    :DCYCle <numeric_value>
    :WIDTh <numeric_value>
```

STATus

```
:OPERation
    :CONDition?
    :ENABle <int_value>
    :EVENt?
    :NTRansition <int_value>
    :PTRansition <int_value>
:PRESet
:QUEStionable
    :CONDition?
    :ENABle <int_value>
    :EVENt?
```

SYSTem

```
:DATE?
:ERRor[:NEXT]?
:HELP:HEADers?
:PON[:TYPE] PRESet|LAST
:PRESet
:TIME?
:TZONe:NAME?
:VERSion?
```

TRACe

```
[:DATA]
    :X:TIME:SSTOp <trace_name>,<numeric_value>,<numeric_value>
    :X:STARt? <trace_name>
    :X:STOP? <trace_name>
    :X[:WAVelength]:SSTOP <trace_name>,<numeric_value>,<numeric_value>
    [:Y]? <trace_name>
        [:POWer] <trace_name>,<data_block>|<numeric_value>{,<numeric value>}
        :RATio <trace_name>,<data_block>|<numeric_value>{,<numeric value>}
:EXCHange <trace_1> | <trace_2>
:FEED:CONTrol <trace_name>, ALWays | NEVer
:POINts <trace_name>[,<numeric_value>]
```

TRIGer

```
[:SEQuence]
    :DELay <numeric_value> [<unit>]
    :OUTPut OFF|ON|0|1
        :PULSE
            :DCYCle <param>
            :WIDTh <param>
    :SLOPe POSitive|NEGative|EITHer
    :SOURce IMMediate|EXTernal|INTernal
```

UNIT

```
:POWer DBM|W|AUTO
:RATio DB|LINear|AUTO
```

Common Commands

`*CLS`

Clears all the event status registers summarized in the status byte register. This command resets the status data structure. It does this by emptying the error queue and clearing all bits in all of the event registers.

`*ESE <numeric_value>`

Sets the bits in the Standard Event Enable register. The Standard Event register monitors HP-IB errors and synchronization conditions such as operation complete, request control, query error, device dependent error, execution error, command error, and power on. The parameter is rounded to an integer value and interpreted as a binary number, representing the bit values of the register.

`*ESE?`

Returns the value of the Standard Event Enable register.

`*ESR?`

Reads and clears the Standard Event Status register. The register is cleared when it is read. The response value is an integer, to be interpreted as a binary number, representing the bit values of the register.

`*IDN?`

Returns a string value which identifies the instrument type and firmware version. The string is a comma-separated list consisting of Manufacturer, Model Number, Serial Number, and Firmware Revision.

`*OPC`

Sets bit 0 in the Standard Event Status register when all pending operations have finished.

`*OPC?`

Returns a 1 when all operations have finished.

`*OPT?`

Returns a comma-separated list of strings that identifies the optical spectrum analyzer's option configuration. A 0 indicates no options are present.

`*RCL <numeric_value>|<filename>[,INTernal|FLOPpy]`

Recalls previously saved instrument settings from the requested register or file.

`*RST`

Executes a device reset and returns the instrument to a known state. This command is not the same as the SYSTem:PRESet command. See page 3-5 for a list of the instrument preset conditions. The *RST settings are the same as for SYSTem:PRESet, except that Repeat Sweep is turned OFF.

`*SAV <numeric_value>|<filename>[,INTernal|FLOPpy]`

Saves instrument settings to the designated register or file.

`*SRE <numeric_value>`

Sets the bits in the Service Request Enable register. The parameter is rounded to an integer value and interpreted as a binary number, representing the bit values of the register. The Service Request Enable register serves as a mask for the Status Byte. When a bit in the Status Byte goes to 1, if the corresponding bit in the Service Request Enable register is a 1, the instrument asserts the Service Request line on the HP-IB.

`*SRE?`

Returns the value of the Service Request Enable register.

`*STB?`

Returns the current value of the instrument's Status Byte. This will not change the Status Byte register. The response value is an integer, to be interpreted as a binary number, representing the bit values of the register. Performing a serial poll on the instrument also reads the Status Byte register, except that bit 6 indicates whether there is a service request that has not been serviced. The most convenient way to clear the Status Byte register is to send a *CLS command. The Status Byte register summarizes the states of the other register sets. It is also responsible for generating service requests.

`*TST?`

Tests the analyzer interface hardware and returns 0 if the interface is functional.

`*WAI`

Prevents the instrument from executing any further commands until the current command has finished executing. The *WAI command ensures that overlapped commands are completely processed before subsequent commands, those sent after the *WAI command, are processed. *This command is not needed by the optical spectrum analyzer, since all commands are non-overlapped, but it is included for compatibility with existing programs that might use it.*

CALCulate Subsystem Commands

The CALCulate subsystem performs post-acquisition data processing. The CALCulate subsystem operates on data acquired by a SENSe function. For more information, refer to page 4-1 of the *1997 SCPI Command Reference*.

Note

CALC: is interpreted as CALC1:. CALC1 controls TRA, CALC2 controls TRB, CALC3 controls TRC, CALC4 controls TRD, CALC5 controls TRE, and CALC6 controls TRF.

`CALCulate[1|2|3|4|5|6]:AVERage:CLEar`

Causes the average data to be cleared and the average counter to be reset to zero.

`CALCulate:AVERage:COUNt <numeric_value>`

`CALCulate:AVERage:COUNt?`

Sets the number of measurements to be averaged. When the number of measurements taken is less than the count, the following formula is used to calculate the data:

$$AVG = \frac{sum\ of\ all\ measurements}{number\ of\ measurements}$$

If the number of measurements is greater than or equal to the count, the following formula is used to calculate the data:

$$New\ average = \frac{count - 1}{count} \times last\ average + \frac{new\ measurement}{count}$$

```
CALCulate[1|2|3|4|5|6]:AVERage[:STATe] OFF|ON|0|1
CALCulate[1|2|3|4|5|6]:AVERage[:STATe]?
```

Turns trace averaging ON and OFF. If a math expression with the corresponding CALCulate subopcode is OFF, the SENSe:DATA is averaged. If the math expression is ON, the result of the math expression is averaged.

The CALCulate:AVERage, CALCulate:MAXimum, and CALCulate:MINimum states are mutually exclusive. Each trace can have only one of these functions on at a time. Turning CALCulate:AVERage ON will automatically turn CALCulate:MAXimum and CALCulate:MINimum OFF. Each trace can have different CALC blocks turned on.

```
CALCulate:MARKer:AOFF
```

Turns off all markers and marker functions.

Note

If no marker number is given in the following marker commands, the command is interpreted as referring to marker number 1. For example, CALC:MARK ON is equivalent to CALC:MARK1 ON.

Note

Going to zero span will turn off all markers. This is because markers are referenced to a particular time or wavelength *not* a particular display position. Going out of zero span will restore the markers to the state they were in before going to zero span. Changing to or from zero span changes the fundamental units for the X-axis.

```
CALCulate:MARKer:FUNCtion:BWIDth|BANDwidth:INTerpolate OFF|ON|0|1
CALCulate:MARKer:FUNCtion:BWIDth|BANDwidth:INTerpolate?
```

Turns the bandwidth marker interpolation ON or OFF. When interpolation is ON, the bandwidth markers will be placed at the exact NDB setting from the normal marker if the trace data allows. The position of the marker will be linearly interpolated between two true trace data points. The default state is ON. If interpolate is OFF, for negative NDB values, the bandwidth markers will be at

values closest to and more negative than the NDB value. For positive NDB values, the bandwidth markers will be at values closest to and more positive than the NDB values. This will typically result in a wider bandwidth measurement.

This is a global setting and controls the interpolation state for all four bandwidth markers.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:NDB <numeric_value>`

`CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:NDB?`

Sets the desired vertical offset from the numbered marker of the bandwidth markers. The parameter units are as specified in the UNIT:RATio command.

This value can be set or queried anytime. The marker does not have to be on or in the bandwidth function.

`CALCulate:MARKer:FUNCtion:BWIDth|BANDwidth:READout FREQuency|WAVelength|TIME`

`CALCulate:MARKer:FUNCtion:BWIDth|BANDwidth:READout?`

Sets the X-axis readout for frequency or wavelength when the instrument is in a non-zero span. This setting controls only the bandwidth marker X-axis readouts and the X:Left? and X:Right? queries. The delta markers have their own setting. This setting controls all four bandwidth markers.

Trying to set the readout to TIME when in a non-zero span generates a “Settings conflict” error. Trying to set the readout to FREQuency or WAVelength when in zero span also generates a “Settings conflict” error. When the instrument is set to zero span, the readout will automatically change to TIME. This command is primarily useful for non-zero spans.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:RESult?`

Returns the difference in the X-axis values between the left and right bandwidth markers. The units returned are determined by the CALCulate:MARKer:FUNCtion:BWIDth|BANDwidth:X:READout state. For READout of FREQuency, the result is returned in Hertz. For READout of WAVelength, the result is returned in meters.

If the bandwidth markers cannot find the desired NDB setting relative to the normal marker, the result returned will be 9.91e37. This value is defined by the SCPI standard to represent NaN (not a number).

This query generates a “Settings conflict” error if the bandwidth function is OFF for the specified marker.

```
CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth[:STATe] OFF|ON|0|1
CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth[:STATe]?
```

Turns the bandwidth marker function ON or OFF for a particular marker. Only one marker function is allowed to be on at a time for each individual marker. Turning on the bandwidth function for a marker will turn off any other marker function and turn on the Bandwidth function. For example, turning on the Bandwidth function for a marker that has the Delta function ON, will turn OFF the Delta function and turn ON the Bandwidth function for the marker.

If the bandwidth function is turned ON for a marker that is OFF, the marker will be turned ON, placed at the center wavelength, and then the bandwidth markers will measure the bandwidth relative to this marker.

```
CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:X:CENTer?
```

Returns the absolute X-axis value from the center of the bandwidth marker (mean of the left and right markers). The units returned are determined by the CALCulate:MARKer:FUNCtion:BWIDth|BANDwidth:X:READout state. For READout of FREQuency, the X value is returned in Hertz. For READout of WAVelength, the X value is returned in meters.

This query generates a “Settings conflict” error if the bandwidth function is OFF for the specified marker.

```
CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:X:LEFT?
```

Returns the absolute X-axis value of the left bandwidth marker. The units returned are determined by the CALCulate:MARKer:FUNCtion:BWIDth|BANDwidth:X:READout state. For READout of FREQuency, the X value is returned in Hertz. For READout of WAVelength, the X value is returned in meters.

This query generates a “Settings conflict” error if the bandwidth function is OFF for the specified marker.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:X:RIGHt?`

Returns the absolute X-axis value of the right bandwidth marker. The units returned are determined by the CALCulate:MARKer:FUNCtion:BWIDth|BANDwidth:X:READout state. For READout of FREQuency, the X value is returned in Hertz. For READout of WAVelength, the X value is returned in meters. For READout of WAVelength, the X value is returned in meters.

This query generates a "Settings conflict" error if the bandwidth function is OFF for the specified marker.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa:RESet`

Sets the reference for the delta marker to the current position of the delta marker.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa[:STATe] OFF|ON|0|1`

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa[:STATe]?`

Turns the delta marker function ON or OFF for a particular marker. Individual markers can have only one marker function on at a time.

Turning the delta function for a marker ON will turn any other marker function OFF. For example, turning the delta function ON for a marker that has the bandwidth function ON, will turn the bandwidth function OFF and turn the delta function ON for the marker.

If the delta function is turned ON for a marker that is OFF, the marker will be turned ON, placed at the center wavelength, and the delta function will be turned ON.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa:X:OFFSet?`

Returns the difference between the absolute X-axis value of the delta marker and the X-axis value of the reference marker.

The units of the value returned by the query are determined by the CALCulate:MARKer:FUNCtion:DELTa:X:READout state. For READout of FREQuency, the units are Hertz. For READout of WAVelength, the units are meters. For READout of TIME, the units are seconds.

This query generates a "Settings conflict" error if the delta function is OFF for the specified marker.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa:X:OFFSet:FREQuency <numeric_value>`

Allows the user to set the marker offset in frequency units. The marker X-axis value corresponds to *the reference X value + the offset value*. The default units of the parameter for this command are Hertz.

This query generates a "Settings conflict" error if the delta function is OFF for the specified marker.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa:X:OFFSet:TIME <numeric_value>`

Allows the user to set the marker offset when the instrument is in zero span. The marker X-axis value corresponds to *the reference X value + the offset value*. The default units of the parameter are seconds.

This query generates a "Settings conflict" error if the delta function is OFF for the specified marker.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa:X:OFFSet[:WAVelength]<numeric_value>`

Allows the user to set the marker offset in wavelength units. The marker X-axis value corresponds to *the reference X value + the offset value*. The default units of the parameter are meters.

Even though the offset READout may be FREQuency, this command can still be used to specify the offset using wavelength units.

For example:

CALC:MARK:FUNC:DELT:X:OFFS:WAV 10NM when readout is WAVElength
CALC:MARK:FUNC:DELT:X:OFFS:FREQ 10THZ when readout is FREQuency
CALC:MARK:FUNC:DELT:X:OFFS:WAV 1E-8M when readout is FREQuency

This query generates a "Settings conflict" error if the delta function is OFF for the specified marker.

`CALCulate:MARKer:FUNCtion:DELTa:X:READout FREQuency|WAVelength|TIME`

`CALCulate:MARKer:FUNCtion:DELTa:X:READout?`

Sets the X-axis readout for frequency or wavelength when the instrument is in a non-zero span. This setting controls only the delta offset and the delta reference X-axis readouts. The bandwidth markers have their own setting. This setting controls all four delta markers.

Trying to set the readout to TIME when in a non-zero span generates a “Settings conflict” error. Trying to set the readout to FREQuency or WAVelength when in a zero span also generates a “Settings conflict” error. When the instrument is set to zero span, the readout will automatically change to TIME. If the delta marker is OFF a “Settings conflict” error is generated. This command is primarily useful for non-zero spans.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa:X:REFerence?`

Returns the X-axis value of the reference marker. The units of the returned value are determined by the CALCulate:MARKer:FUNCtion:DELTa:X:READout setting. For a READout of FREQuency, the return value is in Hertz. For a READout of WAVelength, the return value is in meters. For READout of TIME, the X value is returned in seconds.

This query generates a “Settings conflict” error if the delta function is OFF for the specified marker.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa:Y:OFFSet?`

Returns the difference between the delta marker absolute Y value and the reference Y value.

This query generates a “Settings conflict” error if the delta function is OFF for the specified marker.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa:Y:REFerence?`

Returns the Y-axis value of the reference marker.

This query generates a “Settings conflict” error if the delta function is OFF for the specified marker.

`CALCulate:MARKer[1|2|3|4]:FUNCtion:NOISe:BWIDth|BANDwidth <numeric_value>`

`CALCulate:MARKer[1|2|3|4]:FUNCtion:NOISe:BWIDth|BANDwidth?`

Sets the normalization bandwidth for the marker noise result query. The default units for the parameter are meters. There are only two allowable settings: 1 nm and 0.1 nm. Sending any value outside this range will generate a "Data out of range" error. Sending a value within this range will set the bandwidth to whichever of the two possible settings is closest to the specified value. If the specified noise marker is OFF, a “Settings conflict” error is generated.

```
CALCulate:MARKer[1|2|3|4]:FUNCtion:NOISe:RESult?
```

This query returns the noise marker value normalized to 1 or 0.1 nm. The normalization bandwidth is controlled by the CALCulate:MARKer:FUNCtion:NOISe:BWIDth command.

This query generates a “Settings conflict” error if the noise function is OFF for the specified marker.

```
CALCulate:MARKer[1|2|3|4]:FUNCtion:NOISe[:STATe] OFF|ON|0|1
CALCulate:MARKer[1|2|3|4]:FUNCtion:NOISe[:STATe]?
```

Turns the marker noise function ON or OFF for a particular marker. Individual markers can have only one marker function on at a time. Use the CALCulate:MARKer:X command to position the noise marker.

```
CALCulate:MARKer[1|2|3|4]:FUNCtion:PRESet
```

Turns OFF all marker functions for the specified marker. This command is provided as a convenient way to turn all marker functions off without having to check the state of each individual marker function. If the marker specified by this command is OFF, the marker will be turned ON with all marker functions OFF, that is, the marker will be in the “normal” marker mode.

```
CALCulate:MARKer:INTerpolate OFF|ON|0|1
CALCulate:MARKer:INTerpolate?
```

Turns the normal/delta marker interpolation ON or OFF. When interpolation is ON, the normal/delta markers will be placed at the exact X setting, if the trace data allows. The marker will linearly interpolate between two true trace data points. The default state is OFF.

This setting controls the interpolation state for all four markers, except for the bandwidth markers.

```
CALCulate:MARKer[1|2|3|4]:MAXimum
```

Places the specified marker on the highest point of the trace. The point does *not* have to meet the peak excursion and threshold criteria. The marker trace is determined by the CALCulate:MARKer:TRACe command. If the specified marker is OFF, it will be turned ON and placed on the highest point of the trace.

`CALCulate:MARKer[1|2|3|4]:MAXimum:LEFT`

Places the marker on the next peak located at a shorter wavelength than the current marker wavelength position. This next peak must meet the peak excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search to the left will begin from that point.

`CALCulate:MARKer[1|2|3|4]:MAXimum:NEXT`

Places the marker on the next highest peak from the current marker amplitude. This next highest peak must meet the peak excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search for the next maximum will begin from that point.

`CALCulate:MARKer[1|2|3|4]:MAXimum:RIGHt`

Places the marker on the next peak located at a longer wavelength than the current marker wavelength position. This next peak must meet the peak excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search to the right will begin from that point.

`CALCulate:MARKer[1|2|3|4]:MINimum`

Places the specified marker on the lowest point of the trace. The point does *not* have to meet the pit excursion and threshold criteria. The marker trace is determined by the CALCulate:MARKer:TRACe command. If the specified marker is OFF, it will be turned ON and placed on the lowest point of the trace.

`CALCulate:MARKer[1|2|3|4]:MINimum:LEFT`

Places the marker on the next pit located at a shorter wavelength than the current marker wavelength position. This next pit must meet the pit excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search to the left will begin from that point.

`CALCulate:MARKer[1|2|3|4]:MINimum:NEXT`

Places the marker on the next lowest pit from the current marker amplitude. This next lowest pit must meet the pit excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search for the next minimum will begin from that point.

`CALCulate:MARKer[1|2|3|4]:MINimum:RIGHt`

Places the marker on the next pit located at a longer wavelength than the current marker wavelength position. This next pit must meet the pit excursion and threshold criteria. If the specified marker is OFF, it will be turned ON, placed at the center wavelength, and the search to the right will begin from that point.

`CALCulate:MARKer[1|2|3|4]:PEXCursion[:PEAK] <numeric_value>`

`CALCulate:MARKer[1|2|3|4]:PEXCursion[:PEAK]?`

Sets the peak excursion value for the marker search routines. The peak excursion value is used to determine whether or not a local maximum in the trace is to be considered a peak. To qualify as a peak, both sides of the local maximum must fall by at least the peak excursion value.

`CALCulate:MARKer[1|2|3|4]:PEXCursion:PIT <numeric_value>`

`CALCulate:MARKer[1|2|3|4]:PEXCursion:PIT?`

Sets the pit excursion value for the marker search routines. The pit excursion value is used to determine whether or not a local minimum in the trace is to be considered a pit. To qualify as a pit, both sides of the local minimum must rise by at least the pit excursion value.

`CALCulate:MARKer[1|2|3|4]:SCENter`

Sets the center wavelength to the wavelength value of the marker.

`CALCulate:MARKer:SRANge:LOWer?`

Returns the lower limit for the marker search range. The range used for the marker search range is the same range used for the total power calculation, the trace mean range, and the wavelength sweep range. The return value is in meters, unless span is set to zero, in which case the return value is in seconds.

`CALCulate:MARKer:SRANge:LOWer:FREQuency <param>`

Sets the lower limit for the marker search range. Setting this value when CALCulate:MARKer:SRANge:STATe is OFF will automatically turn CALCulate:MARKer:SRANge:STATe ON. The range used for the marker search range is the same range used for the total power calculation, the trace mean range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Sending the command when the instrument is in a zero span will generate a "Settings conflict" error. The default units for the parameter is in Hertz.

`CALCulate:MARKer:SRANge:LOWer:TIME <param>`

Sets the lower limit for the marker search range. Setting this value when CALCulate:MARKer:SRANge:STATe is OFF will automatically turn CALCulate:MARKer:SRANge:STATe ON. The range used for the marker search range is the same range used for the total power calculation, the trace mean range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Sending this command while span is not set to zero will results in a "Settings conflict" error. Default units for the parameter is in seconds.

`CALCulate:MARKer:SRANge:LOWer[:WAVelength] <param>`

Sets the lower limit for the marker search range. Setting this value when CALCulate:MARKer:SRANge:STATe is OFF will automatically turn CALCulate:MARKer:SRANge:STATe ON. The range used for the marker search range is the same range used for the total power calculation, the trace mean range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Sending the command when the instrument is in a zero span will generate a "Settings conflict" error. Default units for the parameter is in meters; frequency units are allowed.

`CALCulate:MARKer:SRANge[:STATe] OFF|ON|0|1`

`CALCulate:MARKer:SRANge[:STATe]?`

Turns the search range ON or OFF for all the markers. When the search range is ON, all the marker maximum/minimum searches will be within the upper and lower wavelength range. Although there is a single range controlling the total power integration, the marker search range, the mean calculation, and the wavelength sweep range, there are four independent state settings for limiting the total power integration, the marker search, the mean calculation, and the wavelength sweep to the range. If all four states for the total power integration, the marker search, the mean calculation, and the wavelength sweep range are OFF, setting CALCulate:MARKer:SRANge:STATe to ON will initialize the lower range to $start + \frac{span}{3}$ and the upper range to $start + \left(2 \times \frac{span}{3}\right)$.

`CALCulate:MARKer:SRANge:UPPer?`

Returns the upper limit for the marker search range. The range used for the marker search range is the same range used for the total power calculation, the trace mean range, and the wavelength sweep range. The return value is in meters, unless span is set to zero, in which case the return value is in seconds.

`CALCulate:MARKer:SRANge:UPPer:FREQuency <param>`

Sets the upper limit for the marker search range. Setting this value when CALCulate:MARKer:SRANge:STATe is OFF will automatically turn CALCulate:MARKer:SRANge:STATe ON. The range used for the marker search range is the same range used for the total power calculation, the trace mean range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Sending the command when the instrument is in a zero span will generate a “Settings conflict” error. The default units for the parameter is in Hertz.

`CALCulate:MARKer:SRANge:UPPer:TIME <param>`

Sets the upper limit for the marker search range. Setting this value when CALCulate:MARKer:SRANge:STATe is OFF will automatically turn CALCulate:MARKer:SRANge:STATe ON. The range used for the marker search range is the same range used for the total power calculation, the trace mean range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Sending this command while span is not set to zero will result in a "Settings conflict" error. Default units for the parameter is in seconds.

`CALCulate:MARKer:SRANge:UPPer[:WAVelength] <param>`

Sets the upper limit for the marker search range. Setting this value when CALCulate:MARKer:SRANge:STATe is OFF will automatically turn CALCulate:MARKer:SRANge:STATe ON. The range used for the marker search range is the same range used for the total power calculation, the trace mean range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Sending the command when the instrument is in a zero span will generate a "Settings conflict" error. Default units for the parameter is in meters; frequency units are allowed.

`CALCulate:MARKer[1|2|3|4]:SRLevel`

Sets the reference level to the amplitude of the marker.

`CALCulate:MARKer[1|2|3|4][:STATe] OFF|ON|0|1`

`CALCulate:MARKer[1|2|3|4][:STATe]?`

Turns a particular marker ON or OFF. If no number is given for the MARKer node, 1 is assumed. (For example, CALCulate:MARKer ON will turn marker 1 ON.) The marker will be placed on the trace determined by the CALCulate:MARKer:TRACe command. If no trace is specified, the default trace is trace A. The marker will be placed at the center wavelength. Turning a marker OFF will turn off any marker function that was on for that particular marker. When the marker is turned ON again, all the marker functions for that marker will be off.

