# User's Manual

# AQ6375E
# Optical Spectrum Analyzer

Thank you for purchasing the AQ6375E Optical Spectrum Analyzer. This is an instrument that can quickly measure optical characteristics of devices, such as LD, LED light sources, and optical amplifiers. It also has a touch screen and a zoom feature to make it easier to use.

This user's manual explains the features, operating procedures, and handling precautions of the instrument. To ensure correct use, please read this manual thoroughly before operation. Keep this manual in a safe place for quick reference.

The manuals for this instrument are listed on the next page. Please read all manuals.

Contact information of Yokogawa offices worldwide is provided on the following sheet.

| Document No. | Description |
| --- | --- |
| PIM 113-01Z2 | List of worldwide contacts |

## Notes

- The contents of this manual are subject to change without prior notice as a result of improvements to the instrument's performance and functionality. Refer to our website to view our latest manuals.
- The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the contents of this manual without the permission of YOKOGAWA is strictly prohibited.

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## Revisions

- 1st Edition:     October 2022

# Manuals

The following manuals, including this one, are provided as manuals for this instrument. Please read all manuals.

| Manual title | Manual No. | Description |
|---|---|---|
| AQ6375E<br>Optical Spectrum Analyzer<br>User's Manual | IM AQ6375E-01EN | This document. The included CD contains PDF data. This manual explains how to operate this instrument. |
| AQ6375E<br>Optical Spectrum Analyzer<br>Getting Started Guide | IM AQ6375E-02EN | Provided as a printed manual.<br>This guide explains the handling precautions, common operations, troubleshooting measures, and specifications of this instrument. |
| AQ6375E<br>Optical Spectrum Analyzer<br>Remote Control User's Manual | IM AQ6375E-17EN | The included CD contains PDF data. This manual explains the instrument's remote control features, how to configure it, and the commands used to control this instrument from a PC through the interface. |
| Optical Spectrum Analyzer | IM AQ6360-92Z1 | Document for China |
| Safety Instruction Manual | IM 00C01C01-01Z1 | Safety manual (European languages) |

The "EN and "Z1" in the manual numbers are the language codes.

## Manuals in the CD

The included CD (manual CD) contains the following English and Japanese manuals.

| file name | Manual No. | Description |
|---|---|---|
| Features Guide & Users Manual.pdf | IM AQ6375E-01EN | User's Manual |
| Communication Interface.pdf | IM AQ6375E-17EN | Communication Interface User's Manual |

To view the PDF data, you need Adobe Acrobat Reader or a software application that can open PDF data.

## Online help

The User's Manual (IM AQ6375E-01EN) is incorporated in this instrument as help files. For instructions on how to use the help, see section 9.7 in the User's Manual, IM AQ6375E-01EN.

# Conventions Used in This Manual

## Prefixes k and K

Prefixes k and K used before units are distinguished as follows:

k: Denotes 1000. Example: 12 kg, 100 kHz

K: Denotes 1024. Example: 720 KB (file size)

## Displayed characters

Bold characters in procedural explanations are used to indicate panel keys that are used in the procedure and menu items that appear on the screen.

## Notes

The notes and cautions in this manual are categorized using the following symbols.

⚠ *Improper handling or use can lead to injury to the user or damage to the instrument.* This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

**WARNING** Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

**CAUTION** Calls attention to actions or conditions that could cause light injury to the user or damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

*Note* Calls attention to information that is important for the proper operation of the instrument.

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# 1.1 Measuring the Optical Spectrum

## Measurement range

Set the measurement wavelength (frequency and wavenumber) range as follows:

- Combination of the center wavelength (Center) and sweep span (Span)
- Combination of the measurement start wavelength (Start) and stop wavelength (Stop)
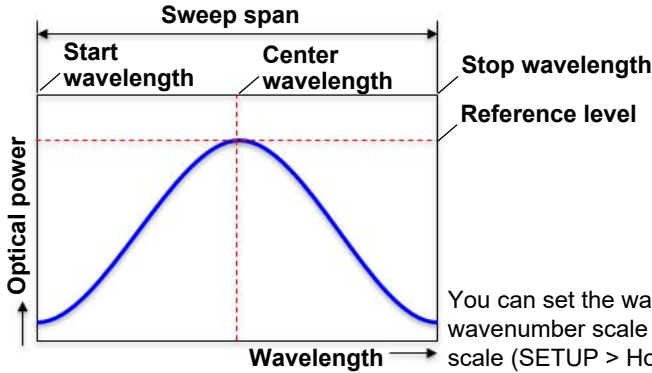


You can set the wavelength, frequency and wavenumber scale display using the horizontal scale (SETUP > Horizontal Scale) settings.
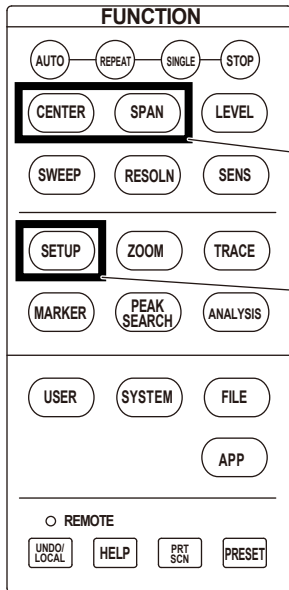


**CENTER**
Set the center wavelength, start wavelength, stop wavelength, etc.

**SPAN**
Set the sweep span, start wavelength, stop wavelength, etc.

**SETUP**
Set the wavelength, frequency and wavenumber scale, etc.

# Level scale

Set the level scale of the waveform display. The level scale unit can be switched between log scale (dBm) and linear scale (e.g., mW).
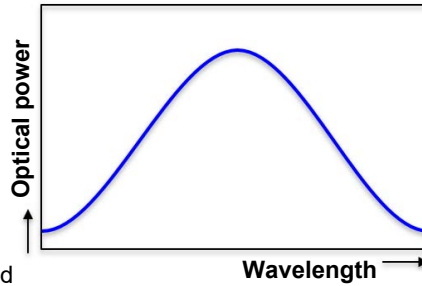
You can set the log and linear scale using the vertical scale (LEVEL) settings.
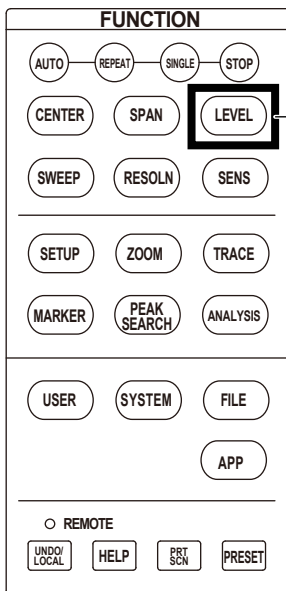
**LEVEL**
Set the reference level, log and linear scale, etc.

# Wavelength resolution

The wavelength resolution expresses the bandwidth of a monochromator's filter characteristics. It is defined as the wavelength span between two points 3 dB down from the peak wavelength of the spectrum when a narrow linewidth light source such as a gas laser is measured. You can select the resolution setting from the following available settings: 0.05 nm, 0.1 nm, 0.2 nm, 0.5 nm, 1 nm, and 2 nm.
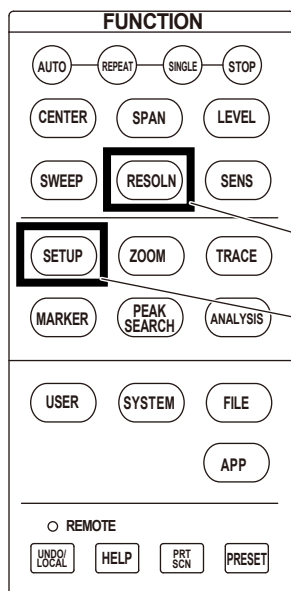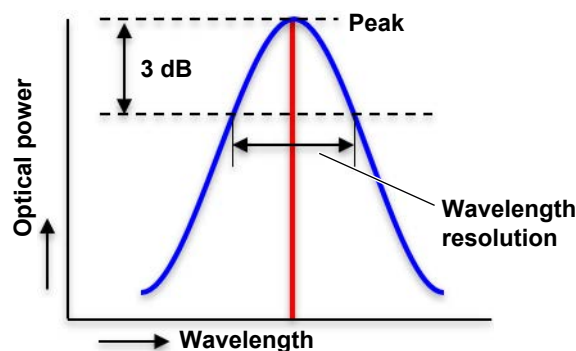


The RESOLN key is a shortcut key for displaying the Resolution menu of the SETUP menu. You can use either key to set the resolution.

**RESOLN**
Resolution setting

**SETUP -> Resolution**
Resolution setting

# Sampling points and sampling interval

Sampling points refer to the number of data points measured (sampled) within the set sweep span (span). You can set this value in the range of 101 to 200001 on this instrument. Sampling interval refers to the wavelength spacing of sampling data.

If you decrease the sampling points, you may be able to measure in a shorter time.
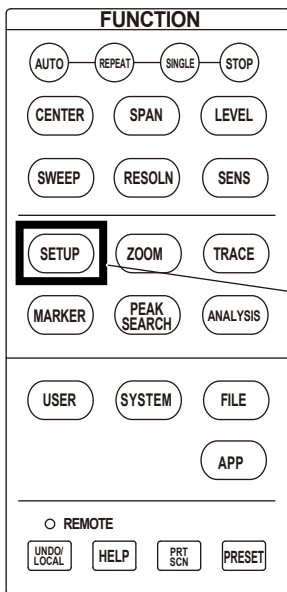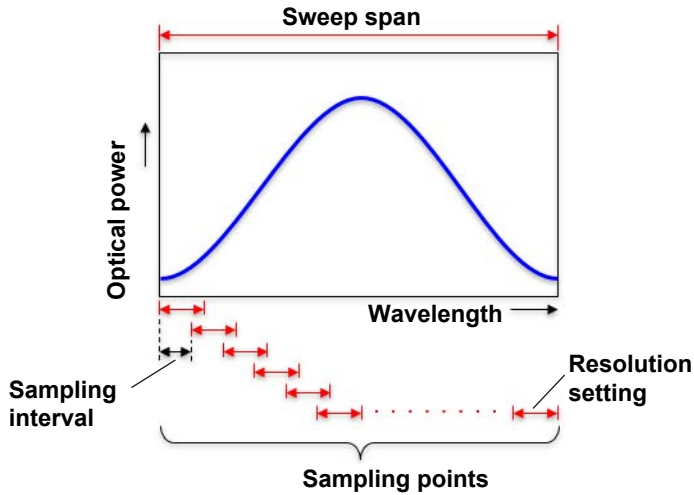




**SETUP**
Sampling points, sampling interval

## Note

If the sampling interval is large (the sampling points are small) relative to the set measurement resolution, the measured spectrum may become inaccurate, such as peaks missing from the spectrum.

In such cases, the letters "UNCAL" will appear in the waveform display area to indicate that the measurement conditions are inappropriate. In normal cases, set the sampling points to AUTO.

For details on UNCAL and sampling interval, see page 1-14.

# Measurement sensitivity

Select the sensitivity setting from seven levels: N/HOLD, N/AUTO, NORMAL, MID, HIGH1, HIGH2, and HIGH3.

If you select N/HOLD, the analog amplifier circuit is set to fixed gain. The gain is set based on the Reference Level setting in the LEVEL menu. If fixed gain is selected, there is a limit on the effective measurement range. The range is from "the reference level –20 dBm" to "the reference level +10 dBm."

If you select a setting other than N/HOLD, the analog amplifier circuit is set to auto gain. This mode allows a wider range of levels to be measured in a single sweep.

For all settings, you can select double speed mode, which measures at a sweep speed that is about twice as fast as usual. For sensitivities in double speed mode, "(x2)" is indicated in the sensitivity setting name such as MID(x2) and NORMAL(x2).

Double speed mode is suitable for measuring light sources such as LED light sources where the change in the spectral level is relatively gradual. It also has the following features.

• Double speed mode has a noise level about 2 dB higher than normal mode.

• If you use double speed mode under UNCAL conditions, for spectral waveforms that have sudden changes, such as those produced by a DFB-LD, the level and wavelength measurement accuracies may degrade. Use it after checking the measurement spectrum.

FUNCTION

AUTO — REPEAT — SINGLE — STOP

CENTER   SPAN   LEVEL

SWEEP   RESOLN   SENS

**SENS**
Measurement sensitivity

SETUP   ZOOM   TRACE

MARKER   PEAK SEARCH   ANALYSIS

**SETUP**
Measurement sensitivity

USER   SYSTEM   FILE

APP

○ REMOTE

UNDO/LOCAL   HELP   PRT SCN   PRESET
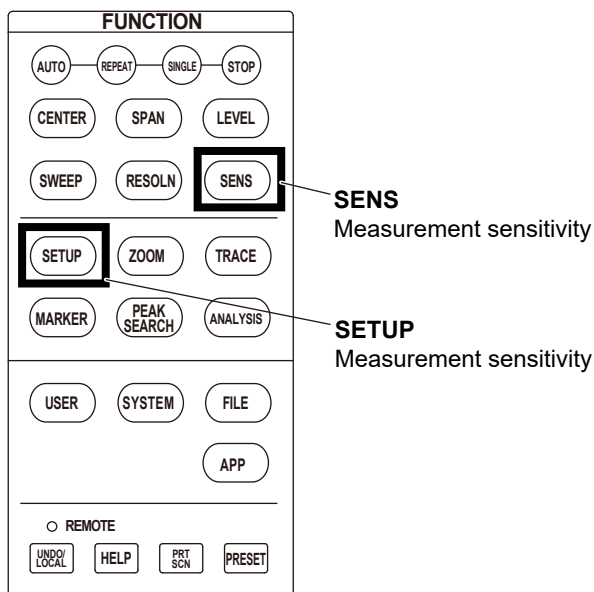
**Correlation diagram between measurement sensitivity and sweep speed**

| Sweep speed: normal | Sweep speed: normal x 2 |
|---|---|
| N/HOLD (Fixed gain) | N/HOLD(x2) |
| N/AUTO | N/AUTO(x2) |
| NORMAL | NORMAL(x2) |
| MID | MID(x2) |
| | |
| | HIGH1(x2) |
| HIGH1 | HIGH2(x2) |
| HIGH2 | HIGH3(x2) |
| HIGH3 | |

Low ← Measurement sensitivity → High

Fast ← Sweep speed → Slow
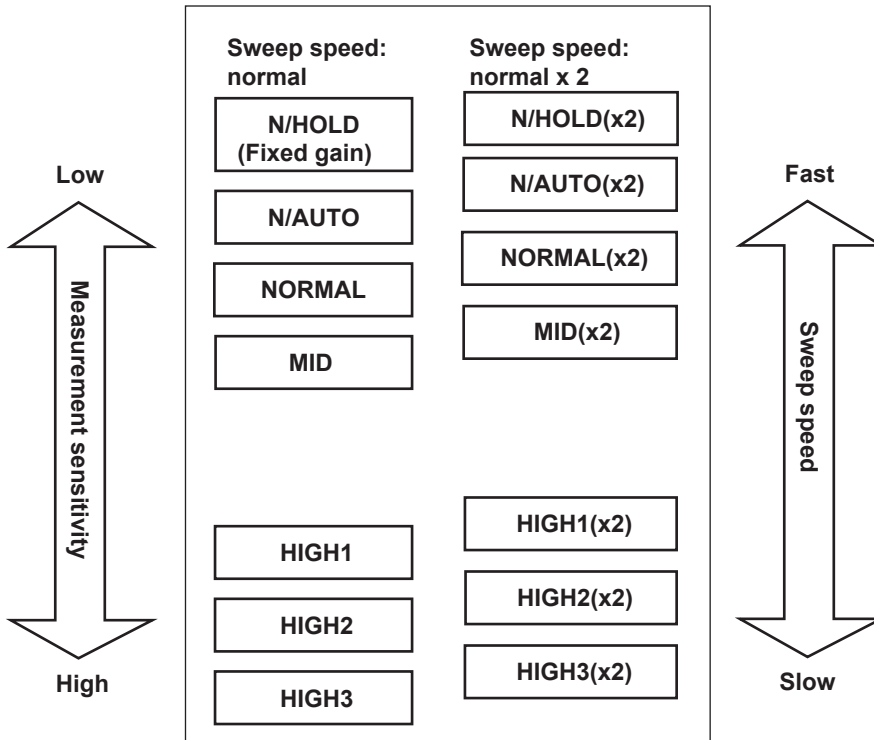
# Noise reduction

This instrument has two types of averaging functions that you can use: averaged measurement and roll-averaged measurement.

- Averaged measurement (Average Times)
- Roll-averaged measurement (Roll Average)

**Averaged measurement**

Sampling is performed multiple times at each sample point during sweeping, and spectral data is obtained from the average values. The average times value is set using Average Times on the SETUP menu.

Averaging cannot be selected when, on the SETUP menu, the measurement sensitivity is set to NORMAL(x2).

**Sampling interval**

Optical power ↑

Wavelength →

Averages the specified number of times and then moves to the next sampling position
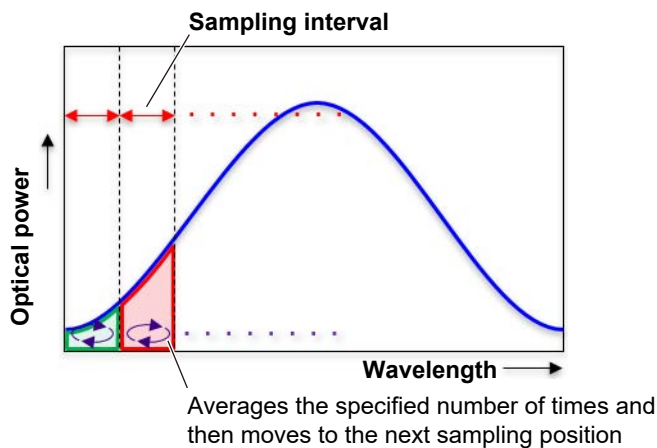
**Roll-averaged measurement**

In roll-averaged measurement, the set measurement range (SPAN) is swept multiple times. Each sweep is averaged with the previous measurement data to update the waveform.

Roll-averaged measurement is set using Roll Average on the TRACE menu.
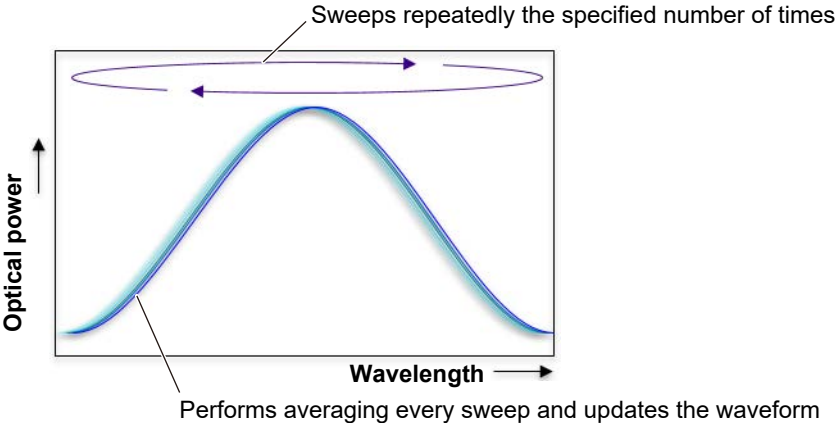
Sweeps repeatedly the specified number of times



Performs averaging every sweep and updates the waveform



**TRACE->Roll Average**
Rolling average

**SETUP->Average Times**
Average times

## Starting a measurement (sweep)

When you start a measurement, the instrument sweeps the set measurement range and measures the spectrum.
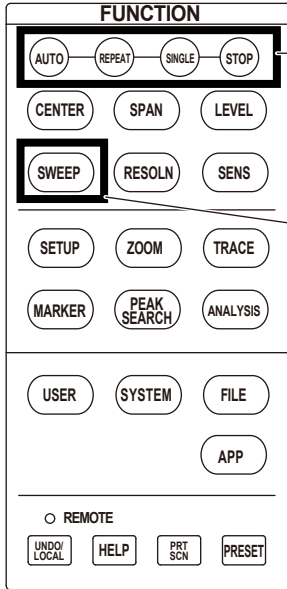


Press these keys to control sweeping directly.
**AUTO**     Auto sweep
**REPEAT**  Repeat sweep
**SINGLE**  Single sweep
**STOP**     Stop sweep

**SWEEP**
Auto sweep, repeat sweep, single sweep, stop sweep

# Function menus

## CENTER key

**Center wavelength, center frequency and center wavenumber (Center)**
This is the center of the measurement range. The specified value is displayed in the center of the waveform display area.
The unit of values (wavelength, frequency or wavenumber) is set using Horizontal Scale on the SETUP menu.

**Start wavelength, start frequency and start wavenumber (Start)**
This is the start point of the measurement range. The specified value is displayed at the left end of the waveform display area.
The unit of values (wavelength, frequency or wavenumber) is set using Horizontal Scale on the SETUP menu.

**Stop wavelength, stop frequency and stop wavenumber (Stop)**
This is the stop point of the measurement range. The specified value is displayed at the right end of the waveform display area.
The unit of values (wavelength, frequency or wavenumber) is set using Horizontal Scale on the SETUP menu.

*Note*
- If you change the measurement range start point (Start) or measurement range stop point (Stop), the measurement range center (Center) and sweep span (Span) will change.
- If you change the measurement range center (Center), the sweep span (Span) will not change.

**Setting the center of the measurement range to the peak wavelength of the waveform (Peak WL -> Center)**
The center wavelength of the measurement range is set to the peak waveform of the trace (A to G) selected using Active Trace on the TRACE menu.

### Setting the center of the measurement range to the center wavelength of the waveform (Mean WL -> Center)

The center of the measurement range is set to the waveform of the trace (A to G) selected using Active Trace on the TRACE menu (the wavelength of the center position between two points that are lower by the threshold value (20 dB) from the peak value of the center wavelength).
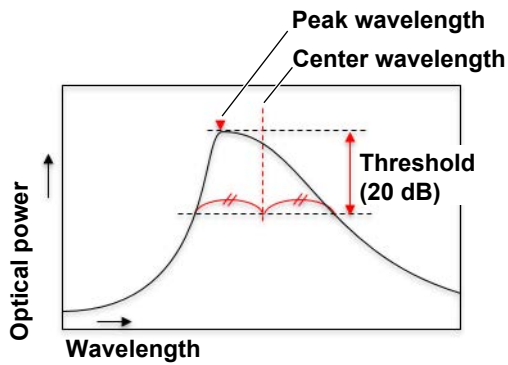


### Auto setting of the center wavelength (Auto Center)

For each sweep, the measurement center wavelength (Center WL) is set to the peak wavelength of the waveform of the trace (A to G) selected using Active Trace on the TRACE menu.

### Setting the measurement range to the waveform display zoom range (View Scale -> Measure)

The measurement range values (center value, sweep span, start point, stop point) are set to the zoom range values (Zoom Center, Zoom Span, Zoom Start, Zoom Stop) on the ZOOM menu.

## SPAN key

### Sweep span (Span)

The sweep span to be measured. The specified value is displayed in the measurement conditions area. The unit of values (wavelength or frequency) is set using Horizontal Scale on the SETUP menu.

### Start wavelength, start frequency and start wavenumber (Start)

This is the start point of the measurement range. The specified value is displayed in the measurement conditions area. The unit of values (wavelength, frequency or wavenumber) is set using Horizontal Scale on the SETUP menu.

### Stop wavelength, stop frequency and stop wavenumber (Stop)

This is the stop point of the measurement range. The specified value is displayed in the measurement conditions area. The unit of values (wavelength, frequency or wavenumber) is set using Horizontal Scale on the SETUP menu.

*Note*
- If you change the measurement range start point (Start) or measurement range stop point (Stop), the measurement range center (Center) and sweep span (Span) will change.
- If you change the measurement range center (Center), the sweep span (Span) will not change.

### Setting the sweep span to the spectral width (Δλ -> Span)

The instrument analyzes the spectral width of the waveform of the trace (A to G) selected using Active Trace on the TRACE menu and sets the sweep span to the obtained result. The spectral width is analyzed by the RMS method (threshold value = 20 dB), and a value six times the obtained spectral width is assigned to the the sweep span.



**Threshold 20 dB**

**Optical power**

**Wavelength**

For the calculation formula, see appendix 2.
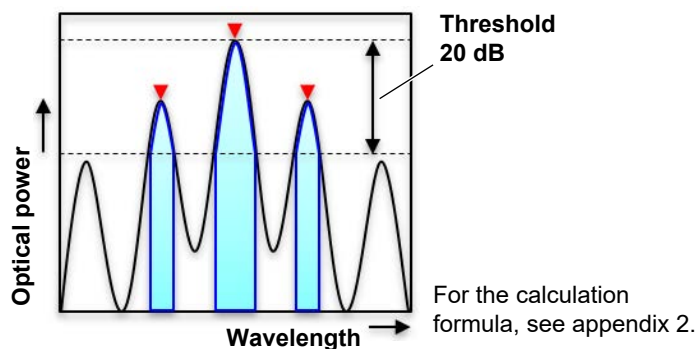
### Level fluctuation measurement time (0nm Sweep Time)

Set the time required to measure from the left edge to the right edge of the screen when the sweep span is 0 nm. When the sweep span is set to 0 nm, the center, start point, and end point of the measurement range will be of the same wavelength. The instrument will measure the level fluctuations of a single wavelength. When level fluctuations are measured, the horizontal scale unit is time. The time set on this menu becomes the range from the left edge to the right edge of the waveform display area.

### Setting the measurement range to the waveform display zoom range (View Scale -> Measure)

The measurement range values (center value, sweep span, start point, stop point) are set to the zoom range values (Zoom Center, Zoom Span, Zoom Start, Zoom Stop) on the ZOOM menu.

## LEVEL key

**Main scale settings**

- **Reference level (Reference Level)**
  The level value that determines where to display the spectral waveform.
  In log scale display, the spectral waveform is displayed so that the position at the vertical scale setting (Y Scale Setting) matches the reference level value.
  In linear scale display, the spectral waveform is displayed so that the reference level is positioned at the top of the screen.

- **Log scale display (Log Scale) and linear scale display (Linear Scale)**
  The vertical scale unit can be switched between log scale display (Log Scale) and linear scale display (Linear Scale). The log scale display shows the scale with the linear value of 1 mW assigned to the log value of 0 dBm.
  For example, if the level range of the measured waveform in terms of log values is –80 dBm to +10 dBm and these values are displayed with linear values, they will be –10 pW to 10 mW. Since the level range of spectral waveform is very wide, in the case of a spectral waveform with peaks and subpeaks such as a DFB-LD light source, using a logarithmic scale makes it possible to display both peaks in the waveform display area.

- **Bottom of the linear scale (Linear Base Level)**
  This is the level value at the bottom of the spectral waveform displayed in the waveform display area during linear scale display. When set to 0, the entire spectral waveform is displayed in the waveform display area. When set to a value close to the peak level value, the vertical axis can be expanded to display the spectral waveform.

- **Setting the reference level to the peak level  (Peak Level -> Ref Level)**
  The reference level is set to the peak level of the active trace waveform. The specified reference level (peak level value) and waveform are displayed in a reference level setting window. Then, you can further change the reference level.

- **Auto setting of the reference level (Auto Ref Level)**
  Each time a measurement is completed, the peak level of the spectral waveform is automatically detected, and this value is used as the reference level to display the spectral waveform in the waveform display area.

- **Switching the power spectral density display (Level Unit)**
  dBm and W are units of level (power value) per resolution step.
  dBm/nm and W/nm are units converted to the level per 1 nm wavelength width (power spectral density). When measuring a light source with a spectrum that is wider than the measurement resolution, such as an LED or ASE light source, displaying the spectral waveform in units of power spectral density reduces the change in the measurement spectrum due to the difference in resolution.

- **Initializing the main scale display (Main Scale Initialize)**
  If the main scale is expanded or reduced after measurement, initialization returns the main scale to its original setting.

**Sub scale settings**

Calculated values are displayed using a sub scale when a trace-to-trace calculation waveform, such as trace C, trace F, and trace G, is displayed.

* **Log sub scale display (Sub Log)**
  When calculated waveforms (see sections 4.5 and 4.6) are displayed, the calculation result is displayed on a log scale. The scale of the calculation results is displayed on the right or left side of the waveform display area.

* **Linear sub scale display (Sub Linear)**
  When calculated waveforms (see sections 4.5 and 4.6) are displayed, the calculation result is displayed on a linear scale. The scale of the calculation results is displayed on the right or left side of the waveform display area.

* **Percentage sub scale display (Sub Scale)**
  When calculated waveforms (see sections 4.5 and 4.6) are displayed, the calculation result is displayed on a percentage scale. The scale of the calculation results is displayed on the right or left side of the waveform display area.

* **Applying an offset to the log sub scale (Offset Level)**
  The display position of a calculated waveform can be moved from its original position by applying an offset to the log value of the calculation result displayed on a log sub scale. This is possible when the log sub scale is displayed.

* **Lower limit of the linear sub scale (Scale Minimum)**
  The display position of a calculated waveform can be moved from its original position by changing the display range of the linear value of the calculation result displayed on a linear sub scale. The entire calculated waveform range can be displayed by specifying zero. This is possible when the linear sub scale is displayed.

* **Auto setting of the sub scale (Auto Sub Scale)**
  When trace-to-trace calculation is executed in a calculated waveform display (see section 4.5), the above sub scale items (Sub Log, Sub Linear, Sub Scale, Offset Level, Scale Minimum) are automatically set, and the calculated waveform is displayed at the optimum position in the waveform display area.

* **Initializing the sub scale display (Main Scale Initialize)**
  If the sub scale is expanded or reduced after measurement, initialization returns the scale to its original setting.

**Vertical scale setting (Y Scale Setting)**

  **Number of divisions in the vertical scale (Y Scale Division)**
  Set the number of divisions in the vertical scale.

  **Position to display the reference value of the main scale (Ref Level Position)**
  Set the number of divisions from the bottom of the waveform display area at which the main scale reference value will be displayed.

  **Position to display the reference value of the log sub scale (Sub Ref Level Position)**
  Set the number of divisions from the bottom of the waveform display area at which the sub scale reference value (0.0 dB) will be displayed.

## SETUP key

**"Measurement range," "Wavelength resolution," "Measurement sensitivity,"**
**"Averaged measurement," "Roll-averaged measurement,"**
**"Sampling points and sampling interval," in Features**

**Wavelength resolution (Resolution)**

Set the wavelength resolution for measuring spectra. Select from the available values, or enter a value of your choice (Custom).

**Measurement sensitivity (Sensitivity)**

**Measurement sensitivity selection (Sensitivity Select)**

Select the measurement sensitivity from the menu.

**Menu**

| | |
|---|---|
| N/HOLD(x2) | |
| N/HOLD | |
| N/AUTO(x2) | |
| N/AUTO | |
| NORMAL(x2) | |
| NORMAL | |
| MID(x2) | |
| MID | |
| HIGH1(x2) | |
| HIGH1 | |
| HIGH2(x2) | |
| HIGH2 | |
| HIGH3(x2) | |
| HIGH3 | |

Low — High: Sensitivity
Fast — Slow: Sweep speed
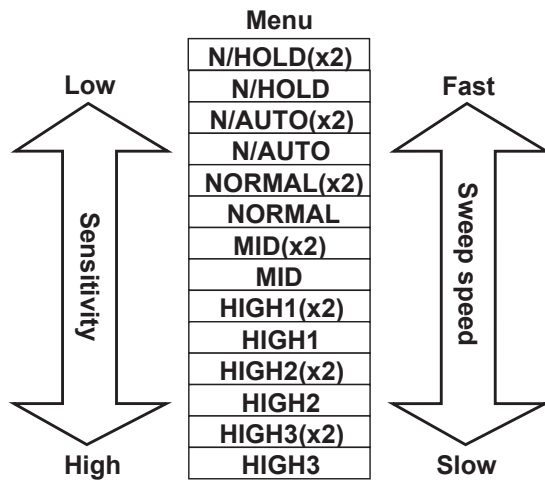
• The internal amplifier is set to fixed gain for N/HOLD. Otherwise, the internal amplifier is set to auto gain.
• (x2) indicates double speed mode.

**Manual setting of the measurement sensitivity (Sensitivity Level)**

Enter the approximate lowest level of the waveform you want to measure as a numerical value (dBm), and the measurement sensitivity will be automatically selected according to that value.

**Average times (Average Times)**

The signal-to-noise ratio (S/N ratio) of measured spectra is improved by carrying out measurements several times and averaging the measurement results. Measurements using average times is possible when a setting that does not have (x2) displayed in the measurement sensitivity menu (sweep speed twice the normal speed) is selected.

**Number of samples (Sampling Points)**

Number of samples (sampling points) is the number of points measured within the range of the specified sweep span. When you set the sampling points, the sampling interval is automatically determined. A smaller number of samples will result in shorter measurement times but a wider sampling interval. Measurement spectra will be inaccurate if the number of samples is too small. The recommended sampling interval setting varies depending on the resolution as shown below. If the specified number is less than the sampling points indicated here, the letters "UNCAL" will appear in the waveform display area to indicate that the measurement conditions are inappropriate. In normal cases, set the sampling points to AUTO.

- **About SMPL AUTO (sampling interval conditions that do not cause UNCAL)**
  "UNCAL" is displayed when a single or repeat sweep is started based on the following relationship between span, setting resolution, and set number of samples:

$$\frac{\text{Span}}{\text{Setting resolution}} \times 5 \; > \; \text{Set number of samples} - 1$$

**Sampling interval (Sampling Interval)**
Sampling interval is the wavelength spacing at which measured data sampled. It is automatically determined when you set the sweep span and sampling points. If you set a wide sampling interval within the set sweep span range, the number of samples will automatically decrease.
The sampling interval can be determined with the following formula.

sampling interval = sweep span (SPAN) ÷ (sampling points − 1)

**Pulse light measurement mode (Pulse Light Measure)**
Set the measurement mode for measuring pulse light.
For details on each mode, see section 3.3.

- **Peak hold mode (Peak Hold)**
  Set the peak hold value of the pulse light. The pulse light is measured based on this value.

- **External trigger mode (Ext Trigger Mode)**
  A mode in which measurements are made by synchronizing the pulse light to the external trigger signal. Set the trigger conditions in the Trigger Setting menu.

- **Gate mode (Gate Mode)**
  The instrument samples data when the external signal (gate signal) is active and measures the pulse light. The instrument receives the gate signal synchronized with the timing at which pulse light is emitted. In the Trigger Setting menu, you need to set the gate mode sampling interval and signal logic.

- **Signal logic (Gate Logic) for displaying pulse light based on gate signals**
  This is the signal logic with which the gate signal is enabled.

**External trigger setting (Trigger Setting)**
  **Edge (Edge)**
  You can set the external trigger signal's edge detection type to rising or falling.

  **Delay (Delay)**
  This is the delay time from the edge detection of the trigger signal to the start of waveform sampling.

**Trigger operation type (Trig Input Mode)**
- **Sampling trigger (Smpl Trig Mode)**
  Waveforms are sampled with the rising or falling edge of the external signal as a trigger.

- **Sweep start trigger (Sweep Trig Mode)**
  The instrument sweeps with the rising edge of the external signal as a trigger.

- **Sweep enable/disable control (Smpl Enable Mode)**
  When the external signal level is low (Low), the instrument sweeps (Single/Repeat).
  When the external signal level changes to high (High), sweeping is paused.
  When the external signal level changes to low again, sweeping resumes from the paused position.

**Trigger signal output (Trig Output Mode)**
- **Sweep status signal output (Sweep Status)**
  The instrument outputs a positive logic (high) signal when sweeping is in progress and a negative logic (low) signal when sweeping is not in progress from the instrument's TRIGGER OUT (trigger output) terminal.

**Horizontal scale unit (Horizontal Scale)**
Select the horizontal scale unit of the waveform display area. The unit switches between nm, THz and cm$^{-1}$ each time you press Horizontal Scale.

**Noise rejection (Smoothing)**
This function reduces the noise in the measurement waveform. Waveform areas where noise is superimposed can be smoothed and measured. Note that when noise is superimposed on sudden changes in the spectrum, the wavelength resolution of the peaks or valleys of the spectrum may be reduced due to the effects of averaging.

## RESOLN key

**Wavelength resolution (Resolution)**

Set the wavelength resolution for measuring spectra. Select from the available values, or enter a value of your choice (Custom).

## SWEEP key

**Auto sweep (Auto)**

This function automatically sets the center wavelength (Center), sweep span (Span), reference level (Reference Level), and resolution (Resolution) and measures the spectrum. When an auto configuration of measurement conditions is completed in an auto sweep, the sweep mode changes to repeat sweep.

**Repeat sweep (Repeat)**

This function repeatedly sweeps the specified measurement wavelength (frequency or wavenumber) range and measures the spectrum.

**Single sweep (Single)**

This function sweeps the specified measurement wavelength (frequency or wavenumber) once and measures the spectrum.

**Measurement stop (Stop)**

Stops sweeping.

**Inter-line marker sweep (Sweep Marker L1-L2)**

This function sweeps the range between line markers L1 and L2 and measures the spectrum.

**Sweep interval (Sweep Interval)**

This function is used to set the time from the start of one sweep to the start of the next sweep.

## SENS key

**Measurement sensitivity selection (Sensitivity Select)**

Select the measurement sensitivity from the menu.

## 1.2 Displaying Optical Spectral Waveforms

### Traces

Traces A to G can be displayed simultaneously in the instrument's waveform display area. In addition to displaying measured waveforms, traces C, F, and G can be used to execute trace calculations and display waveforms of the calculation results.

**FUNCTION**

AUTO — REPEAT — SINGLE — STOP

CENTER  SPAN  LEVEL

SWEEP  RESOLN  SENS

SETUP  ZOOM  TRACE

MARKER  PEAK SEARCH  ANALYSIS

USER  SYSTEM  FILE

APP

○ REMOTE

UNDO/ LOCAL  HELP  PRT SCN  PRESET
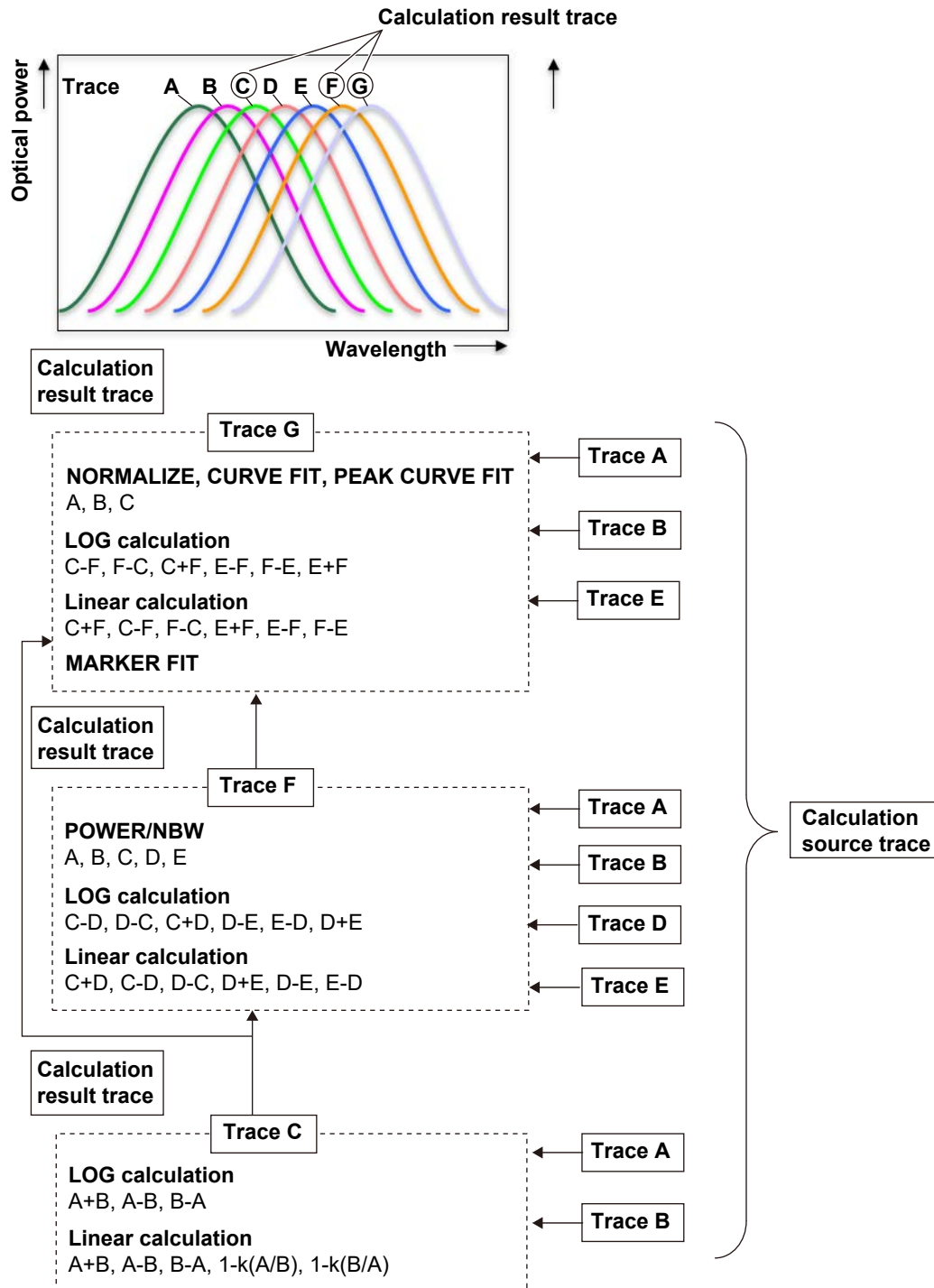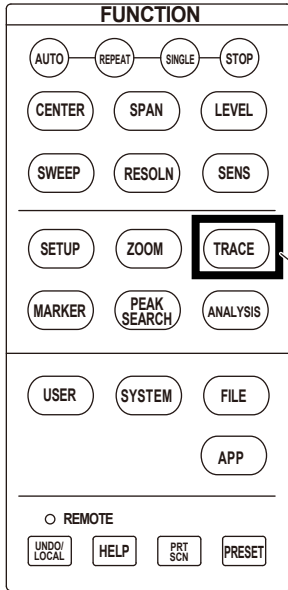
**TRACE**
Write, fix, hold, rolling average, calculate

# Zoom

The waveform display area can be zoomed by specifying the display range of the measured spectral waveform.

How to set the zoom range

- Combination of the zoom center value (Zoom Center) and display span (Zoom Span)
- Combination of the zoom start point (Zoom Start) and stop point (Zoom Stop)
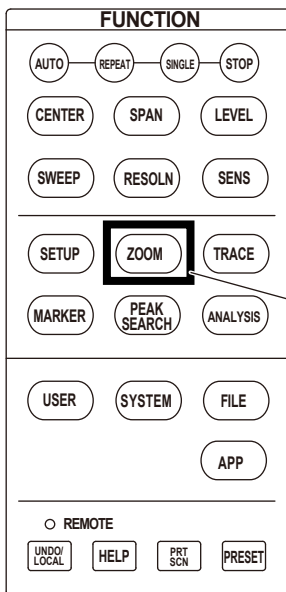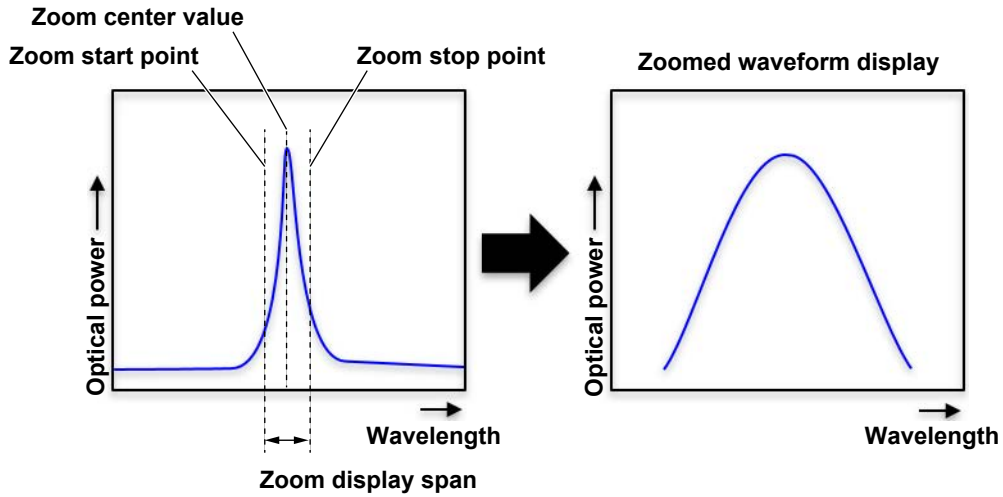




**ZOOM**
Zoom center value, Zoom display span,
zoom start point, zoom stop point

# Peak search

This function determines the peak (local maximum value) and the bottom (local minimum value) of the active trace waveform and sets the moving marker. Based on the set moving marker, you can search for the next peak or bottom and search for the peak or bottom on the right or left side of the moving marker.

By placing a fixed marker at the moving marker position, you can view the wavelength difference and power difference between a fixed marker and the moving marker.
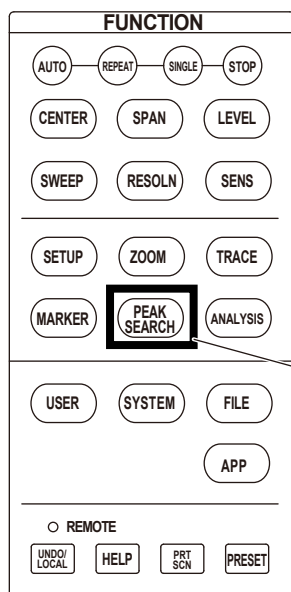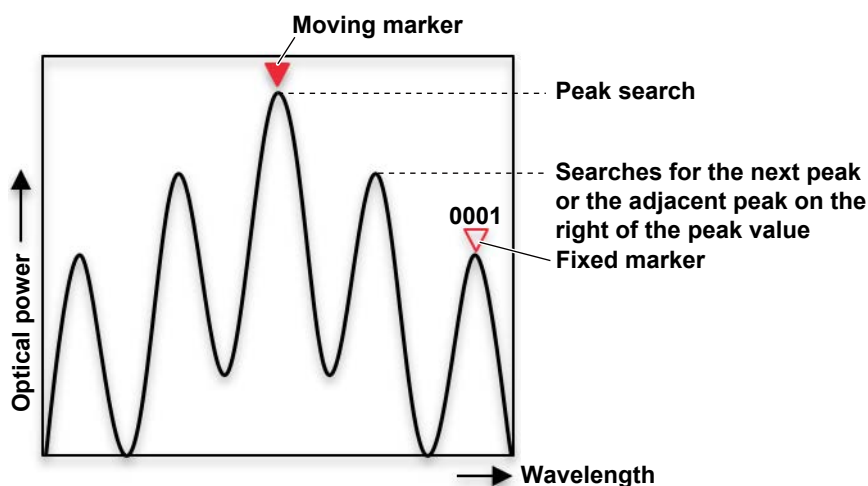




**PEAK SEARCH**
Peak search, bottom search, level order search, left and right search, fixed marker placement

# Markers

You can set markers on the active trace waveform to display in the data area the wavelengths, frequencies or wavenumber and power values at the market positions. There are three types of markers based on the power value calculation methods.

**Power value calculation based on marker type**

- **Normal marker**
  Power values are determined at the marker positions on the waveform.

- **Power spectral density markers**
  The power values per specified normalization bandwidth are determined by assuming the marker position on the waveform to be the center. These markers are used to determine converted power values per given bandwidth such as when measuring the signal noise level.

- **Integral markers**
  The integrated power values over specified frequency ranges are displayed by assuming the marker position on the waveform to be the center. The power values are displayed in the data area. These markers are used to determine the integrated power of a widely spread spectrum such as to determine the signal level from a modulated optical signal spectrum.

**Normal marker**

Power value of the wavelength at the marker position

Moving marker

Optical power

Wavelength

**Power spectral density marker**

Moving marker

Bandwidth power density

Optical power

Wavelength

Normalization bandwidth

**Integral marker**

Moving marker

Center value of the integration range

Integral power value

Optical power

Wavelength

Integral range

**FUNCTION**

AUTO — REPEAT — SINGLE — STOP

CENTER   SPAN   LEVEL

SWEEP   RESOLN   SENS

SETUP   ZOOM   TRACE

MARKER   PEAK SEARCH   ANALYSIS

USER   SYSTEM   FILE

APP

○ REMOTE

UNDO/ LOCAL   HELP   PRT SCN   PRESET
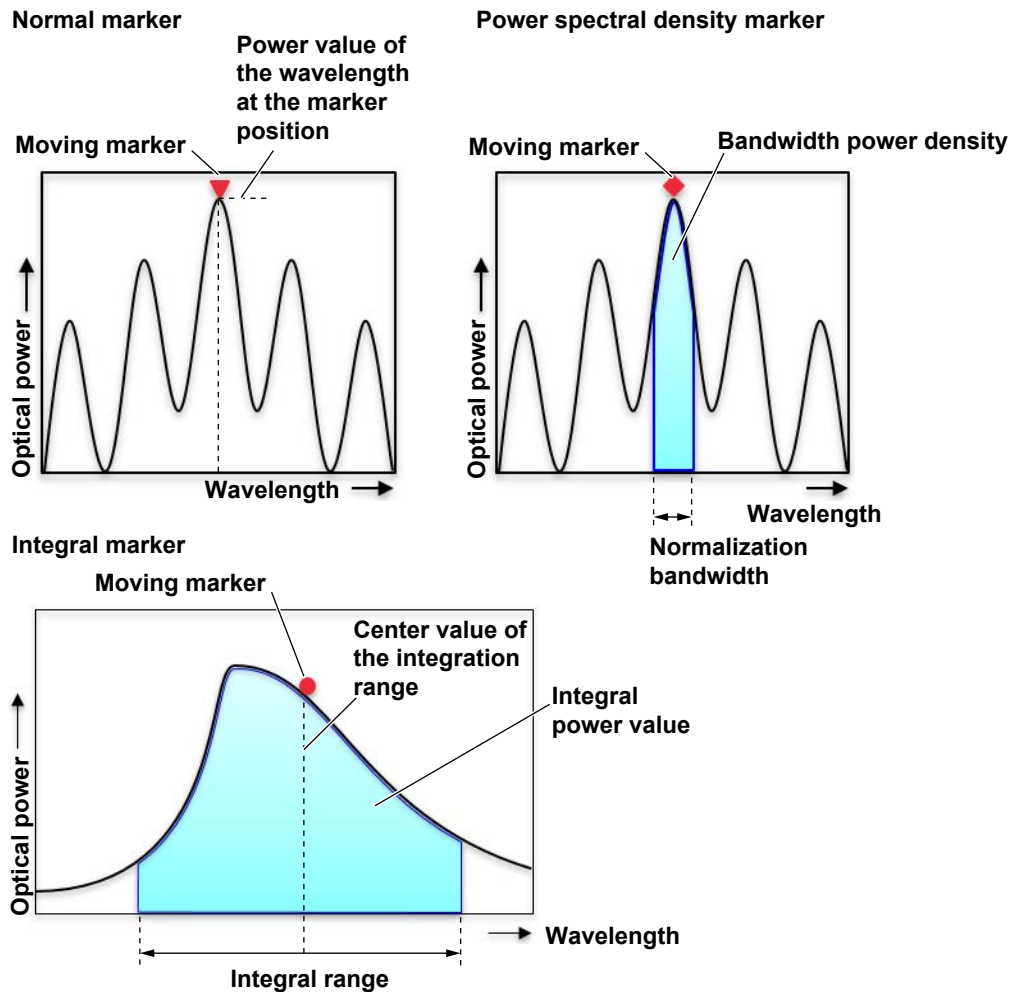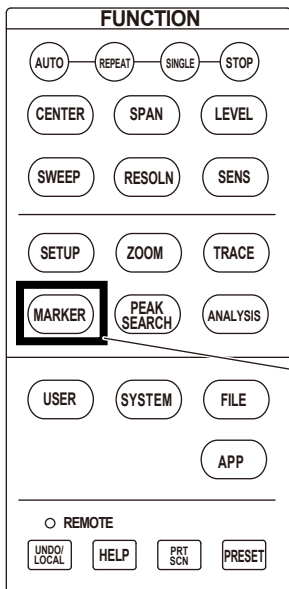
**MARKER->Marker Setting**
Normal marker, power spectral
density marker, integral marker

# Function menus

## TRACE key

### Active trace (Active Trace)

An active trace is a trace in a state that allows it to be set, changed, analyzed, and so on. For example, one-action setup such as Peak WL -> Center, moving marker operation, waveform searching, and various analysis are performed on the active trace.

Select the active trace from A to G.

### Showing and hiding (View A to G)

The spectral waveforms drawn in traces A to G are displayed in the waveform display area.

### Write mode (Write A to G)

The spectral waveform is drawn in the active trace, and the waveform in the trace is updated and displayed in the waveform display area.

### Fixed mode (Fix A to G)

The spectral waveform is not drawn in the active trace. The waveform in the trace is not updated, and the waveform drawn immediately before is displayed in the waveform display area.

### Hold mode (Hold A to G)

The selected spectral waveform, either the spectral waveform with the maximum peak or that with the minimum peak, is drawn in the active trace to update the waveform in the trace and displayed in the waveform display area. Since only spectral waveforms with the maximum peak or those with the minimum peak are drawn in the active trace, the spectral waveforms with the maximum peak or those with the minimum peak are held and the waveform display area.

### Rolling average mode (Roll Average A to G)

The spectral waveform drawn in the trace immediately before and the newly measured spectral waveform are averaged the specified number of times, and the result is displayed in the waveform display area. For example, if 10 is specified, waveforms are swept 10 times, and then the averaged spectral waveform in the waveform display area is updated.

Averaging is performed using the following formula.

$$W_j(i) = W_{j-1}(i) \cdot (n-1)/n + W(i) \cdot 1/n \ (i=1, 2, ..., N)$$

$W_j(i)$: newly displayed waveform

$W_{j-1}(i)$: previously displayed waveform

$W(i)$: newly obtained waveform

$N$: number of samples

$n$: average times

### Calculation mode (Calculate C, F, G)
The result of the selected calculation is displayed in the waveform display area.

## Trace C (Calculate C)

• **Log Math**
This function performs LOG calculations on trace-to-trace data and write the results to trace C.
Calculations can be applied to trace A and trace B.

**C=A-B(LOG)** Subtracts trace B from trace A in LOG form.
**C=B-A(LOG)** Subtracts trace A from trace B in LOG form.
**C=A+B(LOG)** Adds trace A and trace B in LOG form.

• **Linear Math**
This function performs linear calculations on trace-to-trace data and write the results to trace C.
Calculations can be applied to trace A and trace B.

**C=A+B(LIN)** Adds trace A and trace B in linear form.
**C=A-B(LIN)** Subtracts trace B from trace A in linear form.
**C=B-A(LIN)** Subtracts trace A from trace B in linear form.
**C=1-k(A/B)** Given trace A and trace B, calculates 1-k(A/B).
Calculates 1-k × (trace A/Trace B) (linear value), and writes the results to trace C.
The coefficient k can be changed in the range of 1.0000 to 20000.0000 (in steps of 0.0001). If COARSE is enabled in the setting window, you can change the value in 1-2-5 steps.
The coefficient k setting applies to both the <C=1-k(A/B)> calculation and <C=1-k(B/A)> calculation.
The display in the trace area changes to 1-k(A/B).
**C=1-k(B/A)** Given trace A and trace B, calculates 1-k(B/A).
Calculates 1-k × (trace B/Trace A) (linear value), and writes the results to trace C.
The display in the trace area changes to 1-k(B/A).

The calculation results of C=A+B(LIN), C=A-B(LIN), and C=B-A(LIN) are displayed using the main scale.
The calculation results of C=1-k(A/B) and C=1-k(B/A) are displayed using the sub scale.
For details on sub scales, see section 2.6.

## Trace F (Calculate F)

- **Log Math**

This function performs LOG calculations on trace-to-trace data and write the results to trace F.

Calculations can be applied to trace C, trace D, and trace E.

**F=C-D(LOG)** Subtracts trace D from trace C in LOG form.

**F=D-C(LOG)** Subtracts trace C from trace D in LOG form.

**F=C+D(LOG)** Adds trace C and trace D in LOG form.

**F=D-E(LOG)** Subtracts trace E from trace D in LOG form.

**F=E-D(LOG)** Subtracts trace D from trace E in LOG form.

**F=D+E(LOG)** Adds trace D and trace E in LOG form.

The calculation results are displayed using the sub scale. The scale for the calculation results is displayed on the left or right side of the screen. For details on sub scales, see section 2.6.

- **Linear Math**

This function performs linear calculations on trace-to-trace data and write the results to trace F.

Calculations can be applied to trace C, trace D, and trace E.

**F=C+D(LIN)**  Adds trace C and trace D in linear form.

**F=C-D(LIN)**  Subtracts trace D from trace C in linear form.

**F=D-C(LIN)**  Subtracts trace C from trace D in linear form.

**F=D+E(LIN)**  Adds trace D and trace E in linear form.

**F=D-E(LIN)**  Subtracts trace E from trace D in linear form.

**F=E-D(LIN)**  Subtracts trace D from trace E in linear form.

The calculation results are displayed using the main scale.

- **Power/NBW**

Displays in trace F the power per the specified band in the range of 0.1 nm to 10 nm in 0.1 nm resolution. The applicable calculation traces are A to E.

**F=Pwr/NBW A**      Displays the power spectral density of trace A.

**F=Pwr/NBW B**      Displays the power spectral density of trace B.

**F=Pwr/NBW C**      Displays the power spectral density of trace C.

**F=Pwr/NBW D**      Displays the power spectral density of trace D.

**F=Pwr/NBW E**      Displays the power spectral density of trace E.

**Bandwidth**          Sets the bandwidth.

## Trace G (Calculate G)

- **Log Math**

    This function performs LOG calculations on trace-to-trace data and write the results to trace G.

    Calculations can be applied to trace C, trace E, and trace F.

    **G=C-F(LOG)** Subtracts trace F from trace C in LOG form.
    **G=F-C(LOG)** Subtracts trace C from trace F in LOG form.
    **G=C+F(LOG)** Adds trace C and trace F in LOG form.
    **G=E-F(LOG)** Subtracts trace F from trace E in LOG form.
    **G=F-E(LOG)** Subtracts trace E from trace F in LOG form.
    **G=E+F(LOG)** Adds trace E and trace F in LOG form.

    The calculation results are displayed using the sub scale. The scale for the calculation results is displayed on the left or right side of the screen. For details on sub scales, see section 2.6.

- **Linear Math**

    This function performs linear calculations on trace-to-trace data and write the results to trace G.

    Calculations can be applied to trace C, trace E, and trace F.

    **G=C+F(LIN)** Adds trace C and trace F in linear form.
    **G=C-F(LIN)** Subtracts trace F from trace C in linear form.
    **G=F-C(LIN)** Subtracts trace C from trace F in linear form.
    **G=E+F(LIN)** Adds trace E and trace F in linear form.
    **G=E-F(LIN)** Subtracts trace F from trace E in linear form.
    **G=F-E(LIN)** Subtracts trace E from trace F in linear form.

    The calculation results are displayed using the main scale.

- **Normalize**

    This is one of the calculations that normalizes trace data. This function writes the normalize result in trace G and displays it. One of the following traces can be normalized: trace A, trace B, or trace C. The peak of the normalized waveform is 1 if trace G is set to linear scale or 0 dB if it is set to LOG scale. Data is displayed when sweeping is finished to the end.

    The trace area display changes to NORM @.

    **G=NORM A** Normalizes trace A and writes the normalized data to trace G.
    **G=NORM B** Normalizes trace B and writes the normalized data to trace G.
    **G=NORM C** Normalizes trace C and writes the normalized data to trace G.

    The calculation results are displayed using the sub scale. The scale for the calculation results is displayed on the left or right side of the screen. For details on sub scales, see section 2.6.

- **Curve Fit**

  Curve fitting is applied to the specified trace waveform, and the results are drawn in trace G. Calculations are performed on data from the threshold to the peak.

  | | |
  |---|---|
  | **G=CRV FIT A** | Applies curve fitting to trace A. |
  | **G=CRV FIT B** | Applies curve fitting to trace B. |
  | **G=CRV FIT C** | Applies curve fitting to trace C. |
  | **G=MKR FIT** | Applies curve fitting to the placed markers using the current measurement scale. Curve fitting is applied even when markers are placed on different traces. |
  | **Threshold** | Set the threshold value. |
  | **Operation Area** | Set the calculation target range. |
  |     **ALL** | Includes all data in the calculation target trace in the calculation. |
  |     **INSIDE L1-L2** | Includes the data between the line markers in the calculation. |
  |     **OUTSIDE L1-L2** | Includes the data outside the line markers in the calculation. |
  | **Fitting Algorithm** | Select the curve fitting formula. |
  |     **GAUSS** | Normal distribution curve |
  |     **LORENZ** | Lorenz curve |
  |     **3RD POLY** | 3rd order polynomial |
  |     **4TH POLY** | 4th order polynomial |
  |     **5TH POLY** | 5th order polynomial |

- **Peak Curve Fit**

  Peak curve fitting is applied to the specified trace waveform, and the results are drawn in trace G. Calculations are performed on mode peaks that are greater than or equal to the threshold.

  | | |
  |---|---|
  | **G=PKCV FIT A** | Applies peak curve fitting to trace A. |
  | **G=PKCV FIT B** | Applies peak curve fitting to trace B. |
  | **G=PKCV FIT C** | Applies peak curve fitting to trace C. |
  | **Threshold** | Set the threshold value. |
  | **Operation Area** | Set the calculation target range. |
  | **Fitting Algorithm** | Select the curve fitting formula. |
  |     **GAUSS** | Normal distribution curve |
  |     **LORENZ** | Lorenz curve |
  |     **3RD POLY** | 3rd order polynomial |
  |     **4TH POLY** | 4th order polynomial |
  |     **5TH POLY** | 5th order polynomial |

**Trace list (Trace List)**
Lists the measurement conditions and display conditions of all traces.

**Inter-trace waveform copy (Trace Copy)**
Copies waveforms between traces.

**Trace clear (Trace Clear)**
Clears the waveforms in the trace.

**Label (Label)**
Enter the character string to display in the label area of the screen.

**Noise mask (Noise Mask)**
Masks the display of spectral waveforms whose level is less than the specified level.

**Mask line (Mask Line)**
When mask line is set to VERT, the waveform is displayed with level values at or below the specified mask value as the display lower limit value (−210 dBm).
When mask line is set to HRZN, the waveform is displayed with level values at or below the specified mask value as the mask value.

**Trace highlighting (Trace Highlight)**
Highlights the waveform of the selected trace.

## ZOOM key

How to set the zoom range
• Combination of the zoom center value (Zoom Center) and display span (Zoom Span)
• Combination of the zoom start point (Zoom Start) and stop point (Zoom Stop)


**Zoom center wavelength, center frequency and center wavenumber (Zoom Center)**
This is the center value of the zoom range.


**Zoom display span (Zoom Span)**
This is the display span of the zoom range. The spectral waveform is displayed with the zoom center wavelength at the center and at the specified zoom display span.


**Start wavelength, start frequency and start wavenumber (Zoom Start)**
This is the start point of the zoom range. The specified value is displayed at the left end of the waveform display area.
The horizontal scale unit is set using Horizontal Scale on the SETUP menu.


**Stop wavelength, stop frequency and stop wavenumber (Zoom Stop)**
This is the stop point of the Zoom range. The specified value is displayed at the right end of the waveform display area.
The horizontal scale unit is set using Horizontal Scale on the SETUP menu.

### Note
• If you change the zoom start point (Zoom Start) or stop point (Zoom Stop), the zoom center value (Zoom Center) and sweep span (Zoom Span) will change.
• If you change the zoom center value (Zoom Center), the sweep span (Zoom Span) will not change.


**Setting the center of the zoom range to the peak wavelength of the waveform (Peak -> Zoom Ctr)**
The center of the zoom range is set to the peak wavelength of the trace (A to G) selected using Active Trace on the TRACE menu.


**Overview window display (Overview Display)**
When a spectral waveform is displayed zoomed, an overview window can be displayed. In the overview window, you can check which part of the spectral waveform is displayed zoomed.


**Setting the measurement range to the waveform display zoom range (View Scale -> Measure)**
The measurement range values (center value, sweep span, start point, stop point) are set to the zoom range values (Zoom Center, Zoom Span, Zoom Start, Zoom Stop) on the ZOOM menu.


**Zoom range initialization (Initialize)**
Initializes the zoom range values (Zoom Center, Zoom Span, Zoom Start, Zoom Stop).

## PEAK SEARCH key

**"Peak search" in Features**

### Peak search (Peak Search)

A peak search (a search for the maximum level value) is performed on the active trace waveform.

The moving marker is displayed at the peak point, and the marker value is displayed in the data area.

### Bottom search (Bottom Search)

A bottom search (a search for the minimum level value) is performed on the active trace waveform.

The moving marker is displayed at the bottom point, and the marker value is displayed in the data area.

### Next level search (Next Level Search)

On the active trace waveform, the moving marker at the peak or bottom is moved to the next peak (local maximum value) or bottom (local minimum value).

### Next search right (Next Search Right)

On the active trace waveform, the moving marker at the peak or bottom is moved to the peak (local maximum value) or bottom (local minimum value) on its right.

### Next search left (Next Search Left)

On the active trace waveform, the moving marker at the peak or bottom is moved to the peak (local maximum value) or bottom (local minimum value) on its left.

### Fixed marker placement (Set Marker)

Places a fixed marker with the assigned number at the moving marker position.

**Data area**

```
// AQ6375E OPTICAL SPECTRUM ANALYZER //
TR A  ΔPK   : 1552.9940nm        -14.93dBm          Δ-Δn:
TR A  Δ0001: 1551.9740nm         -61.68dBm           1.0200nm        46.74dB
       Δ0002:
       Δ0003:
       Δ0004:
       Δ0005:
```

**Δ: moving marker**
**ΔPK: peak moving marker**
**ΔBT: bottom moving marker**
**Δ0001 to Δ1024: fixed markers**

**Difference between markers**

### Fixed marker clear (Clear Marker)

Clears the specified fixed marker number. The marker value in the data area is also cleared.

### Clearing all markers (All Marker Clear)

Clears all moving markers and fixed markers.

### Auto search (Auto Search)

Turns on or off peak/bottom searching that is performed every sweep.

When set to On, after sweeping ends, a peak/bottom search is performed automatically, and a moving marker is set automatically.

**Spectral waveform mode threshold (Mode Diff)**

Sets the minimum peak/bottom difference (dB) serving as a basis for mode determination during mode detection.

**Search between wavelength line markers (L1 and L2) (Search/Ana Marker L1-L2)**

If you set Search/Ana Marker L1-L2 to On when wavelength line markers L1 and L2 are on, the peak/bottom search target is set between line markers 1 and 2.

**Search in the waveform display zoom range (Search/Ana Zoom Area)**

When Search/Ana Zoom Area is set to On, the peak/bottom search is performed on the data in the zoom display range. If Search/Ana and Zoom Area Search/Ana Marker L1-L2 are both set to On, search is performed in the area where the zoom display range and line marker range overlap.

**Search mode (Search Mode)**

The peak search function described earlier is a "single search" function that executes searches one by one. When the search mode is set to "multi search," the peak (maximum power value) and bottom (minimum power value) of all spectral waveforms that meet the search conditions are searched in a single search.

**Multi search conditions (Multi Search Setting)**

**Threshold (Threshold)**

Set the threshold (detection range level) that is used when the multi search detects modes (peaks/bottoms). For peak searches, the peak detection range is defined as being the levels from the measured waveform's maximum peak to the threshold value. For bottom searches, the bottom detection range is defined as being the levels from the measured waveform's minimum bottom to the threshold value.

**Sorting the data area display (Sort by)**

Set the assignment order of marker numbers. The detected marker values are displayed as a list in the data area. This setting sets the sort order of the detection list.

## MARKER key

### Moving marker display (Marker Active)

You can move the moving marker to any wavelength using the rotary knob, arrow keys, or numeric keypad. You can also drag it with the mouse. The moving marker moves along the waveform, and the marker values are displayed in the data area. If you fix the moving marker at a given position, it turns into a fixed marker. The moving marker applies to the active trace.

### Fixed marker display (Set Marker)

A marker fixed to a specific number using the moving marker is called a fixed marker. You can place up to 1024 fixed markers. Fixed markers can be placed across different traces.
Fixed markers are assigned marker numbers in order from 0001.

### Fixed marker clear (Clear Marker)

Clears the fixed marker with the selected number.

### Marker selection (Marker Setting)

Select a marker you want to use from the three available markers: normal, power spectral density, and integral.

### Normalization bandwidth (Band Width)

Set the normalization bandwidth of the power spectral density marker.

### Setting the center of the measurement range to the wavelength of the moving marker position (Marker -> Center)

The center of the zoom range is set to the wavelength of the moving marker position in the waveform of the trace (A to G) selected using Active Trace on the TRACE menu.

### Setting the center of the zoom range to the wavelength of the moving marker position (Peak -> Zoom Ctr)

The center of the zoom range is set to the wavelength of the moving marker position in the waveform of the trace (A to G) selected using Active Trace on the TRACE menu.

### Setting the reference level to the level of the moving marker position (Marker -> Ref Level)

The spectral waveform is displayed in the waveform display area by assuming the level value at a moving marker position to be the reference level in the waveform of the trace (A to G) selected using Active Trace on the TRACE menu.

### Clearing all markers (All Marker Clear)

Clears all displayed fixed markers and moving markers.

### Wavelength line markers (Line Marker 1, 2)

Wavelengths are displayed as position information in the waveform display area. If two line markers are displayed, the difference in wavelengths between the line markers can be displayed. In addition, two line markers can be displayed and used to set the sweep span, zoom range, and resolution range.

**Level line markers (Line Marker 3, 4)**
Level values are displayed as position information in the waveform display area. If two line markers are displayed, the difference in level values between the line markers can be displayed.

**Setting the sweep span to the range between the wavelength line markers (Marker L1-L2 -> Span)**
The sweep span is set to the wavelength range between the wavelength line markers.

**Setting the zoom range to the spacing between the wavelength line markers (Marker L1-L2 -> Zoom Span)**
The zoom range is set to the wavelength range between the wavelength line markers.

**Clearing all line markers (Marker All Clear)**
Clears all displayed line markers (L1 to L4).

**Marker difference information display method (Marker Display)**
This function sets whether to display the difference relative to the moving marker (Offset) or the difference relative to the next marker (Spacing) in the marker display.

**Auto updating the marker information (Marker Auto Update)**
When a sweep is made and the measurement spectral data is updated, the placement of fixed markers is updated automatically, and the marker information of the new spectral waveform is displayed.

**Unit for displaying marker information (Marker Unit)**
Set the unit (wavelength, frequency or wavenumber) of the marker information displayed in the data area.

**Search or analysis between wavelength line markers (L1 and L2) (Search/Ana Marker L1-L2)**
Peak search, bottom search, and calculation of analysis function (ANALYSIS key) can be performed in the area between wavelength line markers L1 and L2. Set the wavelength line markers using Line Marker 1 and Line Marker 2 in the MARKER menu.

**Search and analysis in the waveform display zoom range (Search/Ana Zoom Area)**
Peak search, bottom search, and calculation of analysis function (ANALYSIS key) can be performed in the zoom range of the waveform display. Set the zoom range using Zoom Center, Zoom Span, Zoom Start, and Zoom Stop in the ZOOM menu.

**Sweeping between wavelength line markers (Sweep Marker L1-L2)**
The instrument sweeps the wavelength range between the wavelength line markers.

# 1.3   Analyzing the Optical Spectrum

## Spectral width

This function calculates the spectral width of the active trace waveform. Select the analysis algorithm from the following four types.

■ **THRESH method**
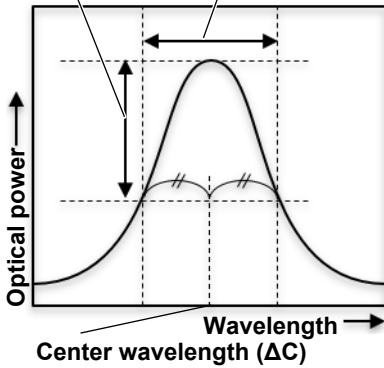


■ **NOTCH width search**
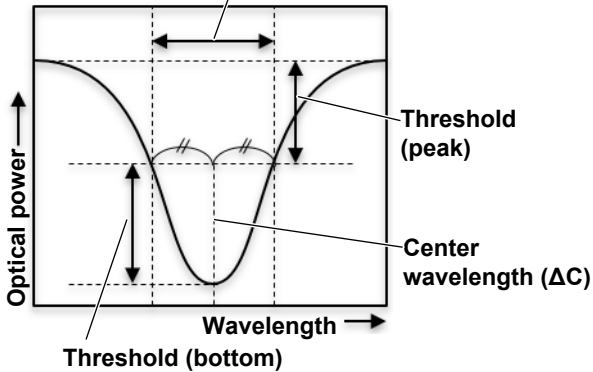


■ **ENVELOPE (envelope curve) method**
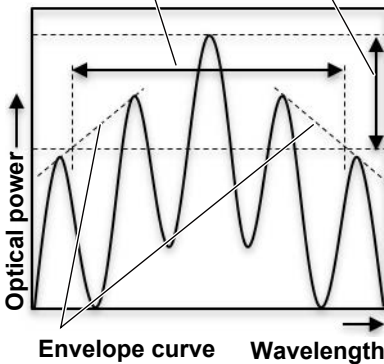


■ **RMS/PEAK RMS method**
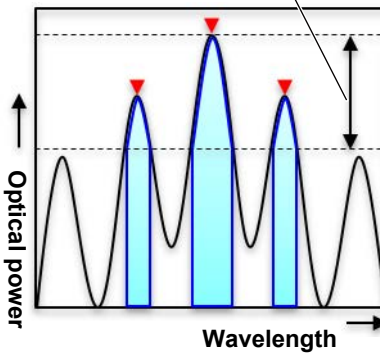


In the RMS method, the spectral width (Δλ) is calculated from the waveform within the threshold value. In the peak RMS method, the spectral width (Δλ) is calculated from the mode peak value within the threshold value. For the calculation formula, see appendix 2.
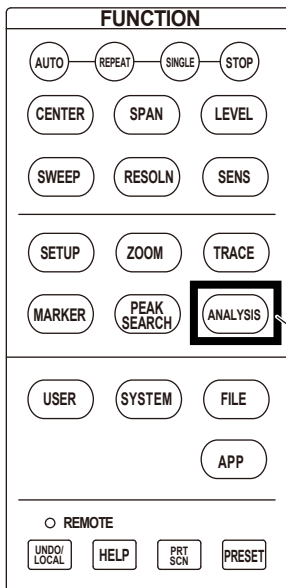


**ANALYSIS -> Spec Width**
Threshold (THRESH), envelope curve (ENVELOPE), RMS, peak RMS, notch (NOTCH)

# SMSR and OSNR

SMSR is an abbreviation for side-mode suppression ratio. SMSR represents the level difference between the mode peak and a side mode.

OSNR is an abbreviation for optical signal to noise ratio. OSNR represents the level difference between the mode peak and noise. Both analysis items can be used to confirm the properties of spectral waveforms with steep peaks such as DFB-LD.
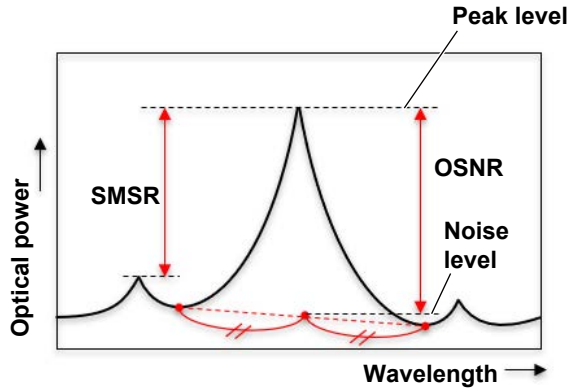


## Note

The light source (DFB-LD) analysis also includes an SMSR.
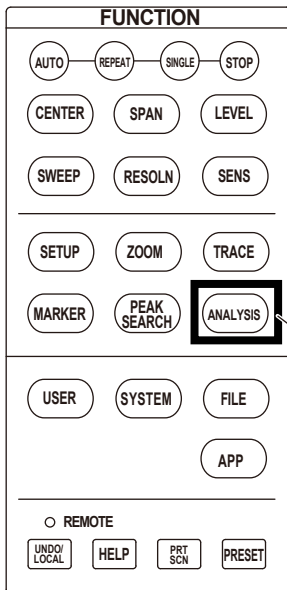


**ANALYSIS -> Analysis 1**
SMSR

Features

# POWER

This function integrates the level values of a spectral waveform and calculates the power (POWER). The integral range is the entire spectrum. When Search/Ana Marker L1-L2 is set to On in the ANALYSIS menu, the integral range is set to the range between the wavelength line markers. For the calculation formula of the power value, see "POWER analysis function" in Appendix 3.
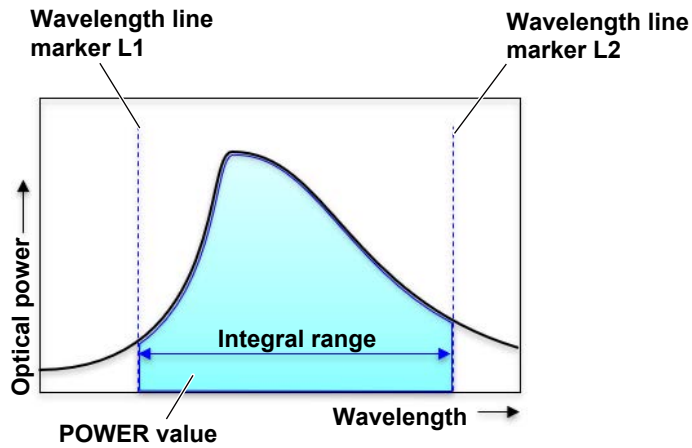


**Note**

The light source (DFB-LD, FP-LD, LED) analysis also includes power.



**ANALYSIS -> Analysis 1**
POWER

# Light source (DFB-LD, FP-LD, LED) spectral analysis

Light source parameters including spectral line width, SMSR, and power, explained earlier in this section, can be analyzed collectively.
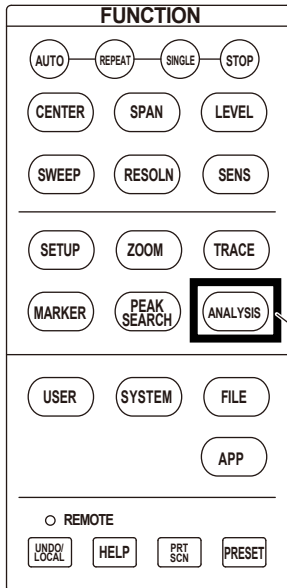


**ANALYSIS -> Analysis 1**
DFB-LD, FP-LD, LED

# WDM signal spectral analysis

This function calculates the center wavelength (λ), level, noise, SNR, and other parameters of each channel from the measured WDM signal spectral waveforms. For an explanation and calculation formula of each parameter, see appendix 4.
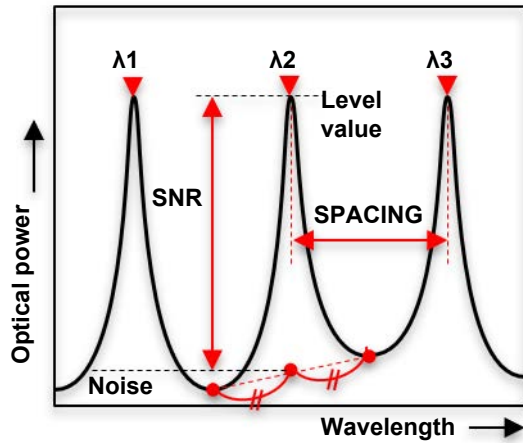


| Analysis item | Description |
|---|---|
| No.1, No.2, ... | Channel number |
| WAVELENGTH | Center wavelength (λ) of the channel |
| LEVEL | Level value of the channel (difference between the peak level and noise level) |
| OFFSET WL | Relative wavelength to the wavelength of the reference channel (REF). Specify REF with a parameter. |
| OFFSET LVL | Relative level to the level of the reference channel (REF) Specify REF with a parameter. |
| SPACING | Wavelength spacing to the adjacent channel |
| LVL DIFF | Level difference from then adjacent channel |
| NOISE | Noise level of the channel |
| SNR | SNR value of the channel |
| GRID WL | Grid wavelength closest to the center wavelength of the channel |
| MEAS WL | Center wavelength (λ) of the channel |
| REL WL | Relative wavelength to the nearest grid wavelength of the channel |
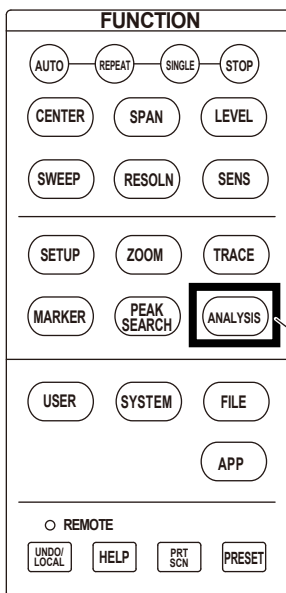


ANALYSIS -> Analysis 2
WDM

# Optical amplifier analysis (Gain, NF analysis)

This function calculates the gain and noise figure (NF) of the optical amplifier from the spectral waveform of the input light to the optical amplifier (Trace A) and the spectral waveform of the output light from the optical amplifier (Trace B). For an explanation and calculation formula of each parameter, see appendix 5.
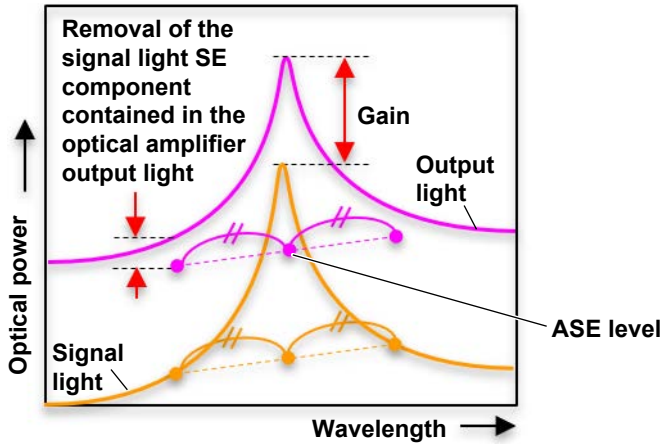


| Analysis item | Description |
|---|---|
| WAVELENGTH | Center wavelength (λ) of the channel |
| INPUT LVL | Level value of the channel signal light |
| OUTPUT LVL | Level value of the channel output light |
| ASE LVL | Level value of the channel ASE light |
| RESOLN | Measurement resolution of the channel |
| GAIN | Gain of the channel |
| NF | NF of the channel |



**ANALYSIS -> Analysis 2**
EDFA-NF

# Optical filter analysis

This function measures the spectral waveform of the input light to the optical filter (Trace A) and the spectral waveform of the output light from the optical filter (Trace B) and measures the characteristics of the optical filter from their difference spectrum (Trace C = A – B). It analyzes the single-channel and multi-channel (WDM signal) spectral waveforms.
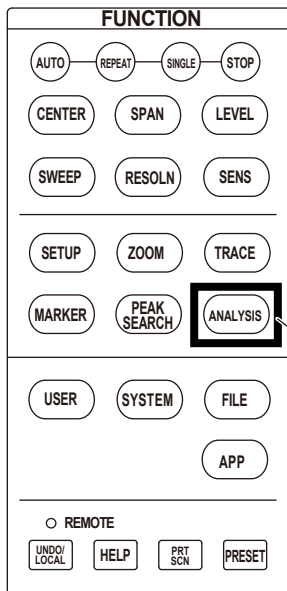
**ANALYSIS -> Analysis 2**
FILTER-PK, FILTER-BTM, WDM FIL-PK, WDM FIL-BTM

## Before analysis

Using the trace function, draw the spectral waveform of the input light in trace A and the spectral waveform of the output light in trace B. Display the difference waveform (C = A – B(LOG)) on trace C. Then, perform the analysis on the difference waveform of trace C. For instructions on how to use the trace function, see section 1.2.

The following illustrations of single-channel and multi-channel optical filter characteristics use differential waveforms.

**Input optical spectrum to the optical filter (Trace A)**

**Output optical spectrum from the optical filter (Trace B)**

**Transmission characteristics of the optical filter (Trace C = A – B (LOG))**
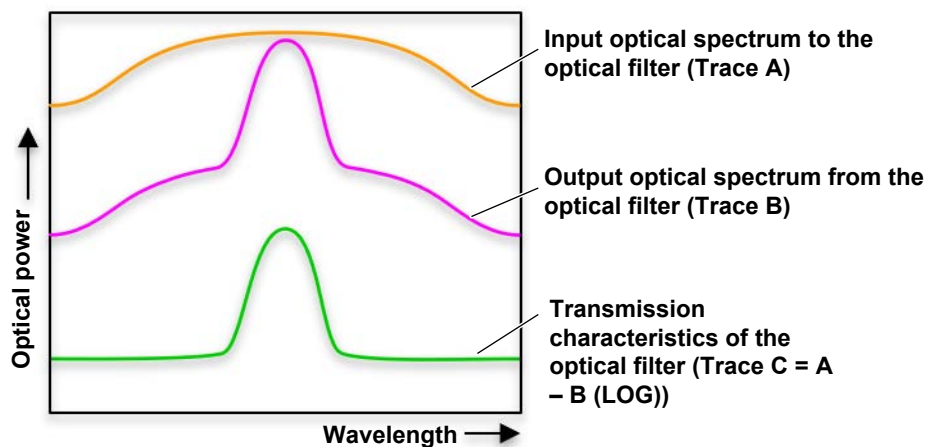
## Single-channel filter characteristics

A single-channel spectral waveform is analyzed. For an explanation and calculation formula of each parameter, see "FILTER PEAK analysis function" and "FILTER BOTTOM analysis function" in Appendix 6.

**FILTER-PK**
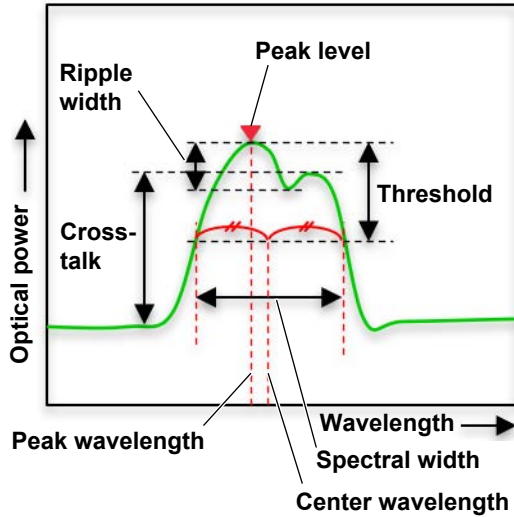
| Analysis item | Description |
|---|---|
| PEAK WL | Peak wavelength |
| CENTER WL | Center wavelength |
| SPECTRUM WIDTH | Spectral width |
| RIPPLE WIDTH | Ripple width |
| CROSS TALK | Crosstalk |

**FILTER-BTM**
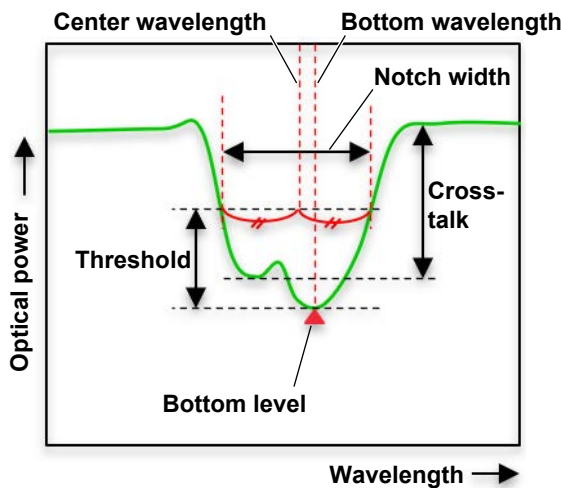
| Analysis item | Description |
|---|---|
| BOTTOM LVL | Bottom level |
| BOTTOM WL | Bottom wavelength |
| CENTER WL | Center wavelength |
| NOTCH WIDTH | Notch width (displayed as SPEC WIDTH on the screen) |
| CROSS TALK | Crosstalk |

## Multi-channel filter characteristics

A multi-channel spectral waveform is analyzed. For an explanation and calculation formula of each parameter, see "WDM FILTER PEAK analysis function" and "WDM FILTER BOTTOM analysis function" in Appendix 6.