```
CALCulate:MARKer[1|2|3|4]:TRACe TRA|TRB|TRC|TRD|TRE|TRF
CALCulate:MARKer[1|2|3|4]:TRACe?
```

Places the marker on a particular trace.

```
CALCulate:MARKer[1|2|3|4]:X?
```

Returns the X-axis value of the normal marker. When the delta function is ON, the absolute X-axis value of the delta marker is returned. When the bandwidth function is ON, the X-axis value of the center marker is returned.

The units of the value returned by the query is determined by the CALCulate:MARKer:X:READout state. For READout of FREQuency, the units returned are in Hertz. For READout of WAVelength, the units returned are meters. For READout of TIME, the units are in seconds.

Sending the query when the specified marker is OFF will generate a “Settings conflict” error.

```
CALCulate:MARKer[1|2|3|4]:X:FREQuency <numeric_value>
```

Sets the X-axis value of the normal marker. When the delta function is ON, the absolute X-axis value of the delta marker is controlled. When the bandwidth function is ON, the X-axis value of the center marker is controlled.

Sending the command when the specified marker is OFF will turn the marker ON and place the marker at the desired position. Sending the command when the instrument is in a zero span will generate a “Settings conflict” error.

```
CALCulate:MARKer:X:READout FREQuency|WAVelength|TIME
CALCulate:MARKer:X:READout?
```

Sets the X-axis readout for frequency or wavelength when the instrument is in a non-zero span. This setting controls only the normal marker X-axis and the delta reference readout. The bandwidth and delta offset markers have their own settings. This setting controls all four normal markers.

Trying to set the READout to TIME when in a non-zero span generates a “Settings conflict” error. Trying to set the READout to FREQuency or WAVelength when in zero span also generate a "Settings conflict" error. When the instrument is set to zero span, the readout will automatically change to TIME. This command is primarily useful for non-zero spans.

`CALCulate:MARKer[1|2|3|4]:X:TIME <numeric_value>`

Sets the X-axis value of the normal marker when the instrument is in zero span. When the delta function is ON, the absolute X-axis value of the delta marker is controlled. When the bandwidth function is ON, the X-axis value of the center marker is controlled. The default units of the parameter is seconds.

Sending the command when the specified marker is OFF will turn the marker ON and place the marker at the desired position. Sending the command when the instrument is in a non-zero span will generate a "Settings conflict" error.

`CALCulate:MARKer[1|2|3|4]:X[:WAVelength] <numeric_value>`

Sets the X-axis value of the normal marker in wavelength units. When the delta function is ON, the absolute X-axis value of the delta marker is controlled. When the bandwidth function is ON, the X-axis value of the center marker is controlled. The default units of the parameter are meters.

Sending the command when the specified marker is OFF will turn the marker ON and place the marker at the desired position. Sending the command when the instrument is in a zero span will generate a "Settings conflict" error.

`CALCulate:MARKer[1|2|3|4]:Y?`

Returns the Y-axis value of the normal marker. When the delta function is ON, the value returned is the absolute Y-axis value of the delta marker. When the bandwidth function is ON, the value returned is the Y-axis value of the center marker.

Sending the command when the specified marker is off will generate a "Settings conflict" error.

```
CALCulate[1|2|3|4|5|6]:MATH[:EXPRession][:DEFine] (<expression>)
CALCulate[1|2|3|4|5|6]:MATH[:EXPRession][:DEFine]?
```

<expression> ::= <trace_name><operator><trace_name>[<operator><numeric_value>]
<operator> ::= +|–|*|/

Note

The parentheses in the above expression are required for proper operation of this command.

Defines a math expression to be used when the math operations are turned ON. The <expression> can contain a <trace_name> as operands. The math operations will be performed in linear units. If, for example, the desired operation is TRA – TRB in log units, the expression should be defined as TRA / TRB. Each CALCulate subsystem can have one expression defined. Recursive expressions are not allowed.

Example Statements:

For the equivalent of the front panel $C = A_{log} - B$ key:

OUTPUT 723 "CALC3:MATH:EXPR (TRA / TRB)"

For the equivalent of the front panel $C = A_{log} + B$ key:

OUTPUT 723 "CALC3:MATH:EXPR (TRA * TRB)"

For the equivalent of the front panel $C = A_{lin} - B$ key:

OUTPUT 723 "CALC3:MATH:EXPR (TRA – TRB)"

For the equivalent of the front panel $C = A_{lin} + B$ key:

OUTPUT 723 "CALC3:MATH:EXPR (TRA + TRB)"

For the equivalent of the front panel $F = C_{log} - D$ key:

OUTPUT 723 "CALC6:MATH:EXPR (TRC / TRD)"

Note

CALC1 controls TRA, CALC2 controls TRB, CALC3 controls TRC, CALC4 controls TRD, CALC5 controls TRE, and CALC6 controls TRF.

`CALCulate[1|2|3|4|5|6]:MATH:STATe OFF|ON|0|1`

`CALCulate[1|2|3|4|5|6]:MATH:STATe`

Determines whether or not math processing is done.

`CALCulate[1|2|3|4|5|6]:MAXimum:CLEar`

Clears the current maximum hold values for the trace and allows a new maximum hold to occur. The trace will be initialized to a very negative dBm value (–300 dBm). If the specified trace is not in the maximum hold state, this command will have no effect.

`CALCulate[1|2|3|4|5|6]:MAXimum[:STATe] OFF|ON|0|1`

`CALCulate[1|2|3|4|5|6]:MAXimum[:STATe]?`

Turns maximum hold on a trace ON or OFF. The maximum hold operation compares the current amplitude value of each point on a trace in the current sweep to the corresponding point detected during the previous sweep, then stores the maximum value. The CALCulate:AVERage, CALCulate:MAXimum, and CALCulate:MINimum states are mutually exclusive. Each trace can have only one of these functions on at a time. Turning CALCulate:MAXimum ON will automatically turn CALCulate:AVERage and CALCulate:MINimum OFF. Each trace is allowed to have a different CALC block turned on. For example, CALCulate1:MAXimum ON, CALCulate2:MINimum ON, CALCulate3:AVERage ON will put trace A in maximum hold, trace B in minimum hold and trace C in trace average mode.

If the math expression with the corresponding CALCulate subopcode is OFF, then the SENSe:DATA is used for the maximum hold operation. If the math expression is ON, the result of the math expression is used for the maximum hold operation.

`CALCulate[1|2|3|4|5|6]:MEAN[:DATA]?`

Returns the arithmetic mean of the trace associated with the subopcode of the CALCulate node. The points of the trace are summed in linear units and the sum is divided by the number of points. When the CALCulate:MEAN:RANge is ON, the mean is calculated over the upper and lower X-axis range limits. If the CALCulate:MEAN:RANge is OFF, the mean is calculated over the entire trace. Sending this query when the CALCulate:MEAN:STATe is OFF will generate a "Settings conflict" error. The MEAN calculation is performed at the end of sweep. Sending this query when the instrument is in the middle of a sweep will return the MEAN calculated for the *previous* sweep.

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe:LOWer?`

This query returns the lower X-axis limit for the trace mean range calculation.

The range used for the trace mean range is the same range used for the total power calculation, the marker search range, and the wavelength sweep range.

The return value is in meters, unless the span is set to zero, in which case the return value is in seconds.

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe:LOWer:FREQuency <numeric_value>[HZ|KHZ|MHZ|GHZ|THZ]`

Sets the lower X-axis limit for the trace mean range calculation. Setting this value when CALCulate:MEAN:RANGe:STATe is OFF will automatically turn CALCulate:MEAN:RANGe:STATe ON.

The range used for the trace mean range is the same range used for the total power calculation, the marker search range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Default units for the parameters are Hertz.

Sending this command when the instrument is in a zero span will generate a “Settings conflict” error.

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe:LOWer:TIME <numeric_value>[NS|US|MS|S]`

Sets the lower X-axis limit for the trace mean range calculation. Setting this value when CALCulate:MEAN:RANGe:STATe is OFF will automatically turn CALCulate:MEAN:RANGe:STATe ON.

The range used for the trace mean range is the same range used for the total power calculation, the marker search range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Default units for the parameters are seconds.

Sending this command while span is not set to zero will result in a "Settings Conflict" error.

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe:LOWer[:WAVelength] <numeric_value>[M|UM|NM|A]`

This command sets the lower X-axis limit for the trace mean range calculation. Setting this value when CALCulate:MEAN:RANGe:STATe is OFF will automatically turn CALCulate:MEAN:RANGe:STATe ON.

The range used for the trace mean range is the same range used for the total power calculation, the marker search range, and the wavelength sweep range. Changing the range with this command will change all four ranges.

Sending this command when the instrument is in a zero span will generate a "Settings conflict" error. Default units for the parameter are meters. Frequency units are also allowed.

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe[:STATe] OFF|ON|0|1`

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe[:STATe]?`

Turns the trace mean calculation range ON or OFF for all traces. Turning the calculation range ON will also turn the CALCulate:MEAN:STATe ON for the specified trace (the trace is specified via its subopcode). There is a single range controlling the total power integration, the trace mean range, the marker search range, and the wavelength sweep range, but there are four independent state settings for limiting the total power calculation, the trace mean calculation, the marker search, and the wavelength sweep to the range.

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe:UPPer?`

This query returns the upper X-axis limit for the trace mean range calculation. The range used for the trace mean range is the same range used for the total power calculation, the marker search range, and the wavelength sweep range.

The returned value is in meters, unless the span is set to zero, in which case the returned value is in seconds.

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe:UPPer:FREQuency <numeric_value>[HZ|KHZ|MHZ|GHZ|THZ]`

Sets the upper X-axis limit for the trace mean range calculation. Setting this value when CALCulate:MEAN:RANGe:STATe is OFF will automatically turn CALCulate:MEAN:RANGe:STATe ON. The range used for the trace mean range is the same range used for the total power calculation, the marker search range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Default units for the parameter are Hertz.

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe:UPPer:TIME <numeric_value>[NS|US|MS|S]`

This command sets the upper limit for the trace mean range calculation. Setting this value when CALCulate:MEAN:RANGe:STATe is OFF will automatically turn CALCulate:MEAN:RANGe:STATe ON. The range used for the trace mean range is the same range used for the total power calculation, the marker search range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Default units for the parameter are seconds.

Sending this command while span is not set to zero will result in a “Settings Conflict” error.

`CALCulate[1|2|3|4|5|6]:MEAN:RANGe:UPPer[:WAVelength] <numeric_value>[M|UM|NM|A]`

This command sets the upper X-axis limit for the trace mean range calculation. Setting this value when CALCulate:MEAN:RANGe:STATe is OFF will automatically turn CALCulate:MEAN:RANGe:STATe ON. The range used for the trace mean range is the same range used for the total power calculation, the marker search range, and the wavelength sweep range. Changing the range with this command will change all four ranges. Default units for the parameter are meters.

Sending the command when the instrument is in a zero span will generate a “Settings conflict” error.

`CALCulate[1|2|3|4|5|6]:MEAN:STATe OFF|ON|0|1`

`CALCulate[1|2|3|4|5|6]:MEAN:STATe?`

Turns the mean power calculation for a trace ON or OFF. Only one mean power calculation can be turned on at a time. For example, if a mean power calculation is being performed on trace A, turning a mean power calculation for trace B ON will turn the calculation for trace A OFF.

`CALCulate[1|2|3|4|5|6]:MINimum:CLEar`

Clears the current minimum hold values for the trace and allows a new minimum hold to occur. The trace will be initialized to the current value of the trace. If the specified trace is not in the minimum hold state, sending this command will have no effect.

`CALCulate[1|2|3|4|5|6]:MINimum[:STATe] OFF|ON|0|1`

`CALCulate[1|2|3|4|5|6]:MINimum[:STATe]?`

Turns minimum hold for a trace ON or OFF. The minimum hold operation compares the current amplitude value of each point on a trace in the current sweep to the corresponding point detected during the previous sweep, then stores the minimum value. The CALCulate:AVERage, CALCulate:MAXimum, and CALCulate:MINimum states are mutually exclusive. Each trace can have only one of these functions on at a time. Turning CALCulate:MINimum ON will automatically turn CALCulate:AVERage and CALCulate:MAXimum OFF. Each trace can have a different CALC block turned on. For example, CALCulate1:MAXimum ON, CALCulate2:MINimum ON, CALCulate3:AVERage ON will put trace A in maximum hold, trace B in minimum hold, and trace C in trace average mode.

If the math expression with the corresponding CALCulate subopcode is OFF, then the SENSe:DATA is used for the minimum hold operation. If the math expression is ON, the result of the math expression is used for the minimum hold operation.

`CALCulate:THReshold <param>[W|MW|UW|DBM]`

`CALCulate:THReshold?`

Sets the value for the marker search threshold.

`CALCulate[1|2|3|4|5|6]:THReshold:STATe ON|OFF|1|0`

`CALCulate[1|2|3|4|5|6]:THREshold:STATe?`

Turns on the marker search threshold function. When this threshold function is ON, marker peak searches will ignore peaks below the threshold value.

`CALCulate[1|2|3|4|5|6]:TPOWer[:DATA]?`

Returns the total power of the specified trace. Trace A corresponds to CALCulate1, trace B to CALCulate2, and so on. Corrections to the total power are made for the slope and variation of the resolution bandwidth filter over the wavelength range of the trace. When the CALCulate:TPOWer:IRANge is ON, the total power is calculated over the upper and lower range limits; otherwise, the total power is calculated over the entire trace. Sending this query when the CALCulate:TPOWer:STATe is OFF will generate a "Settings conflict" error.

`CALCulate[1|2|3|4|5|6]:TPOWer:IRANge:LOWer <numeric_value>[M|UM|NM|A|HZ|KHZ|MHZ|GHZ|THZ]`

`CALCulate[1|2|3|4|5|6]:TPOWer:IRANge:LOWer?`

Sets the lower X-axis limit for the total power integration range for all traces. Setting this value when the CALCulate:TPOWer:IRANge[:STATe] is OFF will automatically turn the CALCulate:TPOWer:IRANge[:STATe] ON. The range used for the total power integration is the same range used for the marker search range, the trace mean range, and the wavelength range. Changing the range with this command will change all four ranges.

Default units for the parameter are meters. Sending the command when the instrument is in a zero span will generate a “Settings conflict” error.

`CALCulate[1|2|3|4|5|6]:TPOWer:IRANge[STATe] OFF|ON|0|1`

`CALCulate[1|2|3|4|5|6]:TPOWer:IRANge[STATe]?`

Turns the total power calculation range for all traces ON or OFF. Setting IRANge:STATe to ON will set the corresponding TPOWer:STATe to ON. Although there is a single range controlling the total power integration, the trace mean calculation, the marker search range, and the wavelength sweep range, there are four independent state settings for limiting the total power calculation, the trace mean, the marker search, and the wavelength sweep to the range. If all four states for the total power integration, the trace mean, the marker search, and the wavelength sweep range are OFF, setting the CALCulate:TPOWer:STATe to ON, will initialize the lower limit to $start + \frac{span}{3}$ and the upper limit to $start + \left(2 \times \frac{span}{3}\right)$.

Sending the command when the instrument is in a zero span will generate a "Settings conflict" error.

`CALCulate[1|2|3|4|5|6]:TPOWer:IRANge:UPPer <numeric_value>[M|UM|NM|A|HZ|KHZ|MHZ|GHZ|THZ]`

`CALCulate[1|2|3|4|5|6]:TPOWer:IRANge:UPPer?`

Sets the upper X-axis limit of the total power integration range for all traces. Setting this value when the CALCulate:TPOWer:IRANge[:STATe] is OFF will automatically turn the CALCulate:TPOWer:IRANge[:STATe] ON. The range used for the total power calculation is the same range used for the marker search range, the trace mean range and the wavelength range. Changing the range with this command will change all four ranges.

Default units for the parameter are meters. Sending the command when the instrument is in a zero span will generate a "Settings conflict" error.

`CALCulate[1|2|3|4|5|6]:TPOWer:STATe OFF|ON|0|1`

`CALCulate[1|2|3|4|5|6]:TPOWer:STATe?`

Turns the total power calculation for a trace ON or OFF. Only one total power calculation can be turned on at a time. For example, if a total power calculation is being performed on trace A, turning a total power calculation for trace B ON will turn the calculation for trace A OFF. Turning this function ON in zero span generates a "Settings conflict" error.

CALibration Subsystem Commands

`CALibration:ALIGn`

Performs an automatic alignment of the instrument at the wavelength of the largest signal found in full span. This aligns the monochrometer output with the photodetector for improved amplitude accuracy. Sending this command with a marker on screen will generate a “Settings conflict” error. See page 3-3 for additional information on this function.

`CALibration:ALIGn:MARKer[1|2|3|4]`

Performs an automatic alignment of the instrument at the wavelength of the specified marker. This aligns the monochrometer output with the photodetector for improved amplitude accuracy. Sending this command without the specified marker on will generate a “Settings conflict” error.

`CALibration:ALIGn:EXTernal`

Performs an alignment of the instrument using an external broadband source. The instrument performs an alignment at each of several wavelengths and stores the values in a wavelength alignment table. This results in improved amplitude accuracy.

`CALibration:ALIGn:PRESET`

Sets the alignment of the instrument to the preset factory-calibrated values.

`CALibration:DATE?`

Returns the date of the most recent factory calibration.

`CALibration:POWer`

Performs a power calibration. The calibration is aborted if the power measured on the input signal is more than 3 dB higher or 10 dB lower than the value specified in the CALibration:POWer:VALue command.

`CALibration:POWer:DATE?`

Returns the date of the most recent power calibration.

`CALibration:POWer:STATe OFF|ON|0|1`

`CALibration:POWer:STATe?`

Specifies whether or not the calibration power data is applied. Amplitude accuracy is only specified with power calibration ON.

`CALibration:POWer:VALue <param>`

`CALibration:POWer:VALue?`

Specifies the power to be used for calibration. Default units are set by the UNITs:POWer command.

`CALibration:POWer:WAVelength <numeric_value>[M|UM|NM|A|HZ|KHZ|MHZ|GHZ]`

`CALibration:POWer:WAVelength?`

Specifies the wavelength of the signal used for the amplitude calibration.

`CALibration:PRESet`

Presets the calibration of the instrument to factory-calibrated values. This cancels the effect of any previous CALibration:POWer or CALibration:WAVelength.

`CALibration:STATe OFF|ON|0|1`

`CALibration:STATe?`

Specifies if the calibration data is applied or not. Amplitude accuracy and wavelength accuracy are only specified when calibration is ON. The response value is the logical *AND* of CALibration:POWer:STATe? and CALibration:WAVelength:STATe?.

`CALibration:WAVelength`

Performs a wavelength calibration. If the wavelength measured on the input signal differs more than ±2.5 nm from the value specified in the CALibration:WAVelength:VALue command, the calibration is aborted.

`CALibration:WAVelength:DATE?`

Returns the date of the most recent wavelength calibration.

`CALibration:WAVelength:MARKer[1|2|3|4]`

Performs a wavelength calibration using the wavelength of the marker as the reference. If the wavelength of the marker differs more than ±2.5 nm from the value specified in the CALibration:WAVelength:VALue command, the calibration is aborted. If this marker is not ON, this command generates a "Settings conflict" error.

`CALibration:WAVelength:STATe OFF|ON|0|1`

`CALibration:WAVelength:STATe?`

Specifies whether or not the calibration wavelength data is applied. Wavelength accuracy is only specified with wavelength calibration ON.

`CALibration:WAVelength:VALue <param>[M|UM|NM|A]`

`CALibration:WAVelength:VALue?`

Specifies the wavelength for calibration. Default units for the parameter are meters.

`CALibration:ZERO[:AUTO] OFF|ON|0|1|ONCE`

`CALibration:ZERO[:AUTO]?`

Specifies whether or not autozeroing is enabled. Autozeroing measures and compensates for the dark current of the photodetector for improved amplitude accuracy. The ONCE parameter causes the dark current to be measured one time, and then the resulting correction is applied to *all* subsequent measurements. Autozeroing ON causes the dark current to be measured between sweeps, and then the resulting correction is applied to the next sweep.

DISPlay Subsystem Commands

`DISPlay[:WINDow[1]]:ANNotation[:ALL] ON|OFF|0|1`

`DISPlay[:WINDow[1]]:ANNotation[:ALL]?`

Turns the screen annotation ON or OFF. Affects only the X-axis and Y-axis labeling and labeling within the graticule.

`DISPlay[:WINDow[1]]:TEXT:CLEar`

Erases all text on the display resulting from previous use of the DISPlay[:WINDow[1]]:TEXT:DATA command.

`DISPlay[:WINDow[1]]:TEXT:DATA <string>|<data_block>`

`DISPlay[:WINDow[1]]:TEXT:DATA?`

Writes text on the display in the Title area. Use the <data_block> parameter to send extended ASCII characters such as control codes and symbols.

`DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]`

Finds the largest input signal using trace A and sets the span and vertical scale to display that signal. This command performs the same function as the front-panel Auto-Meas key.

The following defines the instrument state settings altered by Auto Measure. State settings that are not listed are not altered.

Because many instrument state setting are altered, it is recommended you use this command only to find unknown signals. It is not recommend this command be used in the middle of a measurement routine.

Center Wavelength	According to signal wavelength and bandwidth
Span	Set according to automeasure setup panel. In some cases, this may also be a function of signal characteristics.
Grating Order	Auto

Sensitivity	Set according to automeasure setup panel. In some cases, this may also be a function of signal characteristics.
dB/div	Set according to automeasure setup panel. In some cases, this may also be a function of signal characteristics.
Video Bandwidth	Auto
Auto Range Enable	On
Trans-Z Lock	Off
Repetitive Sweep	On (front panel), Off (remote control)
Sweep Time	Auto
Auto Chop Mode	On
Gated Sweep Enable	Off
Sweep Trigger Mode	Internal
Trace Length	1001
Wavelength Limit	On
Reference Level	According to signal amplitude
Linear Display Mode	Off
Resolution Bandwidth	According to signal characteristics
Res-BW to Span Ratio	0.01
Peak Search on EOS	Off
Line Markers	Off
Trace Integration Limit	Off
Search Limit	Off
Trace Integration	Off
Trace Mean Calculation	Off

For each trace, except trace A:

Trace Math	Off
Update	Off
View	Off
Hold Mode	None
Averaging	Off

Trace A is identical, except:

Update	On
View	On

For each marker, except marker 1:

Visibility	Off
Marker BW	Off
Delta Mode	Off
Marker Trace	Trace A
Noise Marker	Off

Marker 1 is identical, except when the final span is non-zero as follows:

Visibility	On
Wavelength	Highest point on selected signal

```
DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]:MARKer OFF|ON|0|1
DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]:MARKer?
```

Changes the DISPlay:WINDow:TRACe:ALL:SCALe:AUTO command to find the input signal closest to the marker and set span and vertical scale to view that signal.

```
DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]:OPTimize OFF|ON|0|1
DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]:OPTimize?
```

Changes the DISPlay:WINDow:TRACe:ALL:SCALe:AUTO command to optimize sensitivity after finding the input signal. Also sets single sweep mode.

```
DISPlay[:WINDow[1]]:TRACe:GRATicule:GRID[:STATe] OFF|ON|0|1
DISPlay[:WINDow[1]]:TRACe:GRATicule:GRID[:STATe]?
```

Turns the graticule ON or OFF.

```
DISPlay[:WINDow[1]]:TRACe[:STATe] TRA|TRB|TRC|TRD|TRE|TRF,OFF|ON|0|1
DISPlay[:WINDow[1]]:TRACe[:STATe]? TRA|TRB|TRC|TRD|TRE|TRF
```

Turns the trace display ON or OFF. Specifying any trace other than the ones listed will generate an “Illegal parameter value” error.

```
DISPlay[:WINDow[1]]:TRACe:X[:SCALe]:AUTO:SPAN <numeric_value>[M|NM|UM]
DISPlay[:WINDow[1]]:TRACe:X[:SCALe]:AUTO:SPAN?
```

Specifies the final span after a DISPlay:WINDow:TRACe:ALL:SCALe:AUTO command.

```
DISPlay[:WINDow[1]]:TRACe:X[:SCALe]:AUTO:SPAN:AUTO ON|OFF|1|0
DISPlay[:WINDow[1]]:TRACe:X[:SCALe]:AUTO:SPAN:AUTO?
```

Specifies whether the final span after a DISPlay:WINDow:TRACe:ALL: SCALe: AUTO command should be set automatically, based on properties of the measured signal.

```
DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:AUTO:PDIVision <numeric_value>[DB]
DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:AUTO:PDIVision?
```

Specifies the final vertical scale after performing a DISPlay:WINDow:TRACe:ALL:SCALe:AUTO command.

```
DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:AUTO:PDIVision:AUTO OFF|ON|0|1
DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:AUTO:PDIVision:AUTO?
```

Specifies whether the final vertical scale after a DISPlay:WINDow:TRACe:ALL:SCALe:AUTO command should be adjusted automatically, based on signal properties. Y1 refers to the left (power) scale, and Y2 refers to the right (ratio) scale.

```
DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:LINear OFF|ON|0|1
DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:LINear?
```

Specifies whether the vertical scale is in linear units or in log units. Y1 refers to the left (power) scale, and Y2 refers to the right (ratio) scale.

```
DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:PDIVision <numeric_value>[DB]
DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:PDIVision?
```

Specifies the dB per division of the vertical scale. Y1 refers to the left (power) scale, and Y2 refers to the right (ratio) scale.

The maximum value for the vertical scale is 20 dB per division for the power scale or the ratio scale. The minimum value is 0.01 dB per division. The Preset value is 10 dB per division.

```
DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:RLEVel <numeric_value>[DBM|W|UW|NW|MW|DB]
DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:RLEVel?
```

Specifies the power value of the reference level. Default units are set by the UNIT:POWer command for Y1 and the UNIT:RATio command for Y2.

The maximum value for the power reference level is the equivalent of +300 dBm. The minimum value is –300 dBm. The Preset value for the power reference level is 0 dBm.
The maximum value for the ratio reference level is 270 dB. The minimum value is –330 dB. The Preset value for the ratio reference level is 0 dB.

```
DISPlay[:WINDow[1]]:TRACe:Y[1|2}[:SCALe]:RPOSition <numeric value>
DISPlay[:WINDow[1]]:TRACe:Y[1|2][:SCALe]:RPOSition?
```

Selects the position at which the reference level is displayed. The top and bottom graticule lines correspond to 10 and 0, respectively. The default is 9.

```
DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:SPACing LINear|LOGarithmic
DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:SPACing?
```

Specifies the scaling of the vertical axis as logarithmic or linear. In LOG scale, the scale in dB per division is specified by the DISPlay[:WINDow[1]]:TRACe :Y[:SCALe]:PDIVision command.

FORMat Subsystem Commands

```
FORMat[:DATA] REAL[,64]|ASCii
FORMat[:DATA]?
```

Specifies the trace data format used during data transfer via HP-IB. This command affects data transfers for the TRACe[:DATA] subsystem. The ASCII format is a comma-separated list of numbers. The REAL format is a definite-length block of 64-bit floating-point binary numbers. The definite-length block is defined by IEEE 488.2: a "#" character, followed by one digit (in ASCII) specifying the number of length bytes to follow, followed by the length (in ASCII), followed by length bytes of binary data. The binary data is a sequence of 8-byte (64-bit) floating point numbers.

HCOPy Subsystem Commands

`HCOPy:DATA?`

Returns the currently defined printer output as an indefinite length block. After removing the #0 prefix and newline suffix, this block can be saved by the controller and sent directly to a suitable printer.

`HCOPy:DESTination “SYSTem:COMMunicate:INTernal”|”SYStem:COMMunicate:CENtronics”`

`HCOPy:DESTination?`

Selects the I/O port for hard copy output. This affects subsequent presses of the Print key and the HCOPy[:IMMediate] command.

`HCOPy[:IMMediate]`

The entire screen is output to the port defined by the HCOPy:DESTination command. This is equivalent to pressing the Print key.

INITiate Subsystem Commands

```
INITiate:CONTinuous OFF|ON|0|1
INITiate:CONTinuous?
```

Specifies repeat or single sweep.

```
INITiate[:IMMediate]
```

Initiates a new measurement sweep.

MEMory Subsystem Commands

`MEMory:STATe[:EXTended]?`

Returns extended state information as an indefinite length block.

MMEMory Subsystem Commands

`MMEMory:CATalog? [INTernal|FLOPpy]`

Lists all files in the current directory. The return data will be formatted as:

<mem_used>,<mem_free> {,<file listing>}

Each <file listing> indicates the name, type, and size of one file in the directory list:

<file_name>,<file_type>,<file_size>

`MMEMory:DATA <file_name>,<data_block>`

`MMEMory:DATA? <file_name>`

Stores <data_block> in the memory location <file_name>. The query response is the <data_block> stored in <file_name>, where <data_block> is an indefinite block.

`MMEMory:DELete <file_name> [,INTernal|FLOPpy]`

Deletes the specified file.

`MMEMory:INITialize [FLOPpy]`

Formats a disk in the instrument's 3.5 inch disk drive.

`MMEMory:LOAD:TRACe TRA|TRB|TRC|TRD|TRE|TRF,<file_name> [,INTernal|FLOPpy]`

Loads the specified trace from mass storage.

`MMEMory:STORe:TRACe TRA|TRB|TRC|TRD|TRE|TRF,<file_name> [,INTernal|FLOPpy]`

Stores the specified trace to mass storage.

SENSe Subsystem Commands

`[SENSe:]BANDwidth|BWIDth[:RESolution] <numeric_value>[M|NM|UM|A]`

`[SENSe:]BANDwidth|BWIDth[:RESolution]?`

Sets the resolution bandwidth. Available resolution bandwidths are 10 nm, 5 nm, 2 nm, 1 nm, and either 0.07 nm or 0.06 nm. The narrowest resolution bandwidth in 0.7 nm on the HP 86140A and 86143A. It is 0.06 nm on the HP 86142A and 86145A.

> In the AUTO coupled setting, the resolution bandwidth is controlled by the chosen wavelength span and the value set for [SENSe:]BANDwidth|BWIDth[:RESolution]:RATio.

`[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO OFF|ON|0|1`

`[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO?`

Couples the resolution bandwidth to the wavelength span. SENSe:BANDwidth:AUTO ON sets the resolution bandwidth to *span* × *resolution bandwidth ratio*.

> The Preset state of the resolution bandwidth coupling is AUTO.

`[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio <numeric_value>`

`[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio?`

Specifies the ratio of the resolution bandwidth to the span. This parameter is multiplied by the span width to determine the automatic setting of the resolution bandwidth. The default ratio is .01.

`[SENSe:]BANDwidth|BWIDth:VIDeo <numeric_value> [HZ|KHZ|MHZ|GHZ]`

`[SENSe:]BANDwidth|BWIDth:VIDeo?`

Specifies the bandwidth of the post-detection video filter. The minimum value for the video bandwidth is 0.1 Hz. The maximum value is the lesser between 3 kHz and the bandwidth of the currently selected transimpedance amplifier. Available choices move in a 1, 3, 10 sequence.

`[SENSe:]BANDwidth|BWIDth:VIDeo:AUTO OFF|ON|0|1`

`[SENSe:]BANDwidth|BWIDth:VIDeo:AUTO?`

The `[SENSe:]BANDwidth|BWIDth:VIDeo:AUTO` command enables and disables automatic coupling of the video bandwidth.

Video bandwidth filtering occurs after detection of the light. In the autocoupled mode, the video bandwidth has an extremely wide range. This allows the optical spectrum analyzer to avoid unnecessary filtering that would reduce the sweep speed more than required.

Normally, the video bandwidth is coupled to the sensitivity. Manually entering a video bandwidth breaks this coupling. The video bandwidth can be manually set from 100 MHz to 3 kHz, or the bandwidth of the currently selected transimpedance amplifier, whichever is less.

The following functions affect video bandwidth:

- Changing the sensitivity value.
- Changing the reference level.
- Turning autoranging ON or OFF.

The range of video bandwidth available in *Auto* mode is much greater than can be set manually from the front panel. A lower value of video bandwidth requires a longer sweep time. Because of the interdependence between the video bandwidth and sensitivity, it is recommended that either the sensitivity *or* the video bandwidth be changed, whichever is the most important to the measurement task being performed.

Because of the interdependence of sensitivity and video bandwidth, these parameters cannot be set individually. If one of the parameters is set manually, the other is forced into Auto coupled mode and set by the instrument. Set either the desired sensitivity or the desired video bandwidth, depending on which parameter is most important to the current measurement task.

The Preset state of the video bandwidth coupling is AUTO.

`[SENSe:]CHOP[:STATe] OFF|ON|0|1`

`[SENSe:]CHOP[:STATe]?`

Turns the spectrum analyzer chop mode ON or OFF. Chop mode increases dynamic range for long sweep times by subtracting ambient light.

`[SENSe:]CORRection:RVELocity:MEDium AIR|VACuum`

`[SENSe:]CORRection:RVELocity:MEDium?`

Determines whether the wavelengths used and displayed are referenced to air or vacuum.

`[SENSe:]GORDer[:AUTO] OFF|ON|0|1`

`[SENSe:]GORDer[:AUTO]?`

Specifies the spectrum analyzer grating order mode. When ON, allows the instrument to select the best reflection order for the wavelength range. When OFF causes the instrument to use the first-order reflection, regardless of the wavelength.

`[SENSe:]POWer[:DC]:RANGe:AUTO OFF|ON|0|1`

`[SENSe:]POWer[:DC]:RANGe:AUTO?`

Turns the automatic ranging feature ON or OFF. For improved dynamic range, automatic ranging changes the input range during the sweep.

Note

It is recommended this function be in AUTO mode.

`[SENSe:]POWer[:DC]:RANGe:LOCK OFF|ON|0|1`

`[SENSe:]POWer[:DC]:RANGe:LOCK?`

Locks the transimpedance amplifier to the currently selected range.

`[SENSe:]POWer[:DC]:RANGe:LOWer <numeric_value>[DBM|W|UW|NM|MW]`

`[SENSe:]POWer[:DC]:RANGe:LOWer?`

Specifies the desired value for sensitivity. Default units are set by the UNITs:POWer command.

> The maximum value for Sensitivity is +300 dBm. The minimum value is the value that causes the sweep time to become 1000 seconds, and is an attribute of each individual optical spectrum analyzer. The minimum value will always be less than the values for sensitivity shown in the Specifications section of the User's Guide.

`[SENSe:]POWer[:DC]:RANGe:LOWer:AUTO OFF|ON|0|1`

`[SENSe:]POWer[:DC]:RANGe:LOWer:AUTO?`

Turns the automatic setting of sensitivity ON or OFF. Specifying a value for sensitivity with the [SENSe]POWer[:DC]:RANGe:LOWer command will turn Auto OFF.

`[SENSe:]SWEep:POINts <numeric_value>`

`[SENSe:]SWEep:POINts?`

Sets the number of the data points acquired during a sweep. The minimum number of data points is three and the maximum is 10001.

`[SENSe:]SWEep:TIME <numeric_value>[US|MS|S]`

`[SENSe:]SWEep:TIME?`

Specifies the time in which the spectrum analyzer sweeps the displayed wavelength range.

`[SENSe:]SWEep:TIME:AUTO OFF|ON|0|1`

`[SENSe:]SWEep:TIME:AUTO?`

When this function is ON, the sweep time is coupled to the trace length and the span.

`[SENSe:][WAVelength:]CENTer <numeric_value>[M|NM|UM|A|HZ|KHZ|MHZ|GHZ]`

`[SENSe:][WAVelength:]CENTer?`

Specifies the center wavelength. The start and stop wavelength and, if necessary, the span are adjusted so that:

$$Center = Start + \left(\frac{Span}{2}\right)$$

and

$$Center = Stop - \frac{Span}{2}$$

With Wavelength Limit Off, the minimum value for the Center Wavelength is nominally 350.1 nm. The maximum value is 1999.9 nm. These limits are valid for wavelengths referenced in air or vacuum.

With Wavelength Limit On, the minimum value for the Center Wavelength is nominally 600.1 nm. The maximum value is 1699.9 nm. These limits are valid for wavelengths referenced in air or vacuum.

The Preset value for Wavelength Limit is On. The Preset value for Center Wavelength is 1150 nm.

```
[SENSe:][WAVelength:]CENTer:STEP:AUTO OFF|ON|0|1
[SENSe:][WAVelength:]CENTer:STEP:AUTO?
```

When ON, the step size is automatic. When OFF, the step size is fixed. The value is set by the [SENSe:][WAVelength:]CENTer:STEP[:INCRement] command.

```
[SENSe:][WAVelength:]CENTer:STEP[:INCRement] <numeric_value>[M|NM|UM|A]
[SENSe:][WAVelength:]CENTer:STEP[:INCRement]?
```

Specifies the center wavelength step size.

```
[SENSe:][WAVelength:]LIMit OFF|ON|0|1
[SENSe:][WAVelength:]LIMit?
```

Specifies whether the span is limited to the specified range of 600 to 1700 nm.

```
[SENSe:][WAVelength:]OFFSet <numeric_value>[M|NM|UM|A]
[SENSe:][WAVelength:]OFFSet?
```

Specifies the wavelength offset. This is the offset between the measured wavelength and the displayed wavelength.

```
[SENSe:][WAVelength:]SPAN <numeric_value>[M|NM|UM|A]
[SENSe:][WAVelength:]SPAN?
```

Specifies the wavelength span. The start and stop wavelength and, if necessary, the center wavelength are adjusted so that:

$$Span = 2(Center - Start)$$

and

$$Span = 2(Stop - Center)$$

> The minimum value for Wavelength Span is 0.2 nm.
>
> With Wavelength Limit Off, the maximum value for Wavelength Span is 1650 nm.
>
> With Wavelength Limit On, the maximum value for Wavelength Span is 1100 nm.
>
> The Preset value for Wavelength Limit is On. The Preset value for Wavelength Span is 1100 nm.

```
[SENSe:][WAVelength:]SPAN:FULL
```

Sets the wavelength span of the spectrum analyzer to full span.

```
[SENSe:][WAVelength:]SRANge:LOWer <numeric_value>[M|NM|UM|A|HZ|KHZ|MHZ|GHZ]
[SENSe:][WAVelength:]SRANge:LOWer?
```

Sets the lower limit for the wavelength sweep range. Setting this value when SENSe:WAVelength:SRANge:STATe is OFF will automatically turn SENSe:WAVelength:SRANge:STATe ON. The range used for the wavelength sweep range is the same range used for the total power integration, the trace mean range, and the marker search range. Changing the range with this command will change all four ranges.

Sending the command when the instrument is in a zero span will generate a “Settings conflict” error.

Default units for the parameter are meters. Frequency units are allowed.

`[SENSe:][WAVelength:]SRANge[:STATe] OFF|ON|0|1`

`[SENSe:][WAVelength:]SRANge[:STATe]?`

Turns the wavelength sweep range ON or OFF. When the sweep range is ON, the instrument will only sweep between the upper and lower sweep range limits. There is a single range controlling the total power integration, the trace mean calculation, the marker search range, and the wavelength sweep range, but there are four independent state settings for limiting the total power integration, the trace mean, the marker search, and the wavelength sweep to the range. If all four states for the total power integration, the trace mean, the marker search, and the wavelength sweep range are OFF, setting SENSe:WAVelength:SRANge:STATe to ON, will initialize

the lower limit to: $Start + \frac{Span}{3}$ and

the upper limit to: $Start + \left(2 \times \frac{Span}{3}\right)$

Sending the command when the instrument is in a zero span will generate a "Settings conflict" error.

`[SENSe:][WAVelength:]SRANge:UPPer <numeric_value>[M|NM|UM|A|HZ|KHZ|MHZ|GHZ]`

`[SENSe:][WAVelength:]SRANge:UPPer?`

Sets the upper limit for the wavelength sweep range. Setting this value when SENSe:WAVelength:SRANge:STATe is OFF will automatically turn SENSe:WAVelength:SRANge:STATe ON. The range used for the wavelength sweep range is the same range used for the total power integration, the trace mean range and the marker search range. Changing the range with this command will change all four ranges.

Sending the command when the instrument is in a zero span will generate a "Settings conflict" error. Default units for the parameter are meters. Frequency units are allowed.

```
[SENSe:][WAVelength:]STARt <numeric_value>[M|NM|UM|A|HZ|KHZ|MHZ|GHZ]
[SENSe:][WAVelength:]STARt?
```

Specifies the start wavelength. The center wavelength and span are adjusted so that:

$$Start = Center - \frac{Span}{2}$$

and

$$Stop = Center + \frac{Span}{2}$$

If the instrument is in zero span, this command sets the center wavelength to the value specified.

With Wavelength Limit Off, the minimum value for the Start Wavelength is nominally 350 nm. The maximum value is 1999.8 nm. These limits are valid for wavelengths referenced in air or vacuum.

With Wavelength Limit On, the minimum value for the Start Wavelength is nominally 600 nm. The maximum value is 1699.8 nm. These limits are valid for wavelengths referenced in air or vacuum.

The Preset value for Wavelength Limit is On. The Preset value for Start Wavelength is 600 nm.

```
[SENSe:][WAVelength:]STOP <numeric_value>[M|NM|UM|A|HZ|KHZ|MHZ|GHZ]
[SENSe:][WAVelength:]STOP?
```

Specifies the stop wavelength. The center wavelength and span are adjusted so that:

$$Start = Center - \frac{Span}{2}$$

and

$$Stop = Center + \frac{Span}{2}$$

If the instrument is in zero span, this command sets the center wavelength to the value specified.

With Wavelength Limit Off, the minimum value for the Stop Wavelength is nominally 350.2 nm. The maximum value is 2000 nm. These limits are valid for wavelengths referenced in air or vacuum.

With Wavelength Limit On, the minimum value for the Stop Wavelength is nominally 600.2 nm. The maximum value is 1700 nm. These limits are valid for wavelengths referenced in air or vacuum.

The Preset value for Wavelength Limit is On. The Preset value for Stop Wavelength is 1700 nm.

SOURce[n] Subsystem Commands

`SOURce[n]:PULSe:DCYCle <numeric_value>`

`SOURce[n]:PULSe:DCYCle?`

Sets the duty cycle of the sync output. This is equivalent to the TRIGger[:SEQuence]:OUTPut:PULSe:DCYCle command.

`SOURce[n]:PULSe:WIDTh <numeric_value>[S|MS|US|NS]`

`SOURce[n]:PULSe:WIDTh?`

Sets the pulse width of the sync output. This is equivalent to the TRIGger[:SEQuence]:OUTPut:PULSe:WIDTh command.

STATus Subsystem Commands

`STATus:OPERation:CONDition?`

Queries the contents of the operation condition register.

`STATus:OPERation:ENABle <int_value>`

`STATus:OPERation:ENABle?`

Sets or queries the contents of the operation enable register.

`STATus:OPERation[:EVENt]?`

Queries the contents of the operation event register. This query reads the contents of the register and then clears it.

`STATus:OPERation:NTRansition <int_value>`

`STATus:OPERation:NTRansition?`

Sets or queries the contents of the operation negative transition register.

`STATus:OPERation:PTRansition <int_value>`

`STATus:OPERation:PTRansition?`

Sets or queries the contents of the operation positive transition register.

`STATus:PRESet`

Clears the event registers and sets all bits in the enable registers.

`STATus:QUEStionable:CONDition?`

Queries the contents of the questionable condition register.

```
STATus:QUEStionable:ENABle <int_value>
STATus:QUEStionable:ENABle?
```

Sets or queries the contents of the questionable enable register.