**WDM FIL-PK**
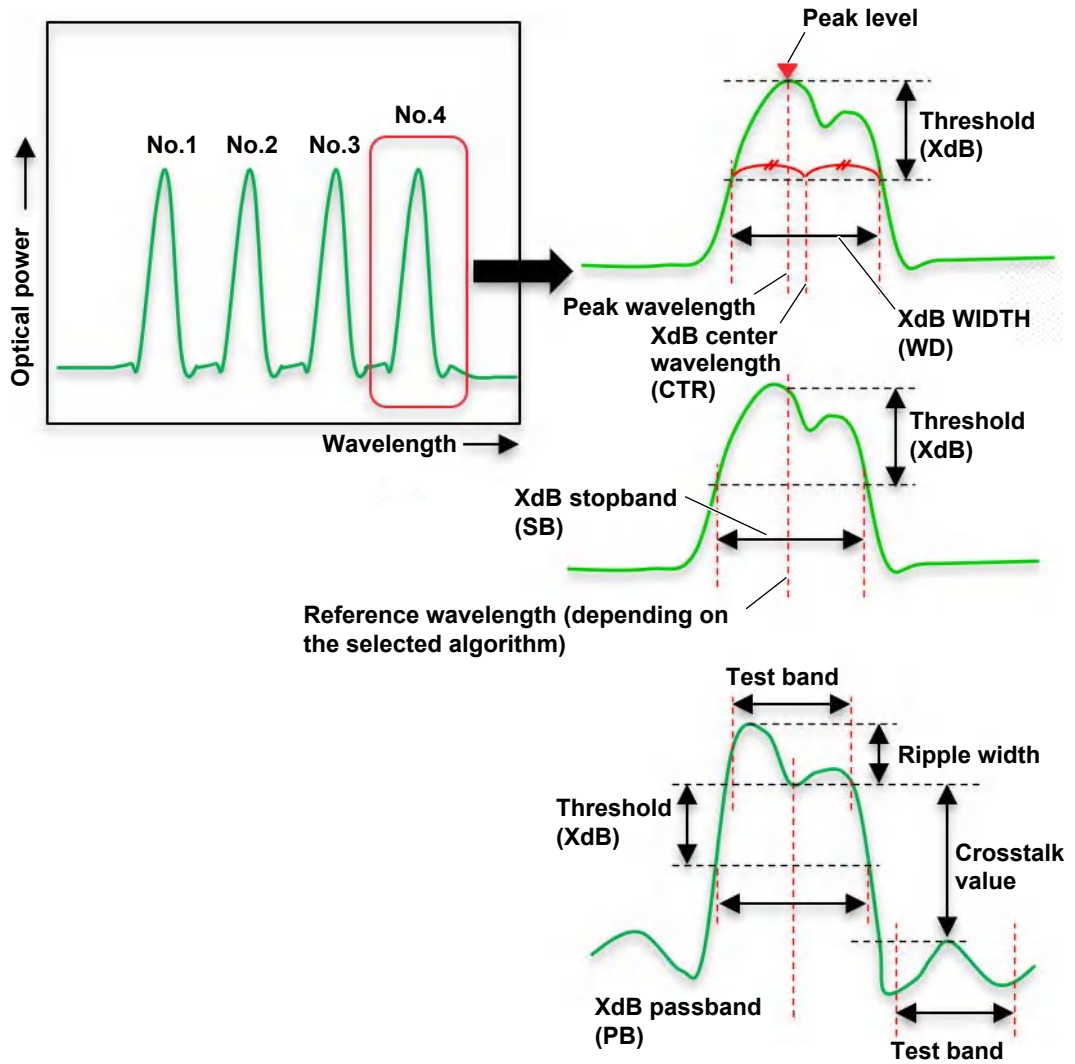


| Analysis item | Description |
|---|---|
| No.1, No.2, ... | Channel number |
| NOMINAL WL | Reference wavelength of the channel |
| PK WL | Peak wavelength of the channel |
| PK LVL | Peak level of the channel |
| XdB WD | XdB width of the channel |
| XdB CTR | XdB center wavelength of the channel |
| XdB SB | XdB stop band of the channel |
| XdB PB | XdB pass band of the channel |
| RIPPLE WIDTH | Ripple width of the channel |
| CROSS TALK | Crosstalk of the channel |

**WDM FIL-BTM**
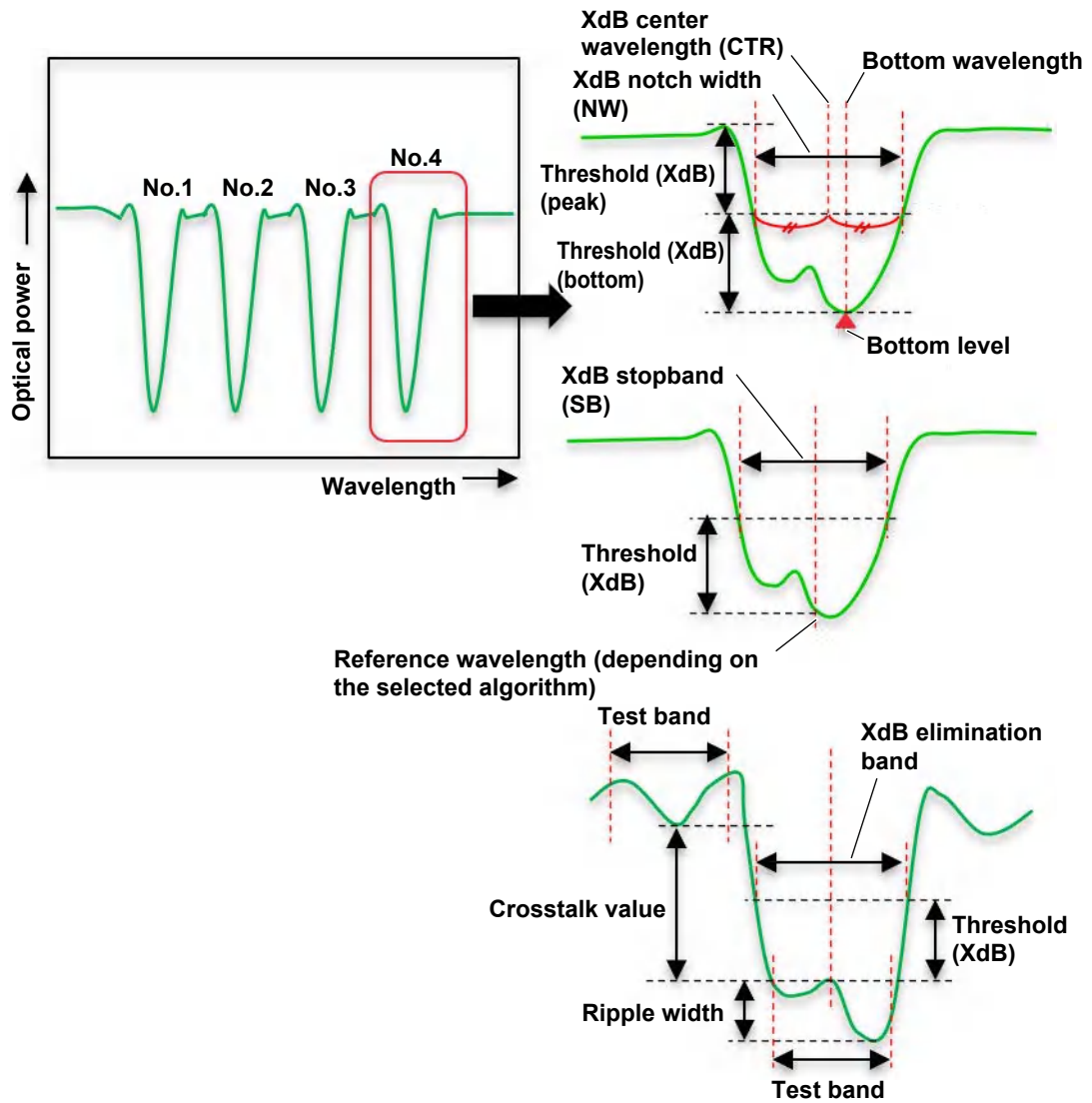


| Analysis item | Description |
|---|---|
| No.1, No.2, ... | Channel number |
| NOMINAL WL | Reference wavelength of the channel |
| BTM WL | Bottom wavelength of the channel |
| BTM LVL | Bottom level of the channel |
| XdB NB | XdB notch width of the channel |
| XdB CTR | XdB center wavelength of the channel |
| XdB SB | XdB stop band of the channel |
| XdB EB | XdB elimination band of the channel |
| RIPPLE WIDTH | Ripple width of the channel |
| CROSS TALK | Crosstalk of the channel |

# Function menus

## ANALYSIS key

**"Spectral width", "SMSR and OSNR", "POWER",
"Light source (DFB-LD, FP-LD, LED) spectral analysis ","WDM signal spectral analysis",
"Optical amplifier analysis (Gain, NF analysis)", "Optical filter analysis" in Features**

**Selecting the spectral width analysis (Spec Width)**
Select the spectral width analysis type from five options.

**Selecting the batch analysis of SMSR, POWER, and light source (Analysis 1)**
Select the analysis type from five options. SMSR and POWER are separate analysis functions.
In the batch analysis of light sources, the content to be analyzed for each light source (DFB-LD, FP-LD, LED) is fixed. The content to be analyzed consists of the spectrum width, SMSR, POWER, and OSNR items.

Batch analysis of light sources

| Light source type | Analysis item |
|---|---|
| DFB-LD | Center wavelength, spectral width, SMSR, POWER, OSNR |
| FP-LD | Center wavelength, spectral width, POWER, number of modes |
| LED | Center wavelength, spectral width, POWER |

### DFB-LD

**Center wavelength, spectral width (-XdB WIDTH)**
This function calculates the spectral width ($\Delta\lambda$) and center wavelength ($\lambda C$) at a level that is lower than the level of the peak wavelength ($\lambda P$) by the threshold of XdB (e.g., –20 dB). For an explanation and calculation formula of each parameter, see "THRESH method," "ENVELOPE (envelope) method," "RMS method," and "PEAK RMS method" in appendix 2.

**Side mode suppression ratio (SMSR)**
This function calculates the difference between the mode peak and a side mode. For an illustration of SMSR, see the figure on page 1-35. For an explanation and calculation formula of each parameter, see "SMSR analysis function" in appendix 3.

**Center wavelength, spectral width (RMS, PK-RMS)**
In the RMS method, the spectral width ($\Delta\lambda$) is calculated from the waveform within the threshold value. In the peak RMS method, the spectral width ($\Delta\lambda$) is calculated from the peak value within the threshold value. For an illustration of RMS and PK-RMS (peak RMS), see the figure on page 1-34. For an explanation and calculation formula of each parameter, see "RMS method" and "PEAK RMS method" in appendix 2.

**Integral of the level value (POWER)**
This function integrates the level values of a spectral waveform and calculates the optical power (POWER). For an illustration of POWER, see the figure under "POWER" on page 1-36. As a parameter, you need to set the integration range for the peak wavelength.

**Optical signal to noise ratio (OSNR)**
This function calculates the level difference between the mode peak and noise. For an illustration of OSNR, see the figure on page 1-35. For an explanation and calculation formula of each parameter, see "Analysis algorithm" and "Automatic parameter setting function" in appendix 4.

## FP-LD

### Center wavelength, spectral width (SPECTRUM WIDTH)
This function calculates the spectral width (Δλ) and center wavelength (λC). For an explanation and calculation formula of each parameter, see "THRESH method," "ENVELOPE (envelope) method," "RMS method," and "PEAK RMS method" in appendix 2.

### Mean wavelength (MEAN WAVELENGTH)
This function calculates the mean wavelength. The mean wavelength is the center position between two points whose levels are less than the level of the peak value by the threshold value (20 dB).



### Total integral of the level value (TOTAL POWER)
This function integrates the level values of a multi-peak spectral waveform one by one and calculates the total optical power (POWER). For an explanation of the OFFSET LEVEL parameter and the calculation formula for POWER, see "POWER analysis function" in appendix 2.

### Number of modes (MODE NO.)
This function calculates the number of modes in a multi-peak spectral waveform. For an explanation and calculation formula of each parameter, see "THRESH method," "ENVELOPE (envelope) method," "RMS method," and "PEAK RMS method" in appendix 2.

## LED

### Center wavelength, spectral width (SPECTRUM WIDTH)
This function calculates the spectral width (Δλ) and center wavelength (λC). For an explanation and calculation formula of each parameter, see "THRESH method," "ENVELOPE (envelope) method," "RMS method," and "PEAK RMS method" in appendix 2.

### Mean wavelength (MEAN WAVELENGTH)
This function calculates the mean wavelength. The mean wavelength is the center position between two points whose levels are less than the level of the peak value by the threshold value (20 dB). For an illustration of the mean wavelength, see the "Mean waveform" figure for FP-LD.

### Total integral of the level value (TOTAL POWER)
This function integrates the level values of a spectral waveform and calculates the total optical power (POWER). For an explanation of the OFFSET LEVEL parameter and the calculation formula for POWER, see "POWER analysis function" in appendix 3.

**Selecting the analysis of the WDM waveform, optical amplifier characteristics, and optical filter characteristics (Analysis 2)**
Select the analysis type from six options.

**Executing an analysis (Analysis Execute)**
This function executes the selected analysis.

**Threshold value for spectral width analysis (Spec Width Thresh)**
Set the threshold value used in the spectral width analysis. Set the value separately for each analysis type.

**Setting the analysis parameters (Parameter Setting)**
For the analysis (Spec Width, Analysis 1, Analysis 2) selected in the ANALYSIS menu, you can set the analysis parameter that is selected in each key menu. For the meanings of the parameters, see appendix 2 to appendix 6.

**Analysis result display screen (Switch Display)**
Select the format of the display screen that shows the results of the analysis (Analysis 2) of the WDM waveform, optical amplifier characteristics, and optical filter characteristics.

**Executing auto analysis (Auto Analysis)**
Each time the instrument sweeps and updates the measurement spectral data, the analysis selected in each key menu is executed for the analysis (Spec Width, Analysis 1, Analysis 2) selected in the ANALYSIS menu.

**Analysis between wavelength line markers (L1 and L2) (Search/Ana Marker L1-L2)**
Peak search, bottom search, and calculation of analysis function (ANALYSIS key) can be performed in the area between wavelength line markers L1 and L2. Set the wavelength line markers using Line Marker 1 and Line Marker 2 in the MARKER menu.

**Search in the waveform display zoom range (Search/Ana Zoom Area)**
Peak search, bottom search, and calculation of analysis function (ANALYSIS key) can be performed in the zoom range of the waveform display. Set the zoom range using Zoom Center, Zoom Span, Zoom Start, and Zoom Stop in the ZOOM menu.

**Editing the grid table (Grid Setting)**
Set the WDM frequency table (grid table) to be referenced inside the instrument when performing spectral waveform analysis.

# 1.4 Saving and Loading Data

## Saving and loading

### Waveform data (Trace)
You can save to a file the data of a specified trace from the measured spectrum waveforms (Traces A to G). You can also load a saved file into a specified trace and display the waveforms.

### Waveform data (all traces) (All Trace)
All trace data (TraceA to G) is collectively saved in a file. The data format is binary and CSV. You can also load saved data into the instrument and display the waveforms.

### Screen capture (Graphics)
You can capture the screen and save it in a specified image format (bmp, jpg, png). You can view saved screen captures on the preview screen.

### Setting data (Setting)
You can save the instrument's measurement conditions and function menu states to a file in binary format. You can also load a saved setting file to change the settings of the instrument.

### Analysis results (Data)
You can save analysis results, the time when the data was saved, and waveform data in CSV format. You can select the items to save from the items in the following figure. You can also view the contents of the saved data file on the preview screen.
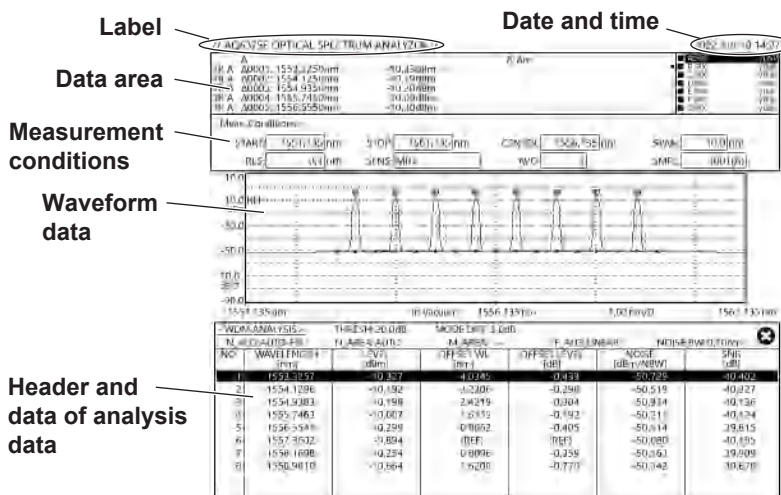
# Function menus

## FILE key

### Save (Save)
You can save the target data in a specified folder.

### Load (Load)
You can select the target data from a file list and load it.

### Target data selection (Item Select)
Select the target data from waveform data (Trace), waveform data (all traces) (All Trace), screen capture (Graphics), setting data (Setting), and analysis results (Data).

### Auto file name format (Auto File Name)
The default name for saving files is automatically set. You can set the file name format to number or date and time.

### Removing USB storage devices (Remove USB Storage)
You can remove USB storage devices (USB memory, external hard disk).

### File operation (File Operation)
The following file operations are available on the file operation window.

- **Copying, moving, and deleting files (Copy, Move, Delete)**
  You can copy, move, or delete the files and folders in the internal memory and USB storage devices.

- **Renaming files (Rename)**
  You can rename existing files and folders.

- **Making folders (New Folder)**
  You can make destination folders that files can be saved or moved to. You can assign names to those folders.

# 1.5 System Setup

## Function menus

### SYSTEM key

**Alignment adjustment (Optical Alignment)**

This function adjusts the optical axis of the monochromator (spectrometer) used inside the instrument. When you execute this function, the optical axis is adjusted automatically using the reference light source built into the instrument. For the procedure, see section **9.3**.

**Wavelength calibration (Wavelength Calibration)**

Wavelength calibration can be performed using the reference light source built into the instrument. Wavelength calibration can also be performed using an external light source. For the procedure, see section **9.3**.

**Wavelength shift (Wavelength Shift)**

This function sets the amount of wavelength shift. When the wavelength shift is changed, the specified value is added to the display value on the wavelength axis. This function is used for purposes such as correcting differences in wavelength display values among different measurement instruments.

**Level shift (Level Shift)**

This function sets the amount of level shift. When the level shift is changed, the specified value is added to the display value on the level axis. It is used to correct the loss of external isolators, filters, or other devices connected to the instrument.

**Switching the wavelength display (Wavelength in)**

For the wavelength values to be displayed, set whether to display the value in air or the value in vacuum.

**Remote interface (Remote Interface)**

Select the connection method for remotely controlling the instrument. Select from GP-IB, NETWORK (SOCKET), and NETWORK (VXI-11).

**GP-IB setting (GP-IB Setting)**

    **GP-IB address (My Address)**

    Set the instrument address.

    **Command format (Command Format)**

    Select whether to use AQ6375E commands or AQ6317 compatible commands for remote control.

### Ethernet settings (Network Setting)

#### TCP/IP settings (TCP/IP Setting)
Set the IP address and subnet mask.

#### Port number (Remote Port No.)
When Remote Interface is set to ETHERNET (SOCKET), specify the port number to use for remote control.

#### Command format (Command Format)
Select whether to use AQ6375E commands or AQ6317 compatible commands for remote control.

#### Login information for remote control (Remote User Account)
When Remote Interface is set to ETHERNET (SOCKET), set the user name and password to use for starting remote control.

#### Remote monitor (Remote Monitor)
You can use the ETHERNET port to monitor the instrument screen or control the instrument from a PC over a network. To use this feature, you need remote monitoring software (not included).

#### Session timeout (Timeout)
When Remote Interface is set to ETHERNET (SOCKET), if no communication takes place for the specified time in remote mode, the communication is automatically disconnected, and the mode changes to local.

### Turning off the display (Display Off)
This function temporarily turns the display off.

### Trigger input (Trigger Input Mode)
The instrument starts spectral data sampling or sweeping using an external signal as a trigger. For the procedure, see section 3.4.

### Trigger output (Trigger Output Mode)
The instrument outputs trigger signals from the trigger output terminal on the rear panel only while the instrument is sweeping. For the procedure, see section 3.5.

### Auto internal amplifier offset (Auto Offset Setting)
Offset adjustment of the amplifier used inside the instrument can be automatically performed at regular intervals.

### Setting the UNCAL Mark and WARNING indicator (Uncal Warning)
You can turn off the warning message that is displayed on the instrument screen when the instrument is in an Uncal state, such as when the number of samples is too small for the sweep span (SPAN).

**Turning off the buzzer (Buzzer)**
You can turn off the buzzer sound that is generated when you tap the instrument screen or when a warning messages displayed.

**Number of digits in the numeric display (Level Display Digit)**
You can set the number of displayed digits for the level values displayed in the instrument's data area.

**Display color (Color Mode)**
You can set the instrument's display color mode to color or black-and-white.

**Language (Language)**
You can change the language of the menu display, warning messages, and so on. The language used in the waveform display area, data area, parameter setting window, and so on is fixed to English (cannot be changed).

**Setting the clock (Set Clock)**
You can set the clock. For the procedure, see section 4.5 in the *AQ6375E Getting Started Guide (IM AQ6375E-02EN)*.

**Registering the user-defined menu (User Key Define)**
You can register frequently used menus in the USER menu.

**Locking the keys (Operation Lock)**
This function disables menu operations except for the USER menu.

**Clearing parameters (Parameter Initialize)**
You can initialize the settings in each menu, parameter values (values displayed in setting windows), alignment adjustment value, wavelength calibration value, and resolution calibration value.

**Viewing the system information (System Information)**
You can view the software version, product suffix code, and network information (e.g., IP address). You can also update the firmware and view the open source software (OSS) license information.

**Test mode (Test Mode)**
The test mode is used to adjust the instrument at the factory and is not used in ordinary situations.

**Shutdown (Shut Down)**
This function turns off the instrument.

## UNDO/LOCAL key

Press UNDO/LOCAL to undo the last operation. An Undo menu will appear on the screen. You can undo or redo up to five operations.

UNDO soft key:           Undoes the last operation

REDO soft key:           Cancels the last undo operation

**FUNCTION**

```
AUTO — REPEAT — SINGLE — STOP
CENTER    SPAN    LEVEL
SWEEP   RESOLN   SENS

SETUP    ZOOM   TRACE
MARKER  PEAK     ANALYSIS
        SEARCH

USER   SYSTEM   FILE
                 APP

○ REMOTE
UNDO/  HELP   PRT   PRESET
LOCAL          SCN
```
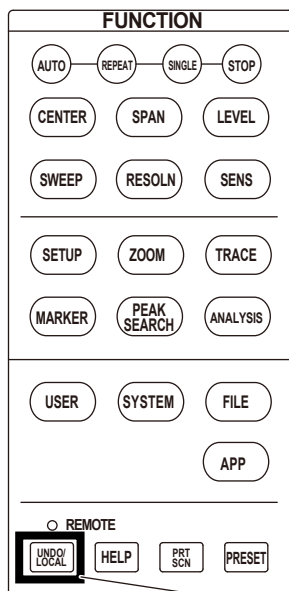
**UNDO/LOCAL**
UNDO, REDO

The function of the key varies depending on the state the instrument is in when you press UNDO/LOCAL.

The following table shows the functions of the UNDO/LOCAL key depending on the instrument state.

| Instrument state | Function |
|---|---|
| Undo action available | If you press UNDO immediately after changing a parameter setting or changing or deleting data, the previous operation is canceled, and the instrument returns to the previous state. |
| During user key registration | If you press UNDO while registering a user key, the registration mode is canceled, and the soft key menu that was displayed when you pressed SYSTEM appears again. |
| Under remote control from an external PC (REMOTE indicator is on) | The instrument returns to local mode from remote mode. The REMOTE indicator turns off. |

## USER key

Up to 24 menus can be registered as user keys.

By registering frequently used menus as user keys, you can access them simply by opening the USER menu.

# 1.6 Application Feature (APP Feature)

## Overview

The application feature (APP feature) is an expansion feature used to install and uninstall various dedicated software applications designed for this instrument.

Various applications are available to assist with the measurement condition setup, analysis, and data saving according to the measurement target, such as DFB-LD, LED, and other light signals and WDM signals.

Add-on applications can be downloaded from YOKOGAWA webpage and installed to expand the features of the instrument.

By factory default, the following applications are preinstalled in the instrument.

- WDM Test
- FP-LD Test
- DFB-LD Test
- LED Test
- SCLaser Test
- Optical fiber end face check
- Maintenance information export

## WDM/FP-LD/DFB-LD/LED/SCLaser Test

The setting items required for various tests and the display and save operations are consolidated in a single test screen. The contents that can be obtained through analysis are the same as those explained in section 6.5 and 6.6. In addition, the measurement conditions operated on the test screen are items that are often used during testing. The screen displays one trace. Waveforms that have undergone tests can be saved as files by tapping.

**Example of an FP-LD test**



**Execute a measurement.**
The procedure described in section 3.2 is included.

**Measurement conditions (resolution, sensitivity, span)**
Typical items are incorporated from the procedures in chapter 2.

**Analysis conditions (calculation algorithm)**
Typical items are included from the procedures in chapter 6 and the parameters in the appendix.

**Display operation**
Switches the unit of the scale display The main scale items of section 2.1 are included.

**Analysis results**
You will get the same results as described in the explanations in sections 6.5 and 6.6.

**Saves waveform and analysis data**
Items of sections 7.2, 7.4, and 7.6 are included.

# Optical fiber end face check (FIP)

You can use a fiber inspection probe recommended by YOKOGAWA to take a photograph that shows the state of a fiber end face. You can display this photograph on the instrument screen. You can also save the photograph.



**Fiber inspection probe**

Recommended product:
DI-1000/DI-2000 (Lightel)

**Optical fiber cable**

**End face of the optical fiber cable**
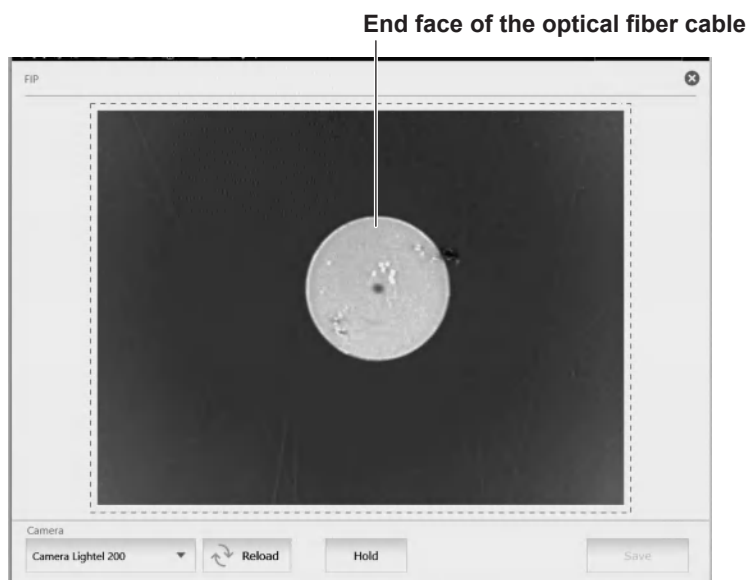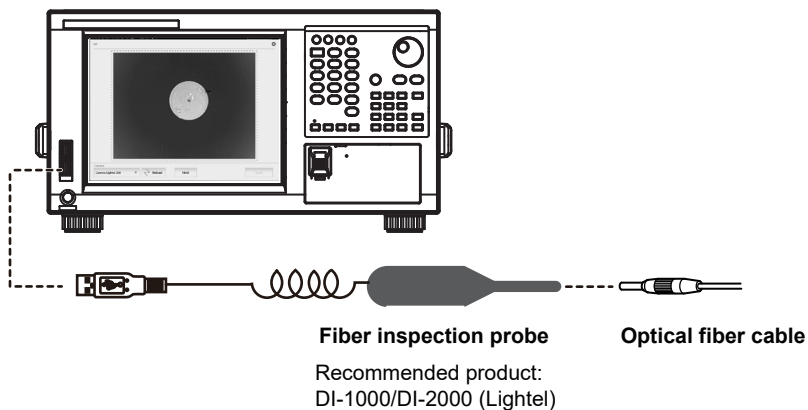


# Maintenance information export (Support file builder)

This is a function that allows you to create a support file for us to investigate the cause if a problem or malfunction occurs while you are using this instrument.

In the event of a problem or malfunction, your YOKOGAWA dealer may ask you to create and send a support file. If you are asked to do so, please create a ZIP file with this function and send the file. You do not need to check the contents of the file.

## Function menus

### APP key

### "WDM/FP-LD/DFB-LD/LED/SCLaser analysis test", "Optical fiber end face check", "Exporting maintenance information" in Features

**Information (Information)**

You can view an overview of the selected application.

**Running the application feature (Execute)**

You can run the selected application.

**Installation (Install)**

You can install application installer files (.apl files) stored in the shared folder or USB memory device.

**Uninstallation (Uninstall)**

You can uninstall applications installed in the instrument.

You can also uninstall preinstalled applications.

## 2.1    Measurement Wavelength (Frequency or Wavenumber) Range

### Procedure

### Setting the horizontal scale

#### Setting the horizontal scale unit to wavelength, frequency, or wavenumber

*1.*    Press **SETUP**. The Setup menu appears.

*2.*    Tap **More 1/2**. The More 2/2 menu appears.

*3.*    Tap **Horizontal Scale nm**. The Horizontal Scale menu appears.
"nm" after "Horizontal Scale" will appear as "nm," "THz,", or "cm$^{-1}$" depending on the horizontal scale unit that was selected before this step.

*4.*    Tap **nm**, **THz**, or **cm$^{-1}$** to select the horizontal scale unit.

*5.*    Tap **Return**.
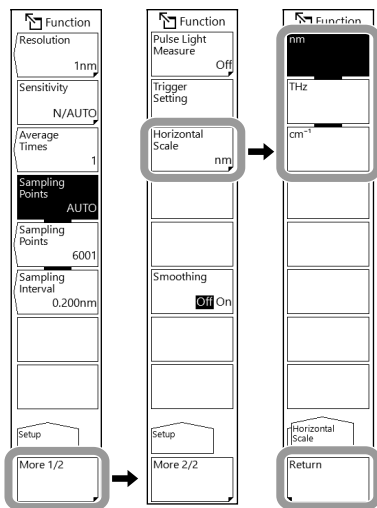


#### Setting the measured wavelength to wavelength in air or that in vacuum

*1.*    Press **SYSTEM**. The System menu appears.

*2.*    Tap **Wavelength in Air/Vacuum**. A confirmation message appears.

*3.*    Tap **Yes**. To cancel, tap **No**.
When you tap Yes, the displayed waveforms, moving markers, and fixed markers will be cleared.



*Note*
- This function takes effect when a measurement is executed after the setting is changed. It is not applied to the waveform that has already been measured.
- When the setting is changed, in Air  (in Air mode) or  in Vacuum  (in Vacuum mode) is displayed, respectively, at the bottom of the waveform screen.
- When the horizontal scale unit is frequency or wavenumber, the mode is fixed at Vacuum, regardless of this setting.

# Setting the center wavelength (center frequency or center wavenumber)

There are four ways to set the center wavelength, center frequency, or center wavenumber:

- Setting the center wavelength (center frequency or center wavenumber) on the Center menu
- Setting the start and stop wavelengths (start and stop frequencies or start and stop wavenumbers) on the Center menu
- Setting using one-action
- Setting the center wavelength (center frequency or center wavenumber) to the moving marker wavelength (frequency or wavenumber)

## Switching between the wavelength, frequency, and wavenumber displays

Set the horizontal scale to nm, THz, or cm$^{-1}$ using the horizontal scale settings on page 2-1. The setup item switches between wavelength, frequency, and wavenumber displays according to the setting.

## Setting the center wavelength (frequency or wavenumber) on the Center menu

1. Press **CENTER**. The Center menu appears.

2. Tap **Center**. A CENTER setting window appears.

3. Enter the center wavelength (frequency or wavenumber) in the displayed window.
   For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

**Setting example (for center wavelength)**



*Note*

- The assigned value is applied to the measurement conditions area.
- When a setting is changed, NEW appears in the measurement condition area.
- If you enter a value outside the setting range, the closest allowed value is assigned.

## Setting the center start and stop wavelengths (frequencies or wavenumbers) on the Center menu

*1.* Press **CENTER**. The Center menu appears.

### Setting the start wavelength (frequency or wavenumber)

*2.* Tap **Start**. A START setting window appears.

*3.* Enter the start wavelength (frequency or wavenumber) in the displayed window.
    For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

### Setting the stop wavelength (frequency or wavenumber)

*4.* Tap **Stop**. A STOP setting window appears.

*5.* Enter the stop wavelength (frequency or wavenumber) in the displayed window.
    For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

**Setting example (for start wavelength)**



*Note*

- The assigned value is applied to the measurement conditions area.
- When a setting is changed, NEW appears in the measurement condition area.
- If you enter a value outside the setting range, the closest allowed value is assigned.

## Setting using one-action

1. Press **CENTER**. The Center menu appears.

2. Tap one of the following four menus.

   Tap **Peak WL** -> **Center**:

   The center wavelength (frequency or wavenumber) is set to the peak wavelength (frequency or wavenumber).

   Tap **Mean WL** -> **Center**:

   The center wavelength (frequency or wavenumber) is set to RMS 20dB center wavelength (frequency or wavenumber).

   Tap **Auto Center Off On** to select On:

   The peak wavelength (frequency or wavenumber) of the measured waveform is assigned automatically to the center wavelength (frequency or wavenumber) for each sweep.

   Tap **View Scale** -> **Measure**:

   The center wavelength (frequency or wavenumber) is set to the currently displayed ZOOM scale (see section 4.1). This is used in the center wavelength (frequency or wavenumber) measurement of the next sweep.
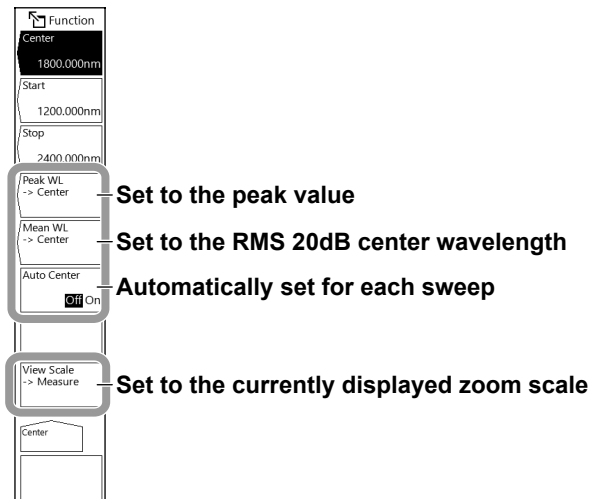


**Set to the peak value**

**Set to the RMS 20dB center wavelength**

**Automatically set for each sweep**

**Set to the currently displayed zoom scale**

## Setting the center wavelength (frequency or wavenumber) to the moving marker wavelength (frequency or wavenumber)

1. Press **MARKER**. The Marker menu appears.

2. With the moving marker (see section 5.1) displayed, tap **Marker** -> **Center**.
   The center wavelength (frequency or wavenumber) is set to the moving marker wavelength (frequency or wavenumber). The displayed waveform is redrawn according to the set center wavelength (frequency or wavenumber).

# Setting the sweep span

There are four ways to set the sweep span:
- Setting the sweep span in the Span menu
- Setting the start and stop wavelengths (start and stop frequencies or start and stop wavenumbers) on the Span menu
- Setting using one-action
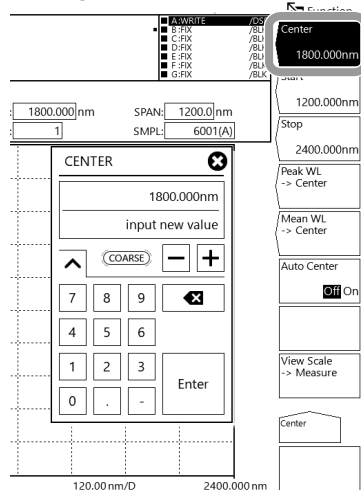- Setting the measurement sweep span to the span between line markers L1 and L2

## Switching between the wavelength, frequency, and wavenumber displays

Set the horizontal scale to nm, THz, or cm$^{-1}$ using the horizontal scale settings on page 2-1. The setup item switches between wavelength, frequency, and wavenumber displays according to the setting.

## Setting the sweep span in the Span menu

1. Press **SPAN**. The Span menu appears.
2. Tap **Span**. A SPAN setting window appears.
3. Enter the sweep span in the displayed window.
   For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

**Setting example (wavelength sweep span)**
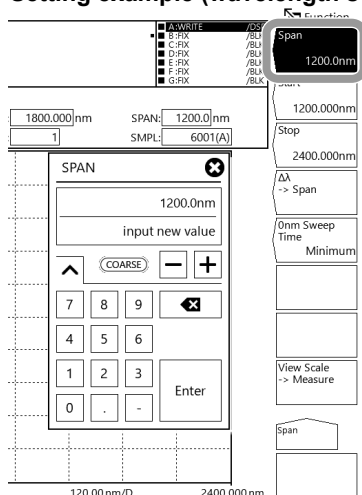


> *Note*
> - The assigned value is applied to the measurement conditions area.
> - When a setting is changed, NEW appears in the measurement condition area.
> - If you enter a value outside the setting range, the closest allowed value is assigned.

## Setting the center start and stop wavelengths (frequencies or wavenumbers) on the Span menu
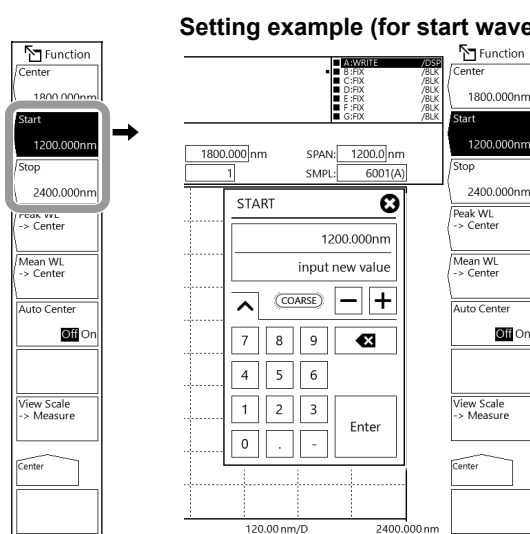
**1.** Press **SPAN**. The Span menu appears.

### Setting the start wavelength (frequency or wavenumber)

**2.** Tap **Start**. A START setting window appears.

**3.** Enter the start wavelength (frequency or wavenumber) in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

### Setting the stop wavelength (frequency or wavenumber)

**4.** Tap **Stop**. A STOP setting window appears.

**5.** Enter the stop wavelength (frequency or wavenumber) in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

**Setting example (for start wavelength)**



### Note

- The assigned value is applied to the measurement conditions area.
- When a setting is changed, NEW appears in the measurement condition area.
- If you enter a value outside the setting range, the closest allowed value is assigned.

## Setting using one-action

1. Press **SPAN**. The Span menu appears.

2. Tap one of the following two menus.

Tap **Δλ -> Span**:
The sweep span is set to RMS 20 dB span × 6 of the active trace waveform.
Tap **View Scale -> Measure**:
The sweep span is set to the currently displayed ZOOM scale (see section 4.1). In the next sweep, the displayed waveform will be redrawn according to the set sweep span.

**Set to RMS 20 dB × 6**

**Set to the currently displayed zoom scale**
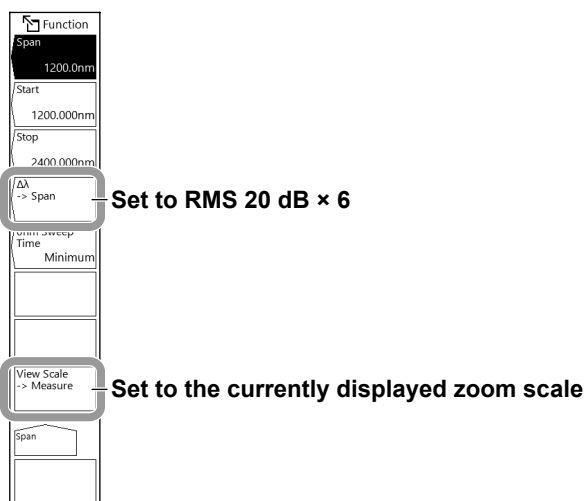
## Setting the measurement sweep span to the span between line markers L1 and L2

1. Press **MARKER**. The Marker menu appears.

2. Tap **More 1/3**. The More 2/3 menu appears.

3. With line markers L1 and L2 displayed (see section 5.2), tap **Marker L1-L2 -> Span**. The sweep span is set to the span between line markers L1 and L2.
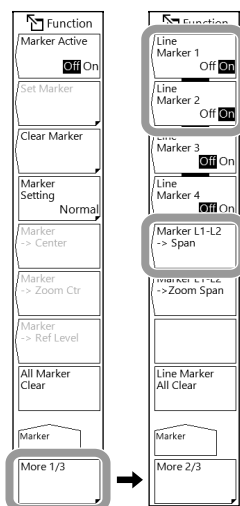
### Note
- If only line marker L1 is displayed, the sweep stop position is set to the right edge of the screen. If only L2 is displayed, the sweep start position is set to the left edge of the screen.
- The Marker L1-L2 -> Span menu cannot be used under the following conditions.
  - When both L1 and L2 are off
  - When the span of the active trace is 0 nm

## Explanation

## Horizontal scale

### Wavelength display mode
- Measured waveforms are displayed with the horizontal scale set to wavelength.
- The measurement scale and display scale are set in terms of wavelength.
- The horizontal scale unit of marker values and analysis results is wavelength.

### Frequency display mode
- Measured waveforms are displayed with the horizontal scale set to frequency.
- The measurement scale and display scale are set in terms of frequency.
- The horizontal scale unit of marker values and analysis results is frequency.

### Frequency display mode
- Measured waveforms are displayed with the horizontal scale set to wavenumber.
- The measurement scale and display scale are set in terms of wavenumber.
- The horizontal scale unit of marker values and analysis results is wavenumber.

### Displayed units for horizontal scale and marker values

The unit displayed for marker values (wavelength, frequency, or wavenumber) can be set separately from the waveform display's horizontal scale unit (wavelength, frequency, or wavenumber) set with Horizontal Scale under SETUP. The default unit is nm.
(For example, it is possible to set the horizontal scale to frequency display mode and marker values to wavelength display mode.)

### Note
The Marker Unit setting changes in sync with the Horizontal Scale setting, but changing the Marker Unit will not change the Horizontal Scale setting.

## Center wavelength (frequency or wavenumber)
## Start wavelength (frequency or wavenumber)
## Stop wavelength (frequency or wavenumber)

Set the horizontal scale to nm, THz, or $cm^{-1}$ using the horizontal scale settings on page 2-1. The display mode switches between wavelength, frequency, and wavenumber displays according to the setting.
The selectable ranges for each item are as follows:

### Standard model (suffix code -10), limited model (suffix code -01)

| Display mode | Center | Start | Stop |
|---|---|---|---|
| Wavelength (nm) | 1200.000 to 2400.000 | 600.000 to 2400.000 | 1200.000 to 3000.000 |
| Frequency (THz) | 125.0000 to 250.0000 | 60.0000 to 250.0000 | 125.0000 to 315.0000 |
| Wavenumber ($cm^{-1}$) | 4167.000 to 8333.000 | 2067.000 to 8333.000 | 4167.000 to 10433.000 |

**Value steps**

When COARSE is selected, you can change the value in steps of 1 nm (0.1 THz or 1 $cm^{-1}$).
Otherwise, you can change the value in steps of 0.1 nm (0.01 THz or 0.1 $cm^{-1}$).

### Extended model (suffix code -20)

| Display mode | Center | Start | Stop |
|---|---|---|---|
| Wavelength (nm) | 1000.000 to 2500.000 | 250.000  to 2500.000 | 1000.000 to 3250.000 |
| Frequency (THz) | 120.0000 to 300.0000 | 30.0000 to 300.0000 | 120.0000 to 390.0000 |
| Wavenumber ($cm^{-1}$) | 4000.000 to 10000.000 | 1000.000 to 10000.000 | 4000.000  to 13000.000 |

The value steps are the same as those for the standard model and limited model.

*Note*

* When you set the start wavelength or stop wavelength, the sweep span will change because the other wavelength does not change. The center wavelength will also change.
* Changing the center wavelength will not change the sweep span.
* The above description also applies to the frequency and wavenumber display modes.

### One-action

This is a general term for the operations that use data from the active trace waveform to set measurement conditions. To use them, a waveform must be displayed in the active trace.

* **Peak WL -> Center**

  The center wavelength is set to the wavelength at the peak value of the active trace waveform.

  When executed, the specified center wavelength is displayed in a center wavelength setting window. Then, you can further change the center wavelength.

  The same is true for the center frequency and center wavenumber.

* **Mean WL -> Center**

  The center wavelength is set to the average (RMS 20 dB center wavelength) of the spectrum in the range from the peak of the active trace waveform down to the threshold (20 dB). Then, you can further change the center wavelength.

  The same is true for the center frequency and center wavenumber.

* **Auto Center Off/On**

  This function sets whether Peak WL -> Center is executed for each sweep.

  When this function is set to ON, the peak in the active trace waveform is automatically detected and assigned to the center wavelength for each sweep.

  The active trace must be set to WRITE.

  When set to On, [AUT CTR] is highlighted at the bottom of the screen.

  The same is true for the center frequency and center wavenumber.

2

Setting the Measurement Conditions

- **View Scale -> Measure**
  The measurement scale (Center, Start, Stop, Span) is set to the currently set zoom scale (Zoom Center, Zoom Span, Zoom Start, Zoom Stop).
  The set scale becomes the measurement scale for the next sweep.

## Moving marker

**Marker -> Center**

The center wavelength is set to the moving marker wavelength. The displayed waveform is redrawn according to the set center wavelength.

The same is true for the center frequency and center wavenumber.

## Sweep span

Set the horizontal scale to nm, THz, or $cm^{-1}$ using the horizontal scale settings on page 2-1. The display mode switches between wavelength, frequency, and wavenumber displays according to the setting.

The selectable ranges for each sweep span are as follows:

## Wavelength sweep span (frequency or wavenumber)
## Start wavelength (frequency or wavenumber)
## Stop wavelength (frequency or wavenumber)

### Standard model (suffix code -10), limited model (suffix code -01)

| Display mode | Sweep span | Start | Stop |
|---|---|---|---|
| Wavelength (nm) | 0, 0.5 to 1200.0 | 600.000  to 2400.000 | 1000.000 to 3000.000 |
| Frequency (THz) | 0, 0.01 to 130.00 | 60.0000 to 250.0000 | 125.0000  to 315.0000 |
| Wavenumber ($cm^{-1}$) | 0, 0.5 to 4200.0 | 2067.000 to 8333.000 | 4167.000  to 10433.000 |

**Value steps**

- **Sweep span**
  When COARSE is selected, you can change the value in 1-2-5 steps. Otherwise, you can change the value in steps of 1 nm (0.1 THz or 1 $cm^{-1}$).

- **Start and stop**
  When COARSE is selected, you can change the values in steps of 1 nm (0.1 THz or 1 $cm^{-1}$). Otherwise, you can change the value in steps of 0.1 nm (0.01 THz or 0.1 $cm^{-1}$).

### Extended model (suffix code -20)

| Display mode | Sweep span | Start | Stop |
|---|---|---|---|
| Wavelength (nm) | 0, 0.5 to 1500.0 | 250.000  to 2500.000 | 1000.000 to 3250.000 |
| Frequency (THz) | 0, 0.01 to 180.00 | 30.0000 to 300.0000 | 120.0000  to 390.0000 |
| Wavenumber ($cm^{-1}$) | 0, 0.5 to 6000.0 | 1000.000 to 10000.000 | 4000.000  to 13000.000 |

The value steps are the same as those for the standard model and limited model.

### Note

- When you change the sweep span, the start wavelength and stop wavelength will change. The center wavelength will not change.
- When you change the center wavelength, the start wavelength and stop wavelength will change but the sweep span will not.
- When you set the start wavelength or stop wavelength, the sweep span will change because the other wavelength does not change. The center wavelength will also change.
- The above description also applies to the frequency and wavenumber display modes.

## One-action

This is a general term for the operations that use data from the active trace waveform to set measurement conditions. To use them, a waveform must be displayed in the active trace.

- Δλ -> **Span**
  The sweep span is set to six times the spectral width based on the RMS method (20 dB threshold) of the active trace waveform.

- **View Scale** -> **Measure**
  The measurement scale (Center, Start, Stop, Span) is set to the currently set zoom scale (Zoom Center, Zoom Span, Zoom Start, Zoom Stop).
  The set scale becomes the measurement scale for the next sweep.

## Line Markers

**Marker L1-L2** -> **Span**
The sweep span is set to the span between line markers 1 and 2.
The setting range is within the available ranges of each model.

# 2.2 Wavelength Resolution

## Procedure

Set the horizontal scale to nm, THz, or cm$^{-1}$ using the horizontal scale settings in section 2.1. The display mode switches between wavelength, frequency, and wavenumber according to the setting.

1. Press **RESOLN**. A Resolution menu and RESOLUTION setting window are displayed.
   (The same window appears when you tap **Resolution** on the Setup menu that appears when you press **SETUP**.)

You can set the value by either of the following methods.

### Selecting by tapping the menu

2. On the Resolution menu, tap the resolution you want.

### Selecting on the RESOLUTION setting window

2. On the RESOLUTION setting window displayed in step 1, tap **–** or **+**. When the value on the RESOLUTION setting screen is equal to any of the values on the Resolution menu, the value on the Resolution menu is highlighted.

3. When the resolution you want to use is highlighted, tap **Exit**.
   If you enter a value not on the Resolution menu, the closest available value on the menu is applied.

**Display example on the standard model**
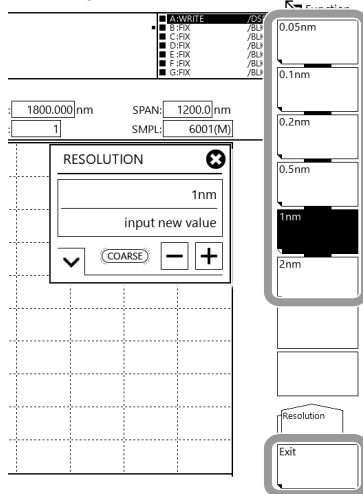


### Note

If the sweep span, sampling points, or resolution setting is inappropriate, [UN CAL] is displayed.

## What to do when "UNCAL" is displayed

Perform any of the following:
- Decrease the sweep span.
- Increase the sampling points.
- Lower the resolution (increase the value).
- Tap Sampling Points AUTO on the Setup menu.

When the sweep span, sampling points, and resolution settings become appropriate, the [UN CAL] disappears.

## Explanation

### Wavelength resolution (frequency and wavenumber)

The available resolution settings are as follows:

#### Standard model (suffix code -10), extended model (suffix code -20)

| Display mode | Settings |
| --- | --- |
| Wavelength | 0.05 nm, 0.1 nm, 0.2 nm, 0.5 nm, 1 nm, 2 nm |
| Frequency | 10 GHz, 20 GHz, 40 GHz, 100 GHz, 200 GHz, 400 GHz |
| Wavenumber | $0.1\ cm^{-1}$, $0.25\ cm^{-1}$, $0.5\ cm^{-1}$, $1\ cm^{-1}$, $2.5\ cm^{-1}$, $5\ cm^{-1}$ |

#### Limited model (suffix code -01)

| Display mode | Settings |
| --- | --- |
| Wavelength | 0.1 nm, 0.2 nm, 0.5 nm, 1 nm |
| Frequency | 20 GHz, 40 GHz, 100 GHz, 200 GHz |
| Wavenumber | $0.25\ cm^{-1}$, $0.5\ cm^{-1}$, $1\ cm^{-1}$, $2.5\ cm^{-1}$ |

## Conditions that do not cause UNCAL

The sampling intervals (see section 2.3) that do not cause UNCAL vary depending on the resolution setting.

For example, to prevent UNCAL from occurring at a resolution of 0.05 nm, the sampling interval must be 0.01 nm or less. To measure at 20 nm sweep span, the sample points must be set at least to $20 \div 0.01 + 1 = 2001$. For details, see "Number of samples (Sampling Points)" in section 1.1.

## Ripples in the 1350 nm to 1450 nm and 1800 nm to 1950 nm area

For details, see "Ripples in the 1350 nm to 1450 nm and 1800 nm to 1950 nm area" in section 3.1, "Measurement Precautions."

# 2.3 Sampling

## Procedure

There are three ways to set sampling:
- Setting the sampling points
- Setting the sampling interval
- Automatically setting the sampling points or sampling interval according to the sweep span and resolution setting

*1.* Press **SETUP**. The Setup menu appears.

*2.* Tap one of the following three menus.

Tap **Sampling Points AUTO**:

Sampling points or sampling interval is automatically set according to the sweep span and wavelength resolution setting. The procedure ends here.

Tap **Sampling Points**:

After tapping, set the sampling points. Proceed to step 3.

Tap **Sampling Interval**:

After tapping, set the sampling interval. Proceed to step 3.

**If you have tapped Sampling Points or Sampling Interval**

*3.* Enter the sampling points or sampling interval in the displayed window.

For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.



**Setting screen when Sampling Points is tapped**

---
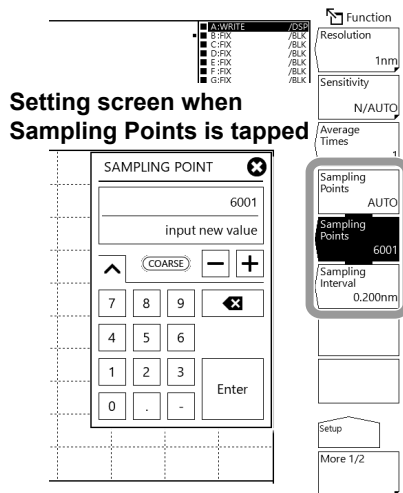
*Note*

- If the sweep span, sampling points, or resolution setting is inappropriate, [UN CAL] is displayed.
- For instructions on what to do when [UN CAL] is displayed, see section 2.2.

## Explanation

### Sampling points (the number of points to measure in a single sweep)

Set the number of measurement points per set sweep span.

Selectable range: 101 to 200001

### Relationship between sampling points, sampling interval, and sweep span

The relationship between sampling points, sampling interval, and sweep span is as follows:

$$\text{Sampling points} = \frac{\text{Sweep span}}{\text{Sampling interval}} + 1$$

Given the same sweep span, the sampling points are automatically determined when the interval is known, and vice versa.

For the sweep span setting range, see the explanation in section 2.1, "Measurement Range."

### *Note*

- Increasing the sampling points or decreasing the sampling interval reduces the sweeping speed.
- Settings that would cause the number of samples in the sweep span to be extremely small cannot be specified.
- Changing the sampling points also changes the sampling interval accordingly.

### Relationship between the sampling interval and wavelength resolution

If settings are entered such that the sampling interval determined by the sweep span and sampling points is extremely long relative to the wavelength resolution, data dropout may occur. In such cases, UNCAL (see section 2.2) is displayed. Enter settings that are appropriate for the resolution.

### Sampling Points AUTO

Sampling points or sampling interval is automatically set according to the sweep span and wavelength resolution setting.

The sampling intervals that do not cause UNCAL vary depending on the resolution setting.

For example, to prevent UNCAL from occurring at a resolution of 0.05 nm, the sampling interval must be 0.01 nm or less. To measure at 20 nm sweep span, the sample points must be set at least to 20 ÷ 0.01 + 1 = 2001. For details, see "Number of samples (Sampling Points)" in section 1.1.

**2** Setting the Measurement Conditions

## 2.4 Measurement Sensitivity

### Procedure

1. Press **SETUP**. The Setup menu appears.
2. Tap **Sensitivity**. The Sensitivity menu appears.
3. Tap **Sensitivity Select.** A Sensitivity selection menu and SENSITIVITY setting window are displayed.

   (You can also display the same menu by pressing **SENS** instead of using SETUP.)

You can set the value by either of the following methods.

### Selecting by tapping the menu

4. Tap **More 1/2** and **More 2/2** to view the available values in the menus. Tap the sweep measurement sensitivity you want to use. The minimum power value corresponding to the selected measurement sensitivity appears in the Sensitivity Level menu.

### Selecting on the SENSITIVITY setting window

4. On the SENSITIVITY setting window displayed in step 3, tap **–** or **+**. On the More 1/2 and More 2/2 menus, the highlighted value changes every time you tap.

5. When the measurement sensitivity you want to use is highlighted, tap **Return**. The minimum power value corresponding to the specified measurement sensitivity appears in the Sensitivity Level menu.

**Display example on the standard model**
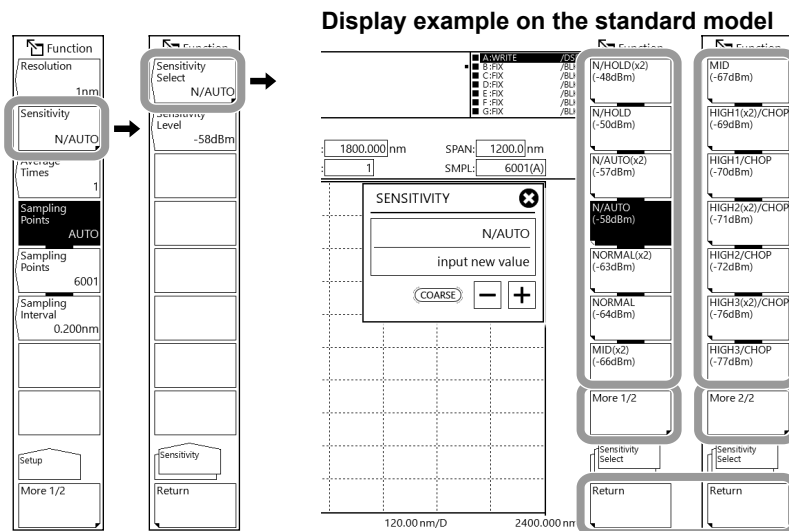
# Setting the measurement sensitivity by entering the measurement level directly

**3.** Tap **Sensitivity Level**. The SENS LEVEL setting window appears.

**4.** Enter the approximate minimum power value you want to measure in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

**5.** Tap **Return**.
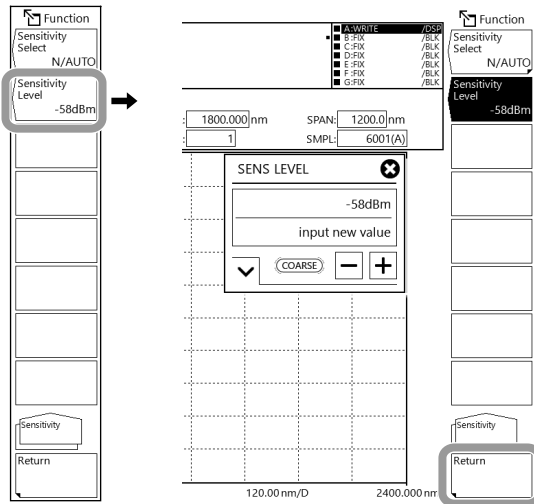


*Note*

- The specified measurement sensitivity is applied to the measurement conditions area.
- When the measurement sensitivity is changed, NEW appears in the measurement condition area.
- If you select a sensitivity setting from HIGH1 to HIGH3, CHOP MODE will be selected unconditionally.

## Explanation

### Measurement sensitivity

Select the measurement sensitivity from the following:

| | | | |
|---|---|---|---|
| N/HOLD(x2) | N/HOLD | N/AUTO(x2) | N/AUTO |
| NORMAL(x2) | NORMAL | MID(x2) | MID |
| HIGH1(x2)/CHOP | HIGH1/CHOP | HIGH2(x2)/CHOP | HIGH2/CHOP |

The following measurement sensitivities are available on the standard and extended model models. They are not available on the limited model.

HIGH3(x2)/CHOP        HIGH3/CHOP

- If you select N/HOLD, the analog amplifier circuit is set to fixed gain mode. The gain is set according to the reference level set in section 2.5. If the gain is fixed, the measurement range is from "reference level – 20 dBm" to "reference level + 10 dBm" due to the limited effective measurement range.
- If you select a setting other than N/HOLD, the analog amplifier circuit is set to auto gain mode. This mode allows a wider range of levels to be measured in a single sweep.
- You can select double speed mode, which measures at a sweep speed that is about twice as fast as usual. "(x2)" is appended to the sensitivity setting name such as NORMAL(x2) and MID(x2).
- The double speed mode is suitable for measuring light sources, such as LED light sources, where the level change of the spectral shape is relatively gradual.
  This mode has the following features.
    - The noise level is approximately 2 dB higher than normal.
    - If used under UNCAL conditions, for waveforms that have sharp spectral shape changes, such as those produced by the DFB-LD, the level and wavelength measurement accuracies may degrade. Use it after checking the measurement spectrum.

### Measurement sensitivity by entering the measurement level directly

Enter the approximate minimum power value you want to measure, and the measurement sensitivity will be set automatically.

# CHOP mode

CHOP mode is for running the chopper inside the monochromator. The stray light inherent in monochromators is reduced by running the chopper. CHOP mode allows higher signal-to-noise measurements.

CHOP mode is enabled at all times for the following measurement sensitivities.

HIGH1(x2)/CHOP, HIGH1/CHOP, HIGH2(x2)/CHOP, HIGH2/CHOP, HIGH3(x2)/CHOP, HIGH3/CHOP

## CHOP mode feature

| CHOP mode | Feature | Advantages | Disadvantages |
|---|---|---|---|
| Disabled | The stray light component is also measured.<br><br>Stray light suppression ratio: 40 dB or more | Measurement is fast even for high-sensitivity measurements. | Since the stray light component is also measured, low level components are inaccurate when the light source power is high. |
| Enabled | Highly dynamic measurements are possible using internal modulation.<br><br>Stray light suppression ratio: 60 dB or more | Measurements can be made with the stray light removed. Long, high-sensitivity measurements are possible because there are no offset fluctuations. | Measurement time is long. |

# Monochromator stray light

For details, see "Monochromator stray light" in section 3.1, "Measurement Precautions."

# 2.5    Level Scale

When measurement waveforms are displayed, the level scale is displayed with absolute values. The level scale with absolute values is the main scale and that with relative values the sub scale. For a description of the sub scale, see section 2.6.

## Procedure

### Configuring the level scale with absolute values (main scale)

*1.*    Press **LEVEL**. The Level menu appears.

### Changing to the log scale display

*2.*    Tap **Log Scale**. The vertical scale is displayed with the currently set log scale value. At the same time, the LOG SCALE setting window appears.

*3.*    Enter the log scale value in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
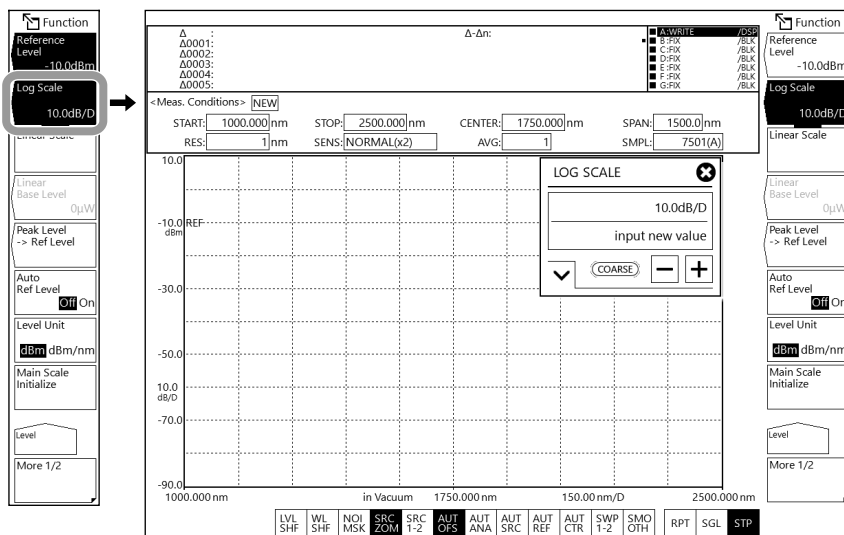
## Changing to the linear scale display

**2.** Tap **Linear Scale**. The vertical scale is displayed with the currently set linear scale value.

**3.** Tap **Linear Base Level**. The BASE LEVEL setting window appears.

**4.** Enter the value at the bottom of the scale in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
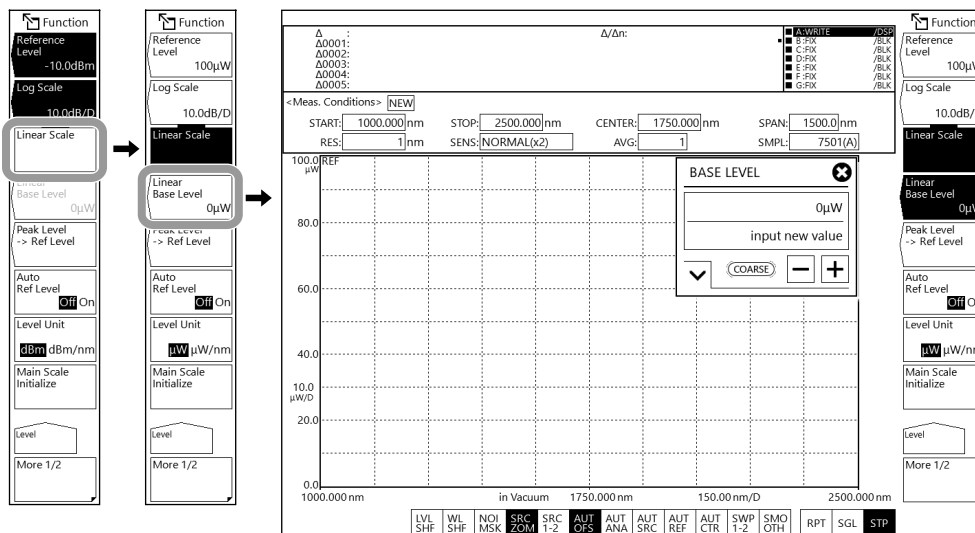


## Setting the vertical scale unit

**2.** Tap **Level Unit**. The vertical scale unit is changed.
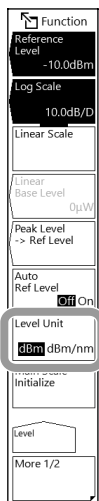
The units that you can select vary depending on the specified horizontal scale unit, vertical scale, and reference level unit.



| Horizontal scale unit (Horizontal Scale) | Vertical scale (Log/Linear Scale) | Reference level unit (Reference Level) | Vertical scale unit options (Level Unit) |
|---|---|---|---|
| nm | Log Scale | — | dBm, dBm/nm |
| | Linear Scale | pW | pW, pW/nm |
| | | nW | nW, nW/nm |
| | | μW | μW, μW/nm |
| | | mW | mW, mW/nm |
| THz | Log Scale | — | dBm, dBm/THz |
| | Linear Scale | pW | pW, pW/THz |
| | | nW | nW, nW/THz |
| | | μW | μW, μW/THz |
| | | mW | mW, mW/THz |
| cm$^{-1}$ | Log Scale | — | dBm |

## Setting the number of divisions in the vertical scale (only for log scale)

**2.** Tap **Log Scale**.

**3.** Tap **More 1/2**. The More 2/2 menu appears.

**4.** Tap **Y Scale Setting**. The Y Scale Setting menu appears.

**5.** Tap **Y Scale Division**. A menu appears for selecting the number of divisions.

**6.** Tap **8** or **10**. The vertical scale is displayed with the specified number of divisions.
For linear scale, the number of divisions is fixed at 10.
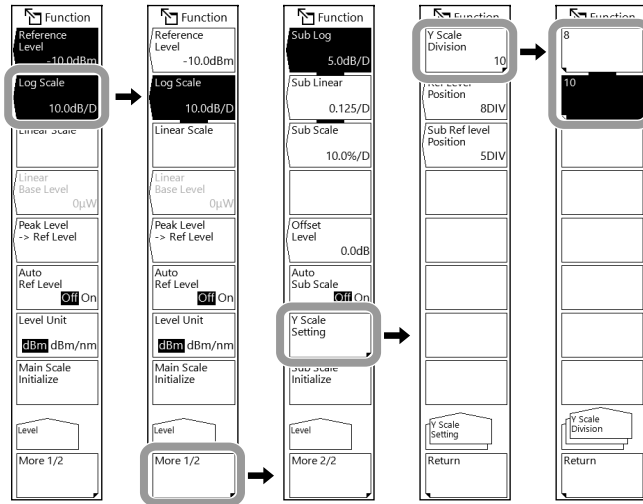


## Setting the reference level position on the screen (for log scale)

**5.** Continuing from step 4 in "Setting the number of divisions in the vertical scale," tap **Ref Level Position**. A window appears for setting the reference level position on the screen (REF position).

**6.** Enter the number of divisions counted from the bottom of the waveform display area.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
- If the REF position value is greater than the number of divisions, it is reduced to the same value as the number of divisions.
- For linear scale, the REF position is fixed at the top (fixed at 10 DIV).
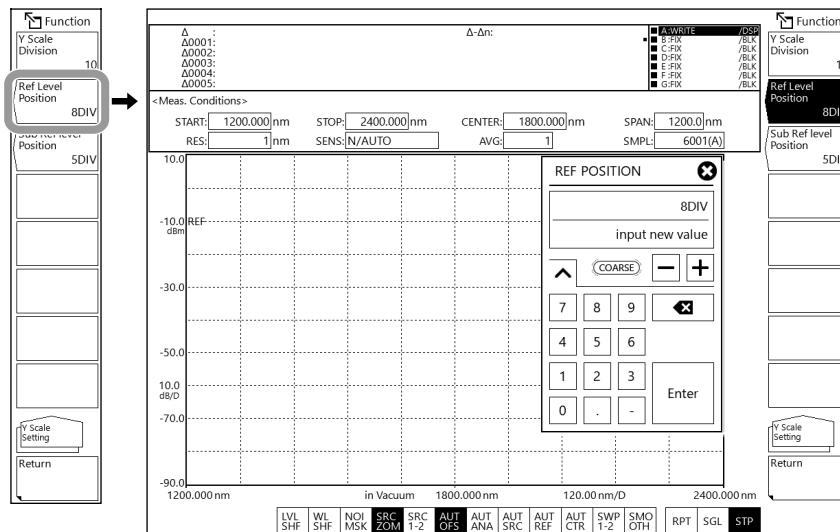
# Setting the reference level

There are three ways to set the reference level.
- Using the Reference Level parameter
- Using the one-action keys
- Setting the reference level to the moving marker level

*1.* Press **LEVEL**. The Level menu appears.

## Using the Reference Level parameter (log scale)

*2.* If the vertical scale is not set to log scale, tap **Log Scale**. If the log scale is displayed, proceed to step 3.

*3.* Tap **Reference Level**. The REF LEVEL setting window appears.

*4.* Enter the reference level in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
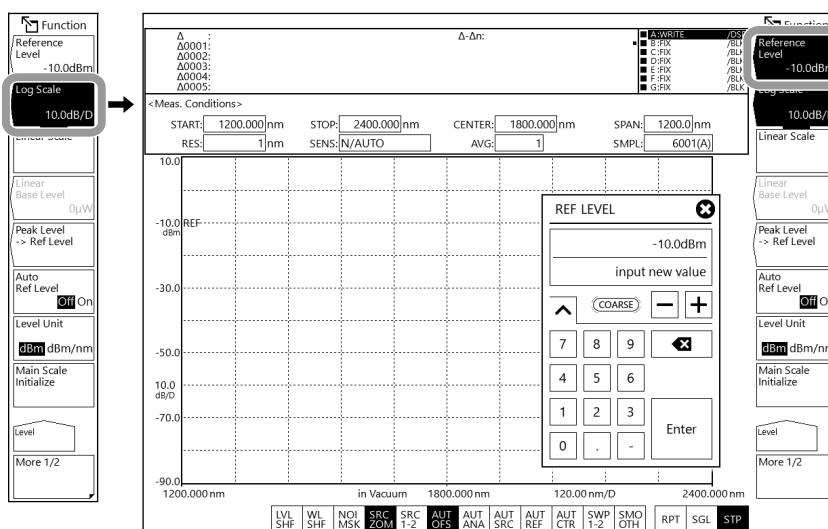


*Note*
The vertical scale setting is applied to the waveform display in real-time.

## Using the Reference Level parameter (linear scale)

**2.** If the vertical scale is not set to linear scale, tap **Linear Scale**. If the linear scale is displayed, proceed to step 3.

**3.** Tap **Reference Level**. The REF LEVEL setting window appears.

**4.** Enter the reference level in the displayed window. When you enter a value, a menu appears for selecting the unit.

**5.** On the unit selection menu, tap the unit you want to use. The reference level will be set.



Enter the reference level.
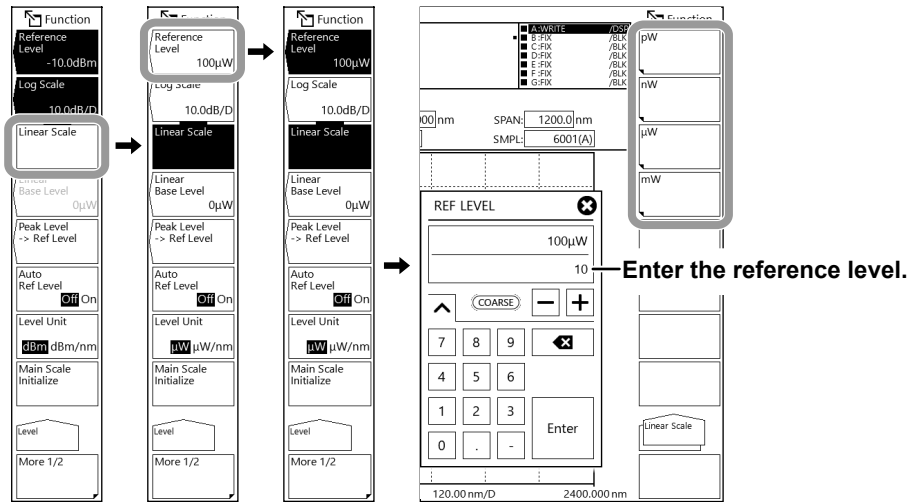
*Note*

If you enter the value using the rotary knob or by tapping – and + on the setting window, the reference level will be set in the current unit.

## Setting using one-action

*2.*    Tap one of the following two menus.

Tap **Peak Level** -> **Ref Level**:

The reference level is set to the peak level of the active trace waveform. The specified reference level is displayed, and the displayed waveform is redrawn according to the new reference level.

Tap **Auto Ref Level Off On** to select On:

For each sweep, the reference level is set to the peak level of the active trace waveform.

- This does not work when the active trace is set to a type other than Write (Max Hold, Min Hold, Calculate, Roll Average).
- If this soft key is on, $\boxed{\substack{\text{AUT}\\\text{REF}}}$ at the bottom of the screen will be highlighted.
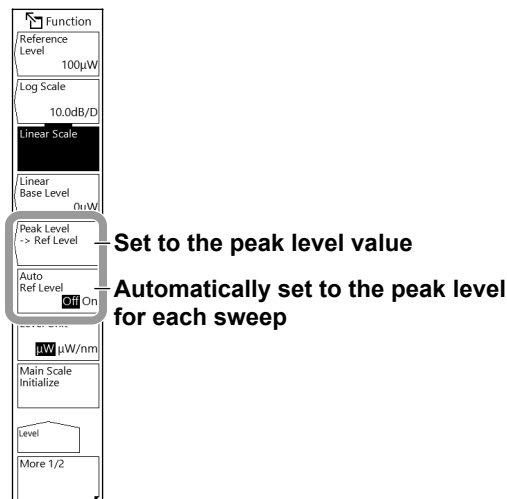
Set to the peak level value

Automatically set to the peak level for each sweep

## Setting the reference level to the moving marker level

*1.*    Press **MARKER**. The Marker menu appears.

*2.*    With the moving marker (see section 5.1) displayed, tap **Marker** -> **Ref Level**. The specified reference level is displayed, and the displayed waveform is redrawn according to the new reference level.
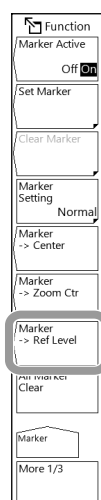
## Explanation

## Level scale with absolute values (main scale)

### Log Scale **.*dB/D

This soft key switches the vertical scale to log display and sets the scale.

Setting range: 0.1 dB/DIV to 10.0 dB/DIV

You can set it in steps of 0.1 dB. When you tap COARSE, you can set it in steps of 1-2-5 (e.g., 1 dB/DIV → 2 dB/DIV → 5 dB/DIV).

When you change this setting, the displayed waveform is redrawn according to the new scale. If you specify a scale greater than 5 dB/DIV in fixed range mode (measurement sensitivity N/HOLD(x2) or N/HOLD), a warning will be displayed because the top and bottom of the waveform will not be measured correctly.

### Measurement sensitivity and effective vertical scale range

If the measurement sensitivity is set to N/HOLD, the internal amplifier is set to fixed gain. The gain is set automatically from the five available settings depending on the reference level (REF) setting. The effective range of measurement data is limited to the following range relative to the reference (REF) level.

REF − 20 dBm < (effective range) < REF + 10 dBm

If the scale is set to 10 dB/DIV, the display will fall outside the effective range. The waveform between the top edge of the screen to REF + 10 dBm and that between the bottom edge to REF − 20 dBm will be inaccurate.

If the measurement sensitivity is set to N/HOLD, we recommend that you use the level scale at 5 dB/DIV or less.

If the measurement sensitivity is N/AUTO, MID, or HIGH 1 to 3, auto gain is used allowing a wide level range to be measured in one sweep. Select the appropriate sensitivity according to the reception level necessary for measurement.

The explanation above of the measurement sensitivity and effective vertical scale range applies also when the measurement sensitivity is set to rapid mode (measurement sensitivities with x2 indication).

### Linear Scale

This soft key sets the scale to linear scale.

Set the scale per division using the reference level.

### Linear Base Level **.*mW

This soft key is used to set the value at the bottom of the scale when the vertical scale is set to linear scale. This soft key is disabled when the vertical scale is set to log scale.

Selectable range: 0.0 to Ref level × 0.9

You can set it in steps of 0.1. When you tap COARSE, you can set it in steps of 1. You can set the same unit as the reference level unit.

When you change this setting, the displayed waveform is redrawn according to the new scale. The scale display at the upper left of the waveform is set to 1/10 of [reference (ref) level − bottom (Base) level (*W/D).

For details on the reference level setting, see the explanation provided later.

### Level Unit dBm dBm/nm

This soft key sets the display to dBm or dBm/nm when the vertical scale is set to log scale.

dBm: Power per resolution (absolute power)

dBm/nm: Power per nm (power spectral density)

For details on how to use dBm and dBm/nm, see "Power spectral density display" in "Features." If you set a calculated waveform to power spectral density, the level unit is automatically set to dBm. If power spectral density is assigned as the calculated waveform to Trace F and the unit is set to dBm/nm, Trace F enters FIX mode, and the waveform is no longer updated.

### Level Unit mW mW/nm

When the vertical scale is set to linear scale, this soft key switches the display between nW, μW, mW, or pW (absolute power), and nW/nm, μW/nm, mW/nm or pW/nm (power spectral density).

## Reference level

### Log scale (Reference Level)

Setting range for the log scale's reference level: –90.0 dBm to 30.0 dBm

You can set it in steps of 0.1. When COARSE is selected, you can set it in steps of 1.

### Linear scale (Reference Level)

Setting range for the linear scale's reference level: 1.00 pW to 1000 mW

When 1.00 to 9.99 (pW, nW, μW, mW) is selected, you can set it in steps of 0.01.

When 10.0 to 99.9 (pW, nW, μW, mW) is selected, you can set it in steps of 0.1.

When 100 to 999 (pW, nW, μW, mW) is selected, you can set it in steps of 1.

When COARSE is selected, you can set it in steps of 1-2-5 (e.g., 1 pW → 2 pW → 5 pW → 10 pW → 20 pW).

If you change the value from 999 to 1.00 or 1.00 to 999, for example, the unit will change (e.g., pW → nW or nW → pW).

## One-action keys

This is a general term for the keys that use data from the active trace waveform to set measurement conditions.

To use them, a waveform must be displayed in the active trace.

- **Peak Level ·> Ref Level**

    The reference level is set to the peak level of the active trace waveform.

    The specified reference level (peak level value) is displayed in a reference level setting window. Then, you can further change the reference level.

    Log scale's variable range: –90.0 dBm to +30.0 dBm

    Linear scale's variable range: 1.00 pW to 1000 mW

    If the peak level value exceeds the allowed range, it is set to the nearest value within the range and a warning is displayed.

## Moving marker

**Marker ·> Ref Level**

The reference level is set to the level of the moving marker placed on the measured waveform. The specified reference level and waveform are displayed in a reference level setting window. Then, you can further change the reference level.

Log scale's variable range: –90.0 dBm to +30.0 dBm

Linear scale's variable range: 1.00 pW to 1000 mW

If the moving marker value exceeds the allowed range (the moving marker is at a point where the level is –210 dBm), it is set to the nearest value within the range and a warning is displayed.

In the following states, the Marker ·> Ref Level key is disabled.

- When the moving marker is off (Marker Active is Off)

## Main Scale Initialize

This function returns only the level scale (main scale of the vertical scale) to its original condition after the waveform is moved or zoomed through dragging or pinching out or pinching in. This is not synchronized to the sub scale display.

# 2.6 Sub Scale

The level scale is displayed based on relative values when a differential waveform (based on LOG values) or normalized waveform is displayed. The sub scale is the level scale with relative values. For details on the level scale with absolute values (main scale), see section 2.5.

## Procedure

### Displaying the sub scale

Display the differential waveform or normalized waveform according to the procedure in section 4.5 or 4.6.
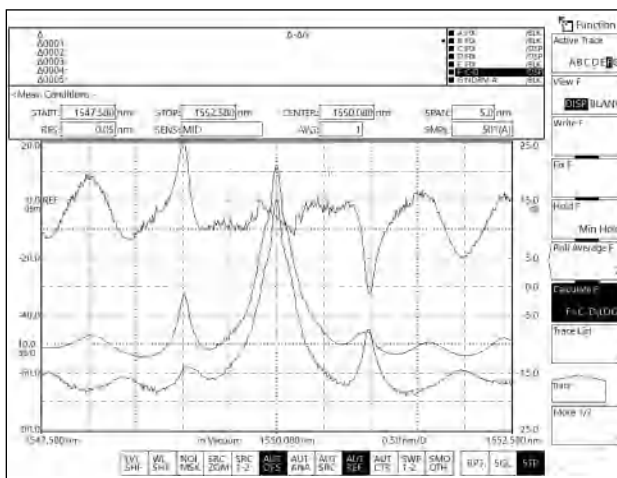


### Auto scaling the sub scale

1. Press **LEVEL**. The Level menu appears.
2. Tap **More 1/2**. The More 2/2 menu appears.
3. Tap **Auto Sub Scale Off On** to select On or Off.
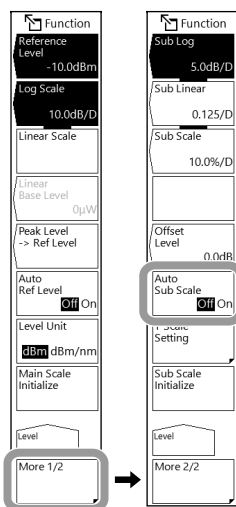
# Log display of the sub scale

*3.* Tap **Sub Log**. The sub scale is displayed with the currently set log scale value. At the same time, the SUB SCALE LOG setting window appears.

*4.* Enter the log scale value in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

## Setting the offset

*3.* Tap **Offset Level**. An offset value setting window appears.

*4.* Enter the offset value in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
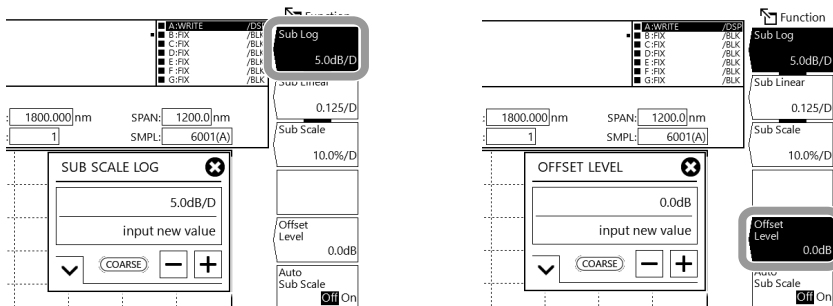


## Setting the REF position

*3.* Tap **Y Scale Setting**. The Y Scale Setting menu appears.

*4.* Tap **Sub Ref level Position**. The REF POSITION setting window appears.

*5.* Enter the REF position in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

*6.* Tap **Return**.
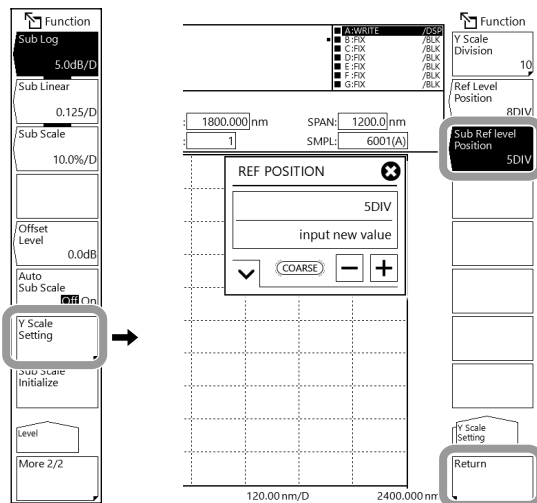


## Note

A sub scale is displayed when differential waveforms (based on log values) or normalized waveforms are displayed. When these waveforms are superimposed on waveforms based on absolute values, the absolute value scale is shown on the left and the relative value scale on the right at the same time. If the left scale is changed to log (8 DIV) or linear (10 DIV), the sub scale is displayed to correspond to the DIV count on the level scale.

## Linear display of the sub scale

**3.** Tap **Sub Linear**. The sub scale is displayed with the currently set linear scale value. At the same time, the SUB SCALE LIN setting window appears.

**4.** Enter the linear scale value in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

### Setting the bottom value

**3.** Tap **Scale Minimum**. The SCALE MIN setting window appears.

**4.** Enter the value at the bottom of the sub scale in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
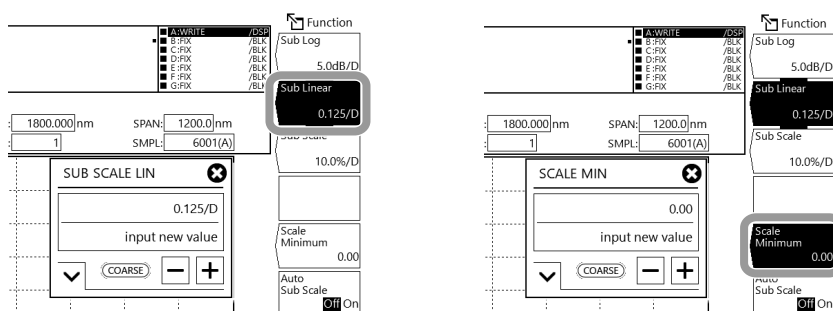
## Setting the sub scale unit to %/D

**3.** Tap **Sub Scale**. The sub scale unit changes to %. At the same time, the SUB SCALE setting window appears.

**4.** Enter the percentage per division in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
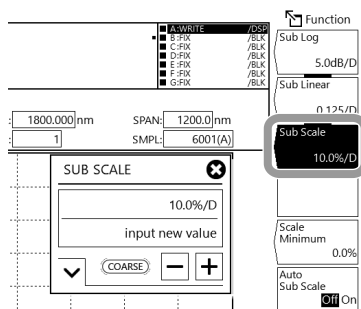
## Initializing the sub scale

**3.** Tap **Sub Scale Initialize**. The sub scale will be initialized.

2

Setting the Measurement Conditions
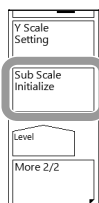
**Explanation**

### Auto scaling of the sub scale (Auto Sub Scale Off On)

This soft key turns on or off the function that displays the sub scale through auto scaling after calculations.

When this soft key is set to on and trace C is displayed, Sub Log or Sub Linear and Offset Level change automatically. When these are changed, the displayed waveform is redrawn according to the new scale.

### Offset value of the sub scale (Offset Level)

This soft key is used to set the offset value. This soft key is valid when the sub scale is dB/D.
Selectable range:   0 dB to ±99.9 dB
You can set it in steps of 0.1. When you tap COARSE, you can set it in steps of 1.

### Sub scale REF position (Sub Ref level Position)

This soft key is used to the sub scale REF position.
You can set the REF position at the specified division counted from the bottom of the screen.
Selectable range: 0 to 10
You can set it in steps of 1. When you tap COARSE, you can set it in steps of 1-2-5.

### Bottom value of the linear sub scale (Scale Minimum)

This soft key is used to set the bottom value of the scale. This soft key is valid when the sub scale is set to Linear or %.
The selectable ranges are as follows:
Linear:    0 to sub scale value (***.*/D)×10
 %:        0 to sub scale value (***.*%/D)×10

### Sub scale unit %/D (Sub Scale)

This soft key sets the sub scale to %.
Selectable range: 0.5 %/D to 125 %/D
You can set it in steps of 0.1. When you tap COARSE, you can set it in steps of 1-2-5.
When you change this setting, the displayed waveform is redrawn according to the new scale.

### Initializing the sub scale (Sub Scale Initialize)

This soft key returns only the sub scale to its original condition after the waveform is moved or zoomed through dragging or pinching out or pinching in. This is not synchronized to the level scale display.