```
STATus:QUEStionable:EVENt?
```

Queries the contents of the questionable event register and then clears it.

SYSTem Subsystem Commands

`SYSTem:DATE?`

Queries the date of the real-time clock of the optical spectrum analyzer.

`SYSTem:ERRor[:NEXT]?`

Queries the earliest entry in the error queue, thus deleting it. The *CLS command clears the error queue.

`SYSTem:HELP:HEADers?`

Returns a list of all commands and queries implemented by the instrument.

`SYSTem:PON[:TYPE] PRESet|LAST`

`SYSTem:PON[:TYPE]?`

Selects the state of the optical spectrum analyzer when it is turned on.

`SYSTem:PRESet`

Performs an instrument preset, setting the instrument to a known state. See page 3-5 for a complete list of the preset conditions.

`SYSTem:TIME?`

Queries the time of the real-time clock of the spectrum analyzer.

`SYSTem:TZONe:NAME?`

Returns the time zone used by the real-time clock of the spectrum analyzer. The time zone must be one of the following:

`HST10`	Hawaii Standard	`GMT0bst`	Greenwich Mean/British Summer
`AST10adt`	Aleutian Standard/Daylight	`WAT1`	Algeria, West Central Africa
`YST9ydt`	Yukon Standard/Daylight	`MET1metdst`	Middle European/Daylight
`PST8PDT`	Pacific Standard/Daylight	`EET2`	Turkey, Finland, Romania, Greece
`MST7`	Mountain Standard only	`CAT2`	Egypt, Sudan, Zaire, Central Africa
`MST7MDT`	Mountain Standard/Daylight	`SAST2sadt`	Republic of South Africa
`CST6CDT`	Central Standard/Daylight	`WST3`	Western Russia (Moscow)
`EST5`	Eastern Standard only	`EAT3`	Eastern Africa, Kenya, Ethiopia
`EST5EDT`	Eastern Standard/Daylight	`WAT3`	Moscow, Saudi Arabia, Syria
`AST4ADT`	Atlantic Standard/Daylight	`PST5`	Pakistan
`NST330NDT`	Newfoundland Standard/Daylight	`IST530`	India
`SAT5`	Peru, Ecuador, Columbia	`TST7`	Thailand
`SAT430`	Venezuela, Guyana, Surinam	`SST7`	Singapore
`SAT4`	Western Brazil, Bolivia, Chile	`EAT8`	Phillipines, Hong Kong, China, Taiwan
`SAT3`	Argentina, Eastern Brazil	`WST8`	Western Australia
`IST1`	Iceland	`JST9`	Japan, Korea
`WAT0`	NW Africa, Morocco, Mauritania	`CST930cdt`	Central Australia Standard/Daylight
`WET0WETDST`	Western Europe/Daylight	`EST10edt`	Eastern Australia Standard/Daylight
`PWT0pst`	Portuguese Winter/Summer	`NZST12nzdt`	New Zealand Standard/Daylight

`SYSTem:VERSion?`

Returns the version of SCPI with which it is compatible.

TRACe Subsystem Commands

`TRACe[:DATA]:X:STARt? TRA|TRB|TRC|TRD|TRE|TRF`

Returns the start value for the X-axis data for the trace. The X-axis data will be evenly spaced points from STARt to STOP. The number of points is determined by the TRACe:POINts setting.

`TRACe[:DATA]:X:TIME:SSTop TRA|TRB|TRC|TRD|TRE|TRF <numeric_value>[S|MS|US]`

This command sets the start and stop values for the X-axis data for the trace and sets the X-axis type to TIME. The first <numeric_value> corresponds to the start, and the second corresponds to the stop. If the stop value is greater than the start value, a “Data out of range” error will be generated. The X-axis data will be evenly spaced points from start to stop. The number of points is determined by the TRACe:POINts setting. If the trace has an expression defined, this expression will be cleared when changing the X-axis start/stop.

Changing the X-axis data in a trace used in an expression (CALCulate:MATH:EXPRession) by another trace may cause an error in the expression if the X-axis data in the operands of the expression no longer match.

`TRACe[:DATA]:X:TYPE? TRA|TRB|TRC|TRD|TRE|TRF`

This query reads the X-axis type for the trace. The X-axis will be WAV for a trace acquired in a normal span, or TIME for a trace acquired in zero span.

The trace names defined for the instrument are: TRA, TRB, TRC, TRD, TRE, and TRF. Specifying any other will generate an “Illegal parameter value” error.

`TRACe[:DATA]:X:[WAVelength]SSTop TRA|TRB|TRC|TRD|TRE|TRF,`
`<numeric_value>[M|UM|NM|A|HZ|KHZ|MHZ|GHZ],<numeric_value>[M|UM|NM|A|HZ|KHZ|MHZ|GHZ]`

Sets the start and stop values for the X-axis data for the trace. The first <numeric_value> corresponds to the start, and the second corresponds to the stop. If the stop value is a shorter wavelength than the start value, a "Data out of range" error will be generated. The X-axis data will be evenly spaced points from start to stop. The number of points is determined by the TRACe:POINts setting. If the trace has an expression defined, this expression will be cleared when the X-axis start/stop is changed.

Changing the X-axis data in a trace used in an expression (CALCulate:MATH:EXPRession) by another trace may cause an error in the expression if the X-axis data in the operands of the expression no longer match.

`TRACe[:DATA]:X:STOP? TRA|TRB|TRC|TRD|TRE|TRF`

Returns the stop value for the X-axis data for the trace. The X-axis data will be evenly spaced points from STARt to STOP. The number of points is determined by the TRACe:POINts setting.

`TRACe[:DATA][:Y]? TRA|TRB|TRC|TRD|TRE|TRF`

Returns the Y-axis data points for the trace. The units are determined by the definition of the trace. The trace data format used in the command is determined by the FORMat subsystem.

```
TRACe[:DATA][:Y][:POWer] TRA|TRB|TRC|TRD|TRE|TRF,<data_block>
                                                |<numeric_value>{,<numeric_value>}
```

Sets the Y-axis data points for the trace. The number of Y-axis data points is determined by the TRACe:POINts setting. If a single numeric value is given, all of the Y-axis data points will be set to that value. If more than one value is sent, the trace length will be set to the number of values sent.

This command should be used where trace data represents power. The trace data format to be used with this command is determined by the FORMat subsystem.

```
TRACe[:DATA][:Y]:RATio TRA|TRB|TRC|TRD|TRE|TRF,<data_block>
                                              |<numeric_value>{,<numeric_value>}
```

Sets the Y-axis data points for the trace. The number of Y-axis data points is determined by the TRACe:POINts setting. If a single numeric value is given, all the Y-axis data points will be set to that value. If more than one value is sent, the trace length will be set to the number of values sent.

This command should be used when the trace data represents a power ratio (unitless number). The trace data format to be used with this command is determined by the FORMat subsystem.