# 2.7 Noise Reduction

## Procedure

### Setting the average times

1. Press **SETUP**. The Setup menu appears.

2. Tap **Average Times**. The AVERAGE TIMES setting window appears.

3. Enter the average times in the displayed window.
   For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
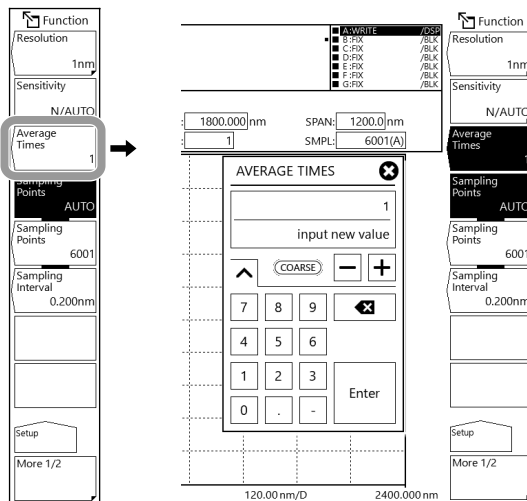


### Setting smoothing

2. Press the **More 1/2** soft key. The More 2/2 menu appears.

3. Tap **Smoothing Off On** to select On.
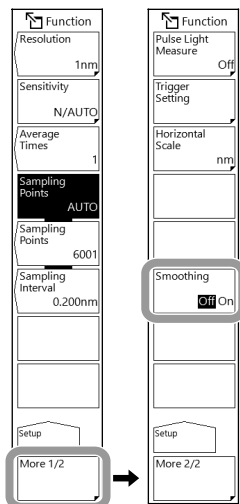
## Explanation

## Average times

This soft key is used to set the average times for each point.

Selectable range: 1 to 999

You can set it in steps of 1. When you tap COARSE, you can set it in steps of 1-2-5.

*Note*

You cannot set the average times when the trigger input mode is set to Smpl Enable Mode.
You cannot set the average times when the pulse light measurement sampling is set to Gate Mode.

## Smoothing

The smoothing function attenuates the noise in the measured waveform.

Waveforms with noise can be smoothed and measured. Note that when noise is superimposed on sudden changes in the spectrum, the peaks and valleys of the spectrum are integrated thereby reducing the measurement resolution. Therefore, do not leave the smoothing function turned on at all times, but use it while checking its effects depending on the measured spectrum.

Also, if a relatively small number of samples is set relative to the sweep span (for example, when UNCAL is displayed), smoothing may not be performed properly.

**When smoothing is off**                **When smoothing is on**
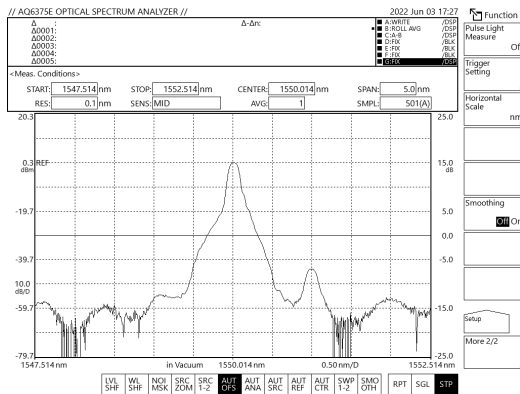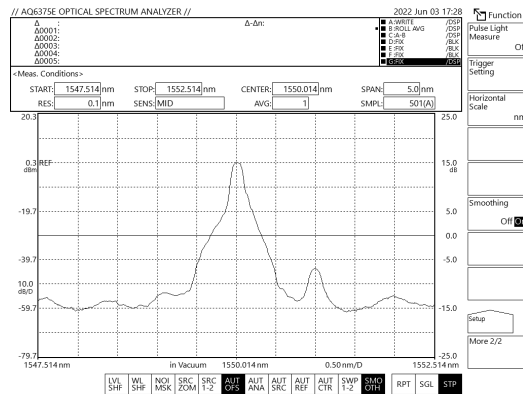
# 3.1    Measurement Precautions

## Types of optical fibers that can be used with this instrument

This instrument can use single-mode optical fibers with a core diameter of 5 to 9.5 µm and multi-mode (GI) optical fibers with a core diameter of 50 µm or 62.5 µm. There are performance limitations depending on which type of optical fiber is used. The table below shows which of the typical types of fiber may be used and the limitations on their use.

### Limitations on wavelength resolution

This instrument's maximum resolution is 0.05 nm. This is obtainable when a single-mode optical fiber with a core diameter up to 9.5 µm is used. The table below shows how the maximum wavelength resolution changes when an optical fiber with a thicker core diameter is used. Setting the wavelength resolution setting smaller than the value in the table will only make the measurement level inaccurate, but will not improve the resolution. Optical fibers with a thick core diameter are especially useful for receiving spatial light for measurement, but they have poor resolution. Choose the best type of optical fiber for your application.

Note that the instrument is designed for input through optical fiber only. It will not work with inputs that do not pass through optical fiber, such as direct input of a gas laser beam to the optical input connector or bringing an LED close in contact with the optical input connector. Note that optical spectrum measured using such methods is unreliable.
To measure spatial light, you need to collect the spatial light into the optical fiber and then apply it to this instrument. A variety of adapters are available for this purpose.

### Summary of usable optical fiber types and usage limitations

| Optical fiber type | | Maximum wavelength resolution [nm] | Absolute level accuracy |
|---|---|---|---|
| Type | Core diameter | | |
| SM | 5 | 0.05 | No |
| | 9.5 | 0.05 | Yes |
| GI | 50 | 0.10 | No |
| | 62.5 | 0.10 | No |
| SI | 50 | 0.10 | No |
| | 80 | 0.20 | No |
| | 100 | 0.50 | No |
| | 200 | 1.00 | No |
| | 400 | 2.00 | No |
| | 800 | 2.00 | No |

# Numerical aperture (NA) of input optical fibers and level measurements

The level measurement errors of this instrument varies depending on the numerical aperture (NA) of the optical fiber connected to the input connector section as shown in the following figure. The absolute level of this instrument is calibrated with a 9.5/125 μm single mode optical fiber (SSMA type in JIS C6835, PC polishing, mode field diameter: 9.5 μm, NA: 0.104 to 0.107). If the NA value is not within this range even for single mode optical fibers, the level accuracy is not guaranteed.

**Numerical aperture of input optical fibers and level errors (representative characteristics)**
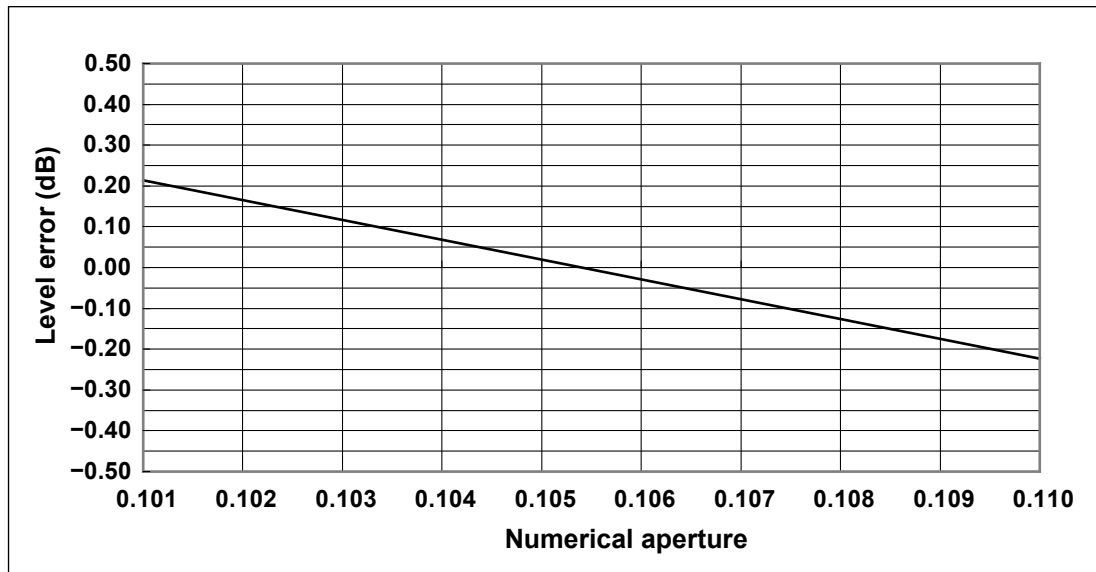


# Absolute level accuracy

The absolute level of this instrument is calibrated with a 9.5 μm single mode optical fiber. The level accuracy when other optical fibers are used is not guaranteed.

For multi-mode (GI) fibers, a relatively accurate spectrum is indicated for low-coherence light, such as white light, natural light, and LEDs. For high-coherence light, such as a laser beam, interference occurs within the optical fiber, and the intensity distribution of light reflected from the end of the fiber varies depending on the fiber form. As such, moving the fiber may change the spectrum (measurement level).

When an optical fiber with a large core diameter or an optical fiber with a large NA value is used, the measurement level is smaller than the true value because only a part of the light emitted from the optical fiber is received, but the relative optical spectrum is accurate.

# Level accuracy at wavelengths at or below the cutoff wavelength (short wavelength) of the connected optical fiber

At wavelengths at or below the cutoff wavelength of the connected optical fiber, light propagates through the optical fiber in multiple modes. When highly coherent light such as a gas laser or DFB-LD light source propagates in multiple modes, the speckle noise contained in the optical fiber output light becomes unstable due to the optical fiber form and may cause inaccuracies in the measurement level.

In such cases, a better coupling between the light source and the optical fiber will reduce the level of inaccuracy.

# Measurement sensitivity and effective vertical scale range

If the measurement sensitivity is set to N/HOLD, the internal amplifier is set to fixed gain. The gain is set automatically from the five available settings depending on the reference level (REF) setting. The effective range of measurement data is limited to the following range relative to the reference (REF) level.

REF − 20 dBm < (effective range) < REF + 10 dBm

If the level scale is set to 10 dB/DIV, the display will fall outside the effective range. The waveform between the top edge of the screen to REF + 10 dBm and that between the bottom edge to REF − 20 dBm will be inaccurate. If the measurement sensitivity is set to N/HOLD, we recommend that you use the level scale at 5 dB/DIV or less. If the measurement sensitivity is N/AUTO, MID, or HIGH1 to HIGH3, auto gain is used allowing a wide level range to be measured in one sweep. Select the appropriate sensitivity according to the reception level necessary for measurement. The explanation above of the measurement sensitivity and effective vertical scale range applies also when the measurement sensitivity is set to rapid mode (measurement sensitivities with x2 indication).

# Monochromator stray light

The instrument has a newly designed, high-performance monochromator. Depending on the measurement conditions, stray light at a level 30 dB to 50 dB below the original spectrum, as well as other stray light specific to the monochromator may occur in wavelength areas about 300 nm away from the peak wavelength. If these stray lights have severe impact on measurements, you can set the sensitivity to a setting from HIGH1/CHOP to HIGH3/CHOP to enable CHOP mode, which reduces their effects.

**Waveform when CHOP mode is disabled**       **Waveform when CHOP mode is enabled**
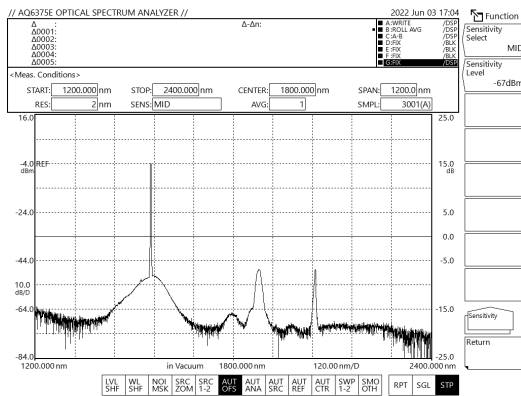


**CHOP mode feature**

| CHOP mode | Feature | Advantages | Disadvantages |
|---|---|---|---|
| Disabled | The stray light component is also measured.<br><br>Stray light suppression ratio: 40 dB or more | Measurement is fast even for high-sensitivity measurements. | Since the stray light component is also measured, low level components are inaccurate when the light source power is high. |
| Enabled | Highly dynamic measurements are possible using internal modulation.<br><br>Stray light suppression ratio: 60 dB or more | Measurements can be made with the stray light removed. Long, high-sensitivity measurements are possible because there are no offset fluctuations. | Measurement time is long. |

# Waveforms with resolutions of 0.05 nm

When the resolution is set to 0.05 nm for measurements of a light source such as a DFB laser in which with the spectral width is narrower than the instrument's resolution, very small spikes may occur at the skirts of the waveform. This is caused by the characteristics of the optical component and is not an indication of a problem. Even if this phenomenon occurs, performance such as resolution and dynamic range is ensured. This phenomenon will disappear if the resolution is changed to a coarser setting.
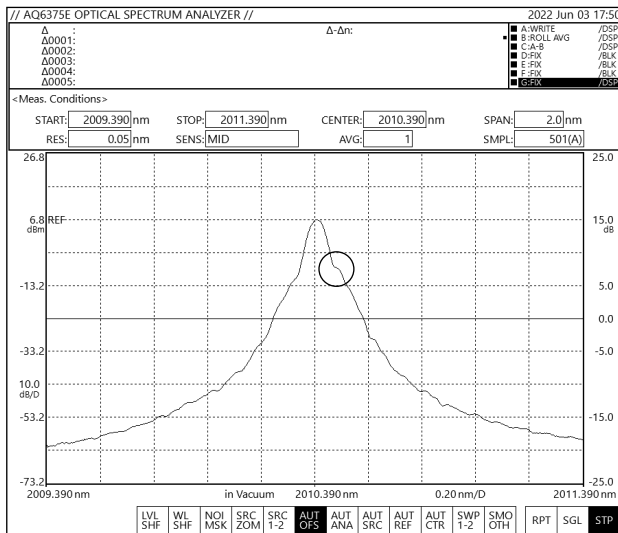


# Ripples in the 1350 nm to 1450 nm and 1800 nm to 1950 nm areas

Water (OH-) ions present in the monochromator absorb light in the 1350 to 1450 nm and 1800 to 1950 nm areas, resulting in ripples in the measurement waveform. The amount of ripples can be reduced by setting a coarser resolution, by using the instrument in a low-humidity environment, or by purging as described in section 3.7 of the *Getting Started Guide*.

# High-order diffracted light

In principle, the monochromator emits high order diffraction light that is integer multiples of the input light. This instrument is equipped with a monochromator containing an optical filter that suppresses input light with wavelengths other than those under measurement to suppress the ghost effect caused by the high-order diffracted light (products with -10 and -20 suffix codes). However, the optical filter cannot completely remove the unnecessary high-order diffracted light. Therefore, it is important to know how the high-order diffracted light will appear.

The figures on the next page are graphs of the wavelengths that appear on the screen versus the actual wavelengths on products with -10 and -20 suffix codes.
The horizontal axis is the wavelengths displayed on the screen, and the vertical axis is the actual wavelengths. In addition, the solid lines on the graph indicate the correspondence between the displayed wavelengths and actual wavelengths. The thick solid line displays the correct optical spectral correspondence (obviously the displayed wavelengths match the actual wavelengths), and the thin solid line displays the correspondence with the ghost caused by high order diffraction light. The numbers written next to the thin solid line indicate the level of suppression of the ghost caused by high order diffraction light relative to the correct optical spectrum. However, the values are rough estimates; they are not guaranteed. For example, if a 1060 nm light is input to this instrument, the intersections of a horizontal line drawn from 1060 nm on the vertical axis and the lines on the graph correspond to the displayed wavelengths. As a result, we can see that in addition to 1060 nm, a ghost appears at the 2120 nm position. We also see that the level of the ghost is suppressed by more than 40 dB relative to the correct optical spectrum.

On products with -10 suffix code, near the 2400 nm measurement wavelength region, the suppression characteristics of the optical filter are low, and the measurement is greatly affected by high order diffraction light. If the input light contains light less than 1150 nm or greater than 1200 nm, reduce such light using an optical filter in advance before making measurements.
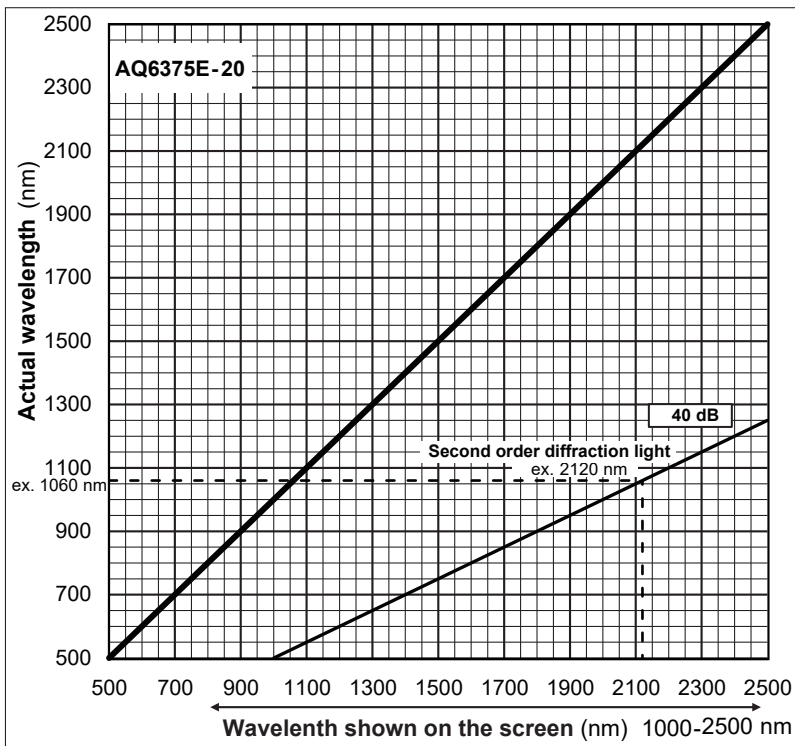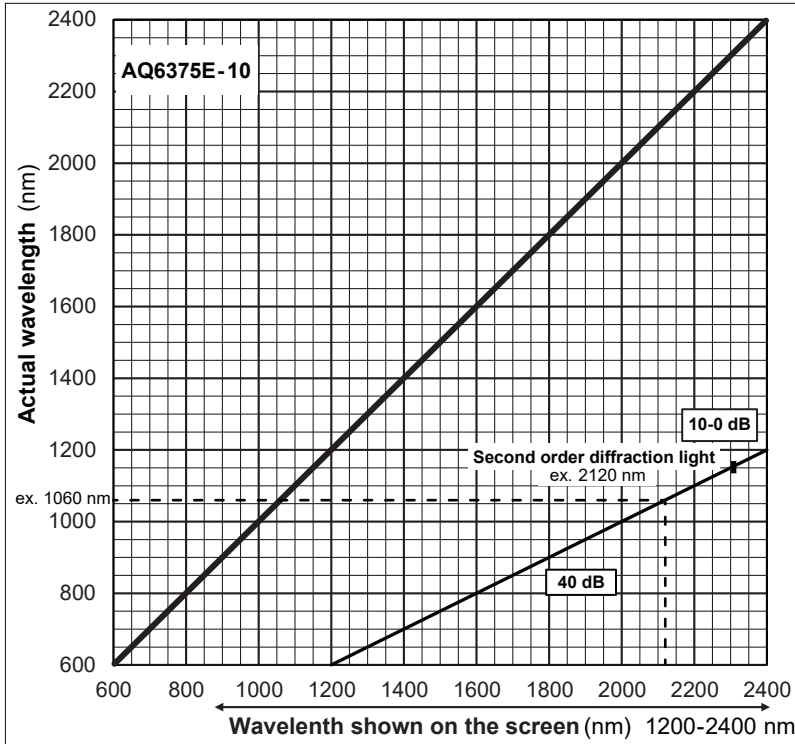
# 3.2 Continuous Light Measurement (CW)

## Procedure

## Auto measurement

With auto measurement, measurements are made by automatically setting the optimal measurement conditions for the light source to be measured.

Press **AUTO**. Auto measurement is executed.
(You can also do the same by tapping **Auto** on the Sweep menu that appears when you press **SWEEP**.)
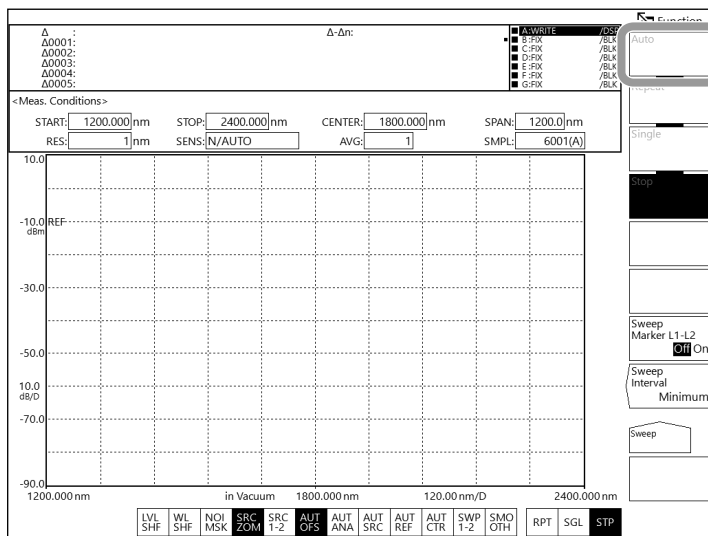
# Starting a measurement (sweep)

*1.* Press **REPEAT** or **SINGLE**. Sweeping will begin.
(You can also do the same by tapping **Repeat** or **Single** on the Sweep menu that appears when you press **SWEEP**.)

*2.* To set the sweep interval, press **SWEEP** and then tap **Sweep Interval**. A SWEEP INTERVAL screen appears.

*3.* To stop sweeping, press **STOP**.
(You can also do the same by tapping **Stop** on the Sweep menu that appears when you press **SWEEP**.)



**Sweep icon**
**Stop**
**Single**
**Repeat**
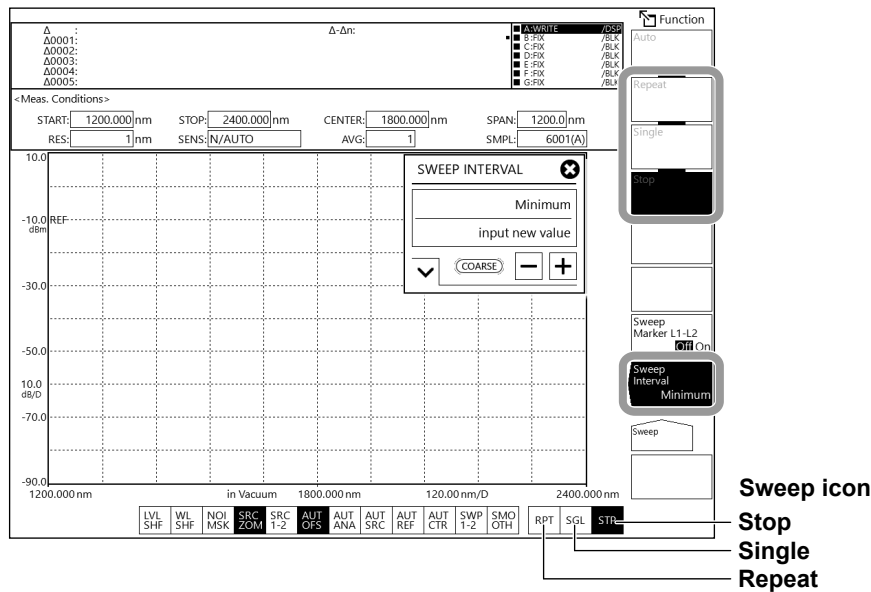
*Note*
- You can also start and stop sweeping by clicking the sweep icon at the bottom of the screen.
- During a sweep, a sweep bar indicating the current sweep status is displayed below the horizontal axis.
- During a sweep, the sweep progress from the start wavelength to the sweep wavelength is indicated as a percentage in the lower left corner of the screen.

# Specifying a sweep range

## Sweeping between line markers

You can sweep between wavelength line markers 1 and 2.

**1.** Display wavelength line markers 1 and 2 at the boundaries of the range you want to sweep.

For instructions on how to display them, see section 5.2.

**2.** Press **SWEEP**. The Sweep menu appears.

**3.** Tap **Sweep Marker L1-L2**. Each time you tap, the value switches between On and Off. Select On.

**4.** Tap **Repeat** or **Single**. Sweeping will begin between the line markers.

**5.** To cancel, tap **Sweep Marker L1-L2** to select Off. The sweep range will be set to the entire range of the screen.



**Line markers**

**Sweep range**
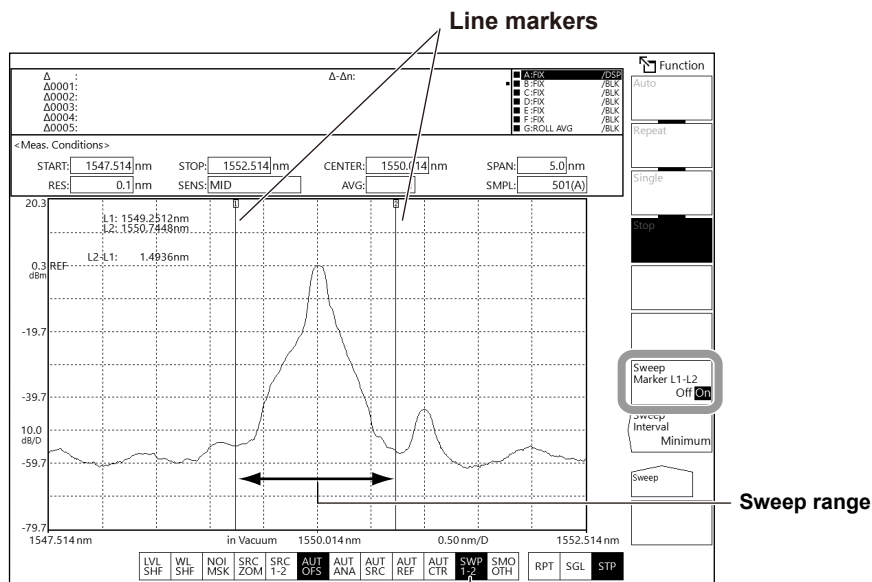
**Highlighted when Sweep Marker L1-L2 is On**

*Note* ————————————————————————————————————
- The instrument sweeps the waveform between line markers L1 and L2.
- If only L1 is set, the instrument sweeps from line marker 1 to the right edge of the screen.
- If only L2 is set, the instrument sweeps from the left edge of the screen to line marker 2.
- If neither L1 or L2 is set, the instrument sweeps from the specified start wavelength to the stop wavelength.

### Setting the sweep span to the interval between line markers

**1.** Display wavelength line markers 1 and 2. For details on wavelength line markers, see section 5.2.

**2.** Press **MARKER**. The Marker menu appears.

**3.** Tap **More** to display the More 2/3 menu.

**4.** Tap **Marker L1-L2 -> Span**. The boundaries of the measurement sweep span are set to the values corresponding to the difference between the wavelength line markers 1 and 2, and the measurement start wavelength and measurement end wavelength are also changed.

A measurement sweep span setting window is also displayed, allowing you to change the measurement sweep span if necessary. For details on th sweep span, see section 2.1.

*Note*

- The sweep span is set to the closest allowed value.
- When only L1 is set, the sweep span is set to the difference between the wavelengths of L1 and the right edge of the screen, and the measurement start wavelength is set to the wavelength of L1.
- When only L2 is set, the sweep span is set to the difference between the wavelengths of the left edge of the screen and L2, and the measurement stop wavelength is set to the wavelength of L2.
- The Marker L1-L2 -> Span soft key cannot be used under the following conditions.
  - When both wavelength line markers 1 and 2 or off
  - When the span of the active trace is 0 nm.

Measurement start wavelength　　Measurement stop wavelength　　Sweep span
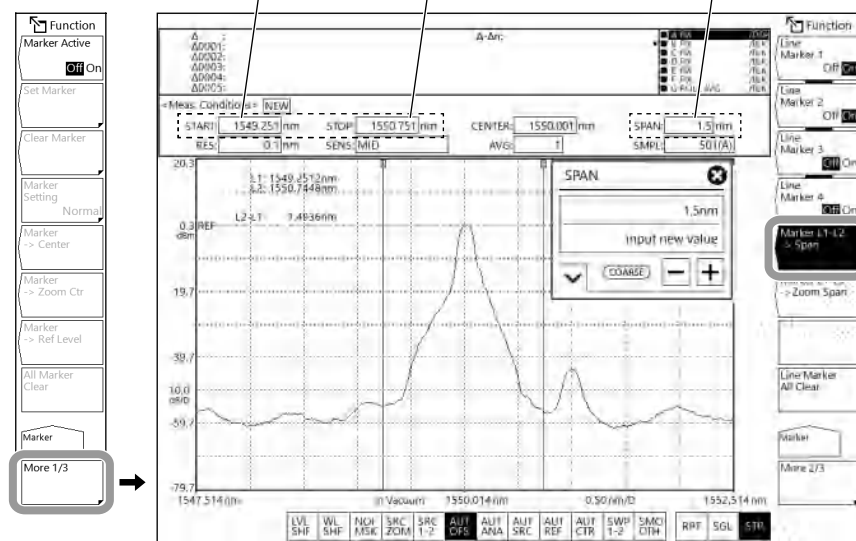
## Auto measurement

The wavelength (frequency or wavenumber) range of input light that auto measurement can performed on is shown below.

### Standard model (suffix code -10), limited model (suffix code -01)

| Display mode | Auto measurement range |
|---|---|
| Wavelength (nm) | 1200.000 to 2400.000 |
| Frequency (THz) | 125.0000 to 250.0000 |
| Wavenumber (cm$^{-1}$) | 4167.000 to 8333.000 |

### Extended model (suffix code -20)

| Display mode | Auto measurement range |
|---|---|
| Wavelength (nm) | 1000.000 to 2500.000 |
| Frequency (THz) | 120.0000 to 300.0000 |
| Wavenumber (cm$^{-1}$) | 4000.000 to 10000.000 |

The following four items are automatically set to make measurements.
- Center wavelength (frequency or wavenumber) (Center)
- Sweep span (Span)
- Reference level (Reference Level)
- Resolution (Resolution)

When an auto configuration of measurement conditions is completed in an auto sweep, the sweep mode changes to repeat sweep. During auto configuration, only the REPEAT, SINGLE, STOP, and UNDO/LOCAL (when in remote mode) keys are enabled.

## Sweep interval

This function is used to set the time from the start of one sweep to the start of the next sweep. If the time required for sweeping is greater than the specified time, the next sweeping is started immediately after the current sweeping ends.

Tapping **Sweep Interval** shows the current time in the parameter setting window.

Selectable range: Minimum, 1 s to 99999 s (If you enter 0, the value is set to Minimum.)

## 3.3　Pulse Light Measurement

### Procedure

There are four ways to measure pulse light.

- Measurement in peak hold mode
- Measurement using gate sampling
- Measurement using external trigger mode (see section 3.4)
- Measurement in terms of the spectrum averaged over time (see the explanation)

## Measurement in peak hold mode

### Setting the peak hold value

1.　Press **SETUP**. The Setup menu appears.

2.　Tap **More** to display the More 2/2 menu.

3.　Tap **Pulse Light Measure**.

4.　Tap **Peak Hold**. The PEAK HOLD setting window appears.

5.　Enter the peak hold value in the displayed window.
Enter a value longer than the period of the pulsed light to be measured as the peak hold value.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
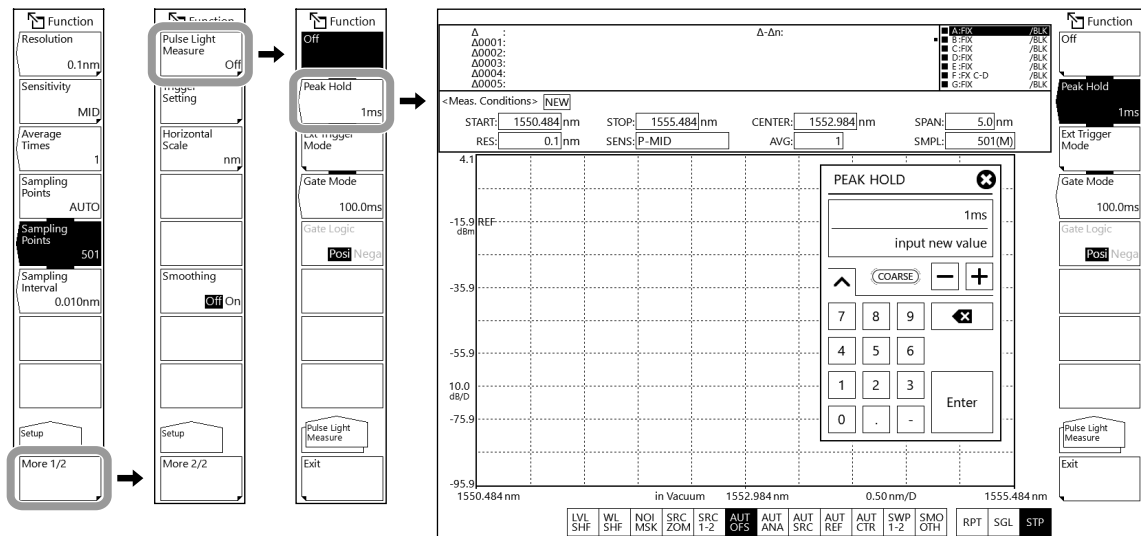
## Displaying the measured waveform

**6.** Press **REPEAT** or **SINGLE**. Sweeping starts, and the waveform is displayed.
(You can also do the same by tapping **Repeat** or **Single** on the Sweep menu that appears when you press **SWEEP**.)

**7.** To stop sweeping, press **STOP**.
(You can also do the same by tapping **Stop** on the Sweep menu that appears when you press **SWEEP**.)

## Note

- There are measurement sensitivity settings that cannot be selected in peak hold mode. If any of these values is selected when you tap Peak Hold, a warning message will be displayed, and the setting will be changed automatically. For details, see "Example of changes made automatically when you tap Peak Hold or Ext Trigger Mode" in the explanation. For details on measurement sensitivity, see section 2.4.
- The appropriate sensitivity is determined according to the pulse width of the pulse light to be measured. For details, see "Sensitivity settings and corresponding pulse widths" in the explanation.
- Set the peak hold value so that it is longer than the period of the pulse light to be measured.

# Measurement using gate sampling

## Setting the sampling interval time

**1.** Press **SETUP**. The Setup menu appears.

**2.** Tap **More** to display the More 2/2 menu.

**3.** Tap **Pulse Light Measure**.

**4.** Tap **Gate Mode**. A SAMPLE INTERVAL setting window appears.

**5.** Enter the sampling interval time in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
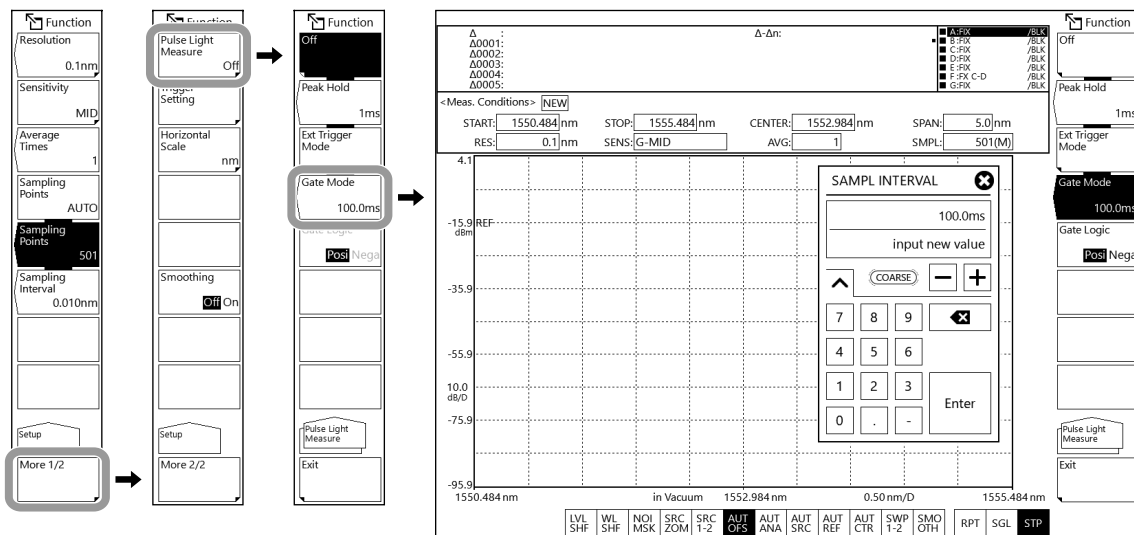
*Note*

- You can select Gate Mode when Trig Input Mode under Trigger Setting is set to Smpl Trig Mode. You cannot select it in Sweep Trig Mode or Smpl Enable Mode. For details on Trigger Setting, see section 3.4.
- There are measurement sensitivity (Sensitivity), Chop mode, and average times (Average Times) settings that cannot be selected in Gate Mode. If any of these values is selected when you tap Gate Mode, a warning message will be displayed, and the setting will be changed automatically. For details, see "Example of changes made automatically when you tap Gate Mode" in the explanation. For details on measurement sensitivity and Chop mode, see section 2.4. For details on average times, see section 2.7.

## Setting the gate signal logic

**6.** Continuing from step 5, tap **Gate Logic**. Each time you tap, the value switches between Posi and Nega.
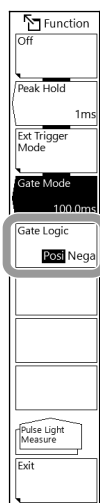
## Measurement using external trigger mode

See section 3.4.

## Measurement in terms of the spectrum averaged over time

See the explanation.

## Explanation

## Pulse Light Measure

This soft key is used to configure the pulse light measurement and set the external trigger mode.

**Peak Hold**

This soft key is used to set the peak hold value of the pulse light. The pulse light is measured based on this value.

Selectable range: 1 ms to 9999 ms

**Ext Trigger Mode**

This soft key performs sampling in sync with an external trigger signal and measures the pulse light.

For details on the external trigger feature, see section 1.1. For details on measurements using external triggers, see section 3.4.

**Gate Mode**

When the external signal (gate signal) is active, this soft key performs sampling and measures the pulse light.

To use this mode, you need to set the sampling interval and signal logic.

**Example of changes made automatically when you tap Peak Hold or Ext Trigger Mode**

Changed automatically to a setting suitable for measuring in peak hold mode or external trigger mode. Be sure to check the settings after changes are made.

| Item | Setting | |
|---|---|---|
| | Before change | After change |
| Measurement sensitivity (Sensitivity) | N/HOLD(x2) | N/HOLD |
| | N/AUTO(x2) | N/AUTO |
| | NORMAL(x2) | NORMAL |
| | MID(x2) | MID |
| | HIGH1(x2)/CHOP | HIGH1/CHOP |
| | HIGH2(x2)/CHOP | HIGH2/CHOP |
| | HIGH3(x2)/CHOP * | HIGH3/CHOP * |

\* Measurement sensitivity available on the standard and extended models

**Example of changes made automatically when you tap Gate Mode**

Changed automatically to a setting suitable for measuring in gate sampling mode. Be sure to check the settings after changes are made.

| Item | Setting | |
|---|---|---|
| | Before change | After change |
| Measurement sensitivity (Sensitivity) | N/HOLD(x2) | N/HOLD |
| | N/AUTO(x2) | N/AUTO |
| | NORMAL(x2) | NORMAL |
| | MID(x2) | MID |
| | HIGH1(x2)/CHOP | MID |
| | HIGH1/CHOP | |
| | HIGH2(x2)/CHOP | |
| | HIGH2/CHOP | |
| | HIGH3(x2)/CHOP * | |
| | HIGH3/CHOP * | |
| Average times (Average Times) | 2 or more | 1 |

\* Measurement sensitivity available on the standard and extended models

## Sensitivity settings and corresponding pulse widths

Measurable sensitivities are determined by the optical pulse width. Select the appropriate sensitivity according to the pulse width from the following table.

**Sensitivity settings and corresponding pulse widths**

| Sensitivity setting | CHOP mode | Sensitivity indication on the screen | | | Corresponding pulse width (min.) |
|---|---|---|---|---|---|
| | | Normal | Peak Hold setting | Ext Trigger setting | |
| N/HOLD | Disabled | N/HOLD | P-N/HOLD | E-N/HOLD | Peak: 100 μs<br>Ext: 50 μs |
| N/AUTO | Disabled | N/AUTO | P-N/AUTO | E-N/AUTO | 300 μs |
| NORMAL | | NORMAL | P-NORMAL | E-NORMAL | 1 ms |
| MID | | MID | P-MID | E-MID | 3 ms |
| HIGH1/CHOP | Enabled | HIGH1/CHOP | P-HIGH1/CHOP | E-HIGH1/CHOP | 50 ms |
| HIGH2/CHOP | Enabled | HIGH2/CHOP | P-HIGH2/CHOP | E-HIGH2/CHOP | 200 ms |
| HIGH3/CHOP* | | HIGH3/CHOP | P-HIGH3/CHOP | E-HIGH3/CHOP | 2000 ms |

\* Measurement sensitivity available on the standard and extended models

## Spectrum measurement averaged over time

Pulse light can be measured as a spectrum averaged over time.

The average level of measured pulse light is displayed as the spectrum level.

For example, if the pulse light is a perfect rectangular wave, the measured level will be (peak level of the pulse light [mW]) × (duty cycle of the pulse light). Thus, if the duty cycle of the pulse light is small, the measured level will be low.

Specify the measurement sensitivity and the optimum average times required for pulse light measurement. The measurable repetition frequency of pulse light varies depending on the measurement sensitivity.

For N/HOLD to MID measurement sensitivities, lower repetition frequency can be measured by increasing the average times. If average times is set to n, the measurable repetition frequency is approximately 1/n for the frequencies in the next table.

For measurement sensitivities when CHOP mode of HIGH1/CHOP to HIGH3/CHOP is enabled, even if you increase the average times, the measurable repetition frequency will remain the same as when average times is 1.

**Sensitivity setting and measurable repetition frequency (when average times is 1)**

| Sensitivity setting | CHOP mode | Repetition frequency |
|---|---|---|
| N/HOLD | Disabled | 1 MHz |
| N/AUTO | | 1 MHz |
| NORMAL | | 200 kHz |
| MID | | 50 kHz |
| HIGH1/CHOP | Enabled | 1 MHz |
| HIGH2/CHOP | | 1 MHz |
| HIGH3/CHOP* | | 1 MHz |

These values are not guaranteed. When measuring, use these as values as guidelines.

\* Measurement sensitivity available on the standard and extended models

# Gate sampling measurement

Gate sampling can be used to measure data only when the gate signal is active during sweeping. By applying an external signal (gate signal) synchronized to the pulse light emission to the instrument, you can efficiently measure pulse light.

Because the gate signal and the sampling time are asynchronous, not all light pulses may be sampled when a single sweep is performed.

A full pulse light can be sampled and a complete waveform can be displayed by using the Max Hold function and measuring several times using repeat sweep.
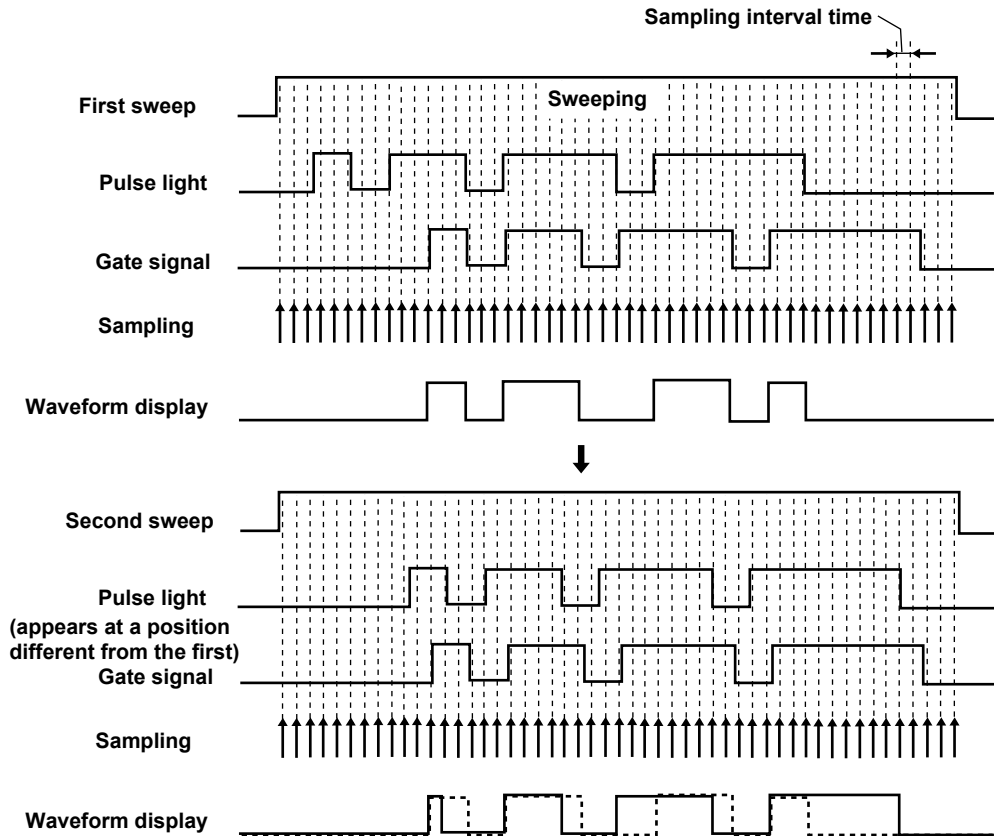
**The broken line shows the Max Hold waveform of the first sweep.**

**Because the instrument does not show data that is sampled when the gate signal is inactive, the wavelength data during this period may be missed, but because the sampling time and gate signal (pulse light) are asynchronous, performing repeat sweep using the Max Hold feature eventually results in all the waveform data in the span range to be shown.**
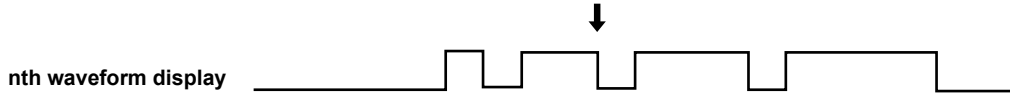
**\* For details on the Max Hold feature, see section 4.3.**

**Sampling interval time**

Set the sampling interval time for sweeping.

Selectable range: 0.1 ms to 1000.0 ms (in steps of 0.1 ms).

An appropriate sampling interval must be set according to the measurement sensitivity.
Refer to the pulse widths corresponding to the sensitivities in the "Sensitivity settings and corresponding pulse widths" table.

**Gate signal logic**

Use Gate Logic to set the gate signal logic.

Posi: Sampling is performed when the gate signal level is high.

Nega: Sampling is performed when the gate signal level is low.

This instrument has an external trigger input terminal on the rear panel. Apply a TTL level signal to the trigger input terminal.

### *Note*

- You cannot change the trigger condition in Gate Mode. For details on trigger conditions, see section 3.4.
- If you change any of the following settings in Gate Mode, a warning message will be displayed, and the Pulse Light Measure setting will be changed automatically to Off.
  - When the measurement sensitivity (Sensitivity) is changed to the "Sweep speed: normalx2"
  - When the measurement sensitivity is changed to a setting that activates CHOP mode
  - When the average times (Average Times) is changed from 1 to 2 or more.
  For details on sweep speed, see section 1.1.
  For details on measurement sensitivity and CHOP mode, see section 2.4. For details on average times, see section 2.7.

# 3.4 Measurement Using External Triggers

## Procedure

### Setting the trigger input mode

1. Press **SYSTEM**. The System menu appears.

2. Tap **More** to display the More 2/4 menu.

3. Tap **Trig Input Mode**.

4. Tap **Smpl Trig Mode** to select the sample trigger mode. Tap **Sweep Trig Mode** to select the sweep trigger mode. Tap **Smpl Enable Mode** to select the sample enable mode.

If you selected Sweep Trig Mode or Smpl Enable Mode, your are finished with this procedure.
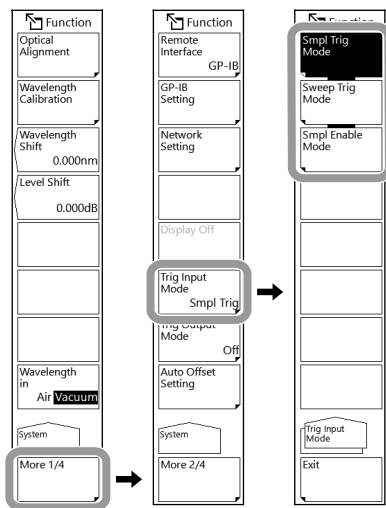


*Note*

- If you select sample trigger mode, set the measurement sensitivity to a "Sweep speed: normal" setting.
- If you select sweep trigger mode, set the measurement sensitivity to a "Sweep speed: normal" setting. Pulse light measurement can be used only in Peak Hold Mode. It cannot be used in Ext Trigger Mode or Gate Mode.
- If you select sample enable mode, there is no limit to the sweep speed. Pulse light measurement cannot be used.
- For details on sweep speed, see section 1.1. For details on pulse light measurement, see section 3.3.

## Selecting the external trigger mode (for Smpl Trig)

**5.**  Press **SETUP**. The Setup menu appears.

**6.**  Tap **More** to display the More 2/2 menu.

**7.**  Tap **Pulse Light Measure**.

**8.**  Tap **Ext Trigger Mode**. The mode is set to external trigger mode.
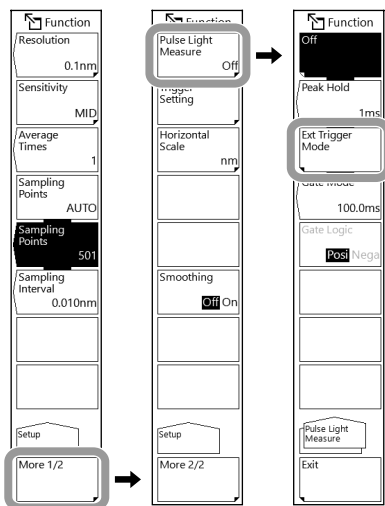


## Setting the trigger conditions (for Smpl Trig)

**9.**  Tap **Trigger Setting**. The Trigger Setting menu appears.

**10.**  Tap **Edge**. The edge switches between rise and fall.

**11.**  Tap **Delay**. A DELAY setting window appears.

**12.**  Enter the delay time in the displayed window.
For instructions on how to select items and how to set values, see chapter 4 in the *Getting Started Guide*.

3

Measuring the Optical Spectrum
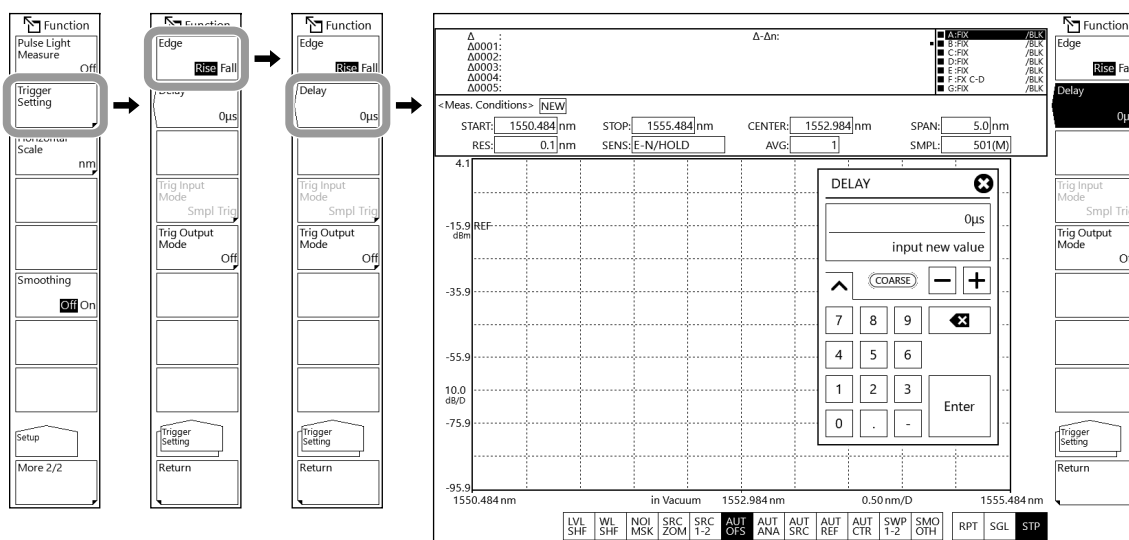
*Note*

- There are measurement sensitivity settings that cannot be selected in external trigger mode. If any of these values is selected when you tap Ext Trigger Mode, a warning message will be displayed, and the setting will be changed automatically. For details, see "Example of changes made automatically when you tap Peak Hold or Ext Trigger Mode" in the explanation of section 3.3. For details on measurement sensitivity, see section 2.4.
- When Average Times is set, sweeping stops when the number of input external trigger signals reaches the number obtained by multiplying the specified sample times by the average times.

## Explanation

The instrument starts data measurement or sweeping using an external signal as a trigger.

This instrument has an external trigger input terminal on the rear panel. Apply a TTL level signal to the trigger input terminal. For details on the external trigger feature, see section 1.1.

Smpl Trig: This soft key starts a measurement based on an external trigger signal. You can select whether to trigger the instrument on the rising or falling edge of the signal. The instrument starts measuring about 1 µs after it is triggered.

Sweep Trig: This soft key starts a single sweep based on an external trigger signal. The instrument will trigger on the falling edge of the signal.

Smpl Enable: This soft key starts a single or repeat sweep when the external trigger signal level is low. The sweep is stopped when the signal level becomes high. If the signal level becomes low again, the sweep starts from the point that it stopped at.

## Signal logic and delay time (for Smpl Trig)

### Edge

This soft key is used to set the detection edge of the external trigger signal.

Rise: Rising edges are used as triggers.

Fall: Falling edges are used as triggers.

### Delay ****µs

This soft key is used to set the delay time between the trigger signal edge detection and data measurement.

Setting range: 0 µs to 1000 µs (normal: 1 step, COARSE: 10 steps)

# Sensitivity settings and corresponding pulse widths

## When Smpl Trig or Sweep Trig is selected

Measurable sensitivities are determined by the optical pulse width. Select the appropriate sensitivity according to the pulse width from the following table.

**Sensitivity settings and corresponding pulse widths**

| Sensitivity setting | CHOP mode | Sensitivity indication on the screen | | | Corresponding pulse width (min.) |
|---|---|---|---|---|---|
| | | Normal | Peak Hold setting | Ext Trigger setting | |
| N/HOLD | | N/HOLD | P-N/HOLD | E-N/HOLD | Peak: 100 µs<br>Ext:   50 µs |
| N/AUTO | Disabled | N/AUTO | P-N/AUTO | E-N/AUTO | 300 µs |
| NORMAL | | NORMAL | P-NORMAL | E-NORMAL | 1 ms |
| MID | | MID | P-MID | E-MID | 3 ms |
| HIGH1/CHOP | | HIGH1/CHOP | P-HIGH1/CHOP | E-HIGH1/CHOP | 50 ms |
| HIGH2/CHOP | Enabled | HIGH2/CHOP | P-HIGH2/CHOP | E-HIGH2/CHOP | 200 ms |
| HIGH3/CHOP* | | HIGH3/CHOP | P-HIGH3/CHOP | E-HIGH3/CHOP | 2000 ms |

\*   Measurement sensitivity available on the standard and extended models

## When Smpl Enable is selected

The minimum necessary pulse width of the external trigger input signal varies according to the sensitivity setting. If the time that the external trigger input signal level is low is less than this pulse width, the instrument cannot perform the sweep.

**Sensitivity settings and minimum pulse widths**

| Sensitivity setting | Minimum pulse width |
|---|---|
| N/HOLD | 70 ms |
| N/AUTO | 70 ms |
| NORMAL | 70 ms |
| MID | 70 ms |
| HIGH1/CHOP | 100 ms |
| HIGH2/CHOP | 250 ms |
| HIGH3/CHOP* | 2050 ms |

\*   Measurement sensitivity available on the standard and extended models

# 3.5 Trigger Output

## Procedure

### Trigger output mode setting

1. Press **SYSTEM**. The System menu appears.

2. Tap **More** to display the More 2/4 menu.

3. Tap **Trig Output Mode**. The Trig Output Mode menu appears.

4. Tap **Sweep Status**.
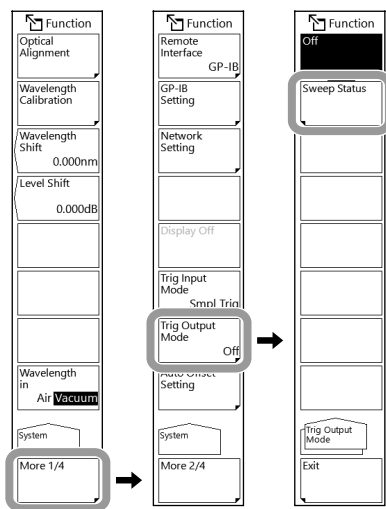


### Note

When pulse light measurement is selected, signals are not output from the trigger output terminal. Set Pulse Light Measure to Off. See section 3.3.

## Explanation

The instrument outputs a positive logic (high) signal when sweeping is in progress and a negative logic (low) signal when sweeping is not in progress from the instrument's TRIGGER OUT (trigger output) terminal. The output signal is TTL level.

# 3.6 Analog Out

## Procedure

### Connecting to an oscilloscope



**AQ6375E**  **Coaxial cable**  **Oscilloscope**

**Input terminal**
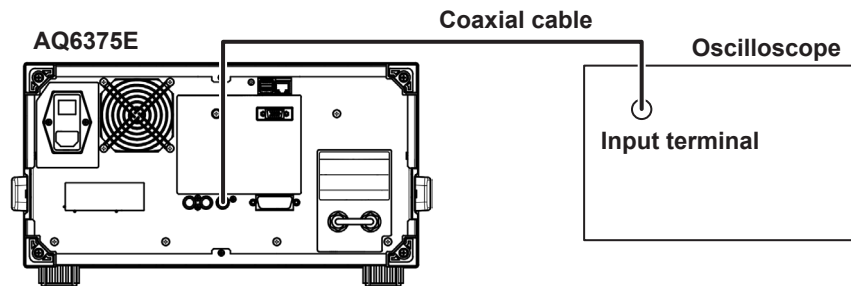
1.  Press **SETUP**. The Setup menu appears.

2.  Tap **Sensitivity** to display the Sensitivity menu.

3.  Tap **Sensitivity Select**. The Sensitivity Select menu appears.

4.  Tap **N/HOLD**. N/HOLD appears under Sensitivity Select.
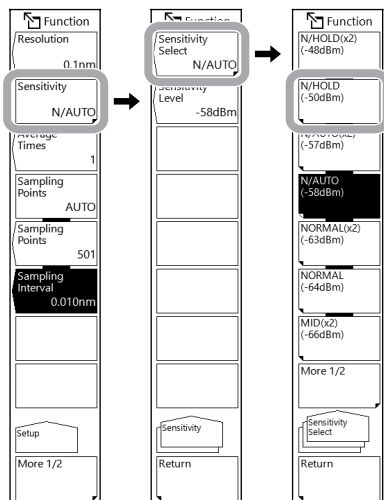


5.  Press **REPEAT** or **SINGLE**. Sweeping will begin, and analog voltage will be output.
    (You can also do the same by tapping **Repeat** or **Single** on the Sweep menu that appears when you press **SWEEP**.)

## Note

- Analog out is enabled only when the sensitivity is set to N/HOLD.
- When the input light level is high, the output voltage level will saturate.

## Explanation

The instrument outputs from its ANALOG OUT terminal on the rear panel an analog voltage according to the input light.

You can use an oscilloscope to observe the changes in the input light over time.

The saturation level and noise level will vary depending on the specified REF level.

The following table shows the relationship between the REF level and saturation level.

**Relationship between the REF level and saturation level**

| REF LEVEL (dBm or dBm/nm) | Saturation level* (dBm) |
| --- | --- |
| 0 < REF | 23 dBm or more |
| −10 < REF <= 0 | 13 dBm or more |
| −20 < REF <= −10 | 3 dBm or more |
| −30 < REF <= −20 | −7 dBm or more |
| REF <= −30 | −17 dBm or more |

*At a wavelength between 1450 nm and 1620 nm

**ANALOG OUT specifications**

| | |
| --- | --- |
| Output saturation voltage | +3 V to +6 V |
| Bandwidth | 10 kHz or more |
| Load | 1 kΩ or more |

# 4.1    Zooming the Waveform Display

## Procedure

You can zoom a waveform in the following ways:
- Setting the zoom center wavelength and display sweep span
- Setting the zoom start wavelength and stop wavelength
- Specifying the range with wavelength line markers
- Specifying the range with the mouse
- Pinching out and pinching in (see section 4.5 in the *Getting Started Guide*)

The procedure when the horizontal scale unit is set to frequency (THz) or wavenumber (cm$^{-1}$) is the same as when the horizontal scale unit is set to wavelength (nm).
For details on setting the horizontal scale unit, see section 2.1.

### Setting the zoom center wavelength and display sweep span

1.  Press **ZOOM**. The Zoom menu appears.

### Setting the zoom center wavelength to the peak wavelength of the displayed waveform

2.  **Tap Peak -> Zoom Ctr**. The zoom center wavelength is set to the peak wavelength. Proceed to step 4.

### Setting the zoom center wavelength to a specified wavelength

2.  Tap **Zoom Center**. The ZOOM CENTER setting window appears.

3.  Enter the zoom center wavelength in the displayed window.
    For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

### Setting the display sweep span (zoom display range)

4.  Tap **Zoom Span**. The ZOOM SPAN setting window appears.

5.  Enter the display sweep span in the displayed window.
    For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

### Unzooming

6.  Tap **Initialize**.

## Setting the zoom start wavelength and stop wavelength

**1.** Press **ZOOM**. The Zoom menu appears.

**2.** Tap **Zoom Start**. The ZOOM START setting window appears.

**3.** Enter the zoom start wavelength in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

**4.** Tap **Zoom Stop**. The ZOOM STOP setting window appears.

**5.** Enter the zoom stop wavelength in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

*Note*

If you enter a value outside the setting range, the closest allowed value is assigned.

**Example of displayed waveform**



Set the zoom center wavelength.
Set the sweep span to be displayed.
Set the zoom start wavelength.
Set the zoom stop wavelength.
Sets the center wavelength of the zoom display to the peak wavelength
Initializes the display scale
The overview window shows the zoom area (Zoom Area) with a dotted frame.
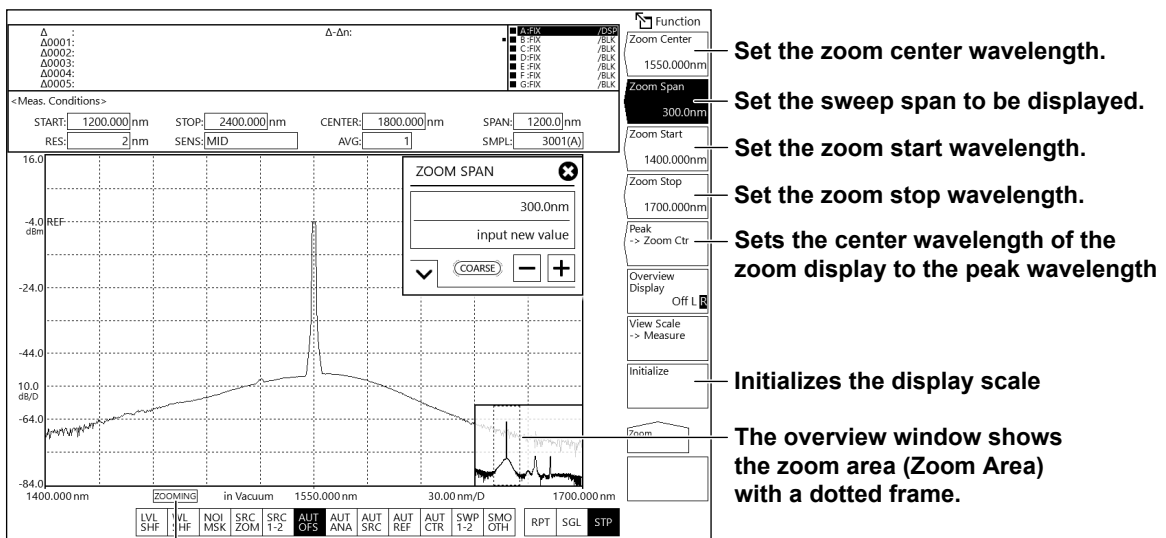
**ZOOMING appears when the display scale is changed (when the waveform is zoomed).**

## Specifying the range with wavelength line markers

**1.** Display wavelength line markers 1 and 2.
For details on wavelength line markers, see section 5.2.

**2.** Press **MARKER**. The Marker menu appears.

**3.** Tap **More** to display the More 2/3 menu.

**4.** Tap **Marker L1-L2 -> Span**. The waveform is zoomed according to the value between the wavelength line markers 1 and 2. A ZOOM SPAN setting window is also displayed, allowing you to change the zoom display sweep span if necessary.

*Note*

- If only L1 is set, the zoom range is from wavelength line marker 1 to the right edge of the screen.
  If only L2 is set, the zoom range is from the left edge of the screen to wavelength line marker 2.
- The zoom range boundaries are set to allowed values closest to the values of L1 and L2.
- The Marker L1-L2 -> Zoom Span soft key cannot be used under the following conditions.
  - When both wavelength line markers 1 and 2 or off
  - When the span of the active trace is 0 nm.

# Specifying the range with the mouse

*1.* In the waveform display area, drag the area you want to zoom with the mouse left button. The area is displayed with a dotted frame (zoom area).

*2.* When you release the left mouse button, the dotted frame is zoomed.
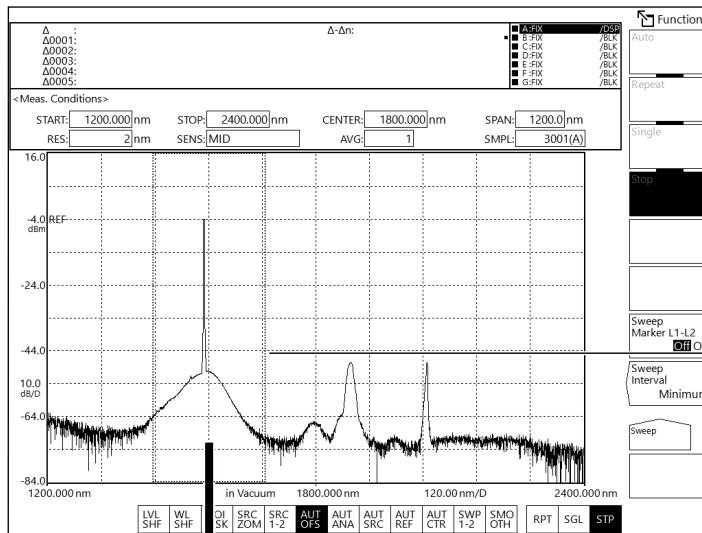


**Drag the mouse in the waveform display area to set the zoom area.**
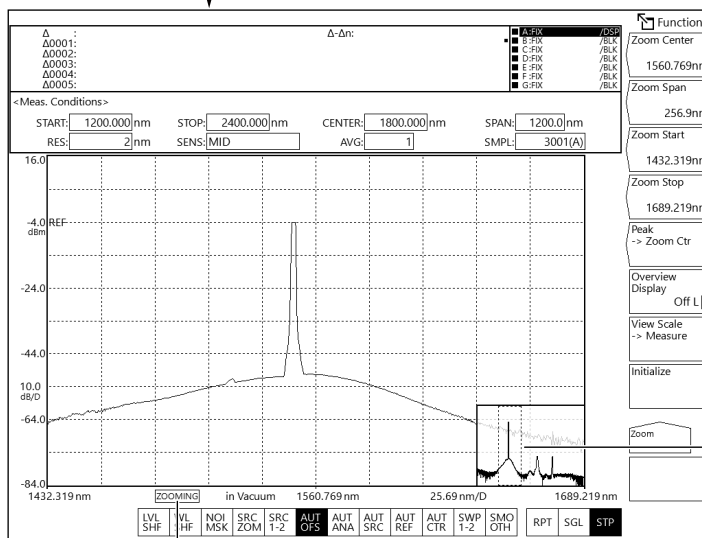
**Zoom**



**The overview window shows the zoom area (Zoom Area) with a dotted frame.**

**ZOOMING appears when the display scale is changed (when the waveform is zoomed).**

*Note*

- If you change the display scale to a value different from the measurement scale, ZOOMING appears on screen. Also, an overview window that shows the measurement scale is displayed in a corner of the measurement screen.
- The overview window shows the zoom area with a dotted frame.
- The display scale is independent of the measurement scale.
- Changing the zoom function settings does not change the measurement conditions.

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**Displaying Optical Spectral Waveforms**

# Configuring the overview window

When the waveform display is enlarged or reduced using the zoom function and the following settings are made, an overview window is displayed at the very bottom of the waveform display area (only displayed when a zoom is in use).

## Showing and hiding the window and setting the display position

1.  Press **ZOOM**. The Zoom menu appears.

2.  Tap **Overview Display**. Each time you tap, the window changes between hidden (Off), displayed on the left (L), and displayed on the right (R).

## Setting the window size

The window size is fixed. It cannot be changed.

## Example of a screen with Overview Display set to L
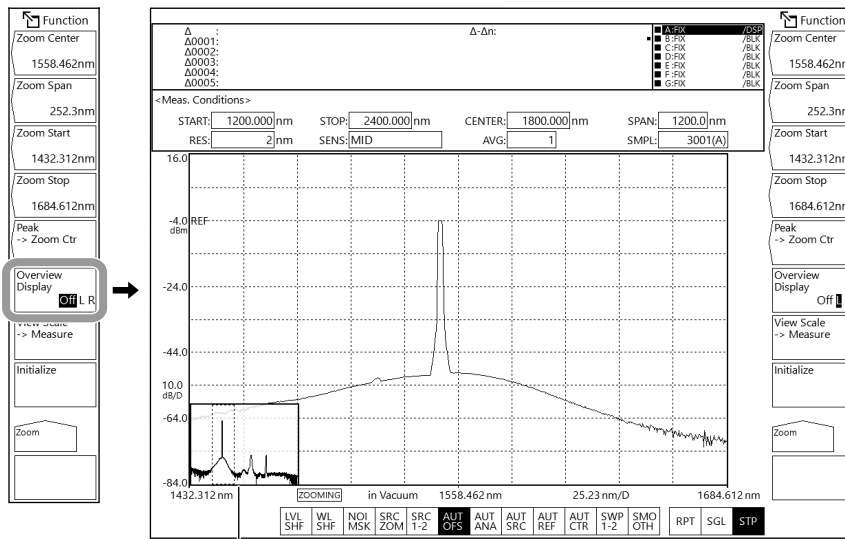


**Overview window**

# Moving the zoom area with the mouse

You can use a mouse to move the zoom area in the overview window.

1.  Move the mouse pointer into the overview window.

2.  Drag the dotted zoom area in the overview window.

    The mouse pointer will change to a hand icon during this process.

## Note

- You can unzoom by double-clicking the overview window.
- For information on power measurement inside the zoom area, see section 6.1.

## Explanation

### Zoom center wavelength (frequency or wavenumber)
### Wavelength display sweep span (frequency or wavenumber)
### Zoom start wavelength (frequency or wavenumber)
### Zoom stop wavelength (frequency or wavenumber)

Set the horizontal scale to nm, THz, or cm$^{-1}$ using the horizontal scale settings in section 2.1. The display mode switches between wavelength, frequency, and wavenumber displays according to the setting.

The selectable ranges for each item are as follows:

### Standard model (suffix code -10), limited model (suffix code -01)

| Display mode | Zoom center | Display sweep span | Zoom start | Zoom stop |
|---|---|---|---|---|
| Wavelength (nm) | 1200.000 to 2400.000 | 0.1 to 1200.0 | 600.000 to 2399.950 | 1200.050 to 3000.000 |
| Frequency (THz) | 125.0000 to 250.0000 | 0.01 to 130.00 | 60.0000 to 249.9950 | 125.0050 to 315.0000 |
| Wavenumber (cm$^{-1}$) | 4167.000 to 8333.000 | 0.1 to 4200.0 | 2067.000 to 8332.950 | 4167.050 to 10433.000 |

**Value steps**

* **Sweep span**

    When COARSE is selected, you can change the value in 1-2-5 steps. Otherwise, you can change the value in steps of 1 nm (0.1 THz or 1 cm$^{-1}$).

* **Zoom center, zoom start, zoom stop**

    When COARSE is selected, you can change the values in steps of 1 nm (0.1 THz or 1 cm$^{-1}$). Otherwise, you can change the value in steps of 0.1 nm (0.01 THz or 0.1 cm$^{-1}$).

### Extended model (suffix code -20)

| Display mode | Zoom center | Display sweep span | Zoom start | Zoom stop |
|---|---|---|---|---|
| Wavelength (nm) | 1000.000 to 2500.000 | 0.1 to 1500.0 | 250.000 to 2499.950 | 1000.050 to 3250.000 |
| Frequency (THz) | 120.0000 to 300.0000 | 0.01 to 180.00 | 30.0000 to 299.9950 | 120.0050 to 390.0000 |
| Wavenumber (cm$^{-1}$) | 4000.000 to 10000.000 | 0.1 to 6000.0 | 1000.000 to 9999.950 | 4000.050 to 13000.000 |

The value steps are the same as those for the standard model and limited model.

## Relationship between zoom center wavelength, wavelength display sweep span, zoom start wavelength, and zoom stop wavelength (the same for frequency and wavenumber)

**Wavelength display sweep span**



**Zoom start wavelength**    **Zoom center wavelength**    **Zoom stop wavelength**
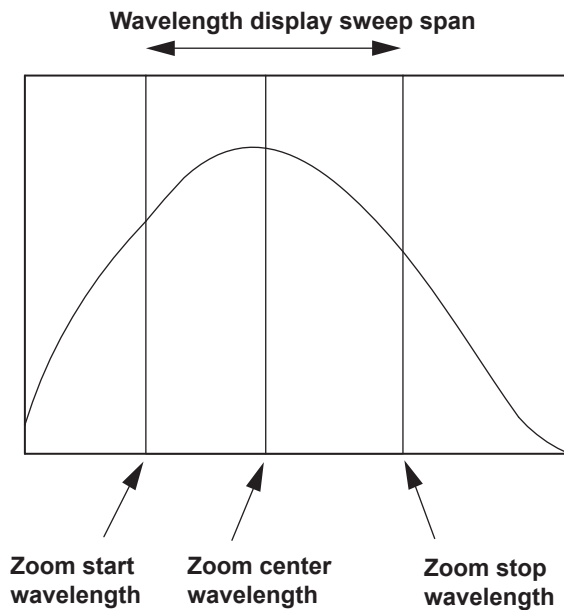
*Note*

- When you change the wavelength display sweep span, the zoom start wavelength and zoom stop wavelength will change. The zoom center wavelength will not change.
- When you change the zoom center wavelength, the zoom start wavelength and zoom stop wavelength will change. The wavelength display sweep span will not change.
- When you set the zoom start wavelength or zoom stop wavelength, the wavelength display sweep span will change because the other wavelength does not change. The center zoom wavelength will also change.
- The above description also applies to the frequency and wavenumber display modes.

## 4.2　Holding the Waveform Display

### Procedure

#### Selecting a trace to update or fix

*1.*　Press **TRACE**. The Trace menu appears.

*2.*　Tap **Active Trace**. The Active Trace menu appears.

In the following explanation, trace B is used as an example.

*3.*　Tap trace B.
The active trace is set to the trace B, and the following operation will be applied to it.

*4.*　Tap **View B** to select **DISP.**
The trace B's trace area display changes to /DSP.

#### Updating the waveform

*5.*　Tap **Write B**.
The trace B's trace area display changes to WRITE.

*6.*　Make a measurement. The waveform data will be updated.

#### Fixing the waveform

*5.*　Tap **Fix B**.
The trace B's trace area display changes to FIX.

*6.*　The waveform data will be fixed. When a measurement is made, the waveform data will not be updated.
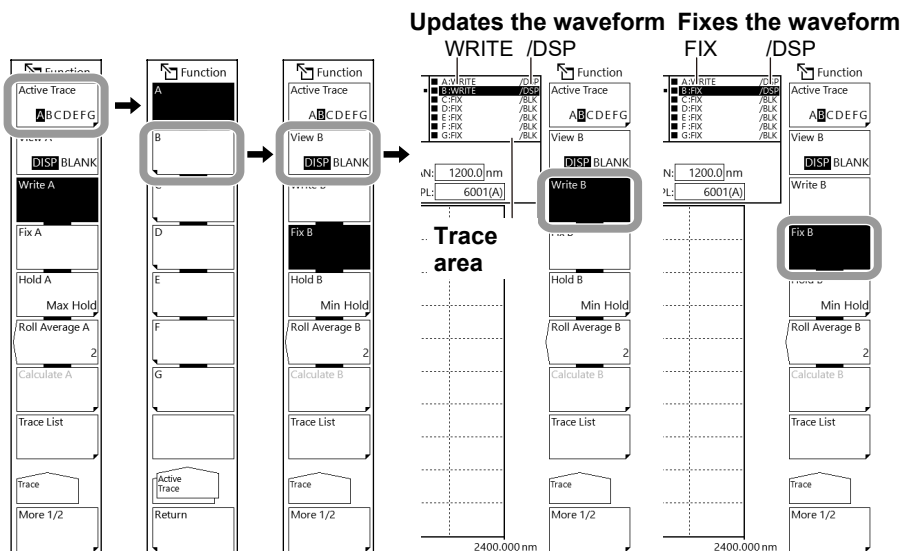


#### Note

- Only a single trace can be the active trace. If you need to change several traces, change them one at a time.
- If all traces are set to FIX, a warning message will appear, and you will not be able to make measurements.
- For details on the trace feature, see section 1.2.

## Explanation

### Active trace

An active trace is a trace in a state that allows it to be set, changed, analyzed, and so on.
A trace shows a waveform and measurement conditions. The instrument has a total of seven independent traces (A through G). You can show or hide each trace or display several traces simultaneously on the waveform screen.

**Active Trace…ABCDEFG**
These soft keys are used to select the active trace from traces A to G.

### Displaying traces

You can select whether to display the active trace on the screen.

**View @…DISP/BLANK**
View @ DISP: The waveform is displayed on the screen. The trace display changes to DSP.
View @ BLANK: The waveform is not displayed on the screen. The trace display changes to BLK.
Each time you tap, the value switches between View @ DISP and View @ BLANK.
If you select BLANK, markers set on the trace will be cleared.
The ampersand (@) indicates the selected trace. It is set to one of the letters from A to G.

### Write mode

**Write @**
This soft key sets the active trace to write mode.
When a trace is set to write mode, waveform data is written to it and updated during measurement. The trace display changes to WRITE.
The ampersand (@) indicates the selected trace. It is set to one of the letters from A to G.

### Fix mode

**FIX @**
This soft key sets the active trace to data fix mode.
When a trace is set to this mode, its waveform data do not change even when a measurement is made. As such, the waveform on the screen is not redrawn. The trace display changes to FIX. If you tap **FIX** during sweeping, the waveform display is fixed at that point.
The ampersand (@) indicates the selected trace. It is set to one of the letters from A to G.

## 4.3 Holding the Maximum or Minimum Waveform Display

### Procedure

#### Selecting a trace to hold

*1.* Press **TRACE**. The Trace menu appears.

*2.* Tap **Active Trace**. The Active Trace menu appears.

In the following explanation, trace B is used as an example.

*3.* Tap trace B.
The active trace is set to the trace B, and the following operation will be applied to it.

*4.* Tap **View B** to select **DISP.**
The trace B's trace area display changes to /DSP. For details on the trace area, see section 4.2.

#### Holding the maximum or minimum value

*5.* Tap **Hold B**. The Hold menu appears.

*6.* To hold the maximum value, tap **Max Hold**.
The trace B's trace area display changes to MAX HOLD.

To hold the minimum value, tap **Min Hold**.
The trace B's trace area display changes to MIN HOLD.

*7.* Make a measurement.
If Max Hold is selected, the waveform data is updated when the measured value is greater than the previous value.
If Min Hold is selected, the waveform data is updated when the measured value is less than the previous value.
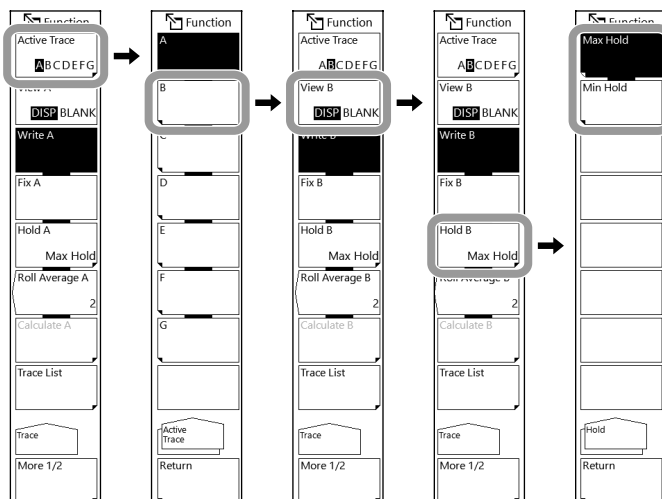


#### Note
Max Hold/Min Hold is valid only when the sweep mode is Repeat. It does not work if you repeat single sweeps.

# 4.4 Averaging the Waveform Display

## Procedure

### Selecting a trace to average

*1.* Press **TRACE**. The Trace menu appears.

*2.* Tap **Active Trace**. The Active Trace menu appears.

In the following explanation, trace B is used as an example.

*3.* Tap trace B.
The active trace is set to the trace B, and the following operation will be applied to it.

*4.* Tap **View B** to select **DISP.**
The trace B's trace area display changes to /DSP. For details on the trace area, see section 4.2.

### Setting the average times

*5.* Tap **Roll Average B**. The ROLL AVERAGE setting window appears.
The trace B's trace area display changes to ROLL AVG.

*6.* Enter the average times in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

*7.* Make a measurement. The sweep average value is updated each time a measurement is made.
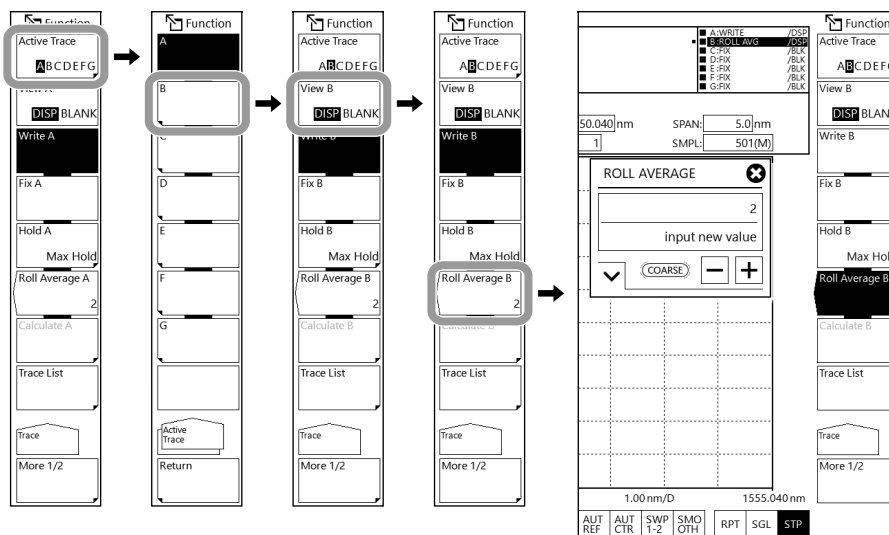


### Note
You can set the average times between 2 and 100.

## Explanation

When a trace is set to Roll Average mode, each time a measurement is made, the sweep average of the current measurement and past measurements is calculated, and the measurement data is updated.

Averaging is performed using the following formula.

$Wj(i) = Wj\text{-}1(i) \cdot (n-1)/n + W(i) \cdot 1/n$ (i=1, 2, ..., N)

Wj (i): newly displayed waveform

Wj-1(i): previously displayed waveform

W (i): newly obtained waveform

N: number of samples

n: average times

### Note

- Sweep averaging is not affected by the noise mask value. Noise mask is executed when the sweep average results are displayed.
- When the measurement sensitivity is set to a setting in which CHOP mode is activated, two sweeps are made for every count.

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## 4.5 Calculating the Waveform Display

### Procedure

#### Selecting traces for calculation

1.  Press **TRACE**. The Trace menu appears.

2.  Tap **Active Trace**. The Active Trace menu appears.

3.  Tap trace **C**, **F**, or **G**, which can be used for trace-to-trace calculation.
    The calculated results are displayed in the selected trace.
    Calculations that can be performed differ depending on the trace selected.

In the following explanation, trace C is used as an example.

4.  Tap **View C** to select **DISP.**
    The trace C's trace area display changes to /DSP. For details on the trace area, see section 4.2.

#### Selecting a calculation

5.  Tap **Calculate C**. The Calculate menu appears.

6.  To perform log calculations, tap **Log Math**. The Log Math menu appears.
    The trace C's trace area display changes.

    To perform linear calculations, tap **Linear Math**. The Linear Math menu appears.

    The trace C's trace area display changes.

7.  On the menu that appears, tap the calculation item. The selected calculation is executed.
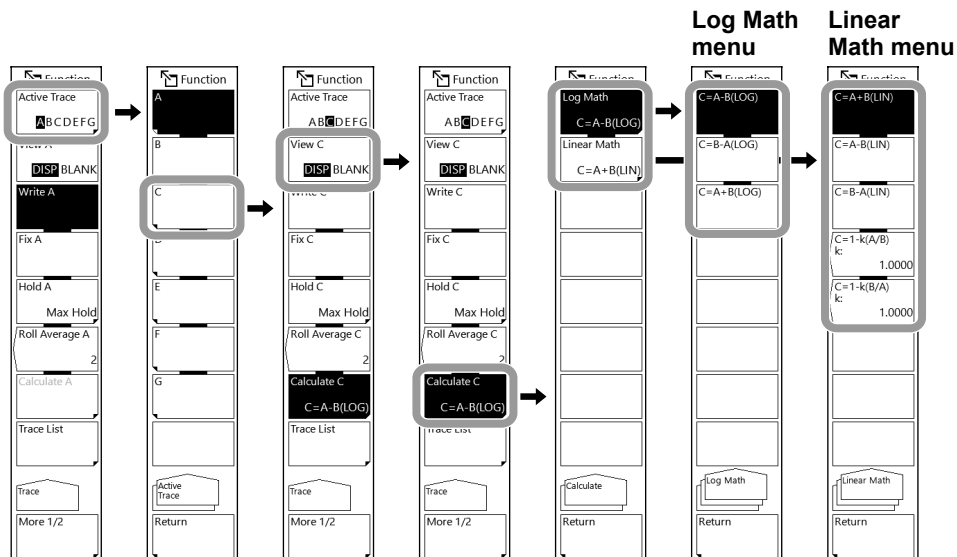


### Note

-   Trace-to-trace calculations can only be performed on C, F, or G. When Active Trace is set to Trace C, F, or G, the Calculate soft key is enabled.
-   If the calculation trace is remeasured or if the measurement center wavelength or measurement span is changed, the calculation is performed again and the results are displayed.
-   If the measurement condition (resolution) of the calculation trace is in conflict, a warning message is displayed.

## Explanation

### Executable trace-to-trace calculations

**Trace C**

| | |
|---|---|
| LOG calculation: | A–B, B–A, A+B |
| Linear calculation: | A+B, A–B, B–A, 1–k(A/B), 1–k(B/A) |

**Trace F**

| | |
|---|---|
| LOG calculation: | C–D, D–C, C+D, D–E, E–D, D+E |
| Linear calculation: | C+D, C–D, D–C, D+E, D–E, E–D |

Power/NBW (A, B, C, D, E)

**Trace G**

| | |
|---|---|
| LOG calculation: | C–F, F–C, C+F, E–F, F–E, E+F |
| Linear calculation: | C+F, C–F, F–C, E+F, E–F, F–E |

Normalize (A, B, C)

Curve Fit (A, B, C)

Marker Fit

Peak Curve Fit (A, B, C)

Calculation results are written to their corresponding traces.

### Details of calculation

The following are explanations given for traces C, F, and G.

#### Trace C: Calculate C

**Log Math**

This function performs LOG calculations on trace-to-trace data and writes the results to trace C.

Calculations can be applied to trace A and trace B.

| | |
|---|---|
| C=A–B(LOG) | Subtracts trace B from trace A in LOG form. |
| C=B–A(LOG) | Subtracts trace A from trace B in LOG form. |
| C=A+B(LOG) | Adds trace A and trace B in LOG form. |

The calculation results are displayed with a sub scale. The scale for the calculation results is displayed on the left or right side of the screen. For details on sub scales, see section 2.6.

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**Linear Math**

This function performs linear calculations on trace-to-trace data and writes the results to trace C.

Calculations can be applied to trace A and trace B.

| | |
|---|---|
| C=A+B(LIN) | Adds trace A and trace B in linear form. |
| C=A–B(LIN) | Subtracts trace B from trace A in linear form. |
| C=B–A(LIN) | Subtracts trace A from trace B in linear form. |
| C=1–k(A/B) | Given trace A and trace B, calculates 1–k(A/B). |
| | Calculates 1 – k × (trace A/Trace B) (linear value), and writes the results to trace C. |
| | The coefficient k can be changed in the range of 1.0000 to 20000.0000 (in steps of 0.0001). If COARSE is enabled in the setting window, you can change the value in 1-2-5 steps. |
| | The coefficient k setting applies to both the <C=1–k(A/B)> calculation and <C=1–k(B/A)> calculation. |
| | The display in the trace area changes to 1–k(A/B). |
| C=1–k(B/A) | Given trace A and trace B, calculates 1–k(B/A). |
| | Calculates 1 – k × (trace B/Trace A) (linear value), and writes the results to trace C. |
| | The display in the trace area changes to 1–k(B/A). |

The calculation results of C=A+B(LIN), C=A–B(LIN), and C=B–A(LIN) are displayed using the main scale.

The calculation results of C=1–k(A/B) and C=1–k(B/A) are displayed with a sub scale. For details on main scale, see section 2.5. For details on sub scale, see section 2.6.

**Specific Examples**

<C=1−k(A/B)> and <C=1−k(B/A)> can be applied to a DUT to estimate the transmission efficiency from the reflection light spectrum or estimate the reflectivity from the transmission light spectrum.

(1) Estimating the transmission efficiency (Trace C) from the reflected light spectrum (Trace A)

Transmitted light spectrum (Trace C) = 1 − k(Trace A/Trace B)
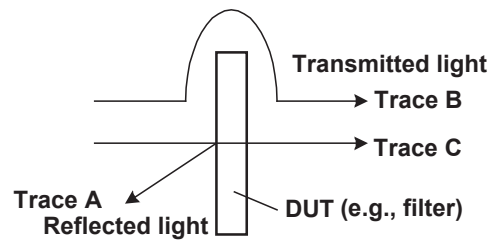


(2) Estimating the reflectivity (Trace C) from the transmitted light spectrum (Trace A)

Reflected light spectrum (Trace C) = 1 − k(Trace A/Trace B)
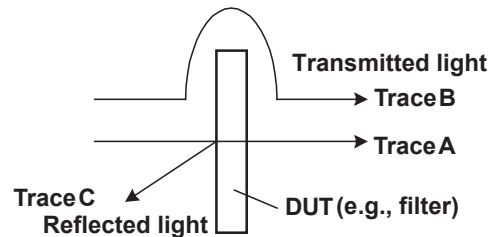


The value of k is an absorption coefficient which is used in determining the DUT reflectivity and transmission efficiency. Different algorithms are used depending on whether transmission efficiency or reflectivity is estimated, so the k value also varies accordingly. The following equation can be used to determine kr and kt. In the equation, Pin is the level prior to DUT input; Pout is the level after DUT input; Pre is the DUT reflection level; kr is the absorption coefficient used to determine the reflectivity; and kt is the absorption coefficient used to determine the transmission efficiency. (Each level is a linear value.)

Estimating the reflected light spectrum from the transmitted light spectrum

$$kt = (Pin - Pre)/Pout$$

Estimating the transmitted light spectrum from the reflected light spectrum

$$kr = (Pin - Pout)/Pre$$

## Trace F: Calculate F

**Log Math**

This function performs LOG calculations on trace-to-trace data and writes the results to trace F.

Calculations can be applied to trace C, trace D, and trace E.

| | |
|---|---|
| F=C–D(LOG) | Subtracts trace D from trace C in LOG form. |
| F=D–C(LOG) | Subtracts trace C from trace D in LOG form. |
| F=C+D(LOG) | Adds trace C and trace D in LOG form. |
| F=D–E(LOG) | Subtracts trace E from trace D in LOG form. |
| F=E–D(LOG) | Subtracts trace D from trace E in LOG form. |
| F=D+E(LOG) | Adds trace D and trace E in LOG form. |

The calculation results are displayed with a sub scale. The scale for the calculation results is displayed on the left or right side of the screen. For details on sub scales, see section 2.6.

**Linear Math**

This function performs linear calculations on trace-to-trace data and writes the results to trace F.

Calculations can be applied to trace C, trace D, and trace E.

| | |
|---|---|
| F=C+D(LIN) | Adds trace C and trace D in linear form. |
| F=C–D(LIN) | Subtracts trace D from trace C in linear form. |
| F=D–C(LIN) | Subtracts trace C from trace D in linear form. |
| F=D+E(LIN) | Adds trace D and trace E in linear form. |
| F=D–E(LIN) | Subtracts trace E from trace D in linear form. |
| F=E–D(LIN) | Subtracts trace D from trace E in linear form. |

The calculation results are displayed using the main scale.

**Power/NBW**

See section 4.8.

## Trace G: Calculate G

**Log Math**

This function performs LOG calculations on trace-to-trace data and writes the results to trace G.

Calculations can be applied to trace C, trace E, and trace F.

| | |
|---|---|
| G=C–F(LOG) | Subtracts trace F from trace C in LOG form. |
| G=F–C(LOG) | Subtracts trace C from trace F in LOG form. |
| G=C+F(LOG) | Adds trace C and trace F in LOG form. |
| G=E–F(LOG) | Subtracts trace F from trace E in LOG form. |
| G=F–E(LOG) | Subtracts trace E from trace F in LOG form. |
| G=E+F(LOG) | Adds trace E and trace F in LOG form. |

The calculation results are displayed with a sub scale. The scale for the calculation results is displayed on the left or right side of the screen. For details on sub scales, see section 2.6.

**Linear Math**

This function performs linear calculations on trace-to-trace data and writes the results to trace G.

Calculations can be applied to trace C, trace E, and trace F.

G=C+F(LIN)      Adds trace C and trace F in linear form.
G=C–F(LIN)      Subtracts trace F from trace C in linear form.
G=F–C(LIN)      Subtracts trace C from trace F in linear form.
G=E+F(LIN)      Adds trace E and trace F in linear form.
G=E–F(LIN)      Subtracts trace F from trace E in linear form.
G=F–E(LIN)      Subtracts trace E from trace F in linear form.

The calculation results are displayed using the main scale.

**Normalize**

This is one of the calculations that normalizes trace data. This function writes the normalized result in trace G and displays it. One of the following traces can be normalized: trace A, trace B, or trace C.
The peak of the normalized waveform is 1 if trace G is set to linear scale or 0 dB if it is set to LOG scale. Data is displayed when sweeping is finished to the end.
The trace area display changes to NORM @.

G=NORM A      Normalizes trace A and writes the normalized data to trace G.
G=NORM B      Normalizes trace B and writes the normalized data to trace G.
G=NORM C      Normalizes trace C and writes the normalized data to trace G.

The calculation results are displayed with a sub scale. The scale for the calculation results is displayed on the left or right side of the screen. For details on sub scales, see section 2.6.

**Curve Fit**

See section 4.7.

**Marker Fit**

See section 4.7.

**Peak Curve Fit**

See section 4.7.

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Displaying Optical Spectral Waveforms

# 4.6 Normalizing the Waveform Display

## Procedure

1. Press **TRACE** and then tap **Active Trace** to select **G**.

2. Tap **View G** to select **DISP.**

3. Tap **Calculate G**. The Calculate menu appears.

4. Tap **Normalize**. The Normalize menu appears.

5. To normalize trace A, select **G=NORM A**. To normalize trace B, select **G=NORM B**. To normalize trace C, select **G=NORM C**.



Example of waveform before normalization



Example of waveform after normalization
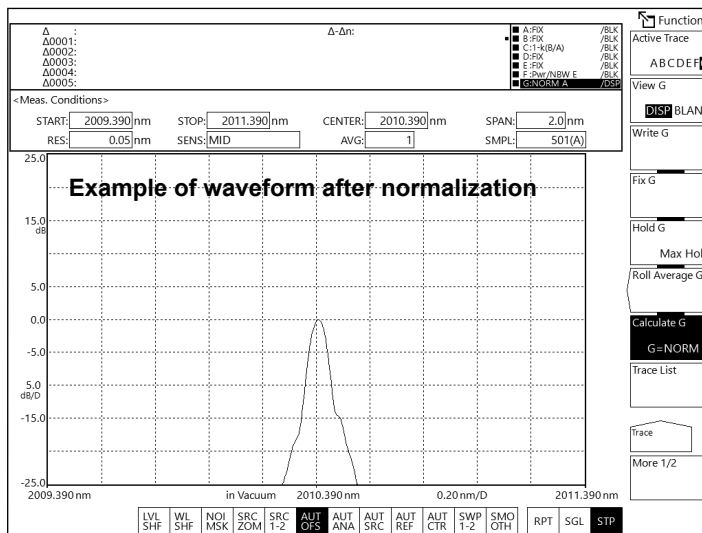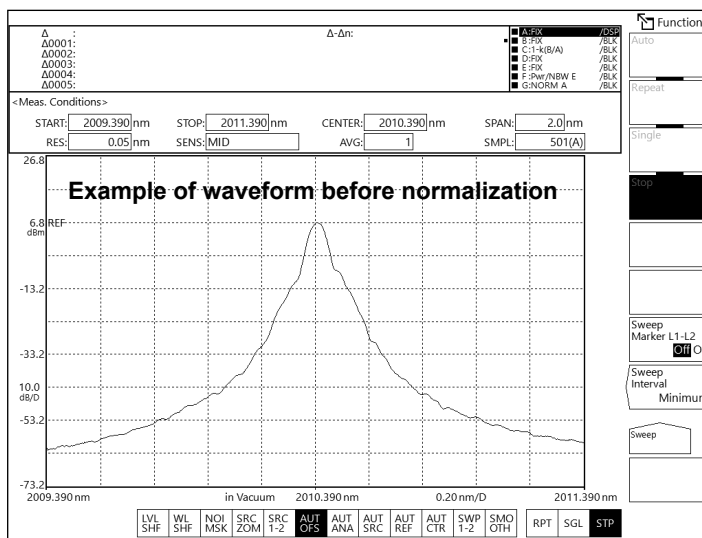
## Note

- Normalization is not possible if the waveform level is low.
- For details on normalization, see section 4.5.

# 4.7 Curve Fitting the Waveform Display

## Procedure

### Setting the target trace

*1.* Press **TRACE** and then tap **Active Trace** to select **G**.

*2.* Tap **View G** to select **DISP.**

*3.* Tap **Calculate G**. The Calculate menu appears.

*4.* Tap **Curve Fit**. The Curve Fit menu appears.

*5.* To curve fit trace A, select **G=CRV FIT A**. To curve fit trace B, select **G=CRV FIT B**. To curve fit trace C, select **G=CRV FIT C**. To curve fit markers, select **G=MKR FIT**.
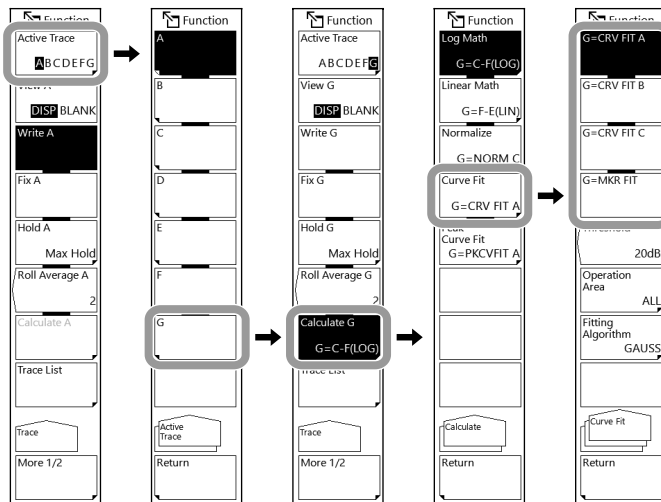


*Note*

If a warning message appears when you select G=MKR FIT, check that:
- The threshold value is set properly.
- The necessary number of markers are placed for the selected curve fitting algorithm.

## Setting the calculation target range

*6.*  Tap **Threshold**. A THRESH setting window appears.

*7.*  Enter the threshold value in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

*8.*  Tap **Operation Area** to select the calculation target range.



**Entire range**

**Inside L1 and L2**

**Outside L1 and L2**
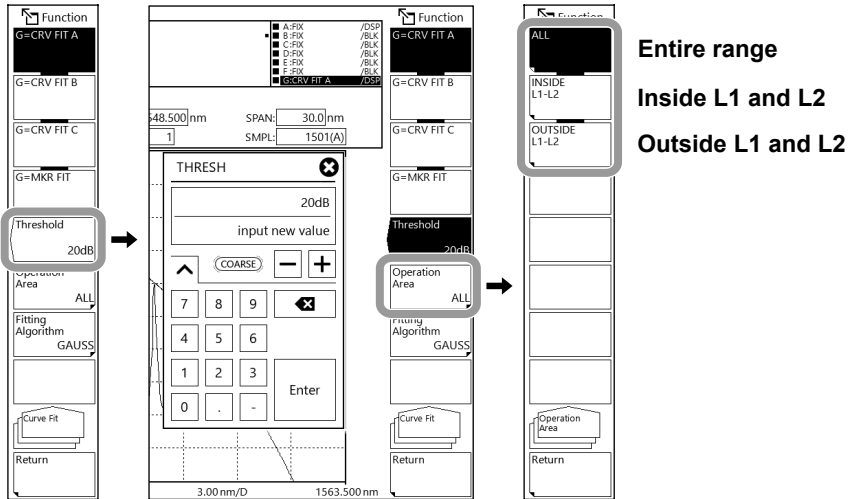
> *Note*
> For details on the calculation target range, see the explanation.

## Selecting the curve fitting algorithm

*9.*  Tap **Fitting Algorithm** to select the curve fitting algorithm you want to use.
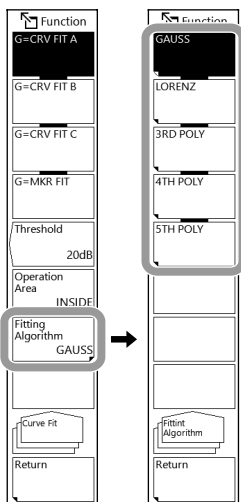


> *Note*
> For details on the curve fitting algorithm, see the explanation.

# Peak curve fitting

**4.** Continuing from step 3, tap **Peak Curve Fit**. The Peak Curve Fit menu appears.

**5.** To peak curve fit trace A, select **G=PKCVFIT A**. To peak curve fit trace B, tap **G=PKCVFIT B**. To peak curve fit trace C, tap **G=PKCVFIT C**.

The rest of the procedure is the same as for curve fitting.

**Example of a screen that appears when peak curve fitting is in progress with the curve fitting algorithm set to GAUSS**

**4**

Displaying Optical Spectral Waveforms
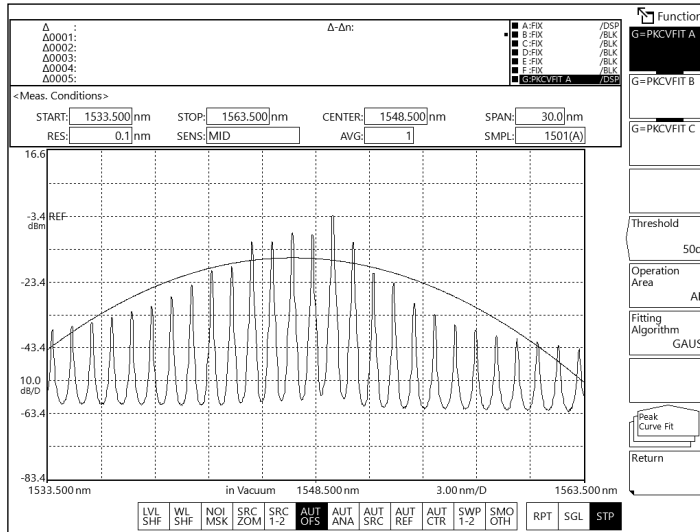
## Explanation

## Curve fit target range

Curve fitting is applied to the specified trace waveform, and the results are drawn in trace G.

Calculations are performed on data from the threshold to the peak.

Set the threshold between 0 dB and 99 dB (in steps of 1).

The trace area display changes to CRV FIT @ and MKR FIT.

## Curve fit target trace

G=CRV FIT A: Applies curve fitting to trace A.

G=CRV FIT B: Applies curve fitting to trace B.

G=CRV FIT C: Applies curve fitting to trace C.

G=MKR FIT: Applies curve fitting to the placed markers using the current measurement scale.

Curve fitting is applied even when markers are placed on different traces.

**Example of a curve-fitted waveform (data range: OUTSIDE L1-L2)**
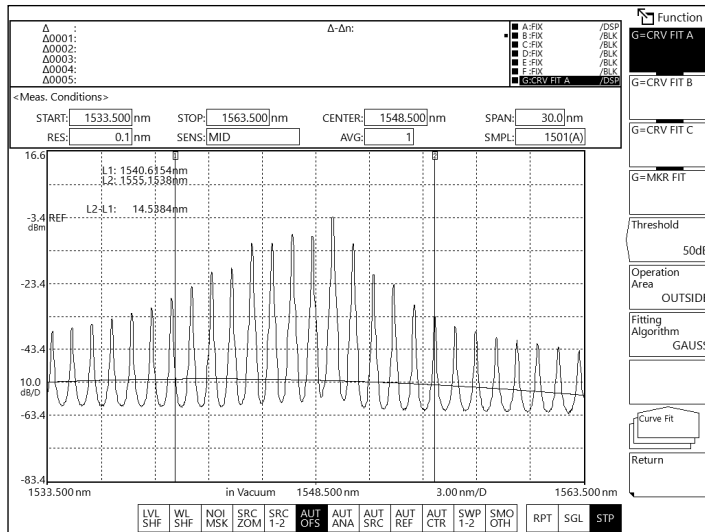


**Example of a marker-fitted waveform (data range: ALL)**
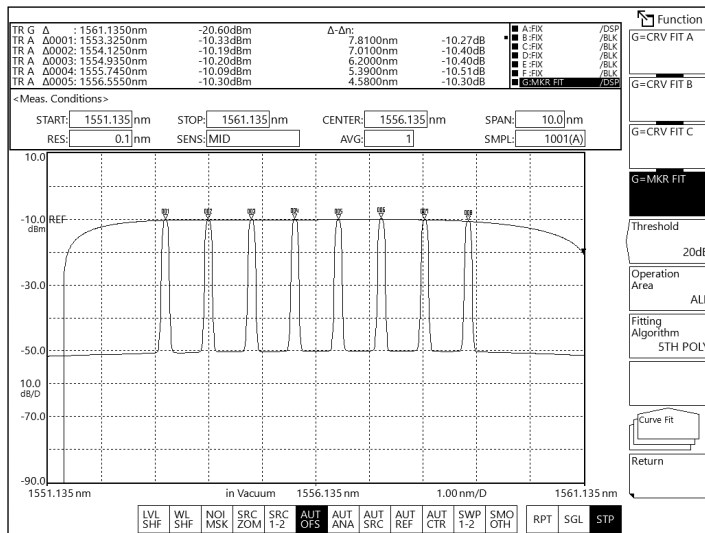
# Peak curve fit target range

Peak curve fitting is applied to the specified trace waveform, and the results are drawn in trace G.

Calculations are performed on mode peaks that are greater than or equal to the threshold.

Set the threshold between 0 dB and 99 dB (in steps of 1).

The trace area display changes to PKCVFIT @.

# Peak curve fit target trace

G=PKCVFIT A:    Applies peak curve fitting to trace A.

G=PKCVFIT B:    Applies peak curve fitting to trace B.

G=PKCVFIT C:    Applies peak curve fitting to trace C.

# Range of target data for calculation

**Vertical axis**

Curve fit: Data from the threshold to the peak.

Peak curve fit: Mode peaks that are greater than or equal to the threshold.

**Horizontal scale**

ALL:                    Includes all data in the calculation target trace in the calculation.

INSIDE L1-L2:       Includes the data between the line markers in the calculation.

OUTSIDE L1-L2:     Includes the data outside the line markers in the calculation.

**When INSIDE L1- L2 is selected**
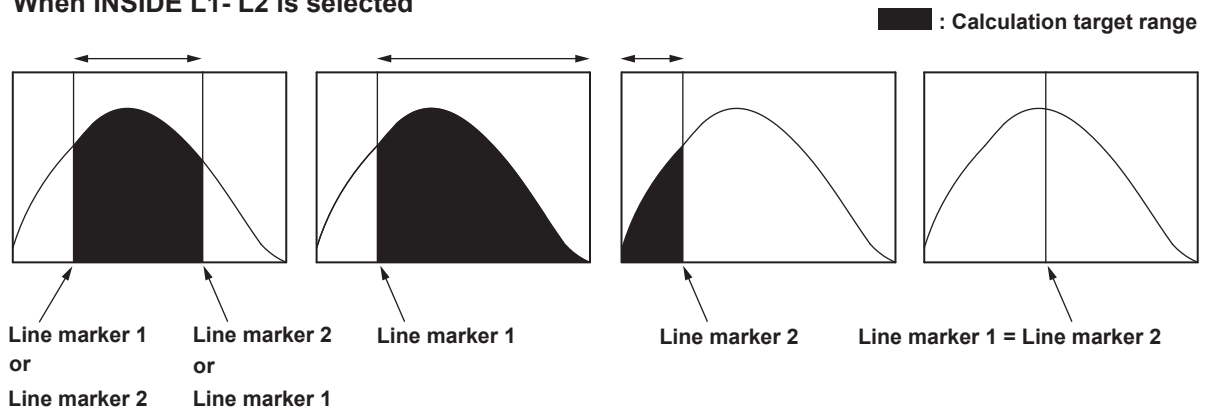


**When OUTSIDE L1- L2 is selected**

4

Displaying Optical Spectral Waveforms
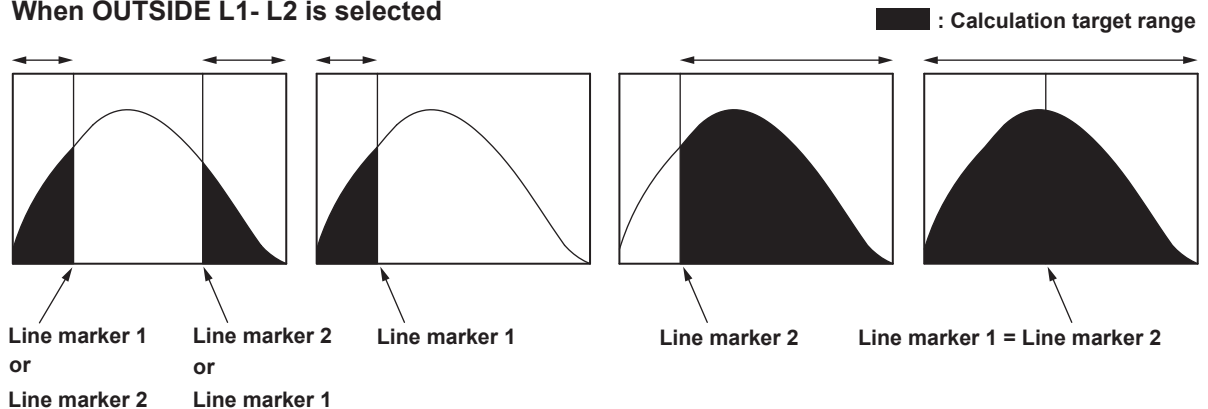
## Curve fitting algorithm

| Soft key display | Function |
|---|---|
| GAUSS | Normal distribution curve |
| LORENZ | Lorenz curve |
| 3RD POLY | 3rd order polynomial |
| 4TH POLY | 4th order polynomial |
| 5TH POLY | 5th order polynomial |

*Note*

If G=MKR FIT is selected, fitting cannot be performed if only a small number of markers are placed.

A warning message appears when the number of markers is as follows. WARNING: 111 <G=MKR FIT>failed

| | |
|---|---|
| GAUSS,LORENZ: | Fewer than three markers |
| 3RD POLY: | Fewer than four markers |
| 4TH POLY: | Fewer than five markers |
| 5TH POLY: | Fewer than six markers |

## 4.8　Displaying Power Spectral Density Waveforms

### Procedure

*1.* Press **TRACE** and then tap **Active Trace** to select **F**.

*2.* Tap **View F** to select **DISP.**

*3.* Tap **Calculate F**. The Calculate menu appears.

*4.* Tap **Power/NBW**. The Power/NBW menu appears.

*5.* To display the power spectral density of trace A, tap **F=Pwr/NBW A**.

　　To display the power spectral density of trace B, tap **F=Pwr/NBW B**.

　　To display the power spectral density of trace C, tap **F=Pwr/NBW C**.

　　To display the power spectral density of trace D, tap **F=Pwr/NBW D**.

　　To display the power spectral density of trace F, tap **F=Pwr/NBW F**.

*6.* Tap **Bandwidth**. A BANDWIDTH window appears.

*7.* Enter the bandwidth in the displayed window.
　　For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
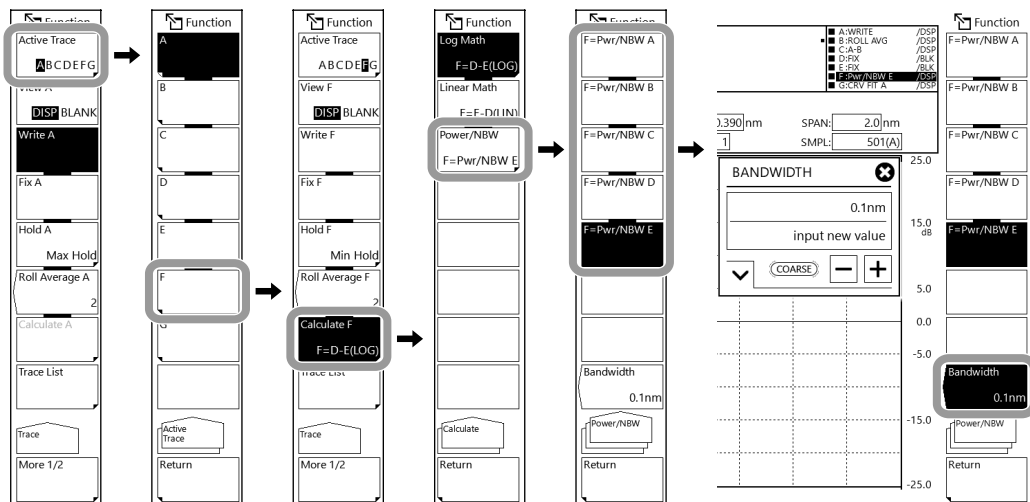


### Explanation

The power spectral density waveform display shows the power per specified band.
Selectable range: 0.1 nm to 10 nm (in 0.1 nm steps)

**Vertical scale unit**
Vertical scale units, namely dBm/nm, mW/nm, µW/nm, nW/nm, and pW/nm, are units for displaying power per nanometer. If trace F is set to Power/NBW, they are automatically changed to dBm, mW, µW, nW, and pW. If trace F is set to Power/NBW and you change the vertical scale to dBm/nm, mW/nm, µW/nm, nW/nm, pW/nm, trace F will switch to FIX mode, and the waveform will no longer be updated. For details on the vertical scale unit, see section 2.5.

# 4.9 Searching Waveforms

## Procedure

### Single search

#### Setting the active trace

**1.** Press **TRACE** and then tap **Active Trace** to set the search target trace to the active trace.

**2.** Tap **View** of the selected trace to select **DISP**.

#### Selecting the single search

**3.** Press **PEAK SEARCH**. A Peak Search menu appears.

**4.** Tap **More** to display the More 2/2 menu.

**5.** Tap **Search Mode** to select **SINGL**.
By default, SINGL (single search) is selected.

#### Peak search

**6.** Continuing from step 5, tap **More** to display the More 1/2 menu.

**7.** Tap **Peak Search**. A moving marker is placed at the peak (maximum value) of the waveform, and the marker values are displayed in the data area.

#### Bottom search

**7.** Continuing from step 6, tap **Bottom Search**. A moving marker is placed at the bottom (minimum value) of the waveform, and the marker value is displayed in the data area.



*Note*

• If the active trace is not set to DISP, you cannot use the moving marker.
Set View @ DISP BLANK under Trace to DISP.

### Setting the Minimum Peak/Bottom Difference of the Mode Judgment Reference

*1.*  Press **PEAK SEARCH**. A Peak Search menu appears.

*2.*  Tap **More** to display the More 2/2 menu.

*3.*  Tap **Mode Diff**. The MODE DIFF setting window appears.

*4.*  Enter the minimum peak/bottom difference of the mode judgment reference in the displayed window.

For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
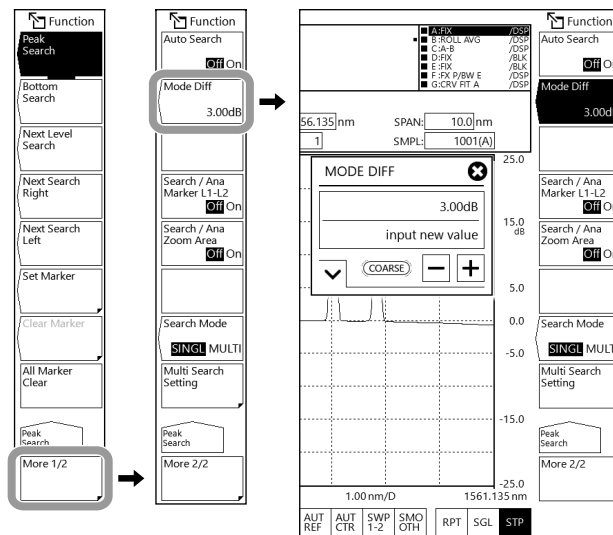


### Searching for the next peak/bottom level

*5.*  Continuing from step 4, tap **More** to display the More 1/2 menu.

*6.*  When the moving marker is displayed at the peak or bottom of the waveform, tap **Next Level Search**. On the marker trace waveform, the moving marker at the peak or bottom is moved to the next peak (local maximum value) or bottom (local minimum value).

### Searching for the level peak/bottom to the right of the moving marker

*5.*  Continuing from step 4, tap **More** to display the More 1/2 menu.

*6.*  When the moving marker is displayed at the peak or bottom of the waveform, tap **Next Search Right**. The moving marker is moved to the next peak (local maximum value) or bottom (local minimum value) on the right.

### Searching for the level peak/bottom to the left of the moving marker

*5.*  Continuing from step 4, tap **More** to display the More 1/2 menu.

*6.*  When the moving marker is displayed at the peak or bottom of the waveform, tap **Next Search Left**. The moving marker is moved to the next peak (local maximum value) or bottom (local minimum value) on the left.

## Auto search

1. Press **PEAK SEARCH**. A Peak Search menu appears.

2. Tap **More** to display the More 2/2 menu.

3. Tap **Auto Search** to select On.
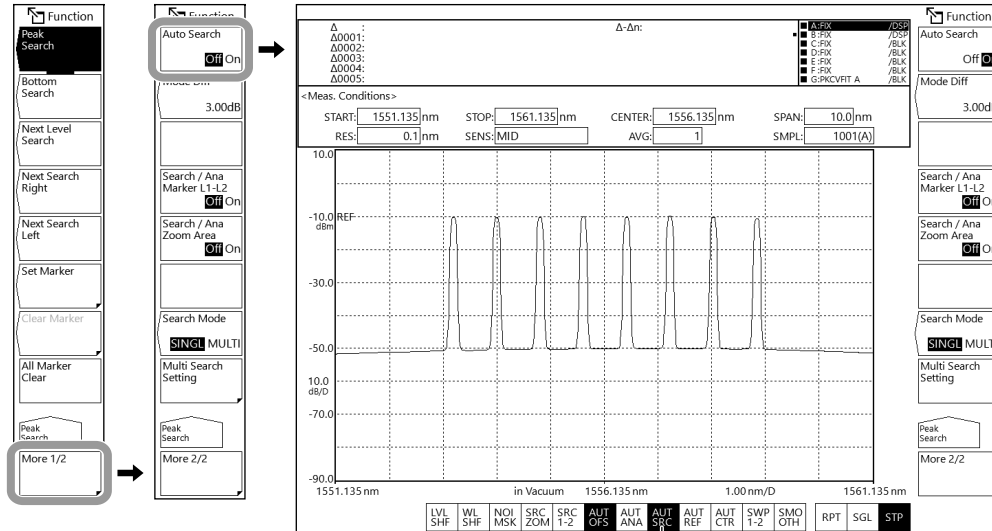


**Highlighted when Auto Search is selec**

# Multi search

## Setting the active trace

1. Press **TRACE** and then tap **Active Trace** to set the search target trace to the active trace.

2. Tap **View** of the selected trace to select **DISP**.

## Selecting the multi search

3. Press **PEAK SEARCH**. A Peak Search menu appears.

4. To perform a peak search, tap **Peak Search**. To perform a bottom search, tap **Bottom Search**.

5. Tap **More** to display the More 2/2 menu.

6. Tap **Search Mode** to select **MULTI**.
   By default, SINGL (single search) is selected.
   When you select MULTI, a peak search or a bottom search is executed.

   For peak search, fixed markers are placed at the multiple peaks of the waveform, and the marker values are displayed in the data area. The moving marker is placed at the highest peak.

   For bottom search, fixed markers are placed at the multiple bottoms of the waveform, and the marker values are displayed in the data area. The moving marker is placed at the lowest bottom.

▼: Moving marker



004: **Marker number**

▽: **Fixed marker**

*Note*

If the active trace is not set to DISP, you cannot use the moving marker.
Set View @ DISP BLANK under Trace to DISP.

### Setting the mode (peak/bottom) detection threshold and the detection list sort order

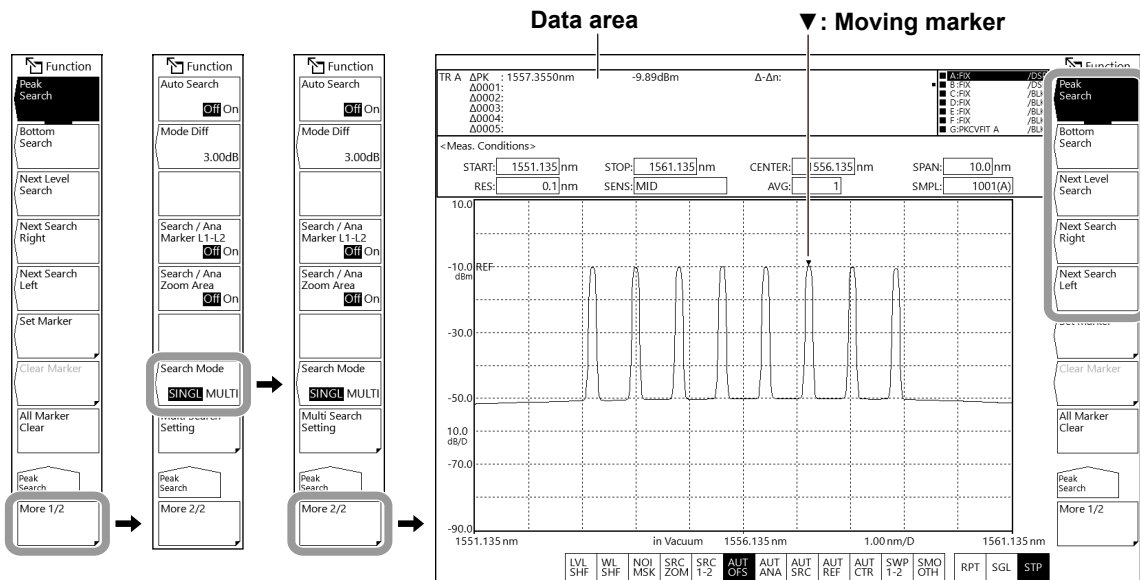*1.* Press **PEAK SEARCH**. A Peak Search menu appears.

*2.* Tap **More** to display the More 2/2 menu.

*3.* Tap **Multi Search Setting**. The Multi Search Setting menu appears.

### Setting the mode (peak/bottom) detection threshold

*4.* Tap **Threshold**. A THRESH setting window appears.

*5.* Enter the mode detection threshold in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

### Setting the detection list sort order

*4.* Tap **Sort by**. Each time you tap, the value switches between WL and LVL.

**4**

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### Searching for the next peak/bottom level

***6.*** Continuing from step 5, tap **Return** to return to the previous level. Tap **More** to display the More 1/2 menu. The rest of the procedure is the same as for single search.

### Searching for the level peak/bottom to the right of the moving marker

***6.*** Continuing from step 5, tap **Return** to return to the previous level. Tap **More** to display the More 1/2 menu. The rest of the procedure is the same as for single search.

### Searching for the level peak/bottom to the left of the moving marker

***6.*** Continuing from step 5, tap **Return** to return to the previous level. Tap **More** to display the More 1/2 menu. The rest of the procedure is the same as for single search.

## Explanation

## Single search

The instrument detects the peak (the maximum level value) or bottom (the minimum level value) of the measured waveform.

### Peak Search

A peak search (a search for the maximum level value) is performed on the active trace waveform.
The moving marker is displayed at the peak point, and the marker value is displayed in the data area. If the peak level is off the screen, its marker is displayed at the top or bottom edge of the screen. Even in this situation, the correct marker value is displayed.
After a measurement is executed, the moving marker becomes movable. You can also scroll and view the contents displayed in the data area.

### Bottom Search

A bottom search (a search for the minimum level value) is performed on the active trace waveform.
The moving marker is displayed at the bottom point, and the marker value is displayed in the data area. If the bottom level is off the screen, its marker is displayed at the top or bottom edge of the screen. Even in this situation, the correct marker value is displayed.
After a measurement is executed, the moving marker becomes movable. You can also scroll and view the contents displayed in the data area.

### Next Level Search

On the active trace waveform, the moving marker at the peak or bottom is moved to the next peak (local maximum value) or bottom (local minimum value).
A warning message will appear if such peak or bottom is not found.

> WARNING 103 : No data in active trace

## Next Search Right

On the active trace waveform, the moving marker at the peak or bottom is moved to the peak (local maximum value) or bottom (local minimum value) on its right.

A warning message will appear if such peak or bottom is not found.

WARNING 103 : No data in active trace

## Next Search Left

On the active trace waveform, the moving marker at the peak or bottom is moved to the peak (local maximum value) or bottom (local minimum value) on its left.

A warning message will appear if such peak or bottom is not found.

WARNING 103 : No data in active trace

## Set Marker

Places a fixed marker with the assigned number at the moving marker position.
Selectable range: 0001 to 1024

The initial number is 0001 when the fixed marker is placed for the first time. At other times, it is the highest number of the placed fixed markers + 1. (Upper limit: 1024)

## Clear Marker

Clears the specified fixed marker number. The marker value in the data area is also cleared.
The default fixed marker number to be cleared is the last assigned fixed marker number.

## All Marker Clear

The moving marker and all fixed markers are cleared.

## Mode Diff

Sets the minimum peak/bottom difference (dB) serving as a basis for mode determination during mode detection.
Selectable range: 0.01 dB to 50.00 dB
(Normal: steps of 0.01, COARSE: steps of 1, default value: 3.00 dB)

## Search/Ana Marker L1-L2

If you set Search/Ana Marker L1-L2 to On when wavelength line markers L1 and L2 are on, the peak/bottom search target is set between line markers 1 and 2.

### *Note*

- The instrument searches the waveform between line markers L1 and L2.
- If only L1 is set, the instrument searches from line marker 1 to the right edge of the screen.
- If only L2 is set, the instrument searches from the left edge of the screen to line marker 2.
- If neither L1 or L2 is set, the instrument searches from the measurement start wavelength to the measurement stop wavelength.
- Search/Ana Marker L1-L2 is shared between the Marker, Peak Search, and Analysis menus.
- When Search/Ana Marker L1-L2 is set to On, the $\boxed{\begin{smallmatrix} SRC \\ 1\text{-}2 \end{smallmatrix}}$ is highlighted at the bottom the screen.

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## Search/Ana Zoom Area

When Search/Ana Zoom Area is set to On, the peak/bottom search is performed on the data in the zoom display range.

If Search/Ana and Zoom Area Search/Ana Marker L1-L2 are both set to On, search is performed in the area where the zoom display range and line marker range overlap.

*Note*

- Search/Ana Zoom Area is shared between the Marker, Peak Search, and Analysis menus.
- When Search/Ana Zoom Area is set to On, the $\boxed{\substack{\text{SRC} \\ \text{ZOM}}}$ is highlighted at the bottom the screen.

## Auto Search

Turns on or off peak/bottom searching that is performed every sweep.

When set to On, after sweeping ends, a peak/bottom search is performed automatically, and a moving marker is set automatically. By default, Auto Search is set to Off.

# Multi search

The instrument detects the peaks (the maximum level values) or bottoms (the minimum level values) of the measured waveform at once.

## Threshold

Set the threshold (detection range level) that is used when the multi search detects modes (peaks/bottoms).

For peak searches, the peak detection range is defined as being the levels from the measured waveform's maximum peak to the threshold value.

For bottom searches, the bottom detection range is defined as being the levels from the measured waveform's minimum bottom to the threshold value.

## Sort by

Set the assignment order of marker numbers. The detected marker values are displayed as a list in the data area. This setting sets the sort order of the detection list.

WL: Displayed in ascending order of wavelength.

LVL: For the peak search, levels are displayed in order starting from the highest level. For the bottom search, levels are displayed in order starting from the lowest level.

## Peak search

A peak search (a search for the maximum level value) is performed on the active trace waveform.

Fixed markers are displayed on the peak points. The moving marker is displayed on the maximum peak (the maximum level value). The marker values are displayed in the data area. If the peak level is off the screen, its marker is displayed at the top or bottom edge of the screen. Even in this situation, the correct marker value is displayed.

After a measurement is executed, the moving marker becomes movable. You can also scroll and view the contents displayed in the data area.

## Bottom Search

A bottom search (a search for the minimum level value) is performed on the active trace waveform.

Fixed markers are displayed on the bottom points. The moving marker is displayed on the minimum bottom (the minimum level value). The marker values are displayed in the data area. If the bottom level is off the screen, its marker is displayed at the top or bottom edge of the screen. Even in this situation, the correct marker value is displayed.

After a measurement is executed, the moving marker becomes movable. You can also scroll and view the contents displayed in the data area.

## Other soft keys

The functions of the following soft keys in multi search are the same as those in single search. See the explanation of single search.

**Next Level Search**

**Next Search Right**

**Next Search Left**

**Set Marker**

**Clear Marker**

**All Marker Clear**

**Mode Diff**

**Search/Ana Marker L1-L2**

**Search/Ana Zoom Area**

**Auto Search**

*Note*

The Mode Diff (mode judgment reference)—the peak/bottom difference—setting is shared between multi search and single search.

# 4.10 Copying and Clearing Waveforms

## Procedure

### Copying traces

*1.* Press **TRACE**. The Trace menu appears.

*2.* Tap **More** to display the More 2/2 menu.

*3.* Tap **Trace Copy**. The Trace Copy menu appears.

*4.* Tap **Source Trace** to display a menu, and tap the copy source trace (**A** to **G**). The menu returns automatically to the previous level.

*5.* Tap **Destination Trace** to display a menu, and tap the copy destination trace (**A** to **G**). The menu returns automatically to the previous level.

*6.* Tap **Copy Execute**. Copying is executed.



*Note*
- After the copy is executed, the copy destination trace status changes to FIX and the view to DISP.
- If the copy source trace and copy destination trace are the same, the copy will not be executed even when you tap Copy Execute.

# Clearing traces

1.  Press **TRACE**. The Trace menu appears.

2.  Tap **More** to display the More 2/2 menu.

3.  Tap **Trace Clear**. The Trace Clear menu appears.

4.  Tap the trace (**A** to **G**) you want to clear the data of. The waveform of the selected trace is cleared, and the menu returns automatically to the previous level.

    To clear the data of all traces, tap **All Trace**.
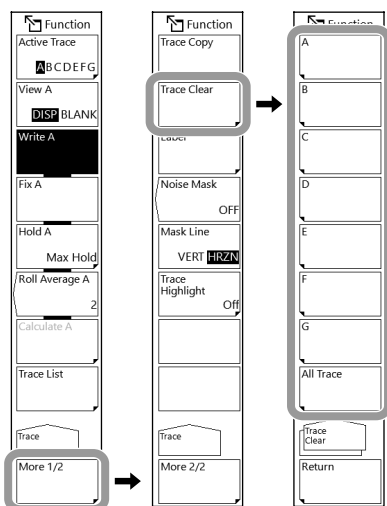


# Displaying the trace list

1.  Press **TRACE**. The Trace menu appears.

2.  Tap **Trace List**. A trace list is displayed.



Active trace

Trace list

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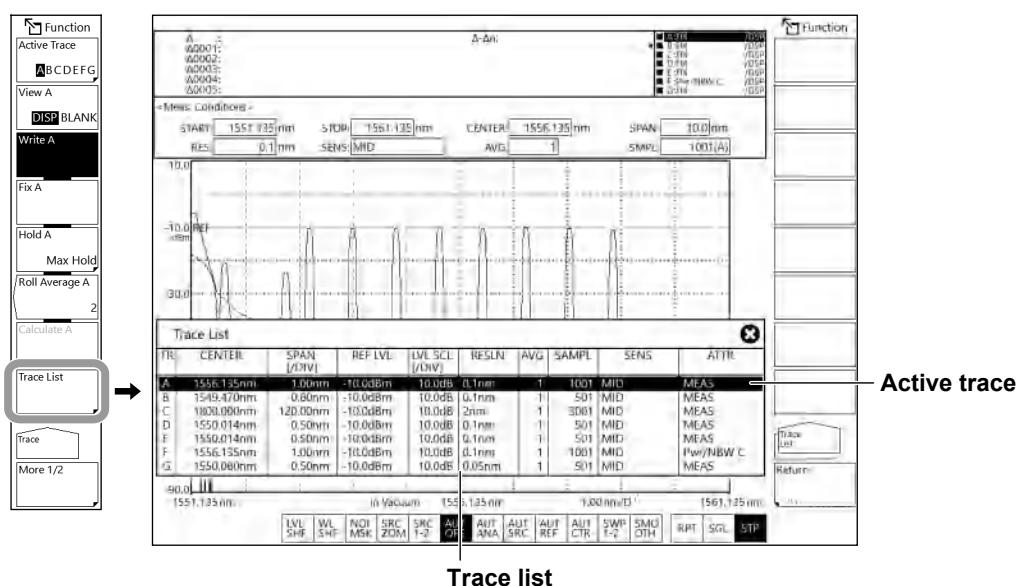
# 4.11 Noise Mask

## Procedure

1. Press **TRACE**. The Trace menu appears.

2. Tap **More** to display the More 2/2 menu.

3. Tap **Noise Mask**. The NOISE MASK setting window appears.

4. Enter the noise mask value in the displayed window. You can set the value to OFF or between –100 to 0.

   For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

5. Tap **Mask Line**. Each time you tap, the value switches between VERT and HRZN.



**Switches bet**

**Highlighted when Noise Mask is selected**

## Explanation

### Noise mask type

#### HRZN

The waveform is displayed by replacing level values less than or equal to the noise mask value with the noise mask value.
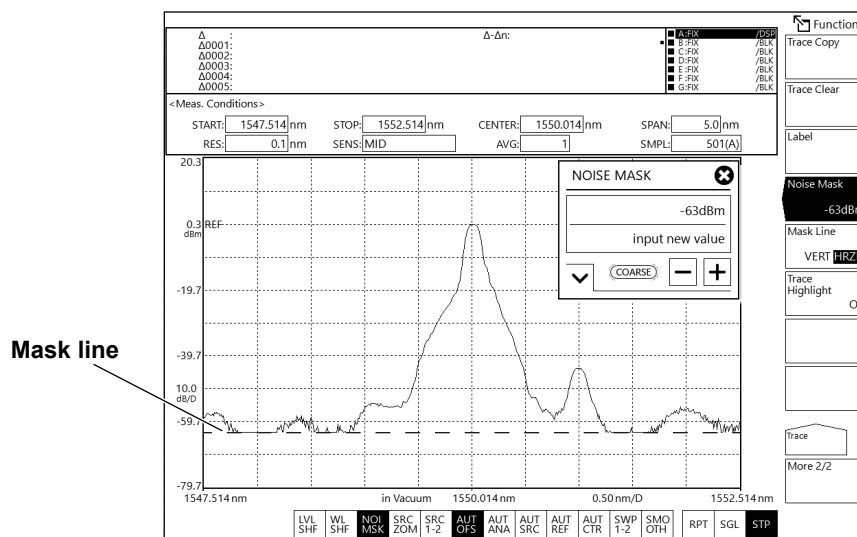


**Mask line**

#### VERT

The waveform is displayed by replacing level values less than or equal to the noise mask value with the display lower limit value (−210 dBm).



**Mask line**

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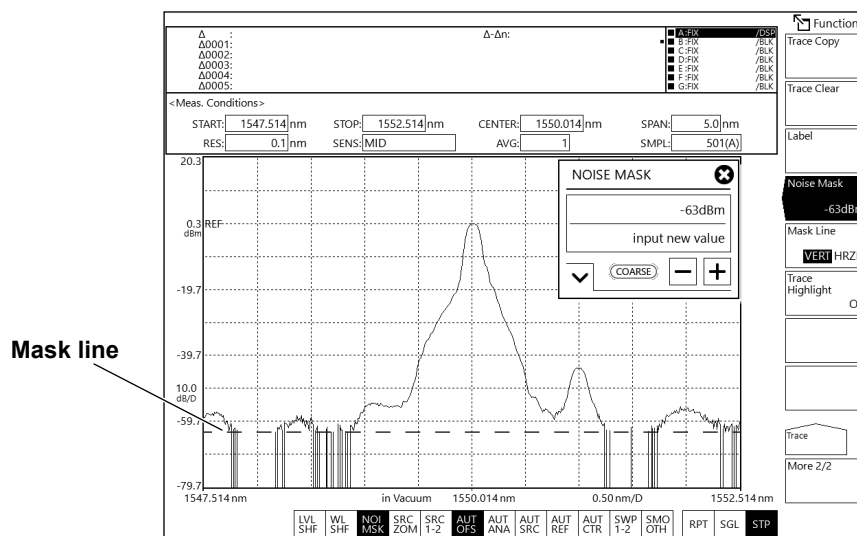
# 4.12 Highlighting the Waveform Display

## Procedure

### Highlighting the active trace waveform

1. Press **TRACE**. The Trace menu appears.

2. Tap **More** to display the More 2/2 menu.

3. Tap **Trace Highlight**. The Trace Highlight menu appears.

4. Tap **Active Trace**. The active trace waveform is highlighted (displayed with thick lines).

### Highlighting all trace waveforms

4. Continuing from step 3, tap **All Trace**. The waveforms of all traces will be highlighted (displayed with thick lines).

### Clearing the highlighting

4. Continuing from step 3, tap the Off.
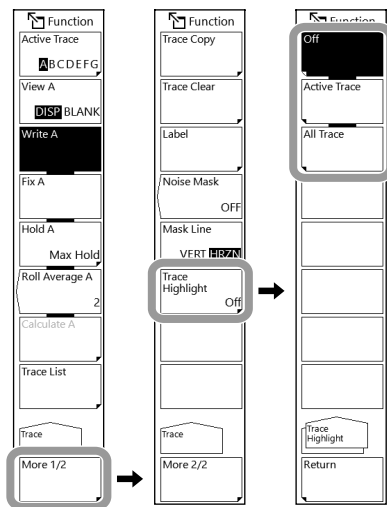
# 5.1 Wavelength and Level Values of an Optical Spectrum

This section explains the wavelength and level values of an optical spectrum when the display mode is wavelength. The following description also applies to the frequency and wavenumber display modes. For details on the display mode, see section 2.1.

## Procedure

### Setting the active trace

1. Press **TRACE** and then tap **Active Trace**.

   Select the trace (A to G) you want to display the wavelength and level values of.

2. Tap **View** of the selected trace to select **DISP**.

### Displaying the moving marker

3. Press **MARKER**. The Marker menu appears.

4. Tap **Marker Active**. The moving marker appears on the screen, and a MOVE MARKER setting window appears.
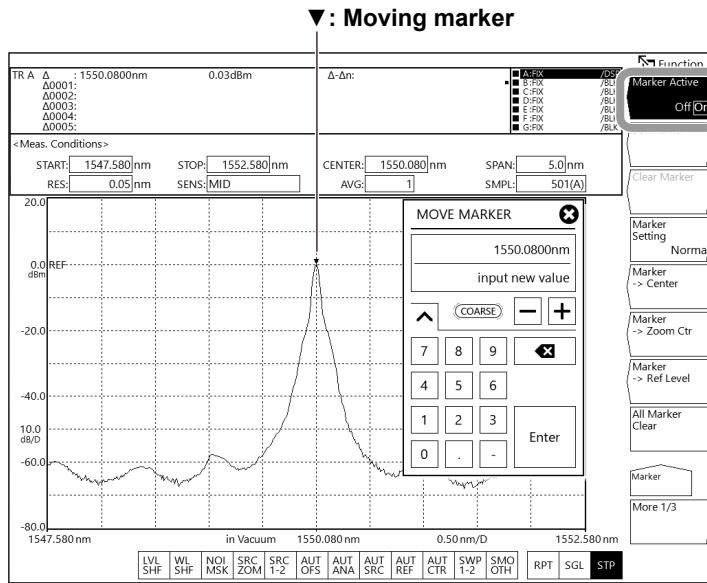
▼ : Moving marker



### Note

If the active trace is not set to DISP, you cannot use the moving marker.
Set View @ DISP/BLANK under Trace to DISP.

# Checking the normal marker

**5.** Check that Marker Setting is set to Normal.

If Marker Setting is set to Power or Integral, carry out the following procedure to set it to Normal.

**5-1.** Tap **Marker Setting**. The Marker Setting menu appears.

**5-2.** Select **Normal Marker**. The normal marker's moving marker ▼ appears on the waveform.

**5-3.** Tap **Return** to return to the previous level.

**5-4.** Tap **Marker Active** again. The MOVE MARKER setting window appears.
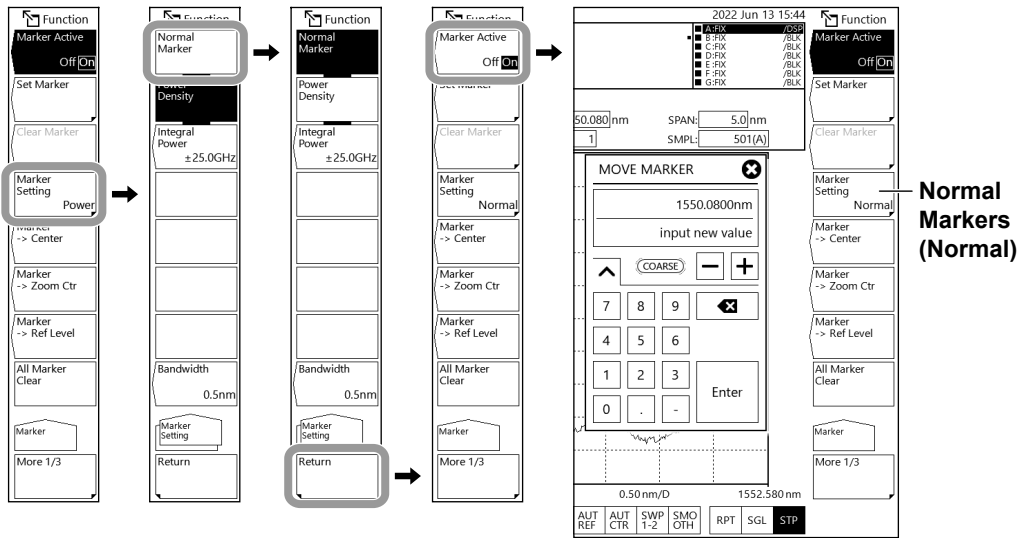


**Note**

There are three types of markers that you can select with Marker Setting: normal marker (Normal), power spectral density marker (Power), and integral marker (Integral). For details on the marker features, see section 1.2.

## Moving the moving marker

**6.** In the MOVE MARKER setting window, enter the marker wavelength.

For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

Or, move the moving marker by referring to the information below.

| Direction | Procedure |
|---|---|
| Move to the right | Turn the rotary knob to the right. |
| | Drag to the right with the mouse or on the touch panel. |
| Move to the left | Turn the rotary knob to the left. |
| | Drag to the left with the mouse or on the touch panel. |

*Note*

If you enter a value outside the setting range, the closest allowed value is assigned.

## Placing a fixed marker

**7.** With the moving marker displayed, tap **Set Marker**.

A Set Marker menu and a SET MARKER setting window appear.

**8.** Tap **Set** or **Cancel**.

If you tap Set, a fixed marker is placed at the current moving marker position, and the menu returns to the previous level.

Fixed markers are automatically numbered starting with 0001. You can also specify any number from 0001 to 1024 in the SET MARKER setting window.

If you tap Cancel, no fixed markers are placed, and the menu returns to the previous level.

▼: Moving marker



Fixed marker

**5**

Displaying Measured Values and Calculated Values Using Markers
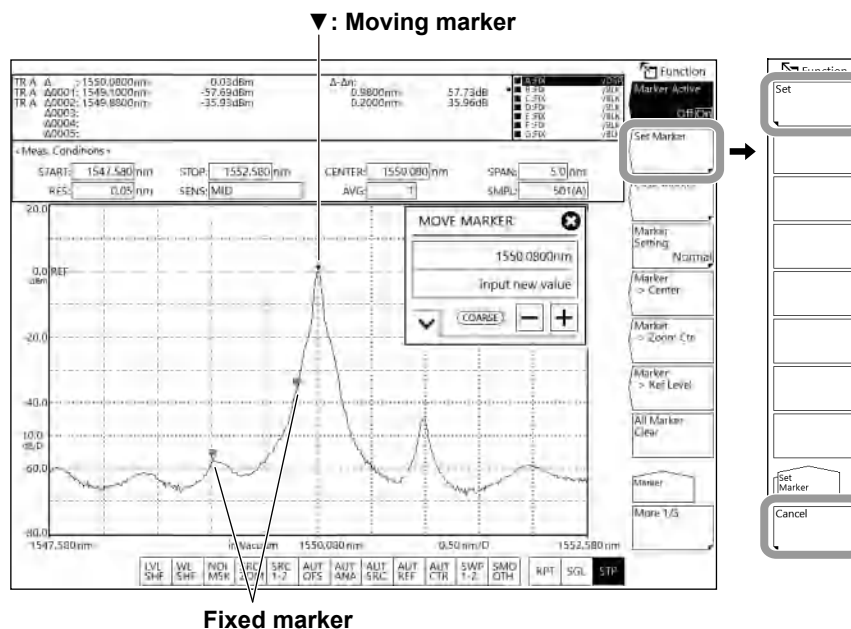
# Clearing a fixed marker

**9.** Tap **Clear Marker**.

A Clear Marker menu and a CLEAR MARKER setting window appear.

**10.** Enter the number of the fixed marker you want to clear in the displayed window.

**11.** Tap **Clear** or **Cancel**.

If you tap Clear, the fixed marker corresponding to the number you entered is cleared, and the menu returns to the previous level.

If you tap Cancel, no fixed markers are cleared, and the menu returns to the previous level.
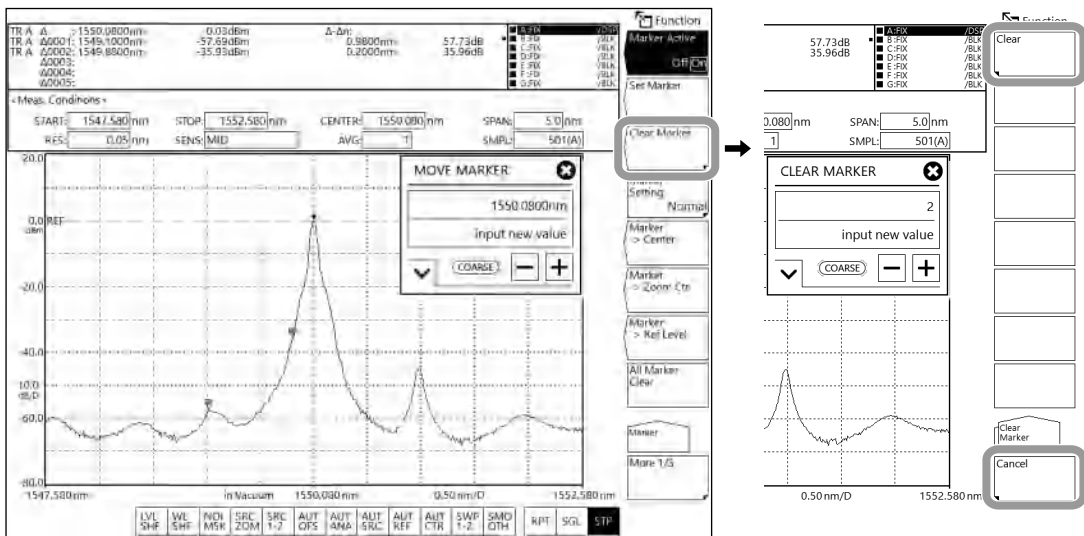


# Clearing all markers

**9.** Tap **All Marker Clear**. The moving marker and all fixed markers are cleared.
The Marker Active settings is also set to Off.
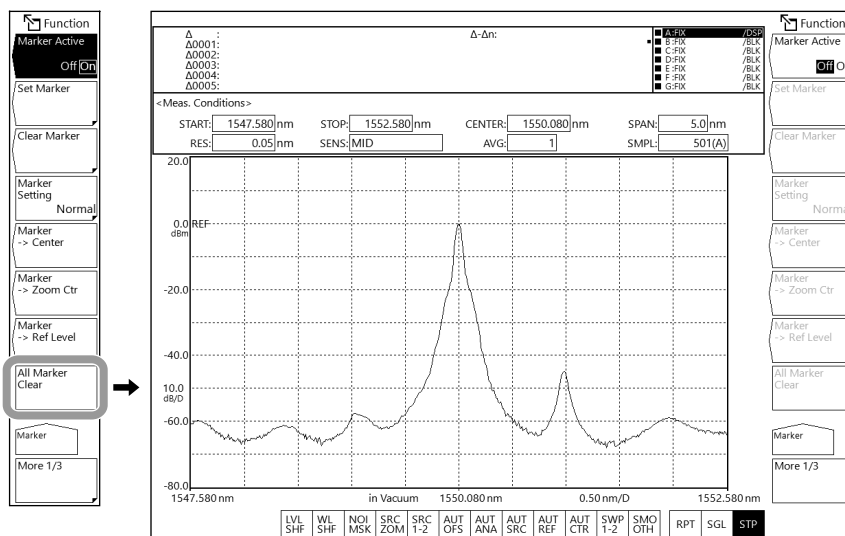
## Using the moving marker to set the center wavelength to be measured, the zoom center wavelength, and the reference level

**Setting the measurement center wavelength to the moving marker wavelength**

With the moving marker displayed, tap **Marker** ⁻> **Center**. The measurement center wavelength is set to the moving marker wavelength. You can further change the measurement center wavelength by entering a value in the displayed setting window. For details on the measurement center wavelength, see section 2.1, "Measurement Wavelength (Frequency) Range."

### Note
The Marker -> Center soft key cannot be used under the following conditions.
- When the moving marker is off
- When the span of the measured data is 0 nm.

**Setting the zoom center wavelength to the moving marker wavelength**

With the moving marker displayed, tap **Marker** ⁻> **Zoom Ctr**. The zoom center wavelength is set to the moving marker wavelength. You can further change the zoom center wavelength by entering a value in the displayed setting window. For details on the zoom center wavelength, see section 4.1, "Zooming the Waveform Display."

### Note
The Marker -> Zoom Ctr soft key cannot be used under the following conditions.
- When the moving marker is off
- When the span of the measured data is 0 nm.

**Setting the reference level to the moving marker level**

With the moving marker displayed, tap **Marker** ⁻> **Ref Level**. The reference level is set to the moving marker level. You can further change the reference level by entering a value in the displayed setting window. For details on the reference level, see section 2.5, "Level Scale."
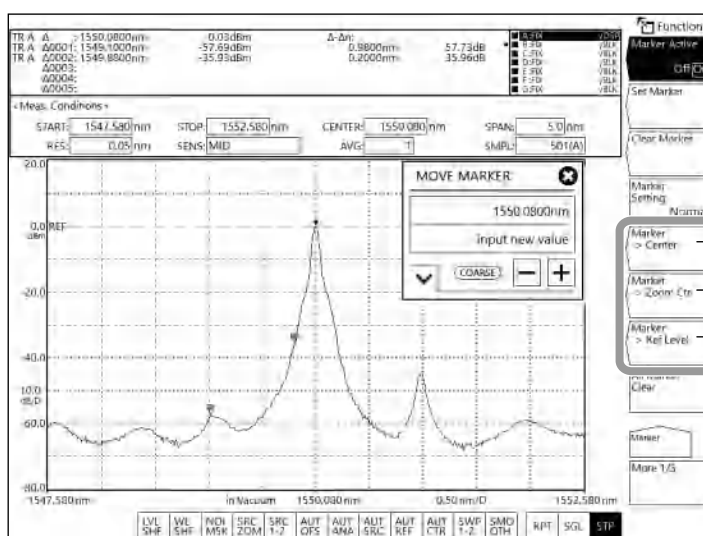


Sets the measurement center wavelength to the moving marker wavelength

Sets the zoom center wavelength to the moving marker wavelength

Sets the reference level to the moving marker level

5

Displaying Measured Values and Calculated Values Using Markers

# Setting the marker difference value display

You can set the marker difference display displayed in the data area to Offset or Spacing.

**1.** Press **MARKER**. The Marker menu appears.

**2.** Tap **More** to display the More 3/3 menu.

**3.** Tap **Marker Display**. The Marker Display menu appears.

**4.** Tap **Offset** or **Spacing**.
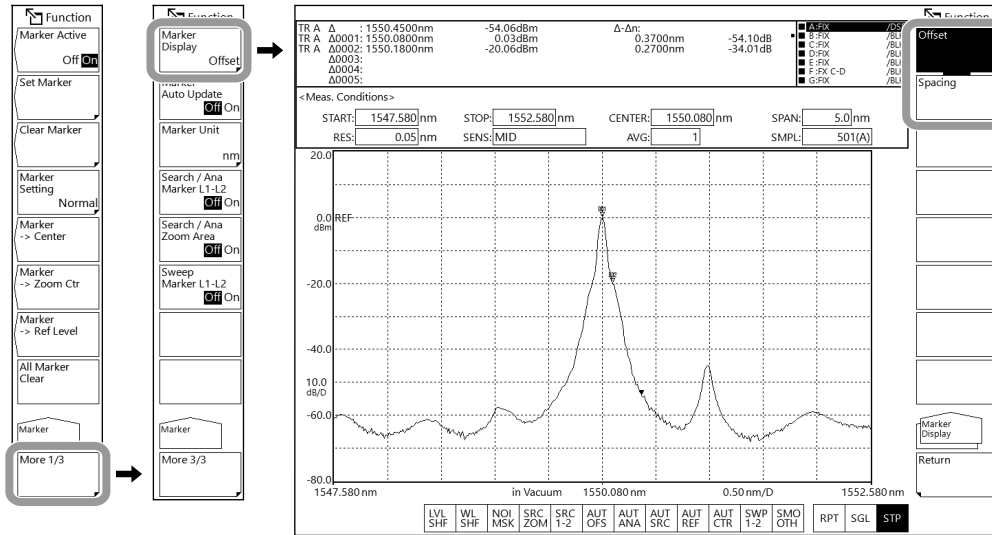


## Note

- When Offset is selected, the difference between the moving marker (▼) and each fixed marker is displayed in the data area.
- When Spacing is selected, the difference between the moving marker and the smallest numbered fixed marker and the difference between adjacent fixed markers are displayed in the data area.

# Automatically updating the level values of the fixed markers

The level values of fixed markers are updated each time the displayed waveform is updated.

*1.* Press **MARKER**. The Marker menu appears.

*2.* Tap **More** to display the More 3/3 menu.

*3.* Tap **Marker Auto Update** to select On.
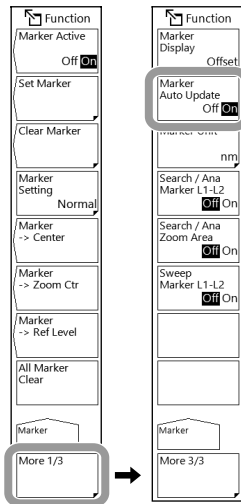


# Setting the unit of marker values

*1.* Press **MARKER**. The Marker menu appears.

*2.* Tap **More** to display the More 3/3 menu.

*3.* Tap **Marker Unit**. The Marker Unit menu appears.

*4.* Tap **nm**, **THz**, or **cm⁻¹** to select the unit of marker values.
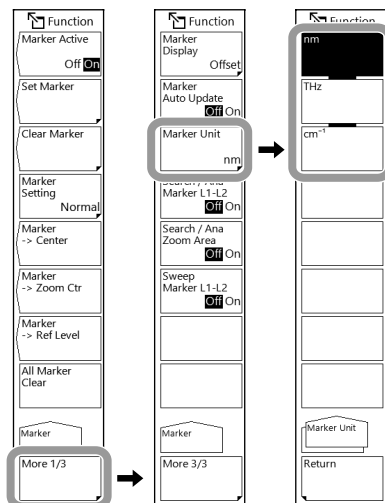


*Note*

The unit displayed for marker values can be set separately from the waveform display's horizontal scale unit set with Horizontal Scale of the SETUP menu.

5

Displaying Measured Values and Calculated Values Using Markers

## Explanation

## Normal marker

### Moving marker

You can move the moving marker to any wavelength using the rotary knob, arrow keys, or numeric keypad. You can also drag it with the mouse.

The moving marker moves along the waveform, and the marker values are displayed in the data area. If you fix the moving marker at a given position, it turns into a fixed marker.

The moving marker applies to the active trace.

### Fixed markers

A marker fixed to a specific position using the moving marker is called a fixed marker. You can place up to 1024 fixed markers. Fixed markers can be placed across different traces.

Fixed markers are assigned marker numbers in order from 0001. You can also enter a number using the rotary knob, arrow keys, or numeric keypad. The maximum number is 1024.

### Marker data in the data area

The data area shows the marker values (wavelength value and level value) of the moving marker and fixed markers.

When there are six or more fixed markers, not all the fixed markers can be displayed in the data area.

To view the marker values that are not displayed, scroll using the mouse wheel, touch panel, or arrow keys. Scrolling with the arrow keys is possible when a SET MARKER setting window (a window for entering the moving marker value) is displayed.

**Display example of wavelength values and level values**
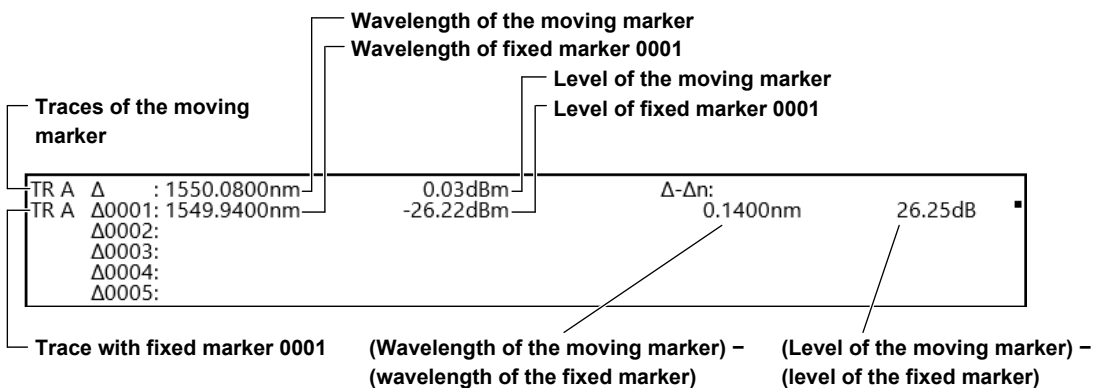


Wavelength of the moving marker
Wavelength of fixed marker 0001
Level of the moving marker
Level of fixed marker 0001
Traces of the moving marker

```
TR A   Δ      : 1550.0800nm         0.03dBm          Δ-Δn:
TR A   Δ0001: 1549.9400nm         -26.22dBm             0.1400nm          26.25dB  ▪
       Δ0002:
       Δ0003:
       Δ0004:
       Δ0005:
```

Trace with fixed marker 0001
(Wavelength of the moving marker) − (wavelength of the fixed marker)
(Level of the moving marker) − (level of the fixed marker)

## Marker display

This function sets whether to display the difference relative to the moving marker (Offset) or the difference relative to the next marker (Spacing) in the marker display. (Default value: Offset)

If the active trace span is 0 nm, the wavelength difference relative to the moving marker is 0.000 nm.

If a fixed marker is placed at the −210 dBm wavelength value, the level difference from that fixed marker is displayed as "??????????."

### Offset

This soft key sets the difference value display as the difference between each marker and the moving marker.
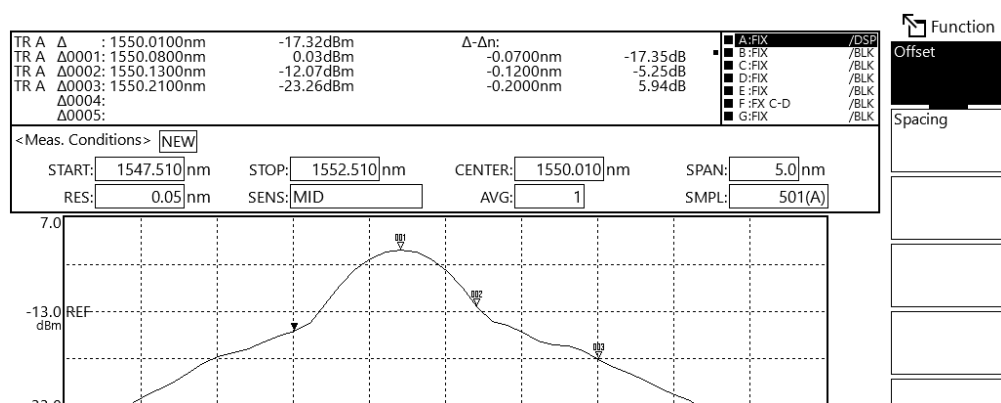


When a fixed marker is positioned and the moving marker is set to a wavelength value of −210 dBm, the level difference is set to −210.00 dB, regardless of the fixed marker's level.

### Spacing

This soft key sets the difference value display as the difference between each marker and the next marker.

<div style="text-align:right">5</div>

Displaying Measured Values and Calculated Values Using Markers
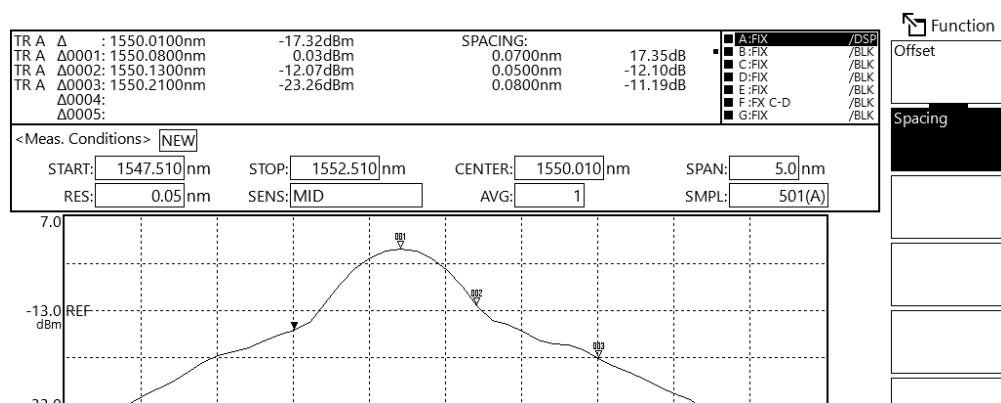
## 5.2 Wavelength/Level Difference between Optical Spectra

This section explains the wavelength and level values of an optical spectrum when the display mode is wavelength. The following description also applies to the frequency and wavenumber display modes. For details on the display mode, see section 2.1.

## Procedure

### Wavelength line markers

**Displaying wavelength line markers**

1. Press **MARKER**. The Marker menu appears.

2. Tap **More** to display the More 2/3 menu.

3. Tap **Line Marker 1** or **Line Marker 2** to select On. A wavelength line marker and a LINE MARKER 1 or LINE MARKER 2 settings window appears.
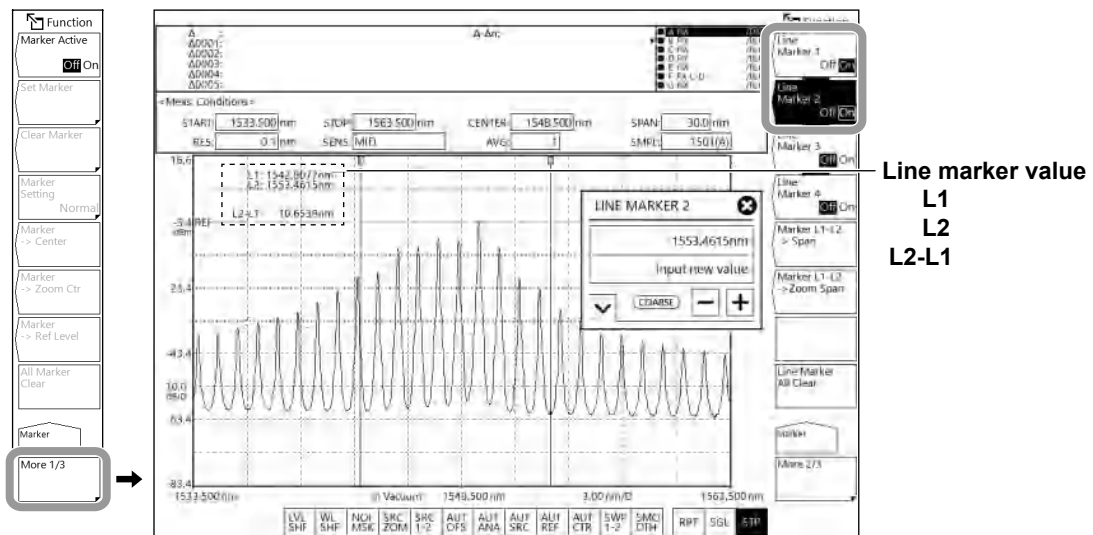


*Note*
- You cannot set wavelength line markers if the active trace measurement data span is 0 nm.
- Line marker values are displayed in the upper left of the waveform area. When both wavelength line markers 1 and 2 are displayed, the wavelength difference (L2−L1) is shown below the marker values.

**Moving wavelength line markers**

4. In the LINE MARKER 1 or LINE MARKER 2 setting window, enter the marker wavelength.
   For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
   Or, move the wavelength line markers by referring to the information below.

| Direction | Procedure |
|---|---|
| Move to the right | Turn the rotary knob to the right. |
| | Drag to the right with the mouse or on the touch panel. |
| Move to the left | Turn the rotary knob to the left. |
| | Drag to the left with the mouse or on the touch panel. |

**Clearing wavelength line markers**

4. Tap **Line Marker 1** or **Line Marker 2** to select Off.

# Level line markers

**Displaying level line markers**

*1.* Press **MARKER**. The Marker menu appears.

*2.* Tap **More** to display the More 2/3 menu.

*3.* Tap **Line Marker 3** or **Line Marker 4** to select On. A level line marker and a LINE MARKER 3 or LINE MARKER 4 settings window appears.
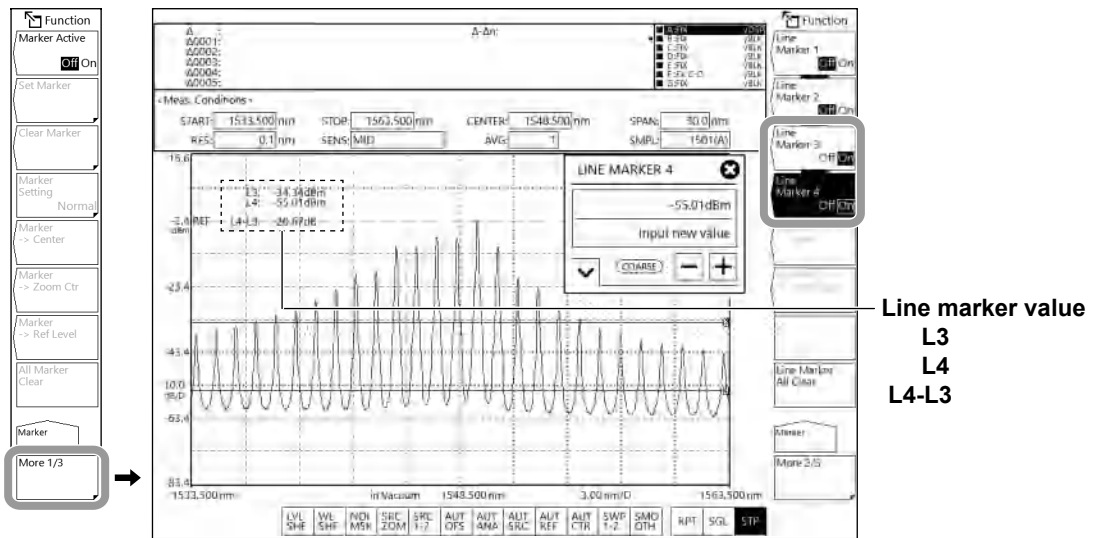


Line marker value
L3
L4
L4-L3

*Note*

Line marker values are displayed in the upper left of the waveform area. When both level line markers 3 and 4 are displayed, the level difference (L4−L3) is shown below the line marker values.

**Moving level line markers**

*4.* In the LINE MARKER 3 or LINE MARKER 4 setting window, enter the marker level.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.
Or, move the level line markers by referring to the information below.

| Direction | Procedure |
|---|---|
| Move up | Turn the rotary knob to the right. |
| | Drag up with the mouse or on the touch panel. |
| Move down | Turn the rotary knob to the left. |
| | Drag down with the mouse or on the touch panel. |

**Clearing level line markers**

*4.* Tap **Line Marker 3** or **Line Marker 4** to select Off.

# Clearing all line markers

*4.* When line markers are displayed, tap **Line Marker All Clear**. All the line markers that are displayed are cleared.

## Explanation

### Line markers

#### Wavelength line markers

Line marker values are displayed in the upper left of the waveform area.

When both wavelength line markers 1 and 2 are displayed, the wavelength difference (L2−L1) is shown below the marker values.

#### Level line markers

Line marker values are displayed in the upper left of the waveform area.

When both level line markers 3 and 4 are displayed, the level difference (L4−L3) is shown below the line marker values.

*Note*

You can move a line marker by dragging it with the mouse.

#### Line markers in the overview window

When a waveform is zoomed, an overview window can be displayed at the bottom of the waveform display area. When line markers are displayed, they are also displayed in the overview window.

For instructions on how to display the overview window, see section 4.1.

*Note*

The line markers in the overview window are synchronized to those on the waveform screen.



**Overview window**

**Line markers are synchronized.**

## 5.3    Power Spectral Density

This section explains the wavelength and level values of an optical spectrum when the display mode is wavelength. The following description also applies to the frequency and wavenumber display modes. For details on the display mode, see section 2.1.

### Procedure

#### Setting the active trace

*1.*    Press **TRACE** and then tap **Active Trace**.
Select the trace (A to G) you want to display the power spectral densities of.

*2.*    Tap **View** of the selected trace to select **DISP**.

#### Displaying the moving marker

*3.*    Press **MARKER**. The Marker menu appears.

*4.*    Tap **Marker Active** to select On.

**Note**
To use power spectral density markers, set the active trace to DISP.

#### Displaying power spectral density markers

*5.*    Tap **Marker Setting**. The Marker Setting menu appears.

*6.*    Select **Power Density**. A power spectral density moving marker ♦ appears on the waveform.

*7.*    Tap **Bandwidth**. A BANDWIDTH window appears.

*8.*    Enter the normalization bandwidth in the displayed window.
For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.

**Power spectral density/BW   ◆ : Power spectral density marker**

*Note*

- The power spectral density and "/BW" are displayed in the data area.
- The power spectral density marker cannot be assigned to a subtraction waveform (subtraction based on Log Math=LOG) or normalization waveform. For details on waveform calculation, see section 4.5.

## Moving the moving marker

**9.** Continuing from step 8, tap **Return** to return to the previous level.

**10.** Tap **Marker Active**. The MOVE MARKER setting window appears.

**11.** Enter the marker wavelength in the displayed window.
For the input procedure, see section 5.1.

## Placing a fixed marker

The procedure is the same as that for normal markers as explained in section 5.1.

Fixed power spectral density markers are displayed with ◊.

## Clearing a fixed marker

The procedure is the same as that for normal markers as explained in section 5.1.

## Clearing all markers

The procedure is the same as that for normal markers as explained in section 5.1.

## Explanation

## Power spectral density markers

Power spectral density markers show power values per normalization bandwidth by assuming the marker position on the waveform to be the center. The power values are displayed in the data area. These markers are used to determine converted power values per given bandwidth such as when measuring the signal noise level.

Selectable range for the normalization bandwidth: 0.1 nm and 10.0 nm.

Like normal markers, fixed markers can be placed on power spectral density markers. The normalization bandwidth setting applies to the moving marker and all fixed markers.

It is also possible to simultaneously display the power spectral densities of fixed markers placed on different traces.

For instructions on how to place fixed markers and how to display data between markers, see section 5.1.

**Display example of power spectral density markers**
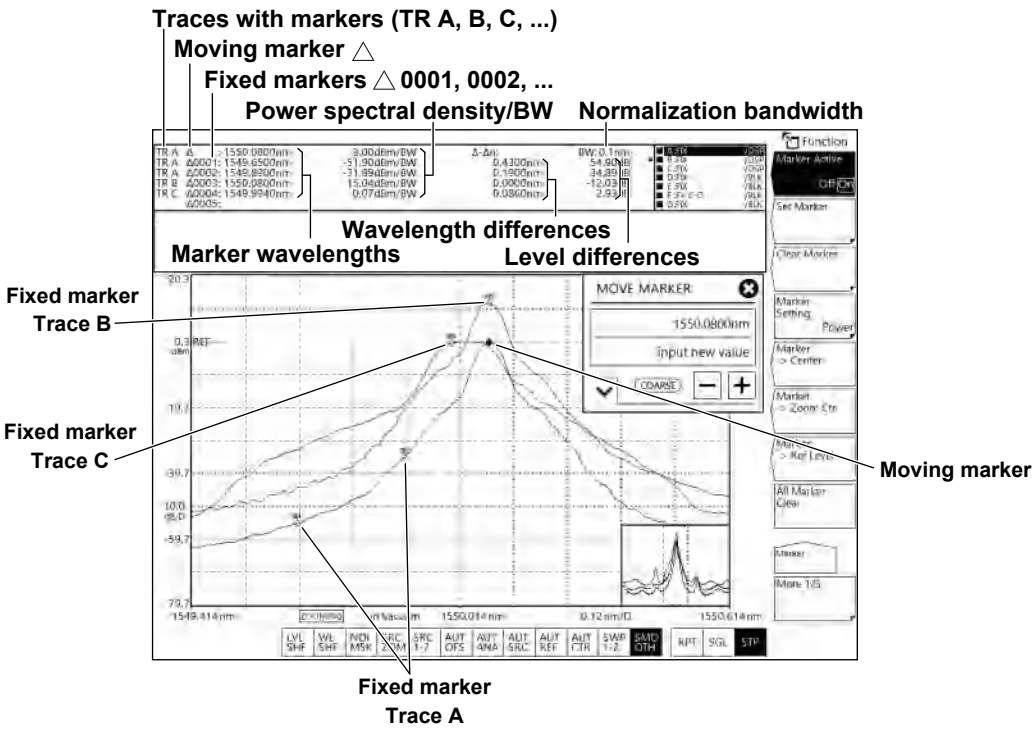


### Note
You can display power spectral density markers and search waveforms using single search (SINGL) by setting Marker Setting to Power Density. However, multi search (MULTI) is not possible when power spectral density markers are displayed. If you perform a multi search when power spectral density markers are displayed, they are automatically changed to normal markers.
For details on waveform searching, see section 4.9.

# 5.4 Integral Power Value

This section explains the wavelength and level values of an optical spectrum when the display mode is wavelength. The following description also applies to the frequency and wavenumber display modes. For details on the display mode, see section 2.1.

## Procedure

### Setting the active trace

1. Press **TRACE** and then tap **Active Trace**.
   Select the trace (A to G) you want to display the power spectral densities of.

2. Tap **View** of the selected trace to select **DISP**.

### Displaying the moving marker

3. Press **MARKER**. The Marker menu appears.

4. Tap **Marker Active** to select On.

*Note*
To use integral spectral density markers, set the active trace to DISP.

### Displaying integral power markers

5. Tap **Marker Setting**. The Marker Setting menu appears.

6. Select **Integral Power.** A moving integral power marker ● is displayed on the waveform, and an INTEGRAL RANGE setting window appears.

7. Enter the integral frequency range in the displayed window.
   For instructions on how to select items and set values, see chapter 4 in the *Getting Started Guide*.