```
TRACe:EXCHange TRA,TRB|TRC|TRD|TRE|TRF
TRACe:EXCHange TRB, TRC
```

Exchanges both the X-axis and Y-axis data of the two traces. The only trace pairs that can be exchanged are TRA with any trace, and TRB with TRC. Specifying any other trace will generate an “Illegal parameter value” error.

The TRACe:FEED:CONTrol of the two traces is set to NEVer before the data is exchanged. Both X-axis and Y-axis data will be exchanged. After the data is exchanged, the TRACe:FEED:CONTrol of the two traces is left at NEVer.

Changing the X-axis data in a trace used in an expression (CALCulate:MATH:EXPRession) may cause an error in the expression if the X-axis data in the operands of the expression no longer match.

`TRACe:FEED:CONTrol TRA|TRB|TRC|TRD|TRE|TRF,ALWays|NEVer`

`TRACe:FEED:CONTrol? TRA|TRB|TRC|TRD|TRE|TRF`

Controls how often the specified trace accepts new data. Setting the TRACe:FEED:CONTrol command to ALWays will allow the trace to always accept new data whenever data is available from the FEED. This is equivalent to turning on the trace update from the front panel.

Setting the TRACe:FEED:CONTrol command to NEVer will cause no new data to be fed into the trace. This is equivalent to turning off the trace update from the front panel.

When switching from NEVer to ALWays, all the valid data from the data source is immediately copied into the trace. If, for example:

- the instrument is in single sweep mode.
- TRA has SENSe:DATA as the FEED and NEVer as the FEED:CONTrol.
- SENSe:DATA contains valid measurement data

Setting the TRACe:FEED:CONTrol command from NEVer to ALWays for TRA will immediately copy the SENSe:DATA into trace A. If the instrument was in continuous sweep mode, and a sweep was in progress, setting the CONTrol command from NEVer to ALWays would immediately copy all the valid SENSe:DATA for the partial sweep.

`TRACe:POINts TRA|TRB|TRC|TRD|TRE|TRF,<numeric_value>`

`TRACe:POINts? TRA|TRB|TRC|TRD|TRE|TRF`

Sets the number of data points to be used in the trace. Use only for downloading data with trace subsystem commands. Use SENSe:SWEep:POINts for changing the measurement trace length. Refer to “[SENSe:]SWEep:POINts <numeric_value>” on page 4-84.

TRIGger Subsystem Commands

`TRIGger[:SEQuence]:DELay <numeric_value>[S|MS|US|NS]`

`TRIGger[:SEQuence]:DELay?`

Specifies the trigger delay used to start a measurement.

`TRIGger[:SEQuence]:OUTPut OFF|ON|AUTO`

`TRIGger[:SEQuence]:OUTPut?`

Controls the ADC trigger output. When OFF the signal will be a TTL LOW. When ON the signal will be a TTL HIGH. When AUTO is specified the signal will go HIGH *before* the sampling interval of the detector and go LOW *after* the sampling interval of the detector.

`TRIGger[:SEQuence]:OUTPut:PULSe:DCYCle <numeric_value>`

`TRIGger[:SEQuence]:OUTPut:PULSe:DCYCle?`

Sets the duty cycle of the sync output. This is equivalent to the SOURce[n]:PULSe:DCYCle command.

`TRIGger[:SEQuence]:OUTPut:PULSe:WIDTh <numeric_value>[S|MS|US|NS]`

`TRIGger[:SEQuence]:OUTPut:PULSe:WIDTh?`

Sets the pulse width of the sync output. This is equivalent to the SOURce[n]:PULSe:WIDTh command.

`TRIGger[:SEQuence]:SLOPe POSitive|NEGative|EITHer`

`TRIGger[:SEQuence]:SLOPe?`

Specifies the polarity of triggering used to start a measurement. Specifying the slope sets the trigger source to INTernal.

`TRIGger[:SEQuence]:SOURce IMMediate|EXTernal|INTernal`

`TRIGger[:SEQuence]:SOURce?`

Specifies the source, or type, of triggering used to start a measurement. Setting the source to anything other than INTernal sets the slope to EITHer.

UNIT Subsystem Commands

`UNIT:POWer DBM|W|AUTO`

`UNIT:POWer?`

Specifies the amplitude units for the input, output, and display of the active window and sets the UNIT:RATio units to the corresponding setting.

`UNIT:RATio DB|LINear|AUTO`

`UNIT:RATio?`

Specifies units for the input and output of values that represent power ratios. These commands are:

CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:NDB
DISPlay:WINDow:TRACe:Y:SCALe:AUTO:PDIVision
DISPlay:WINDow:TRACe:Y:SCALe:PDIVision
TRACe:DATA:Y?

This command also sets UNIT:POWer to the corresponding setting.

HP 71450 Series Commands to HP 86140 Series Equivalents

The following table provides a list of the HP 71450 series commands and the SCPI equivalent commands for the HP 86140 series analyzers.

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (1 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
ABORT	
ABS	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
ACTDEF	
ACTPARM	
ADAPBTL	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
ADAPBPCTL	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
ADBTL	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
ADCTL	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
ADCTRG	TRIGger[:SEQuence]:SLOPe POSitive|NEGative|EITHer TRIGger[:SEQuence]:SOURce IMMediate|EXTernal|INTernal
ADCTRGDLY	TRIGger[:SEQuence]:DELay <numeric_value>[<unit>]
ADCTRGSYN	TRIGger[:SEQuence]:OUTPut OFF|ON|0|1|AUTO
ADD	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
ALIGN	CALibration:ALIGn:EXTernal
ALIGNPRST	CALibration:ALIGn:PRESet
AMB	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
AMBMC	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (2 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
AMBMCPL	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
AMBPL	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
AMC	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
AMCPL	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
AMETER	
AMPCOR	[SENSe:]CORRection:OFFSet[:MAGNitude] <numeric_value>
AMPMKR	CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:NDB <param>
AMPU	
ANNOFF	
ANNOT	DISPlay[:WINDow[1]]:ANNotation[:ALL] OFF|ON|0|1
APB	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
APBDCTL	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
AUNITS	UNIT:POWer DBM|W|AUTO
AUTOALIGN	CALibration:ALIGn[:AUTO] CALibration:ALIGn:AUTO:MARKer[1|2|3|4]
AUTOMDB	DISPlay[:WINDow[1]]:TRACe:Y:SCALe:AUTO:PDIVision <param> DISPlay[:WINDow[1]]:TRACe:Y:SCALe:AUTO:PDIVision:AUTO:PDIVision :AUTO OFF|ON|0|1
AUTOMEAS	DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]
AUTOMMKR	DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]:MARKer OFF|ON|0|1
AUTOMOPT	DISPlay[:WINDow[1]]:TRACe:ALL[:SCALe][:AUTO]:OPTimize OFF|ON|0|1
AUTOMSP	DISPlay[:WINDow[1]]:TRACe:X:SCALe:AUTO:SPAN <param> DISPlay[:WINDow[1]]:TRACe:X:SCALe:AUTO:SPAN:AUTO OFF|ON|0|1
AUTORNG	[SENSe:]POWer:AC:RANGe:AUTO OFF|ON|0|1
AVG	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
AXB	TRACe:EXCHange TRA, TRB
AXC	TRACe:EXCHange TRA, TRC
BIT	
BLANK	DISPlay[:WINDow[1]]:TRACe[:STATe] <trace>,OFF|ON|0|1

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (3 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
BML	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
BP	
BTC	
BXC	TRACe:EXCHange TRB, TRC
CAL	CALibration:PRESet CALibration:POWer CALibration:WAVelength CALibration:WAVelength:MARKer
CALCOR	CALibration:STATe CALibration:POWer:STATe CALibration:WAVelength:STATe
CALDATA	
CALPWR	CALibration:POWer:VALue
CALWL	CALibration:WAVelength:VALue
CATALOG	MMEMory:CATalog?
CENTERWL	[SENSe:]WAVelength:CENTer <param>
CHEIGHT	
CHOP	[SENSe:]CHOP[:STATe] OFF|ON|0|1
CLRDSP	
CLRW	TRACe:FEED:CONTrol <trace>, ALWays
CLS	*CLS
COMPRESS	
CONCAT	
CONFIG	
CONTS	INITiate:CONTinuous ON|1
CORSEL	
CORTOLIM	
CWIDTH	
DE	
DEBUG	
DELETE	
DFB_	
DISPOSE	
DISPU	

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (4 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
DIV	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
DL	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
DONE	*OPC?
DSPLY	
DSPMODE	
DSPTEXT	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
DWINDOW	
ENTER	
ERASE	
ERR	SYSTem:ERRor?
EXP	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
FETCH	
FFT	
FFTKNL	
FORMAT	MMEMory:INITialize [FLOPpy]
FP_	
FP_MKBW	
FP_TH	
FS	[SENSe:][WAVelength:]SPAN:FULL
FUNCDEF	
GATESWP	
GRAPH	
GRAT	DISPlay[:WINDow[1]]:TRACe:GRATicule:GRID[:STATe] OFF|ON|0|1
GRATORDER	[SENSe:]GORDer[:AUTO] OFF|ON|0|1
GRATSCRL	
GRID	
HD	
ID	*IDN?
IF/THEN	
IGEN	
IGENDTYCY	SOURce[n]:PULSe:DCYCle <numeric_value>
IGENLIMIT	

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (5 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
IGENPW	SOURce[n]:PULSe:WIDTh <numeric_value>
INSTMODE	
INT	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
IP	SYSTem:PRESet
IT	
IWINDOW	
KEYCLR	
KEYDEF	
KEYPST	
LED_	
LG	DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:SPACing LOGarithmic DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:PDIVision <numeric_value>[<unit>]
LIGHT	
LIMIAMP	
LIMIBEEP	
LIMIBOT	
LIMIDEL	
LIMIDONE	
LIMIEDIT	
LIMIFAIL	
LIMIHALF	
LIMILINE	
LIMINEXT	
LIMIRCL	
LIMIREL	
LIMISAV	
LIMISCRL	
LIMISDEL	
LIMISEG	
LIMITEST	
LIMITYPE	
LIMIWL	
LIMTOCOR	
LINES	
LINET	

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (6 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
LN	DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:SPACing LINear
LOAD	
LOG	
MDS	FORMat[:DATA] <param>
MEAN	CALCulate[1|2|3|4|5|6]:MEAN:STATe ON CALCulate[1|2|3|4|5|6]:MEAN[:DATA]?
MEASU	
MEASURE	
MEM	
MIN	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
MINH	CALCulate[1|2|3|4|5|6]:MINimum[:STATe] ON
MK	
MKA	CALCulate:MARKer[1|2|3|4]:Y?
MKACT	CALCulate:MARKer[1|2|3|4][:STATe] ON|1
MKAL	CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:X:LEFT?
MKAR	CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:X:RIGHt?
MKBW	CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:RESult? CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth[:STATe]
MKBWA	CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:NDB CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:RESult?
MKCONT	
MKCWL	CALCulate:MARKer[1|2|3|4]:SCENter
MKD	CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:NDB CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:RESult?
MKDACT?	
MKDREFA	
MKDREFF	
MKMIN	CALCulate:MARKer[1|2|3|4]:MINimum
MKN	CALCulate:MARKer[1|2|3|4]:FUNCtion:PRESet CALCulate:MARKer[1|2|3|4]:X <param>
MKNOISE	CALCulate:MARKer[1|2|3|4]:FUNCtion:NOISe[:STATe] OFF|ON|0|1 CALCulate:MARKer[1|2|3|4]:FUNCtion:NOISe:RESult?
MKOFF	CALCulate:MARKer:AOFF CALCulate:MARKer[1|2|3|4][:STATe] OFF|0
MKP	
MKPABS	

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (7 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
MKPAUSE	
MKPITX	CALCulate:MARKer[1|2|3|4]:PEXCursion:PIT <param>
MKPK	CALCulate:MARKer[1|2|3|4]:MAXimum CALCulate:MARKer[1|2|3|4]:MAXimum:NEXT CALCulate:MARKer[1|2|3|4]:MAXimum:LEFT CALCulate:MARKer[1|2|3|4]:MAXimum:RIGHt CALCulate:MARKer[1|2|3|4]:MINimum:NEXT CALCulate:MARKer[1|2|3|4]:MINimum:LEFT CALCulate:MARKer[1|2|3|4]:MINimum:RIGHt
MKPX	CALCulate:MARKer[1|2|3|4]:PEXCursion[:PEAK] <param>
MKREAD	CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth:READout FREQuency|WAVelength|TIME CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa:X:READout FREQuency|WAVelength|TIME
MKRL	CALCulate:MARKer[1|2|3|4]:SRLevel
MKSP	
MKSS	
MKSTOP	
MKT	
MKTRACE	CALCulate:MARKer[1|2|3|4]:TRACe <source_trace>
MKTRACK	
MKTUNE	
MKTV	
MKTYPE	CALCulate:MARKer[1|2|3|4]:FUNCtion:NOISe[:STATe] OFF|ON|0|1 CALCulate:MARKer[1|2|3|4]:FUNCtion:DELTa[:STATe] OFF|ON|0|1 CALCulate:MARKer[1|2|3|4]:FUNCtion:BWIDth|BANDwidth[:STATe] OFF|ON|0|1 CALCulate:MARKer[1|2|3|4]:FUNCtion:PRESet
MKWL	CALCulate:MARKer[1|2|3|4]:X <param>
MOD	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
MODADD	
MODID	
MOV	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
MPY	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
MSG	
MSI	

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (8 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
MXM	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
MXMH	CALCulate[1|2|3|4|5|6]:MAXimum[:STATe] ON
NORM	
NSTATE	
ONEOS	
ONMENU	
ONMKR	
ONUSER	
ONWINDOW	
OP	
OPTSW	
OR	
OUTPUT	
OVRW	
PA	
PAUSE	
PD	
PDA	
PDL_	
PDLCALC	
PDLDEV	
PDL_DEV?	
PDLEXIT	
PDLINIT	
PDLREV	
PDL_REV?	
PDLSCALE	
PDLSRC	
PDL_SRC?	
PDMEAS	
PDWL	
PEAKS	CALCulate:MARKer[1|2|3|4]:MAXimum CALCulate:MARKer[1|2|3|4]:X? CALCulate:MARKer[1|2|3|4]:MAXimum:NEXT CALCulate:MARKer[1|2|3|4]:X?

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (9 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
PEN	
PERASE	
PERSIST	
PLOT	HCOPy[:IMMediate]
POSU	
POWERON	SYSTem:PON[:TYPE] PRESet|LAST
PR	
PREFX	
PROTECT	
PSTATE	
PU	
PURGE	MMEMory:DELete <file_name>[,INTernal|FLOPpy]
PWRBW	
RB	[SENSe:]BANDwidth|BWIDth[:RESolution] <param> [SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO OFF|ON|0|1
RBR	[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio <param>
RCLD	
RCLS	*RCL <numeric_value>|<filename>[,INTernal|FLOPpy]
RCLT	MMEMory:LOAD:TRACe <trace>, <file_name>
RCLU	
READMENU	
RELHPIB	
REPEAT/ UNTIL	
RETURN	
REV	*IDN?
RL	DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:RLEVel <numeric_value>[<unit>]
RLPOS	DISPlay[:WINDow[1]]:TRACe:Y[:SCALe]:RPOSition <numeric_value>
RMS	
ROFFSET	[SENSe:]CORRection:OFFSet[:MAGNitude] <numeric_value>
RQS	*SRE
SAVED	
SAVES	*SAV <numeric_value>|<filename>[,INTernal|FLOPpy]
SAVET	MMEMory:STORe:TRACe <trace>, <file_name>
SAVEU	
SCALE	

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (10 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
SENS	[SENSe:]POWer:AC:RANGe:LOWer <numeric_value>|<step> [SENSe:]POWer:AC:RANGe:AUTO OFF|ON|0|1
SER	*IDN?
SMOOTH	
SNGLS	INITiate:CONTinuous OFF|0
SP	[SENSe:]WAVelength:SPAN <param>
SPANWL	[SENSe:]WAVelength:SPAN <param>
SQR	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
SRINPUT	
SRQ	
SS	[SENSe:]WAVelength:CENTer:STEP[:INCRement] <param> [SENSe:]WAVelength:CENTer:STEP:AUTO OFF|ON|0|1
ST	[SENSe:]SWEep:TIME <param> [SENSe:]SWEep:TIME:AUTO OFF|ON|0|1
STARTUP	
STARTWL	[SENSe:]WAVelength:STARt <param>
STATE	
STB	*STB?
STDEV	
STOPWL	[SENSe:]WAVelength:STOP <param>
STOR	
STORREF	
SUB	CALCulate1:MATH:EXPRession[:DEFine] <expression> CALCulate1:MATH:STATe ON
SUM	CALCulate[1|2|3|4|5|6]:TPOWer:STATe ON CALCulate[1|2|3|4|5|6]:TPOWer[:DATA]?
SUMSQR	
SWEEP	INITiate:CONTinuous OFF|ON|0|1
SWPMODE?	INITiate:CONTinuous?
TDF	FORMat[:DATA] <param>
TEST	*TST?
TEXT	DISPlay[:WINDow[1]]:TEXT:DATA <string>|<block>
TH	CALCulate[1|2|3|4|5|6]:THReshold <param>
THREED	
THREEDH	

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (11 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
THREEDV	
TIME	
TITLE	DISPlay[:WINDow[1]]:TEXT:DATA <string>|<block>
TM	TRIGger[:SEQuence]:SOURce IMMediate|EXTernal|INTernal
TP	
TRA/TRB/TRC	TRACe:DATA[:Y]? <trace_name> TRACe[:DATA][:Y][:POWer] <trace_name>,<data_block>| <numeric_value>{,<numeric_value>} TRACe:DATA[:Y]:RATio <trace_name>,<block>| <numeric_value>{,<numeric_value>}
TRCOND	
TRDEF	SENSe:SWEep:POINts <numeric value>
TRDSP	DISPlay[:WINDow[1]]:TRACe[:STATe] <trace>,OFF|ON|0|1
TRNSZLOCK	[SENSe:]POWer:RANGe:LOCK
TRPST	DISPlay[:WINDow[1]]:TRACe[:STATe] TRA,ON DISPlay[:WINDow[1]]:TRACe[:STATe] TRB,OFF DISPlay[:WINDow[1]]:TRACe[:STATe] TRC,OFF CALCulate1:MATH:STATe OFF CALCulate1:AVERage[:STATe] OFF CALCulate2:AVERage[:STATe] OFF CALCulate3:AVERage[:STATe] OFF TRACe:POINts TRA,800 TRACe:POINts TRB,800 TRACe:POINts TRC,800
TRSTAT	DISPlay[:WINDow[1]]:TRACe[:STATe]? <trace>
TS	INITiate[:IMMediate]
TWNDOW	
USERERR	
USERKEY	
USERLOCK	
USERMSG	
USERWARN	
USTATE	
VARDEF	
VARIANCE	
VAVG	CALCulate[1|2|3|4|5|6]:AVERage:COUNt <numeric_value> CALCulate[1|2|3|4|5|6]:AVERage[:STATe] OFF|ON|0|1

Table 4-8. HP 71450 Series Commands to HP 86140 Series Commands (12 of 12)

HP 71450 Series Command	Equivalent HP 86140 Series Command
VB	[SENSe:]BANDwidth|BWIDth:VIDeo <param> [SENSe:]BANDwidth|BWIDth:VIDeo:AUTO OFF|ON|0|1
VIEW	DISPlay[:WINDow[1]]:TRACe[:STATe] <trace>,OFF|ON|0|1
VTDL	
VTH	
VTL	
VW	
WAIT	
WARN?	
WARNCTRL	
WLLIMIT	[SENSe:][WAVelength:]LIMit OFF|ON|0|1
WLMKRL	CALCulate[1|2|3|4|5|6]:TPOWer:IRANge:LOWer <param>
WLMKRR	CALCulate[1|2|3|4|5|6]:TPOWer:IRANge:UPPer <param>
WLOFFSET	[SENSe:][WAVelength:]OFFSet <numeric_value>
WLUNITS	
XAMPSW	
XCH	
XERR	SYSTem:ERRor?
XWARN	
ZERO	CALibration:ZERO[:AUTO] OFF|ON|0|1|ONCE
ZOOMRB	CALCulate:MARKer[1|2|3|4]:SCENter [SENSe:]BANDwidth|BWIDth[:RESolution] <param> [SENSe:][WAVelength:]SPAN 0

5

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Status Listings

Overview

This document describes the status listings of the HP 86140 series optical spectrum analyzers. Status conditions for the optical spectrum analyzer are grouped into categories.

Error

Indicates the instrument is malfunctioning. Measurement accuracy is probably affected. Errors can be caused by either a hardware or a firmware problem. The instrument requires repair at a Hewlett-Packard service center.

Status error

Indicates an internal hardware function is unavailable or not operating within specifications. This is usually a temporary problem, such as a temperature control loop being unsettled. Status errors cannot be cleared by the user. When the condition causing the error is corrected the error will go away.

Warning

A warning is displayed when the optical spectrum analyzer cannot satisfy a request from the user. Parameter entries that are out of range, illegal or unrecognized remote commands or missing hardware options can cause a warning to be displayed. A warning can be displayed if a requested measurement, for example AutoMeasure, cannot be performed due to a missing input signal.

UNCAL

This message alerts the user the requested instrument setup can cause an invalid measurement. For example, manually setting the sweep time to a value that is too fast for other instrument settings.

Notice

A user alert indicating something in the state of the instrument has changed. For example, if the user specifies a particular value for the current duty cycle, a notice will be displayed when the optical spectrum analyzer modifies the pulse width .

The following table lists the error numbers and their definitions.

Number Range	Definition
–1 to –999	Standard SCPI errors
1000 to 2999	OSA notices
3000 to 4999	Application specific notices
5000 to 7999	OSA warnings
8000 to 9999	Application specific warnings
10000 to 11999	OSA status errors
12000 to 13999	Application specific status errors
20000 to 21999	OSA errors
22000 to 23999	Application specific errors
30000 to 32767	Firmware errors

Error Reporting Behavior

Errors are displayed in an on-screen dialog box. To continue operation, the user must acknowledge the error by pressing a button.

Status errors are displayed with a descriptive line in the lower-left corner of the graticule. Immediately press the System key below the display, and then press the *Help* softkey to the right of the display to display more information. A softkey menu is displayed that includes, *Show Critical Errors*, *Show HW Errors*, *Show Warnings*, and *Show Notices*. If there are any errors, warnings or notices, one or more of these keys are enabled. Press the key to display a more complete description of the condition causing the message.

Warnings and notices are displayed in a status line at the bottom of the screen. They are cleared when any front-panel key, other than the System key, is pressed, or they will clear automatically after a few seconds. To view warnings and notices, press the front-panel System key, the *Help* softkey and then the *Show Warnings* or *Show Notices* softkey. UNCAL is displayed as red text in the lower-right corner of the graticule. It is only displayed when a condition exists that can lead to an inaccurate measurement. There are cases when valid measurements can be made while an UNCAL condition exists, but the operator should use caution.

SCPI-Defined Errors

These error messages and descriptions were copied from the *SCPI 1997 Volume 2: Command reference*. The sentences enclosed in brackets "[ ]" are copied from the error descriptions in the SCPI reference. References are also made to IEEE 488.2 sections for further clarification of events.

Not all the available SCPI error messages were utilized in the optical spectrum analyzer. Only those pertinent to the instrument were implemented.

Note that some of the error messages do not contain descriptions or help messages. These error numbers are reserved for future expansion. This document is subject to further change and development.

Standards related information

Further information on the Standard Commands for Programmable Instruments (SCPI) standard is available from the SCPI consortium.

Contact:

Fred Bode, Executive Director
SCPI Consortium
8380 Hercules Drive, Suite P3
La Mesa, CA 91942
Phone: (619) 697-8790
FAX: (619) 697-5955
CompuServe Number: 76516,254
Fbode@vxinl.com

For more detailed information on the IEEE 488.2 Standard, order a reference copy.

Contact:

The Institute of Electrical and Electronics Engineers, Inc.
345 East 47th Street
New York, New York 10017-2394
Phone: (800) 678-IEEE (US) 8 a.m. – 4:30 p.m. (EST)
(908) 981-1393 (International)
Fax: (908) 981-9667

Standard SCPI errors (–1 to –999)

All positive numbers are instrument-dependent. All negative numbers are reserved by the SCPI standard with certain standard error/event codes described in this document. The value, zero, is also reserved to indicate that no error or event has occurred.

Error/event numbers

The system-defined error/event numbers are chosen on an enumerated ("1 of N") basis. The SCPI-defined error/event numbers and the <error/event description> portions of the full queue item are listed here. The first error/event described in each class (for example, –100, –200, –300, –400) is a "generic" error. In selecting the proper Error/event number to report, more specific error/event codes are preferred, and the generic error/event is used only if the others are inappropriate.

Command errors

An <error/event number> in the range [–199 , –100] indicates that an IEEE 488.2 syntax error has been detected by the instrument's parser. The occurrence of any error in this class shall cause the command error bit (bit 5) in the event status register (IEEE 488.2, section 11.5.1) to be set.

One of the following events has occurred:

- An IEEE 488.2 syntax error has been detected by the parser. That is, a controller-to-device message was received which is in violation of the IEEE 488.2 standard. Possible violations include a data element which violates the device

listening formats or whose type is unacceptable to the device.

- An unrecognized header was received. Unrecognized headers include incorrect device-specific headers and incorrect or unimplemented IEEE 488.2 common commands.
- A Group Execute Trigger (GET) was entered into the input buffer inside of an IEEE 488.2 <PROGRAM MESSAGE>.

  Events that generate command errors shall not generate execution errors, device-specific errors, or query errors; see the other error definitions in this chapter.

Table 5-1. Command Errors (1 of 4)

Error Number	Error Description [description/explanation/examples]
–101	desc = “Invalid character” help = “” [A syntactic element contains a character which is invalid for that type; for example, a header containing an ampersand, SETUP&. This error might be used in place of errors –114, –121, –141, and perhaps some others.]
–102	desc = “Syntax error” help = “” [An unrecognized command or data type was encountered for example, a sting was received when the instrument does not accept strings.]
–103	desc = “Invalid separator” help = “” [The parser was expecting a separator and encountered an illegal character; for example, the semicolon was omitted after a program message unit, *EMC 1:CH1:VOLTS 5.]
–104	desc = “Wrong Parameter Type” help = “” [The parser recognized a data element different than one allowed; for example, numeric or string data was expected but block data was encountered.]
–105	desc = “GET not allowed” help = “” [A Group Execute Trigger was received within a program message (see IEEE 488.2, 7.7).]

Table 5-1. Command Errors (2 of 4)

Error Number	Error Description [description/explanation/examples]
–108	desc = "Parameter not allowed" help = "" [More parameters were received than expected for the header; for example, the *EMC common command only accepts one parameter, so receiving *EMC 0,1 is not allowed.]
–109	desc = "Missing parameter" help = "" [Fewer parameters were received than required for the header; for example, the *EMC common command requires one parameter, so receiving *EMC is not allowed.]
–112	desc = "Program mnemonic too long" help = "" [The header contains more that twelve characters (see IEEE 488.2, 7.6.1.4.1).]
–113	desc = "Undefined header" help = "" [The header is syntactically correct, but it is undefined for this specific device; for example, *XYZ is not defined for any device.]
–120	desc = "Numeric Data Error" help = " [This error, as well as errors –121 through –129, are generated when parsing a data element which appears to be numeric, including the non-decimal numeric types. This particular error message should be used if the device cannot detect a more specific error.]
–121	desc = "Invalid character in number" help = "" [An invalid character for the data type being parsed was encountered; for example, an alpha in a decimal numeric or a "9" in octal data.]
–123	desc = "Exponent too large" help = "" [The magnitude of the exponent was larger than 32000 (see IEEE 488.2, 7.7.2.4.1).]
–124	desc = "Too many digits" help = "" [The mantissa of a decimal numeric data element contained more than 255 digits excluding leading zeros (see IEEE 488.2, 7.7.2.4.1).]

Table 5-1. Command Errors (3 of 4)

Error Number	Error Description [description/explanation/examples]
–128	desc = “Numeric data not allowed” help = “” [A legal numeric data element was received, but the device does not accept one in this position for the header.]
–131	desc = “Invalid suffix” help = “” The suffix does not follow the syntax described in IEEE 488.2, 7.7.3.2, or the suffix is inappropriate for this device.]
–134	desc = “Suffix too long” help = “” [The suffix contained more than 12 characters (see IEEE 488.2, 7.7.3.4).]
–138	desc = “Suffix not allowed” help = “” [A suffix was encountered after a numeric element which does not allow suffixes.]
–148	desc = “Character data not allowed” help = “” [A legal character data element was encountered where prohibited by the device.]
–150	desc = “String data error” help = “” [This error, as well as errors –151 through –159, are generated when parsing a string data element. This particular error message should be used if the device cannot detect a more specific error.]
–151	desc = “Invalid string data” help = “” A string data element was expected, but was invalid for some reason (see IEEE 488.2, 7.7.5.2); for example, an END message was received before the terminal quote character.]
–158	desc = “String data not allowed” help = “” [A string data element was encountered but was not allowed by the device at this point in parsing.]

Table 5-1. Command Errors (4 of 4)

Error Number	Error Description [description/explanation/examples]
–161	desc = "Invalid block data" help = "" [A block data element was expected, but was invalid for some reason (see IEEE 488.2, 7.7.6.2); for example, an END message was received before the length was satisfied.]
–168	desc = "Block data not allowed" help = "" [A legal block data element was encountered but was not allowed by the device at this point in parsing.]
–170	desc = "Expression error" help = "" [This error, as well as errors –171 through –179, are generated when parsing an expression data element. This particular error message should be used if the device cannot detect a more specific error.]
–171	desc = "Invalid expression" help = "" [The expression data element was invalid (see IEEE 488.2, 7.7.7.2); for example, unmatched parentheses or an illegal character.]
–178	desc = "Expression data not allowed" help = "" [A legal expression data was encountered but was not allowed by the device at this point in parsing.]
–181	desc = "Invalid outside macro definition" help = "" [Indicates that a macro parameter placeholder ($<number) was encountered outside of a macro definition.]
–183	desc = "Invalid inside macro definition" help = "" Indicates that the program message unit sequence, sent with a *DDT or *DMC command, is syntactically invalid (see IEEE 488.2, 10.7.6.3).]

Execution errors

An <error/event number> in the range [–299 , –200] indicates that an error has been detected by the instrument's execution control block. The occurrence of any error in this class shall cause the execution error bit (bit 4) in the event status register (IEEE 488.2, section 11.5.1) to be set.

One of the following events has occurred:

- A <PROGRAM DATA> element following a header was evaluated by the device as outside of its legal input range or is otherwise inconsistent with the device's capabilities.
- A valid program message could not be properly executed due to some device condition.

Execution errors shall be reported by the device after rounding and expression evaluation operations have taken place. Rounding a numeric data element, for example, shall not be reported as an execution error. Events that generate execution errors shall not generate Command Errors, device-specific errors, or Query Errors; see the other error definitions in this section.