Integral power value <integral frequency range>   ●: Integral power marker

Integral range
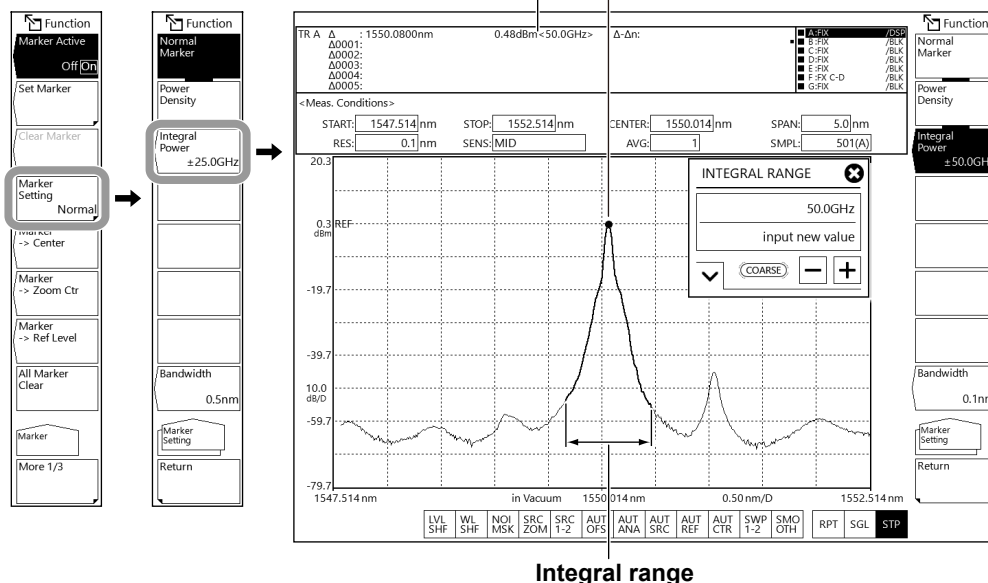
*Note*

- An integral power value and <integral frequency range> are displayed in the data area.
- The power spectral density marker cannot be assigned to a subtraction waveform (subtraction based on Log Math=LOG) or normalization waveform. For details on waveform calculation, see section 4.5.

## Moving the moving marker

**8.** Continuing from step 7, tap **Return** to return to the previous level.

**9.** Tap **Marker Active**. The MOVE MARKER setting window appears.

**10.** Enter the marker wavelength in the displayed window.

For the input procedure, see section 5.1.

## Placing a fixed marker

The procedure is the same as that for normal markers as explained in section 5.1.

Fixed integral power markers are displayed with ○.

## Clearing a fixed marker

The procedure is the same as that for normal markers as explained in section 5.1.

## Clearing all markers

The procedure is the same as that for normal markers as explained in section 5.1.

# Explanation

## Integral power markers

The integrated power values over specified frequency ranges are displayed by assuming the marker position on the waveform to be the center. The power values are displayed in the data area. These markers are used to determine the integrated power of a widely spread spectrum such as to determine the signal level from a modulated optical signal spectrum.
Selectable range for integral frequency: ±1.0 GHz to ±999.9 GHz

The waveform in the integration range appears highlighted (in blue).
Like normal markers, fixed markers can be placed on integral power markers. The integration frequency range setting can be set separately for the moving marker and each fixed marker.
It is also possible to simultaneously display the integral power values of fixed markers placed on different traces.
For instructions on how to place fixed markers and how to display data between markers, see section 5.1.

**Display example of integral power markers**
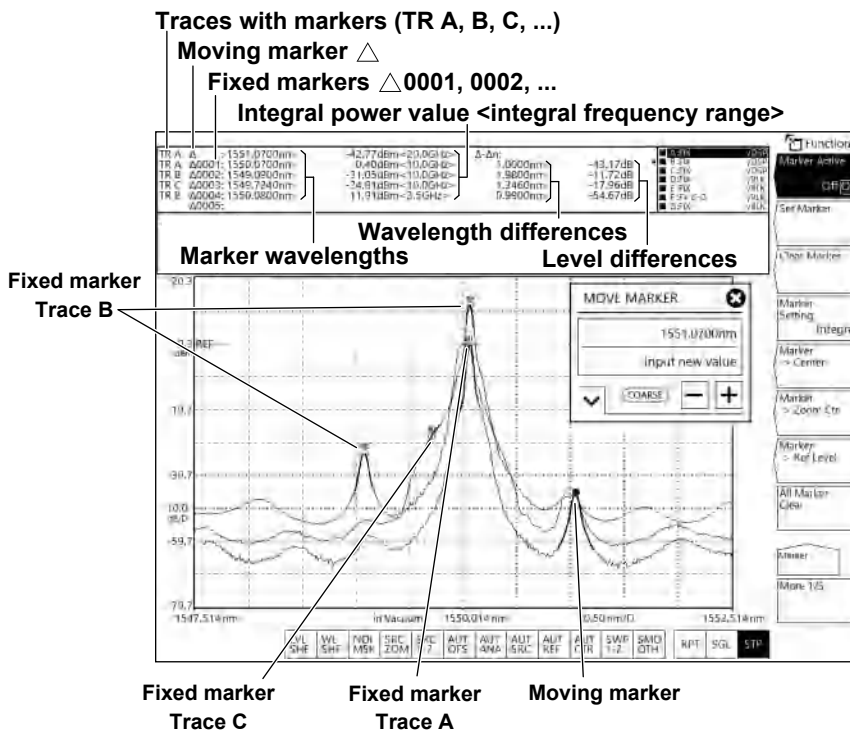


*Note*

You can display integral power markers and search waveforms using single search (SINGL) by setting Marker Setting to Integral Power. However, multi search (MULTI) is not possible when integral power markers are displayed. If you perform a multi search when integral power markers are displayed, they are automatically changed to normal markers.
For details on waveform searching, see section 4.9.

# 6.1    Specifying an Analysis Range

## Analysis between line markers

**Setting line markers**

The instrument analyzes the range between wavelength line markers L1 and L2, which were set in section 5.2, "Wavelength/Level Difference between Optical Spectra."

For instructions on how to set wavelength line markers L1 and L2, see section 5.2, "Wavelength/Level Difference between Optical Spectra."

**Specifying an Analysis Range**

*1.*    Press **ANALYSIS**. The ANALYSIS menu appears.

*2.*    Tap **More** to display the More 2/2 menu.

*3.*    Tap **Search/Ana Marker L1- L2** to select On.

You can also set Search/Ana Marker L1- L2 to On or Off using the MARKER menu that appears by pressing MARKER.

*4.*    To cancel, tap **Search/Ana Marker L1- L2** to select Off. Analysis will be performed over the entire screen.



Line markers

Turns Search/Ana Marker L1-L2 on and off

Highlighted when Search/Ana Marker L1-L2 is on

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Analyzing Optical Spectral Waveforms

# Analysis in the zoom area

**Power measurement in the zoom area**

The instrument analyzes the measured waveform in the zoom area.

For instructions on how to zoom waveforms, see section 4.1, "Zooming the Waveform Display."

**1.** Press **ANALYSIS**. The ANALYSIS menu appears.

**2.** Tap **More** to display the More 2/2 menu.

**3.** Tap **Search / Ana Zoom Area** to select On.

You can also set Search/Ana Zoom Area to On or Off using the MARKER menu that appears by pressing MARKER.

**4.** To cancel, tap **Search/Ana Zoom Area** to select Off. Analysis will be performed over the entire screen.



Turns Search/Ana Zoom Area on and off
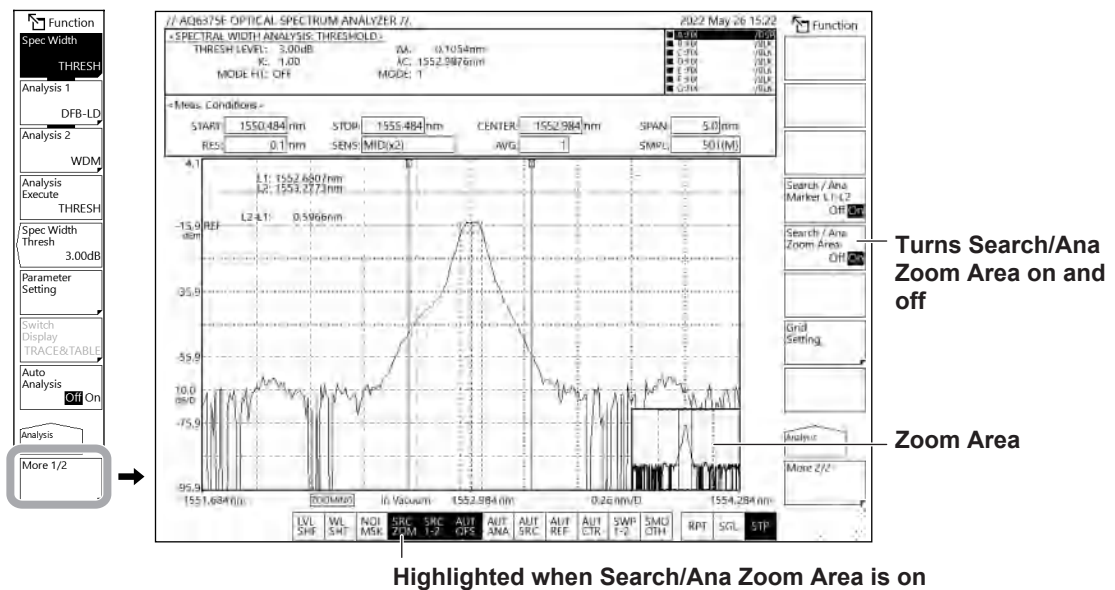
Zoom Area

**Highlighted when Search/Ana Zoom Area is on**

## Explanation

## Analysis range

The analysis range can be set between line markers or within the zoom area.

If the analysis is enabled for both between the line markers and within the zoom area, the analysis range is set to the intersection of the two areas.

If the analysis for both are disabled, the analysis range is set to the entire range of the measurement scale.

### Between line markers

The instrument analyzes the waveform between line markers L1 and L2.

If only L1 is set, the instrument measures from line marker 1 to the right edge of the screen.

If only L2 is set, the instrument measures from the left edge of the screen to line marker 2.

If neither L1 or L2 is set, the instrument measures from the specified start wavelength to the stop wavelength.

### Zoom area

The instrument analyzes the waveform within the specified zoom area.

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Analyzing Optical Spectral Waveforms

## 6.2 Spectral Width (THRESH, ENVELOPE, RMS, PEAK RMS, NOTCH)

### Procedure

Spectral width can be measured from the measured waveform.

1. Press **ANALYSIS**. The ANALYSIS menu appears.

2. Tap **Spec Width**. The Spectrum Width menu appears.

3. Tap **THRESH**, **ENVELOPE**, **RMS**, **PEAK RMS**, or **NOTCH**. An analysis is performed, and the results are displayed in the data area.



Data area

Change the threshold.

Change the analysis parameters.

Turns auto analysis on and off
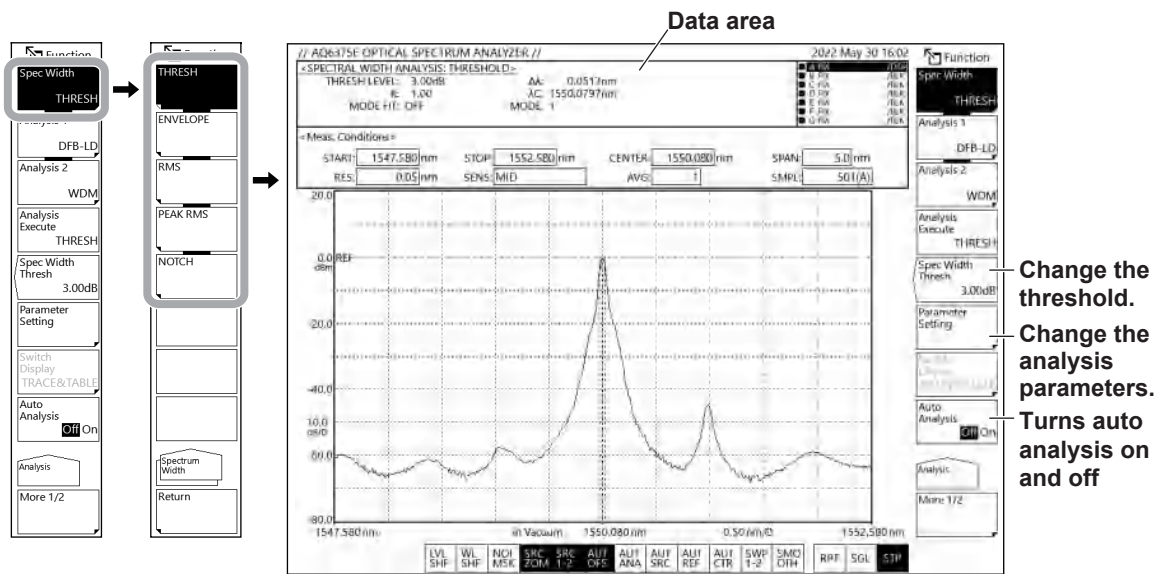
**Changing the analysis parameters**

**4.** Continuing from step 3, tap **Parameter Setting**. A Parameter Setting window appears.

**When THRESH is selected**

Analysis Setting [THRESH]

THRESH LEVEL:  3.00 dB ——— **Threshold**
K:  1.00 ——— **Multiplying factor**
MODE FIT: ○ON ●OFF ——— **Turns mode fitting on and off**

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**When ENVELOPE is selected**

Analysis Setting [ENVELOPE]

THRESH LEVEL1:  3.05 dB ——— **Threshold**
THRESH LEVEL2:  13.00 dB ——— **Threshold for counting the number of modes**
K:  1.00 ——— **Multiplying factor**

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**When RMS is selected**

Analysis Setting [RMS]

THRESH LEVEL:  20.00 dB ——— **Threshold**
K:  2.35 ——— **Multiplying factor**

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**When PEAK RMS is selected**

Analysis Setting [PEAK RMS]

THRESH LEVEL:  20.00 dB ——— **Threshold**
K:  2.35 ——— **Multiplying factor**

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**When NOTCH is selected**

Analysis Setting [NOTCH]

THRESH LEVEL:  3.00 dB ——— **Threshold**
K:  1.00 ——— **Multiplying factor**
TYPE: ○PEAK ●BOTTOM ——— **Reference position**

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Function
Spec Width
THRESH
Analysis 1
DFB-LD
Analysis 2
WDM
Analysis Execute
THRESH — **Executes analysis**
Spec Width Thresh
3.00dB
Parameter Setting
Switch Display TRACE&TABLE
Auto Analysis
Off On
Analysis
More 1/2

**5.** Set the analysis parameters on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

**6.** Tap **Close Window** or "X" in the upper right of the window. The Parameter Setting window will close.

**7.** Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area.

**Changing the threshold value for each algorithm**

If you want to change just the threshold level, you can also use Spec Width Thresh.

This value is also applied to the Parameter Setting threshold described above.

When Spec Width is set to ENVELOPE, you can only change THRESH1.

**4.** Continuing from step 3, tap **Spec Width Thresh**. A threshold setting window appears.

**5.** Set the threshold on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

**6.** Press **ENTER**.

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Analyzing Optical Spectral Waveforms

### Automatic Analysis on Each Sweep

*4.* Continuing from step 3, tap **Auto Analysis Off On** to select On. At the end of each sweep, the Spec Width, Analysis 1, or Analysis 2 function (whichever is selected) is executed automatically.

*Note*

- Auto Analysis and Auto Search for searching waveforms cannot be set to On simultaneously. If either one is set to On, the other is set to Off. For details on waveform searching, see section 4.9.
- When Auto Analysis is set to On, AUT ANA is highlighted at the bottom of the screen.

## Explanation

## Algorithm

**Spectral width analysis algorithm**

| Algorithm | Description |
|-----------|-------------|
| THRESH | Determines spectral width from the width between points where the waveform crosses the threshold value. |
| ENVELOPE | Determines spectral width from waveform envelope. |
| RMS | Determines spectral width from waveform standard deviation. |
| PEAK RMS | Determines spectral width from waveform mode peak standard deviation. |
| NOTCH | Determines the notch width from the waveform bottom or from the bottom and peak. |

*Note*
- For details on the spectral width analysis algorithms and parameters, see appendix 2, "Data Calculation Algorithms for Spectral Widths."

## Result display

Analysis results are displayed in the data area.

```
<SPECTRAL WIDTH ANALYSIS: THRESHOLD>
     THRESH LEVEL:  3.00dB          Δλ:      0.0052nm
                K:  1.00            λC: 1551.2530nm
        MODE FIT:  OFF             MODE:  1
```

**Analysis parameter values**

**Analysis results**
**Δλ: spectral width**
**λC: center of spectral width**
**MODE: number of modes**

**Spec Width Thresh**

You can set threshold values for each spectral width analysis algorithm. After the value is set, analysis is executed and the display is updated.

You can set the value between 0.01 and 50.00 dB. You can set it in steps of 0.01. When COARSE is enabled, you can set it in steps of 1.00. Each analysis algorithm has its own threshold value.

**6**

Analyzing Optical Spectral Waveforms

# 6.3 SMSR

## Procedure

SMSR can be measured from the measured waveform of a DFB-LD.

*1.* Press **ANALYSIS**. The ANALYSIS menu appears.

*2.* Tap **Analysis 1**. A menu appears for selecting the analysis function.

*3.* Tap **SMSR**. An analysis is performed, and the results are displayed in the data area.
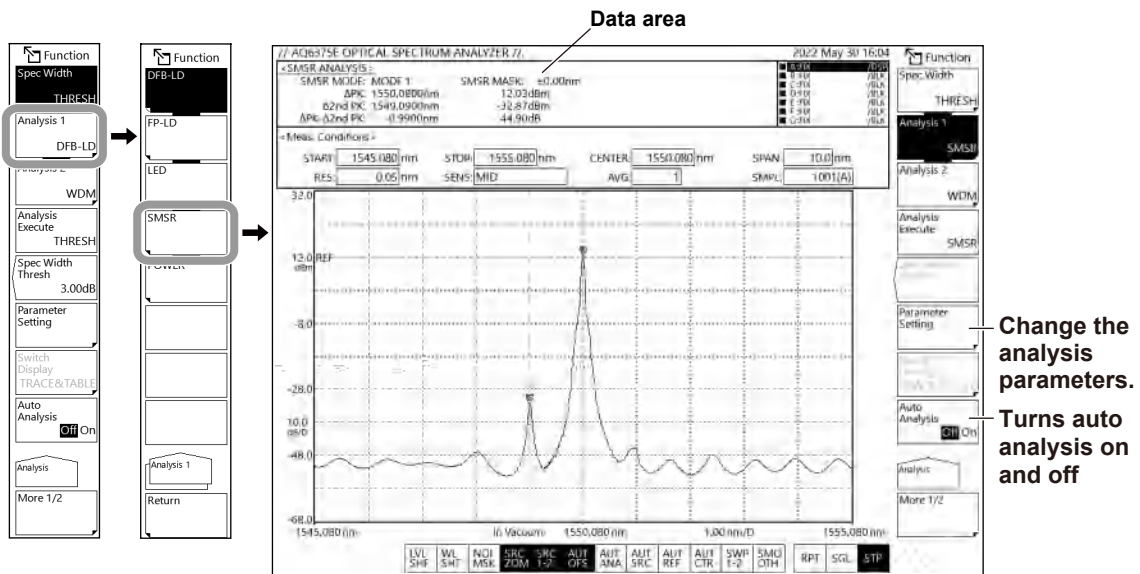


**Changing the analysis parameters**

*4.* Continuing from step 3, tap **Parameter Setting**. An SMSR measurement parameter setting screen appears.
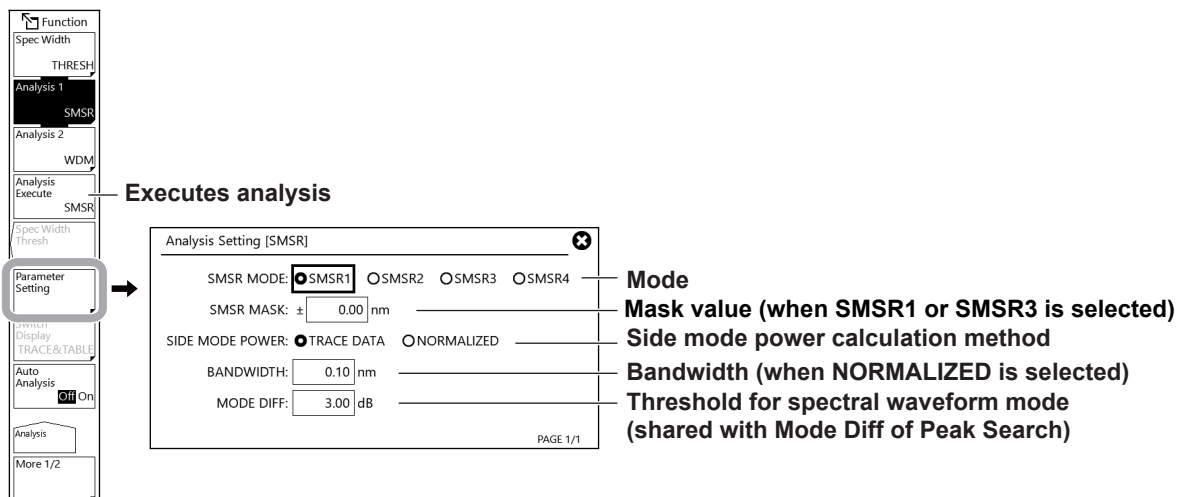


*5.* Set the analysis parameters on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

*6.* Tap **Close Window** or "X" in the upper right of the window. The SMSR measurement parameter setting window will close.

7. Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area.

## Explanation

### SMSR

SMSR is an abbreviation for side-mode suppression ratio.

SMSR represents the difference between the mode peak and the side-mode level. It is one of the parameters used to evaluate the performance of DFB-LDs and the like.
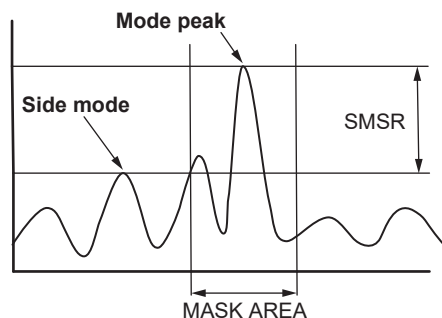


### SMSR Mode

SMSR Mode specifies how to define the side mode.

SMSR1: The main mode is defined as the highest mode peak. The side mode is defined as the highest mode peak outside of the mask area.

SMSR2: The main mode is defined as the highest mode peak. The side mode is defined as the highest mode peak adjacent to the main mode. You cannot set the mask.

SMSR3: The main mode is defined as the highest mode peak. The side modes are defined as the highest mode peaks outside of the mask area—one on the left side and one on the right side of the mask area.

SMSR4: The main mode is defined as the highest mode peak. The side modes are defined as the mode peaks adjacent to the main mode. You cannot set the mask.

### Side Mode Power

You can select whether to use the waveform data (TRACE DATA) or normalize data (NORMALIZED) for the side mode power.

*Note*

For details on SMSR analysis algorithms, see appendix 3, "Details of Analysis Functions."

### Result display

Analysis results are displayed in the data area.

**Example with SMSR MODE set to SMSR3**

```
<SMSR ANALYSIS>
  SMSR MODE: MODE 1        SMSR MASK:   ±1.00nm      BW: 0.10nm
        ΔPK: 1551.2530nm            8.60dBm
    Δ2nd PK: 1549.6970nm          -30.89dBm/BW
  ΔPK-Δ2nd PK:   -1.5560nm          39.49dBm
```

**Analysis results**
**ΔPK: mode peak wavelength and level value**
**Δ2nd PK: side mode wavelength and level value**
**ΔPK-Δ2nd PK: differences in the wavelengths and levels**

**Analysis parameter values**
**SMSR MODE: side mode definition method (MODE1 to MODE4)**
**SMSR MASK: mask setting range (MODE1 MODE3)**
**BW: Normalization bandwidth**

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Analyzing Optical Spectral Waveforms

# 6.4 Power

## Procedure

Optical power can be measured by integrating the measured waveform levels.

1. Press **ANALYSIS**. The ANALYSIS menu appears.

2. Tap **Analysis 1**. A menu appears for selecting the analysis function.

3. Tap **POWER**. An analysis is performed, and the results are displayed in the data area.



**Data area**

**Change the analysis parameters.**

**Turns auto analysis on and off**
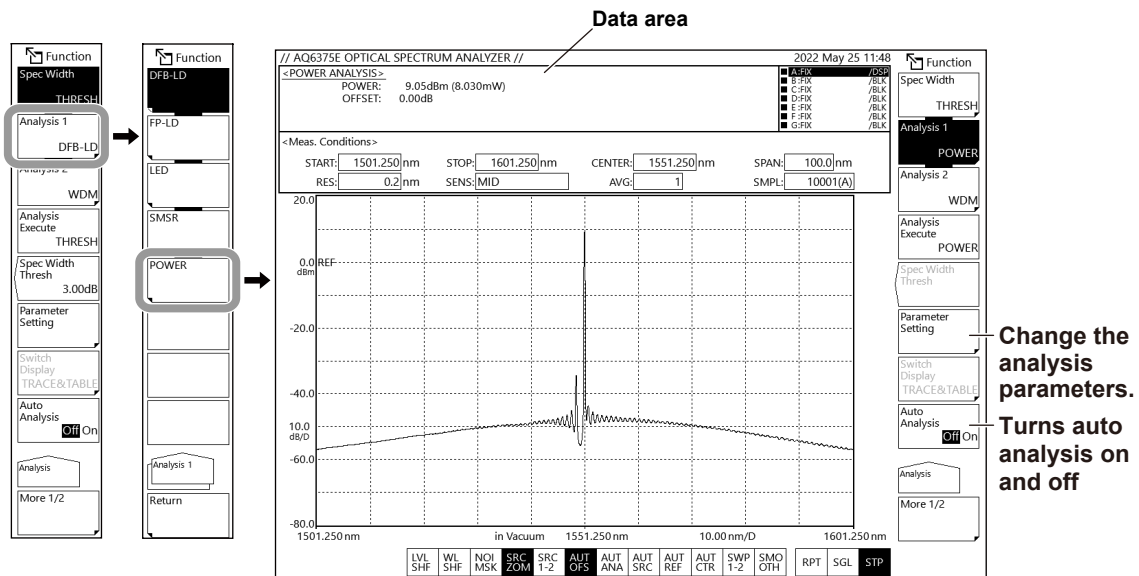
### Changing the analysis parameters

4. Continuing from step 3, tap **Parameter Setting**. A POWER measurement parameter setting screen appears.
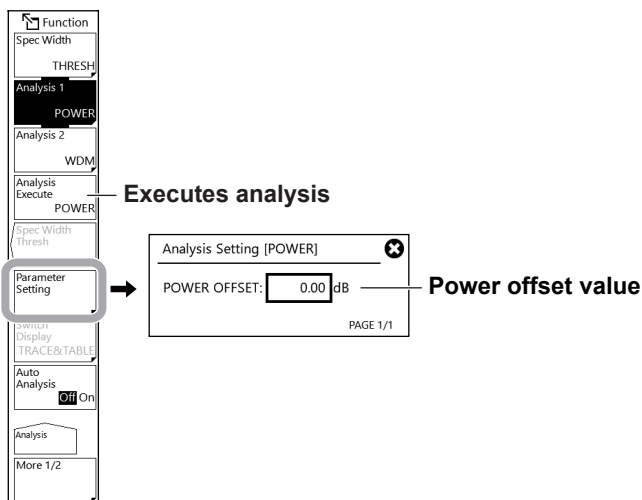


**Executes analysis**

**Power offset value**

5. Set the analysis parameters on the setting window.

   For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

6. Tap **Close Window** or "X" in the upper right of the window. The POWER measurement parameter setting window will close.

7. Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area.

*Note*

For details on power analysis algorithms, see appendix 3, "Details of Analysis Functions."

## Explanation

**Result display**

Analysis results are displayed in the data area.

```
<POWER ANALYSIS>
        POWER:      9.05dBm (8.030mW)
        OFFSET:     0.00dB
```

**Power offset value**          **Optical power**

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Analyzing Optical Spectral Waveforms

# 6.5 Light Source (DFB-LD, FP-LD, LED)

## Procedure

Light source parameters can be analyzed from the measured waveform of each light source (DFB-LD, FP-LD, LED).

*1.* Press **ANALYSIS**. The ANALYSIS menu appears.

*2.* Tap **Analysis 1**. A menu appears for selecting the analysis function.

*3.* Tap **DFB-LD**, **FP-LD**, or **LED** according to the type of light source to be analyzed. An analysis is performed, and the results are displayed in the data area.



Data area (example of FP-LD)

Change the analysis parameters.

Turns auto analysis on and off
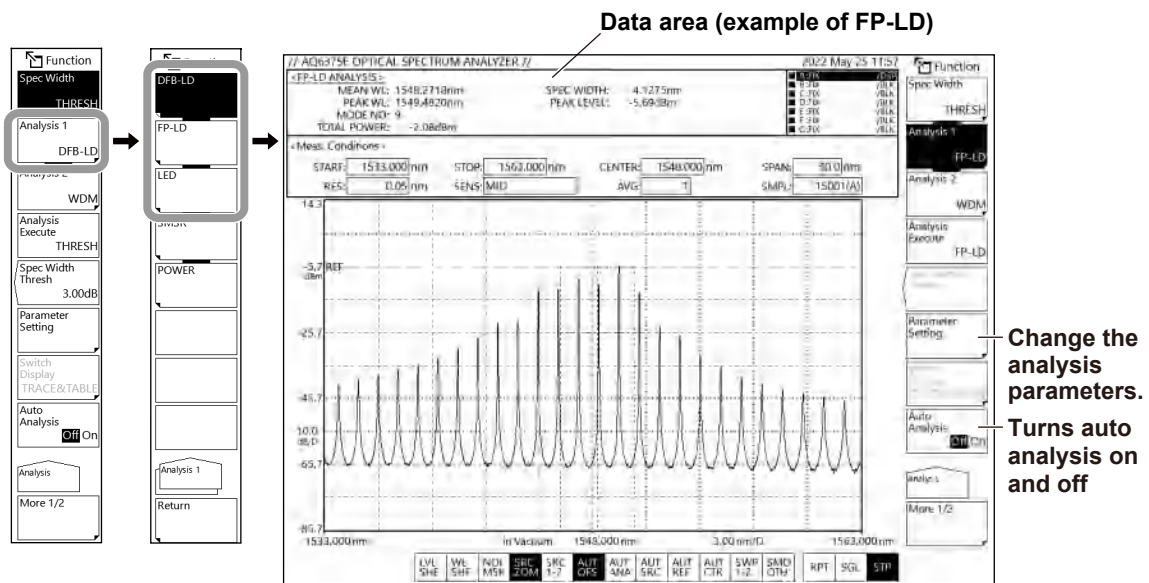
**Changing the analysis parameters**

*4.* Continuing from step 3, tap **Parameter Setting**. A window appears for setting the DFB-LD, FP-LD, and LED measurement parameters.



Executes analysis

Analysis Setting [FP-LD]

A. SPECTRUM WIDTH

ALGO: ●ENVELOPE ○THRESH ○RMS ○PK-RMS

THRESH: 20.00 dB

THRESH2: 20.00 dB

K: 2.00

MODE FIT: ○ON ○OFF

MODE DIFF: 3.00 dB

Prev Page   Next Page   PAGE 1/3
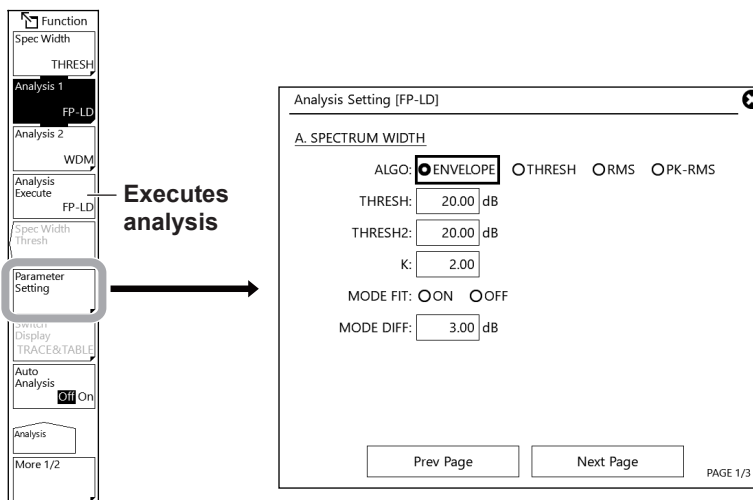
## DFB-LD

### Set the -XdB center/width (Page 1/4).

Analysis Setting [DFB-LD]

A. -XdB CENTER / WIDTH

ALGO: ● ENVELOPE  ○ THRESH  ○ RMS  ○ PK-RMS
THRESH:  20.00 dB
THRESH2:  20.00 dB
K:  1.00
MODE FIT: ○ ON  ○ OFF
MODE DIFF:  3.00 dB

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### Set the SMSR (Page 2/4).

Analysis Setting [DFB-LD]

B. SMSR

SMSR MODE: ● SMSR1  ○ SMSR2  ○ SMSR3  ○ SMSR4
SMSR MASK: ±  0.00 nm
MODE DIFF:  3.00 dB
SIDE MODE POWER: ● TRACE DATA  ○ NORMALIZED
BANDWIDTH:  0.10 nm

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### Set the RMS and power (Page 3/4).

Analysis Setting [DFB-LD]

C. RMS

ALGO: ● RMS  ○ PK-RMS
THRESH:  20.00 dB
K:  2.35
MODE DIFF:  3.00 dB

D. POWER

SPAN:  0.40 nm

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### Set the OSNR (Page 4/4).

Analysis Setting [DFB-LD]

E. OSNR

MODE DIFF:  3.00 dB
NOISE ALGO: ○ AUTO-FIX  ● MANUAL-FIX
○ AUTO-CTR  ○ MANUAL-CTR  ○ PIT
NOISE AREA:  0.40 nm
MASK AREA: ---
FITTING ALGO: ● LINEAR  ○ GAUSS  ○ LORENZ
○ 3RD POLY  ○ 4TH POLY  ○ 5TH POLY
NOISE BW:  0.10 nm
SIGNAL POWER: ● PEAK  ○ INTEGRAL
INTEGRAL RANGE: ±  10.0 GHz

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**6**

Analyzing Optical Spectral Waveforms

### FP-LD

**Set the spectrum width (Page 1/3).**

Analysis Setting [FP-LD]                    ✖

A. SPECTRUM WIDTH

ALGO: ⦿ENVELOPE  ○THRESH  ○RMS  ○PK-RMS

THRESH:      20.00 dB

THRESH2:     20.00 dB

K:            2.00

MODE FIT: ○ON  ○OFF

MODE DIFF:    3.00 dB

[ Prev Page ]   [ Next Page ]   PAGE 1/3

**Set the mean wavelength (Page 2/3).**

Analysis Setting [FP-LD]                    ✖

B. MEAN WAVELENGTH

ALGO: ○ENVELOPE  ⦿THRESH  ○RMS  ○PK-RMS

THRESH:      20.00 dB

THRESH2:     20.00 dB

K:            2.00

MODE FIT: ○ON  ⦿OFF

MODE DIFF:    3.00 dB

[ Prev Page ]   [ Next Page ]   PAGE 2/3

**Set the total power and number of modes (Page 3/3).**

Analysis Setting [FP-LD]                    ✖

C. TOTAL POWER

OFFSET LEVEL:    0.00 dB

D. MODE NO.

ALGO: ○ENVELOPE  ⦿THRESH  ○RMS  ○PK-RMS

THRESH:      20.00 dB

THRESH2:     20.00 dB

K:            2.00

MODE FIT: ○ON  ⦿OFF

MODE DIFF:    3.00 dB

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### LED

**Set the spectrum width (Page 1/2).**

Analysis Setting [LED]                      ✖

A. SPECTRUM WIDTH

ALGO: ⦿ENVELOPE  ○THRESH  ○RMS  ○PK-RMS

THRESH:       3.00 dB

THRESH2:     20.00 dB

K:            1.00

MODE FIT: ○ON  ○OFF

MODE DIFF:    3.00 dB

[ Prev Page ]   [ Next Page ]   PAGE 1/2

**Set the mean wavelength and total power (Page 2/2).**

Analysis Setting [LED]                      ✖

B. MEAN WAVELENGTH

ALGO: ○ENVELOPE  ⦿THRESH  ○RMS  ○PK-RMS

THRESH:      20.00 dB

THRESH2:     20.00 dB

K:            2.00

MODE FIT: ⦿ON  ○OFF

MODE DIFF:    3.00 dB

C. TOTAL POWER

OFFSET LEVEL:    0.00 dB

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**5.** Set the analysis parameters on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

**6.** Tap **Close Window** or "X" in the upper right of the window. The setting window will close.
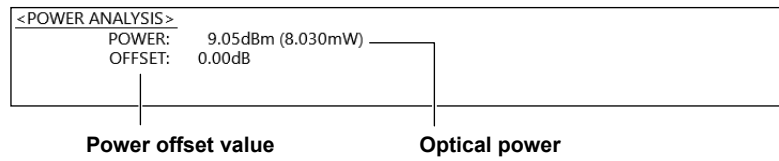
7. Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area.

*Note*

For details on the analysis algorithms for the DFB-LD, FP-LD, and LED light sources and related parameters, see appendix 3, "Details of Analysis Functions."

## Explanation

### Result display

Analysis results are displayed in the data area.

**DFB-LD**

```
<DFB-LD ANALYSIS>
        SMSR:      3.95dB              OSNR:    58.01dB(/0.10nm) ——————— OSNR
      PEAK WL: 1549.4820nm      PK LEVEL:    -5.69dBm       σ:    1.7455nm
  20.00dB WIDTH:    9.1086nm      CTR WL: 1547.2286nm      Kσ:    4.1019nm
    MODE OFFSET:   -2.2680nm                              POWER:   -9.64dBm
```

PK LEVEL: peak level
CTR WL: center wavelength

σ: standard deviation
Kσ: spectral width based on the RMS method
POWER: power

SMSR: side mode suppression ratio
PEAK WL: peak wavelength
20.00dB Width: spectral width at the 20 dB cutoff level
MODE OFFSET: wavelength difference between the peak mode and side mode

**FP-LD**

```
<FP-LD ANALYSIS>
      MEAN WL: 1548.2718nm       SPEC WIDTH:      4.1275nm
      PEAK WL: 1549.4820nm       PEAK LEVEL:     -5.69dBm
      MODE NO: 9
   TOTAL POWER:     -2.08dBm
```

MEAN WL: mean wavelength
PEAK WL: peak wavelength
MODE NO.: number of modes
TOTAL POWER: total power

SPEC WIDTH: spectral width
PEAK LEVEL: peak level

**LED**

```
<LED ANALYSIS>
      MEAN WL: 1548.2787nm       SPEC WIDTH:      0.0500nm
      PEAK WL: 1549.4820nm       PEAK LEVEL:     -5.69dBm
   TOTAL POWER:     -2.08dBm
```

MEAN WL: mean wavelength
PEAK WL: peak wavelength
TOTAL POWER: total power

SPEC WIDTH: spectral width
PEAK LEVEL: peak level

**6**

Analyzing Optical Spectral Waveforms

# 6.6 WDM Signals

## Procedure

The center wavelength, level, and SNR of each channel can be measured from the measured waveform of a WDM transmission signal.

1. Press **ANALYSIS**. The ANALYSIS menu appears.

2. Tap **Analysis 2**. A menu appears for selecting the analysis function.

3. Tap **WDM**. An analysis is performed, and the results are displayed in the data area and table.

   You can switch the analysis results screen using the menu that appears by tapping **Switch Display**.

   TRACE & TABLE: A waveform and table are displayed.

   TRACE: Only the waveform is displayed.

   TABLE: Only the table is displayed.



Data area

Change the analysis parameters.

Switches the display screen

Turns auto analysis on and off

List

## Note

If you tap the analysis results list while the waveform is zoomed, the waveform of the channel you tapped appears in the center of the waveform screen.

**Changing the analysis parameters**

**4.** Continuing from step 3, tap **Parameter Setting**. An WDM analysis parameter setting window appears.



Set the channel detection (Page 1/3).

**Executes analysis**
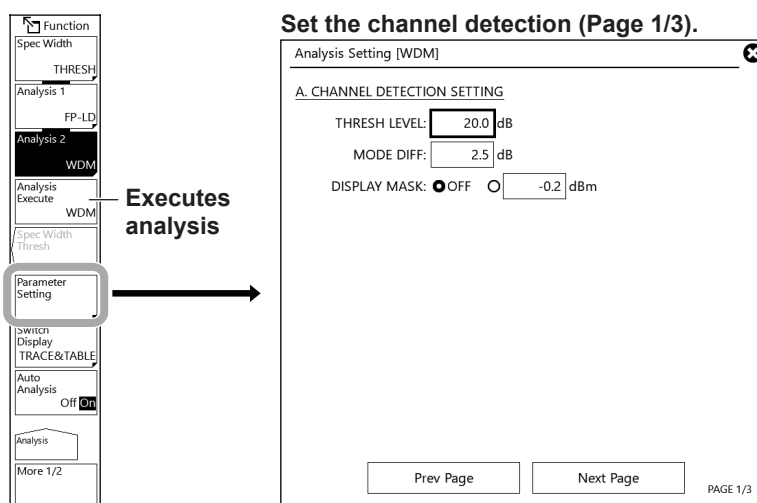
Set the interpolation (Page 2/3).
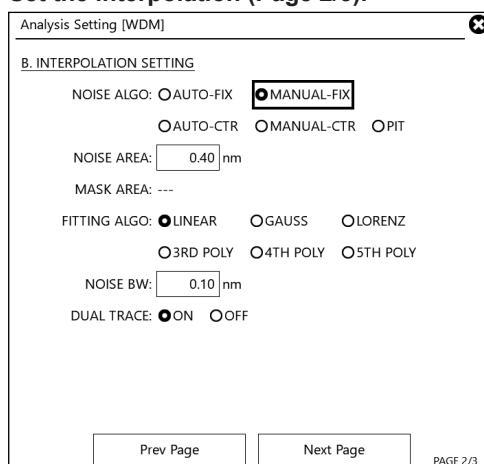
Set the display and other settings (Page 3/3).
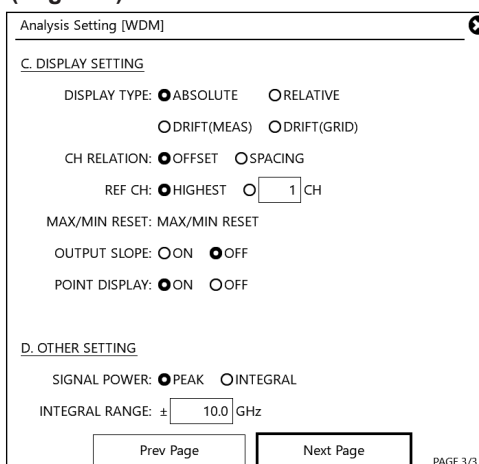
**5.** Set the analysis parameters on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

**6.** Tap **Close Window** or "X" in the upper right of the window. The WDM analysis parameter setting window will close.

**7.** Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area and table.

## Note

For details on the WDM analysis algorithm and parameters, see appendix 4, "WDM Analysis Function."

**6**

Analyzing Optical Spectral Waveforms

## Explanation

**Analysis parameters**

There are three types of WDM analysis parameter setting windows.

Change the parameter settings according to the analysis being performed.

- Channel detection parameters (CHANNEL DETECTION SETTING)
- Noise level measurement parameters (INTERPOLATION SETTING)
- Parameters related to the display method of analysis results and other settings (DISPLAY SETTING, OTHER SETTING)

For details on parameters, see appendix 4, "WDM Analysis Function."

**Result display**

Analysis results are displayed in the data area and table.

**Data area**

| | | | Δ-Δn: |
|---|---|---|---|
| Δ | : | | |
| TR D Δ0001: 1553.3250nm | -10.33dBm | | |
| TR D Δ0002: 1554.1250nm | -10.19dBm | | |
| TR D Δ0003: 1554.9350nm | -10.20dBm | | |
| TR D Δ0004: 1555.7450nm | -10.09dBm | | |
| TR D Δ0005: 1556.5550nm | -10.30dBm | | |

**Wavelength** **Level**

**List**

| | | | | | | |
|---|---|---|---|---|---|---|
| <WDM ANALYSIS> | THRESH: 20.0dB | MODE DIFF: 3.0dB | | | | |
| N_ALG: AUTO-FIX | N_AREA: AUTO | M_AREA: --- | F_ALG: LINEAR | | NOISE BW: 0.10nm | |
| NO. | WAVELENGTH [nm] | LEVEL [dBm] | OFFSET WL [nm] | OFFSET LEVEL [dB] | NOISE [dBm/NBW] | SNR [dB] |
| 1 | 1553.3257 | -10.327 | -4.0345 | -0.433 | -50.729 | 40.402 |
| 2 | 1554.1296 | -10.192 | -3.2306 | -0.298 | -50.519 | 40.327 |
| 3 | 1554.9383 | -10.198 | -2.4219 | -0.304 | -50.334 | 40.136 |
| 4 | 1555.7463 | -10.087 | -1.6139 | -0.192 | -50.211 | 40.124 |
| 5 | 1556.5541 | -10.299 | -0.8062 | -0.405 | -50.114 | 39.815 |
| 6 | 1557.3602 | -9.894 | (REF) | (REF) | -50.080 | 40.185 |
| 7 | 1558.1698 | -10.254 | 0.8096 | -0.359 | -50.163 | 39.909 |
| 8 | 1558.9810 | -10.664 | 1.6208 | -0.770 | -50.342 | 39.678 |

**Center wavelength**   **Signal level**   **Wavelength difference from the reference channel**   **Level difference from the reference channel**   **Noise power**   **Power noise SN ratio**

# 6.7 Gain and Noise Figure of Optical Amplifiers

## Procedure

This feature measures the gain and noise figure (NF) of an optical amplifier from the measured waveform of the signal light input to the optical amplifier and the measured waveform of the output light from the optical amplifier.

1. Press **ANALYSIS**. The ANALYSIS menu appears.

2. Tap **Analysis 2**. A menu appears for selecting the analysis function.

3. Tap **EDFA-NF**. An analysis is performed, and the results are displayed in the data area and table.

   You can switch the analysis results screen using the menu that appears by tapping **Switch Display**.

   TRACE & TABLE: A waveform and table are displayed.

   TABLE: Only the table is displayed.

   TRACE: Only the waveform is displayed.

   GRAPH & TABLE: A graph and table are displayed.

   GRAPH: Only the graph is displayed.



**Data area**

**Switches the screen**

**List**

*Note*

If you tap the analysis results list while the waveform is zoomed, the waveform of the channel you tapped appears in the center of the waveform screen.

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**Displaying the gain (Gain) and noise factor (NF) graphs**

*4.*  Tap **Switch Display**.

*5.*  Tap **Graph& Table** or **Graph**. A soft key menu appears for setting the graph display and markers.

*6.*  Tap **Line Marker Y1** to select On. Marker Y1 is displayed in the graph display, and a window appears for setting the marker Y1 position.

*7.*  Enter the Line Marker Y1 position.

*8.*  Likewise, Tap **Line Marker Y2**, and set **Y2**.



Turns Y1 on and off
Turns Y2 on and off
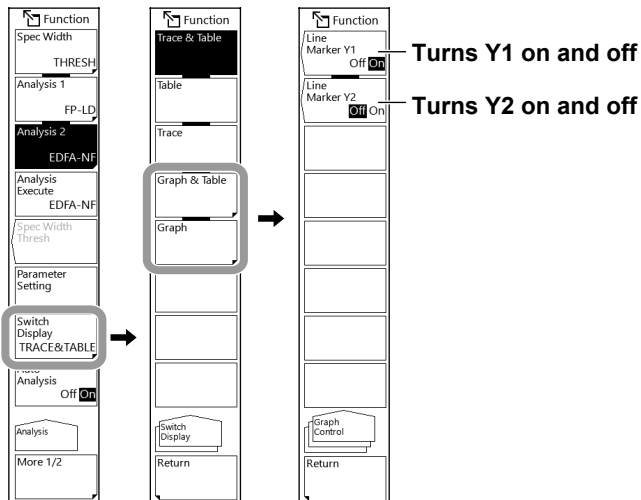
*Note*

If both markers Y1 and Y2 are turned on, the difference between the markers are displayed in the marker information.

**Changing the analysis parameters**

*4.*  Continuing from step 3, tap **Parameter Setting**. The EDFA-NF analysis parameter setting screen appears.



Executes analysis

**Set the channel detection (Page 1/3).**

Analysis Setting [EDFA-NF]

A. CHANNEL DETECTION SETTING

THRESH LEVEL:   20.0 dB

MODE DIFF:   3.0 dB

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**Set the interpolation (Page 2/3).**

Analysis Setting [EDFA-NF]                    ✕

B. INTERPOLATION SETTING

OFFSET(IN):        0.00  dB

OFFSET(OUT):       0.00  dB

ASE ALGO: ●AUTO-FIX    ○MANUAL-FIX

○AUTO-CTR   ○MANUAL-CTR

FITTING AREA: AUTO

MASK AREA: ---

FITTING ALGO: ○LINEAR    ○GAUSS      ○LORENZ

○3RD POLY  ○4TH POLY  ○5TH POLY

POINT DISPLAY: ●ON   ○OFF

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**Set the NF calculation and other settings (Page 3/3).**

Analysis Setting [EDFA-NF]                    ✕

C. NF CALCULATION SETTING

RES BW: ○MEASURED   ●CAL DATA

SHOT NOISE: ●ON   ○OFF

D. OTHER SETTING

SIGNAL POWER: ●PEAK   ○INTEGRAL

INTEGRAL RANGE: ±    10.0  GHz

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**5.** Set the analysis parameters on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

**6.** Tap **Close Window** or "X" in the upper right of the window. The EDFA-NF analysis parameter setting window will close.

**7.** Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area and table.

*Note*

For details on the optical amp analysis algorithm and parameters, see appendix 5, "Optical Amp Analysis Function."

**6**

Analyzing Optical Spectral Waveforms

**Example of optical amp gain and noise figure analysis**
Analysis of optical amp gain and noise figure is performed after measuring the signal light going into the optical amp and the output light leaving the optical amp.

• **Acquiring the waveform to be analyzed**
The following configuration and general procedure is used to measure optical amp gain and noise.

Signal light measurement configuration
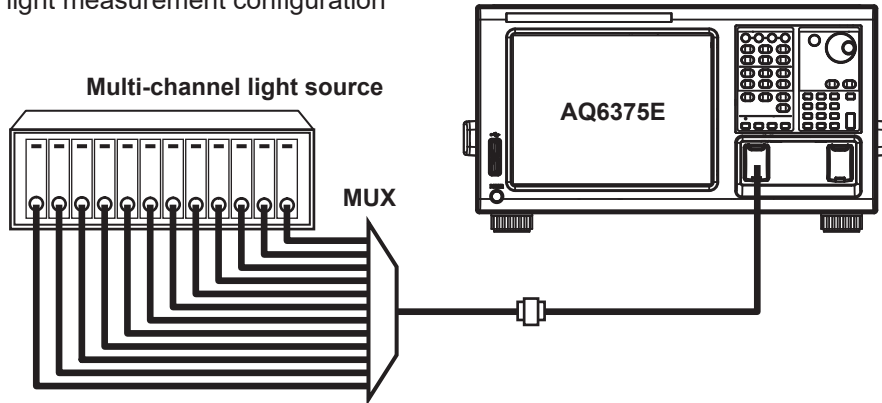


Output light measurement configuration
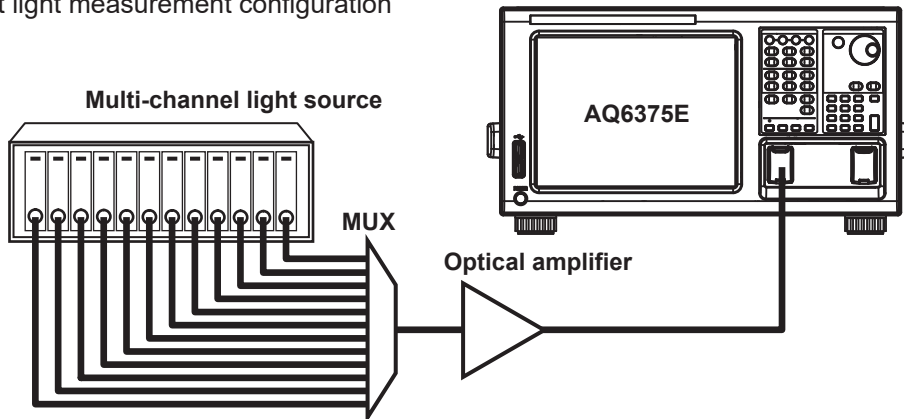
- **Writing to Trace A the Waveform of the Signal Light Input to the Optical Amp**

*1.* Input the signal light sent to the optical amp into the instrument.

*2.* Press **TRACE** and then tap **Active Trace** to select **A**.

*3.* Tap **View A** to select **DISP.**

*4.* Tap **Write A**. Trace A is set to write mode.

*5.* Measure the signal light waveform according to measurement conditions for the signal light waveform.

(For details on the measurement procedure, see chapter 3, "Measuring the Optical Spectrum.")

*6.* Tap **Fix A** under **TRACE**. Trace A is set to fix mode.

*Note*

If all traces from trace A to trace G have been set to fix mode (FIX) as a result of step 6, a warning is displayed. However, this does not pose a problem because trace B is set to write mode in the next step.

- **Writing to Trace B the Waveform of the Output Light from the Optical Amp**

*7.* Input the light output from the optical amp into the instrument.

*8.* Press **TRACE** and then tap **Active Trace** to select **B**.

*9.* Tap **View B** to select **DISP.**

*10.* Tap **Write B**. Trace B is set to write mode.

*11.* Measure the waveform of the output light with the same measurement conditions used for measuring the signal light waveform.

## Explanation

### Setting EDFA-NF analysis parameters

EDFA-NF analysis parameters are broadly divided into the following three categories.

Change the parameter settings according to the analysis being performed.

- Channel detection parameters (CHANNEL DETECTION SETTING)
- ASE level measurement parameters (INTERPOLATION SETTING)
- NF calculation and other parameters (NF CALCULATE SETTING, OTHER SETTING)

For details on parameters, see appendix 5, "Optical Amp Analysis Function."

### Result display

Analysis results are displayed in the data area and table.

**Data area**

| | | | Δ-Δn: |
|---|---|---|---|
| Δ | : | | |
| TR A | Δ0001: 1553.3210nm | -30.47dBm | |
| TR A | Δ0002: 1554.1250nm | -30.55dBm | |
| TR A | Δ0003: 1554.9330nm | -30.26dBm | |
| TR A | Δ0004: 1555.7410nm | -31.02dBm | |
| TR A | Δ0005: 1556.5480nm | -30.46dBm | |

**Wavelength** **Level**

**List**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| <NF ANALYSIS> | TH: 20.0dB | MODE DIFF: 3.0dB | | OFST(IN): 1.00dB | | OFST(OUT): 0.00dB | | ⊗ |
| | A_ALGO: AUTO-FIX | F_AREA: AUTO | | M_AREA: --- | | F_ALGO: LINEAR | | |
| NO. | WAVELENGTH [nm] | INPUT LVL [dBm] | OUTPUT LVL [dBm] | ASE LVL [dBm] | RESOLN [nm] | GAIN [dB] | NF [dB] | |
| 1 | 1553.3211 | -29.465 | -3.944 | -26.870 | 0.039 | 25.499 | 9.739 | |
| 2 | 1554.1253 | -29.544 | -3.562 | -26.644 | 0.039 | 25.961 | 9.521 | |
| 3 | 1554.9332 | -29.252 | -3.357 | -26.443 | 0.039 | 25.874 | 9.827 | |
| 4 | 1555.7405 | -30.023 | -3.567 | -26.267 | 0.038 | 26.433 | 9.461 | |
| 5 | 1556.5484 | -29.455 | -3.245 | -26.148 | 0.038 | 26.188 | 9.843 | |
| 6 | 1557.3555 | -29.353 | -3.287 | -26.066 | 0.038 | 26.043 | 10.087 | |
| 7 | 1558.1637 | -29.297 | -2.624 | -26.091 | 0.038 | 26.653 | 9.469 | |
| 8 | 1558.9757 | -29.370 | -3.198 | -26.223 | 0.038 | 26.150 | 9.859 | |

**Center wavelength** **Input level** **Output level** **ASE level** **Measurement resolution** **Gain** **Noise figure**

# 6.8　Optical Filter Characteristics Measurement

## Procedure

Optical filter characteristics can be measured from the measured waveform of the light input to the optical filter from the light source, as well as from the measured waveform light output from the optical filter.

### Filter measurement (single channel)

You can analyze a waveform whose number of modes is 1. Select from the following:

FILLTER-PK:　　Filter peak analysis

FILTER-BTM:　　Filter bottom analysis

1.　Press **ANALYSIS**. The ANALYSIS menu appears.

2.　Tap **Analysis 2**. A menu appears for selecting the analysis function.

3.　Tap **FILTER-PK** or **FILTER-BTM**. An analysis is performed, and the results are displayed in the data area.

**Changing the filter peak analysis parameters**

**4.** Select FILTER-PK in step 3, tap **Parameter Setting**. A Filter-PK analysis parameter setting screen appears.

**Set the peak level and peak wavelength (Page 1/4).**
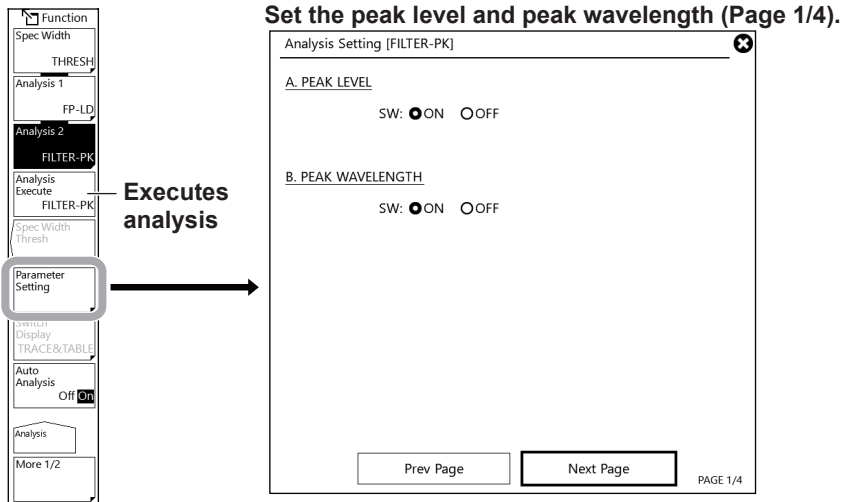


**Set the center wavelength (Page 2/4).**
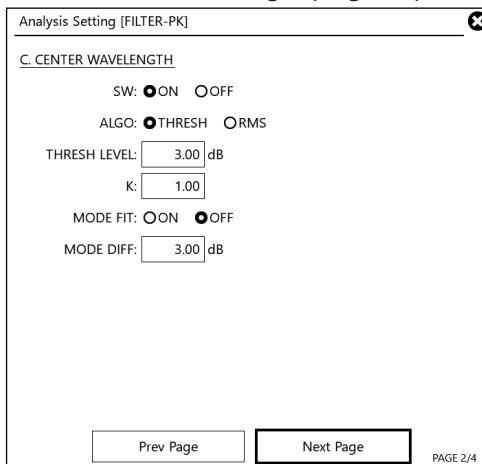


**Set the spectral width and ripple width (Page 3/4).**
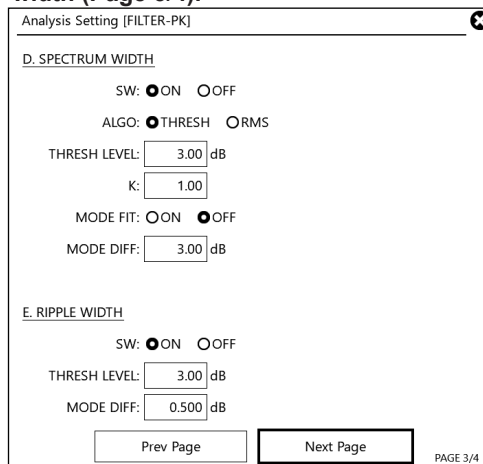


**Set the crosstalk (Page 4/4).**
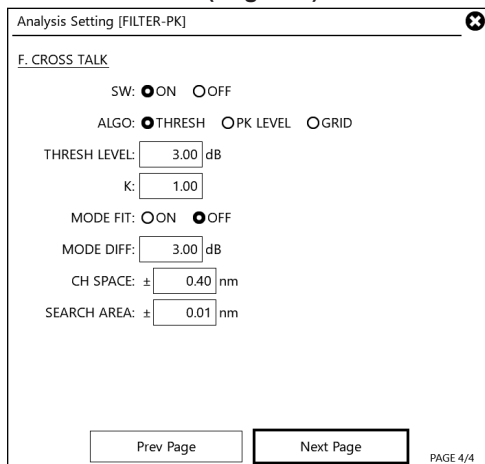


**5.** Set the analysis parameters on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

**6.** Tap **Close Window** or "X" in the upper right of the window. The WDM analysis parameter setting window will close.

**7.** Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area and table.

*Note*

For details on the optical filter analysis algorithm and parameters, see appendix 6, "Optical Filter Analysis Function."

### Changing the filter bottom analysis parameters

This is used if the optical filter is of a notch type rather than a pass band type.

**4.** Select FILTER-BTM in step 3, tap **Parameter Setting**. A Filter-PK analysis parameter setting screen appears.



**Set the bottom level, bottom wavelength, and center wavelength (Page 1/3).**

**Set the notch width (Page 2/3).**
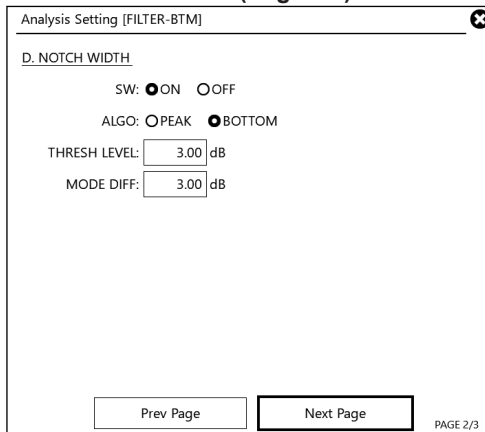
**Set the crosstalk (Page 3/3).**
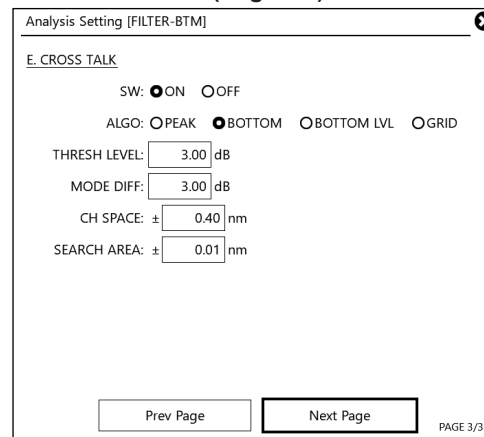
**5.** Set the analysis parameters on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

**6.** Tap **Close Window** or "X" in the upper right of the window. The WDM analysis parameter setting window will close.

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Analyzing Optical Spectral Waveforms

**7.** Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area and table.

---

*Note*

For details on the optical filter analysis algorithm and parameters, see appendix 6, "Optical Filter Analysis Function."

---

## Filter measurement for WDM (multi channel)

You can analyze multi-mode waveforms. Select from the following:

WDM FIL-PK: WDM filter peak analysis

WDM FIL-BTM: WDM filter bottom analysis

**1.** Press **ANALYSIS**. The ANALYSIS menu appears.

**2.** Tap **Analysis 2**. A menu appears for selecting the analysis function.

**3.** Tap **WDM FIL-PK** or **WDM FIL-BTM**. An analysis is performed, and the results are displayed in the data area.

You can use the **SWITCH DISPLAY** soft key to switch the analysis results screen.

TRACE & TABLE: A waveform and table are displayed.

TRACE: Only the waveform is displayed.

TABLE: Only the table is displayed.



---
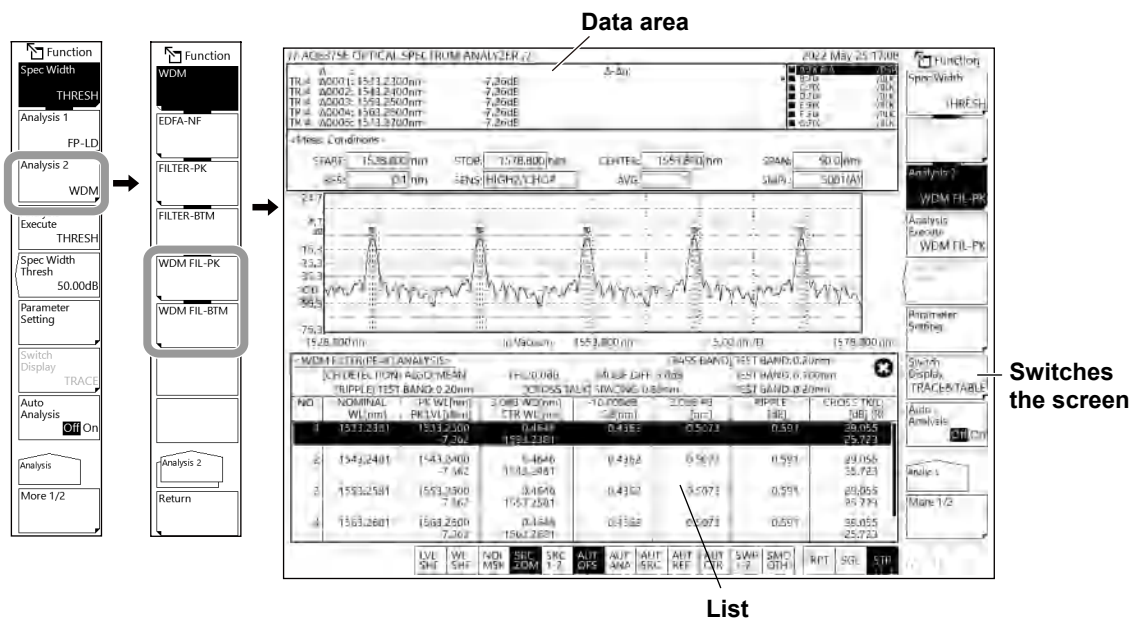
*Note*

If you tap the analysis results list while the waveform is zoomed, the waveform of the channel you tapped appears in the center of the waveform screen.

---

**Changing the WDM filter peak analysis parameters**

**4.** Select WDM FIL-PK in step 3, tap **Parameter Setting**. A Filter-PK analysis parameter setting screen appears.

**Set the channel detection/nominal wavelength, peak wavelength/level, and XdB width/center wavelength (Page 1/3).**



**Executes analysis**
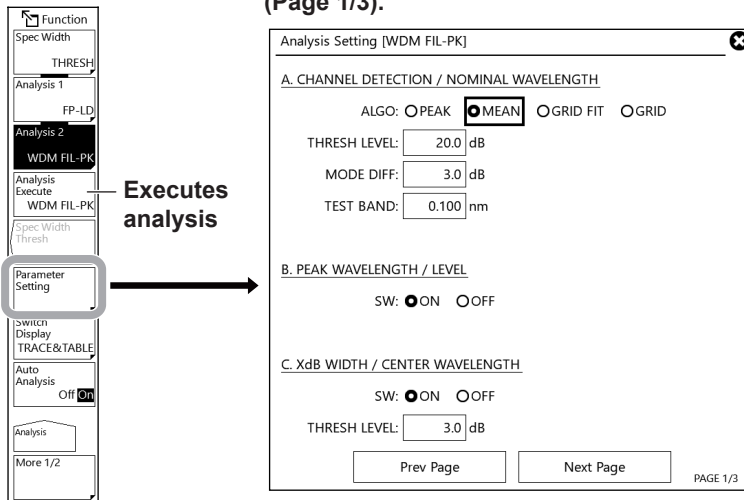
**Set the XdB stop band and XdB pass band (Page 2/3).**
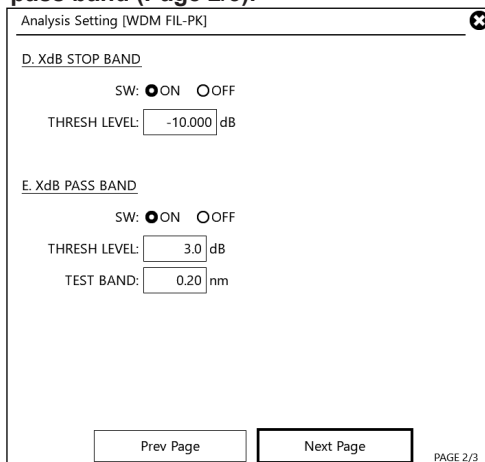


**Set the ripple and cross talk (Page 3/3).**
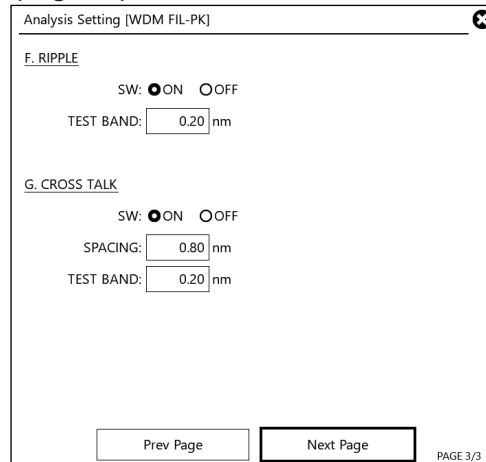


**5.** Set the analysis parameters on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

**6.** Tap **Close Window** or "X" in the upper right of the window. The WDM analysis parameter setting window will close.

**7.** Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area and table.
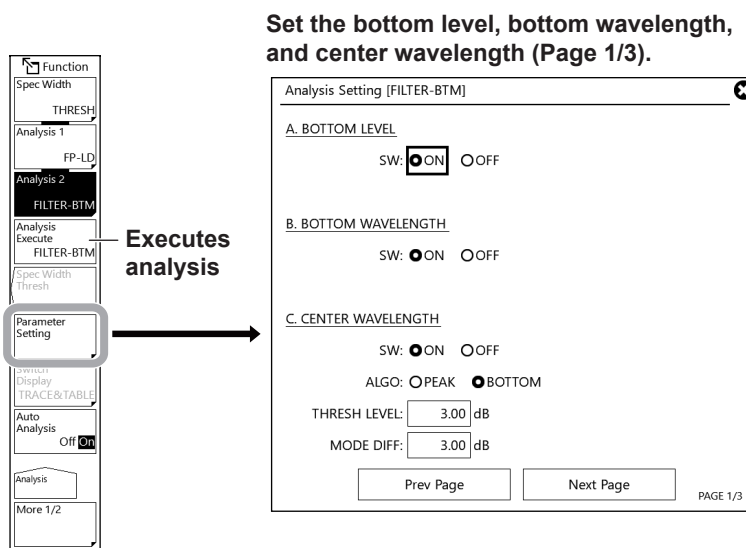
*Note*

For details on the optical filter analysis algorithm and parameters, see appendix 6, "Optical Filter Analysis Function."

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Analyzing Optical Spectral Waveforms

**Changing the WDM filter bottom analysis parameters**

**4.** Select WDM FIL-BTM in step 3, tap **Parameter Setting**. A Filter-PK analysis parameter setting screen appears.
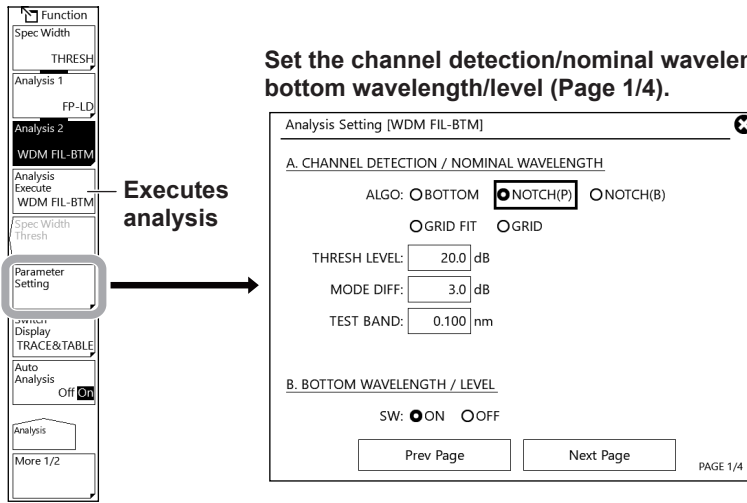
**Set the channel detection/nominal wavelength and bottom wavelength/level (Page 1/4).**



**Executes analysis**

Analysis Setting [WDM FIL-BTM]

A. CHANNEL DETECTION / NOMINAL WAVELENGTH

ALGO: ○BOTTOM  ●NOTCH(P)  ○NOTCH(B)

○GRID FIT  ○GRID

THRESH LEVEL: 20.0 dB

MODE DIFF: 3.0 dB

TEST BAND: 0.100 nm

B. BOTTOM WAVELENGTH / LEVEL

SW: ●ON  ○OFF

Prev Page    Next Page    PAGE 1/4

**Set the XdB notch width/center wavelength and XdB stop band (Page 2/4).**

Analysis Setting [WDM FIL-BTM]

C. XdB NOTCH WIDTH / CENTER WAVELENGTH

SW: ●ON  ○OFF

ALGO: ○NOTCH(P)  ●NOTCH(B)

THRESH LEVEL: 3.0 dB

D. XdB STOP BAND

SW: ●ON  ○OFF

THRESH LEVEL: -10.000 dB

Prev Page    Next Page    PAGE 2/4

**Set the XdB elimination band and ripple (Page 3/4).**
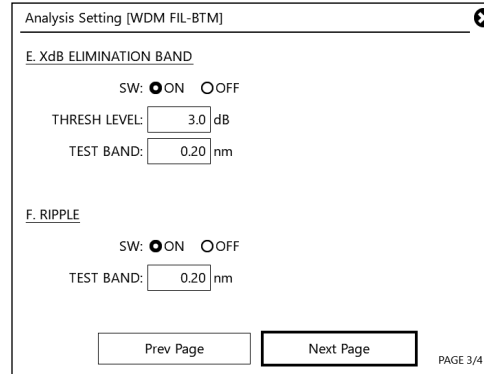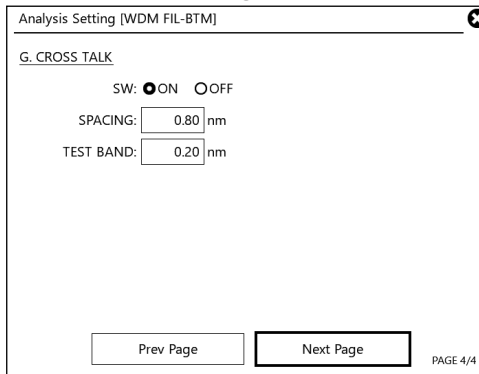
Analysis Setting [WDM FIL-BTM]

E. XdB ELIMINATION BAND

SW: ●ON  ○OFF

THRESH LEVEL: 3.0 dB

TEST BAND: 0.20 nm

F. RIPPLE

SW: ●ON  ○OFF

TEST BAND: 0.20 nm

Prev Page    Next Page    PAGE 3/4

**Set the crosstalk (Page 4/4).**

Analysis Setting [WDM FIL-BTM]

G. CROSS TALK

SW: ●ON  ○OFF

SPACING: 0.80 nm

TEST BAND: 0.20 nm

Prev Page    Next Page    PAGE 4/4

**5.** Set the analysis parameters on the setting window.

For instructions on how to select items and how to set values, see chapter 4 in the Getting Started Guide.

**6.** Tap **Close Window** or "X" in the upper right of the window. The WDM analysis parameter setting window will close.

7. Tap **Analysis Execute**. An analysis is performed according to the changed parameters, and the results are displayed in the data area and table.

*Note*

For details on the optical filter analysis algorithm and parameters, see appendix 6, "Optical Filter Analysis Function."

First measure the waveform of the wideband light source as a reference waveform, and then subtract the WDM optical filter's output waveform from the reference waveform to measure the characteristics of the WDM optical filter.

## Acquiring the waveform to be analyzed

The following configuration and general procedure is used to measure WDM optical filter characteristics.

A pass band type WDM optical filter is used as an example.

Reference spectrum
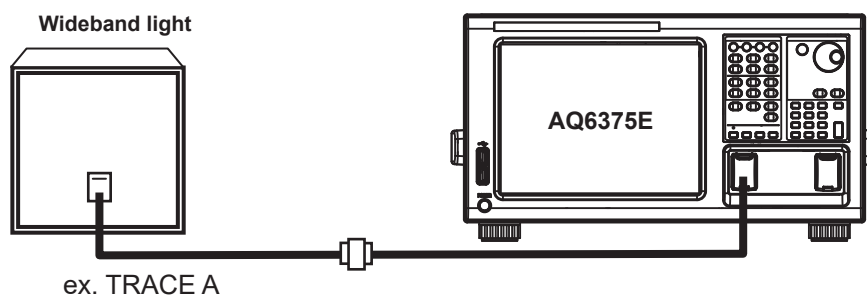


ex. TRACE A

Spectrum measurement after passing through the filter



ex. TRACE B

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Analyzing Optical Spectral Waveforms
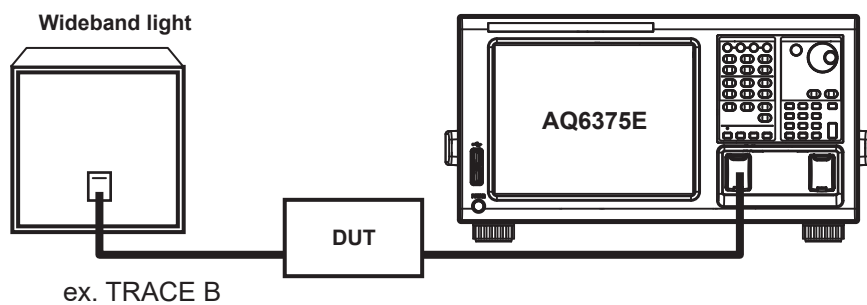
**Writing to trace A the waveform of the light source input to the optical filter**

1.  Input into the instrument the light emitted from the light source that is to be input to the optical filter .

2.  Press **TRACE** and then tap **Active Trace** to select **A**.
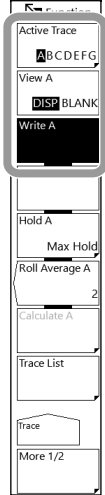


3.  Tap **View A** to select **DISP.**

4.  Tap **Write A**. Trace A is set to write mode.

5.  Measure the signal light waveform according to measurement conditions for the signal light waveform.

(For details on the measurement procedure, see chapter 3, "Measuring the Optical Spectrum.")

6.  Tap **Fix A** under **TRACE**. Trace A is set to fix mode.

*Note*

If all traces from trace A to trace G have been set to fix mode (FIX) as a result of step 6, a warning is displayed. However, this does not pose a problem because trace B is set to write mode in the next step.

**Writing to trace b the waveform of the output light from the optical filter**

1.  Apply the emitted light from the light source to the optical filter, and then apply the light that is output from the optical filter into the instrument.

2.  Press **TRACE** and then tap **Active Trace** to select **B**.

3.  Tap **View B** to select **DISP.**

4.  Tap **Write B**. Trace B is set to write mode.

5.  Measure the waveform of the output light with the same measurement conditions used for measuring the light source waveform.

**Writing to trace c the difference between traces**

*2.*  Press **TRACE** and then tap **Active Trace** to select **C**.

*3.*  Press the **View C** soft key and select **DISP**.

*4.*  Tap **Calculate C**.

*5.*  Tap **Log Math**. A menu appears for selecting the formula.

*6.*  Tap **C=A-B(LOG)**. The waveform obtained by subtracting the trace B waveform from the trace A waveform is displayed in trace C.



6

Analyzing Optical Spectral Waveforms
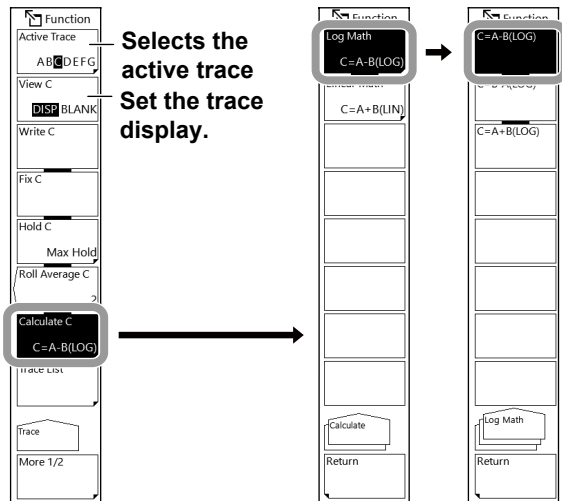
**Explanation**

## Setting WDM FIL-PK filter analysis parameters

WDM FIL-PK analysis parameters are broadly divided into the following two categories.

Change the parameter settings according to the analysis being performed.

- Channel detection parameters
- Parameter settings for each analysis item

For details on parameters, see appendix 6, "Details of Optical Filter Analysis Functions."

## Channel detection parameters

These parameters are used to set the algorithm and threshold level for WDM channel detection.

### ALGO

Select one of the four algorithms shown below for detecting the WDM channel and analyzing the reference wavelength of each channel.

- PEAK
- MEAN
- GRID FIT
- GRID

The channel detection and reference wavelength analysis results for each channel vary depending on the algorithm selected.

- **When PEAK is selected**

  Each mode peak is detected as a channel.

  The peak wavelength of each channel is the reference wavelength.

- **When MEAN is selected**

  Each mode peak is detected as a channel.

  The 3 dB center wavelength of each channel is the reference wavelength.

- **When GRID FIT is selected**

  The mode peak detected within grid wavelength ± (test band/2) is set as the channel.

  The grid wavelength closest to each channel is the reference wavelength.

- **When GRID is selected**

  The wavelengths registered in the grid table wavelength are recognized as channels.

  Grid wavelength is set as the reference wavelength.

### THRESH LEVEL

This parameter sets the threshold level for channel detection.

### MODE DIFF

This parameter sets the minimum value for the peak/bottom difference during channel peak detection.

### TEST BAND

This parameter sets the bandwidth for reference wavelength analysis.

## Parameter settings for each analysis item

Set the parameters of each WDM optical filter analysis item.

An analysis parameter setting screen appears.

### Note

For details on the optical filter analysis algorithm and parameters, see appendix 6, "Optical Filter Analysis Function."

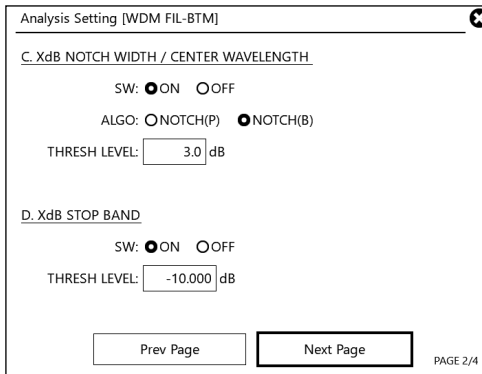## 6.9 Measurement of Level Fluctuations in Single-Wavelength Light (0 nm Sweeping)

This function measures the changes over time in the level of a specific wavelength. It is useful for purposes such as optical axis alignment when connecting an optical fiber to a light source. The following discussion pertains to an example in which the spatial light of an He-Ne gas laser (1523.488 nm) is input to an optical fiber.

**Setting the center wavelength to 1523.488 nm**

1. Press **CENTER**. The CENTER menu appears.

2. Tap **Center**. A center wavelength setting window appears.
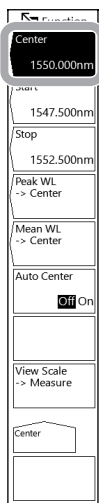


3. Enter 1523.488 nm on the window.

**Setting the resolution to 2.000 nm**

4. Press **SETUP**. The SETUP menu appears.

5. Tap **Resolution**. A menu appears for selecting the resolution. A resolution setting window also appears.
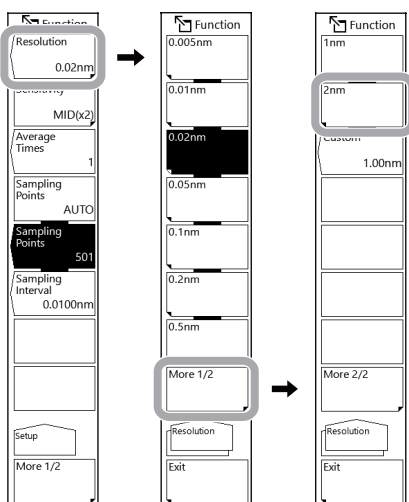


6. Tap **2nm** on the resolution selection menu, or enter 2 nm on the resolution setting window.

**Setting the sweep span to 0 nm**

*7.* Press **SPAN**. A soft key menu appears for setting the sweep span.

*8.* Tap **Span**. A sweep span setting window appears.

Span
5.0nm — **Set the sweep span.**

Start
1520.988nm

Stop
1525.988nm

Δλ
-> Span

0nm Sweep
Time
Minimum — **Set the sweep time.**

View Scale
-> Measure
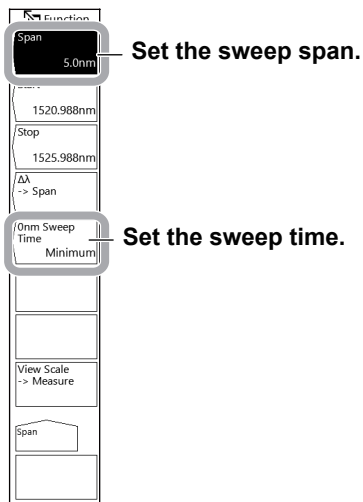
Span

*9.* Set the sweep span to 0 nm on the sweep span setting window.

The measurement start wavelength, measurement center wavelength, and measurement stop wavelength are all set to 1523.488 nm.

**Setting the sweep time**

*10.* Tap **0 nm Sweep Time**. A window appears for setting the sweep time.

*11.* Set the sweep time on the sweep time setting window.

*12.* Press **SWEEP** and then tap **Repeat**. Sweeping will begin.

*Note*
- When the sweep range is set to 0nm, the horizontal scale changes to time.
- The sweeping time varies depending on the measurement sensitivity (Sensitivity of the SETUP menu). If the value set with this key is less than the sweep time for each sensitivity, the value becomes invalid and the Minimum setting is used.

**6**

Analyzing Optical Spectral Waveforms

## Explanation

The following figure shows the configuration for applying the spatial light of an He-Ne gas laser (1523.488 nm) into an optical fiber.
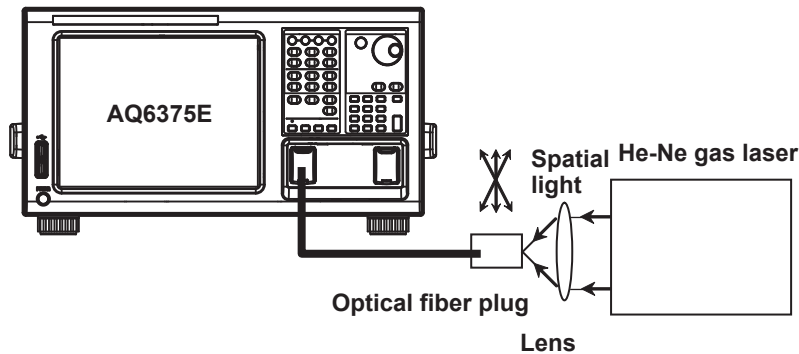


The sweep span is set to 0 nm, the center wavelength is fixed, and the level of a single wavelength of light is measured.

The optical fiber plug is adjusted while observing the displayed waveform so as to set the light source input level to the peak.

**0nm Sweep Time**

When the sweep span is 0 nm, the horizontal scale is time.

Set the time required to measure from the left edge to the right edge of the screen.

You can set the value to Minimum or between 1 to 50 s. You can set it in steps of 1 s. If COARSE is enabled in the setting window, you can set the value in 1-2-5 steps.

If you enter 0, Minimum will be shown on the display.

Note that the sweep time varies depending on the measurement sensitivity (Sensitivity of the SETUP menu). If the value set with this key is less than the sweep time for each sensitivity, the value becomes invalid and the Minimum setting is used.

The sampling points are automatically set to 1001.

# 6.10 Editing the Grid Table

## Procedure

**Editing the standard grid table**

1. Press **ANALYSIS**. The ANALYSIS menu appears.

2. Press the **More 1/2** soft key to display the More 2/2 menu.

3. Tap **Grid Setting**. A grid table edit menu appears.



**Set the start wavelength or frequency of the grid.**

**Set the stop wavelength or frequency of the grid.**

**Set the reference frequency of the grid.**

**Set the grid spacing.**
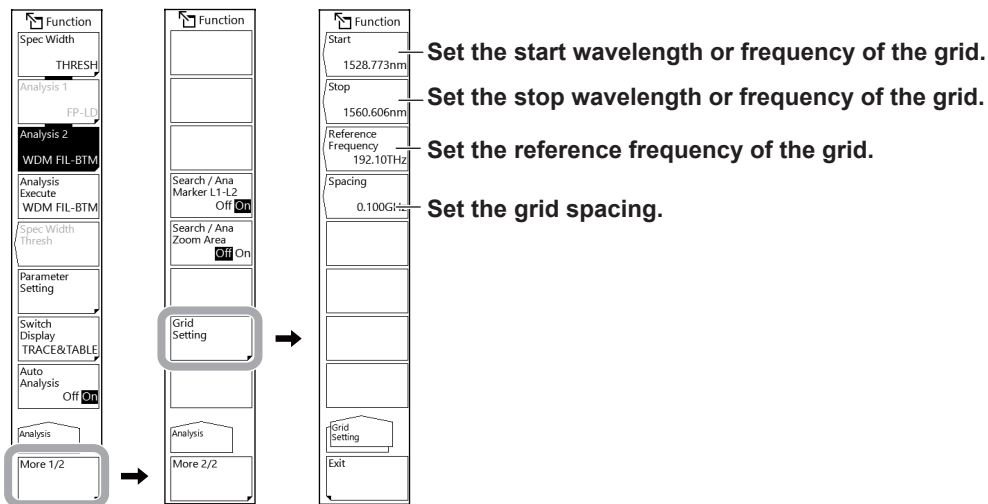
*Note*

The unit for Grid Start and Stop settings varies depending on the Marker unit. Set Reference Frequency and Spacing in units of frequency (Hz) regardless of the Marker unit.

**Switching the unit of the wavelength scale to frequency on the grid table**

1. Press **MARKER**.

2. Tap **More** to display the More 3/3 menu.

3. Tap **Marker Unit**. A menu appears for selecting the maker unit.

4. Tap **nm**, **THz**, or **cm⁻¹**.

For details on setting the marker, see Chapter 5, "Displaying Measured Values and Calculated Values Using Markers."

## Explanation

**Grid table**

A grid table contains wavelengths (frequencies) that are referenced by part of the analysis function when it is executed.
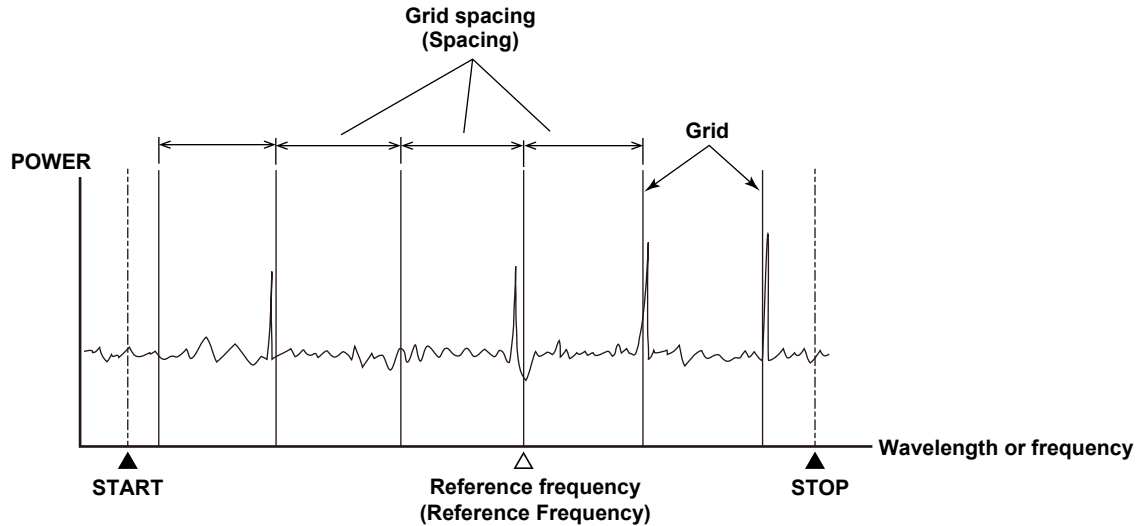


- **Start**
  Set the start point.

- **Stop**
  Set the stop point.

- **Reference Frequency**
  Set the reference frequency of the grid table. You can set the value between 125.00 THz and 250.00 THz.

- **Spacing**
  Set the frequency spacing.

*Note*

For details on the grid table, see appendix 1, "WDM Wavelength Grid Table."

# 7.1    USB Storage Devices

## Compatible USB storage devices

The instrument supports USB memory devices and hard drives compliant with USB 1.0 or USB 2.0.
For more details, contact your nearest YOKOGAWA dealer.

## Removing a USB storage device

Be sure to follow the procedure below to remove a USB storage device.
When several USB storage devices are connected, the instrument recognizes the storage device connected first. To remove a storage device connected later, follow the procedure below to remove the earliest connected storage device, restart the instrument, and then remove the next storage device by following the procedure below.

*1.*    Press **FILE**. The FILE menu appears.
   Check whether **Remove USB Storage** is unavailable (dimmed). If it is, the USB storage device can be removed.

*2.*    If Remove USB Storage is available, tap **Remove USB Storage**. The Remove USB Storage soft key becomes unavailable (dimmed), and the USB storage device can be removed.



**Removable state**
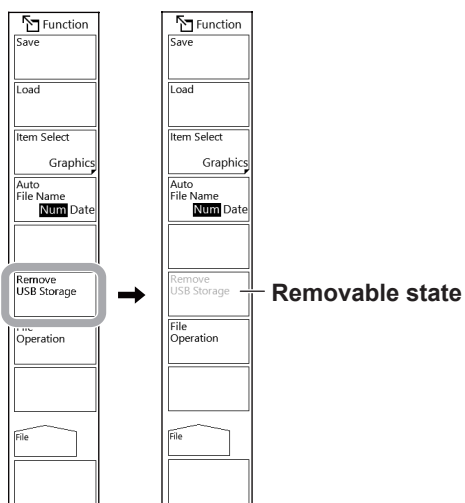
*Note*
   For handling storage devices, follow the instruction manual supplied with the storage device.

## 7.2 Saving and Loading Waveform Data

### Procedure

You can save waveforms displayed on the instrument to a USB storage device or internal memory and load data from a USB storage device.

For details on file operation, see section 7.7, "File Operations."

---

⚠️ **CAUTION**

Do not remove the USB storage device or turn off the power when the USB storage device access indicator is blinking. Doing so may damage the USB storage device or corrupt its data.

Before you remove a USB storage device, be sure to follow the procedure in section 7.1 to make the USB storage device ready to be removed.

---

### Saving trace data

**Selecting the format of files saved automatically with file names**

*1.* Press **FILE**. The FILE menu appears.

*2.* Tap **Auto File Name**. Select Num (serial number) or Date (date).



*Note*

You can also set this on the Save window, described later.

---

**Setting the type of file to save to Trace**

*3.* Tap **Item Select**. The Item Select menu appears.

*4.* Tap **Trace**. Trace is selected, and the menu returns to the previous level.
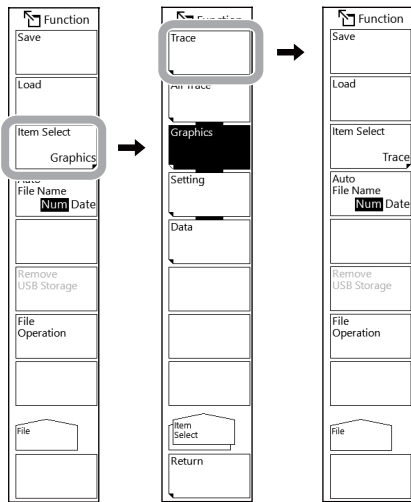


**Selecting the trace to save, save destination, and data format**

*5.* Tap **Save**. A Save window appears.

*6.* Tap the trace you want to save.

*7.* In the file list, open the folder you want to save waveform data in.

*8.* Tap Binary or CSV to select the data format.



Moves to the higher-level folder
Select the trace to save.
Select the file list sort method.
Select what to save (select Trace).
Select the file list display mode (List, Thumbnail, Preview).
Select the storage area (INT, EXT).
Add a folder.
Rename a folder or file.
Delete folders and files.
Save destination path
Select the format when assigning file names automatically (Num, Date).
Type of data to be saved
Closes the window
Starts saving

**File name**
**Serial number (Num): Wxxxx (xxxx: serial number)**
**Date (Date): WyyyyMMdd_hhmmss**
**(yyyy: year, MM: month, dd: day, hh: hour, mm: minute, ss: second)**
**When assigning a specific file name, enter the file name.**

7

Saving and Loading Data

**Specifying a file name**

You can save waveform data by specifying a file name.

If you do not specify a file name, the file will automatically be assigned a name using a serial number or date.

*9.* In the Save window, tap the file name display area twice. A keyboard appears.

*10.* Enter a file name using the keyboard, and tap Done.

The file name will be entered.

**Saving the file**

*11.* On the Save window, tap **Save**. The file is saved.

If you tap **Close** before you tap Save, the window will close without saving the data.

*12* When overwriting a file, a confirmation message appears. Tap OK.

To cancel overwriting, tap Cancel.

# Loading trace data

**Setting the type of file to load to TRACE**
The instrument can load trace data saved in binary format (.WXC) or CSV format.

*1.* Press **FILE**. The FILE menu appears.

*2.* Tap **Item Select**. A menu appears for selecting the file type.

*3.* Tap **Trace**. Trace is selected, and the menu returns to the previous level.

*4.* Tap **Load**. A Load window appears.



Moves to the higher-level folder
Select what to load (select Trace).
Select the file list sort method.
Select the file list display mode (List, Thumbnail, Preview).
Select the storage area (INT, EXT).
Current folder
Select the load destination.
Select the trace to load.
Starts loading
Closes the window
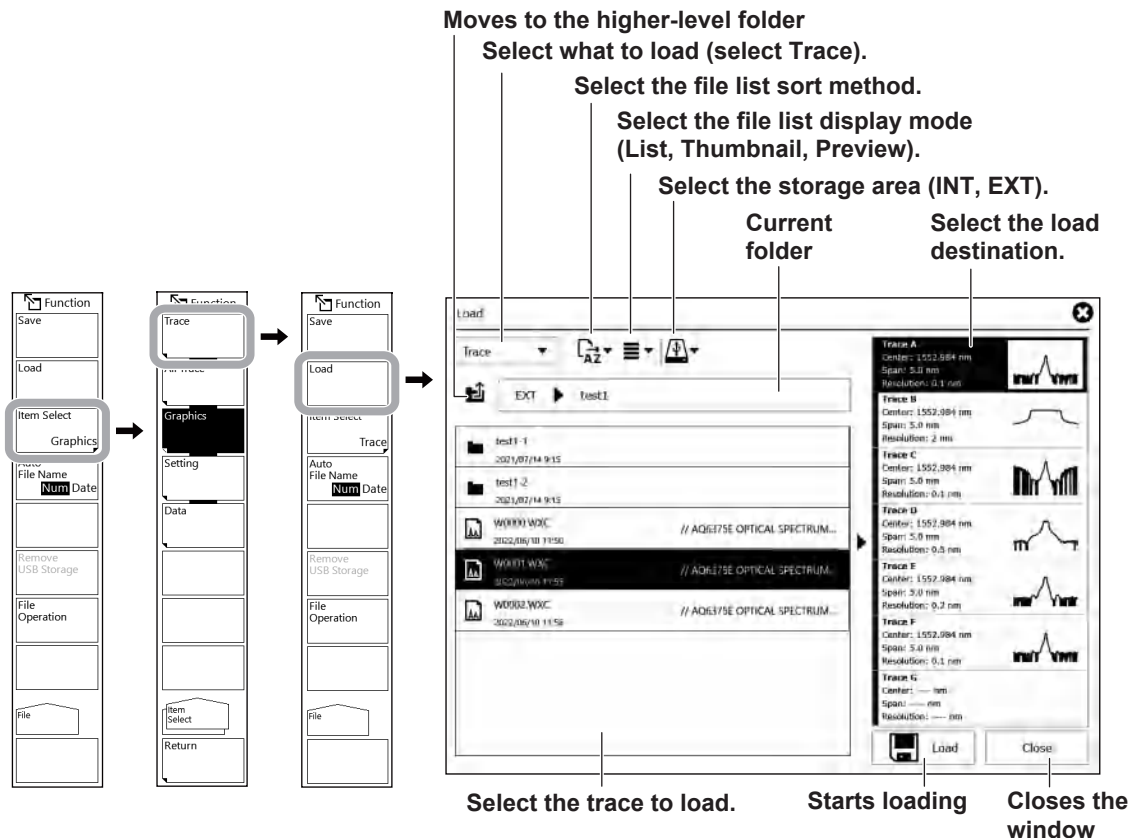
**Loading the File**

*5.* On the Load window, tap **Load**. The file is loaded.

If you tap **Close** before you tap Load, the window will close without loading the trace.

If you select a trace number that already has trace data loaded and execute the load, the data will be overwritten with the new trace data.

7

Saving and Loading Data

## Explanation

You can save the data of traces A to G to internal memory or a USB storage device or load previously saved data to trace A to G.

## Data format

You can save data in the following two data formats.

**BIN**

Data is saved in binary format.

The data can be loaded into the instrument, and waveforms can be displayed.

The file size will be smaller than that of ASCII format.

The extension is .WXC.

**CSV**

Data is saved in comma-separated (CSV) ASCII format.

The data can be loaded into the instrument, and waveforms can be displayed.

You can view the waveform data directly using an external application. The file size will be larger than that of binary format.

The extension is .CSV.

## File name

You can save files by assigning their names automatically or with specific names.

If you do not specify a file name, the following file name will be assigned automatically according to the Auto File Name setting.

When Auto File Name is set to NUM

    File name:         WXXXX.CSV (or .WXC)

                       XXXX is a serial number from 0000 to 9999.

When Auto File Name is set to DATE

    File name:         WyyyyMMdd_hhmmss.CSV (or .WXC)

                       yyyyMMdd:  Year (Gregorian) month day

                       hhmmss:    Hour (24 hours) minute second

                       (Date/time when the file list was updated)

*Note*

- The date and time used to assign a name to a file created with a remote or program command are the date and time when the file was created.
- The maximum number of characters that you can use for a file name is 56 (including the extension). The characters that you can use are shown below.
  !#$%&'()-
  0123456789@
  ABCDEFGHIJKLMNOPQRSTUVWXYZ^
  abcdefghijklmnopqrstuvwxyz{}¯

# File size

The file size varies depending on the data that you are saving. Check that there is sufficient free space at the storage destination before saving the data.

# CSV data format

CSV data is saved in the following format.

```
75ECSV
// AQ6375E OPTICAL SPECTRUM ANALYZER //        Header block
40
"CTRWL",1553.200000
"SPAN", 20.000000
"START WL",1543.200000
"STOP WL",1563.200000
"WLFREQ", 0
"REFL",-10.0
"LSCL",10.0
"RESLN",0.200
"CUSTOM RES", 0
"AVG", 1
"SMPLAUTO", 0
"SMPL", 1001
"SMPLINTVL",0.02
"HIGH 1"                                        Measurement condition parameters
"SENS LEVEL",-80                                (fixed to 40 lines)
"MEAS"
"LSUNT",0
"NMSKV","OFF"
"RESCOR",0
"SMOOTH",0
"MEASWL",1
"MODELNAME",AQ6375E
"NEBWCAL0",10020
"NEBWCAL1",10020
"NEBWCALWL",  0
"RESCAL0_0",  9076
"RESCAL0_1",   -1
"RESCAL0_2",  691
"RESCAL1_0", 10000
"RESCAL1_1",    0
"RESCAL1_2",    0

 [TRACE DATA]                                   Measurement data block start header
1543.2000, -66.267
1543.2200, -66.295                              Measurement data block
       ⋮                                        Sample points of waveform data

1563.2000, -65.371
```

**Header block**

| 75ECSV | File header |
|---|---|
| // AQ6375E OPTICAL SPECTRUM ANALYZER // | Label (56 characters) |
| 40 | Number of lines containing measurement condition parameters |

**Measurement condition parameters**

| | |
|---|---|
| "CTRWL",1553.200000 | Center wavelength |
| "SPAN", 20.000000 | Sweep span |
| "START WL",1543.200000 | Measurement start wavelength |
| "STOP WL",1563.200000 | Measurement stop wavelength |
| "WLFREQ", 0 | Horizontal scale mode |
| | (0: wavelength mode, 1: frequency mode, 2: wavenumber mode) |
| "REFL",-10.0 | Reference level |
| "LSCL",10.0 | Main level scale |
| "RESLN",0.200 | Measurement resolution |
| "CUSTOM RES", 0 | User-specified resolution value |
| "AVG", 1 | Average times |
| "SMPLAUTO", 0 | Sample points setting mode |
| | (0: MANUAL, 1: AUTO, 2: SMPL INTVL) |
| "SMPL", 1001 | Number of measured sampling points |
| "SMPLINTVL",0.02 | Measurement sampling interval |
| "HI1_CHOP" | Measurement sensitivity |
| ("GATE LOGIC") | Gate signal logic |
| | Saved only when gate mode is enabled |
| | POSI or NEGA (POSI: 0, NEGA: 1) |
| "SENS LEVEL",-70 | Sensitivity level |
| "MEAS" | Measurement type |
| "LSUNT",0 | Vertical scale mode (0: dBm, 1: dBm/nm) |
| "NMSKV","OFF" | Noise mask setting |
| | (NMSKV: VERTICAL, NMSKH: HOLIZONTAL) |
| "RESCOR",0 | Software resolution correction (0: OFF, 1: ON) |
| "SMOOTH",0 | Smoothing (0: OFF, 1: ON) |
| "MEASWL",1 | Wavelength in air or vacuum (0: AIR, 1: VACUUM) |
| "MODELNAME",AQ6375E | Model name |
| "NEBWCAL0",10020 | Resolution correction coefficient |
| "NEBWCAL1",1002 | Resolution correction coefficient |
| "NEBWCALWL",  0 | Resolution correction wavelength |
| "RESCAL0_0",  9076 | RMS resolution correction coefficient |
| "RESCAL0_1",  -1 | RMS resolution correction coefficient |
| "RESCAL0_2",  691 | RMS resolution correction coefficient |
| "RESCAL1_0", 10000 | RMS resolution correction coefficient |
| "RESCAL1_1",  0 | RMS resolution correction coefficient |
| "RESCAL1_2",  0 | RMS resolution correction coefficient |

The reference level and main level scale are saved to one of the following depending on the vertical scale.

Main level scale

| Vertical scale | Save format | Description |
|---|---|---|
| LOG | "REFL",***.* | Reference level |
| | "LSCL",**.* | Level scale |
| Linear | "REFL",***.* | Reference level |
| | "LSCL",-**.* | Level scale |
| | "BASEL",*.*********** | Base level |

Sub level scale

| Vertical scale | Save format | Description |
|---|---|---|
| LOG | "REFL",***.* | Reference level |
| | "SSCLG",***.* | Level scale |
| | "LOFST",***.* | Level offset |
| Linear | "REFL",***.* | Reference level |
| | "SSCLN",-*.*** | Level scale |
| | "SMIN",**.** | Base level |
| % | "REFL",***.* | Reference level |
| | "SSPS",***.* | Level scale |
| | "SMINP",***.* | Base level |

Measurement sensitivity

The data below is saved as measurement sensitivity depending on the measurement sensitivity type.

| Measurement sensitivity | Format | | | |
|---|---|---|---|---|
| | Normal measurement | PEAK HOLD Peak hold measurement | EXT TRIGGER External trigger measurement | GATE MODE Gate mode measurement |
| N/HOLD(x2) | "NORM_HLD(x2)" | — | — | — |
| N/HOLD(x1) | "NORM_HLD(x1)" | "P-NORM_HLD(x1)" | "E-NORM_HLD(x1)" | "G-NORM_HLD(x1)" |
| N/AUTO(x2) | "NORM_AUT(x2)" | — | — | — |
| N/AUTO(x1) | "NORM_AUT(x1)" | "P-NORM_AUT(x1)" | "E-NORM_AUT(x1)" | "G-NORM_AUT(x1)" |
| NORMAL(x2) | "NORMAL(x2)" | — | — | — |
| NORMAL(x1) | "NORMAL(x1)" | "P-NORMAL(x1)" | "E-NORMAL(x1)" | "G-NORMAL(x1)" |
| MID(x2) | "MID(x2)" | — | — | — |
| MID(x1) | "MID(x1)" | "P-MID(x1)" | "E-MID(x1)" | "G-MID(x1)" |
| HIGH1(x2)_CHOP | "HI1(x2)_CHOP" | — | — | — |
| HIGH1(x1)_CHOP | "HI1_CHOP" | "P-HI1_CHOP" | "E-HI1_CHOP" | — |
| HIGH2(x2)_CHOP | "HI2(x2)_CHOP" | — | — | — |
| HIGH2(x1)_CHOP | "HI2_CHOP" | "P-HI2_CHOP" | "E-HI2_CHOP" | — |
| HIGH3(x2)_CHOP* | "HI3(x2)_CHOP" | — | — | — |
| HIGH3(x1)_CHOP* | "HI3_CHOP" | "P-HI3_CHOP" | "E-HI3_CHOP" | — |

▒  The measurement sensitivity is fixed to CHOP mode for HIGH1 to HIGH3.
*   Setting not available on the limited model (AQ6375E-01)

**Measurement type**

The data below is saved as a waveform identifier depending on the waveform type.

| Format | Waveform type | Format | Waveform type | Format | Waveform type |
|---|---|---|---|---|---|
| "MEAS" | WRITE | "D+E" | D+E(LOG) | "E-FL" | E-F(LIN) |
| "MAXH" | MAX HOLD | "C+DL" | C+D(LIN) | "F-EL" | F-E(LIN) |
| "MINH" | MIN HOLD | "C-DL" | C-D(LIN) | "NORM A" | NORM A |
| "RAVG", *** | ROLL AVG | "D-CL" | D-C(LIN) | "NORM B" | NORM B |
| "A-B" | A-B(LOG) | "D+EL" | D+E(LIN) | "NORM C" | NORM C |
| "B-A" | B-A(LOG) | "D-EL" | D-E(LIN) | "CVFT A",** | CRV FIT A |
| "A+B" | A+B(LOG) | "E-DL" | E-D(LIN) | "CVFT B",** | CRV FIT B |
| "A-BL" | A-B(LIN) | "C-F" | C-F(LOG) | "CVFT C",** | CRV FIT C |
| "B-AL" | B-A(LIN) | "F-C" | F-C(LOG) | "CVFTPK A",** | PKCVFIT A |
| "A+BL" | A+B(LIN) | "E-F" | E-F(LOG) | "CVFTPK B",** | PKCVFIT B |
| "1-K(A/B)",*****.**** | 1-K(A/B) | "F-E" | F-E(LOG) | "CVFTPK C",** | PKCVFIT C |
| "1-K(B/A)",*****.**** | 1-K(B/A) | "C+F" | C+F(LOG) | "MKRFT",** | MKR FIT |
| "C-D" | C-D(LOG) | "E+F" | E+F(LOG) | "PWRNBW A",** | Power NBW A |
| "D-C" | D-C(LOG) | "C+FL" | C+F(LIN) | "PWRNBW B",** | Power NBW B |
| "D-E" | D-E(LOG) | "C-FL" | C-F(LIN) | "PWRNBW C",** | Power NBW C |
| "E-D" | E-D(LOG) | "F-CL" | F-C(LIN) | "PWRNBW D",** | Power NBW D |
| "C+D" | C+D(LOG) | "E+FL" | E+F(LIN) | "PWRNBW E",** | Power NBW E |

**Waveform data block**

The measured waveform data is stored as sets of wavelength (in nm) and level. The number of sets equals the number of measurement samples.

Waveforms measured in frequency mode are stored using their frequencies (THz).

Level values are stored as log values if the vertical scale is LOG, and as linear values if the vertical scale is linear.

Log scale

| | |
|---|---|
| [TRACE DATA] | Header indicating the start of the trace data |
| ****.****, ±***.***(CR)(LF) | Wavelength value, level value (LOG) of the first point |
| ****.****, ±***.***(CR)(LF) | Wavelength value, level value (LOG) of the second point |
| : | |
| ****.****, ±***.***(CR)(LF) | Wavelength value, level value (LOG) of the last point |

Linear scale

| | |
|---|---|
| [TRACE DATA] | Header indicating the start of the trace data |
| ****.****,*.***E±***(CR)(LF) | Wavelength value, level value (linear) of the first point |
| ****.****,*.***E±***(CR)(LF) | Wavelength value, level value (linear) of the second point |
| : | |
| ****.****,*.***E±***(CR)(LF) | Wavelength value, level value (linear) of the last point |

**7**

Saving and Loading Data

# 7.3 Saving and Loading Waveform Data (All Trace)

## Procedure

You can save waveform data (all measured trace data) displayed on the instrument to a USB storage device and load data from a USB storage device.

---

### ⚠️ CAUTION

Do not remove the USB storage device or turn off the power when the USB storage device access indicator is blinking. Doing so may damage the USB storage device or corrupt its data.

Before you remove a USB storage device, be sure to follow the procedure in section 7.1 to make the USB storage device ready to be removed.

---

## Saving all trace data

**Selecting the format of files saved automatically with file names**

*1.* Press **FILE**. The FILE menu appears.

*2.* Tap **Auto File Name**. Select Num (serial number) or Date (date).



### *Note*
You can also set this on the Save window, described later.

**Setting the type of file to save to All Trace**

*3.* Tap **Item Select**. A menu appears for selecting the file type.

*4.* Tap **All Trace**. All Trace is selected, and the menu returns to the previous level.
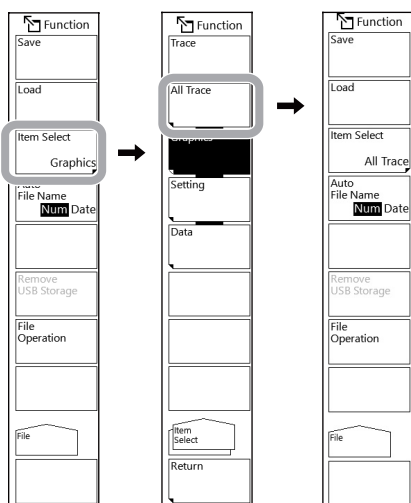


**Selecting the Save Destination and Data Format**

*5* Tap **Save**. A Save window appears.

*6.* In the file list, open the folder you want to save setting data in.

*7.* Tap Binary or CSV to select the data format.



Moves to the higher-level folder

Select the file list sort method.

Select the file list display mode (List, Thumbnail, Preview).

Select the storage area (INT, EXT).

Select what to save (select All Trace).

Add a folder.

Rename a folder or file.

Delete folders and files.

Save destination folder

Select the format when assigning file names automatically (Num, Date).

Select the data format.

Closes the window

Starts saving

**File name**
**Serial number (Num): Axxxx (xxxx: serial number)**
**Date (Date): AyyyyMMdd_hhmmss**
**(yyyy: year, MM: month, dd: day, hh: hour, mm: minute, ss: second)**
**When assigning a specific file name, enter the file name.**

7

Saving and Loading Data

**Specifying a file name**

You can save all trace waveform data by specifying a file name.

If you do not specify a file name, the file will automatically be assigned a name using a serial number or date.

*8.* In the Save window, tap the file name display area twice. A keyboard appears.

*9.* Enter a file name using the keyboard, and tap **Done**.

The file name will be entered.

**Saving the file**

*10.* On the Save window, tap **Save**. The file is saved.

If you tap **Close** before you tap Save, the window will close without saving the data.

*11.* When overwriting a file, a confirmation message appears. Tap **OK**.

To cancel overwriting, tap **Cancel**.

# Loading All Trace Data

**Setting the type of file to load to All Trace**

The instrument can load all trace waveform data saved in binary format (.WAC) or CSV format.

1. Press **FILE**. The FILE menu appears.

2. Tap **Item Select**. A menu appears for selecting the file type.

3. Tap **All Trace**. All Trace is selected, and the menu returns to the previous level.

4. Tap **Load**. A Load window appears.



Select what to load (select All Trace).
Select the file list sort method.
Moves to the higher-level folder
Select the file list display mode (List, Thumbnail, Preview).
Select the storage area (INT, EXT).
Current folder

Select the setting data to load.
Starts loading
Closes the window

**Loading the File**

5. On the Load window, tap **Load**. The file is loaded.

If you tap **Close** before you tap Load, the window will close without loading the setting data.

7

Saving and Loading Data
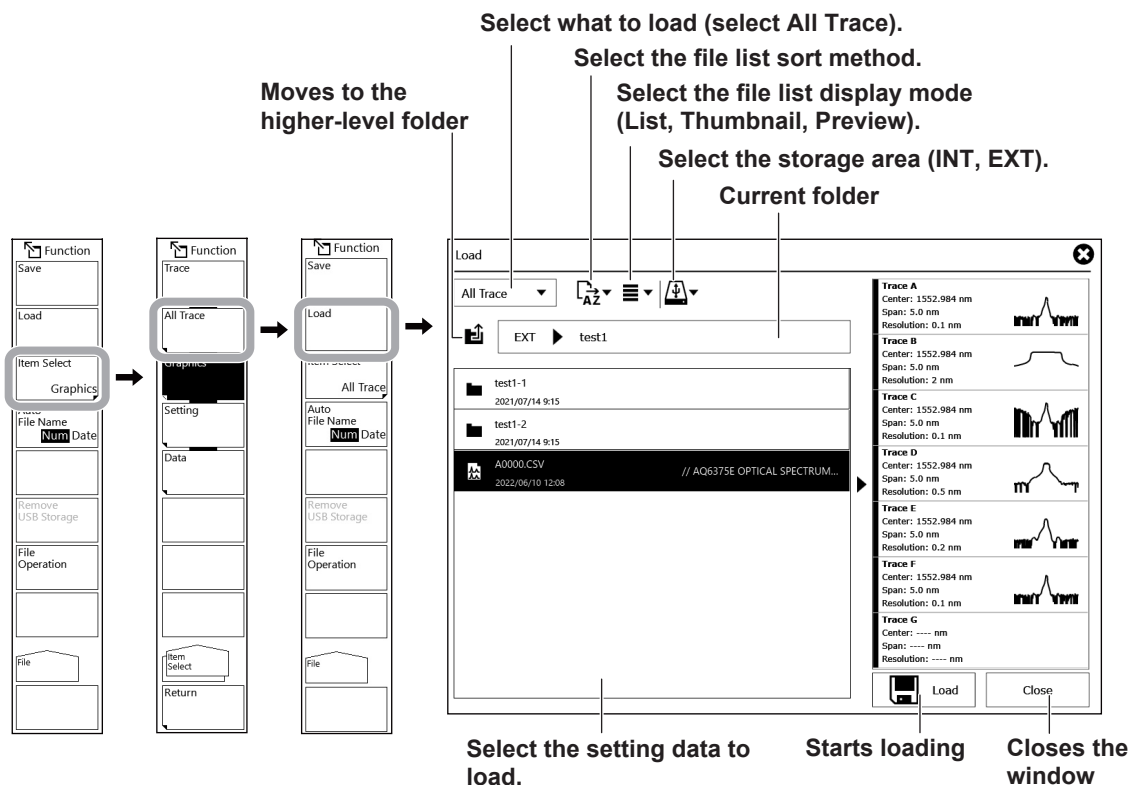
## Explanation

You can save measured waveform data in a single file in the internal memory or a USB storage device and load previously saved data into traces A and G and display it.

## Data format

You can save data in the following two data formats.

**BIN**

Data is saved in binary format. The data can be loaded into the instrument, and waveforms can be displayed.

The file size will be smaller than that of ASCII format.

The extension is .WAC.

**CSV**

Data is saved in comma-separated (CSV) ASCII format. The data can be loaded into the instrument, and waveforms can be displayed.

You can view the waveform data directly using an external application. The file size will be larger than that of binary format.

The extension is .CSV.

## File name

You can save files by assigning their names automatically or with specific names.

If you do not specify a file name, the following file name will be assigned automatically according to the Auto File Name setting.

When Auto File Name is set to Num

    File name:      AXXXX.CSV (or .WAC)

                    XXXX is a serial number from 0000 to 9999.

When Auto File Name is set to Date

    File name:      AyyyyMMdd_hhmmss.CSV (or .WAC)

                    yyyyMMdd:  Year (Gregorian) month day

                    hhmmss:     Hour (24 hours) minute second

                    (Date/time when the file list was updated)

### Note

- The date and time used to assign a name to a file created with a remote or program command are the date and time when the file was created.
- The maximum number of characters that you can use for a file name is 56 (including the extension). The characters that you can use are shown below.
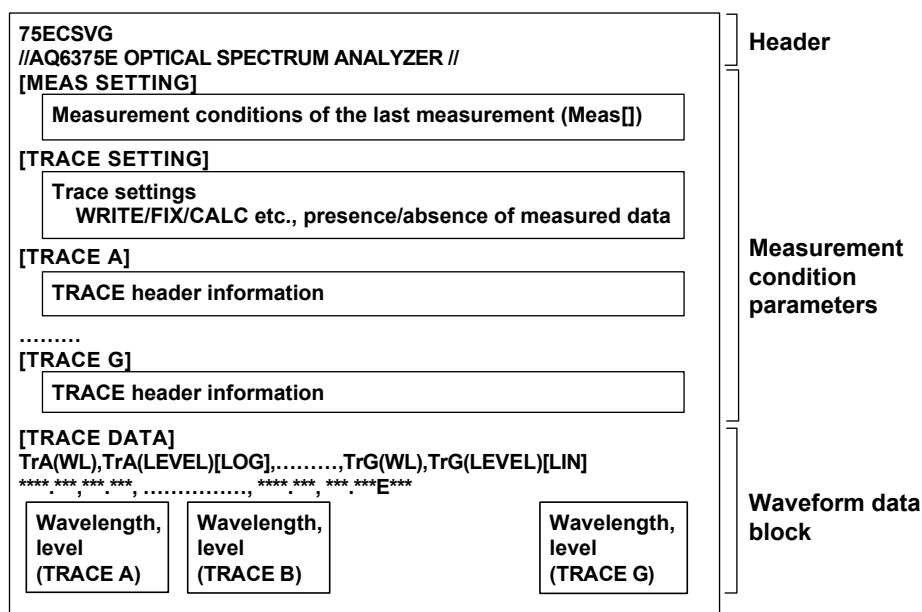  !#$%&'()-
  0123456789@
  ABCDEFGHIJKLMNOPQRSTUVWXYZ^
  abcdefghijklmnopqrstuvwxyz{}¯

## File size

The file size varies depending on the data that you are saving. Check that there is sufficient free space at the storage destination before saving the data.

# CSV data format

CSV data is saved in the following format.

```
75ECSVG                                                              ┐
//AQ6375E OPTICAL SPECTRUM ANALYZER //                               ┘ Header
[MEAS SETTING]
    ┌──────────────────────────────────────────────────────┐
    │ Measurement conditions of the last measurement (Meas[])│
    └──────────────────────────────────────────────────────┘
[TRACE SETTING]
    ┌──────────────────────────────────────────────────────┐
    │ Trace settings                                         │
    │    WRITE/FIX/CALC etc., presence/absence of measured data│
    └──────────────────────────────────────────────────────┘
[TRACE A]                                                              Measurement
    ┌──────────────────────────────────────────────────────┐         condition
    │ TRACE header information                                │         parameters
    └──────────────────────────────────────────────────────┘
.........
[TRACE G]
    ┌──────────────────────────────────────────────────────┐
    │ TRACE header information                                │
    └──────────────────────────────────────────────────────┘
[TRACE DATA]
TrA(WL),TrA(LEVEL)[LOG],………,TrG(WL),TrG(LEVEL)[LIN]
****.***,***.***,……………,****.***,***.***E***
┌──────────┐ ┌──────────┐              ┌──────────┐               Waveform data
│Wavelength,│ │Wavelength,│              │Wavelength,│               block
│level      │ │level      │              │level      │
│(TRACE A)  │ │(TRACE B)  │              │(TRACE G)  │
└──────────┘ └──────────┘              └──────────┘
```

## Header

75ECSVG          File header

// AQ6375E OPTICAL SPECTRUM ANALYZER //  Label (56 characters)

## Measurement condition parameters

Measurement conditions of each trace, measurement conditions when files were saved, and trace settings are saved.

    [MEAS SETTING] section:   Measurement settings when files were saved

    [TRACE SETTING] section:  Trace settings

                           (active trace information, each trace's settings, presence/absence of measured data)

    [TRACE A] to [TRACE G]:   Measurement conditions for each trace

The waveform condition format is the same as that of the waveform file.

See section 7.2, "Saving and Loading Waveform Data."

## Measured data

The measured waveform data of traces A through G are saved as wavelength and level vales of the measured number of samples.

Unmeasured trace data is not saved.

Waveforms measured in Frequency mode are also saved as wavelength values.

**7**

Saving and Loading Data

## 7.4 Saving Analysis Data

### Procedure

You can save analysis results, the time when the data was saved, and waveform data in ASCII format.

⚠️ **CAUTION**

Do not remove the USB storage device or turn off the power when the USB storage device access indicator is blinking. Doing so may damage the USB storage device or corrupt its data.

Before you remove a USB storage device, be sure to follow the procedure in section 7.1 to make the USB storage device ready to be removed.

### Saving Analysis Data

**Selecting the format of files saved automatically with file names**

Select the method of automatically setting the file name by referring to page 7-2.

**Setting the type of file to save to Data**

1. Press **FILE**. The FILE menu appears.

2. Tap **Item Select**. A menu appears for selecting the file type.

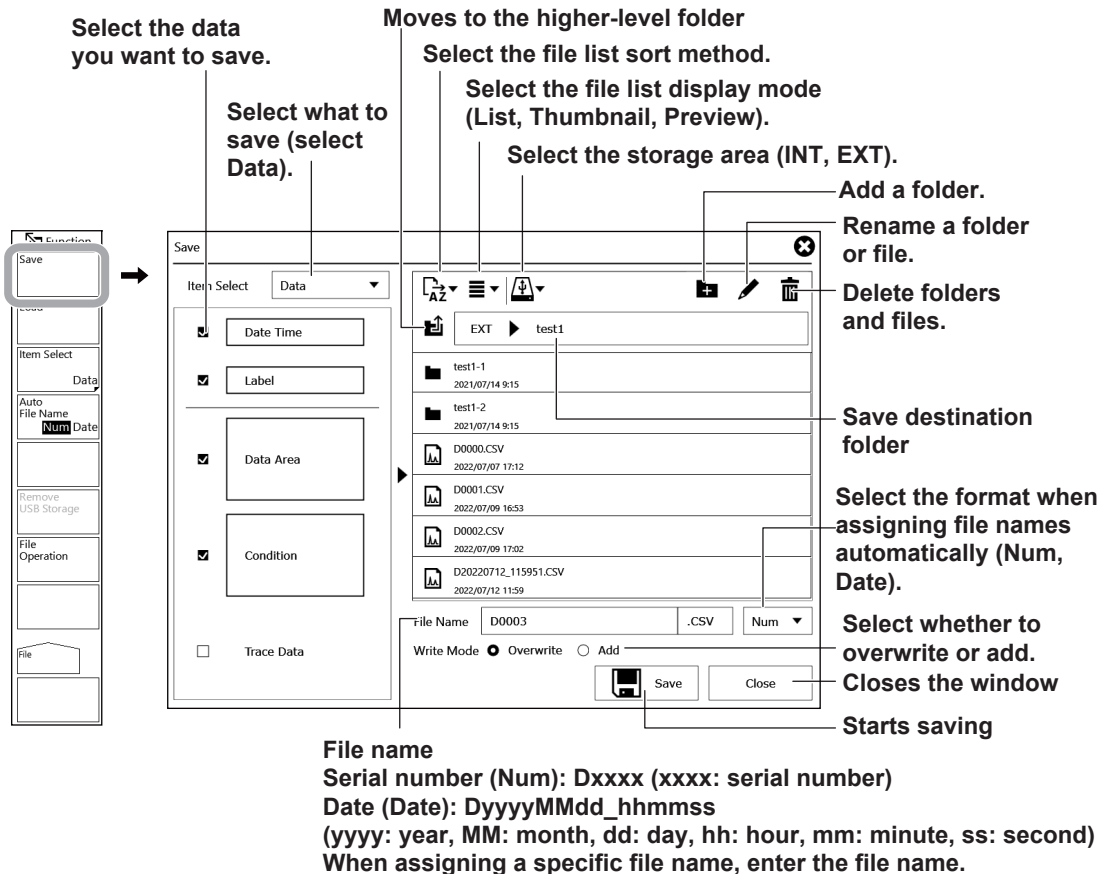3. Tap **Data**. Data is selected, and the menu returns to the previous level.
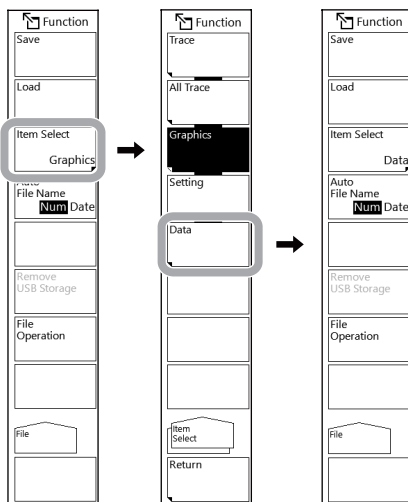


*Note*

You can also set this on the Save window, described later.

**Selecting the data items to save and save destination**

**5** Tap **Save**. A Save window appears.

**6.** Select the check boxes of the data items you want to save.

**7.** In the file list, open the folder you want to save analysis data in.



**File name**
**Serial number (Num): Dxxxx (xxxx: serial number)**
**Date (Date): DyyyyMMdd_hhmmss**
**(yyyy: year, MM: month, dd: day, hh: hour, mm: minute, ss: second)**
**When assigning a specific file name, enter the file name.**

**Specifying a file name**

You can save analysis data by specifying a file name.

If you do not specify a file name, the file will automatically be assigned a name using a serial number or date.

**8.** In the Save window, tap the file name display area twice. A keyboard appears.

**9.** Enter a file name using the keyboard, and tap **Done**.

The file name will be entered.

**Saving the file**

**10.** On the Save window, tap **Save**. The file is saved.

If you tap **Close** before you tap Save, the window will close without saving the data.

**11.** When overwriting a file, a confirmation message appears. Tap **OK**.

To cancel overwriting, tap **Cancel**.

**7**

**Saving and Loading Data**

## Explanation

### Data format

Analysis results saved in comma-separated (CSV) ASCII format.

You can set the file list display mode to preview to preview the analysis results.

The extension assigned to files when analysis results are saved is as follows:

    CSV (ASCII format):   .CSV

### File name

You can save files by assigning their names automatically or with specific names.

If you do not specify a file name, the following file name will be assigned automatically according to the Auto File Name setting.

When Auto File Name is set to NUM

    File name:        DXXXX.CSV

                        XXXX is a serial number from 0000 to 9999.

When Auto File Name is set to Date

    File name:        DyyyyMMdd_hhmmss.CSV

                        yyyyMMdd:  Year (Gregorian) month day

                        hhmmss:    Hour (24 hours) minute second

                        (Date/time when the file list was updated)

### Note

- The date and time used to assign a name to a file created with a remote or program command are the date and time when the file was created.
- The maximum number of characters that you can use for a file name is 56 (including the extension). The characters that you can use are shown below.
  !#$%&'()-
  0123456789@
  ABCDEFGHIJKLMNOPQRSTUVWXYZ^
  abcdefghijklmnopqrstuvwxyz{}¯

## Data to save

The following data can be saved.

| Saved item | Default value | Description |
|---|---|---|
| Date Time | ON | Date and time |
| Label | ON | Label |
| Data Area | ON | Data area value |
| Condition | ON | Measurement conditions |
| Trace Data | OFF | Trace data |

## File size

The file size varies depending on the data that you are saving. Check that there is sufficient free space at the storage destination before saving the data.

## Overwriting

If a file with the same name exists at the save destination, you can select whether to overwrite the file or add data to the file.

Overwrite:   The file is overwritten.

Add:   Data is added to the existing data in the file.

**7**

Saving and Loading Data

## Data format

The analysis data format is shown below.

```
75EDAT2
TEST
2022 Oct 07 16:42
<NF ANALYSIS>
TH[dB],20.00
MODE DIFF[dB],3.00
OFST(IN)[dB],0.00
OFST(OUT)[dB],0.00
A_ALGO,AUTO-FIX
F_AREA,AUTO
M_AREA,---
F_ALGO,LINEAR
INTEGRAL RANGE[GHz],50.0
NO.,WAVELENGTH[nm],INPUT LVL[dBm],OUTPUT LVL[dBm],ASE LVL[dBm],RESOLN[nm],GAIN[dB],NF[dB]
1,1544.4983,-29.320,-2.260,-22.281,0.102,27.017,8.533
2,1545.3041,-29.530,-2.420,-22.184,0.101,27.064,8.619
CTRWL,1551.670000
SPAN,20.000000
REFL[dBm],-10.0
LSCL,10.0
RESLN,0.100
AVG,1
SMPL,2001
HIGH 2
NMSK,OFF
1541.6700, -23.200
```

Label

Date/time saved

Header and data of analysis results

Measurement condition parameters

Sample points of waveform data (wavelength and level values)

## 7.5 Saving and Loading Setting Data

### Procedure

You can save the instrument's measurement conditions and settings to a file in binary format.

---

⚠️ **CAUTION**

Do not remove the USB storage device or turn off the power when the USB storage device access indicator is blinking. Doing so may damage the USB storage device or corrupt its data.

Before you remove a USB storage device, be sure to follow the procedure in section 7.1 to make the USB storage device ready to be removed.

---

### Saving setting data

**Selecting the format of files saved automatically with file names**

*1.* Press **FILE**. The FILE menu appears.

*2.* Tap **Auto File Name**. Select Num (serial number) or Date (date).

```
┌─────────────┐
│ ⭲ Function  │
│ Save        │
│             │
│ Load        │
│             │
│ Item Select │
│    Graphics │
│ Auto        │
│ File Name   │
│  Num  Date  │
│             │
│ Remove      │
│ USB Storage │
│ File        │
│ Operation   │
│             │
│             │
│ File        │
│             │
│             │
└─────────────┘
```

> *Note*
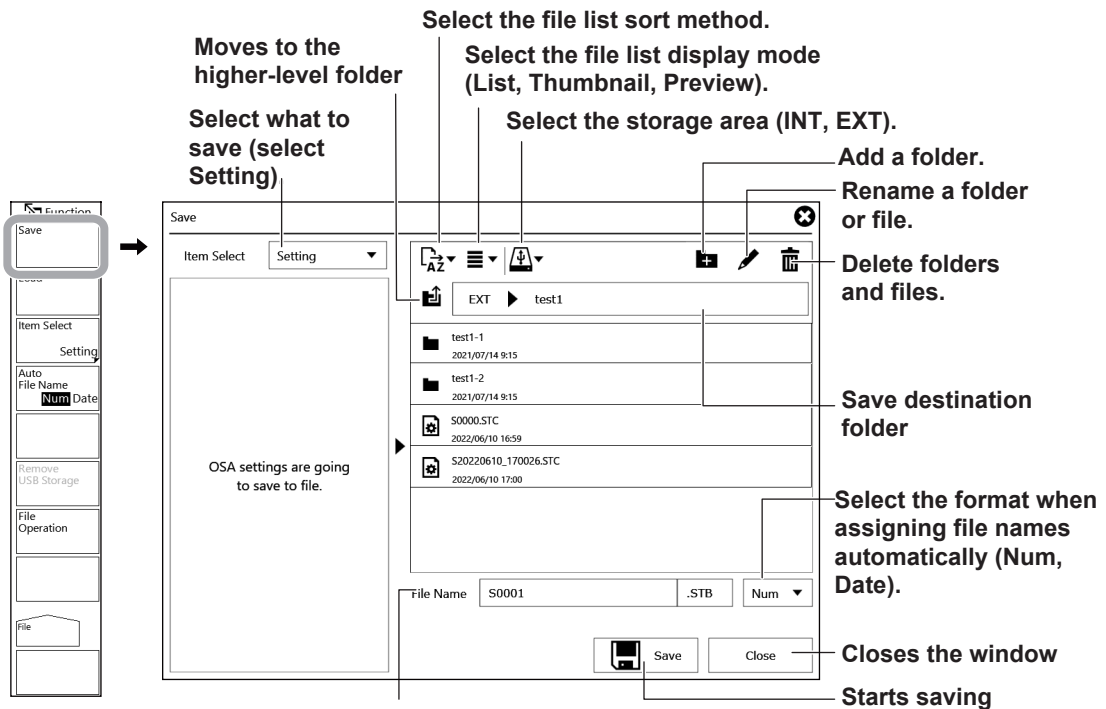> You can also set this on the Save window, described later.

**Setting the type of file to save to Setting**

*3.* Tap **Item Select**. A menu appears for selecting the file type.

*4.* Tap **Setting**. Setting is selected, and the menu returns to the previous level.
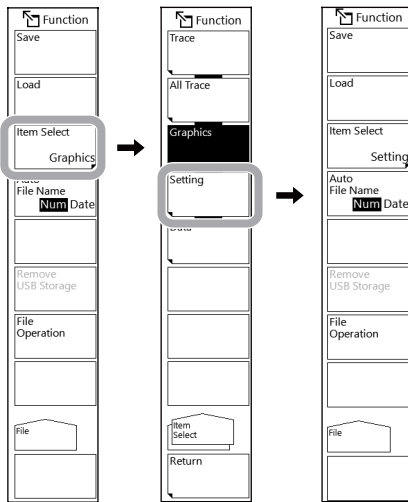


**Selecting the save destination**

*5* Tap **Save**. A Save window appears.

*6.* In the file list, open the folder you want to save setting data in.



**File name**
**Serial number (Num): Sxxxx (xxxx: serial number)**
**Date (Date): SyyyyMMdd_hhmmss**
**(yyyy: year, MM: month, dd: day, hh: hour, mm: minute, ss: second)**
**When assigning a specific file name, enter the file name.**

**Specifying a file name**

You can save setting data by specifying a file name.

If you do not specify a file name, the file will automatically be assigned a name using a serial number or date.

*7.* In the Save window, tap the file name display area twice. A keyboard appears.

*8.* Enter a file name using the keyboard, and tap Done.
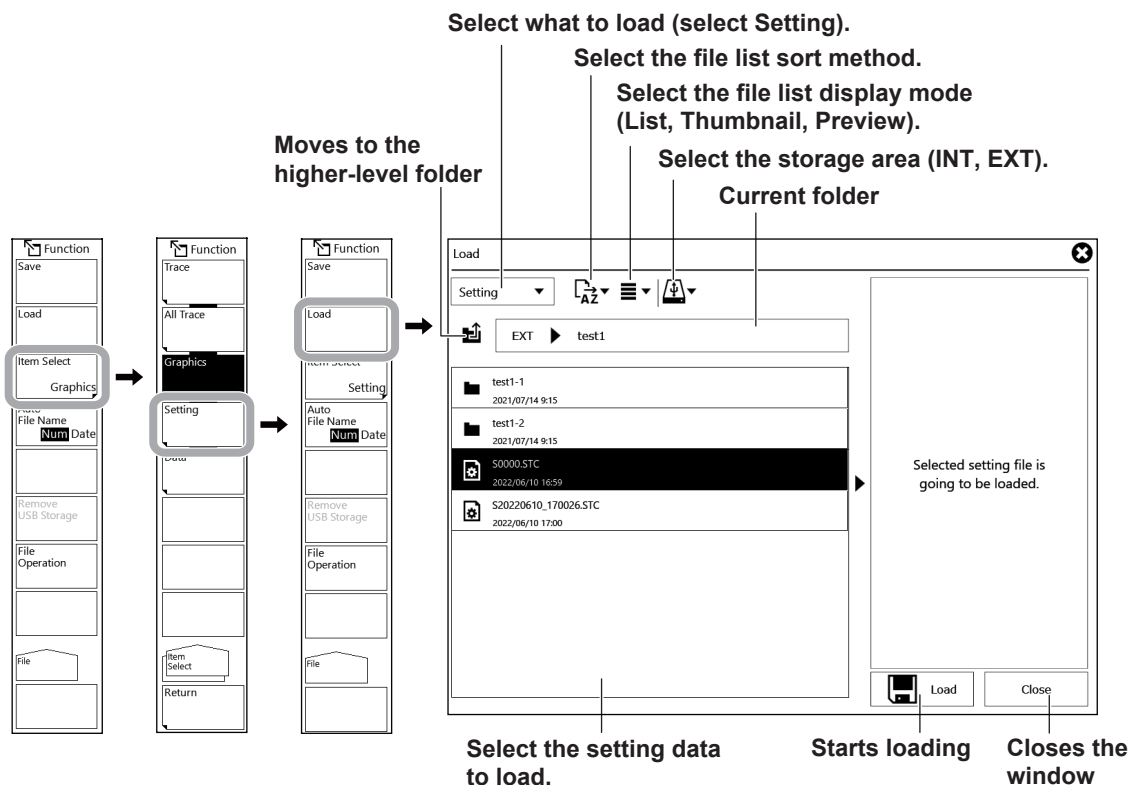
The file name will be entered.

**Saving the file**

*9.* On the Save window, tap **Save**. The file is saved.

If you tap **Close** before you tap Save, the window will close without saving the data.

*10.* When overwriting a file, a confirmation message appears. Tap **OK**.

To cancel overwriting, tap **Cancel**.

# Loading setting data

**Setting the type of file to load to Setting**

*1.* Press **FILE**. The FILE menu appears.

*2.* Tap **Item Select**. A menu appears for selecting the file type.

*3.* Tap **Setting**. Setting is selected, and the menu returns to the previous level.

*4.* Tap **Load**. A Load window appears.



Select what to load (select Setting).

Select the file list sort method.

Select the file list display mode (List, Thumbnail, Preview).

Select the storage area (INT, EXT).

Current folder

Moves to the higher-level folder

Select the setting data to load.

Starts loading

Closes the window

7

Saving and Loading Data

**Loading the File**

*5.* On the Load window, tap **Load**. The file is loaded.

If you tap **Close** before you tap Load, the window will close without loading the setting data.

## Explanation

You can save setting data to the internal memory or USB storage device and also load setting data saved previously and change the instrument settings.

## Data format

Setting data is saved in binary format.

Data is saved to a file with .STC extension.

## File name

You can save files by assigning their names automatically or with specific names.

If you do not specify a file name, the following file name will be assigned automatically according to the Auto File Name setting.

When Auto File Name is set to Num

File name:  SXXXX.STC

XXXX is a serial number from 0000 to 9999.

When Auto File Name is set to Date

File name:  SyyyyMMdd_hhmmss.STC

yyyyMMdd:  Year (Gregorian) month day

hhmmss:  Hour (24 hours) minute second

(Date/time when the file list was updated)

## *Note*

- The date and time used to assign a name to a file created with a remote or program command are the date and time when the file was created.
- The maximum number of characters that you can use for a file name is 56 (including the extension). The characters that you can use are shown below.
  !#$%&'()-
  0123456789@
  ABCDEFGHIJKLMNOPQRSTUVWXYZ^
  abcdefghijklmnopqrstuvwxyz{}̄

## File size

The file size is about 74 KB.

## 7.6 Saving Screen Capture Data

### Procedure

You can capture the screen and save it in a file.

---

⚠️ **CAUTION**

Do not remove the USB storage device or turn off the power when the USB storage device access indicator is blinking. Doing so may damage the USB storage device or corrupt its data.

Before you remove a USB storage device, be sure to follow the procedure in section 7.1 to make the USB storage device ready to be removed.

---

**Selecting the format of files saved automatically with file names**

*1.* Press **FILE**. The FILE menu appears.

*2.* Tap **Auto File Name**. Select Num (serial number) or Date (date).



*Note*
You can also set this on the Save window, described later.

**7**

**Saving and Loading Data**

**Setting the type of file to save to Graphic**

**3.** Tap **Item Select**. A menu appears for selecting the file type.

**4.** Tap **Graphics**. Graphics is selected, and the menu returns to the previous level.
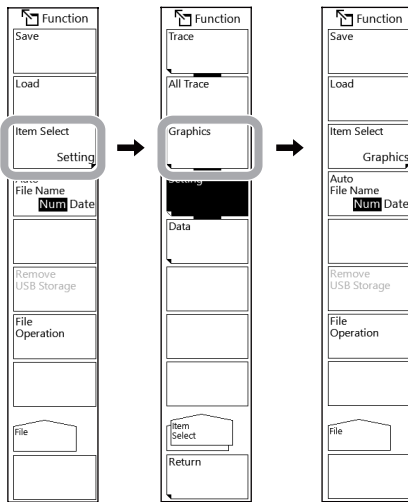


**Selecting the data format, color mode, and save destination**

**5** Tap **Save**. A Save window appears.

**6.** Tap BMP, JPG, or PNG to select the format to save the data in.

**7.** Tap Black & White, Color, or Preset Color to select the color mode.

A preview appears for the selected color mode.

**8.** In the file list, open the folder you want to save setting data in.



Select the file list sort method.

Moves to the higher-level folder

Select the file list display mode (List, Thumbnail, Preview).

Select what to save (select Graphics).

Select the storage area (INT, EXT).

Add a folder.

Rename a folder or file.

Delete folders and files.

Save destination folder

Select the format when assigning file names automatically (Num, Date).

Select the data format (BMP, JPG, PNG).

Closes the window

Starts saving

Sets the color mode

Screen capture preview

File name
Serial number (Num): Gxxxx (xxxx: serial number)
Date (Date): GyyyyMMdd_hhmmss
(yyyy: year, MM: month, dd: day, hh: hour, mm: minute, ss: second)
When assigning a specific file name, enter the file name.

### Specifying a file name

You can save screen capture data by specifying a file name.

If you do not specify a file name, the file will automatically be assigned a name using a serial number or date.

*7.* In the Save window, tap the file name display area twice. A keyboard appears.

*8.* Enter a file name using the keyboard, and tap Done.

The file name will be entered.

### Saving the file

*9.* On the Save window, tap **Save**. The file is saved.

If you tap **Close** before you tap Save, the window will close without saving the data.

*10.* When overwriting a file, a confirmation message appears. Tap **OK**.

To cancel overwriting, tap **Cancel**.

**7**

Saving and Loading Data

## Explanation

### Data format

You can save the data in bitmap format (BMP), JPEG format (JPG), or PNG format (PNG).

The extension assigned to files when analysis results are saved is as follows:

    BMP (bitmap format):  .bmp

    JPEG syntax:          .jpg

    PNG syntax:          .png

### File name

You can save files by assigning their names automatically or with specific names.

If you do not specify a file name, the following file name will be assigned automatically according to the Auto File Name setting.

When Auto File Name is set to Num

    File name:       GXXXX.BMP (or .JPG or .PNG)

                     XXXX is a serial number from 0000 to 9999.

When Auto File Name is set to Date

    File name:       GyyyyMMdd_hhmmss.BMP (or .JPG or .PNG)

                     yyyyMMdd:  Year (Gregorian) month day

                     hhmmss:    Hour (24 hours) minute second

                       (Date/time when the file list was updated)

#### Note

- The date and time used to assign a name to a file created with a remote or program command are the date and time when the file was created.
- The maximum number of characters that you can use for a file name is 56 (including the extension). The characters that you can use are shown below.
  !#$%&'()-
  0123456789@
  ABCDEFGHIJKLMNOPQRSTUVWXYZ^
  abcdefghijklmnopqrstuvwxyz{}¯

### Color

Black & White:    A black-and-white screen capture is produced.

Color:             A color screen capture is produced.

Preset Color:    Only the waveforms and markers are saved in color. All other items are saved in black and white.

### File size

The file size varies depending the data format and color setting.

|  | BMP | JPG | PNG |
|---|---|---|---|
| **Black & White** | Approx. 2.7 MB | Depends on the waveform and color mode | Depends on the waveform and color mode |
| **Color** | Approx. 2.7 MB | Depends on the waveform and color mode | Depends on the waveform and color mode |
| **Preset Color** | Approx. 2.7 MB | Depends on the waveform and color mode | Depends on the waveform and color mode |

## 7.7    File Operations

### Procedure

You can perform file operations such as renaming and copying files.

---

⚠️ **CAUTION**

Do not remove the USB storage device or turn off the power when the USB storage device access indicator is blinking. Doing so may damage the USB storage device or corrupt its data.

Before you remove a USB storage device, be sure to follow the procedure in section 7.1 to make the USB storage device ready to be removed.

---

### Opening the file operation window

*1.* Press **FILE**. The FILE menu appears.

*2.* Tap **File Operation**.

A file operation window appears.



Select the file list sort method.
Select the file list display mode.
Select the type of files to display in the list.
Select the storage area (INT, EXT).
Moves to the higher-level folder
Current folder

Number of items in the list
Number of selected items
Type of files shown in the list
Delete folders and files.
Rename a folder or file.
Move folders and files.
Copy folders and files.
Add a new folder.
Select multiple folders and files.

# Selecting a file or folder

**Selecting the current folder**

**3.** Tapping ⬆ on the file operation window changes the current folder to the higher-level folder. You can also tap a folder in the area showing the path to the current folder.

You can change the storage device by tapping ⬒▼ on the file operation window.

⬜ INT : Instrument internal storage

⬒ EXT : External storage (USB storage)

**Selecting a single file or folder**

**4.** Tap a file or folder in the list.

To open a folder, tap it twice.

**Selecting multiple files and folders (for copying, moving, or deleting)**

**5.** Tap **Multi Select**. An icon appears for selecting or unselecting all files and folders.

**Selects all files and folders**

**Unselects all files and folders**



**New Folder is unavailable.**

**Rename is unavailable.**
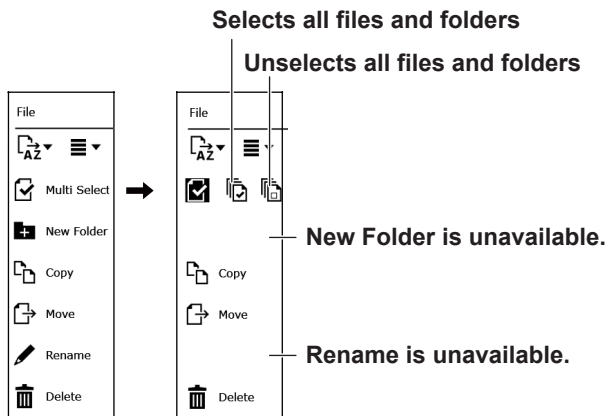
**6.** Tap the files or folders you want to select. All the files or folders you tap will be selected.

To select all the displayed files and folders collectively, tap 🗎.

To unselect all the displayed files and folders collectively, tap 🗎.

# Deleting files and folders

**7.** Select the files and folders that you want to delete according to steps 3 to 6.

**8.** Tap **Delete**. A menu appears for confirming the deletion.

**9.** Tap **OK**. The selected files or folders will be deleted. Tap **Cancel** if you do not want to delete them.
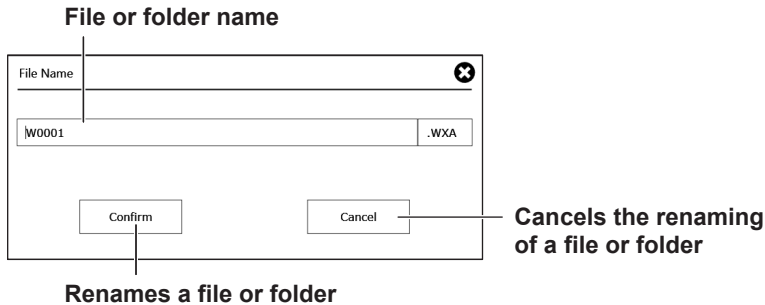
## Copying files and folders

7.   Select the files and folders that you want to copy according to steps 3 to 6.

8.   Tap **Copy**. A window appears for selecting the copy destination.

9.   Select the copy destination folder.

10.  Tap **Execute** on the copy destination window. A menu appears for confirming the copy.

11.  Tap **OK**. The selected files or folders will be copied. Tap **Cancel** if you do not want to copy them.

## Moving files and folders

7.   Select the files and folders that you want to move according to steps 3 to 6.

8.   Tap **Move**. A window appears for selecting the move destination.

9.   Select the move destination folder.

10.  Tap **Execute** on the move destination window. A menu appears for confirming the move.

11.  Tap **OK**. The selected files and folders will be moved. They will be deleted from their original folder. Tap **Cancel** if you do not want to move them.

**7**

Saving and Loading Data

# Renaming a file and folder

**5.**   Select the file or folder that you want to rename according to steps 3 and 4.

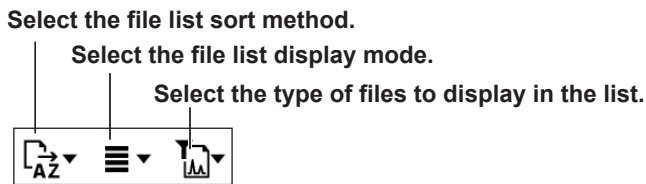**6.**   Tap **Rename**. A window appears for changing the file name or folder name.

**File or folder name**



File Name                                              ⊗

W0001                                          .WXA

Confirm              Cancel          ──── **Cancels the renaming of a file or folder**

**Renames a file or folder**

**7.**   Double-tap the area showing the file name or folder name. A keyboard appears.

**8.**   Enter the new file or folder name using the keyboard.

**9.**   Tap **Done** on the keyboard. The keyboard will close, and the new file or folder name appears in the window for changing the file or folder name.

**10.**   Tap **Confirm**. The file or folder name will be changed.

Tap **Cancel** if you do not want to change the file or folder name.
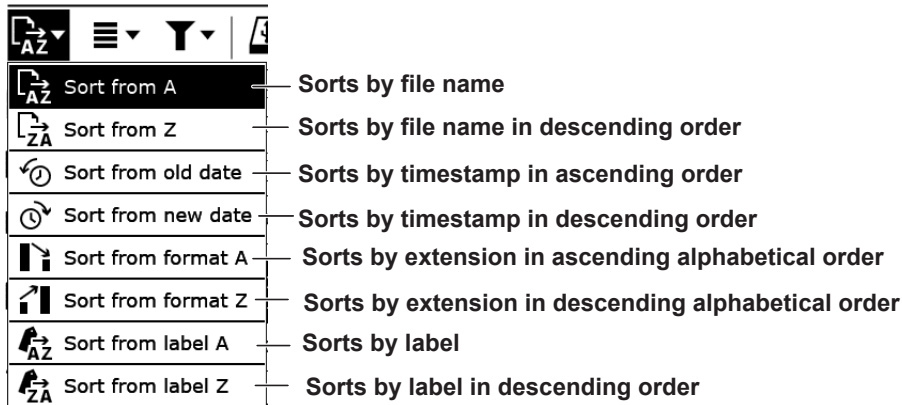
# Making a folder

**5.**   Select the folder that you want to make a folder in according to steps 3 and 4.

**6.**   Tap **New Folder**. A window appears for entering a folder name.

**7.**   Double-tap the folder name input area. A keyboard appears.

**8.**   Enter the name of the folder you want to make using the keyboard.

**9.**   Tap **Done** on the keyboard. The keyboard will close, and a window will appear for entering the folder name.

**10.**   Tap **Confirm**. The new folder will be created.

Tap **Cancel** if you do not want to make the folder.

# Changing the list display

**Select the file list sort method.**
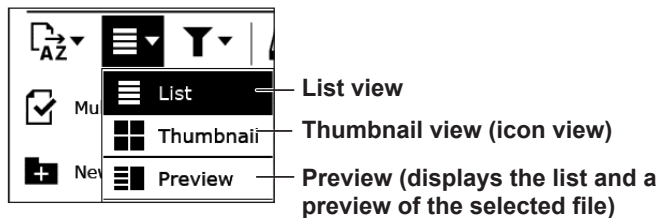**Select the file list display mode.**
**Select the type of files to display in the list.**

**Changing the sort order**

*3.* Tap the sort icon on the file operation window.

- Sort from A —— **Sorts by file name**
- Sort from Z —— **Sorts by file name in descending order**
- Sort from old date —— **Sorts by timestamp in ascending order**
- Sort from new date —— **Sorts by timestamp in descending order**
- Sort from format A —— **Sorts by extension in ascending alphabetical order**
- Sort from format Z —— **Sorts by extension in descending alphabetical order**
- Sort from label A —— **Sorts by label**
- Sort from label Z —— **Sorts by label in descending order**

*4.* Tap the sort method you want to apply. The list will be sorted.

**Changing the file list display mode**

*3.* On the file operation window, tap the icon for changing the list display mode.

- List —— **List view**
- Thumbnail —— **Thumbnail view (icon view)**
- Preview —— **Preview (displays the list and a preview of the selected file)**

*4.* Tap the display mode you want to apply. The display mode will change.

**Changing the type of files to list**

*3.* On the file operation window, tap the icon for changing the list display mode.

- Trace —— **Displays the folders and trace files in the current folder**
- All Trace —— **Displays the folders and all trace files in the current folder**
- Graphics —— **Displays the folders and screen capture files in the current folder**
- Setting —— **Displays the folders and setting files in the current folder**
- Data —— **Displays the folders and analysis files in the current folder**
- All File —— **Displays all folders and files**

Multi Select, New Folder, Copy, Move

*4.* Tap the type of file you want to list. The type of displayed files will change.

## Explanation

### File and folder names

The maximum number of characters that you can use for file or folder name is 56 (including the extension).
The characters that you can use are shown below.
!#$%&'()-
0123456789@
ABCDEFGHIJKLMNOPQRSTUVWXYZ^
abcdefghijklmnopqrstuvwxyz{}¯

### Sorting files

You can sort the file list in ascending or descending order by file name, file format (extension), date, and label.

# 8.1    Overview of the Application Feature

The application feature (APP feature) is an expansion feature that allows the installation, uninstallation, and use of various software applications designed exclusively for this instrument. Various applications are available to assist with the measurement condition setup, analysis, and data saving according to the measurement target, such as DFB-LD, LED, and other light signals and WDM signals.

Additional add-on applications can be downloaded from YOKOGAWA webpage and installed to expand the features of the instrument.

## Installed applications

The following six applications are preinstalled in the instrument.
- WDM Test
- FP-LD Test
- DFB-LD Test
- LED Test
- SCLaser Test
- FIP
- Support file builder

### *Note*
When you run an application, the following working folders may be created in the instrument's internal memory.
- OSAAnalysis
- Appli_Data

After you close the application, you can delete these folders using the file operation menu (see section 7.7). If the free space in the internal memory is low, it may affect the operation of the application, so delete them if necessary.

## Installing and uninstalling applications

You can install new applications or uninstall applications you no longer use. For the procedure, see section 8.2.

**8**

**Useful Applications**

# 8.2 Installing and Uninstalling Applications

## Procedure
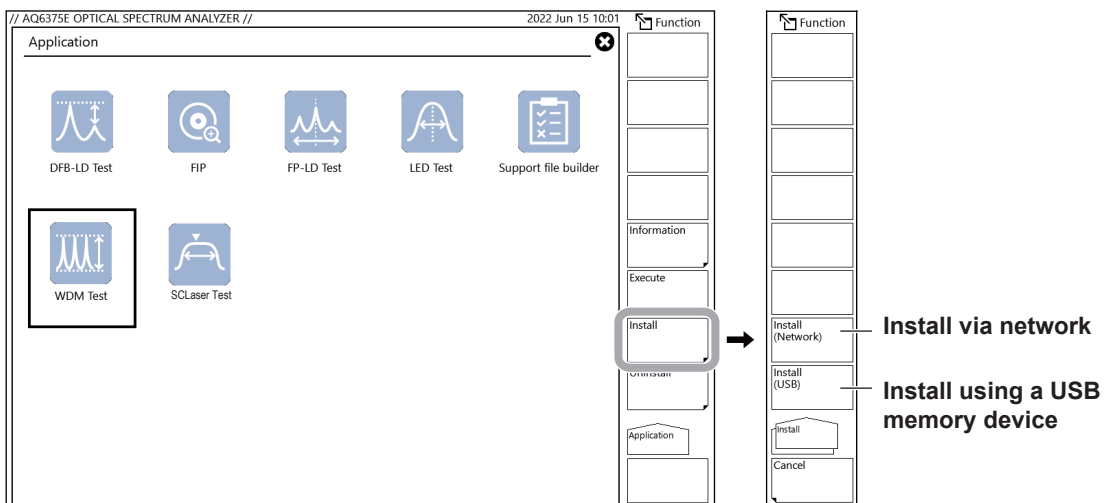
### Installing applications

You can install applications using a USB memory device or over the network (using a shared folder).

First, copy the application installation files (.apl) to a USB memory device, or connect to the network.

When installing from a USB device, make a folder with the name "INSTALL_APPS" in the root folder of the USB memory device, and store the installers in it.

**1.** Press **APP**. The APP menu appears.

**2.** Tap **Install**. The Install menu appears.

**3.** Tap **Install (USB)** or **Install (Network)**.

A confirmation message appears for you to continue or cancel the installation.



**4.** Tap **Continue**. To cancel, tap **No**.

A list will appear showing the applications to be installed.

**5.** Tap **Yes (Reboot)**. The instrument will restart, and the applications will be installed.

## Uninstalling an application

*1.* Press **APP**. The APP menu appears.

*2.* Tap the application you want to uninstall.

*3.* Tap **Uninstall**. The Uninstall menu appears.

*4.* Tap **Execute**.
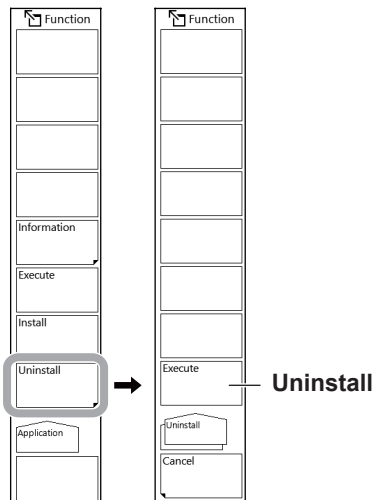


*5.* Tap **Yes (Reboot)**. The instrument will restart, and the application will be uninstalled.

## Explanation

### Installing applications

You can install applications stored in the shared folder or USB memory device.
For details on shared folders, see section 9.5 "Ethernet Communication."

**Installing from a USB memory device**
When installing from a USB device, make a folder with the name "INSTALL_APPS" in the root folder of the USB memory device, and store the installers in it.

**Installing from a shared folder**
To install an application using a shared folder, connect a PC containing the application installer to the instrument via a network. Tap Install (Network) on the instrument, and then, using a file management application on the PC, copy the application installer (.APL extension) to the UPDATE folder (shared folder) in the instrument's internal memory. You will be able to access the UPDATE folder from the PC after tapping Install (Network). You need to enter a user name and password to connect a PC to the instrument.
User name:    user
Password:    yokogawa
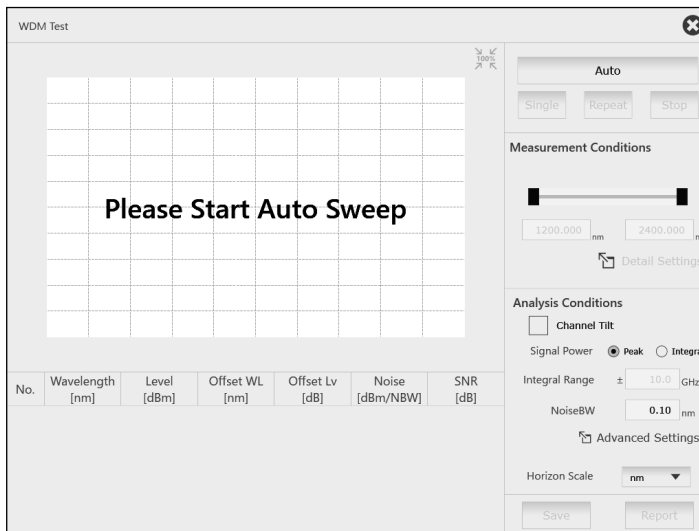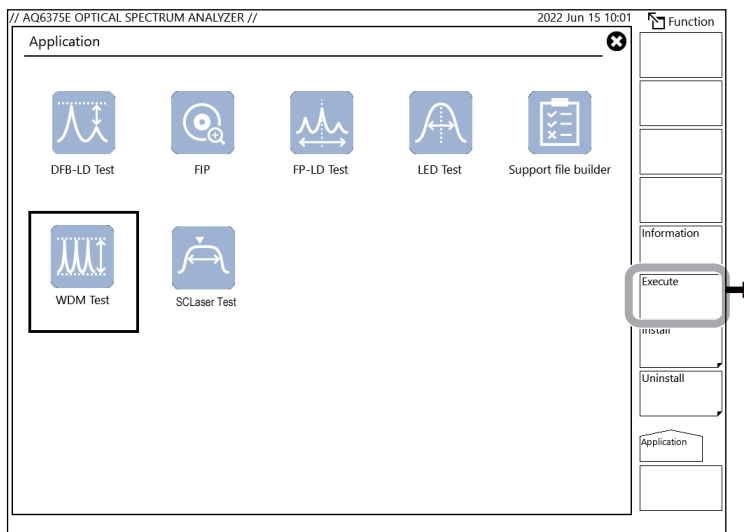
### Uninstalling an application

You can uninstall applications installed in the instrument.
You can also uninstall preinstalled applications.

8

**Useful Applications**

## 8.3 WDM Test

### Running a WDM test

1. Press **APP**. The APP menu appears.

2. Double-tap **WDM Test**, or tap the **WDM test** icon and then tap **Execute**. A WDM Test application window will appear.

**3.** Tap **AUTO**. Waveforms are displayed.



Closes the window

Executes a sweep

Measurement range (start wavelength, stop wavelength)

Set advanced measurement conditions.

Displays channel tilt

Optical signal power calculation method

Set the integral range.

Set the noise bandwidth.

Set advanced analysis conditions.

Horizontal scale unit

Runs the report feature

Analysis results

Saves waveform data

# Changing the measurement conditions

**4.** Continuing from step 3, tap **Detail Settings**. A window appears for setting measurement conditions.

**5.** Change the measurement conditions in the window.

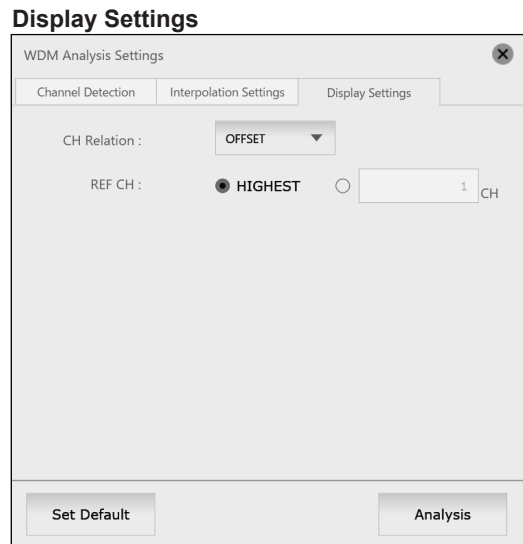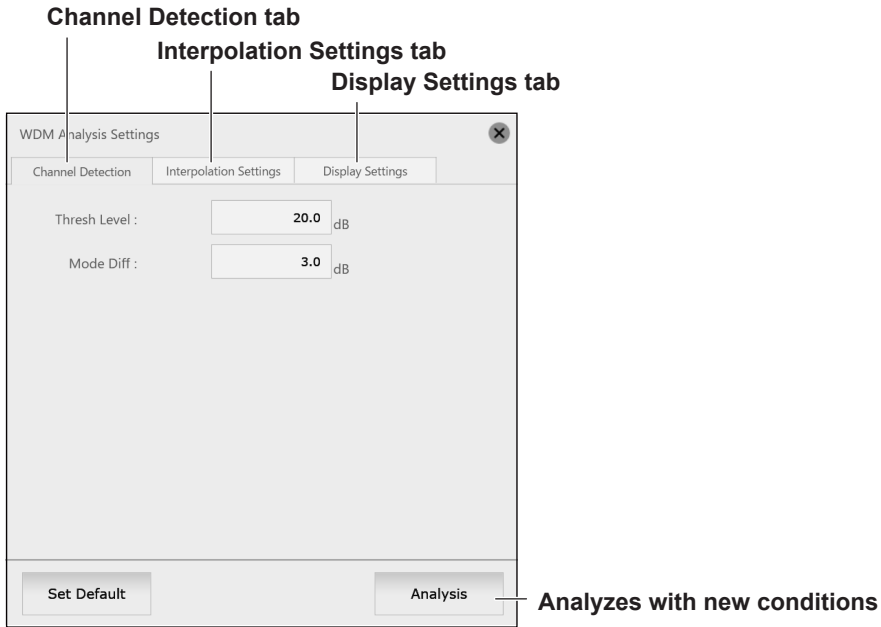**6.** Tap **Sweep**. The instrument makes a measurement using the new measurement conditions.



Sweeps with new conditions

**8**

Useful Applications

# Changing the analysis conditions

**4.**   Continuing from step 3, tap **Advanced Settings**. A window appears for setting analysis conditions.

**5.**   Change the analysis conditions in the window.

**6.**   Tap **Analysis**. The instrument performs an analysis using the new analysis conditions.

**Channel Detection tab**

**Interpolation Settings tab**

**Display Settings tab**

WDM Analysis Settings

| Channel Detection | Interpolation Settings | Display Settings |

Thresh Level :          20.0   dB

Mode Diff :          3.0   dB

Set Default          Analysis          — **Analyzes with new conditions**

**Interporation Settings**

WDM Analysis Settings

| Channel Detection | Interpolation Settings | Display Settings |

Noise Algo :          MANUAL-FIX  ▼

Noise Area :          0.40   nm

Fitting Algo :          LINEAR  ▼

Mask Area :          0.20   nm

Noise BW :          0.10   nm

Set Default          Analysis

**Display Settings**

WDM Analysis Settings

| Channel Detection | Interpolation Settings | Display Settings |

CH Relation :          OFFSET  ▼

REF CH :          ● HIGHEST    ○          1   CH

Set Default          Analysis

# Creating a report

**4.** After completing a measurement or analysis, tap **Report**.

A window appears for creating a report.

Pastes the measured data
Pastes the analysis results
Pastes the measurement conditions
Pastes the analysis conditions
Turns the paint feature on
Turns the erase feature on (active when the paint feature is on)



Deletes the selected waveforms and tables
Saves as image data
Returns to the previous screen

**Pasting an image**

**5.** Tap **Waveform**, **Analysis Result**, **Measure Conditions**, or **Analysis Conditions** to paste the respective image.

**Moving, enlarging, reducing an image**

**6.** Swipe the pasted image to move it.

Swipe any of the four corners of the image to enlarge or reduce the image.

**Deleting an image**

**7** Tap an image and then tap **Delete**. The image will be deleted.

8

**Useful Applications**

**Drawing or deleting a line with the paint feature**

*8.* Tap **Paint ON**. Paint ON changes to Paint OFF, and Erase ON becomes active.

Swipe where you want to draw a line. A line is drawn over the swiped path.

To erase a line, tap **Erase ON** when Erase ON is active. Erase ON changes to Erase OFF. Tap the line you want to erase.

When you tap Paint OFF, Paint OFF changes to Paint ON, and the paint feature is turned off.

# Closing an application

Tap the "X" in the upper right of the window. When a confirmation message appears, tap Yes. The application will close, and the APP menu will appear.

# 8.4 FP-LD Test

## Procedure

### Running an FP-LD test

*1.* Press **APP**. The APP menu appears.

*2.* Double-tap **FP-LD Test**, or tap the **FP-LD Test** icon and then tap **Execute**. An FP-LD test application window will appear.

8

Useful Applications

**3.** Tap **AUTO**. Waveforms are displayed.



Executes a sweep

Set the measurement conditions.
(Resolution, sensitivity, span)

Set the analysis conditions.
(Calculation algorithm)

Set advanced analysis conditions.

Horizontal scale unit

Saves waveform data

**Analysis results**

# Changing the analysis conditions

**4.** Continuing from step 3, tap **Advanced Settings**. A window appears for setting analysis conditions.

**5.** Change the analysis conditions in the window.

**6.** Tap **Analysis**. The instrument performs an analysis using the new analysis conditions.



Analyzes with new conditions
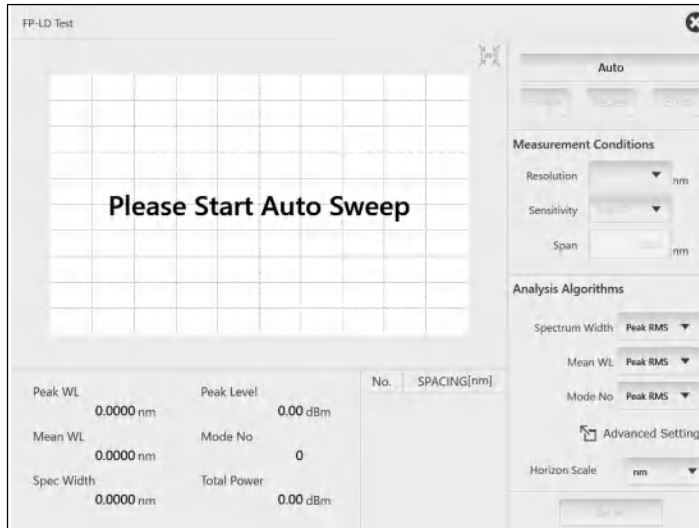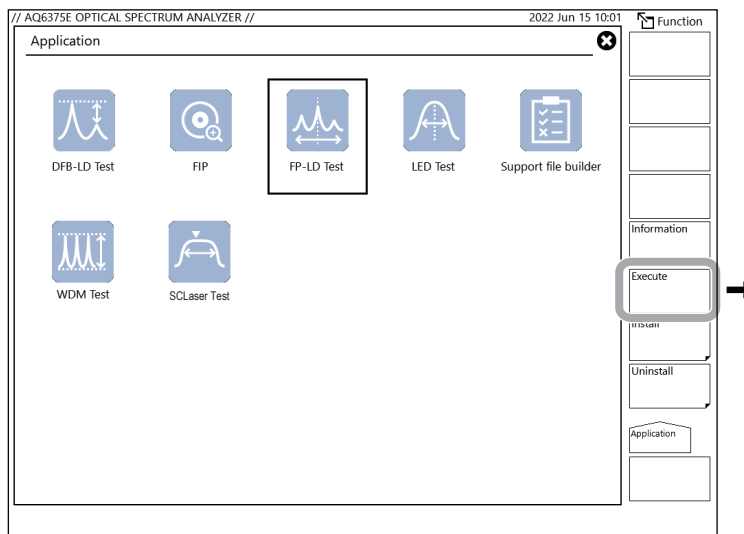
## Closing an application

Tap the "X" in the upper right of the window. When a confirmation message appears, tap Yes. The application will close, and the APP menu will appear.

## 8.5    DFB-LD Test

### Running an DFB-LD test

1.  Press **APP**. The APP menu appears.

2.  Double-tap **DFB-LD Test**, or tap the **DFB-LD Test** icon and then tap **Execute**. An DFB-LD test application window will appear.
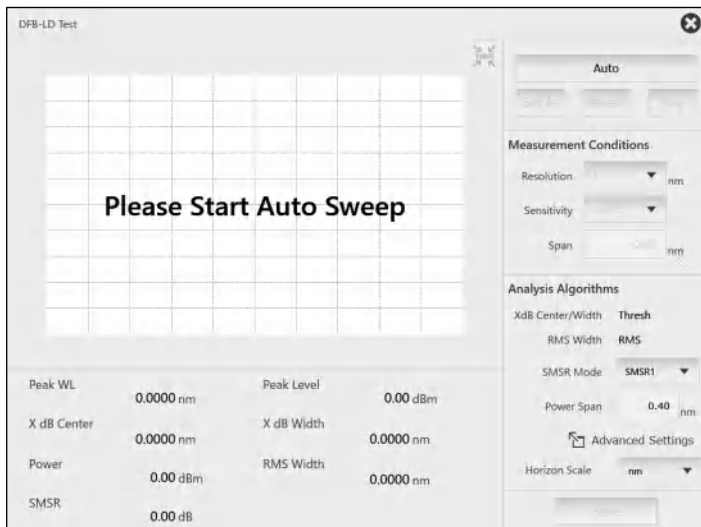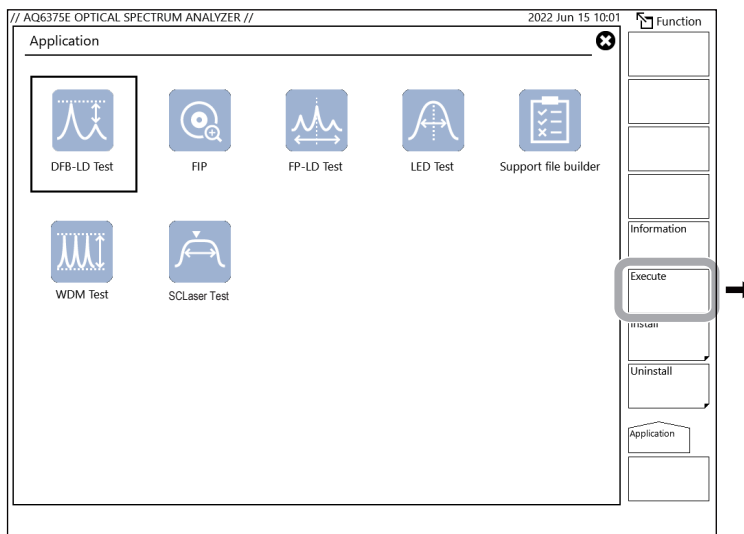
**3.** Tap **AUTO**. Waveforms are displayed.



Closes the window

Executes a sweep

Set the measurement conditions.
(Resolution, sensitivity, span)

Set the analysis conditions.
(calculation algorithm (fixed
to Thresh and RMS), SMSR
mode, level integral range)

Set advanced analysis conditions.

Horizontal scale unit

**Analysis results**          **Saves waveform data**

8

Useful Applications

# Changing the analysis conditions

**4.** Continuing from step 3, tap **Advanced Settings**. A window appears for setting analysis conditions.

**5.** Change the analysis conditions in the window.

**6.** Tap **Analysis**. The instrument performs an analysis using the new analysis conditions.



# Closing an application

Tap the "X" in the upper right of the window. When a confirmation message appears, tap Yes. The application will close, and the APP menu will appear.