Table 5-2. Execution Errors (1 of 3)

Error Number	Error Description [description/explanation/examples]
–200	desc = "Execution error" help = "" [This is the generic syntax error for devices that cannot detect more specific errors. This code indicates only that an Execution Error as defined in IEEE 488.2, 11.5.1.1.5 has occurred.]
–213	desc = "INIT:IMM command ignored" help = "An initiate immediate remote command was received. The instrument was in continuous sweep mode when the command was received. The remote command is ignored unless the instrument is in single sweep mode. To select single sweep mode use the INIT:CONT OFF command."
–221	desc = "Settings Conflict Error" help = "A request was made but the instrument settings resulting from the request are in conflict with each other." [Indicates that a legal program data element was parsed but could not be executed due to the current device state (see IEEE 488.2, 6.4.5.3 and 11.5.1.1.5.)]

Table 5-2. Execution Errors (2 of 3)

Error Number	Error Description [description/explanation/examples]
–222	desc = "Data out of range" help = "A numeric value was entered which is outside the legal range of values for the parameter. The name of the parameter is listed at the end of the error message." [Indicates that a legal program data element was parsed but could not be executed because the interpreted value was outside the legal range as defined by the device (see IEEE 488.2, 11.5.1.1.5.)]
–222	desc = "Span out of range" help = "A numeric value was entered which is outside the legal range of values for the span setting. This occurs if the value is too large less than zero or between zero and 0.2nm. Zero span may not be entered by using the DOWN arrow key from 0.2nm; a numeric value of zero must be entered instead." [Indicates that a legal program data element was parsed but could not be executed because the interpreted value was outside the legal range as defined by the device (see IEEE 488.2, 11.5.1.1.5.)]
–223	desc = "Too much data" help = "" [Indicates that a legal program data element of block, expression, or string type was received that contained more data than the device could handle due to memory or related device-specific requirements.]
–224	desc = "Illegal parameter value" help = "" [Used where exact value, from a list of possibles, was expected.]
–257	desc = "File name error" help = "" [Indicates that a legal program command or query could not be executed because the file name on the device media was in error; for example, an attempt was made to copy to a duplicate file name. The definition of what constitutes a file name error is device-specific.]
–272	desc = "Macro Exec Error" help = "" [Indicates that a syntactically legal macro program data sequence could not be executed due to some error in the macro definition (see IEEE 488.2, 10.7.6.3.)]

Table 5-2. Execution Errors (3 of 3)

Error Number	Error Description [description/explanation/examples]
–273	desc = "Illegal macro label" help = "" [Indicates that the macro label defined in the *DMC command was a legal string syntax, but could not be accepted by the device (see IEEE 488.2, 10.7.3 and 10.7.6.2); for example, the label was too long, the same as a common command header, or contained invalid header
–276	desc = "Macro recursion error" help = "" [Indicates that a syntactically legal macro program data sequence could not be executed because the device found it to be recursive (see IEEE 488.2, 10.7.6.6).]
–277	desc = "Macro redefinition not allowed" help = "" [Indicates that a syntactically legal macro label in the *DMC command could not be executed because the macro label was already defined (see IEEE 488.2, 10.7.6.4).]
–278	desc = "Macro header not found" help = "" [Indicates that a syntactically legal macro label in the *GMC? query could not be executed because the header was not previously defined.]

Device-specific errors

An <error/event number> in the range [–399, –300] or [1, 32767] indicates the instrument has detected an error which is not a command error, a query error, or an execution error; some device operations did not properly complete, possibly due to an abnormal hardware or firmware condition. These codes are also used for self-test response errors. The occurrence of any error in this class should cause the device-specific error bit (bit 3) in the event status register (IEEE 488.2, section 11.5.1) to be set. The meaning of positive error codes is device-dependent and may be enumerated or bit mapped; the <error message> string for positive error codes is not defined by SCPI and available to the device designer. Note that the string is not optional; if the designer does not wish to implement a string for a particular error, the null string should be sent (for example, 42,""). The occurrence of any error in this class should cause the device-specific error bit (bit 3) in the event status register (IEEE

488.2, section 11.5.1) to be set. Events that generate device-specific errors shall not generate command errors, execution errors, or query errors; see the other error definitions in this section.

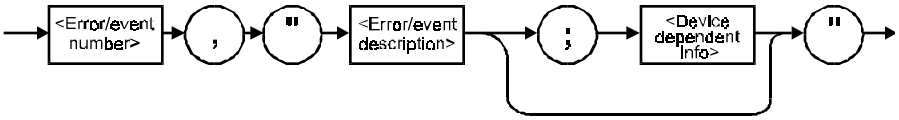


Table 5-3. Device-Specific Errors

Error Number	Error Description [description/explanation/examples]
–310	desc = "System error" help = "" [Indicates that some error, termed "system error" by the device, has occurred. This code is device-dependent.]
–321	desc = "Out of memory" help = "" [An internal operation needed more memory than was available.]

Query errors

An <error/event number> in the range [–499, –400] indicates that the output queue control of the instrument has detected a problem with the message exchange protocol described in IEEE 488.2, chapter 6. The occurrence of any error in this class shall cause the query error bit (bit 2) in the event status register (IEEE 488.2, section 11.5.1) to be set. These errors correspond to message exchange protocol errors described in IEEE 488.2, section 6.5.

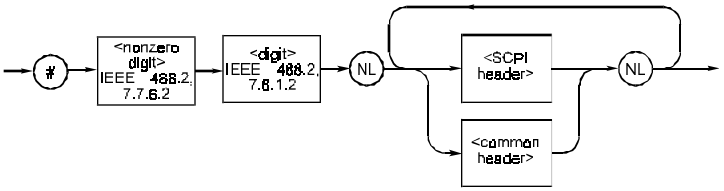
One of the following is true:

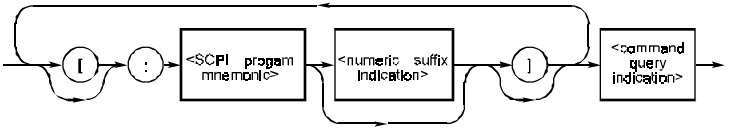
- An attempt is being made to read data from the output queue when no output is either present or pending.
- Data in the output queue has been lost.

Events that generate query errors will not generate command errors, execution errors, or device-specific errors; see the other error definitions in this section.

Table 5-4. Query Errors

Error Number	Error Description [description/explanation/examples]
–400	Query error [This is the generic query error for devices that cannot detect more specific errors. This code indicates only that a Query Error as defined in IEEE 488.2, 11.5.1.1.7 and 6.3 has occurred.]
–410	Query INTERRUPTED [Indicates that a condition causing an INTERRUPTED Query error occurred (see IEEE 488.2, 6.3.2.3); for example, a query followed by DAB or GET before a response was completely sent.]
–420	Query UNTERMINATED [Indicates that a condition causing an UNTERMINATED Query error occurred (see IEEE 488.2, 6.3.2.2); for example, the device was addressed to talk and an incomplete program message was received.]
–430	Query DEADLOCKED [Indicates that a condition causing an DEADLOCKED Query error occurred (see IEEE 488.2, 6.3.1.7); for example, both input buffer and output buffer are full and the device cannot continue.]
–440	Query UNTERMINATED after indefinite response [Indicates that a query was received in the same program message after an query requesting an indefinite response was executed (see IEEE 488.2, 6.5.7.5).]





OSA Notices

System control-related error messages or warnings

The OSA system changed a setting and generated a warning that the operation was performed.

Table 5-5. System Control Errors or Warnings

Error Number	Error Description [description/explanation/examples]
1000	desc = "Sensitivity forced to Auto" help = "Sensitivity has been forced to the Auto setting because another instrument setting was made which does not permit sensitivity to be in the Manual setting."
1001	desc = "Old Mezzanine board in system" help = "This OSA has an old mezzanine board installed. It is not necessary to upgrade the mezzanine board but the software will not be able to correctly determine which light source options are available."
1002	desc = "No Delta Marker Amplitude for" help = "The delta marker amplitude display has been turned off due to a units mismatch. The amplitude units of the reference marker are different than those of the delta marker. Values in differing units cannot be compared."
1003	desc = "Trace length increased" help = "Trace length has been increased because the wavelength limit function was turned off. The minimum trace length is larger when the wavelength limit function is off and trace length was below the new minimum value."
2999	desc = "The Notices list has overflowed" help = "The Notices list has overflowed. The last entries received have been deleted."

OSA Warnings

Table 5-6. OSA Warnings (1 of 11)

Error Number	Error Description [description/explanation/examples]
5000	desc = "AutoMeasure cannot find an input signal" help = "The auto-measure procedure cannot find a usable input signal. Make sure you have a signal connected to the optical input. Auto-measure will not work with very small input signals. They must be measured manually."
5001	desc = "AutoAlign cannot find an input signal" help = "The auto-align procedure cannot find a usable input signal. Make sure you have a signal connected to the optical input."
5002	desc = "Cal aborted: there is no active marker" help = "A wavelength calibration using the wavelength of the active marker was requested. The calibration cannot be made because all markers are turned off. Place a marker on the calibration signal and try again."
5003	desc = "Cal aborted: trace resolution is inadequate" help = "A wavelength calibration using the wavelength of the active marker was requested. The calibration cannot be done because the resolution of the marker's trace is inadequate. Trace resolution is defined as wavelength span divided by (trace points – 1) and must be less than 10pm. This problem can be corrected by one or more of the following steps: 1. Reduce wavelength span 2. Increase number of trace points"
5004	desc = "Cal aborted: wavelength correction too large" help = "A wavelength calibration was requested. The calibration was aborted since the correction needed is larger than 2nm. Make sure you have the correct index of refraction set. If the wavelength error is still this large the OSA may need to be serviced. The wavelength calibration function is not intended to apply large arbitrary offsets. Use the wavelength offset function for this purpose."

Table 5-6. OSA Warnings (2 of 11)

Error Number	Error Description [description/explanation/examples]
5005	desc = "Cal aborted: amplitude correction too large" help = "An amplitude calibration was requested. The calibration was aborted since the correction needed is more than +3dB or less than –10dB. Make sure you have done an Auto-Align prior to calibration. If the amplitude error is still this large the OSA may need to be serviced. The amplitude calibration function is not intended to apply large arbitrary offsets. Use the amplitude offset function for this purpose."
5006	desc = "Cal aborted: cannot find an input signal" help = "The calibration procedure cannot find an input signal close enough to the wavelength and/or amplitude specified. Make sure the wavelength and/or amplitude specified for calibration are correct and verify that an input signal of the correct wavelength and/or amplitude is connected to the optical input."
5007	desc = "Calibration aborted: signal disappeared" help = "The calibration procedure found a signal which subsequently disappeared. Make sure the calibration signal is connected to the optical input and try again."
5008	desc = "Calibration was not successful" help = "The requested calibration procedure did not complete successfully. Verify the instrument setup and the presence of a valid calibration signal. This problem can sometimes be caused by removing or changing the amplitude of the calibration signal during the calibration procedure. In rare cases this error can occur after the OSA has received a severe mechanical shock. Try running AutoAlign"
5009	desc = "I/O error" help = "An error occurred while processing an input/output request"
5010	desc = "The floppy disk is full" help = "There is not enough free space left on the floppy disk to contain the new file(s). Either make room on the existing floppy by deleting unwanted files or try a different floppy disk."
5011	desc = "There is no disk in the floppy disk drive" help = "An operation was requested which uses the floppy disk. There is no disk detected in the floppy disk drive. If there is a disk in the drive it may be of a format which cannot be read. This problem can be fixed by inserting a disk in the floppy disk drive or replacing the current disk with one which is properly formatted."

Table 5-6. OSA Warnings (3 of 11)

Error Number	Error Description [description/explanation/examples]
5012	desc = "The floppy disk is not formatted" help = "An operation was requested which uses the floppy disk. The disk currently in the drive does not appear to be formatted. Use the format utility to format the disk or replace it with a formatted disk."
5013	desc = "The floppy disk is write protected" help = "An operation was requested which writes to the floppy disk. The disk currently in the drive is write-protected. Turn off write protection on the current floppy disk or replace it with another disk."
5014	desc = "The internal memory is full" help = "An operation was requested which uses internal memory. There is not enough free space left in internal memory for this operation. You must make room by deleting one or more files."
5015	desc = "Up/down keys will not alter the span when it is zero" help = "The up/down step keys may not be used to alter the span setting when it is zero. A non-zero numeric value must be entered for span in order to leave zero span mode."
5016	desc = "Incompatible measurement file" help = "An attempt was made to recall a measurement file which is incompatible with the current version of software."
5017	desc = "The requested file does not exist" help = "An attempt was made to access a file which does not exist. Check the spelling of the file name against the listing of available files."
5020–5030	desc = "I/O Error" help "An unexpected error occurred during the I/O operation. Please try the operation again. If the operation involves the floppy disk drive, try a different floppy disk. If the error persists, please make a note of the error number and contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices.
5031	desc = "Could not initialize floppy" help => "A request was made to initialize a floppy disk. The operation did not succeed. Check to see that there is a floppy disk inserted in the drive and that the disk is not write protected. This can also be caused by a defective floppy disk."

Table 5-6. OSA Warnings (4 of 11)

Error Number	Error Description [description/explanation/examples]
5032–5043	desc = "I/O Error" help "An unexpected error occurred during the I/O operation. Please try the operation again. If the operation involves the floppy disk drive, try a different floppy disk. If the error persists, please make a note of the error number and contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices.
5044	desc = "Please cycle power to synchronize system time" help = "The system time clock has been set backwards. Due to internal system requirements it is necessary to cycle power before continuing. Please turn power off and back on again. This must be done to ensure proper system operation."
5045	desc = "Sweep limit markers too close together" help = "The sweep limit function is on and the line markers are too close together. The OSA cannot limit the sweep range to such a small value. The current sweep may be using a wider range than requested. Move the line markers farther apart or turn off sweep limit to resolve this problem."
5046	desc = "AutoAlign cannot find input signal at marker" help = "The auto-align procedure could not find a usable input signal. If there is an active marker auto-align will attempt to align at the marker wavelength without searching for a signal peak. This error can also occur if the input signal amplitude is very low or if the OSA has received a large mechanical shock or if the input signal is removed after the auto-align procedure has begun. Be sure a signal is connected to the optical input. If there is an active marker make sure it is placed on the input signal or turn off all markers."
5047	desc = "Signal disappeared during AutoAlign" help = "The auto-align procedure did not complete. The input signal disappeared during the auto-align procedure. Make sure the input signal is connected to the optical input and try again."
5048	desc = "Wrong trace X axis units for peak to center" help = "The peak-to-center function was requested. This function will only execute if the active trace X axis has units of meters (um nm pm). Change the active trace to one with an X axis in meters or re-measure the active trace in a non-zero span."

Table 5-6. OSA Warnings (5 of 11)

Error Number	Error Description [description/explanation/examples]
5049	desc = "Wrong marker X axis units for active trace" help = "The active marker cannot be placed on the active trace because the desired X axis units do not match the X axis units of the active trace. This is normally caused by recalling a wavelength trace in zero span or a zero span trace in a wavelength span. It can also be caused by loading a trace with conflicting units by remote control."
5050	desc = "Trace not displayed: wrong X axis units" help = "View has been turned on for this trace but it cannot be displayed. The X axis units in the trace do not match the X axis units being displayed. This is normally caused by trying to view a wavelength trace in zero span or a zero span trace in a wavelength span. It can also be caused by loading a trace with conflicting units by remote control."
5051	desc = "AutoMeasure cannot find input signal at marker" help = "The auto-measure function was requested. The auto-measure at marker option was enabled but the active marker was not placed on a valid signal. A valid signal was found but the active marker is too far from that signal. To correct this problem place the marker on the desired signal turn off all markers or disable the auto-measure at marker function."
5052	desc = "Sweep time auto is not allowed in zero span" help = "The sweep time function was requested to switch from manual to auto while in zero span. Automatic sweep time coupling cannot be done in zero span. The desired sweep time must be set explicitly."
5053	desc = "Noise marker not allowed." help = "A request was made to enable the noise marker readout. The readout cannot be enabled for one of the following reasons. Noise markers cannot be used on traces which have X axis units other than meters. This typically occurs in zero span where the X axis units are seconds. Noise markers cannot be used on traces which have Y axis units other than power. This typically happens when trace math is on and the trace Y axis represents a ratio."
5054	desc = "Bandwidth markers are not allowed in zero span" help = "A request was made to enable the bandwidth marker readout while the OSA was in zero span. Bandwidth markers are not permitted when span is set to zero. If a bandwidth marker readout is required set span to a value greater than zero."

Table 5-6. OSA Warnings (6 of 11)

Error Number	Error Description [description/explanation/examples]
5055	desc = "Firmware Upgrade was not successful" help => "A firmware upgrade operation was requested. The firmware upgrade operation cannot be done at this time due to an internal software problem. " + <-.serviceCenterHelp
5056	desc = "Trajectory align cannot find input signal" help = "The trajectory align procedure cannot find a usable input signal. Make sure you have a signal connected to the optical input."
5057	desc = "Invalid settings for trajectory align" help = "The external trajectory align function was requested. It cannot be executed because the start and/or stop wavelength settings are invalid. Start and stop wavelengths must be between 600nm and 1700nm. In addition the difference between start and stop wavelengths (span) must be greater than 25nm. To correct this problem adjust the start and/or stop wavelength settings to be valid."
5058	desc = "Out of memory" help = "The OSA has run out of execution memory. An internal function was aborted due to lack of execution memory. The correction for this problem is to cycle power."
5059	desc = "Trajectory align: marginal input signal" help = "The trajectory align procedure was aborted due to an input signal with marginal amplitude. The input signal was large enough when the function began it's operation but later became too small. This usually happens when the signal is on the edge of being too small. To correct this problem increase the input signal level. If this is not possible then a slight increase in signal level can sometimes be achieved by cleaning optical fiber connectors."
5060	desc = "Trajectory align failed" help = "The trajectory align procedure failed. The trajectory adjustments computed were invalid. This is usually occurs after the OSA has received a large mechanical shock. To correct this problem try the trajectory align procedure again. If the error persists, contact the HP support center nearest your location."
5061	desc = "Invalid marker trace" help = "The marker could not be positioned. The marker is on a trace which does not contain any valid data. This is sometimes caused by a trace math result which is invalid."

Table 5-6. OSA Warnings (7 of 11)

Error Number	Error Description [description/explanation/examples]
5062	desc = "ADC Triggered Sweep Too Fast" help = "A sweep was taken with one of the ADC trigger modes enabled. The sweep rate was too fast to allow trace data to be acquired for every wavelength. To resolve this problem increase sweep time or increase the frequency the external trigger input signal."
5063	desc = "Key disabled during applications" help = "The key you pressed is not active while an application is running. Exiting the application should re-enable the key."
5064	desc = "Invalid measurement file" help = "An attempt was made to recall a measurement file which is contains invalid or corrupt data."
5065	desc = "Error detected in DSP sub-system" help = " The Digital Signal Processor has reported an unexpected error. Please record the hexadecimal number listed with the error and cycle power. If the error persists, contact the HP support center nearest your location."
6700	desc = "Math expression input parameter undefined." help = "A math expression could not be evaluated because one or more input arguments are undefined. Please check the spelling of all input arguments."
6701	desc = "Math expression input parameter has error." help = "A math expression could not be evaluated because an error is present on one or more of the input arguments. The error must be cleared before the expression can be evaluated."
6702	desc = "Math expression parameter has zero length." help = "A math expression could not be evaluated because one or more input arguments has a zero length. This is often caused when the subset of a trace contains no points such as when advanced line marker functions are turned on and the line markers are too close together. It can also be caused when peak/pit searches find no peaks or pits."
6720	desc = "Math expression input parameter has error." help = "A math expression could not be evaluated because of improper input arguments. This could be due to one or more input arguments having the wrong type or size or because one or more inputs are not defined."
6721	desc = "Internal error in marker search" help => "A marker search function has failed due to an internal software problem. Please try the operation again. If the error persists, contact the HP support center nearest your location."

Table 5-6. OSA Warnings (8 of 11)

Error Number	Error Description [description/explanation/examples]
6722	desc = "Math expression input cannot be boolean." help = "A math expression could not be evaluated because one or more of the input arguments is boolean. This function does not allow boolean input arguments."
6723	desc = "Trace X axis values do not match." help = "A math expression could not be evaluated because the input arguments have differing X axis values. This function requires that all input arguments have identical X axis values. All trace inputs must be taken with identical start/stop settings."
6724	desc = "Error in source trace" help => "The source trace has an error. The error may possibly be that the source trace contains no points. Please try the operation again. If the error persists, contact the HP support center nearest your location."
6725	desc = "Trace lengths do not match." help = "A math expression could not be evaluated because the inputs have differing sizes (trace lengths). All inputs to this function must be of the same size."
6726	desc = "Trace lengths do not match." help = "A math expression could not be evaluated because the inputs have differing sizes (trace lengths). All inputs to this function must be of the same size."
6727	desc = "Y axis counts do not match." help = "A math expression could not be evaluated because the inputs have differing numbers of Y axis data. All input arguments to this function must have the same number of Y axis data points."
6728	desc = "Incorrect number of inputs for math expression" help = "A math expression could not be evaluated because the number of input arguments to the function is incorrect."
6729	desc = "Math expression expects units of dBm." help = "A math expression could not be evaluated because the input argument does not have the required Y axis units of dBm."
6730	desc = "Math expression expects units of watts." help = "A math expression could not be evaluated because the input argument does not have the required Y axis units of watts."

Table 5-6. OSA Warnings (9 of 11)

Error Number	Error Description [description/explanation/examples]
6731	desc = "Illegal combination of trace Y axis units" help = "A math expression could not be evaluated because the combination of Y axis units in the input arguments do not make sense. For example it is valid to divide watts by watts or to divide watts by a unitless value but it is invalid to divide a unitless value by watts."
6732	desc = "Illegal combination of trace X axis units" help = "A math expression could not be evaluated because the input arguments have differing X axis units. All input arguments must have identical X axis units. This commonly happens when trace math is attempted between a zero span trace (time units) and a non-zero span trace (wavelength units)."
6733	desc = "Invalid combination of Y axis units" help = "A math expression could not be evaluated because of an invalid combination of Y axis units. The math operation being performed only allows one of the arguments to have units. All other arguments must be unitless. The math operator is shown in parenthesis in the short message above. For example multiplying a trace in watts (dBm) by another trace in watts (dBm) is not permitted."
6734	desc = "Too many inputs have Y axis units" help = "A math expression could not be evaluated because of an invalid combination of inputs. Only one input argument is allowed to have non-blank Y axis units."
6735	desc = "Trace has too many Y axes" help = "A math expression could not be evaluated because of an invalid input. One of the arguments contains multiple sets of Y data. Only one set of Y data is allowed for this math function."
6736	desc = "Math expression expects boolean inputs." help = "A math expression could not be evaluated because of an invalid input. The math function requires all of it's arguments to be boolean. At least one of the arguments is not boolean."
6737	desc = "Invalid math constant" help = "During evaluation of a math expression an invalid constant was encountered. The constant has undefined or default settings for it's X and/or Y values."
6738	desc = "Out of memory" help = "A trace or math operation was requested. There is insufficient memory available to perform the operation. Try reducing trace length or cycle power."

Table 5-6. OSA Warnings (10 of 11)

Error Number	Error Description [description/explanation/examples]
6739	desc = "Too many peaks or pits" help = "A marker search operation was requested. There are too many valid pits or peaks in the current trace. Reduce the number of valid pits or peaks by increasing the peak or pit excursion setting."