# 8.6    LED Test

## Procedure

### Running an LED test

1. Press **APP**. The APP menu appears.

2. Double-tap **LED Test**, or tap the **LED Test** icon and then tap **Execute**. An LED Test application window will appear.
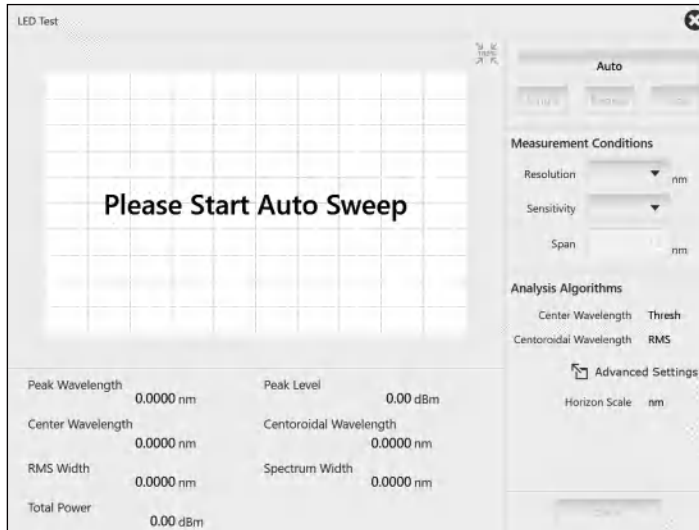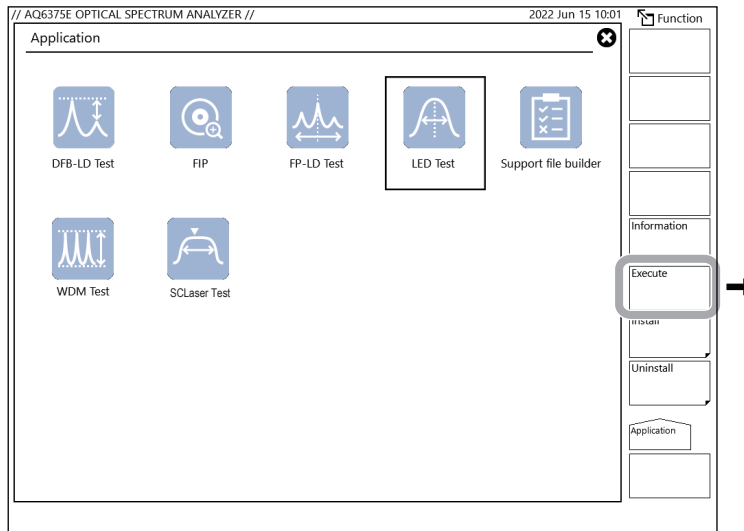
**3.** Tap **AUTO**. Waveforms are displayed.



Closes the window
Executes a sweep
Set the measurement conditions. (Resolution, sensitivity, span)
Set the analysis conditions. (calculation algorithm (fixed to Thresh, RMS)
Set advanced analysis conditions.
Horizontal scale unit (fixed to nm)

**Analysis results**    **Saves waveform data**

## Changing the analysis conditions

**4.** Continuing from step 3, tap **Advanced Settings**. A window appears for setting analysis conditions.

**5.** Change the analysis conditions in the window.

**6.** Tap **Analysis**. The instrument performs an analysis using the new analysis conditions.



Analyzes with new conditions

## Closing an application

Tap the "X" in the upper right of the window. When a confirmation message appears, tap Yes. The application will close, and the APP menu will appear.

## 8.7 SCLaser Test

### Procedure

### Running an SCLaser test

*1.* Press **APP**. The APP menu appears.

*2.* Double-tap **SCLaser Test**, or tap the **SCLaser Test** icon and then tap **Execute**. An SCLaser Test application window will appear.

**3.** Tap **AUTO**. Waveforms are displayed.

Closes the window

Executes a sweep

Measurement range (start wavelength, stop wavelength)

Set advanced measurement conditions.

Set the analysis conditions. (Thresh level)

Set advanced analysis conditions.

Horizontal scale unit

**Analysis results**

**Saves waveform data**

## Changing the measurement conditions

**4.** Continuing from step 3, tap **Detail Settings**. A window appears for setting measurement conditions.

**5.** Change the measurement conditions in the window.

**6.** Tap **Sweep**. The instrument makes a measurement using the new measurement conditions.

Sweeps with new conditions

## Changing the analysis conditions

**4.** Continuing from step 3, tap **Advanced Settings**. A window appears for setting analysis conditions.

**5.** Change the analysis conditions in the window.

**6.** Tap **Analysis**. The instrument performs an analysis using the new analysis conditions.

Advanced Settings

Spectrum Width Analysis

Analysis Algo — Thresh

Thresh — 20.00 dB

K — 1.00

Mode Fit — ● OFF

Mode Diff — 3.00 dB

Set Default

Analysis — Analyzes with new conditions

## Closing an application

Tap the "X" in the upper right of the window. When a confirmation message appears, tap Yes. The application will close, and the APP menu will appear.

**8**

**Useful Applications**

# 8.8 Optical Fiber End Face Check

By connecting an off-the-shelf fiber inspection probe (with a USB interface) to an instrument USB port, you can display the image of optical fiber end face on the instrument display. You can save the image to a file.

## Procedure

### Running FIP

1. Press **APP**. The APP menu appears.

2. Double-tap **FIP**, or tap the **FIP** icon and then tap **Execute**. An FIP application window will appear.





**Holds the image**   **Saves the image as image data**

**Updates the camera connection information**

**Select the camera connected to the USB port.**
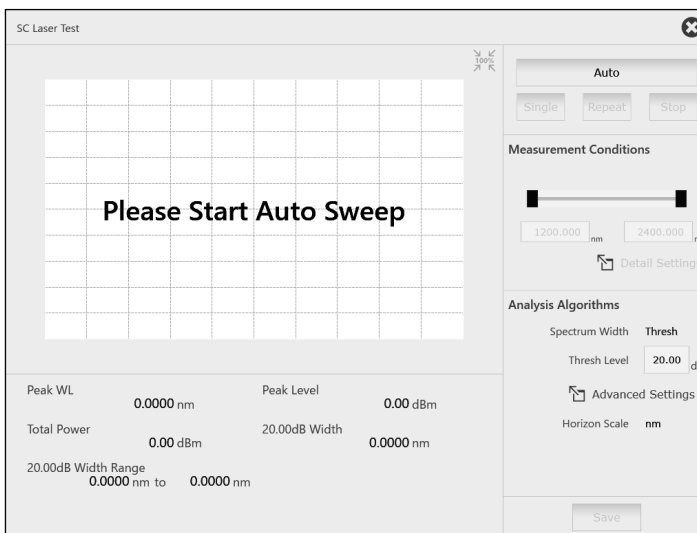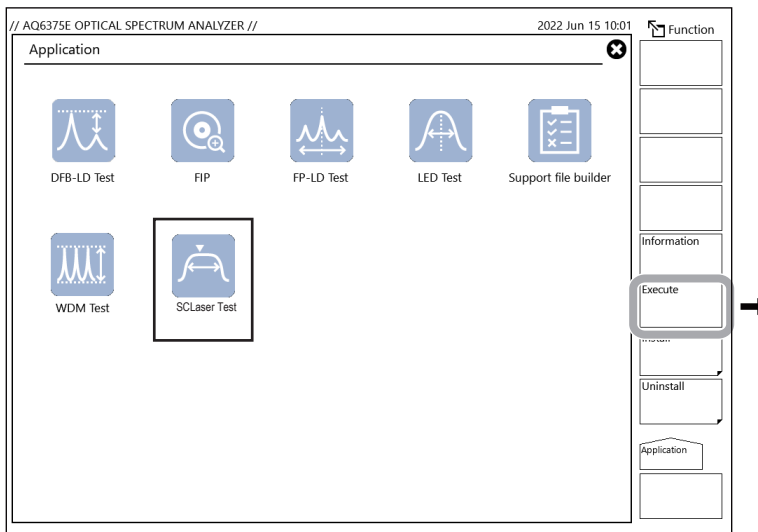
# Closing an application

Tap the "X" in the upper right of the window. When a confirmation message appears, tap Yes. The application will close, and the APP menu will appear.

**8**

**Useful Applications**
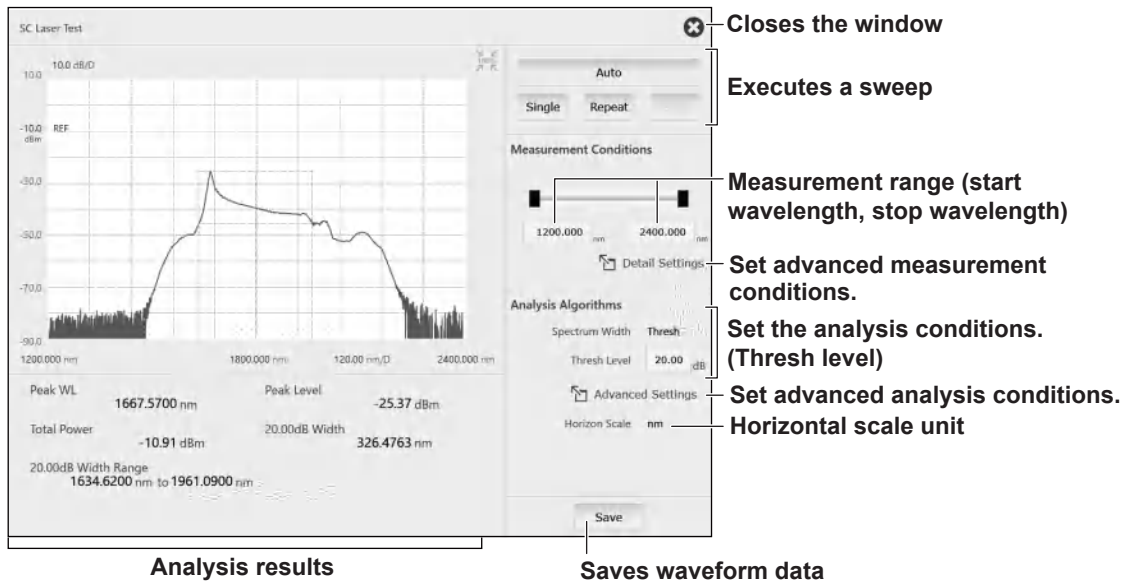
# 8.9 Exporting Maintenance Information

You can export the maintenance information of this instrument to a zip file. If necessary, provide it to your YOKOGAWA dealer when requesting a maintenance.

The following information will be exported. You can select which information to export.

• All trace data       • Setting data          • System log
• Application list      • Storage information    • Calibration log
• OS log

## Procedure

### Running the Support file builder

*1.* Press **APP**. The APP menu appears.

*2.* Double-tap **Support file builder**, or tap the **Support file builder** icon and then tap **Execute**. A Support file builder application window will appear.



Instrument information

Select the items you want to save.

Exports to a zip file
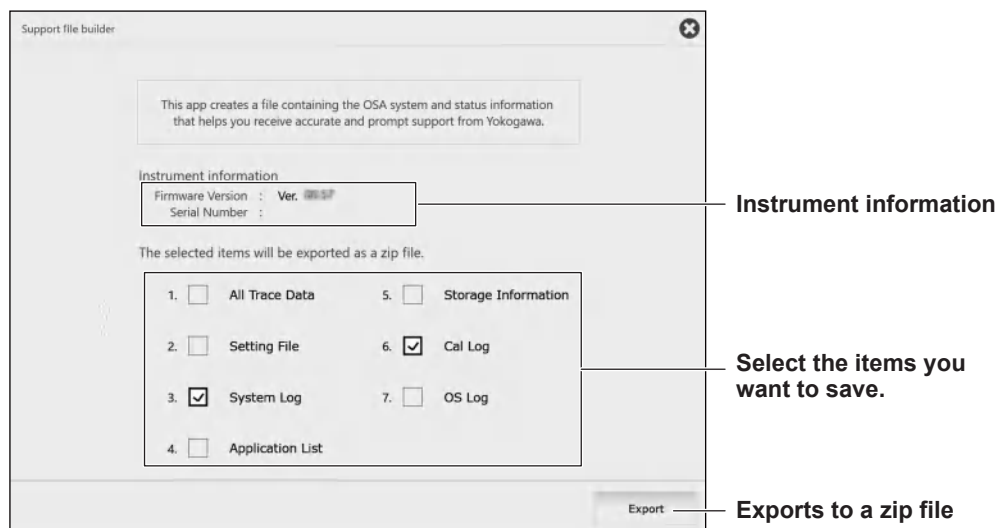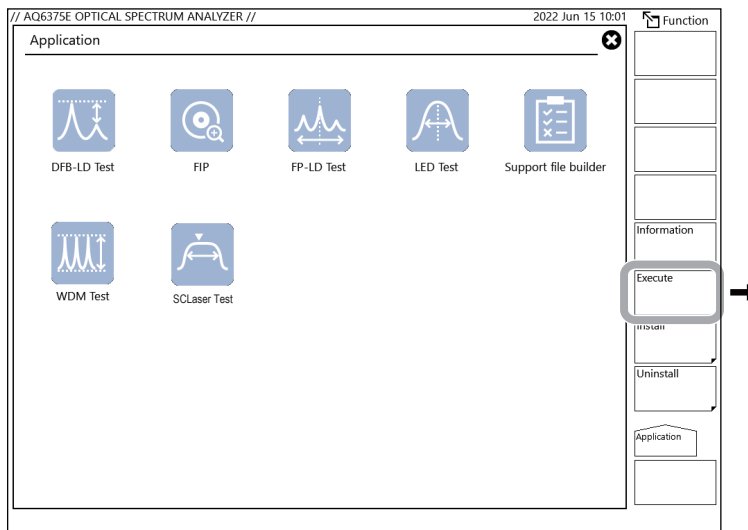
# Exporting maintenance information

**3.** Tap the information you want to export. The check boxes next to the items you tap will be selected.

**4.** After selecting all the items you want to export, tap **Export**.

A data save window appears.

Moves to the higher-level folder

Select the file list sort method.

Select the file list display mode
(List, Thumbnail, Preview).

Select the storage area (INT, EXT).

**Fixed to Zip**

Add a folder.

Rename a folder or file.

Delete folders and files.

Save destination path

Select the format when assigning file names automatically (Num, Date).

Closes the window

Starts saving
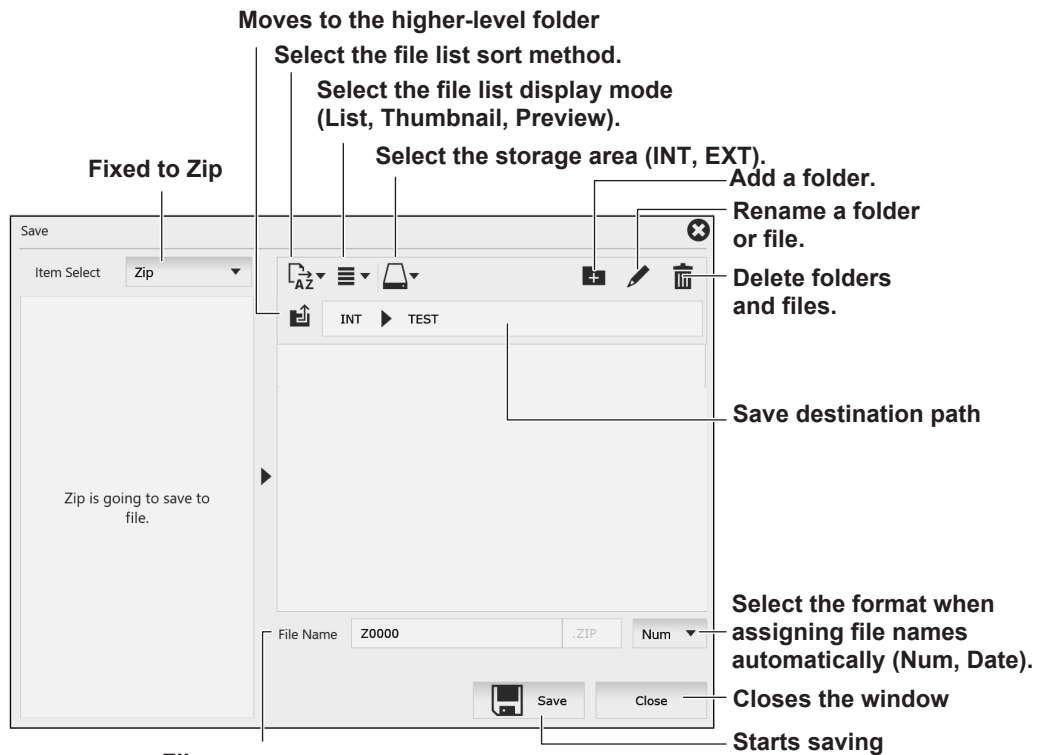
**File name**
**Serial number (Num): Zxxxx (xxxx: serial number)**
**Date (Date): ZyyyyMMdd_hhmmss**
**(yyyy: year, MM: month, dd: day, hh: hour, mm: minute, ss: second)**
**When assigning a specific file name, enter the file name.**

**5.** Specify the same destination and file name, and tap **Save**.

The file name is automatically assigned. A serial number or date and time is inserted after the first "Z" character in the file name. For details on file operation, see chapter 7.

**6.** To close the window, tap the "X" in the upper right of the window. The window shown in step 2 appears.

# Closing an application

Tap the "X" in the upper right of the window. When a confirmation message appears, tap Yes. The application will close, and the APP menu will appear.
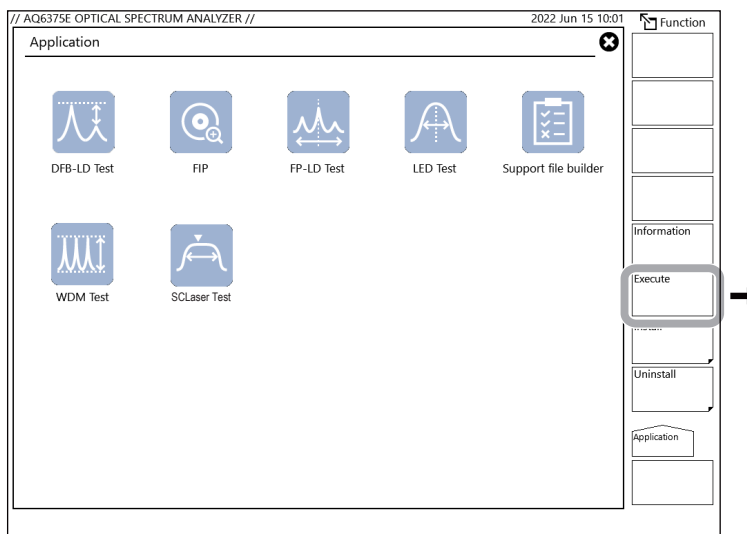
**8**

**Useful Applications**

# 9.1    Registering User-Defined Menus

## Procedure

*1.*    Press **SYSTEM**. The SYSTEM menu appears.

*2.*    Tap **More** to display the More 3/4 menu.

*3.*    Tap **User Key Define**. A registration window (User Key Define Mode) appears.

   To cancel the menu registration and close the window, tap the "X" in the upper right of the window, or press **UNDO/LOCAL**.

*4.*    Press the panel key that the menu you want to register belongs to.

*5.*    Tap the menu you want to register. If the menu is on page 2 or later, tap More to display the menu. The menu name appears in the key registration display area of the registration window.

*6.*    Press **USER**. The USER menu appears.

*7.*    Tap the location where you want to register the menu you selected in step 5. The menu name to be registered appears. At the same time, the key registration display area of the registration window is cleared. If a menu is already registered, it is overwritten.

*8.*    To clear a registered menu, leave the registration window (User Key Define Mode) in step 3 empty, and carry out steps 6 and 7.



**USER menu**

Registered in the location you tap

The name of the menu you tapped appears.

Tap the menu you want to register.
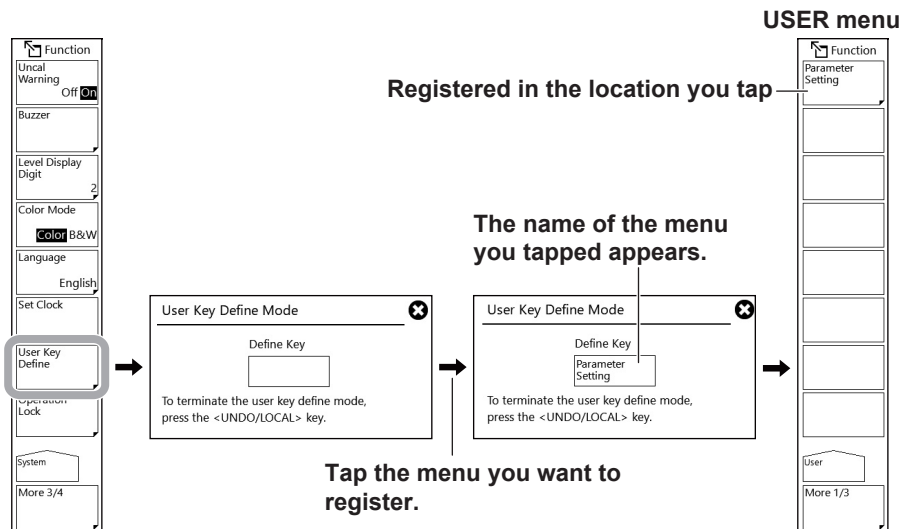
### Note

• As a general rule, you can only register the menus that appear after pressing a panel key. You cannot register the sub menus that appear after tapping a menu. Menus, such as More, that cannot be registered do not appear in the key registration display area.

• Registered menus execute actions that are assigned to those menus.

## Explanation

Up to 24 menus can be registered as user keys.

By registering frequently used menus as user keys, you can access them simply by opening the USER menu.

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System Setup

# 9.2 Locking the Keys

This feature prevents the instrument from being operated using keys other than those registered as user keys.

For details on how to register user keys, see section 9.1, "Registering User-Defined Menus."

## Procedure

### Locking the keys

**1.** Press **SYSTEM**. The SYSTEM menu appears.

**2.** Tap **More** to display the More 3/4 menu.

**3.** Tap **Operation Lock**. A password input window appears.

To cancel the operation, tap the "X" in the upper right of the window.

**4.** Enter the password. The default password is "1234."

**5.** Tap **LOCK**. A message appears stating that the keys have been locked, and the menu changes to the USER menu.
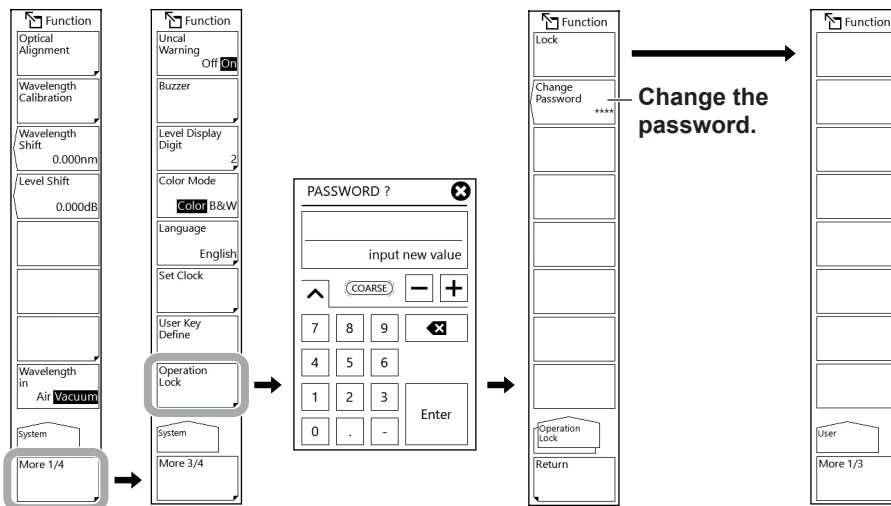


## Note

- If no user keys are registered, nothing will appear on the USER menu.
- While the keys are locked, only the following panel controls can be used.
  USER, HELP, and PRT SCN keys and POWER switch
- If you forget the password, initialize the data (ALL CLEAR). For the procedure, see section 9.9, "Resetting the Instrument to Its Factory Default Settings."
- The power switch is available even while the keys are locked. If you turn off the instrument in lock mode, it will start in lock mode when the power is turned back on.

**Changing the password**

**5.** Tap **Change Password**. A password input window appears.

**6.** Enters a new 4-digit password. A window appears for reentering the new password.

**7.** Reenter the password entered in step 6. A message appears indicating that the password has been changed.

*Note*
- The characters that can be used for the password are numbers from 0 to 9.
- If you forget the password when the keys are locked, you will not be able to unlock. If you change the password from the default, manage your password carefully.

## Unlocking the keys

**1.** Press any of the locked keys (other than USER, HELP, PRT SCN keys or POWER switch). A menu appears for unlocking the keys along with a warning message.

**2.** Tap **Unlock**. A password input window appears.

**3.** Enter the password. A message appears indicating that the keys have been locked, and the menu changes to the USER menu.
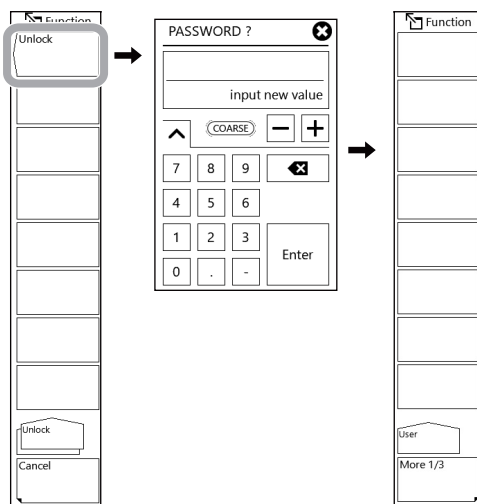


*Note*
Even when the keys are locked, you can still use the instrument remote commands as usual. However, you cannot unlock the keys when the instrument is in remote mode. In such a case, press UNDO/LOCAL to switch the instrument to local mode, and then unlock the keys. For details on switching between local and remote modes, see section 1.2 in the Remote Control User's Manual (IM AQ6375E-17EN).

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System Setup

# 9.3    Measurement Items

## Procedure

### Alignment adjustment

Connect the instrument's optical input connector and optical output connector using a 9.5/125 µm SM (single mode) optical fiber.

*1.*    Press **SYSTEM**. The SYSTEM menu appears.

*2.*    Tap **Optical Alignment** .

*3.*    Tap **Execute**. Alignment adjustment is executed automatically. When the alignment adjustment finishes a few minutes later, the previous screen will appear.

If you tap CANCEL while the alignment adjustment is in progress, it will be canceled.
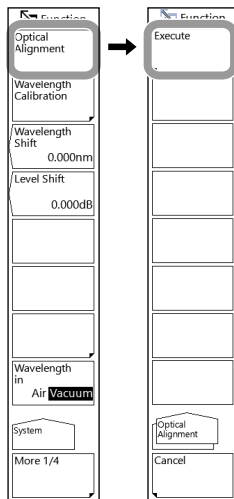


### *Note*

- After executing an alignment, the instrument also performs internal wavelength calibration automatically.
- If you cancel an alignment adjustment, it will be invalid. The instrument will be in the same condition as it was before the alignment adjustment was executed.

# Wavelength calibration

**Calibrating the wavelength using the built-in reference light source**
Connect the instrument's optical input connector and optical output connector using a 9.5/125 μm SM (single mode) optical fiber.

1. Press **SYSTEM**. The SYSTEM menu appears.

2. Tap **Wavelength Calibration**.

3. Tap **Built-In Source**.

4. Tap **Execute**. Wavelength calibration is executed. It will take a few minutes for the wavelength calibration to complete. After the calibration finishes, the original screen appears.

   If you tap CANCEL while the wavelength calibration is in progress, it will be canceled.
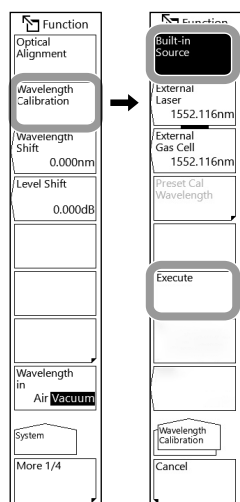
*Note*

- When you turn on the instrument, be sure to calibrate the wavelength after the instrument warms up.
- When using this instrument for the first time or when using it after it has been subjected to large vibration, be sure to adjust the alignment after it warms up.
- If the instrument's wavelength error is greater than or equal to ±20 nm, wavelength calibration using the built-in reference light source is not possible.
  (Because readjustment is required, contact your nearest YOKOGAWA dealer.)

**Calibrating the wavelength using an external light source**

In addition to the built-in reference light source, the instrument can be calibrated using a light source that you provide.

However, the following light sources cannot be used for wavelength calibration.

**Laser type**
- When the specified wavelength is different from that of the calibration light source
- If the instrument's wavelength error is greater than or equal to ±0.5 nm, readjustment is necessary. Contact your nearest YOKOGAWA dealer.
- If the calibration light source level is less than or equal to –40 dBm

**Gas cell absorption line type**
- When using a reference light source with multiple absorption lines if the instrument's wavelength deviation is greater than the wavelength spacing of the absorption lines (because the adjacent absorption line will be assumed to be the reference wavelength)

- **Connecting an external light source**

*1.* Connect the external light source's optical output connector to the instrument's optical input connector using a 9.5/125 µm SM (single mode) optical fiber.



**SM optical fiber cable (9.5/125 µm)**
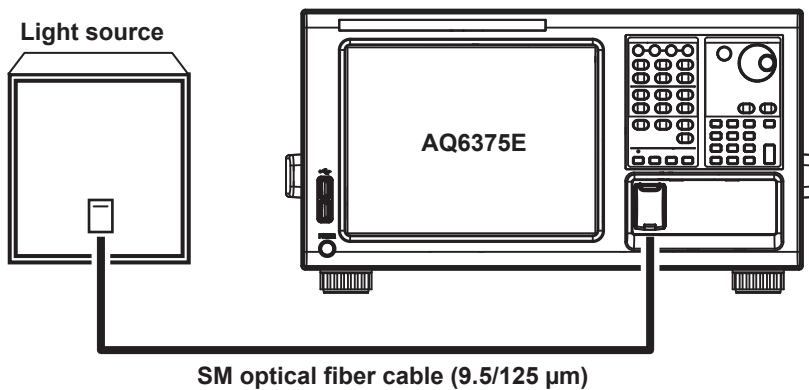
- **Setting the type of external light source and the calibration wavelength value**

*2.* Press **SYSTEM**. The SYSTEM menu appears.

*3.* Tap **Wavelength Calibration**.

Set the type of external light source (laser or gas cell absorption line) and the calibration wavelength value. There are two ways to set the wavelength value:

- **Laser type**

**4.** Tap **External Laser**. A window appears for setting the wavelength of the external light source.

**5.** Set the laser wavelength value on the setting window. You can set the wavelength between 1200 nm and 2400 nm(1000 nm and 2500 nm for extended model).

If you tap **Preset Cal Wavelength**, you can select from the preset wavelengths 1523.488 nm, 1530.372 nm, and 1552.116 nm.

**6.** Tap **Execute**. Wavelength calibration is executed. After the calibration finishes, the original screen appears.

If you tap CANCEL while the wavelength calibration is in progress, it will be canceled.



**Displays the preset wavelengths.**

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**System Setup**
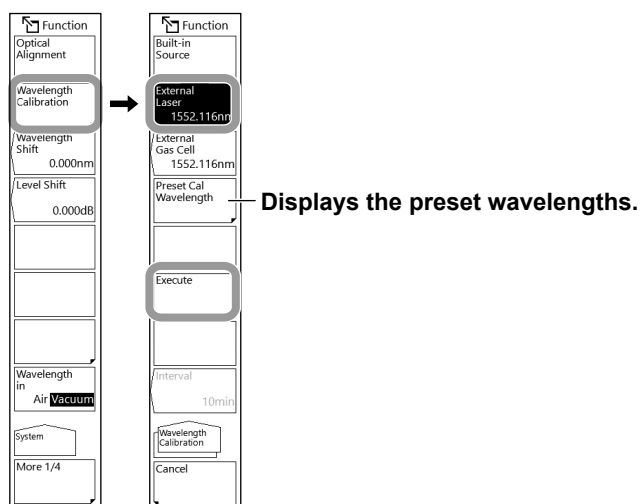
- **Gas cell absorption line type**

*4.*   Tap **External Gas Cell**. A window appears for setting the wavelength of the external light source.

*5.*   Set the wavelength value of the gas cell absorption line on the setting window. You can set the wavelength between 1200 nm and 2400 nm(1000 nm and 2500 nm for extended model).

If you tap **Preset Cal Wavelength**, you can select from the preset wavelengths 1523.488 nm, 1530.372 nm, and 1552.116 nm.

*6.*   Tap **Execute**. Wavelength calibration is executed. After the calibration finishes, the original screen appears.

If you tap CANCEL while the wavelength calibration is in progress, it will be canceled.



Displays the preset wavelengths
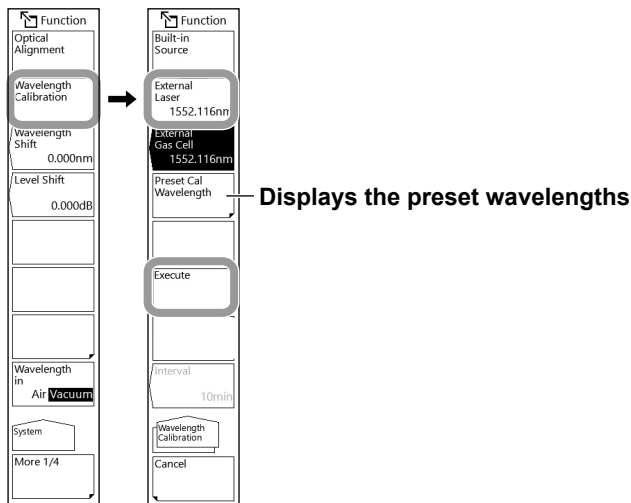
## Setting the auto offset

You can set whether to perform auto offset on the amplifier circuit in the instrument.

*1.* Press **SYSTEM**. The SYSTEM menu appears.

*2.* Tap **More** to display the More 2/4 menu.

*3.* Tap **Auto Offset Setting**. The auto offset setting menu appears.

*4.* Tap **Auto Offset**. The value toggles between On and Off. When set to On, auto offset is enabled.

*5.* Tap **Interval** to set the auto offset execution interval.

(We recommend the default value of 10 min.)



**Turns auto offset on or off**

**Set the offset execution interval when auto offset is on.**
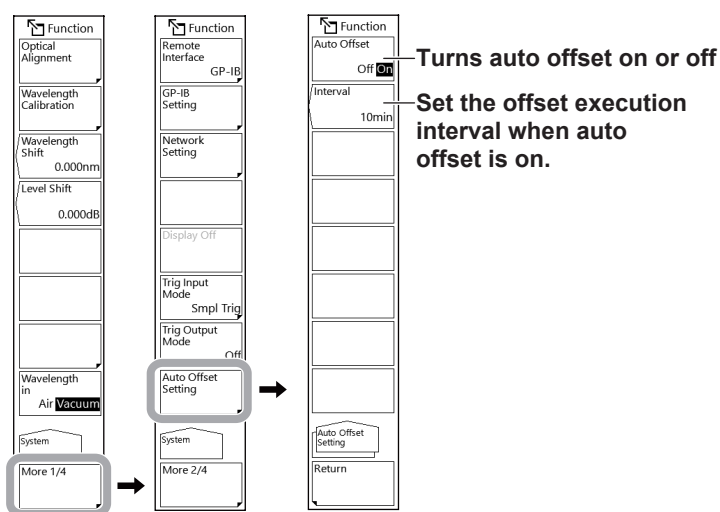
### *Note*

- If the Auto Offset is Off, the offset can vary over time, and the level axis performance can degrade. Normally, have this turned on.
- When Auto Offset is On, | AUT OFS | is displayed in blue (highlighted during black-and-white display) at the bottom of the screen.

## Clearing measured data, analysis conditions, parameters, etc.

You can clear all measurement parameters (excluding remote interface parameters (GP-IB, SOCKET, VXI-11)), display parameters, analysis parameters, and waveform display.

*1.* Press **PRESET**. A message appears for confirming the execution of the clear operation.

*2.* Tap **Yes**. The measured data and parameter settings are cleared. If you do not want to clear them, tap **No**. The previous menu will appear.



**9**

**System Setup**
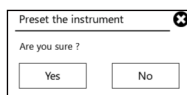
**Explanation**

## Alignment adjustment

Executes an optical axis adjustment of the optical section (monochromator) using the instrument's internal reference light source.

## Wavelength calibration

Executes a wavelength calibration using the internal light source or external light source (laser beam, gas cell absorption line).

During wavelength calibration, a message indicating that the offset is being adjusted is displayed in the lower left corner and in the top center of the screen.

## Auto offset

When Auto Offset is set to On, the offset of the internal amplifier circuit is adjusted at the specified time interval (default value: 10 min).

When Auto Offset is set to Off, auto offset adjustment will not be executed. When the setting is changed from Off to On, an offset adjustment is executed immediately. If repeat sweep is in progress, offset adjustment is executed when sweeping reaches 100%. If a single sweep is in progress, offset adjustment is executed when the sweep is completed.

During offset adjustment, a message indicating that the offset is being adjusted is displayed in the lower left corner and in the top center of the screen.

*Note*

- If, during offset adjustment, you operate the keys or use remote commands to execute a sweep, the sweep will start after the offset adjustment is completed.

## Clearing measured data, analysis conditions, parameters, etc.

You can clear all measurement parameters, display parameters, analysis parameters, and waveform display. It is the same operation as when the instrument receives an *RST remote command.

The following data is not cleared.

- Remote interface (GP-IB, SOCKET, VXI-11) settings
- Wavelength calibration data and alignment adjustment data
- Various type of data saved to internal memory

# 9.4 Display Items

## Setting the UNCAL mark and warning display

*1.* Press **SYSTEM**. The SYSTEM menu appears.

*2.* Tap **More** to display the More 3/4 menu.

*3.* Tap **Uncal Warning**. The value toggles between On and Off. When set to On, the UNCAL mark and warning can be displayed.



Turns Uncal warning on or off
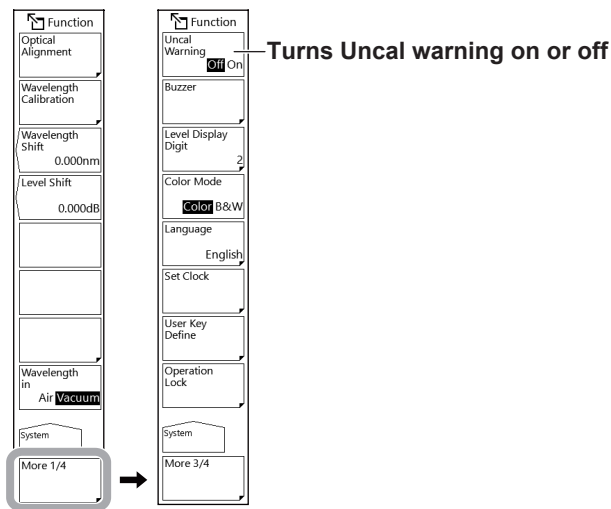
## Turning the display off

This function temporarily turns the display off.

*1.* Press **SYSTEM**. The SYSTEM menu appears.

*2.* Tap **Display Off**. The display turns off.



Turns off the display
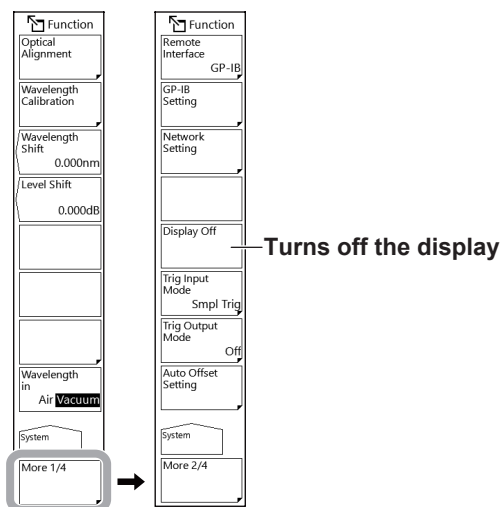
If you press a panel key or move the mouse, the display will turn on.

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System Setup

# Changing the displayed language

You can set the language of the menus and setting windows to English or Chinese.

1. Press **SYSTEM**. The SYSTEM menu appears.

2. Tap **More** to display the More 3/4 menu.

3. Tap **Language**.

4. Tap **English** or **Chinese**.

   If you do not want to change the setting, tap Return.
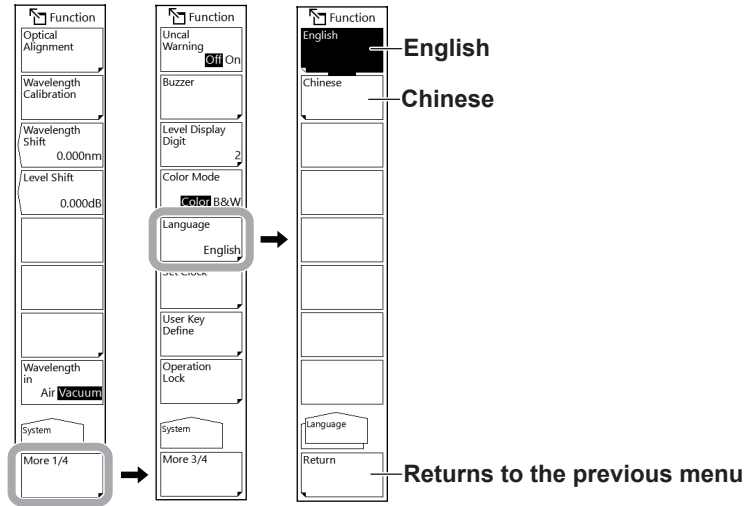


# Correcting the displayed values

**Setting the amount of wavelength shift**

1. Press **SYSTEM**. The SYSTEM menu appears.

2. Tap **Wavelength Shift**. A window appears for setting the amount of wavelength shift.

3. Enter the amount of wavelength shift on the window.
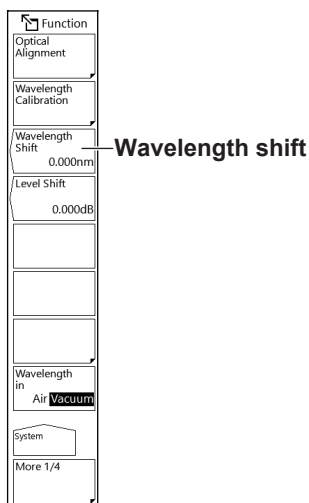
**Setting the amount of level shift**

*1.* Press **SYSTEM**. The SYSTEM menu appears.

*2.* Tap **Level Shift**. A window appears for setting the amount of level shift.

*3.* Enter the amount of level shift on the window.
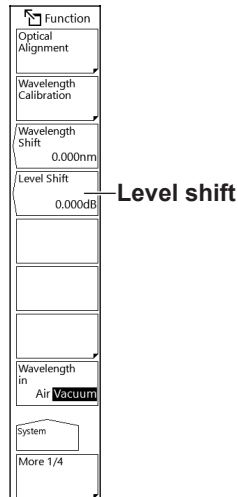


— **Level shift**

*Note*

After you enter the amount of wavelength or level shift, it is applied to the displayed values when the next measurement is performed.

**Determining the amount of level shift**

The amount of level shift is used to correct the loss of external isolators, filters, or other devices connected to the instrument.

*1.* Set up a light source such as a DFB-LD with a spectrum width that is sufficiently narrower than the instrument's resolution setting (with a wavelength of 1310 nm or 1550 nm).

*2.* Connect the light source and the instrument using an optical fiber cord and set the instrument's resolution to 2 nm.

*3.* Perform a measurement to determine the peak level.

*4.* Disconnect the optical fiber cord from the instrument and connect it to a light power meter to measure the light power.

*5.* Calculate the difference between the peak level value obtained from the instrument and the power value obtained from the light power meter, and set this amount as the instrument's level shift.

**9**

System Setup
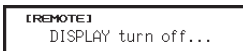
## Explanation

### Turning the display off

This function temporarily turns the display off. Use this function when you are using the instrument in a darkroom or similar environment in which the light from the screen has an effect on the work. Select Display Off to turn off the backlight and display.

**When remote commands have been used to turn the display off**

If remote commands have been used to turn the display off, even if you perform panel key or mouse operations to turn the display on, the following message will be displayed and the display will be turned off after approximately 5 seconds.

```
[REMOTE]
    DISPLAY turn off...
```

To keep the display turned on, use a remote command, or press UNDO/LOCAL to switch the instrument from remote to local mode.

### Display Language

The following items can be displayed in English or Chinese.
- Menu
- Title of parameter input windows
- Warnings and messages

### Correcting the displayed values

**WL SHIFT **.**nm**

This function sets the amount of wavelength shift.

When the wavelength shift is changed, the specified value is added to the display value on the wavelength axis. The amount of wavelength shift is used to correct the differences in wavelength display values among different measurement instruments.

You can set the value between –5.000 and 5.000 nm. You can set it in steps of 0.001 nm. When COARSE is selected, you can set it in steps of 0.1 nm.

When you set the amount of wavelength shift, $\boxed{\substack{\text{WL}\\\text{SHF}}}$ will appear highlighted at the bottom of the screen.

**LEVEL SHIFT***.***dB**

This function sets the amount of level shift.

When the level shift is changed, the specified value is added to the display value on the level axis. The amount of level shift is used to correct the loss of external isolators, filters, or other devices connected to the instrument.

You can set the value between –60.000 and 60.000dB. You can set it in steps of 0.001dB. When COARSE is selected, you can set it in steps of 0.1 dB.

When you set the amount of level shift, $\boxed{\substack{\text{LVL}\\\text{SHF}}}$ will appear highlighted at the bottom of the screen.

# 9.5 Ethernet Communication

## Procedure

### Configuring the communication interface

1. Press **SYSTEM**. The SYSTEM menu appears.

2. Tap **More** to display the More 2/4 menu.

3. Tap **Remote Interface**. The Remote Interface menu appears.

4. Tap **NETWORK (SOCKET)** or **NETWORK (VXI-11)** to set the communication interface to Ethernet.



**Socket communication**

**VXI-11 communication**
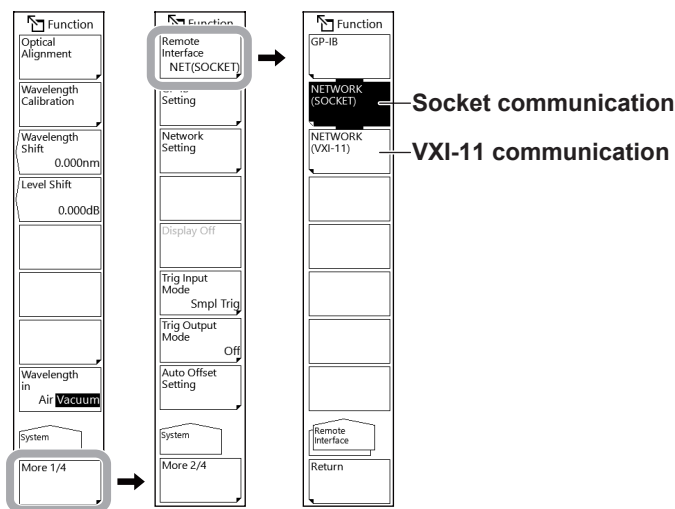
## Configuring the network settings

*1.* Press **SYSTEM**. The SYSTEM menu appears.

*2.* Tap **More** to display the More 2/4 menu.

*3.* Tap **Network Setting**. The Network Setting menu appears.

| Function | Function | Function | |
|---|---|---|---|
| Optical Alignment | Remote Interface NET(SOCKET) | TCP/IP Setting | — Set the TCP/IP parameters. |
| Wavelength Calibration | GP-IB Setting | Remote Port No. 10001 | — Set the port number. |
| Wavelength Shift 0.000nm | Network Setting | Command Format AQ6375E | — Set the command format. |
| Level Shift 0.000dB | | Remote User Account | — Set the user account. |
| | Display Off | Remote Monitor | — Configure the remote monitor. |
| | Trig Input Mode Smpl Trig | Folder Sharing Disable | — Set folder sharing. |
| | Trig Output Mode Off | | |
| Wavelength in Air Vacuum | Auto Offset Setting | TIMEOUT Infinite | — Set the timeout. |
| System | System | Network Setting | |
| More 1/4 | More 2/4 | Return | |

**Setting the TCP/IP parameters**

*4.* Tap **TCP/IP Setting**. The TCP/IP setting menu appears.

Configure IPv4 and IPv6 according to the network you are using.

**Setting the IPv4**

*5.* Tap **AUTO (DHCP)** or **MANUAL**.

To use a DHCP server, select AUTO (DHCP).

*6.* If you select MANUAL, set the IP address, subnet mask, and default gateway. If you select AUTO, proceed to step 8.

Tap the IP address, subnet mask, and default gateway input boxes. A setting window appears.

*7.* Set the IP address, subnet mask, and default gateway on the setting window.

**Setting the IPv6**

*5.* Tap **AUTO** or **MANUAL**.

*6.* If you select MANUAL, set the IP address, subnet prefix length, and default gateway. If you select AUTO, proceed to step 8.

Tap the IP address, subnet prefix length, and default gateway input boxes. A setting window appears.

*7.* Set the IP address, subnet prefix length, and default gateway on the setting window.

**8.** When you finish setting all the items, tap **Done**.



### Setting the port number (not used with the VXI-11)

**4.** Continuing from step 3, tap **Remote Port No**. A window appears for setting the port number.

**5.** Set the port number on the setting window.

### Setting the user account (not used with the VXI-11)

**4.** Continuing from step 3, tap **Remote User Account**. The Remote User Account menu appears.

**5.** Tap **User Name**. A keyboard appears.

The default value is anonymous.

**6.** Enter the user name using up to 11 alphanumeric characters. If the user name is set to anonymous, you do not have to set a password.

**7.** Tap **Password**. A keyboard appears.

**8.** Enter the password using up to 11 alphanumeric characters.



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### Configuring the Remote Monitor

This function can be used to monitor the instrument's screen and control the instrument from a remote PC that is connected over TCP/IP.

4. Continuing from step 3, tap **Remote Monitor**. The remote monitor setting menu appears.

5. Tap **Monitor Port**. The value toggles between On and Off. A remote monitor can be connected when the setting is on.

6. To disconnect the remote monitor, tap **Disconnect**. The monitor will be disconnected from the PC.



Turns monitor port on or off

Port number (fixed to 20001)

Disconnects remote monitoring
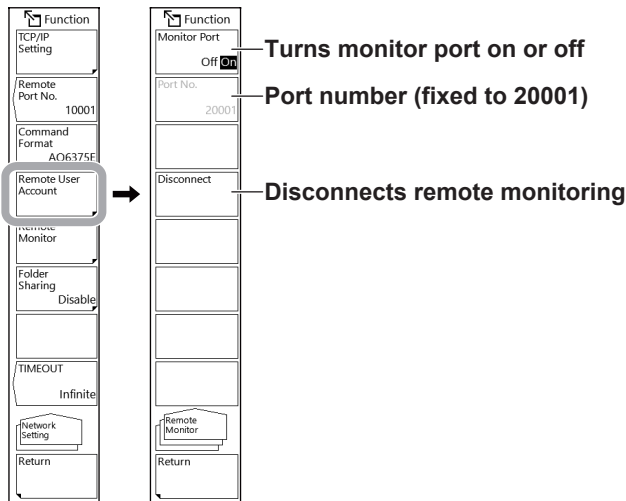
### Setting folder sharing

The user area folder of the instrument's internal memory can be shared with a PC.

4. Continuing from step 3, tap **Folder Sharing**. The Folder Sharing menu appears.

5. Tap **Read Only**. The user area folder of the instrument is shared over the network (read only).

   Tapping **Disable** will disable folder sharing.

   The user name and password needed to access the shared folder are as follows:

   User name: user

   Password: yokogawa

### Setting the remote timeout (not used with the VXI-11)

4. Continuing from step 3, tap Time Out. A setting window appears.

5. Set the timeout value on the setting window.

## Explanation

## Configuring the network settings

**Setting the TCP/IP parameters**

Configure IPv4 and IPv6 according to the network that this instrument is connected to.

If both IPv4 and IPv6 are enabled, either one will be selected automatically according to the network that this instrument is connected to.

- **IPv4**

  If a DHCP server is available on the network that the instrument is connected to, an IP address is automatically assigned to the instrument. In this case, select AUTO (DHCP) in the TCP/IP settings.

- **IPv6**

  "AUTO" is usually used, but you can also set a fixed IP address manually.

  If you are setting the IP address manually, set also the subnet prefix length and default gateway.

  Set the IP address and default gateway in hexadecimal notation.

For details about the network that you intend to connect the instrument to, contact your network administrator.

**REMOTE PORT NO. (not used with the VXI-11)**

Set the port number to use to control the instrument remotely over the network (socket). (Default value: 10001)

**User authentication (not used with the VXI-11)**

If you want to connect to the instrument from your PC over an Ethernet network, user authentication is required. If the user name is anonymous, you do not have to enter a password.

The instrument supports plaintext authentication and the MD5 algorithm (RSA Data Security, Inc. MD5 Message DigestAlgorithm).

**Remote monitoring**

This function can be used to monitor the instrument's screen and control the instrument from a remote PC that is connected to the instrument through a TCP/IP port.

To use this feature, you need remote monitoring software (not included). You cannot use the remote monitoring port to perform remote control with normal remote commands.

For information on remote monitoring software, contact your nearest YOKOGAWA dealer.

### User name and password

A user name and password are required to access the instrument using this function.

Enter the user name using up to 11 alphanumeric characters. If the user name is set to anonymous, you do not have to set a password.

Enter the password using up to 11 alphanumeric characters.

### MONITOR PORT

Enables and disables the remote monitor TCP/IP port.

If you set this to Off, the remote monitor will be disabled.

### PORT NO.

This is the remote monitor TCP/IP port number. It is fixed to 20001. You cannot use this port to perform remote control with normal remote commands.

### DISCONNECT

If you tap this menu while remote monitoring is connected, remote monitoring with the external PC will be disconnected. This menu can only be used when remote monitoring is connected.

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**Folder sharing**

The user area folder of the instrument's internal memory can be shared with a PC. When the user area folder is shared, files in the folder can be copied to the PC over a network. Note that you cannot save files to the instrument.

If you are prompted to enter a user name and password when accessing the instrument's shared folder from the PC, enter the following information.

User name: user

Password:   yokogawa

**Timeout period (not used with the VXI-11)**

If no communication takes place for the specified time in remote mode, the communication is automatically disconnected, and the mode changes to local.

When you change the timeout period, the elapsed time is reset.

You can set the time to Infinite (0 s) or between 1 and 21600 s (6 hours).

# 9.6 Sounding the Buzzer

## Procedure

1. Press **SYSTEM**. The SYSTEM menu appears.

2. Tap **More** to display the More 3/4 menu.

3. Tap **Buzzer**. The Buzzer menu appears.

4. Tap **Click** or **Warning**. Each time you tap, the value switches between ON and OFF. When set to ON, the buzzer sound is enabled.



**Buzzer when keys are used**

**Warning display buzzer**
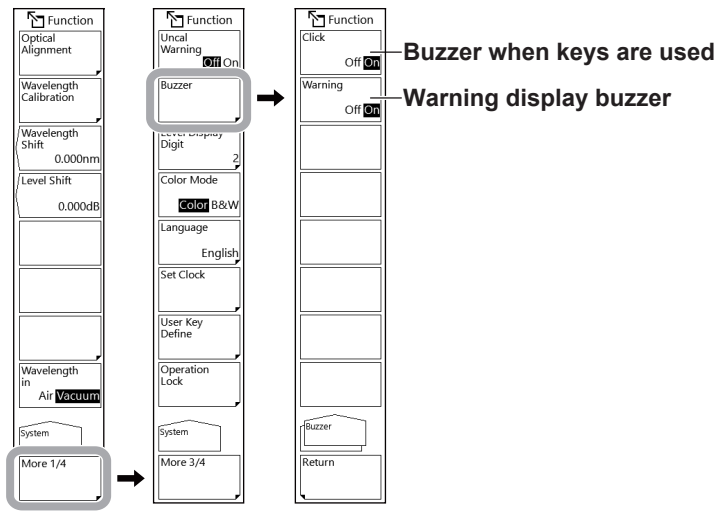
# 9.7 Displaying Manuals with the Help Feature

## Procedure

*1.* Press **HELP**. An explanation appears for the displayed menu.

*2.* To finish, press any panel key.

# 9.8 Viewing the System Information

## Procedure

### Viewing the system information

*1.* Press **SYSTEM**. The SYSTEM menu appears.

*2.* Tap **More** to display the More 4/4 menu.

*3.* Tap **System Information**. The system information appears.

*4.* Tap **Return** to return to the previous menu.
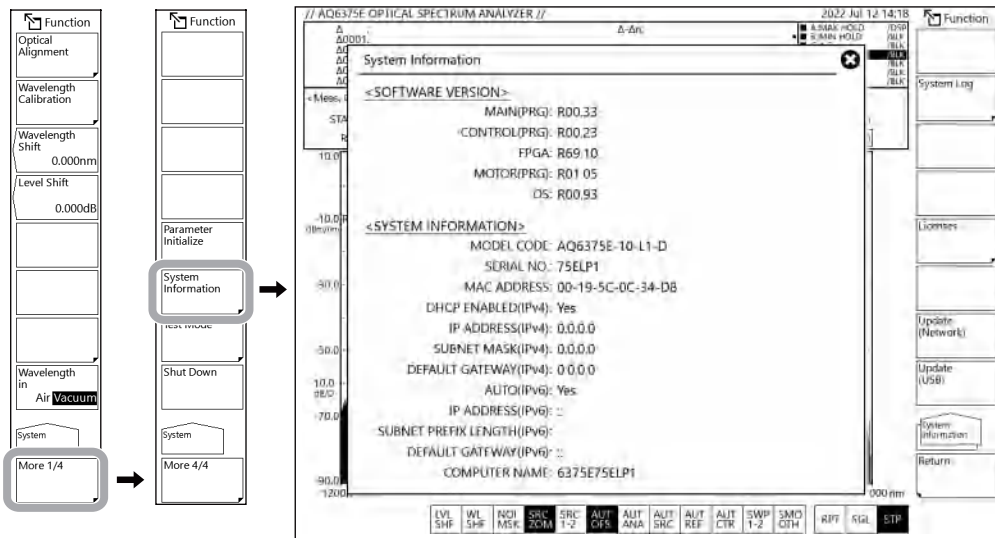
## Displaying or clearing the system log and copying to USB memory

**Viewing the system log**

**4.**  Continuing from step 3, tap **System Log**. The System Log menu appears.

**5.**  Tap **View**. The system log is displayed on the screen.

**6.**  Tap **Done** to return to the previous menu.
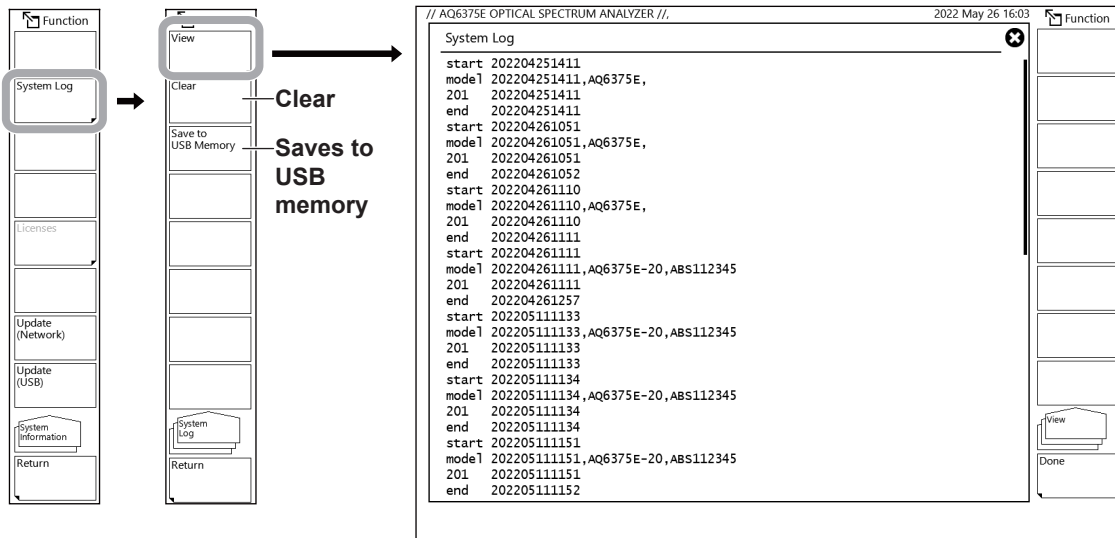


**Clearing the system log**

**7.**  Tap **Clear**. When a confirmation message appears, tap **Yes**. The system log will be cleared.

**Saving the system log to USB memory**

**8.**  Connect a USB memory device, and then tap **Save to USB Memory**. The system log will be saved to the USB memory device.

File name: SystemLog.txt

## Viewing the open source software (OSS) license

**4.** Continuing from step 3, tap **Licenses**. The Licenses menu appears.

**5.** From the list showing the firmware and installed applications, tap the software you want to view the license information of, or move the cursor to the software and tap **Select**.

The OSS license information will appear.

**6.** To close the license information, tap the "X" in the upper right of the window.



Move the cursor

Displays the OSS license information
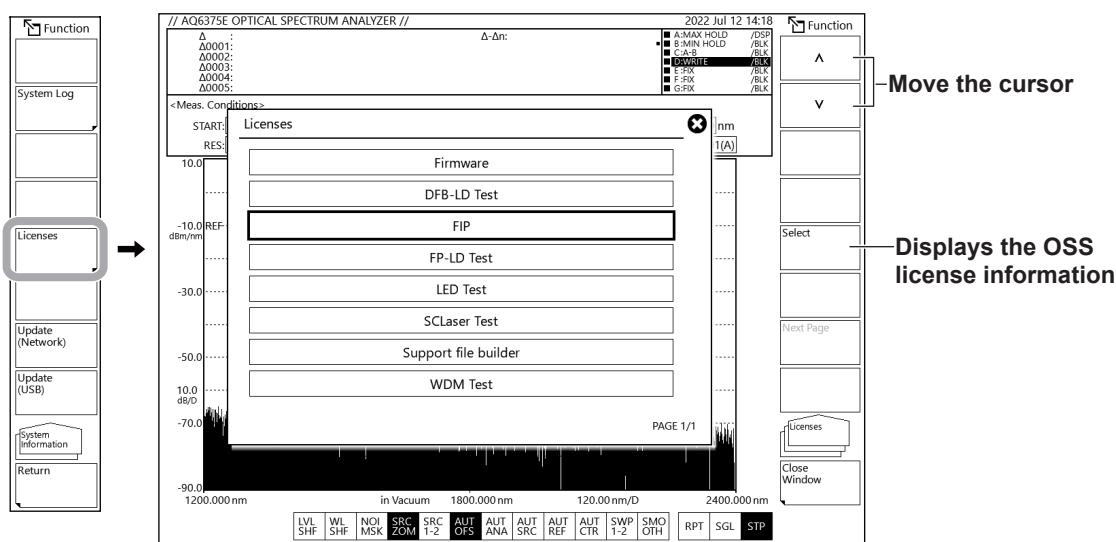
## Explanation

The following items are displayed as system information.

### Software version

| | |
|---|---|
| MAIN(PRG) | |
| CONTROL(PRG) | |
| FPGA | Version of the installed software |
| MOTOR(PRG) | |
| OS | |

### System information

| | |
|---|---|
| MODEL CODE | Model |
| SERIAL NO. | Serial number |
| MAC ADDRESS | MAC address of the Ethernet port |
| DHCP ENABLED(IPv4) | |
| IP ADDRESS(IPv4) | |
| SUBNET MASK(IPv4) | |
| DEFAULT GATEWAY(IPv4) | |
| AUTO(IPv6) | TCP/IP settings |
| IP ADDRESS(IPv6) | |
| SUBNET PREFIX LENGTH(IPv6) | |
| DEFAULT GATEWAY(IPv6) | |
| COMPUTER NAME | Computer name (device name on the network) |

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System Setup

## 9.9 Resetting the Instrument to Its Factory Default Settings

### Procedure

*1.* Press **SYSTEM**. The SYSTEM menu appears.

*2.* Tap **More** to display the More 4/4 menu.

*3.* Tap **Parameter Initialize**. A menu appears for setting the items to be initialized.

*4.* Select the initialization type according to the items you want to initialize.

*5.* Tap **Execute**. Initialization is executed.

To cancel, tap **Cancel**.



**Initialize parameters.**

**Initialize calibration data.**

**Initialize parameters and calibration data.**
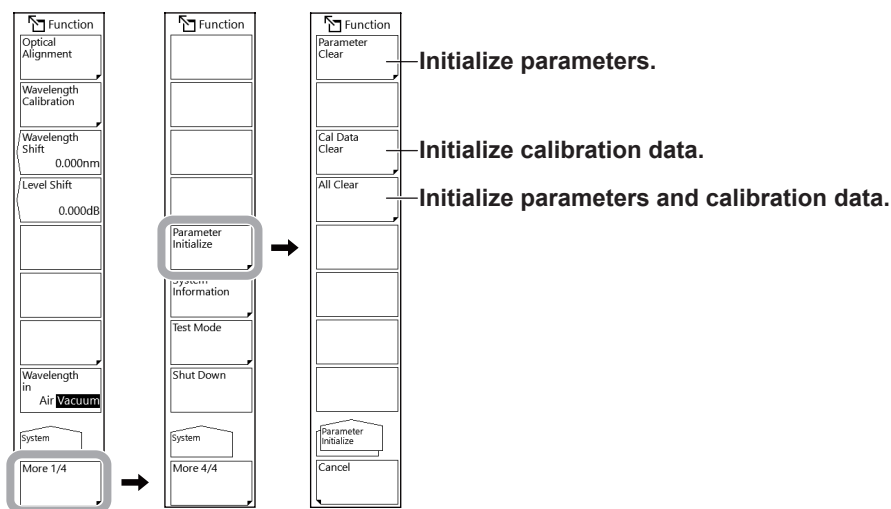
### Explanation

You can reset the instrument to its factory default settings.

However, the following items will not be initialized.

- TCP/IP Setting
- Remote User Account

The following three types of initialization are available depending on the items to be initialized.

- Parameter Clear

  The parameter setting value of each function is initialized.

  The waveform data of traces A to G is also initialized.

  Use this to initialize the instrument to the default condition.

- Cal Data Clear

  Alignment adjustment value, wavelength calibration value, and resolution calibration value are initialized.

- All Clear

  All parameter values, data as well as wavelength calibration value and alignment adjustment value are initialized.

The default values for each setting are shown below.

## SWEEP

| Function | Default value | Maximum value | Minimum value |
|---|---|---|---|
| Sweep Marker L1-L2 (Off/On) | Off | - | - |
| Sweep Interval | Minimum=0 | 99999 | Minimum=0 |

## CENTER

### Standard model (AQ6375E-10), Limited model (AQ6375E-01)

| Function | Default value | Maximum value | Minimum value |
|---|---|---|---|
| Center (nm)<br>(Center (THz))<br>(Center (cm-1)) | 1800.000<br>(187.3703)<br>(6250.000) | 2400.000<br>(250.0000)<br>(8333.000) | 1200.000<br>(125.0000)<br>(4167.000) |
| Start (nm)<br>(Start (THz))<br>(Start (cm-1)) | 1200.000<br>(124.9135)<br>(4166.667) | 2400.000<br>(250.0000)<br>(8333.000) | 600.000<br>(60.0000)<br>(2067.000) |
| Stop (nm)<br>(Stop (THz))<br>(Stop (cm-1)) | 2400.000<br>(249.8270)<br>(8333.333) | 3000.000<br>(315.0000)<br>(10433.000) | 1200.000<br>(125.0000)<br>(4167.000) |
| AUTO CENTER Off/On | Off | - | - |

### Extended model (AQ6375E-20)

| Function | Default value | Maximum value | Minimum value |
|---|---|---|---|
| Center (nm)<br>(Center (THz))<br>(Center (cm-1)) | 1750.000<br>(209.8547)<br>(7000.000) | 2500.000<br>(300.0000)<br>(10000.000) | 1000.000<br>(120.0000)<br>(4000.000) |
| Start (nm)<br>(Start (THz))<br>(Start (cm-1)) | 1000.000<br>(119.9170<br>(4000.000) | 2500.000<br>(300.0000)<br>(10000.000) | 250.000<br>(30.0000)<br>(1000.000) |
| Stop (nm)<br>(Stop (THz))<br>(Stop (cm-1)) | 2500.000<br>(131.7769)<br>(10000.000) | 3250.000<br>(390.0000)<br>(13000.000) | 1000.000<br>(120.0000)<br>(4000.000) |
| AUTO CENTER Off/On | Off | - | - |

## SPAN

### Standard model (AQ6375E-10), Limited model (AQ6375E-01)

| Function | Default value | Maximum value | Minimum value |
|---|---|---|---|
| Span (nm)<br>(Span (THz))<br>(Span (cm-1)) | 1200.0<br>(124.91)<br>(4166.7) | 1200.0<br>(130.00)<br>(4200.0) | 0 / 0.5<br>(0/0.01)<br>(0/0.5) |
| Start (nm)<br>(Start (THz))<br>(Start (cm-1)) | 1200.000<br>(124.9135)<br>(4166.667) | 2400.000<br>(250.0000)<br>(8333.000) | 600.000<br>(60.0000)<br>(2067.000) |
| Stop (nm)<br>(Stop (THz))<br>(Stop (cm-1)) | 2400.000<br>(249.8270)<br>(8333.333) | 3000.000<br>(315.0000)<br>(1043.000) | 1200.000<br>(125.0000)<br>(4167.000) |
| 0nm Sweep Time | Minimum | 50 | Minimum |

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**Extended model (AQ6375E-20)**

| Function | Default value | Maximum value | Minimum value |
|---|---|---|---|
| Span (nm)<br>(Span (THz))<br>(Span (cm-1)) | 1500.0<br>(179.88)<br>(6000.0) | 1500.0<br>(180.00)<br>(6000.0) | 0 / 0.1<br>(0.00)<br>(0.0) |
| Start (nm)<br>(Start (THz))<br>(Start (cm-1)) | 1000.000<br>(119.9170)<br>(4000.000) | 25000.000<br>(300.0000)<br>(10000.000) | 250.000<br>(30.0000)<br>(1000.000) |
| Stop (nm)<br>(Stop (THz))<br>(Stop (cm-1)) | 25000.000<br>(299.7925)<br>(10000.000) | 3250.000<br>(390.0000)<br>(13000.000) | 1000.000<br>(120.0000)<br>(4000.000) |
| 0nm Sweep Time | Minimum | 50 | Minimum |

# LEVEL

| Function | | Default value | Maximum value | Minimum value |
|---|---|---|---|---|
| Reference Level | | -10.0 (Log)<br>(100 µW (Linear)) | 30.0 (Log)<br>(1000 mW (Linear)) | -90.0 (Log)<br>(1.00 pW (Linear)) |
| Log Scale | | 10.0, On | 10.0 | 0.1 |
| Linear Scale | | Off | - | - |
| Linear Base Level | | 0 | REF×0.9 | 0.00 |
| Auto Ref Level (Off/On) | | Off | - | - |
| Level Unit (dBm  dBm/nm (dBm/THz)) | | dBm | - | - |
| Sub Log | | 5.0, On | 10.0 | 0.1 |
| Sub Linear | | 0.125, Off | 1.250 | 0.005 |
| Sub Scale | | 10.0, Off | 125.0 | 0.5 |
| Offset Level | | 0.0 | 99.9 | -99.9 |
| Auto Sub Scale (Off/On) | | Off | - | - |
| Y Scale  Setting | Y Scale Division | 10 | 10 | 8 |
| | Ref Level Position | 8 | 10 | 0 |
| | Sub Ref Level Position | 5 | 10 | 0 |

# SETUP

| Function | | Default value | Maximum value | Minimum value |
|---|---|---|---|---|
| Resolution (nm) | | 1 | 2 | 0.05<br>0.1(Limited model) |
| | Sensitivity Select | N/AUTO | - | - |
| | Sensitivity Level (dBm) | Approx. –60<br>(varies depending on the instrument) | -48<br>(varies depending on the instrument) | -77<br>(varies depending on the instrument) |
| Average Times | | 1 | 999 | 1 |
| Sampling Points (Auto) | | Auto | - | - |
| Sampling Points | | Calculation value of <Sampling Points Auto> | 200001 | 101 |
| Sampling Interval (nm) | | Calculation value of <Sampling Points Auto> | SPAN/100 | 0.002 |
| Pulse Light Measure | | Off | - | - |
| Trigger Setting | Edge (Rise/Fall) | RISE | - | - |
| | Delay (µs) | 0 | 1000 | 0 |
| | Trig Input Mode | Smpl Trig | | |
| | Trig Output Mode | Off | | |
| Horizontal Scale (nm/THz) | | nm | - | - |
| Smoothing (Off/On) | | Off | - | - |

## ZOOM

**Standard model (AQ6375E-10), Limited model (AQ6375E-01)**

| Function | Default value | Maximum value | Minimum value |
|---|---|---|---|
| Zoom Center (nm) | 1800.000 | 2400.000 | 1200.000 |
| (Zoom Center (THz)) | (187.3703) | (250.0000) | (125.0000) |
| (Zoom Center (cm$^{-1}$)) | (6250.000) | (833.000) | (4167.000) |
| Zoom Span (nm) | 1200.0 | 1200.0 | 0.1 |
| (Zoom Span (THz)) | (124.91) | (130.00) | (0.01) |
| (Zoom Span (cm$^{-1}$)) | (4166.7) | (4200.0) | (0.1) |
| Zoom Start (nm) | 1200.000 | 2399.950 | 600.000 |
| (Zoom Start (THz)) | (124.9135) | (249.9950) | (60.0000) |
| (Zoom Start (cm$^{-1}$)) | (4166.667) | (8332.950 | (2067.000) |
| Zoom Stop (nm) | 2400.000 | 3000.000 | 1200.050 |
| (Zoom Stop (THz)) | (249.8270) | (315.0000) | (125.0050) |
| (Zoom Stop (cm$^{-1}$)) | (833.333) | (10433.000) | (4167.050) |
| Overview Display (Off/L/R) | R | - | - |

**Extended model (AQ6375E-20)**

| Function | Default value | Maximum value | Minimum value |
|---|---|---|---|
| Zoom Center (nm) | 1750.000 | 2500.000 | 1000.000 |
| (Zoom Center (THz)) | (209.854) | (300.0000) | (120.0000) |
| (Zoom Center (cm$^{-1}$)) | (7000.000) | (10000.000) | (4000.000 |
| Zoom Span (nm) | 1500.0 | 1500.0 | 0.1 |
| (Zoom Span (THz)) | (179.88) | (180.00) | (0.01) |
| (Zoom Span (cm$^{-1}$)) | (6000.0) | (6000.0) | (0.1) |
| Zoom Start (nm) | 1000.000 | 2499.950 | 250.000 |
| (Zoom Start (THz)) | (119.9170) | (299.9950) | (30.0000) |
| (Zoom Start (cm$^{-1}$)) | (4000.000) | (9999.950 | (1000.000) |
| Zoom Stop (nm) | 2500.000 | 3250.000 | 1000.050 |
| (Zoom Stop (THz)) | (299.7925) | (390.0000) | (120.0050) |
| (Zoom Stop (cm$^{-1}$)) | (10000.000) | (13000.000) | (4000.050) |
| Overview Display (Off/L/R) | R | - | - |

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# TRACE

| Function | | | Default value | Maximum value | Minimum value |
|---|---|---|---|---|---|
| Active Trace (A/B/C/D/E/F/G) | | | A | - | - |
| View | | | DISP<br>(B, C, D, E, F, G: BLANK) | - | - |
| FIX | | | TRACE B/C/D/E/F/G | - | - |
| Hold | | | Max Hold<br>(B, D, E: Min Hold<br>C, E, G: Max Hold) | - | - |
| Roll Average | | | 2 | 100 | 2 |
| Calculate C | Log Math | | C=A-B(LOG) | - | - |
| | (Linear Math) | | (C=A+B(LIN)) | - | - |
| Calculate F | Log Math | | (F=C-D(LOG)) | - | - |
| | (Linear Math) | | (F=C+D(LIN)) | - | - |
| | Power/NBW | | (F=Pwr/NBW A) | | |
| CalculateG | Log Math | | (G=C-F(LOG)) | - | - |
| | (Linear Math) | | (G=C+F(LIN)) | - | - |
| | (Normalize) | | (G=NORM A) | - | - |
| | (Curve Fit) | | (G=CRV FIT A) | - | - |
| | | (Threshold) | (20) | 99 | 0 |
| | | (Operation Area) | (ALL) | - | - |
| | | (Fitting Algorithm) | (GAUSS) | - | - |
| | (Peak Curve Fit) | | (G=PKCVFIT A) | - | - |
| | | (Threshold) | (20) | 99 | 0 |
| | | (Operation Area) | (ALL) | - | - |
| | | (Fitting Algorithm) | (GAUSS) | - | - |
| Trace Copy | Source Trace | | A | - | - |
| | Destination Trace | | B | - | - |
| Label | | | // AQ6375E OPTICAL<br>SPECTRUM ANALYZER // | - | - |
| Noise Mask | | | OFF | - | - |
| Mask Line (VERT/HRZN) | | | HRZN | - | - |
| Trace Highlight | | | Off | - | - |

## MARKER

| Function | | Default value | Maximum value | Minimum value |
|---|---|---|---|---|
| Maker Active (Off/On) | | Off | - | - |
| (Set Marker) | (Set) | 1 | 1024 | 1 |
| (Marker Setting) | | Normal Maker | | |
| Line Marker  1 (Off/On) | Standard model Limited model | Off | WL=2400.0000 (FREQ=249.82705) (WNUM=8333.333) | WL=1200.0000 (FREQ=124.91352) (WNUM=4166.6667) |
| | Extended model | | WL=2500.0000 (FREQ=299.79246) (WNUM=10000.000) | WL=1000.0000 (FREQ=119.91698) (WNUM=4000.000) |
| Line Marker  2 (Off/On) | Standard model Limited model | Off | WL=2400.0000 (FREQ=249.82705) (WNUM=8333.333) | WL=1200.0000 (FREQ=124.91352) (WNUM=4166.6667) |
| | Extended model | | WL=2500.0000 (FREQ=299.79246) (WNUM=10000.000) | WL=1000.0000 (FREQ=119.91698) (WNUM=4000.000) |
| Line Marker  3 (Off/On) | | Off | LOG=50.00 (LINEAR=1.000E+05 mW) | LOG=-210.00 (LINEAR=0.000pW) |
| Line Marker  4 (Off/On) | | Off | LOG=50.00 (LINEAR=1.000E+05 mW) | LOG=-210.00 (LINEAR=0.000pW) |
| Marker Display | | Offset | - | - |
| Marker Auto Update (Off/On) | | Off | - | - |
| Marker Unit (nm/THz) | | nm | - | - |
| Search/Ana Marker L1-L2 (Off/On) | | Off | - | - |
| Search/Ana Zoom Area Off/On | | On | - | - |
| Sweep Marker L1-L2 (Off/On) | | Off | - | - |

## PEAK SEARCH

| Function | | Default value | Maximum value | Minimum value |
|---|---|---|---|---|
| Peak Search | | On | - | - |
| Bottom Search | | Off | - | - |
| Set Marker | | 1 | 1024 | 1 |
| Auto Search (Off/On) | | Off | - | - |
| Mode Diff | | 3.00 | 50.00 | 0.01 |
| Search/Ana Marker L1-L2 (Off/On) | | Off | - | - |
| Search/Ana Zoom Area (Off/On) | | On | - | - |
| Search Mode SINGL/MULTI | | SINGL | - | - |
| Multi Search Setting | Threshold | 50.00 | 99.99 | 0.01 |
| | Sort by (WL/LVL) | WL | - | - |

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## ANALYSIS

| Function | | Default value | Maximum value | Minimum value |
|---|---|---|---|---|
| Spec Width | | THRESH | - | - |
| Analysis 1 | | DFB-LD | - | - |
| Analysis 2 | | WDM | - | - |
| Spec Width Thresh | | 3.00 | 50.00 | 0.01 |
| (Switch Display) | TRACE&TABLE/TABLE/ TRACE/GRAPH&TABLE/ GRAPH | TRACE&TABLE | - | - |
| Auto Analysis (Off/On) | | Off | - | - |
| Search/Ana L1-L2 (Off/On) | | Off | - | - |
| Search/Ana Zoom Area (Off/On) | | On | - | - |
| Grid Setting | Start | 1528.773 | 2398.340 | 1200.000 |
| | Stop | 1560.606 | 2398.340 | 1200.000 |
| | Reference Frequency | 192.10 | 250.00 | 125.00 |
| | Spacing | 50.000 | 999.999 | 0.100 |

**Parameter Setting**

| | Function | Default value | Maximum value | Minimum value |
|---|---|---|---|---|
| THRESH | THRESH LEVEL | 3.00 | 50.00 | 0.01 |
| | K | 1.00 | 10.00 | 1.00 |
| | MODE FIT | OFF | - | - |
| ENVELOPE | THRESH LEVEL1 | 3.00 | 50.00 | 0.01 |
| | THRESH LEVEL2 | 13.00 | 50.00 | 0.01 |
| | K | 1.00 | 10.00 | 1.00 |
| RMS | THRESH LEVEL | 20.00 | 50.00 | 0.01 |
| | K | 2.35 | 10.00 | 1.00 |
| PEAK RMS | THRESH LEVEL | 20.00 | 50.00 | 0.01 |
| | K | 2.35 | 10.00 | 1.00 |
| NOTCH | THRESH LEVEL | 3.00 | 50.00 | 0.01 |
| | K | 1.00 | 10.00 | 1.00 |
| | TYPE | BOTTOM | - | - |
| DFB-LD / -XdB CENTER/WIDTH | ALGO (ENVELOPE/THRESH/ RMS/PK-RMS) | THRESH | - | - |
| | THRESH | 20.00 | 50.00 | 0.01 |
| | (THRESH2) | 20.00 | 50.00 | 0.01 |
| | K | 1.00 | 10.00 | 1.00 |
| | MODE FIT (ON/OFF) | OFF | - | - |
| | MODE DIFF | 3.00 | 50.00 | 0.01 |
| DFB-LD / SMSR | SMSR MODE (SMSR1/SMSR2/ SMSR3/SMSR4) | SMSR1 | - | - |
| | SMSR MASK | 0.00 | 99.99 | 0.00 |
| | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | SIDE MODE POWER (TRACE DATA/NORMALIZED | TRACE DATA | - | - |
| | (BANDWIDTH) | 0.10 | 1.00 | 0.01 |
| DFB-LD / RMS | ALGO (RMS/PK RMS) | RMS | - | - |
| | THRESH | 20.00 | 50.00 | 0.01 |
| | K | 2.35 | 10.00 | 1.00 |
| | (MODE DIFF) | 3.00 | 50.00 | 0.01 |
| DFB-LD / POWER | SPAN | 0.40 | 500.00 | 0.01 |
| DFB-LD / OSNR | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | NOISE ALGO (AUTO-FIX/ MANUAL-FIX/AUTO-CTR/ MANUAL-CTR/PIT) | PIT | - | - |
| | NOISE AREA | PIT | - | - |
| | (MASK AREA) | - | - | - |
| | (FITTING ALGO (LINEAR/ GAUSS/LORENZ/3RD POLY/4TH POLY/5TH POLY)) | - | - | - |
| | NOISE BW | 0.10 | 1.00 | 0.01 |
| | SIGNAL POWER | PEAK | - | - |
| | (INTEGRAL RANGE) | 10.0 | 999.9 | 1.0 |

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| | | Function | Default value | Maximum value | Minimum value |
|---|---|---|---|---|---|
| FP-LD | SPECTRUM WIDTH | ALGO (ENVELOPE/THRESH/ RMS/PK-RMS) | PK-RMS | - | - |
| | | THRESH | 20.00 | 50.00 | 0.01 |
| | | (THRESH2) | 20.00 | 50.00 | 0.01 |
| | | K | 2.35 | 10.00 | 1.00 |
| | | (MODE FIT (ON/OFF)) | OFF | - | - |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | MEAN WAVELENGTH | ALGO (ENVELOPE/THRESH/RMS/PK-RMS) | PK-RMS | - | - |
| | | THRESH | 20.00 | 50.00 | 0.01 |
| | | (THRESH2) | 20.00 | 50.00 | 0.01 |
| | | K | 2.35 | 10.00 | 1.00 |
| | | (MODE FIT (ON/OFF)) | OFF | - | - |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | TOTAL POWER | OFFSET LEVEL | 0.00 | 10.00 | -10.00 |
| | MODE NO. | ALGO (ENVELOPE/THRESH/ RMS/PK-RMS) | PK-RMS | - | - |
| | | THRESH | 20.00 | 50.00 | 0.01 |
| | | (THRESH2) | 20.00 | 50.00 | 0.01 |
| | | K | 2.35 | 10.00 | 1.00 |
| | | (MODE FIT (ON/OFF)) | OFF | - | - |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| LED | SPECTRUM WIDTH | ALGO (ENVELOPE/THRESH/ RMS/PK-RMS) | THRESH | - | - |
| | | THRESH | 3.00 | 50.00 | 0.01 |
| | | (THRESH2) | 20.00 | 50.00 | 0.01 |
| | | K | 1.00 | 10.00 | 1.00 |
| | | MODE FIT (ON/OFF) | OFF | - | - |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | MEAN WAVELENGTH | ALGO (ENVELOPE/THRESH/ RMS/PK-RMS) | RMS | - | - |
| | | THRESH | 20.00 | 50.00 | 0.01 |
| | | (THRESH2 ) | 20.00 | 50.00 | 0.01 |
| | | K | 2.35 | 10.00 | 1.00 |
| | | MODE FIT (ON/OFF) | OFF | - | - |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | TOTAL POWER | OFFSET LEVEL | 0.00 | 10.00 | -10.00 |
| | SMSR | SMSR MODE (SMSR1/SMSR2/ SMSR3/SMSR4) | SMSR1 | - | - |
| | | SMSR MASK | 0.00 | 99.99 | 0.00 |
| | | SIDE MODE POWER (TRACE DATA/NORMALIZED) | TRACE DATA | - | - |
| | | (BANDWIDTH) | 0.10 | 1.00 | 0.01 |
| | | Mode Diff | 3.00 | 50.00 | 0.01 |
| POWER | | POWER OFFSET | 0.00 | 10.00 | -10.00 |

| | | Function | Default value | Maximum value | Minimum value |
|---|---|---|---|---|---|
| WDM | CHANNEL DETECTION SETTING | THRESH LEVEL | 20.0 | 99.9 | 0.1 |
| | | MODE DIFF | 3.0 | 50.0 | 0.1 |
| | | DISPLAY MASK | OFF | 0.0 | -100.0 |
| | INTERPOLATION SETTING | NOISE ALGO (AUTO-FIX/MANUAL-FIX/ AUTO-CTR/MANUAL-CTR/PIT) | AUTO-FIX | - | - |
| | | NOISE AREA | AUTO | 10.00 | 0.01 |
| | | (MASK AREA) | - | - | - |
| | | (FITTING ALGO (LINEAR/ GAUSS/LORENZ/3RD POLY/4TH POLY/5TH POLY)) | LINEAR | - | - |
| | | NOISE BW | 0.10 | 1.00 | 0.01 |
| | | DUAL TRACE (ON/OFF) | OFF | - | - |
| | DISPLAY SETTING | DISPLAY TYPE (ABSOLUTE/ RELATIVE/ DRIFT(MEAS)/DRIFT(GRID)) | ABSOLUTE | - | - |
| | | CH RELATION (OFFSET/ SPACING) | OFFSET | - | - |
| | | REF CH | HIGHEST | 1024 | 1 |
| | | OUTPUT SLOPE (ON/OFF) | OFF | - | - |
| | | POINT DISPLAY (ON/OFF) | ON | - | - |
| | OTHER SETTING | SIGNAL POWER (PEAK/ INTEGRAL) | PEAK | - | - |
| | | (INTEGRAL RANGE) | 10.0 | 999.9 | 1.0 |
| EDFA-NF | CHANNEL DETECTION SETTING | THRESH LEVEL | 20.0 | 99.9 | 0.1 |
| | | MODE DIFF | 3.0 | 50.0 | 0.1 |
| | INTERPOLATION SETTING | OFFSET(IN) | 0.00 | 99.99 | -99.99 |
| | | OFFSET(OUT) | 0.00 | 99.99 | -99.99 |
| | | ASE ALGO (AUTO-FIX/ MANUAL-FIX/AUTO-CTR/ MANUAL-CTR) | AUTO-FIX | - | - |
| | | FITTING AREA | AUTO | 10.00 | 0.01 |
| | | (MASK AREA) | - | - | - |
| | | (FITTING ALGO (LINEAR/ GAUSS/LORENZ/3RD POLY/4TH POLY/5TH POLY)) | LINEAR | - | - |
| | | POINT DISPLAY ON/OFF | ON | - | - |
| | NF CALCULATION SETTING | RES BW (MEASURED/CAL DATA) | CAL DATA | - | - |
| | | SHOT NOISE (ON/OFF) | ON | - | - |
| | OTHER SETTING | SIGNAL POWER (PEAK/ INTEGRAL) | PEAK | - | - |
| | | (INTEGRAL RANGE) | 10.0 | 999.9 | 1.0 |

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| | | Function | Default value | Maximum value | Minimum value |
|---|---|---|---|---|---|
| FILTER-PK | PEAK LEVEL | SW (ON/OFF) | ON | - | - |
| | PEAK WAVE LENGTH | SW (ON/OFF)) | ON | - | - |
| | CENTER WAVELENGTH | SW (ON/OFF) | ON | - | - |
| | | ALGO (THRESH/RMS) | THRESH | - | - |
| | | THRESH LEVEL | 3.00 | 50.00 | 0.01 |
| | | K | 1.00 | 10.00 | 1.00 |
| | | MODE FIT (ON/OFF) | OFF | - | - |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | SPECTRUM WIDTH | SW (ON/OFF) | ON | - | - |
| | | ALGO (THRESH/RMS) | THRESH | - | - |
| | | THRESH LEVEL | 3.00 | 50.00 | 0.01 |
| | | K | 1.00 | 10.00 | 1.00 |
| | | MODE FIT (ON/OFF) | OFF | - | - |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | RIPPLE WIDTH | SW (ON/OFF) | ON | - | - |
| | | THRESH LEVEL | 3.00 | 50.00 | 0.01 |
| | | MODE DIFF | 0.500 | 50.000 | 0.001 |
| | CROSS TALK | SW (ON/OFF) | ON | - | - |
| | | ALGO (THRESH/PK LEVEL/ GRID) | THRESH | - | - |
| | | THRESH LEVEL | 3.00 | 50.00 | 0.01 |
| | | K | 1.00 | 10.00 | 1.00 |
| | | MODE FIT (ON/OFF) | OFF | - | - |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | | CH SPACE | 0.40 | 50.00 | 0.00 |
| | | (SEARCH AREA) | 0.01 | 10.00 | 0.01 |
| FILTER-BTM | BOTTOM LEVEL | SW (ON/OFF) | ON | - | - |
| | BOTTOM WAVE LENGTH | SW (ON/OFF) | ON | - | - |
| | CENTER WAVE LENGTH | SW (ON/OFF) | ON | - | - |
| | | ALGO (PEAK/BOTTOM) | BOTTOM | - | - |
| | | THRESH LEVEL | 3.00 | 50.00 | 0.01 |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | NOTCH WIDTH | SW (ON/OFF) | ON | - | - |
| | | ALGO (PEAK/BOTTOM) | BOTTOM | - | - |
| | | THRESH LEVEL | 3.00 | 50.00 | 0.01 |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | CROSS TALK | SW (ON/OFF) | ON | - | - |
| | | ALGO (PEAK/BOTTOM/ BOTTOM LVL/GRID) | BOTTOM | - | - |
| | | THRESH LEVEL | 3.00 | 50.00 | 0.01 |
| | | MODE DIFF | 3.00 | 50.00 | 0.01 |
| | | CH SPACE | 0.40 | 50.00 | 0.00 |
| | | (SEARCH AREA) | 0.01 | 10.00 | 0.01 |

| | | Function | Default value | Maximum value | Minimum value |
|---|---|---|---|---|---|
| WDM FIL-PK | CHANNEL DETECTION/ NOMINAL WAVELENGTH | ALGO (PEAK/MEAN/GRID FIT/ GRID) | MEAN | - | - |
| | | THRESH LEVEL | 20.0 | 99.9 | 0.1 |
| | | MODE DIFF | 3.0 | 50.0 | 0.1 |
| | | (TEST BAND) | 0.100 | 9.999 | 0.001 |
| | PEAK WAVELENGTH / LEVEL | SW (ON/OFF) | ON | - | - |
| | XdB WIDTH/ CENTER WAVELENGTH | SW ON/OFF | ON | - | - |
| | | THRESH LEVEL | 3.0 | 50.0 | 0.1 |
| | XdB STOP BAND | SW (ON/OFF) | ON | - | - |
| | | THRESH LEVEL | -10.000 | 30.000 | -90.000 |
| | XdB PASS BAND | SW (ON/OFF) | ON | - | - |
| | | THRESH LEVEL | 3.0 | 50.0 | 0.1 |
| | | TEST BAND | 0.20 | 99.99 | 0.01 |
| | RIPPLE | SW (ON/OFF) | ON | - | - |
| | | TEST BAND | 0.20 | 99.99 | 0.01 |
| | CROSS TALK | SW (ON/OFF) | ON | - | - |
| | | SPACING | 0.80 | 99.99 | 0.01 |
| | | TEST BAND | 0.20 | 99.99 | 0.01 |
| WDM FIL-BTM | CHANNEL DETECTION / NOMINAL WAVELENGTH | ALGO (BOTTOM/NOTCH(P)/ NOTCH(B)/GRID FIT/GRID) | NOTCH(B) | - | - |
| | | THRESH LEVEL | 20.0 | 99.9 | 0.1 |
| | | MODE DIFF | 3.0 | 50.0 | 0.1 |
| | | (TEST BAND) | 0.100 | 9.999 | 0.001 |
| | BOTTOM WAVELENGTH / LEVEL | SW (ON/OFF) | ON | - | - |
| | XdB NOTCH WIDTH / CENTER WAVELENGTH | SW (ON/OFF) | ON | - | - |
| | | ALGO (NOTCH(P)/NOTCH(B)) | NOTCH(B) | - | - |
| | | THRESH LEVEL | 3.0 | 50.0 | 0.1 |
| | XdB STOP BAND | SW (ON/OFF) | ON | - | - |
| | | THRESH LEVEL | -10.000 | 30.000 | -90.000 |
| | XdB ELIMINATION BAND | SW (ON/OFF) | ON | - | - |
| | | THRESH LEVEL | 3.0 | 50.0 | 0.1 |
| | | TEST BAND | 0.20 | 99.99 | 0.01 |
| | RIPPLE | SW (ON/OFF) | ON | - | - |
| | | TEST BAND | 0.20 | 99.99 | 0.01 |
| | CROSS TALK | SW (ON/OFF) | ON | - | - |
| | | SPACING | 0.80 | 99.99 | 0.01 |
| | | TEST BAND | 0.20 | 99.99 | 0.01 |

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**System Setup**

# FILE

| Function | | | Default value | Maximum value | Minimum value |
|---|---|---|---|---|---|
| Save | DRIVE INT/EXT | | INT | - | - |
| | Trace | File Type | Binary | - | - |
| | All Trace | File Type | CSV | - | - |
| | Graphics | Black&White/ Color/Preset Color | Color | - | - |
| | | File Type | PNG | - | - |
| | Data | Date Time | ON | - | - |
| | | Label | ON | - | - |
| | | Data Area | ON | - | - |
| | | Condition | ON | - | - |
| | | Trace Data | OFF | - | - |
| | | Write Mode | Overwrite | | |
| Item Select | | | Trace | - | - |
| Auto File Name (Num/Date) | | | Num | | |

## SYSTEM

| Function | | | Default value | Maximum value | Minimum value |
|---|---|---|---|---|---|
| Wavelength Calibration | (External Laser) | Standard model Limited model | 1523.488,  OFF | 2400.000 | 1200.000 |
| | | Extended model | | 2500.000 | 1000.000 |
| | (External Gas Cell) | Standard model Limited model | 1530.372, OFF | 2400.000 | 1200.000 |
| | | Extended model | | 2500.000 | 1000.000 |
| Wavelength Shift | | | 0.000 | 5.000 | -5.000 |
| Level Shift | | | 0.000 | 60.000 | -60.000 |
| Wavelength in (Air/Vacuum) | | | Vacuum | - | - |
| Remote Interface | | | GP-IB | - | - |
| GP-IB Setting | My Address | | 1 | 30 | 0 |
| | Command Format | | AQ6375E | - | - |
| Network Setting | TCP/IP Setting* | IPv4 SETTING | AUTO | - | - |
| | | IPv6 SETTING | DISABLE | - | - |
| | Remote Port No. | | 10001 | 65535 | 1024 |
| | Command Format | | AQ6375E | - | - |
| | Remote User Account* | | anonymous | - | - |
| | Remote Monitor | Monitor Port (Off/On) | On | - | - |
| | | Port No. | 20001 (FIX) | - | - |
| | Folder Sharing | | Disable | | |
| | TIMEOUT | | Infinite | 21600 | 0 (Infinite) |
| Trig Input Mode | | | Smpl Trig | - | - |
| Trig Output Mode | | | Off | - | - |
| Auto Offset Setting | Auto Offset  (Off/On) | | On | - | - |
| | Interval | | 10 | 999 | 10 |
| Uncal Warning (Off/On) | | | On | - | - |
| Buzzer | Click (Off/On) | | On | - | - |
| | Warning (Off/On) | | On | - | - |
| Level Display Digit | | | 2 | 3 | 1 |
| Color Mode (Color/B&W) | | | Color | - | - |
| Language | | | English | - | - |
| Set Clock | YR-MO-DY | | On | - | - |
| | MO-DY-YR | | Off | - | - |
| | DY-MO-YR | | Off | - | - |

*: Will not be initialized.