6741	desc = "Constant with multiple Y values" help = "During evaluation of a math expression a constant was encountered which contains more than one Y value. Constants are only permitted to have one Y value."
6742	desc = "Requested amplitude not found" help = "A math expression to search for a specific amplitude in a trace did not succeed. There are no trace points with the desired amplitude."
6744	desc = "Excursion should be in dB" help = "The units for the excursion are not in dB."
6745	desc = "Log of a negative number is not allowed." help = "During evaluation of a math expression the logarithm of a negative number was encountered."
6746	desc = "Math expression contains a circular reference." help = "A new math expression was entered. The expression was rejected because it would create a circular reference. For example if trace math for trace C is set to (A-B) then setting trace math for trace B to (C+D) would create a circular reference."
6747	desc = "Next peak not found" help = "A next-peak search was requested. There are no more peaks on the current marker's trace in the requested direction. To find additional peaks reduce the marker peak excursion setting or adjust sensitivity."
6748	desc = "Next pit not found" help = "A next-pit search was requested. There are no more pits on the current marker's trace in the requested direction. To find additional pits reduce the marker pit excursion setting or adjust sensitivity."
6749	desc = "Peak not found" help = "A peak search was requested. There are no valid peaks on the current marker's trace. Try decreasing the marker peak excursion setting or adjust the sensitivity setting."

Table 5-6. OSA Warnings (11 of 11)

Error Number	Error Description [description/explanation/examples]
6750	desc = "Pit not found" help = "A pit search was requested. There are no valid pits on the current marker's trace. Try decreasing the marker pit excursion setting or adjust the sensitivity setting."
6751	desc = "Trace has no centroid" help = "The trace has no centroid. This may occur because the sum of trace points' amplitudes is zero or there a no trace points."
6752	desc = "The reference point is outside trace bounds" help = "The reference point's wavelength is either too small or too large. The reference point will be clipped to a trace endpoint."
6753	desc = "The window specified is invalid." help = "The window specified is invalid. The window should be a constant."
6754	desc = "Search failed: no data" help = "A marker search operation was requested. After clipping the trace data to screen limits and line marker limits (if enabled) there was no data to search. This can be caused when all trace data points are beyond current X axis screen limits or when there are no trace data points between the line markers. Trace data values which exceed the current Y axis screen limits will not cause this problem. Adjust the current X axis screen limits and/or move the line markers to include at least one trace data point."
6755	desc = "Attempt to divide by 0" help = "At least one point was attempted to be divided by 0. The result for these divisions has been set to not-a-number. Please realize that further calculations with not-a-number values are undefined."
6756	desc = "Syntax error; bad token: " help = "The grammar expression entered cannot be parsed. Please check the string entered. The bad token attempts to indicate where the error occurred. The end of line indicates that the OSA expected more information. Please consult the manual for additional help."
7998	desc = "Unknown error detected" help = "An unlisted error was reported by the instrument software. If this error persists contact Hewlett-Packard for assistance."
7999	desc = "The warning list has overflowed" help = "The Warning list has overflowed. The last entries received have been deleted."

Application-Specific Warnings

Table 5-7. Application-Specific Warnings (1 of 6)

Error Number	Error Description [description/explanation/examples]
8001	desc = "Incorrect application type is listed in spec file." help = "The application expects the first non-comment line of the specification file to contain the APPLICATION keyword followed by the application type. Either the APPLICATION keyword was missing or the wrong application type was specified for this particular application."
8002	desc = "A keyword cannot be used as a variable name." help = "The application has a list of keywords reserved for specification file use. These reserved words cannot be used as a name for one of the measurement parameters."
8003	desc = "The variable name has already been used." help = "The application allows new names to be assigned to measurement parameters. Once assigned these names can only be used as inputs to other measurements. Only the first ten characters are significant. The line number indicates where the problem was found. The word in the parentheses is the variable name causing the problem."
8004	desc = "Wrong number of input parameters." help = "The wrong number of inputs were found for a specification file command. The line number listed is where the problem was found in the specification file. The first number in parentheses is the number of inputs found and the second number is the number of inputs required."
8005	desc = "An input parameter has the wrong units." help = "One of the input parameters to the specification file has the wrong units specified. The line number listed is where the problem was found in the specification file. The first units listed in the parentheses was the units used by the parameter and the second units is the units required by the parameter. An empty pair of quotes '' indicates unitless."

Table 5-7. Application-Specific Warnings (2 of 6)

Error Number	Error Description [description/explanation/examples]
8006	desc = "The specification file cannot be imported." help = "An error occurred while trying to import the specification file. Refer to the previous warnings for more information on specific errors in the specification file."
8007	desc = "The specification file has a syntax error." help = "One of the specification file lines has a syntax problem. The problem occurred on the line number listed. The string in the parentheses caused the problem."
8008	desc = "A variable was used where a constant is expected." help = "A variable name was used as a parameter where only a constant value or the DEFAULT keyword is allowed. The line number indicates where the problem was found. The variable name in the parentheses caused the problem."
8009	desc = "The variable name has not been defined." help = "An undefined variable name was used as a parameter for a specification. All variables used as parameters must be defined in a specification statement preceding the variable's use. The line number indicates where the problem was found. The variable name in the parentheses is the undefined variable."
8010	desc = "A variable can be used only once per statement." help = "A variable name was used as multiple parameters for the same specification statement. The input parameter was ignored because using multiple references is not allowed. The line number indicates where the problem was found. The variable name in the parentheses is the variable causing the problem."
8011	desc = "A keyword was used where a variable is expected." help = "The application specification file has a list of reserved words which are used to specify the measurements to be made. These keywords cannot be used as input parameters for specification statements. The input parameter was ignored for this case. The line number indicates where the problem was found. The word in the parentheses is the reserved word causing the problem."
8012	desc = "A label is required to identify the spec file." help = "The label string is used to identify the specification file. It is required after specifying the application type. An empty string (pair of double quotes) is acceptable input."
8013	desc = "The specification file cannot be exported." help = "An error occurred while trying to export the specification file."

Table 5-7. Application-Specific Warnings (3 of 6)

Error Number	Error Description [description/explanation/examples]
8014	desc = "Print statement ignored: no path is specified" help = "The PRINT statement needs to be after a PATH statement to indicate which PATH data is to be printed. The PRINT statement at the line number specified came before any PATH statement. This PRINT statement will not trigger any printouts."
8015	desc = "DEFAULT cannot be used for a parameter." help = "A parameter cannot be specified as DEFAULT. The parameter needs to be either a previously defined variable name or an actual value. The bad parameter was found on the line number specified. The number in the parentheses is the number of the parameter causing the problem."
8016	desc = "A duplicate command is in the spec file." help = "Certain commands should be used only once in the specification file. The duplicate command was found on the line number specified. The command in the parentheses is the duplicate."
8017	desc = "A required command is missing from the spec file." help = "Certain commands must be used in the specification file. The missing command is listed in the parentheses. This command should be used only once in the file."
8018	desc = "The normalization interval limited to maximum." help = "The normalization interval has a maximum value of 24 and a minimum value of 0.1 hours. The interval specified in the specification file is outside this range. The specification file can still be used but the calibration interval will be 24 hours."
8019	desc = "The spec file could not be loaded." help = "The application found a problem with the specification file. Possible causes can include the following: the file is incompatible with the application the file is from a previous version of the application the file was corrupted. The file with the problem is specified within the parentheses. Try re-importing the specification file."
8020	desc = "The default spec file was loaded." help = "The default specification file for the application was loaded. This is done when the application is first started or if a problem occurred when trying to load another specification file. Refer to the previous warnings for information on any problems loading another file."

Table 5-7. Application-Specific Warnings (4 of 6)

Error Number	Error Description [description/explanation/examples]
8021	desc = "The spec file could not be found." help = "The application tried to load a specification file which could not be found in the internal memory. This may have occurred if the last file used by the application was deleted. The filename is specified within the parentheses."
8022	desc = "A closing quote is missing." help = "The specification file contained a line with an opening quote but no closing quote could be found."
8023	desc = "A default path name was used." help = "The imported specification file was given a default path name. All specification files must have at least one PATH statement before any of the measurement statements. A default path name was used either because some measurement statements were used before a PATH statement or there was no PATH statement at all in the file."
8024	desc = "A variable is expected." help = "The statement expected a variable as an input parameter. The line number indicates which statement did not have the proper input parameter type."
8025	desc = "The path name has already been used." help = "The application allows new names to be assigned to measurement paths. Once assigned these names can no longer be used by other measurement paths. Only the first thirty-two characters are significant. The line number indicates where the problem was found. The word in the parentheses is the path name causing the problem."
8026	desc = "A path name was used where a variable is expected." help = "The input parameters for measurement statements can take variables as inputs. These variables are the results of other measurement statements. A path name is the name of a measurement path not the result of a measurement and cannot be used as an input parameter. The input parameter was ignored for this case. The line number indicates where the problem was found. The word in the parentheses is the path name causing the problem."
8027	desc = "A parameter value was outside the legal range." help = "A parameter value was used which was outside the allowable range. The first number in the parentheses is the number of the parameter causing the problem. The other two numbers are the minimum and maximum values allowed. These values are in base units (e.g meters watts)."

Table 5-7. Application-Specific Warnings (5 of 6)

Error Number	Error Description [description/explanation/examples]
8028	desc = "A minimum non-zero span is required." help = "The application cannot run in a zero span setting. The start and stop wavelength must be separated by a minimum span. The line number indicates the line in the specification file which had a start and stop wavelength pair that did not meed the minimum span requirement."
8029	desc = "The requested function is not yet implemented." help = "The statement within the specification file is not implemented in this version of the application. The word in parentheses has been reserved for future use. The statement at the specified line number needs to be removed before the specification file can be imported."
8030	desc = "A SETUP statement is needed before SWEEP." help = "The wavelength limits of the SWEEP statement are checked against the wavelength limits in the SETUP statement. This check requires that the SETUP statement occur before the SWEEP statement. The line number indicates which SWEEP statement is not preceded by the SETUP statement."
8031	desc = "The SWEEP limits are outside the SETUP range." help = "The start and stop values for the SWEEP statement must be within the start and stop values of the SETUP statement. The line number indicates which SWEEP statement has values out of range. The number in the parentheses indicates which parameter is out of range."
8032	desc = "The units of the inputs are not compatible." help = "The units of the inputs to a math operation need to be compatible with the operation desired. Addition and subtraction need to have matching units. Multiplication needs to have a unitless parameter. Division needs a unitless denominator or the units for the numerator and denominator need to match. The line number indicates which statement had the mismatched input units."
8033	desc = "The reference point is outside the SETUP range." help = "The reference point value must be within the start and stop values of the SETUP statement. The line number indicates which statement had the value out of range."
8034	desc = "The values are associated with different axes." help = "The variables used in a basic math operation like ADD or DIV must be associated with the same data axis (e.g. wavelength or amplitude). Mixing the axes values within a single math operation is not allowed. The line number indicates which statement had the incompatible variables."

Table 5-7. Application-Specific Warnings (6 of 6)

Error Number	Error Description [description/explanation/examples]
8035	desc = "The search limits are outside the SETUP range." help = "The search limits for statements like PEAK or CENTER_OF_MASS must be within the start and stop values of the SETUP statement. The line number indicates which statement has values out of range. The number in the parentheses indicates which parameter is out of range."
8036	desc = "The specification units do not match." help = "The units for the minimum and maximum specification values need to match. The line number indicates which statement has the mismatching units."
8037	desc = "The specification units do not match the input units." help = "The units for the minimum and maximum specification values need to match the units for the input parameters. The line number indicates which statement has the mismatching units."

OSA Status Errors

Table 5-8. OSA Status Errors

Error Number	Error Description [description/explanation/examples]
10000	desc = "Sweep Uncalibrated" help = "The current setting of sweep time may be too fast. This could result in an invalid measurement. In certain cases it is possible to sweep faster than the coupled sweep time without compromising measurement accuracy. Please refer to the users manual and relevant application notes for more information."
11998	desc = "Too Many Hardware Status Errors" help = "The Hardware Status Error list has overflowed. Additional more recent items have been deleted."

OSA Errors

Table 5-9. OSA Errors (1 of 2)

Error Number	Error Description [description/explanation/examples]
20001	desc = "Error detected in ADC sub-system" help = "An error has been detected in the Analog-to-Digital converter subsystem. Please record the hexadecimal number listed with the error and cycle power. If the error persists, contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices."
20002	desc = "Error detected in slit positioning system" help = "An error has been detected in the motor which controls the resolution bandwidth slit wheel. Please record the hexadecimal number listed with the error and cycle power. If the error persists, contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403- 0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices."
20003	desc = "Error detected in grating positioning system" help = "An error has been detected in the motor which controls the diffraction grating. Please record the hexadecimal number listed with the error and cycle power. If the error persists, contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices."
20004	desc = "Monochromator calibration data is invalid" help = "Factory calibration data for the monochromator is invalid. Please record the hexadecimal number listed with the error and cycle power. If the error persists, contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices."

Table 5-9. OSA Errors (2 of 2)

Error Number	Error Description [description/explanation/examples]
20005	desc = "Trans-Impedance calibration data is invalid" help = "Factory calibration data for the trans-impedance amplifier is invalid. Please record the hexadecimal number listed with the error and cycle power. If the error persists, contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices."
20006	desc = "Monochromator flatness calibration data is invalid" help = "Factory flatness data for the monochromator is invalid. Please record the hexadecimal number listed with the error and cycle power. If the error persists, contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices."
20007	desc = "Sweep Timeout" help = "A sweep was started but did not finish in the expected amount of time. The trace data acquired during this sweep may not be valid. Try taking another sweep. If the error persists, contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices."
21999	desc = "The Error list has overflowed" help = "The Error list has overflowed. The last entries received have been deleted."

Firmware Errors

Table 5-10. Firmware Errors

Error Number	Error Description [description/explanation/examples]
30000	desc = "Internal Communications Error" help = "An internal software error has occurred involving communications between different software processes. Please record this error including the extra text and cycle power. If the error persists, contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices."
30001	desc = "Auto-Measure Software Error" help = "An error has been detected in the auto-measure software. There is an internal problem with the software. Please make a note of the text in parentheses at the end of the error message and cycle power. If the error persists, contact the nearest Hewlett-Packard Instrument support center for assistance. In the U.S., call (800) 403-0801. See the *HP 86140 series Users Guide* for a listing of the HP sales and service offices."

6

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Reference

Options and Accessories

Table 6-1. Options and Accessories (1 of 2)

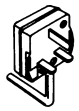
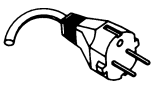
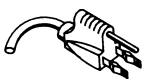
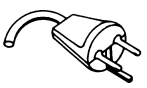
Option/HP Part Number	Description	HP 86140A	HP 86142A	HP 86143A	HP 86145A
004	Built-in 1300 nm/1550 nm EELED Source	✔	✔		
005	Built-in 1550 nm EELED Source	✔	✔		
006	Wavelength Calibration Source[a]	✔	✔	✔	✔
Certificate of Calibration (included)		✔	✔	✔	✔
Alternative Connector Interface:					
Standard	FC/PC	✔	✔	✔	✔
011	HMS-10	✔	✔	✔	✔
013	DIN	✔	✔	✔	✔
014	ST	✔	✔	✔	✔
017	SC	✔	✔	✔	✔
Additional Connector Interfaces			See HP 81000 series		
9270-1370	Printer paper (box of 5 rolls) [b]	✔	✔	✔	✔
C4735A	101/102 Keyboard (OSA requires US layout)	✔	✔	✔	✔
C3751B	PS/2 Style Mouse	✔	✔	✔	✔
Option 030	External 10 dB Attenuator (FC/PC)	✔	✔	✔	✔
Option AX4	Rackmount Flange Kit	✔	✔		
9211-2657	Transit Case	✔	✔		

Table 6-1. Options and Accessories (2 of 2)

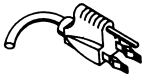
Option/HP Part Number	Description	HP 86140A	HP 86142A	HP 86143A	HP 86145A
9211-5604	Transit Case			✔	✔
Option 042	Soft Carrying Case			✔	✔
HP N1031A	BenchLink Software[c] (included)	✔	✔	✔	✔

a. Contact your local field representative for availability.
b. Always use HP paper. Use of other thermal paper may degrade image quality and damage the printer head.
c. HP N1031A BenchLink software allows transfer of measurement results over an HP-IB interface to a PC for the purposes of archiving, printing and further analysis.

AC Line-Power Cords

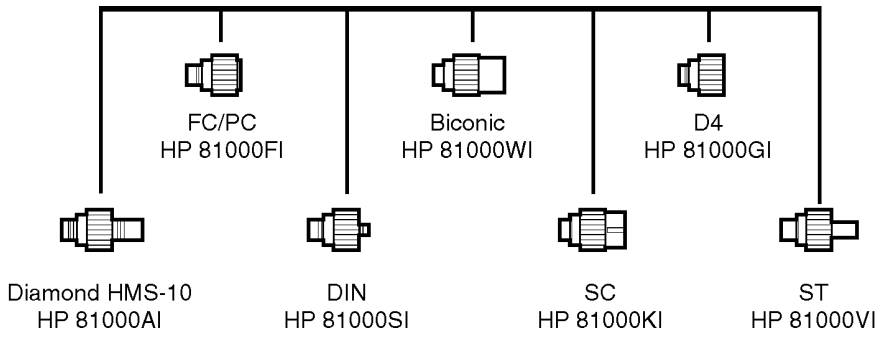
Plug Type		Cable Part No.	Plug Description	Length (in/cm)	Color	Country
250V		8120-1351 8120-1703	Straight *BS1363A 90°	90/228 90/228	Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
250V		8120-1369 8120-0696	Straight *NZSS198/ ASC 90°	79/200 87/221	Gray Mint Gray	Australia, New Zealand
250V		8120-1689 8120-1692 8120-2857p	Straight *CEE7-Y11 90° Straight (Shielded)	79/200 79/200 79/200	Mint Gray Mint Gray Coco Brown	East and West Europe, Saudi Arabia, So. Africa, India (unpolarized in many nations)
125V		8120-1378 8120-1521 8120-1992	Straight *NEMA5-15P 90° Straight (Medical) UL544	90/228 90/228 96/244	Jade Gray Jade Gray Black	United States, Canada, Mexico, Philippines, Taiwan
250V		8120-2104 8120-2296	Straight *SEV1011 1959-24507 Type 12 90°	79/200 79/200	Mint Gray Mint Gray	Switzerland
220V		8120-2956 8120-2957	Straight *DHCK107 90°	79/200 79/200	Mint Gray Mint Gray	Denmark
250V		8120-4211 8120-4600	Straight SABS164 90°	79/200 79/200	Jade Gray	Republic of South Africa India

* Part number shown for plug is the industry identifier for the plug only. Number shown for cable is the HP part number for the complete cable including the plug.

Plug Type	Cable Part No.	Plug Description	Length (in/cm)	Color	Country
100V 	8120-4753	Straight MITI	90/230	Dark Gray	Japan
	8120-4754	90°	90/230		

* Part number shown for plug is the industry identifier for the plug only. Number shown for cable is the HP part number for the complete cable including the plug.

Front-Panel Fiber-Optic Adapters



Printer Head Cleaning Procedure

Lint from normal use of the printer may eventually collect on the printer head and degrade print quality. Use the procedure provided in this section to clean the printer head.

WARNING **This servicing procedure is for use by qualified personnel only. To avoid electrical shock, do not perform this procedure unless you are qualified to do so.**

CAUTION Electrostatic discharge (ESD) can damage or destroy the printer. Therefore, this procedure must always be performed at a static-safe work station.

Static-safe Work Station

Figure 6-1 on page 6-8 shows an example of a static-safe work station using conductive table and floor mats and wrist and heel straps. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground. Refer to Table 6-2 for information on ordering static-safe accessories.

Table 6-2. Static-Safe Accessories

HP Part Number	Description
9300-0797	3M static control mat 0.6 m × 1.2 m (2 ft× 4 ft) and 4.6 cm (15 ft) ground wire. (The wrist-strap and wrist-strap cord are not included. They must be ordered separately.)
9300-0980	Wrist-strap cord 1.5 m (5 ft).
9300-1383	Wrist-strap, color black, stainless steel, without cord, has four adjustable links and a 7 mm post-type connection.
9300-1169	ESD heel-strap (reusable 6 to 12 months).

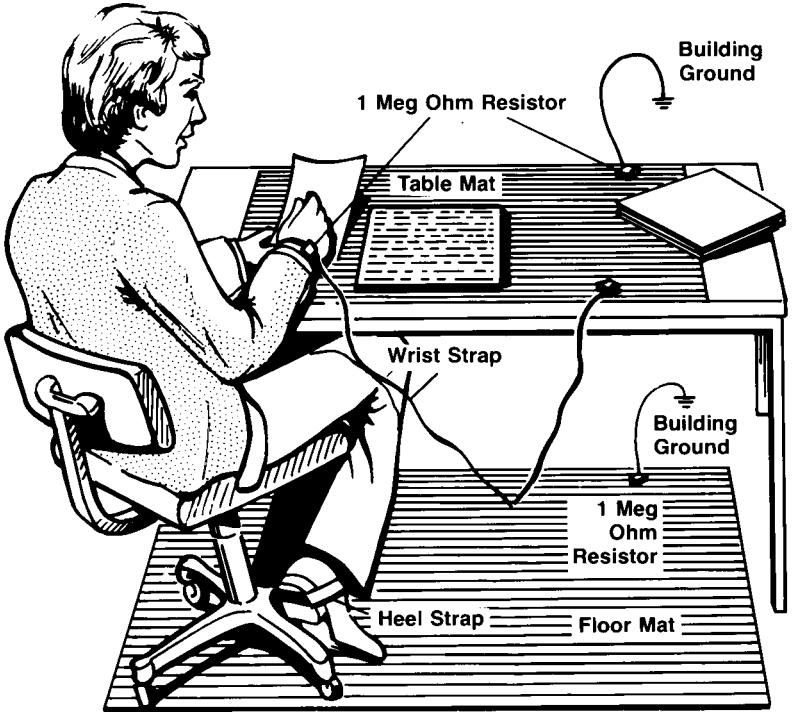


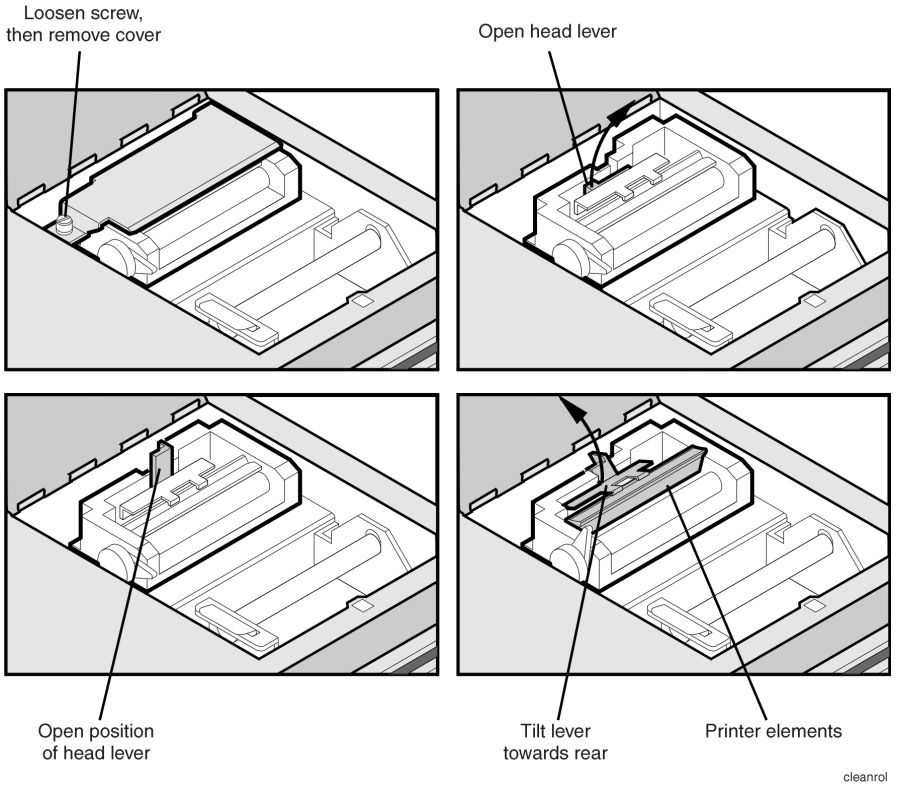
Figure 6-1. Example of a static-safe workstation

Procedure

1. Turn off the HP 86140-series optical spectrum analyzer, and remove the line power cord.
2. Place the instrument at a static-safe work station as described in the introduction to this procedure.
3. Use a coin or screwdriver to open the printer door that is located on the top of the instrument.

CAUTION Avoid dropping the coin or screwdriver, used to open the printer door, into the printer assembly.

4. Lift up the paper latch as shown in the following diagram, and remove the paper.



5 Unscrew the retaining screw that secures the sheet-metal cover that protects the printer head from electrostatic discharge. Slide the sheet-metal cover towards the retaining screw and then lift it straight up to remove.

6 Lift the printer head lever to the vertical position. Then, tilt the lever towards the instrument's rear panel to rotate the printer head up.

7 Clean the printer head using a cotton swab and isopropyl alcohol.

CAUTION Use of other cleaning materials or fluids may damage the printer.

8 After the printer head has thoroughly dried, use the printer head lever to return the printer head to its original position.

9 Replace and secure the sheet-metal cover for the printer head.

10 Replace the printer paper, and close the printer access door.

Cleaning Connections for Accurate Measurements

Advances in measurement capabilities make connectors and connection techniques more important than ever. Damage to the connectors on calibration and verification devices, test ports, cables, and other devices can increase downtime and expense.

Refer to “Cleaning Optical Connectors” on page 6-17 for suggestions which will help you get the best performance from your connectors.

Many times an instrument must be serviced to replace a damaged connector. Thousands of dollars and hours, or even days, of lost time can be avoided if better care is given to the fiber-optic connector. Observing the simple precautions presented in this section can help you avoid this expense. This section also contains a brief list of tips for caring for electrical connections.

What you’ll find in this section

Choosing the Right Connector 6-11
Inspecting Connectors 6-13
- Measuring insertion loss and return loss 6-16
- Visual inspection of fiber ends 6-17

Cleaning Optical Connectors 6-17
- Cleaning a non-lensed connector 6-18
- Cleaning an adapter 6-19

Choosing the Right Connector

A critical, but often overlooked, factor in making a good lightwave measurement is the selection and care of the fiber-optic connector. The differences in connector types are mainly in the mechanical assembly that holds the ferrule in position against another identical ferrule. Connectors also vary in the polish, curve, and concentricity of the core within the cladding. Mating one style of cable to another requires an adapter. Hewlett-Packard offers adapters for most instruments to allow testing with many different cables.

The system tolerance for reflection and insertion loss must be known when selecting a connector from the wide variety currently available. Some items to consider when selecting a connector are:

- How much insertion loss can be allowed?
- Will the connector need to make multiple connections? Some connectors are better than others, and some are very poor for making repeated connections.
- What is the reflection tolerance? Can the system take reflection degradation?
- Is an instrument-grade connector with a precision core alignment required?
- Is repeatability tolerance for reflection and loss important? Do your specifications take repeatability uncertainty into account?
- Will a connector degrade the return loss too much, or will a fusion splice be required? For example, many DFB lasers cannot operate with reflections from connectors. Often as much as 90 dB isolation is needed.

Over the last few years the FC/PC style connector has emerged as the most popular connector for fiber-optic applications. While not the highest performing connector, it represents a good compromise between performance, reliability, and cost. If properly maintained and cleaned, this connector can withstand many repeated connections.

However, many instrument specifications require tighter tolerances than most connectors, including the FC/PC can deliver. These instruments cannot tolerate connectors with the large non-concentricities of the fiber common with ceramic style ferrules. When tighter alignment is required, HP instruments typically use a connector such as the Diamond HMS-10, which has concentric tolerances within a few tenths of a micron. HP then uses a special universal adapter which allow other cable types to mate with this precision connector.



Universal adapters to Diamond HMS_10.

The HMS-10 encases the fiber within a soft nickel silver (CuNiZn) center which is surrounded by a tough tungsten carbide casing, as shown in Figure 6-2.

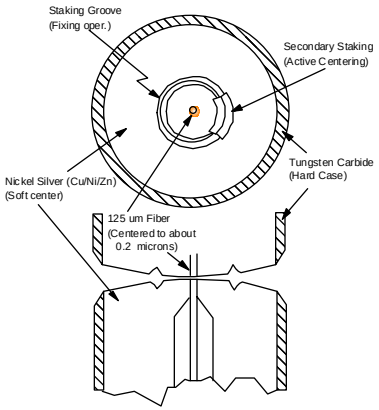


Figure 6-2. Cross-section of the Diamond HMS-10 connector.

The nickel silver allows an active centering process that permits the glass fiber to be moved to the desired position. This process first stakes the nickel silver to fix the fiber in a near-center position., then uses a post-active staking to shift the fiber into the desired position within 0.2 µm. This process, plus the keyed axis, allows very precise core-to-core alignments. This connector is found on most HP lightwave instruments.

The soft core, while allowing precise centering, is also the chief liability of this connector. The soft material is easily damaged. Care must be taken to minimize excessive scratching and wear. While minor wear is not a problem if the glass face is not affected, scratches or grit can cause the glass fiber to move out of alignment. Also, if unkeyed connectors are used, the nickel silver can be pushed onto the glass surface. Scratches, fiber movement, or glass contamination will cause loss of signal and increased reflections, resulting in poor return loss.

Inspecting Connectors

Because fiber-optic connectors are susceptible to damage that is not immediately obvious to the naked eye, bad measurements can be made without the user even being aware of a connector problem. Although microscopic examination and return loss measurements are the best way to ensure good connections, they are not always practical. An awareness of potential problems, along with good cleaning practices, can ensure that optimum connector performance is maintained. With glass-to-glass interfaces, it is clear that any degradation of a ferrule or fiber endface, any stray particles, or finger oil on the endface, can have a significant effect on connector performance. Many times an instrument must be serviced to replace a damaged connector when thousands of dollars and lost time could have been avoided if better care were given to the fiber-optic connector.

Figure 6-3 is a close-up micrograph of a clean cable endface. In contrast, Figure 6-4 shows a connector endface that was either not cleaned, or not properly cleaned. Material is smeared and ground into the endface causing light scattering and poor reflection. Not only is the precision polish lost, but this action can grind off the glass face and destroy the connector.

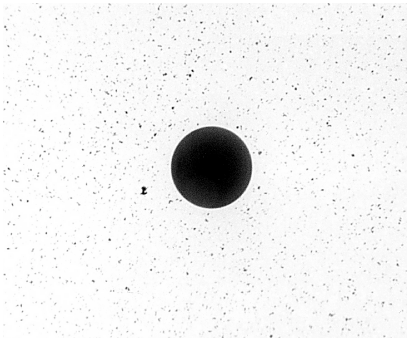


Figure 6-3. A clean and problem-free connector

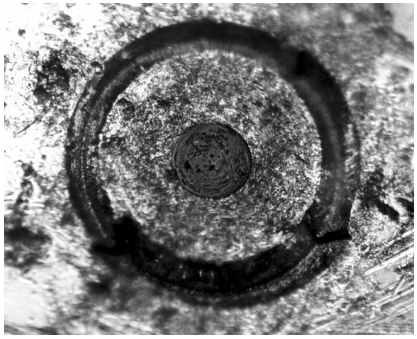


Figure 6-4. A dirty endface from poor cleaning

Repeated connections made without removing loose particles, or using improper cleaning tools can lead to physical damage of the glass fiber endface, as shown in Figure 6-4. When severe, the damage on one connector end can be transferred to another good connector that comes in contact with it.



Figure 6-5. A damaged fiber end from using an improper cleaning procedure

The cure for these problems is disciplined connector care. as described in the following list and in "Cleaning Connections for Accurate Measurements" on page 6-10.

Guidelines

Use the following guidelines to achieve the best possible performance when making measurements on a fiber-optic system:

- Keep connectors covered when not in use.
- Use dry connections whenever possible.
- Never use metal or sharp objects to clean the connector and never scrape the connector.
- Avoid matching gel and oils.

  While these often work well on first insertion, they are great dirt magnets. The oil or gel grabs and holds grit that is then ground into the fiber endface. Also, some early gels were designed for use with the FC, non-contacting connectors, using small glass spheres. When used with contacting connectors, these glass balls can scratch and pit the fiber. If an index matching gel or oil must be used, apply it to a freshly cleaned connector, make the measurement, and then immediately clean it off. Never use a gel for longer-term connections and never use it to improve a damaged connector. The gel can mask the extent of damage and continued use of a damaged fiber can transfer damage to the instrument.
- When inserting a fiber-optic cable into a connector or adapter, gently insert it in as straight a line as possible. Make sure the fiber end does not touch the outside of the mating connector or adapter. Tipping and inserting at an angle can scrape material off the inside of the connector or even break the inside sleeve of connectors made with ceramic material.
- Avoid over tightening connections.

  Unlike common electrical connections, tighter is *not* better. The purpose of the connector is to bring the endfaces of two fibers together. Once they touch, tightening only causes a greater force to be applied to the delicate endfaces. With some connectors, the end can set itself off-axis with a tight connection, due to the curved face, resulting in misalignment and excessive return loss. Many measurements are actually improved by backing off the connector pressure. Also, if a piece of grit does happen to get by the cleaning procedure, the tighter connection is more likely to damage the glass. Tighten the connectors just until the two fibers touch.
- Keep connections covered when not in use.

- Use fusion splices on the more permanent critical nodes. Choose the best connector possible. Replace connecting cables regularly. Frequently measure the return loss of the connector to check for degradation, and clean *every* connector, *every* time.

  All connectors should be treated like the high-quality lens of a good camera. The weak link in instrument and system reliability is often the inappropriate use and care of the connector. Because current connectors are so easy to use, there tends to be reduced vigilance in connector care and cleaning. It takes only one missed cleaning for a piece of grit to permanently damage the glass and ruin the connector.

Measuring insertion loss and return loss

Consistent measurements with your lightwave equipment are a good indication that you have good connections. Since return loss and insertion loss are key factors in determining optical performance they can be used to determine connector degradation. A smooth, polished fiber end should produce a good return loss measurement. The quality of the polish establishes the difference between the “PC” (physical contact) and the “Super PC” connectors. Most connectors today are physical contact which make glass-to-glass connections, therefore it is critical that the area around the glass core be clean and free of scratches. Although the major area of a connector, excluding the glass, may show scratches and wear, if the glass has maintained its polished smoothness, the connector can still provide a good low level return loss connection.

If you test your cables and accessories for insertion loss and return loss upon receipt, and retain the measured data for comparison, in the future you will be able to tell if any degradation has occurred. Typical values are less than 0.5 dB of loss, and sometimes as little as 0.1 dB of loss with high performance connectors. Return loss is a measure of reflection: the less reflections the better. The larger the return loss, the smaller the reflection. The most physically contacting connectors have return losses better than 50 dB, although 30 to 40 dB is more common.

Visual inspection of fiber ends

Visual inspection of fiber ends can be helpful. Contamination or imperfections on the cable end can be detected, as well as cracks or chips in the fiber itself. Use a microscope with 100× to 200× magnification to inspect the entire end face for contamination, raised metal, or dents in the metal as well as any other imperfections. Inspect the fiber for cracks and chips. Visible imperfections not touching the fiber core may not affect performance, unless the imperfections keep the fibers from contacting.

Cleaning Optical Connectors

CAUTION

The connectors on the instrument are *not* easily cleaned. Before connecting cables to the lightwave instrument, it is *very* important they are cleaned following the procedures in this section.

The procedures in this section provide the proper steps for cleaning fiber-optic cables and HP universal adapters. The initial cleaning, using alcohol as a solvent, gently removes any grit and oil. If a caked-on layer of material is still present, this can happen if the beryllium-copper sides of the ferrule retainer get scraped and deposited on the end of the fiber during insertion of the cable, a second cleaning should be performed. It is not uncommon for a cable or connector to require more than one cleaning.

CAUTION

Hewlett-Packard strongly recommends that index matching compounds *not* be applied to their instruments and accessories. Some compounds, such as gels, may be difficult to remove and can contain damaging particulates. If you think the use of such compounds is necessary, refer to the compound manufacturer for information on application and cleaning procedures.

Table 6-3. Cleaning Accessories

Item	HP Part Number
Isopropyl alcohol	8500-5344
Cotton swabs	8520-0023
Small foam swabs	9300-1223
Compressed dust remover (non-residue)	8500-5262

Table 6-4. Dust Caps Available for Lightwave Instruments

Item	HP Part Number
Laser shutter cap	08145-64521
FC/PC dust cap	08154-44102
Biconic dust cap	08154-44105
DIN dust cap	5040-9364
HMS10/HP dust cap	5040-9361
ST dust cap	5040-9366

Cleaning a non-lensed connector

CAUTION Do not use any type of foam swab to clean optical fiber ends. Foam swabs can leave filmy deposits on fiber ends that can degrade performance.

1. Apply pure isopropyl alcohol to a clean lint-free cotton swab or lens paper.
2. Clean the ferrules and other parts of the connector while avoiding the end of the fiber.
3. Apply isopropyl alcohol to a new clean lint-free cotton swab or lens paper.
4. Clean the fiber end with the swab or lens paper.

   Do *not* scrub during this initial cleaning because grit can be caught in the swab and become a gouging element.

5 Immediately dry the fiber end with a clean, dry, lint-free cotton swab or lens paper.

6 Blow across the connector end face from a distance of 6 to 8 inches using filtered, dry, compressed air. Aim the compressed air at a shallow angle to the fiber end face.

Nitrogen gas or compressed dust remover can also be used.

CAUTION

Do not shake, tip, or invert compressed air canisters. This releases particles from the can into the air. Refer to the instructions on the compressed air canister.

7 As soon as the connector is dry, connect or cover it for later use.

If the performance after the initial cleaning seems poor, try cleaning the connector again. Often a second cleaning will restore proper performance. The second cleaning should be more arduous, with a scrubbing action.

Cleaning an adapter

The fiber-optic input and output connectors on many HP instruments employ a universal adapter such as those shown in the following picture. These adapters allow you to connect the instrument to different types of fiber-optic cables.



Figure 6-6. Universal adapters

1 Apply isopropyl alcohol to a clean foam swab.

Cotton swabs can be used as long as no cotton fibers remain after cleaning. The foam swabs listed in the introduction to this section are small enough to fit into adapters.

Although foam swabs can leave filmy deposits, these deposits are very thin, and the risk of other contamination buildup on the inside of the adapters greatly outweighs the risk of contamination by foam swabs.

2 Clean the adapter with the foam swab.

3 Dry the inside of the adapter with a clean, dry foam swab.

4 Blow through the adapter using filtered, dry, compressed air.

CAUTION Do not shake, tip, or invert compressed air canisters. This releases particles from the can into the air. Refer to the instructions on the compressed air canister.

Returning the Instrument for Service

The instructions in this section show you how to properly package the instrument for return to a Hewlett-Packard service office. For a list of offices, refer to "Hewlett-Packard Sales and Service Offices" on page 6-24.

If the instrument is still under warranty or is covered by an HP maintenance contract, it will be repaired under the terms of the warranty or contract (the warranty is at the front of this manual). If the instrument is no longer under warranty or is not covered by an HP maintenance plan, Hewlett-Packard will notify you of the cost of the repair after examining the unit.

When an instrument is returned to a Hewlett-Packard service office for servicing, it must be adequately packaged and have a complete description of the failure symptoms attached.

When describing the failure, please be as specific as possible about the nature of the problem. Include copies of additional failure information (such as the instrument failure settings, data related to instrument failure, and error messages) along with the original cal data disks and the instrument being returned.

Please notify the service office before returning your instrument for service. Any special arrangements for the instrument can be discussed at this time. This will help the HP service office repair and return your instrument as quickly as possible.

Preparing the instrument for shipping

1 Write a complete description of the failure and attach it to the instrument. Include any specific performance details related to the problem. The following

information should be returned with the instrument.

- Type of service required.
- Date instrument was returned for repair.
- Description of the problem:
  - Whether problem is constant or intermittent.
  - Whether instrument is temperature-sensitive.
  - Whether instrument is vibration-sensitive.
  - Instrument settings required to reproduce the problem.
  - Performance data.
- Company name and return address.
- Name and phone number of technical contact person.
- Model number of returned instrument.
- Full serial number of returned instrument.
- List of any accessories returned with instrument.
- The original cal data disks.

2 Cover all front or rear-panel connectors that were originally covered when you first received the instrument.

CAUTION Cover electrical connectors to protect sensitive components from electrostatic damage. Cover optical connectors to protect them from damage due to physical contact or dust.

CAUTION Instrument damage can result from using packaging materials other than the original materials. Never use styrene pellets as packaging material. They do not adequately cushion the instrument or prevent it from shifting in the carton. They may also cause instrument damage by generating static electricity.

3 Pack the instrument in the original shipping containers. Original materials are available through any Hewlett-Packard office. Or, use the following guidelines:

- Wrap the instrument in antistatic plastic to reduce the possibility of damage caused by electrostatic discharge.
- For instruments weighing less than 54 kg (120 lb), use a double-walled, corrugated cardboard carton of 159 kg (350 lb) test strength.
- The carton must be large enough to allow approximately 7 cm (3 inches) on all sides of the instrument for packing material, and strong enough to accommodate the weight of the instrument.
- Surround the equipment with approximately 7 cm (3 inches) of packing material, to protect the instrument and prevent it from moving in the carton. If packing foam is not available, the best alternative is S.D-240 Air Cap™ from

Sealed Air Corporation (Commerce, California 90001). Air Cap looks like a plastic sheet filled with air bubbles. Use the pink (antistatic) Air Cap™ to reduce static electricity. Wrapping the instrument several times in this material will protect the instrument and prevent it from moving in the carton.

4. Seal the carton with strong nylon adhesive tape.
5. Mark the carton “FRAGILE, HANDLE WITH CARE”.
6. Retain copies of all shipping papers.

Hewlett-Packard Sales and Service Offices

Before returning an instrument for service, call the HP Instrument Support Center at (800) 403-0801.

Hewlett-Packard Sales and Service Offices (1 of 2)

U.S. FIELD OPERATIONS

Headquarters
Hewlett-Packard Company
19320 Pruneridge Avenue
Cupertino, CA 95014 U.S.A.
(800) 752-0900

California, Northern
Hewlett-Packard Company
301 East Evelyn
Mountain View, CA 94041
(415) 694-2000

California, Southern
Hewlett-Packard Company
1421 South Manhatten Ave.
Fullerton, CA 92631
(714) 999-6700

Colorado
Hewlett-Packard Company
24 Inverness Place, East
Englewood, CO 80112
(303) 649-5000

Georgia
Hewlett-Packard Company
2000 South Park Place
Atlanta, GA 30339
(404) 955-1500

Illinois
Hewlett-Packard Company
5201 Tollview Drive
Rolling Meadows, IL 60008
(708) 342-2000

New Jersey
Hewlett-Packard Company
150 Green Pond Road, Dock 1
Rockaway, NJ 07866
(201) 586-5910

Texas
Hewlett-Packard Company
930 East Campbell Road
Richardson, TX 75081
(214) 231-6101

EUROPEAN FIELD OPERATIONS

Headquarters
Hewlett-Packard S.A.
150, Route du Nant-d'Avril
1217 Meyrin 2/Geneva Switzerland
(41 22) 780.8111

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Hewlett-Packard Strasse
61352 Bad Homburg Germany
(+49 6172) 16-0

Great Britain
Hewlett-Packard Ltd.
Eskdale Road, Winnersh Triangle
Wokingham, Berkshire RG11 5DZ

Hewlett-Packard Sales and Service Offices (2 of 2)

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Headquarters
Hewlett-Packard Company
3495 Deer Creek Rd.
Palo Alto, California 94304-1316
(415) 857-5027

Australia
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
(61 3) 895-2895

Canada
Hewlett-Packard Ltd.
17500 South Service Road
Trans-Canada Highway
Kirkland, Quebec H9J 2X8
Canada
(514) 697-4232

China
China Hewlett-Packard Company
38 Bei San Huan X1 Road
Shuang Yu Shu
Hai Dian District
Beijing, China
(86 1) 256-6888

Japan
Hackioji-Hewlett-Packard Ltd.
9-1 Takakura-Cho, Hachioji
Tokyo 192, Japan
(+81-26) 60-2111

Singapore
Hewlett-Packard Singapore Ltd.
Pte. Ltd.
Alexandra P.O. Box 87
Singapore 9115
(65) 271-9444

Taiwan
Hewlett-Packard Taiwan
8th Floor, H-P Building
337 Fu Hsing North Road
Taipei, Taiwan
(886 2) 712-0404

7

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Specifications and Regulatory Information

Specifications and Regulatory Information

This chapter contains specifications and characteristics for HP 86140 series optical spectrum analyzers.

The specifications in this chapter apply to all functions autocoupled over the temperature range 0°C to +55°C and relative humidity < 95% (unless otherwise noted). All specifications apply after the instrument's temperature has been stabilized after 1 hour continuous operation and the auto-align routine has been run. Unless otherwise noted, specifications apply without USER CAL.

Calibration Cycle

This instrument requires periodic verification of performance. The instrument should have a complete verification of specifications at least once every two years.

Definition of Terms

Characteristics and specifications

The distinction between specifications and *characteristics* is described as follows:

Specifications describe warranted performance.

Characteristics provide useful, but nonwarranted information about the functions and performance of the instrument. *Characteristics are printed in italics*.

Wavelength

Absolute Accuracy (after user cal) refers to the wavelength accuracy after the user has performed the internal wavelength calibration using a source of known wavelength.

Reproducibility refers to the amount of wavelength drift which can occur over the specified time while the OSA is swept across a source of known wavelength.

Tuning Repeatability refers to the wavelength accuracy of returning to a wavelength after having tuned to a different wavelength.

Resolution

FWHM refers to the Full-Width-Half-Maximum resolutions that are available. This indicates the width at half power level of the signal after passing through the resolution slits.

Amplitude

Sensitivity is defined as the signal level that is equal to six times the RMS value of the noise. Displayed sensitivity values are nominal. Slightly lower values may have to be entered to achieve specified sensitivity.

Scale Fidelity refers to the potential errors in amplitude readout at amplitudes other than at the calibration point. This specification is sometimes called linearity.

Flatness refers to the total amplitude flatness errors over the indicated wavelength range. (This error may be removed at a given wavelength by performing the user amplitude cal.)

Polarization Dependence refers to the amplitude change that can be seen by varying the polarization of the light entering the OSA. This is not to be confused with amplitude variations caused by the varying distribution of energy between the different modes in fiber that is multimode at the wavelength of interest.

Dynamic range

Dynamic Range is a measure of the ability to see low-level signals that are located very close (in wavelength) to a stronger signal. In electrical spectrum analyzers, this characteristic is generally called shape factor.

Sweep time

Maximum Sweep Rate refers to the maximum rate that the instrument is able to acquire data and display it. This rate may be limited by multiple internal processes.

Sweep Cycle Time refers to the time required to make a complete sweep and prepare for the next sweep. It can be measured as the time from the start of one sweep to the start of the next sweep.

Specifications

	HP 86140A and HP 86143A	HP 86142A and HP 86145A
WAVELENGTH		
Range	600 nm to 1700 nm	600 nm to 1700 nm
Span Range (continuously variable)	0.2 nm to full range and zero span	0.2 nm to full range and zero span
Accuracy		
After calibration with internal wavelength reference signal [a]	*±0.025 nm (1510–1570), ±0.035 nm (1570–1640)*	*±0.025 nm (1510–1570), ±0.035 nm (1570–1640)*
After user calibration within ±40 nm of calibration signal [a]	*±0.05 nm*	*±0.05 nm*
After user calibration over full wavelength range [a]	±0.2 nm	±0.2 nm
Absolute accuracy (2 year factory calibration cycle) [a]	±0.5 nm	±0.5 nm
Reproducibility, ≤ 1 minute [a]	±0.003 nm	±0.003 nm
Span Linearity [a,b]	±0.05 nm, for spans <40 nm	±0.05 nm, for spans < 40 nm
Span Linearity (1525 to 1570 nm) [a,b]	*±0.02 nm*	*±0.02 nm*
Tuning Repeatability [a]	±0.003 nm	±0.003 nm
RESOLUTION BANDWIDTH (RBW)		
FWHM (selectable) [a,c]	0.07, 0.1, 0.2, 0.5, 1, 2, 5, 10 nm	0.06, 0.1, 0.2, 0.5, 1, 2, 5, 10 nm
Corrected Resolution Bandwidth Accuracy (using noise markers)[a]		
≥0.5 nm, 1525 to 1610 nm	±4%	±3%
0.2 nm, 1525 to 1610 nm	±6%	±5%
0.1 nm, 1525 to 1610 nm	±12%	±10%

	HP 86140A and HP 86143A	HP 86142A and HP 86145A
AMPLITUDE		
Sensitivity [d]		
600 to 750 nm (no averaging required) [e]	–60 dBm	–60 dBm
750 to 900 nm (no averaging required) [e]	–75 dBm	–75 dBm
900 to 1250 nm (no averaging required) [e]	–75 dBm	–75 dBm
1250 to 1610 nm (no averaging required) [e]	–90 dBm	–90 dBm
1610 to 1700 nm (no averaging required) [b]	–80 dBm	–80 dBm
Maximum Measurement Power		
1525 to 1700 nm	*+15 dBm*	*+15 dBm*
600 to 1000 nm	*+15 dBm*	*+15 dBm*
1000 to 1525 nm	*+12 dBm*	*+12 dBm*
Maximum Safe Power		
Total Safe Power	+30 dBm	+30 dBm
Total Power, within any 10 nm portion of the spectrum	+23 dBm	+23 dBm
Calibration Accuracy at –20 dBm, 1310 nm/1550 nm [f]	±0.5 dB	±0.5 dB
Scale Fidelity		
Autorange off, ≤0 dBm [b,g]	±0.07 dB	±0.05 dB
Autorange on, ≤0 dBm [b,g]	±0.1 dB	±0.07 dB
Display Scale (log scale)	0.01 to 20 dB/Div, –120 to +90 dBm	0.01 to 20 dB/Div, –120 to +90 dBm
Amplitude Stability (1310 nm/1550 nm)	±0.01 dB at 1 min *±0.02 dB at 15 min.*	±0.01 dB at 1 min *±0.02 dB at 15 min.*
Flatness		
1290 to 1330 nm [a, f]	±0.2 dB	±0.2 dB
1525 to 1570 nm [a, f]	±0.2 dB	—
1525 to 1610 nm [a, f]	—	±0.2 dB
1250 to 1610 nm [a,h, f]	±0.7 dB	±0.7 dB
Polarization Dependence [a,i,j]		
1310 nm	±0.25 dB	±0.12 dB
1530 nm, 1565 nm	±0.2 dB	±0.05 dB
1600 nm	±0.25 dB	±0.08 dB
1250 to 1650 nm	±0.3 dB	±0.25 dB
1250 to 1650 nm (Option 025)	±0.4 dB	—

	HP 86140A and HP 86143A	HP 86142A and HP 86145A
DYNAMIC RANGE		
In 0.1 nm resolution [a,k]		
1250 to 1610 nm (chop mode on) at ±0.5 nm, ±1 nm, ±5 nm	*–70 dB*	*–70 dB*
1550 nm at ±0.8 nm (±100 GHz at 1550 nm)	–60 dB	–60 dB
1550 nm at ±0.5 nm (±62.5 GHz at 1550 nm)	–55 dB	–58 dB
1550 nm at ±0.4 nm (±50 GHz at 1550 nm)	–52 dB	–55 dB
1550 nm at ±0.2 nm (±25 GHz at 1550 nm)	—	*–40 dB*
MONOCHROMATOR INPUT		
Input Return Loss		
Straight connector (9/125 μm) [l]	>35 dB	>35 dB
PULSE MODE ACCURACY		
Turn On (≥ 2 μs after rising edge)	*< ±0.2 dB (starting from dark)*	*< ±0.2 dB (starting from dark)*
Turn Off (≥ 10 μs after falling edge)	*< ±0.2 dB*	< ±0.2 dB (30 dB extinction)
SWEEP		
Maximum Sweep Rate	*40 nm/50 ms*	
Maximum Sampling Rate in Zero Span	*50 μs/trace point*	
Sweep Cycle Time		
50 nm span, auto zero off	*<180 ms*	
50 nm span, auto zero on	*< 340 ms*	
100 nm span, auto zero on	*< 400 ms*	
Full span, auto zero on	*< 1 s*	
Sweep Cycle Time (30 nm span auto zero on)		
–80 dBm sensitivity [d]	*1.8 s*	
–90 dBm sensitivity [d]	*32 s*	
ADC Trigger Accuracy		
Jitter (distributed uniformly)	*<±0.5 μs*	
Trigger Delay range	*2 μs— 6.5 ms*	

	HP 86140A and HP 86143A	HP 86142A and HP 86145A
COMPUTER INTERFACING		
Remote Control		
Compatibility	IEEE-488.1, IEEE-488.2 (100%)	
Interfaces	HP-IB, Parallel Printer Port, External VGA Monitor, Keyboard (PS/2) and Mouse	
Floppy Disk	3.5 inch 1.44 MB, MS-DOS	
Data Export	Spreadsheet and Word Processor Compatible (CSV ASCII)	
Graphics Export	CGM	
Instrument Drivers	Universal Instrument Drivers (PNP), Compatible with HP VEE, Labview, Visual Basic and C++	

a. With applied input fiber 9/125 μm.
b. Temperature range 20° to 30°C.
c. Resolution of 10 nm is available in first order only.
d. Sensitivity is defined as signal value >6 × RMS noise value.
e. Temperature range 0° to 30°C.
f. For resolution ≥0.1 nm.
g. Excluding amplitude errors at low power levels due to noise.
h. Between 1350 nm and 1420 nm absorption of light by atmospheric moisture affects flatness.
i. For resolution ≥0.2 nm.
j. At room temperature.
k. Excluding multiple order grating response.
l. Depends on the quality of the attached connector.

General Specifications

	HP 86140A and HP 86142A Benchtop	HP 86143A and HP 86145A Portable
Dimensions	222 mm H × 425 mm W × 427 mm D (8.8 in × 16.8 in × 16.8 in)	163 mm H × 325 mm W × 427 mm D (6.4 in × 12.8 in × 16.8 in)
Weight	16.5 kg (36 lb)	14.5 kg (31 lb)
Environmental		
Temperature[a]	Operating: 0°C to 55°C; Storage: –40°C to 70°C	
Humidity	Operating: < 95% RH; Storage: Non-condensing	
Altitude	Up to 15,000 feet (4,572 meters)	
EMI	Conducted and radiated interference is in compliance with CISPR Publication 11, IEC 801-3, IEC 801-4, and IEC 555-2	
Power Requirements		
Voltage and Frequency	90 Vac to 260 Vac, 44 to 444 Hz	
Maximum Power Consumption	230 W	

a. Floppy disk and printer operating temperature range 0°C to 45°C.

Option 004/005 EELED Sources

	HP 86140A and HP 86142A
Minimum Spectral Power Density [a]	
1540 to 1560 nm (Option 005)	> –40 dBm/nm (100 nW/nm)
1470 to 1620 nm (Option 005)	*> –60 dBm/nm (1 nW/nm)*
1300 to 1320 nm (Option 004)	> –40 dBm/nm (100 nW/nm)
1540 to 1560 nm (Option 004)	> –40 dBm/nm (100 nW/nm)
1250 to 1620 nm (Option 004)	*> –60 dBm/nm (1 nW/nm)*
Return Loss	
With straight connector	*> 25 dB*
Stability (ambient temperature <±1°C)	
Over 15 minutes	*< ±0.02 dB*
Over 6 hours	*< ±0.05 dB*

a. Temperature range 0°C to 45°C.

Regulatory Information

- Laser Classification: This product contains an FDA Laser Class I (IEC Laser Class 1) laser.
- This product complies with 21 CFR 1040.10 and 1040.11.

Notice for Germany: Noise Declaration

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

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and EN 45014

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

Declares that the products

Product Name:	HP 86140A Series Optical Spectrum Analyzer
Model Number:	HP 86140A, HP 86142A, HP 86143A, HP 86145A
Product Options:	This declaration covers all options of the above products.

Conform to the following product specifications:

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

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

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 28 Oct. 1998

Greg Pfeiffer/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH Department HQ-TRE, Herreneberger Strasse 130, D71034 Boblingen, Germany (FAX +49-7031-14-3143)

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