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System Setup

# Appendix 1   Grid Table for WDM Wavelength

Some analytical functions refer to the grid table for analysis (see the following table). The instrument has a table of nominal center frequencies specified by the ITU-T (International Telecommunication Union-Telecommunication sector) G692.

**List of analytical functions with grid tables**

| Function | Item | Parameter name | Parameter |
|---|---|---|---|
| WDM | DISPLAY SETTING | DISPLAY TYPE | DRIFT(GRID) |
| FILTER PEAK | CROSS TALK | ALGO | GRID |
| FILTER BOTTOM | CROSS TALK | ALGO | GRID |
| WDM FILTER PEAK | CHANNEL DETECTION/ | ALGO | GRIF FIT |
|  | NOMINAL WAVELENGTH |  | GRID |
| WDM FILTER BOTTOM | CHANNEL DETECTION/ | ALGO | GRIF FIT |
|  | NOMINAL WAVELENGTH |  | GRID |

*Note*

The unit of the wavelength axis in the grid tables can be set to wavelength or frequency using the MARKER UNIT setting.

The following table shows the parameter ranges.

**Standard Model (-10) and Limited model (-01)**

| Type | Parameter range |
|---|---|
| Start frequency | 125.0000~250.0000THz |
| Stop frequency | 125.0000~250.0000THz |
| Reference frequency | 125.00~250.00THz |
| Frequency spacing | 0.100~999.999GHz |

**Extended model (-20)**

| Type | Parameter range |
|---|---|
| Start frequency | 120.0000~300.0000THz |
| Stop frequency | 120.0000~300.0000THz |
| Reference frequency | 120.00~300.00THz |
| Frequency spacing | 0.100~999.999GHz |

This is a grid table that users can edit.

It is created automatically by setting the start/stop wavelength (frequency), reference wavelength (frequency), and frequency spacing.

**App**

**Appendix**

# Appendix 2   Data Calculation Algorithms for Spectrum Widths

The instrument can calculate spectrum widths of waveforms being displayed. This section provides four types of spectrum width calculation methods as well as algorithms for the notch width calculation.

## THRESH method

This method is used to obtain the spectrum widths of two points, which are lower than the peak level by a threshold value (THRESH [dB]) specified by a parameter, as well as their center wavelengths.
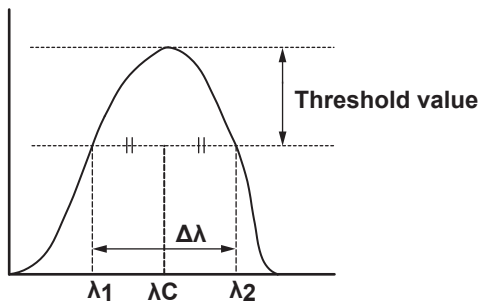The following table shows the details of the parameters of the THRESH method.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|---|---|---|---|---|---|
| THRESH | TH | 3.00 | 0.01 to 50.00 | dB | Threshold value |
| K | K | 1.00 | 1.00  to 10.00 | - | Multiplying factor |
| MODE FIT | MODE FIT | OFF | ON / OFF | - | Sets whether the half of maximum point is aligned to the mode peak. |

Algorithms differ depending on the number of mode peaks. Algorithms for these numbers are described below.

**One mode peak**



- A mode search is performed to obtain the mode peaks.
- Wavelengths, which cross the line below the mode peak by the threshold value (THRESH[dB]), are assigned to $\lambda 1$ and $\lambda 2$.
- New $\lambda 1$ and $\lambda 2$ are obtained by multiplying factor K to the original $\lambda 1$ and $\lambda 2$ according to the following equations.
  $\lambda'C = (\lambda 2 + \lambda 1)/2$
  $\lambda 1 = K \times (\lambda 1 - \lambda'C) + \lambda'C$
  $\lambda 2 = K \times (\lambda 2 - \lambda'C) + \lambda'C$
- The spectral width is determined from the following equation.
  $\Delta\lambda = \lambda 2 - \lambda 1$
- Center wavelength $\lambda C$ is determined from the following equation.
  $\lambda C = (\lambda 2 + \lambda 1)/2$

*Note*
> If "MODE FIT" is set to ON for one mode peak, the spectral width $\Delta\lambda$ and the center wavelength $\lambda C$ will become as follows.
>   $\Delta\lambda = 0.0000$ nm
>   $\lambda C$ = mode peak wavelength

**Two or more mode peaks**
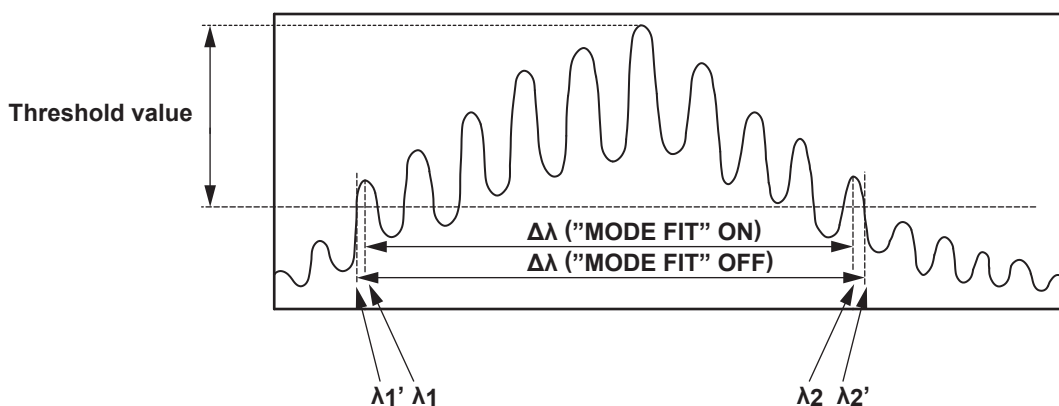


- If "MODE FIT" is ON, the wavelengths of the mode peaks, which are outermost from the threshold value (THRESH[dB]) among the mode peaks, are assigned to λ1 and λ2.
  If "MODE FIT" is OFF, the wavelengths, which are located outside λ1 and λ2, and which cross the line below the mode peak with the largest mode peak level by the threshold value (THRESH[dB]), are assigned to λ'1 and λ'2.

- If "MODE FIT" is ON, New λ1 and λ2 are obtained by multiplying factor K to the original λ1 and λ2 according to the following equations.

  When "MODE FIT" is ON
  $λ'C = (λ2 + λ1)/2$
  $λ1 = K × (λ1 − λ'C) + λ'C$
  $λ2 = K × (λ2 − λ'C) + λ'C$

  When "MODE FIT" is OFF
  $λ'C = (λ'2 + λ'1)/2$
  $λ'1 = K × (λ'1 − λ'C) + λ'C$
  $λ'2 = K × (λ'2 − λ'C) + λ'C$

- The spectral width is determined from the following equation.
  $Δλ = λ2 − λ1$ (when "MODE FIT" is ON)
  $Δλ = λ'2 − λ'1$ (when "MODE FIT" is OFF)

- Center wavelength λC is determined from the following equation.
  $λC = (λ2 + λ1)/2$ (when "MODE FIT" is ON)
  $λC = (λ'2 + λ'1)/2$ (when "MODE FIT" is OFF)

MODE displayed in the data area are to be the number of mode peaks between λ1 and λ2.

**App**

**Appendix**

# ENVELOPE (envelope curve) method

This method is used in conjunction with a straight line (envelope) connecting mode peaks to obtain the spectrum widths of the two points, which are lower than the peaks by a configured threshold value (THRESH [dB]), as well as their center wavelengths.

The following table shows the details of the parameters of the ENVELOPE method.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|---|---|---|---|---|---|
| THRESH 1 | TH1 | 3.00 | 0.01 to 50.00 | dB | Threshold value |
| THRESH 2 | TH2 | 13.00 | 0.01 to 50.00 | dB | Threshold value when the number of modes is calculated |
| K | K | 1.00 | 1.00 to 10.00 | - | Multiplying factor |

Algorithms differ depending on the number of valid mode peaks.

Valid mode peaks mean the mode peaks, among the mode peaks obtained from a mode search, whose level (LOG) is equal to or greater than the line that is below the peak level by the lower limit (THRESH2).

Algorithms for these numbers of valid modes are described below.

**One valid mode peak**



- A mode search is performed to obtain the mode peaks.
- Wavelengths, which cross the line below the mode peak by the threshold value (THRESH 1[dB]), are assigned to λ1 and λ2.
- New λ1 and λ2 are obtained by multiplying factor K to the original λ1 and λ2 according to the following equations.

  $λ'C=(λ2+λ1)/2$

  $λ1 = K × (λ1 − λ'C) + λ'C$

  $λ2 = K × (λ2 − λ'C) + λ'C$

- The spectral width is determined from the following equation.

  $Δλ = λ2 − λ1$

- Center wavelength λC is determined from the following equation.

  $λC=(λ2+λ1)/2$

**Two valid mode peaks**



- The levels (LOG) of the two valid mode peaks are assigned to LG1 and LG2 in order from the left.

- $\lambda 1$ and $\lambda 2$ are determined using the following method.
- When $|LG2 - LG1| \leq$ threshold value (THRESH 1[dB]), $\lambda$ becomes $\lambda 1$ and $\lambda 2$ from the left.
- When $|LG2 - LG1| >$ threshold value (THRESH 1[dB])
  Two valid mode peaks are connected with a straight line (envelope).
  If LG1>LG2, the wavelength for the left mode peak is assigned to $\lambda 1$. The wavelength of the point where the line below the peak level by the threshold value (THRESH 1[dB]) and the straight line (envelope) cross is assigned to $\lambda 2$.
  If LG1<LG2, the wavelength for the right mode peak is assigned to $\lambda 2$. The wavelength of the point where the line below the peak level by the threshold value (THRESH 1[dB]) and the straight line (envelope) cross is assigned to $\lambda 1$.

- New $\lambda 1$ and $\lambda 2$ are obtained by multiplying factor K to the original $\lambda 1$ and $\lambda 2$ according to the following equations.
  $\lambda'C = (\lambda 2 + \lambda 1)/2$
  $\lambda 1 = K \times (\lambda 1 - \lambda'C) + \lambda'C$
  $\lambda 2 = K \times (\lambda 2 - \lambda'C) + \lambda'C$

- The spectral width is determined from the following equation.
  $\Delta\lambda = \lambda 2 - \lambda 1$

- Center wavelength $\lambda C$ is determined from the following equation.
  $\lambda C = (\lambda 2 + \lambda 1)/2$

**App**

**Appendix**

**Three or more valid mode peaks**
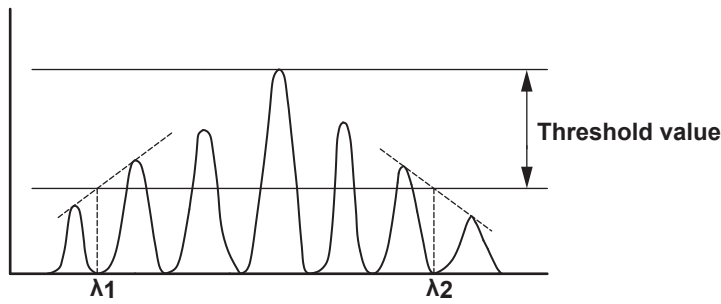


*   The levels (LOG) of three or more valid mode peaks are assigned to LG1, LG2, . . ., LGn in order from the left. The level of the mode peak at the highest level is assigned to LGp.

*   λ1 is obtained using the following method.
*   When |LGp-LG1| ≤  threshold value (THRESH1[dB])
    The wavelength of the LG1 mode peak is assigned to λ1.
*   When |LGp-LG1| >  threshold value (THRESH1[dB])
    i          The leftmost mode peak that is greater than |LGp-THRESH1| is determined.
    ii         The mode peak obtained in (i) and the highest mode peak on the left of (i) are
               connected with a straight line.
    iii        The point where the line of |LGp−THRESH1| and the straight line (envelope) cross is
    assigned to λ1.

*   λ2 is obtained using the following method.
*   When |LGp-LGn| ≤  threshold value (THRESH1[dB])
    The wavelength of the LG1 mode peak is assigned to λ2.
*   When |LGp-LGn| >  threshold value (THRESH1[dB])
    i          The rightmost mode peak that is greater than |LGp-THRESH1| is determined.
    ii         The mode peak obtained in (i) and the highest mode peak on the right of (i) are
               connected with a straight line.
    iii        The point where the line of |LGp−THRESH1| and the straight line (envelope) cross is
    assigned to λ2.

*   New λ1 and λ2 are obtained by multiplying factor K to the original λ1 and λ2 according to the
    following equations.
    λ'C=(λ2+λ1)/2
    λ1 = K × (λ1 − λ'C) + λ'C
    λ2 = K × (λ2 − λ'C) + λ'C

*   The spectral width is determined from the following equation.
    Δλ = λ2 − λ1
*   Center wavelength λC is determined from the following equation.
    λC=(λ2+λ1)/2

# RMS method

The RMS method is used to obtain the spectrum width and its center wavelength.

The following table shows the details of the parameters of the RMS method.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|-----------|--------------|---------------|-------|------|-------------|
| THRESH | TH | 20.00 | 0.01 to 50.00 | dB | Threshold value |
| K | K | 2.35 | 1.00 to 10.00 | - | Multiplying factor |

The algorithm is described below.
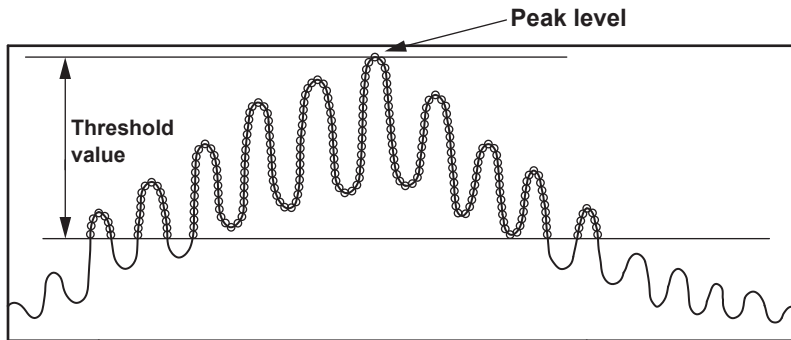


- The data points lying between the threshold value TH and peak level, within the displayed waveform, are removed, and the spectrum width is determined by the following calculation.
- When the wavelength at each point is λi and the level at each point is Pi, the mean wavelength λc can be found by the following expression.

$$\lambda c = \frac{\sum P_i \times \lambda_i}{\sum P_i}$$

- Mean wavelength λc found above is used to find spectrum width Δλ with the following expression.

$$\Delta \lambda = K \times \sqrt{\frac{\sum P_i \times (\lambda_i - \lambda_c)^2}{\sum P_i}}$$

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# PEAK RMS method

The PEAK RMS method is used to obtain the spectrum width and its center wavelength.

The following table shows the details of the parameters of the PEAK RMS method.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|-----------|--------------|---------------|-------|------|-------------|
| THRESH | TH | 20.00 | 0.01 to 50.00 | dB | Threshold value |
| K | K | 2.35 | 1.00 to 10.00 | - | Multiplying factor |

The algorithm is described below.
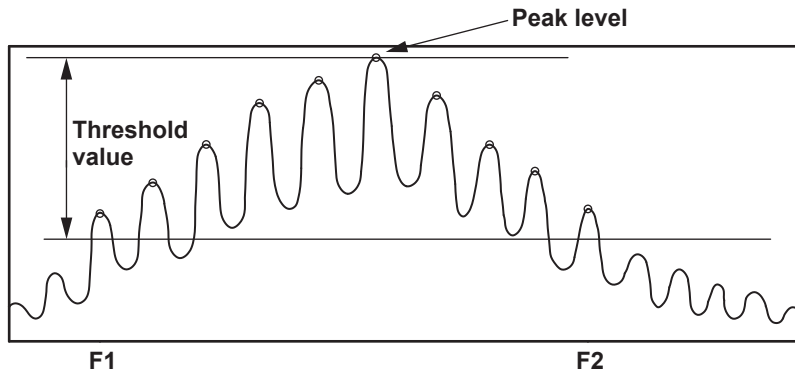


- The mode peaks lying between the threshold value TH and peak level, within the displayed waveform, are removed, and the spectrum width is determined by the following calculation. MODE NUM in the data area shows the number of mode peaks exceeding the threshold value TH.

- When the wavelength at each point is $\lambda_i$ and the level at each point is $P_i$, the mean wavelength $\lambda_c$ can be found by the following expression.

$$\lambda c = \frac{\sum P_i \times \lambda_i}{\sum P_i}$$

- Mean wavelength $\lambda_c$ found above is used to find spectrum width $\Delta\lambda$ with the following expression.

$$\Delta\lambda = K \times \sqrt{\frac{\sum P_i \times (\lambda_i - \lambda_c)^2}{\sum P_i}}$$

# NOTCH width measurement

The bottom level is determined, and the NOTCH width for the bottom level and its center wavelength are determined.

The following table shows the details of NOTCH analysis parameters.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|-----------|--------------|---------------|-------|------|-------------|
| THRESH | TH | 3.00 | 0.01 to 50.00 | dB | Threshold value |
| K | K | 1.00 | 1.00 to 10.00 | - | Multiplying factor |
| TYPE | TYPE | BOTTOM | BOTTOM / PEAK | - | Reference position for searching |

The algorithm is described below. The algorithm differs depending on the analysis type (BOTTOM or PEAK). The algorithms for each type of analysis are described below.

**When "TYPE" is BOTTOM**
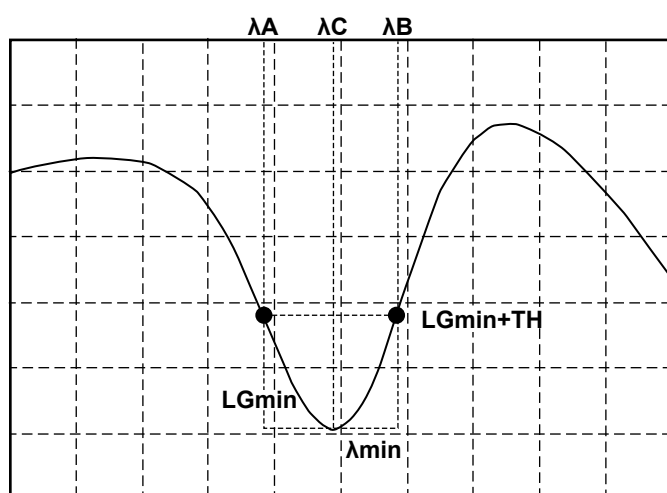


- The minimum level "LGmin" is obtained. The wavelength of this point assigned to λmin.
- The rightmost wavelength located on the left of λmin and that crosses the level (LOG) of |LGmin + threshold value (THRESH[dB])| is assigned to λA.
- Set the leftmost wavelength located on the right of λmin and that crosses the level (LOG) of |LGmin + threshold value (THRESH[dB])| is assigned to λB.
- New λA and λB are obtained by multiplying factor K.
  λ'C=(λB+λA)/2
  λA = K × (λA − λ'C) + λ'C
  λB = K × (λB − λ'C) + λ'C
- The notch width is determined from the following equation.
  Δλ = λA − λB
- Center wavelength λC is determined from the following equation.
  λC=(λA+λB)/2

**When "TYPE" is PEAK**
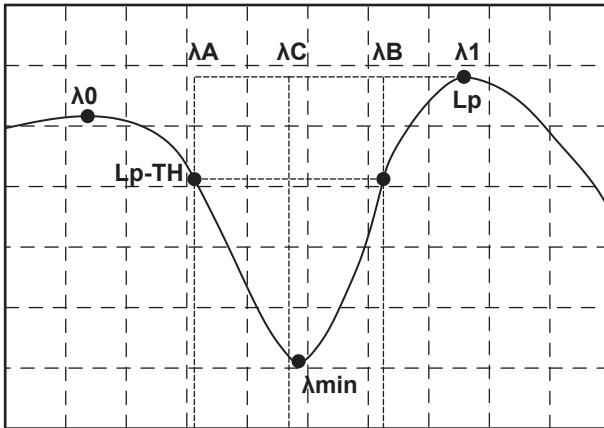


- The minimum level "LGmin" is obtained. The wavelength of this point assigned to λmin.
- LG0 at the peak level (LOG) on the left of LGmin is determined. The wavelength of this point assigned to λ0.
- LG1 at the peak level (LOG) on the right of LGmin is determined. The wavelength of this point assigned to λ1.
- The larger of the two levels, LG0 or LG1, is assigned to Lp.
- The leftmost wavelength between λ0 and λ1 crossing the level (LOG) of |Lp−threshold value (THRESH[dB])| is assigned to λA.
- The rightmost wavelength between λ0 and λ1 crossing the level (LOG) of |Lp−threshold value (THRESH[dB])| is assigned to λB.
- New λA and λB are obtained by multiplying factor K.
  λ'C=(λB+λA)/2
  λA = K × (λA − λ'C) + λ'C
  λB = K × (λB − λ'C) + λ'C
- The notch width is determined from the following equation.
  Δλ = λA − λB
- Center wavelength λC is determined from the following equation.
  λC=(λA+λB)/2

# Appendix 3  Details of Each Analytical Function

This section describes the algorithms of analyses available under ANALYSIS 1.

ANALYSIS 1 provides such functions as collective analysis of various light sources, power analysis, SMSR analysis, and PMD analysis.

## SMSR analysis function

The optical spectrum after the measurement of DFB-LD is used to analyze the SMSR (Side Mode Suppression Ratio) of DFB-LD. The following table shows the details of SMSR analysis parameters.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|---|---|---|---|---|---|
| SMSR MODE | MODE | SMSR1 | SMSR1/SMSR2/SMSR3/SMSR4 | - | Execution mode during SMSR measurement |
| SMSR MASK | MASK | ±0.00 | 0.00 to 99.99 | nm | Setting of near-peak mask range during SMSR1 or SMSR3 measurement |
| SIDE MODE POWER | - | TRACE DATA | NORMALIZED or TRACE DATA | - | Whether to normalize the power value of the side mode with the resolution bandwidth |
| BANDWIDTH | - | 0.10 | 0.01 to 3.00 | nm | Resolution bandwidth setting (available only when SIDE MODE NORM is ON) |
| MODE DIFF | - | 3 | 0.01 to 50.00 | dB | Minimum value for peak/bottom difference detection. |

The algorithm differs depending on the SMSR mode.

The analysis algorithms of each mode are described below.

### SMSR1

The main mode is defined as the highest mode peak. The side mode is defined as the highest mode peak outside of the mask area.

The analysis algorithm for the SMSR1 mode is as follows:

*1.* A mode search is performed to determine the mode peak.

*2.* The wavelength of the main mode is assigned to λA.

*3.* The wavelength of the side mode is assigned to λB.

If relevant points do not exist, the wavelength of the highest level outside of the mask area is assigned to λB.

If there are multiple wavelengths that can be assigned to λB, the leftmost wavelength is assigned to λB.

The side mode level LB is determined.

- When the SIDE MODE POWER parameter is TRACE DATA

    Level where LB = λB

- When the SIDE MODE POWER parameter is NORMALIZED

    A value obtained by normalizing the level where LB = λB by the resolution bandwidth

*4.* The levels (linear values) of λA and λB are assigned to LA and LB, respectively.

*5.* SMSR and Δλ are determined from the following equations.

SMSR=LA/LB

Δλ = λB − λA

## SMSR2

The main mode is defined as the highest mode peak. The side mode is defined as the highest mode peak adjacent to the main mode.



The analysis algorithm for the SMSR2 mode is as follows:

*1.* A mode search is performed to determine the mode peak.

*2.* The wavelength of the main mode is assigned to λA.

*3.* The wavelength of the side mode is assigned to λB.

If there are no mode peaks other than the one whose wavelength has been assigned to λA, λB is assigned to λA.

The side mode level LB is determined.

- When the SIDE MODE POWER parameter is TRACE DATA

    Level where LB = λB

- When the SIDE MODE POWER parameter is NORMALIZED

    A value obtained by normalizing the level where LB = λB by the resolution bandwidth

4. The levels (linear values) of λA and λB are assigned to LA and LB, respectively.

5. SMSR and Δλ are determined from the following equations.

SMSR=LA/LB

Δλ = λB – λA

**SMSR3**

The main mode is defined as the highest mode peak. The side modes are defined as the highest mode peaks outside of the mask area—one on the left side and one on the right side of the mask area.



The analysis algorithm for the SMSR3 mode is as follows:

1. A mode search is performed to determine the mode peak.

2. The main mode point is assigned to PA. The wavelength of this point is assigned to λA.

3. The wavelength of the side mode that has a wavelength shorter than PA is assigned to λB. The wavelength of the side mode that has a wavelength longer than PA is assigned to λC.

   If relevant points do not exist, for the levels outside the mask area, the wavelength at the highest level whose wavelength is shorter than PA is assigned to λB and the wavelength at the highest level whose wavelength is longer than PA is assigned to λC.

   The side mode levels LB, and LC are determined.

   • When the SIDE MODE POWER parameter is TRACE DATA

      Level where LB = λB

      Level where LC = λC

   • When the SIDE MODE POWER parameter is NORMALIZED

      A value obtained by normalizing the level where LB = λB by the resolution bandwidth

      A value obtained by normalizing the level where LC = λC by the resolution bandwidth

4. The levels (linear values) of λA, λB, and λC are assigned to LA, LB, and LC, respectively.

5. SMSR and Δλ are determined from the following equations.

SMSR(L)=LA/LB

SMSR(R)=LA/LC

Δλ(L) = λB – λA

Δλ(R) = λC – λA

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**SMSR4**

The main mode is defined as the highest mode peak. The side modes are defined as the mode peaks adjacent to the main mode.



The analysis algorithm for the SMSR4 mode is as follows:

*1.*   A mode search is performed to determine the mode peak.

*2.*   The main mode point is assigned to PA. The wavelength of this point is assigned to λA.

*3.*   The wavelength of the side mode that has a wavelength shorter than PA is assigned to λB. The wavelength of the side mode that has a wavelength longer than PA is assigned to λC.

   If there is no mode peak whose wavelength is shorter than PA, λB is set equal to λA. If there is no mode peak whose wavelength is longer than PA, λC is set equal to λA.

   The side mode levels LB, and LC are determined.

   •   When the SIDE MODE POWER parameter is TRACE DATA

      Level where LB = λB

      Level where LC = λC

   •   When the SIDE MODE POWER parameter is NORMALIZED

      A value obtained by normalizing the level where LB = λB by the resolution bandwidth

      A value obtained by normalizing the level where LC = λC by the resolution bandwidth

*4.*   The levels (linear values) of λA, λB, and λC are assigned to LA, LB, and LC, respectively.

*5.*   SMSR and Δλ are determined from the following equations.

   SMSR(L)= LA/LB

   SMSR(R)=LA/LC

   Δλ(L) = λB − λA

   Δλ(R) = λC − λA

## POWER analysis function

This function determines the total power by integrating the level values of the measured waveform. Using the line marker search function and zoom area search function is convenient when performing power analysis.

The following table shows the details of POWER analysis parameters.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|---|---|---|---|---|---|
| POWER OFFSET | OFST | 0.00 | –10.00 to 10.00 | dB | Compensation value in power measurement |

The algorithm is described below.

- The resolution bandwidth is determined for all display points.
  (The values for λx = λSHIFT + λOFST are determined through interpolation using a table.)
  In the vacuum wavelength mode (MEAS WL AIR/VACUUM key under SET UP), the following equation is used to obtain λx.
  λ0=λ+λSHIFT
  λx=λ0/N(λ0)+λOFST

If the X-axis display mode is frequency, the equation below is used to convert the resolution bandwidth (frequency) Ri for all display points to wavelength values.

Ri=(λixλixRfi)/C

where 　λi :　Wavelength (nm) at each point

　　　　Rfi :　Resolution bandwidth (THz)

　　　　C :　Speed of light in the vacuum ($2.99792458 \times 10^8$[m/s])

- The resolution bandwidth for the ith point is assigned to Ri and the level to Li.
- The total power is determined from the following equation.

$$POWER = \frac{SPAN}{SAMPLE - 1} \times \sum \frac{Li}{Ri} \times POWEROFFSET$$

## DFB-LD analysis function

The following parameters for DFB-LD light sources are analyzed collectively.

- -XdB WIDTH (Center WL/SPWD)
- SMSR
- RMS
- POWER
- OSNR

The following table shows the details of DFB-LD analysis parameters.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|---|---|---|---|---|---|
| -XdB CENTER/ WIDTH | ALGO | THRESH | ENVELOPE/ THRESH/RMS/PK-RMS | - | - |
| | THRESH | 20.00 | 0.01 to 50.00 | dB | - |
| | THRESH2 | 20.00 | 0.01 to 50.00 | dB | Valid only when ALGO is ENVELOPE. |
| | K | 1.00 | 1.00 to 10.00 | - | - |
| | MODE FIT | OFF | ON / OFF | - | Valid only when ALGO is THRESH. |
| | MODE DIFF | 3.00 | 0.01 to 50.00 | dB | Invalid when ALGO is RMS. |
| SMSR | SMSR MODE | SMSR1 | SMSR1/SMSR2/ SMSR3/SMSR4 | - | - |
| | SMSR MASK | ±0.00 | 0.00 to 99.99 | nm | - |
| | MODE DIFF | 3.00 | 0.01 to 50.00 | dB | - |
| | SIDE MODE POWER | TRACE DATA | TRACE DATA/ NORMALIZED | - | - |
| | BANDWIDTH | 0.10 | 0.01 to 1.00 | nm | - |
| RMS | ALGO | RMS | RMS/PK-RMS | - | - |
| | THRESH | 20.00 | 0.01 to 50.00 | dB | - |
| | K | 2.35 | 0.01 to 10.00 | - | - |
| | MODE DIFF | 3.00 | 0.01 to 50.00 | dB | Invalid when ALGO is RMS. |
| POWER | SPAN | 0.40 | 0.01 to 10.00 | nm | - |
| OSNR | MODE DIFF | 3.00 | 0.01 to 50.00 | dB | - |
| | NOISE ALGO | PIT | AUTO-FIX/ MANUAL-FIX/ AUTO-CTR/ MANUAL-CTR/PIT | - | - |
| | NOISE AREA | AUTO | AUTO/ 0.01 to 10.00 | nm | - |
| | MASK AREA | - | -/ 0.01 to 10.00 | nm | - |
| | FITTING ALGO | LINEAR | LINEAR/GAUSS/ LORENZ/3RD POLY/4TH POLY/5TH POLY | - | - |
| | NOISE BW | 0.10 | 0.01 to 1.00 | nm | - |
| | SIGNAL POWER | PEAK | PEAK/INTEGRAL | - | - |
| | INTEGRAL RANGE | 10.0 | 1.0 to 999.9 | GHz | - |

For details on the DFB-LD analysis algorithms, see the data calculation algorithms for spectrum widths, the SMSR analysis algorithms, and the WDM analysis algorithms (OSNR analysis).

# FP-LD analysis function

The following parameters for FP-LD light sources are analyzed collectively.

- SPECTRUM WIDTH
- MEAN WAVELENGTH
- TOTAL POWER
- MODE NO.

The following table shows the details of FP-LD analysis parameters.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|---|---|---|---|---|---|
| SPECTRUM WIDTH | ALGO | PK-RMS | ENVELOPE / THRESH / RMS / PK-RMS | - | |
| | THRESH | 20 | 0.01 to 50.00 | dB | |
| | THRESH2 | 20 | 0.01 to 50.00 | dB | Valid only when ALGO is ENVELOPE. |
| | K | 2.35 | 1.00 to 10.00 | - | |
| | MODE FIT | OFF | ON / OFF | - | Valid only when ALGO is THRESH. |
| | MODE DIFF | 3 | 0.01 to  50.00 | dB | |
| MEAN WAVELENGTH | ALGO | PK-RMS | ENVELOPE / THRESH / RMS / PK-RMS | - | |
| | THRESH | 20 | 0.01 to 50.00 | dB | |
| | THRESH2 | 20 | 0.01 to  50.00 | dB | Valid only when ALGO is ENVELOPE. |
| | K | 2.35 | 1.00 to 10.00 | - | |
| | MODE FIT | OFF | ON / OFF | - | Valid only when ALGO is THRESH. |
| | MODE DIFF | 3 | 0.01 to 50.00 | dB | |
| TOTAL POWER | OFFSET LEVEL | 0 | -10.00 to 10.00 | dB | |
| MODE NO. | ALGO | PK-RMS | ENVELOPE / THRESH / RMS / PK-RMS | - | |
| | THRESH | 20.00 | 0.01 to 50.00 | dB | |
| | THRESH2 | 20.00 | 0.01 to 50.00 | dB | Valid only when ALGO is ENVELOPE. |
| | K | 2.35 | 1.00 to 10.00 | - | |
| | MODE FIT | OFF | ON / OFF | - | Valid only when ALGO is THRESH. |
| | MODE DIFF | 3.00 | 0.01 to 50.00 | dB | |

For details on the FP-LD analysis algorithms, see the data calculation algorithms for spectrum widths and power analysis algorithms.

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# LED analysis function

The following parameters for LED light sources are analyzed collectively.

• SPECTRUM WIDTH

• MEAN WAVELENGTH

• TOTAL POWER

The following table shows the details of LED analysis parameters.

| Parameter | Abbreviation | Default value | Range | Unit | Description |
|---|---|---|---|---|---|
| SPECTRUM WIDTH | ALGO | THRESH | ENVELOPE / THRESH / RMS / PK-RMS | - | |
| | THRESH | 3 | 0.01 to 50.00 | dB | |
| | THRESH2 | 20 | 0.01 to 50.00 | dB | Valid only when ALGO is ENVELOPE. |
| | K | 1 | 1.00 to 10.00 | - | |
| | MODE FIT | OFF | ON / OFF | - | Valid only when ALGO is THRESH. |
| | MODE DIFF | 3 | 0.01 to 50.00 | dB | |
| MEAN WAVELENGTH | ALGO | RMS | ENVELOPE / THRESH / RMS / PK-RMS | - | |
| | THRESH | 20 | 0.01 to 50.00 | dB | |
| | THRESH2 | 20 | 0.01 to 50.00 | dB | Valid only when ALGO is ENVELOPE. |
| | K | 2.35 | 1.00 to 10.00 | | |
| | MODE FIT | OFF | ON / OFF | - | Valid only when ALGO is THRESH. |
| | MODE DIFF | 3 | 0.01 to 50.00 | dB | |
| TOTAL POWER | OFFSET LEVEL | 0 | –10.00 to 10.00 | dB | |

For details on the LED analysis algorithms, see the data calculation algorithms for spectrum widths and power analysis algorithms.

# Appendix 4   WDM Analysis Function

This function provides the analyses of noise level and SNR in each mode within the measurement range of WDM waveforms.

## Analysis Items

| | |
|---|---|
| NO.: | Channel number i |
| WAVELENGTH: | Center wavelength $\lambda i$ of the channel |
| LEVEL: | Level (peak level − noise level) $Li$ of the channel |
| OFFSET WL: | Relative wavelength to the wavelength of the reference channel (REF) |
| OFFSET LVL: | Relative level to the level of the reference channel (REF) |
| SPACING: | Wavelength spacing to the adjacent channel |
| LVL DIFF: | Level difference from then adjacent channel |
| NOISE: | Noise level $LNi$ of the channel |
| SNR: | SNR value $SNi$ of the channel |
| GRID WL: | Nearest grid wavelength to the channel |
| MEAS WL: | Center wavelength $\lambda i$ of the channel |
| REL WL: | Relative wavelength to the nearest grid wavelength of the channel |

### Note

dBm/nm and dBm/THz figures are changed to dBm figures before execution.

## Parameters

### Channel Detection Parameters

| Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|
| THRESH | 20.0 | 0.1 to 99.9 | dB | Threshold value for channel detection. |
| MODE DIFF | 3.0 | 0.1 to 50.0 | dB | Minimum value for peak/bottom difference during channel detection. |
| DISPLAY MASK | OFF | OFF, -100.0 to 0.0 | dBm | Levels equal to or below this level are not detected as WDM channels. |

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### SNR Analysis Parameters

| Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|
| NOISE ALGO | AUTO-FIX | AUTO-FIX<br>MANUAL-FIX<br>AUTO-CTR<br>MANUAL-CTR<br>PIT | - | Selection of algorithms for noise level measurement. |
| NOISE AREA | 0.40nm | 0.01 to 10.00 | nm | A range of waveform data for use in noise level analysis is specified as a range centering on channel wavelengths.<br><br>When N_ALGO is:<br>•  AUTO-FIX: "AUTO"<br>•  MANUAL-FIX: **.**<br>•  AUTO-CTR: "Between Ch"<br>•  MANUAL-CTR: "Between Ch"<br>•  PIT: "PIT" |
| MASK AREA | 0.20nm | 0.01 to 10.00 | nm | Specifies the signal optical spectrum range to be masked within the waveform data, while using the channel wavelength as its center.<br>When N_ALGO is:<br>•  AUTO-FIX          "–"<br>•  MANUAL-FIX<br>  When F_ALGO is LINEAR:          "–"<br>  Other cases: Parameter value input<br>•  AUTO-CTR:          "–"<br>•  MANUAL-CTR<br>  When F_ALGO is LINEAR: "–"<br>  Other causes: Parameter value input<br>Limiter is applied during input to ensure NOISE AREA ≥ MASK AREA.<br>•  PIT          "–" |
| FITTING ALGO | LINEAR | LINEAR<br>GAUSS<br>LORENZ<br>3RD POLY<br>4TH POLY<br>5TH POLY | - | Selection of a fitting algorithm for obtaining noise levels. |
| NOISE BW | 0.10nm | 0.01  to 1.00 | nm | Noise bandwidth setting. |
| DUAL TRACE | OFF | ON/OFF | - | OFF:  The active trace is analyzed.<br>ON:  Wavelengths and levels are calculated from TRACE A. Noise levels are calculated from TRACE B. |

**Display parameters**

| Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|
| DISPLAY TYPE | ABSOLUTE | ABSOLUTE RELATIVE DRIFT(MEAS) DRIFT(GRID) | - | Setting of the format to display wavelengths, levels, noises, and SNRs, which are the results of analyses.<br>ABSOLUTE:        Absolute values<br>RELATIVE:        Relative values to the grid<br>DRIFT(MEAS):    Drift relative to a past measured wavelength<br>DRIFT(GRID):    Drift relative to the grid wavelength |
| CH RELATION | OFFSET | OFFSET SPACING | - | Setting of the format to display wavelengths between channels and level relative values during DISPLAY: ABSOLUTE.<br>This parameter is valid only when DISPLAY is set to ABSOLUTE.<br>OFFSET:             Offset values by using one arbitrary channel as the reference.<br>SPACING:          Offset values compared to an adjacent channel |
| REF CH | HIGHEST | HIGHEST **** | - | Setting of the reference channel when CH RELATION is set to OFFSET.<br>This parameter is valid only when DISPLAY is set to ABSOLUTE and also when CH RELATION is set to OFFSET.<br><br>HIGHEST:           A channel with the highest level is used as the reference.<br>****:        The ****th channel is used as the reference. |
| MAX/MIN RESET | — | — | - | Pressing the button resets MAX/MIN.<br>Button valid only when DISPLAY is set to DRIFT. |
| OUTPUT SLOPE | OFF | ON/OFF | - | ON/OFF of the function to obtain the least square approximation line of the channel peak. |
| POINT DISPLAY | ON | ON/OFF | - | ON/OFF of the function to display the data range used for fitting into the waveform window. |

**Other settings**

| Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|
| SIGNAL POWER | PEAK | PEAK INTEGRAL | - | Setting of the signal power calculation method<br>PEAK:   Peak level value<br>INTEGRAL:          Level value obtained by integration |
| INTEGRAL RANGE | 10.0 | 1.0 to 999.9 | GHz | Setting of the integral range for determining the signal optical power<br>Valid when the SIGNAL POWER setting is INTEGRAL.<br>If the set value is Δf, the integral is calculated in the range of channel center wavelength ±Δf. |

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**Appendix**

## Analysis Algorithm

**Data range used in the fitting calculation**



1. Channel detection is performed on the measured waveform data according to the following procedure.

   All maximum points and minimum points are found to obtain mode peaks where peak/ bottom differences between maximum points and minimum points on both sides are equal to or greater than MODE DIFF.

   Of the obtained mode peaks, only the ones whose level difference compared to the highest peak is equal to or greater than THRESH are chosen. However, mode peaks with a level difference equal to or less than DISPLAY MASK are excluded. The number of mode peaks chosen in this manner is the number of channels N.

2. The wavelength $λ'i$ of each mode peak is determined.

3. The center wavelengths $λ'i$ of each mode peak that are 2 points down A[dB] to the left and right from mode peak $λ'I$ are determined (where A[dB] is 3 dB or the MODE DIFF setting, whichever is smaller).

4. The signal level LSi of each mode is determined according to the parameter SIGNAL POWER setting.

   For "PEAK"

       LSi = Level LPi of each mode peak

   For "INTEGRAL"

       LSi = The integral of the power value in the range of the center wavelength $±Δf$ [GHz] of each mode

   ($Δf$: parameter INTEGRAL RANGE setting value)

**5.** The noise area and mask area for performing the NOISE fitting are determined according to the setting of the parameter NOISE ALGO.

If the mask area is set outside the noise area when the channel wavelength λi is the center, the mask area and the noise area will be the same value.

**6.** The measurement resolution RBi of each channel is determined from the values stored in the instrument.

**7.** Fitting waveforms are generated from the noise area and mask area determined in 5 according to the setting of the parameter FITTING ALGO, and the level at the center wavelength λi is determined as the noise level LNi.

**8.** The signal level LSi and noise level LNi obtained in steps 4 and 7 are used to determine the level Li of each channel using the following equation.

Li = LSi(linear) − LNi(linear)

**9.** The normalized noise level LNNi is determined from the following equation.

LNNi=[LNi(LOG)–10×Log(RBi[nm])]+10×Log(NBW)

NBW =noise bandwidth (configurable parameter)

**10.** The mode peak level Li obtained in steps 8 and 9 and the normalized noise level LNNi are used to determine SNi from the following equation.

SNi=10×log(Li)–LNNi

**11.** The analysis results found above are displayed according to the DISPLAY SETTING parameter.

**App**

**Appendix**

# Automatic parameter setting function

This instrument has a function that automatically configures the noise area and mask area settings. To perform automatic setting, set the algorithm to AUTO-FIX, AUTO-CTR, or PIT.

**AUTO-FIX**

- **Noise Algorithm**
  The left and right noise areas (NA_Ri, NA_Li) of each channel are determined according to the number of detected WDM channels as follows:

  **When the number of WDM channels "n" is 1**
  The measurement resolution of SNi calculation trace and the value of the noise measurement point NOISE AREA in accordance with the resolution are determined internally, and then the values are found from the following equations.
  NA_Ri=λi+NOISE AREA
  NA_Li = λi – NOISE AREA

  **When the number of WDM channels "n" is 2 or more**
  The channel spacing of each channel (spacing of λi.) is determined. With the minimum spacing assigned to SPACING and using NOISE AREA = SPACING / 2, the NOISE AREA is determined using the following equation.
  NA_Ri=λi+NOISE AREA(i=1,2,…,n)
  NA_Li = λi – NOISE AREA (i = 1, 2, …, n)

- **Fitting algorithm**
  When AUTO-FIX is selected, LINEAR is used for the fitting algorithm. The details of the calculation are as follows:
  - ELi and ERi are determined as the level (LOG) of each position of the noise areas NA_Li and NA_Ri.
  - The data of the straight line connecting the two points of ELi and ERi is used to fill the inside of the fitting range.
  - The level of λi of the data generated in the fitting is assigned to the noise level LNi.

*Note* ───────────────────────────────────────
   Because LINEAR is used, it is not possible to set mask areas.
───────────────────────────────────────────────

**AUTO-CTR**

- **Noise Algorithm**

  The left and right noise areas (NA_Ri, NA_Li) of each channel are determined according to the number of detected WDM channels as follows (while treating the center points between channels as NA_Ri and NA_Li).

  **When the number of WDM channels "n" is 1**

  The measurement resolution of SNi calculation trace and the value of the noise measurement point NOISE AREA in accordance with the resolution are determined internally, and then the values are found from the following equations.

  NA_Ri=$\lambda$i+NOISE AREA

  NA_Li = $\lambda$i − NOISE AREA

  **When the number of WDM channels "n" is 2 or more**

  $\lambda$N1 = (3$\lambda$1 − $\lambda$2)/2

  i=2,3,…,n

  $\lambda$Ni = ($\lambda$i − $\lambda$i-1)/2

  $\lambda$Nn+1 = (3$\lambda$n − $\lambda$n-1)/2

  When the above values are calculated, the following results will be obtained.

  i=1,2,…,n

  NA_Li=$\lambda$Ni

  NA_Ri=$\lambda$Ni+1

- **Fitting algorithm**

  When AUTO-CTR is selected, LINEAR is used for the fitting algorithm. The details of the calculation are as follows:

  - ELi and ERi are determined as the level (LOG) of each position of the noise areas NA_Li and NA_Ri.
  - The data of the straight line connecting the two points of ELi and ERi is used to fill the inside of the fitting range.
  - The level of $\lambda$i of the data generated in the fitting is assigned to the noise level LNi.

*Note* _____

Because LINEAR is used, it is not possible to set mask areas.

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**PIT**

- **Noise Algorithm**

  For each channel, the minimum level position in the area up to the next channel is determined from the measured waveform and used as NOISE AREA.

  For the left-most and right-most channels, the internal NOISE AREA is used for the outer NOISE AREA.

  **When the number of WDM channels "n" is 1**

  The measurement resolution of SNi calculation trace and the value of the noise measurement point NOISE AREA in accordance with the resolution are determined internally, and then the values are found from the following equations.

  NA_Ri = λi + NOISE AREA

  NA_Li = λi − NOISE AREA

  **When the number of WDM channels "n" is 2 or more**

  i=1

     NA_Li = λi − (λNi − λi)

     NA_Ri=λNi

  i=2,3,…,n-1

     NA_Li=λN(i - 1)

     NA_Ri=λNi

  i=n

     NA_Li=λN(i-1)

     NA_Ri = λi + (λi − λN(i-1))

- **Fitting algorithm**

  When PIT is selected, LINEAR is used for the fitting algorithm. The details of the calculation are as follows:

  - ELi and ERi are determined as the level (LOG) of each position of the noise areas NA_Li and NA_Ri.
  - The data of the straight line connecting the two points of ELi and ERi is used to fill the inside of the fitting range.
  - The level of λi of the data generated in the fitting is assigned to the noise level LNi.

*Note*

Because LINEAR is used, it is not possible to set mask areas.

## DUAL TRACE Parameter Setting

This function enables more precise analyses by measuring waveforms with different measurement resolutions at trace A and trace B and also by performing measurements with resolutions different in noise level from the signal level of each channel.

When "DUAL TRACE" is ON, targets for the analysis of each trace are as follows:

*   TRACE A: trace subject to channel detection
*   TRACE A: calculation traces λi and Li
*   TRACE B: noise level LNi calculation trace

## OUTPUT SLOPE function

The parameter "OUTPUT SLOPE" provides a function to obtain the least square approximation curve of channel peaks. This function makes it possible to measure gain tilts. If "OUTPUT SLOPE" is set to ON, results will be displayed in the waveform display section and in the analysis table.



Slope value

Least squares approximation curve
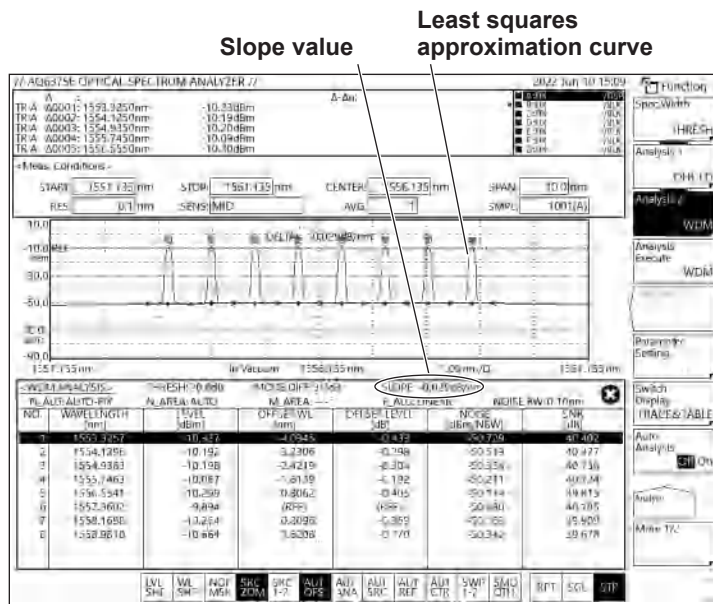
## Items to be Displayed When DISPLAY is Set

**ABSOLUTE**

Results of analyses are displayed with absolute values.
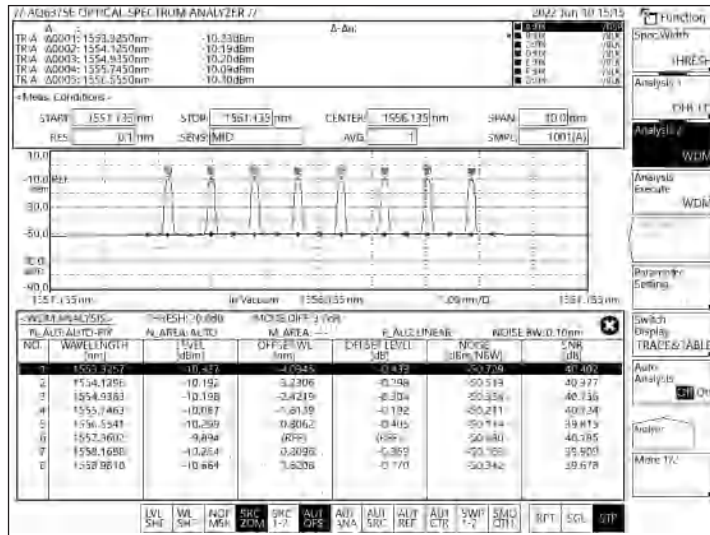


- **Explanations of displayed items**

  | | |
  |---|---|
  | NO: | Channel number |
  | WAVELENGTH: | Center wavelength λi of the channel |
  | LEVEL: | Level (peak level − noise level) of the channel |
  | OFFSET WL: | Relative wavelength to the wavelength of the reference channel (REF) |
  | OFFSET LEVEL: | Level relative to the wavelength of the reference channel (REF) |
  | SPACING: | Wavelength spacing to the adjacent channel |
  | LEVEL DIFF: | Level difference from then adjacent channel |
  | NOISE: | Noise level of the channel |
  | SNR: | SNR value of the channel |

- OFFSET WL/LVL is displayed when the parameter CH RELATION is "OFFSET." SPACING and LVL DIFF are displayed when the parameter CH RELATION is "SPACING."

- When ABSOLUTE and CH RELATION are OFFSET, it is possible either to set the reference channel to the mode peak with the highest level or to set a mode peak that will become the reference arbitrarily.

- When REF CH is HIGHEST

  The WDM mode peak with the highest level shall be the reference. The wavelength difference and level difference (LOG) compared to it shall be OFFSET WL and OFFSET LEVEL of each WDM mode peak.

- When REF CH is ***

  REF CHANNEL*** shall be the reference. The wavelength difference and level difference (LOG) against it shall be OFFSET WL and OFFSET LEVEL of each WDM mode peak.

  (If the ***th mode peak does not exist, the WDM mode peak on the longest wavelength shall be the reference.)

**RELATIVE**

Of the analytical results, wavelength values are displayed as relative values to the values in the grid table.
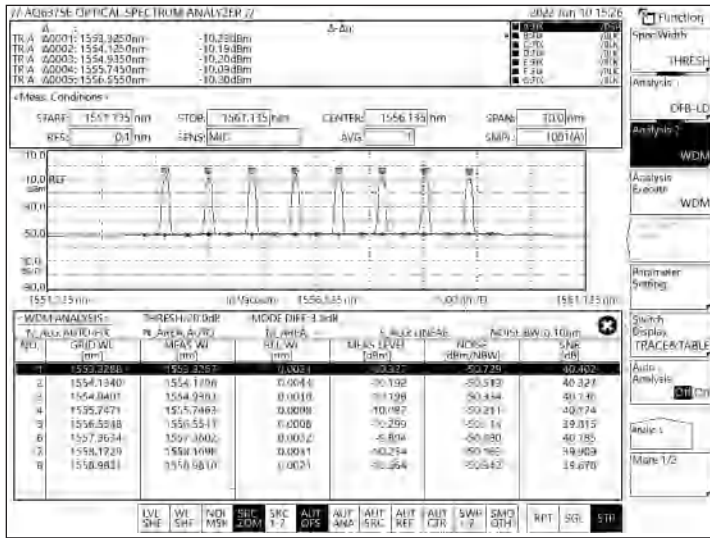


- **Explanations of displayed items**

  | | |
  |---|---|
  | NO: | Channel number |
  | GRID WL: | Grid wavelength of the channel |
  | MEAS WL: | Center wavelength λi of the channel |
  | REL WL: | Relative wavelength to the grid wavelengths of the channel |
  | MEAS LEVEL: | Level (peak level − noise level) of the channel |
  | NOISE: | Noise level of the channel |
  | SNR: | SNR value of the channel |

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**DRIFT(MEAS)**

Wavelengths measured previously are used as references to display wavelength/level changes (drifts).
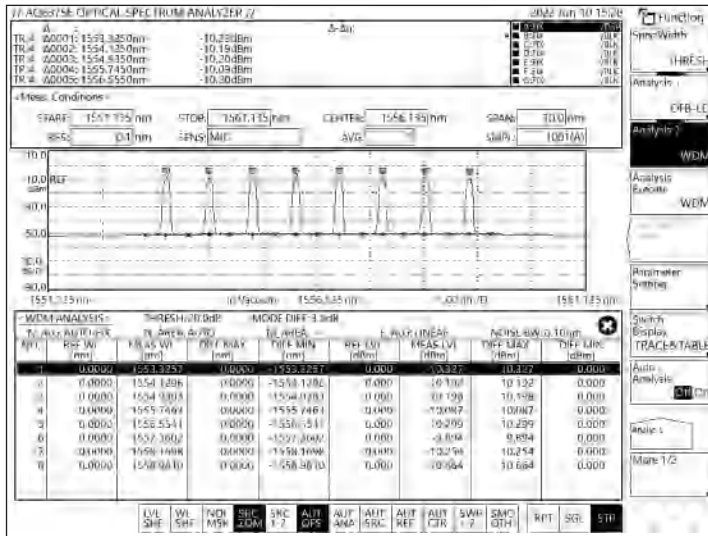


- **Explanations of displayed items**

| | |
|---|---|
| NO: | Channel number |
| REF WL: | Reference wavelength of the channel (previous wavelength measured) |
| MEAS WL: | Center wavelength $\lambda i$ of the channel |
| DIFF MAX (wavelength): | Maximum value of the relative wavelength to the reference wavelength of the channel |
| DIFF MIN (wavelength): | Minimum value of the relative wavelength to the reference wavelength of the channel |
| REF LVL: | Reference level of the channel (previous measurement level) |
| MEAS LVL: | Measurement level of the channel |
| DIFF MAX (level): | Maximum value of the relative level to the reference level of the channel |
| DIFF MIN (level): | Minimum value of the relative level to the reference level of the channel |

Reference wavelength/level can be changed under the following conditions.

- Active trace waveform data when MAX/MIN RESET is set by the parameter.
- The first waveform data measured when wavelength axes (SPAN WL/START WL/ STOP WL) were changed according to the measurement conditions.

**DRIFT(GRID)**

Grid wavelengths are used as references to display wavelength/level changes (drifts). Note that reference levels are previous measurement levels.
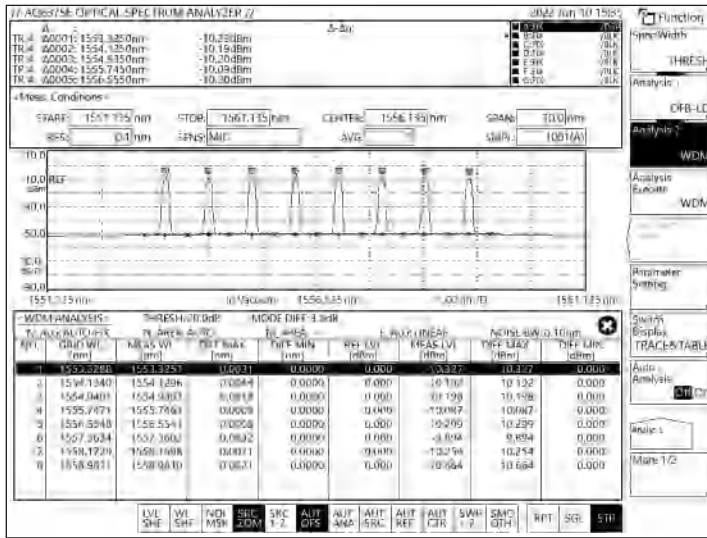


- **Explanations of displayed items**

| | |
|---|---|
| NO: | Channel number |
| GRID WL: | Reference wavelength of the channel (grid wavelength) |
| MEAS WL: | Center wavelength λi of the channel |
| DIFF MAX (wavelength): | Maximum value of the relative wavelength to the reference wavelength of the channel |
| DIFF MIN (wavelength): | Minimum value of the relative wavelength to the reference wavelength of the channel |
| REF LVL: | Reference level of the channel (previous measurement level) |
| MEAS LVL: | Measurement level of the channel |
| DIFF MAX (level): | Maximum value of the relative level to the reference level of the channel |
| DIFF MIN (level): | Minimum value of the relative level to the reference level of the channel |

- Absolute values and reference values to the grid table are displayed. The grid table can be freely configured.
- Reference wavelength/level can be changed under the following conditions.
  - When MAX/MIN RESET is set by the parameter, reset is performed by the active trace waveform data.
  - Reset is performed by the first waveform data that was measured when wavelength axes (SPAN WL/START WL/STOP WL) were changed by measurement conditions.

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**Appendix**

# Appendix 5 Optical Amp Analysis Function

This function analyzes gains and NF (noise figures) of optical fiber amplifiers.

## Analysis item

| | |
|---|---|
| λi | Center wavelength of each channel. -> Center frequency during the frequency mode. |
| LINi | Signal optical power of each channel (after OFFSET compensation) |
| LOUTi | Output optical power of each channel (after OFFSET compensation) |
| LASEi | ASE power of each channel (after OFFSET compensation) |
| Rbi | Measurement resolution of each channel |
| Gi | Gain of each channel |
| Nfi | NF of each channel |

## Parameters

### Channel Detection Parameters

| Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|
| THRESH | 20.0 | 0.1 to 99.9 | dB | Threshold value for channel detection. |
| MODE DIFF | 3.0 | 0.1 to 50.0 | dB | Minimum value for peak/bottom difference during channel detection. |

### NF calculations

| Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|
| OFFSET(IN) | 0.00 | -99.99 to 99.99 | dB | Level offset value of signal optical power. |
| OFFSET(OUT) | 0.00 | -99.99 to 99.99 | dB | Level offset value of output optical power. |
| ASE ALGO | AUTO-FIX | AUTO-FIX MANUAL-FIX AUTO-CTR MANUAL-CTR | - | Selection of the algorithm for ASE level measurement. |
| FIT AREA | 0.40nm | 0.01 to 10.00 | nm | A range of waveform data for use in ASE level analysis is specified as a range centering on channel wavelengths. When ASE ALGO is<br>• AUTO-FIX:　　　"AUTO"<br>• MANUAL-FIX:　　**.**<br>• AUTO-CTR:　　"Between Ch"<br>• MANUAL-CTR:　"Between Ch" |
| MASK AREA | 0.20nm | 0.01 to 10.00 | nm | Specifies the signal optical spectrum range to be masked within the waveform data, while using the channel wavelength as its center. When ASE ALGO is<br>• AUTO-FIX: "–"<br>• MANUAL-FIX:<br>　When F_ALGO is LINEAR: "–"<br>　Other causes: Parameter value input<br>• AUTOL-CTR: "–"<br>• MANUAL-CTR:<br>　FITTING ALGO set to LINEAR: "–"<br>　Other cases: Parameter value input<br>　Limiter is applied during input to ensure FITTING AREA ≥ MASK AREA. |
| FITTING ALGO | LINEAR | LINEAR GAUSS LORENZ 3RD POLY 4TH POLY 5TH POLY | - | Selection of a fitting algorithm for obtaining ASE levels. |

| Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|
| POINT DISPLAY | ON | ON / OFF | - | ON/OFF of the function to display the data range used for fitting into the waveform window. |
| RES BW | CAL DATA | MEASURED CAL DATA | - | Sets the method for calculating the measurement resolution RBi of each channel.<br>MEASURED: The value of the THRESH 3dB width is determined from the TRACE B waveform.<br>CAL DATA: The resolution bandwidth stored in the instrument is determined. |
| SHOT NOISE | ON | ON / OFF | - | Selects whether the Shot Noise component is included in the calculation of the NF value.<br>ON:      Included.<br>OFF:     Not included. |

**Other settings**

| Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|
| SIGNAL POWER | PEAK | PEAK INTEGRAL | - | Setting of the signal power calculation method<br>PEAK:           Peak level value<br>INTEGRAL:       Level value obtained by integration |
| INTEGRAL RANGE | 10.0 | 1.0 to 999.9 | GHz | Setting of the integral range for determining the signal optical power<br>Valid when the SIGNAL POWER setting is INTEGRAL. If the set value is Δf, the integral is calculated in the range of channel center wavelength ±Δf. |

# Analysis Algorithm

**1.** WDM analysis is performed on the signal optical waveform data of TRACE A to perform channel detection. However, the DISPLAY MASK parameter is not used.

**2.** The center wavelength λi of each channel and signal optical level LIN'i of TRACE A optical signal are determined according to the SIGNAL POWER parameter setting. (The computation of the power value from this point uses linear values.)

For "PEAK"

LIN'i = The level of each mode peak

For "INTEGRAL"

LIN'i = The integral of the power value in the range of the center wavelength ±Δf [GHz] of each mode

(Δf: the INTEGRAL RANGE parameter setting value)

**3.** The output optical level LOUT'i of each channel is determined from the output optical waveform data of TRACE B according to the SIGNAL POWER parameter setting.

For "PEAK"

LOUT'i = The level of each mode peak

For "INTEGRAL"

LOUT'i = The integral of the power value in the range of the center wavelength ±Δf [GHz] of each mode

(Δf: the INTEGRAL RANGE parameter setting value)

**4.** LINi and LOUTi, which are generated by compensating OFFSET (IN,OUT) for signal optical level and output optical level, respectively are determined.

**5.** The fitting area and mask area for performing the ASE fitting are determined according to the setting of the parameter ASE ALGO.

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**6.** Measurement resolution RBi of each channel is determined.

If the RES BW parameter is set to "MEASURED," the THRESH 3d width is determined from the TRACE B waveform and assigned to RBi.

If the RES BW parameter is set to "CAL DATA," the actual resolution stored in the instrument is determined and assigned to RBi.

**7.** The signal optical SE elements contained in the output optical spectrum is removed in the following order, and the result is drawn into TRACE C.

**1.** Levels (linear) on both sides of the channel of the fitting area that was obtained in step 5 are determined.

**2.** The obtained levels on both sides are used to obtain the ASE level L'ASEi via the linear interpolation.

At this point, if the SIGNAL POWER parameter is "INTEGRAL," L'ASEi is converted to a level near the integration range $\pm \Delta f$ [GHz].

**3.** LASEi, which is generated by compensating OFFSET (OUT) for the provisional ASE level L'ASEi is determined.

**4.** Gain Gi (linear) is determined from the following equation.

Gi = (LOUTi − LASEi)/LINi

**5.** The TRACE A data (linear) is multiplied by the gain Gi and subtract the result from the TRACE B data (linear). Then, the result is drawn into TRACE C. (The signal light SE component contained in the output optical spectrum is eliminated.)

**8.** In the TRACE C data (linear) generated in step 7, fitting is performed according to the settings of the parameter FITTING ALGO, and the estimated ASE spectrum is created in TRACE C.

The data used in the fitting is from the range of the center wavelength of each channel $\pm$ FIT AREA to the range of MASK AREA.

The level at λi in TRACE C is determined in terms of the ASE level LASE_AMP'i with the signal light SE component removed.

LASE_AMPi is determined by compensating OFFSET (OUT).

NF (linear) is calculated from the following equations.

- **NF value (during the air wavelength mode)**

$$NFi = \frac{N(\lambda i)^2}{h \times c^2} \times \frac{\lambda i^3}{RBi} \times \frac{LASE\_AMPi}{Gi} + \frac{1}{Gi} \qquad \text{(SHOT NOIZE parameter: ON)}$$

$$NFi = \frac{N(\lambda i)^2}{h \times c^2} \times \frac{\lambda i^3}{RBi} \times \frac{LASE\_AMPi}{Gi} \qquad \text{(SHOT NOIZE parameter: OFF)}$$

- **NF value (during the vacuum wavelength mode)**

$$NFi = \frac{1}{h \times c^2} \times \frac{\lambda i^3}{RBi} \times \frac{LASE\_AMPi}{Gi} + \frac{1}{Gi} \qquad \text{(SHOT NOIZE parameter: ON)}$$

$$NFi = \frac{1}{h \times c^2} \times \frac{\lambda i^3}{RBi} \times \frac{LASE\_AMPi}{Gi} \qquad \text{(SHOT NOIZE parameter: OFF)}$$

where  N(λi):  Refraction index of the air

C:  Speed of light in the vacuum ($2.99792458 \times 10^8$[m/s])

h:  Planck's constant $6.6260755 \times 10^{-34}$ [J•s]

NFi, Gi, and LASE_AMPi are converted into LOG.

# Automatic parameter setting function

This instrument has a function that automatically configures the fitting area and mask area settings.

**AUTO-FIX**

• **ASE algorithm**

The fitting algorithm is LINEAR.

Since the algorithm is LINEAR, the mask area setting will not be required.

The left and right fitting areas (NA_Ri, NA_Li) of each channel are determined according to the number of detected channels as follows:

### When the number of channels "n" is 1

The measurement resolution of trace B and the value of the noise measurement point NOISE AREA in accordance with the resolution are determined internally, and then the values are found from the following equations.

$NA\_Ri = \lambda i + NOISE\ AREA$

$NA\_Li = \lambda i - NOISE\ AREA$

If the number of WDM channels (N) is 1, the noise area is determined by internal processing based on the measurement resolution.

### When the number of channels "n" is 2 or more

The channel spacing of each channel (spacing of $\lambda i$) is determined. With the minimum spacing assigned to SPACING and using NOISE AREA = SPACING/2, the NOISE AREA is determined using the following equation.

$NA\_Ri = \lambda i + NOISE\ AREA (i = 1, 2, \ldots, n)$

$NA\_Li = \lambda i - NOISE\ AREA (i = 1, 2, \ldots, n)$

**AUTO-CTR**

• **ASE algorithm**

The fitting algorithm is LINEAR.

Since the algorithm is LINEAR, the mask area setting will not be required.

The left and right fitting areas (NA_Ri, NA_Li) of each channel are determined according to the number of detected channels as follows (while treating the center points between channels as NA_Ri and NA_Li).

### When the number of channels "n" is 1

The measurement resolution of trace B and the value of the noise measurement point NOISE AREA in accordance with the resolution are determined internally, and then the values are found from the following equations.

$NA\_Ri = \lambda i + NOISE\ AREA$

$NA\_Li = \lambda i - NOISE\ AREA$

### When the number of channels "n" is 2 or more

$\lambda N1 = (3\lambda 1 - \lambda 2)/2$

$i = 2, 3, \ldots, n$

$\lambda Ni = (\lambda i + \lambda i\text{-}1)/2$

$\lambda Nn+1 = (3\lambda - \lambda n\text{-}1)/2$

When the above values are calculated, the following results will be obtained.

$i = 1, 2, \ldots, n$

$NA\_Li = \lambda Ni$

$NA\_Ri = \lambda Ni+1$

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# Appendix 6    Optical Filter Analysis Function

## FILTER PEAK analysis function

This function analyzes collectively the measured waveforms of optical filters via multiple parameters.

It can be used for filter analysis only if the number of modes is one. Items and algorithms for analysis are the same as in the AQ6317 series.

### Analysis item

PEAK LEVEL:          Peak level
PEAK WL:             Peak wavelength
CENTER WL:           Center wavelength
SPEC WIDTH:          Wavelength width at threshold value TH
RIPPLE:              Ripple width
CROSS TALK:          Crosstalk

### Parameters

| Item | Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|---|
| PEAK WAVELENGTH | SW | ON | ON or OFF | - | Display ON/OFF switch |
| PEAL WL | SW | ON | ON or OFF | - | Display ON/OFF switch |
| CENTER WAVELENGTH | SW | ON | ON or OFF | - | Display ON/OFF switch |
| | ALGO | THRESH | THRESH RMS | - | Selection of algorithm for spectrum width. |
| | THRESH LEVEL | THRESH : 3.00 RMS : 3.00 | 0.01 to 50.00 | dB | Threshold value for channel detection. |
| | K | THRESH : 1.00 RMS : - | 1.00 to 10.00 | - | Multiplying factor Valid only when ALGO is THRESH. |
| | MODE FIT | THRESH : OFF RMS : - | ON or OFF | - | Whether "half of maximum point" is set to the mode peak. Valid only when ALGO is THRESH. |
| | MODE DIFF | THRESH : 3.00 RMS : - | 0.01 to 50.0 | dB | Minimum value of the peak/bottom difference during channel detection. Valid only when ALGO is THRESH. |
| SPECTRUM WIDTH | SW | ON | ON or OFF | - | Display ON/OFF switch |
| | ALGO | THRESH | THRESH RMS | - | Selection of algorithm for spectrum width. |
| | THRESH LEVEL | THRESH : 3.00 RMS : 3.00 | 0.01 to 50.00 | dB | Threshold value for channel detection. |
| | K | THRESH : 1.00 RMS : - | 1.00 to 10.00 | - | Multiplying factor Valid only when ALGO is THRESH. |

| Item | Parameter | Default | Range | Unit | Description |
|------|-----------|---------|-------|------|-------------|
| SPECTRUM WIDTH | MODE FIT | THRESH : OFF RMS : - | ON or OFF | - | Whether "half of maximum point" is set to the mode peak. Valid only when ALGO is THRESH. |
| | MODE DIFF | THRESH : 3.00 RMS : - | 0.01~50.0 | dB | Minimum value of the peak/bottom difference during channel detection. Valid only when ALGO is THRESH. |
| RIPPLE WIDTH | SW | ON | ON or OFF | - | Display ON/OFF switch |
| | THRESH LEVEL | 3 | 0.1 to 50.0 | dB | Threshold value for channel detection. |
| | MODE DIFF | 0.5 | 0.001~50.0 | dB | Minimum value for peak/bottom difference during channel detection. |
| CROSS TALK | SW | ON | ON or OFF | - | Display ON/OFF switch |
| | ALGO | THRESH | THRESH PK LEVEL GRID | - | Selection of algorithm for spectrum width. |
| | THRESH LEVEL | THRESH : 3.00 PK LEVEL : - GRID : - | 0.1 to 50.0 | dB | Threshold value for channel detection. Valid only when ALGO is THRESH. |
| | K | THRESH : 1.00 PK LEVEL: - GRID : - | 1.00 to 10.00 | - | Multiplying factor Valid only when ALGO is THRESH. |
| | MODE FIT | THRESH : OFF PK LEVEL: - GRID : - | ON or OFF | - | Whether "half of maximum point" is set to the mode peak. Valid only when ALGO is THRESH. |
| | MODE DIFF | THRESH : 3.00 PK LEVEL: - GRID : - | 0.01~50.0 | - | Minimum value of the peak/bottom difference during channel detection. Valid only when ALGO is THRESH. |
| | CH SPACE | 0.4 | 0.00 to 50.00 | nm | Channel spacing setting. |
| | SEARCH AREA | 0.01 | 0.01 to 10.00 | nm | Analysis range setting. Valid only when ALGO is GRID. |

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**Description**
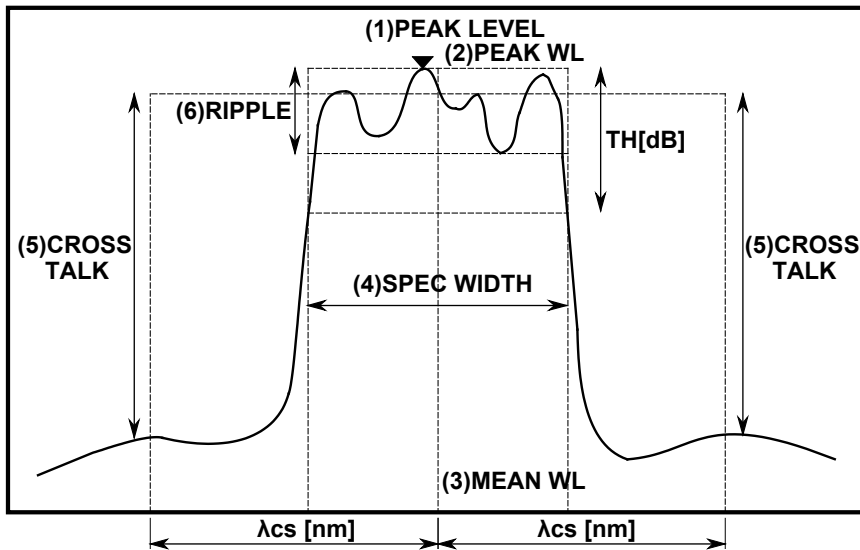


(1) Peak level (PEAK LEVEL)                    value of the level at the waveform peak position

(2) Peak wavelength (PEAK WL)              value of the wavelength at the waveform peak position

(3) Center wavelength (MEAN WL):          value of the center wavelength at the threshold value TH

(4) Spectrum width (SPEC WIDTH):          spectrum width at the threshold value TH

(5) Cross talk (CROSS TALK)

• In the case of THRESH / PEAK LVL algorithms

The value of the level on the reference wavelength (MEAN WL for THRESH and PEAK WL for PEAK LVL) is determined. Also, the value of the level at the wavelength which is ±λCH SPACE[nm] away from the reference wavelength is determined. Then, the difference in level value between the two is assumed to be the cross talk.

• In the case of ITU-T algorithms

The ITU-T grid wavelength, which is nearest to the peak wavelength, is assigned to the reference wavelength. The difference between the bottom level within the range of the reference wavelength ±λSEARCH AREA[nm] and the peak level within the range of the position ±λCH SPACE[nm] away from the reference wavelength ±λSEARCH AREA[nm] are assumed to be the cross talk.

(6) Ripple width (RIPPLE)

A spectrum width search is performed. The value of the peak level − bottom level within the obtained spectrum width is assumed to be the ripple width.

*Note*
• Unless the parameter "MODE DIFF" is set to a value smaller than uneven portions of a waveform regarded as a ripple, RIPPLE = 0 will result.
• RIPPLE = 0 if the parameter setting is "THRESH" < "MODE DIFF"

# FILTER BOTTOM analysis function

This function analyzes collectively the measured waveforms of optical filters via multiple parameters.

It is used for filter analysis if the number of modes is one. Items and algorithms for analysis are the same as in the AQ6317 series.

## Analysis item

BOTTOM LEVEL:     Bottom level
BOTTOM WL:        Bottom wavelength
CENTER WL:        Center wavelength
NOTCH WIDTH:      Notch width (displayed as SPEC WIDTH on the screen)
CROSS TALK:       Crosstalk

## Parameters

| Item | Parameter | Default | Range | Unit | Description |
|---|---|---|---|---|---|
| BOTTOM LEVEL | SW | ON | ON or OFF | - | Display ON/OFF switch |
| BOTTOM WAVELENGTH | SW | ON | ON or OFF | - | Display ON/OFF switch |
| CENTER WAVELENGTH | SW | ON | ON or OFF | - | Display ON/OFF switch |
| | ALGO | BOTTOM | PEAK BOTTOM | - | Selection of algorithm for spectrum width. |
| | THRESH LEVEL | 3.00 | 0.01 to 50.00 | dB | Threshold value for channel detection. |
| | MODE DIFF | 3.00 | 0.01 to 50.00 | dB | Minimum value for peak/bottom difference during channel detection. |
| NOTCH WIDTH | SW | ON | ON or OFF | - | Display ON/OFF switch |
| | ALGO | BOTTOM | PEAK BOTTOM | - | Selection of algorithm for spectrum width. |
| | THRESH LEVEL | 3.00 | 0.01 to 50.00 | dB | Threshold value for channel detection. |
| | MODE DIFF | 3.00 | 0.01 to 50.00 | dB | Minimum value for peak/bottom difference during channel detection. Valid only when ALGO is THRESH. |
| CROSS TALK | SW | ON | ON or OFF | - | Display ON/OFF switch |
| | ALGO | BOTTOM | PEAK BOTTOM BOTTOM LVL GRID | - | Selection of algorithm for spectrum width. |
| | THRESH LEVEL | 3.00 | 0.01 to 50.00 | dB | Minimum value for peak/bottom difference during channel detection. Valid when ALGO is PEAK/ BOTTOM. |
| | MODE DIFF | 3.00 | 00 to 50.0 | - | Multiplying factor Valid only when ALGO is THRESH. |
| | CH SPACE | 0.40 | 0.00 to 50.00 | nm | Channel spacing setting. |
| | SEARCH AREA | 0.01 | 0.01 to 10.00 | nm | Analysis range setting. Valid only when ALGO is GRID. |

**App**

Appendix

### Description
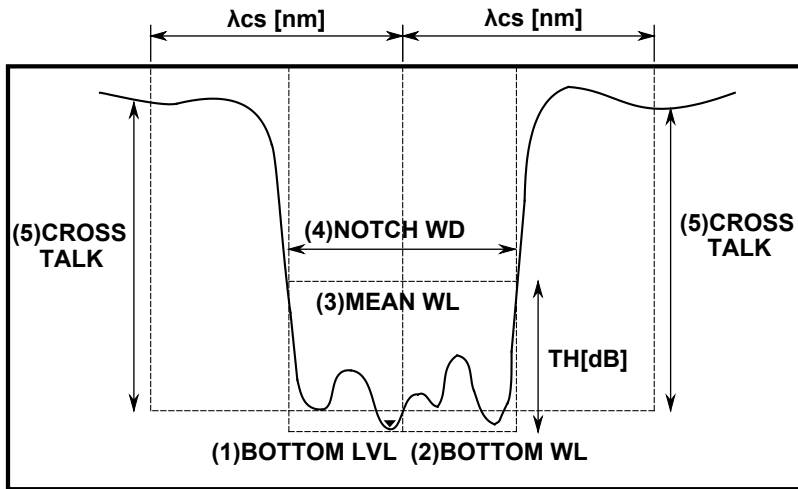


(1) Bottom level (BTM LVL)               Value of level at the waveform bottom position

(2) Bottom wavelength (BTM WL)           Value of wavelength at the waveform bottom position

(3) Center wavelength (MEAN WL)          Value of center wavelength at the threshold value TH

(4) Notch width (NOTCH WD)               Notch width at the threshold value TH

(5) Cross talk (CRS TALK)

• In the case of PEAK/BOTTOM/BOTTOM LVL algorithms

  The level value at the reference wavelength (MEAN WL for PEAK/BOTTOM, BOTTOM WL for BOTTOM LVL) is determined. Also, the level value at the wavelength which is ±λCH SPACE[nm] away from the reference wavelength is determined. Then, the difference in level value between the two is assumed to be the cross talk.

• In the case of ITU-T algorithms

  The ITU-T grid wavelength, which is nearest the bottom wavelength, is assigned to the reference wavelength. The difference between the peak level within the range of the reference wavelength ±λSEARCH AREA[nm] and the bottom level within the range of the position ±λCH SPACE[nm] away from the reference wavelength ±λSEARCH AREA[nm] is assumed to be the cross talk.

# WDM FILTER PEAK analysis function

This function analyzes collectively multiple items for each channel via the measured waveforms of multi-channel optical filters. Unlike the FILTER PEAK analysis, filter analysis is possible on multi-mode waveforms.

## Analysis item

| Analysis Item | Description |
|---|---|
| Nominal Wavelength | Reference wavelength/frequency of each channel. |
| Peak Wavelength / Level | Peak wavelength/frequency and level of each channel. |
| xdB Width / Center Wavelength | xdB width of each channel and its center wavelength/frequency. |
| xdB stop-band | Wavelength width/frequency width across xdB of each channel. |
| xdB pass-band | Pass band xdB from the bottom within the test band of each channel. |
| Ripple | Max-min level (flatness) within the test band of each channel. |
| Cross Talk | Difference in level from the position xnm away from each channel. |

## Parameters

| Item | Parameter | Default | Range | Unit |
|---|---|---|---|---|
| Channel detection, Nominal Wavelength | ALGORHYTHM | MEAN | PEAK / MEAN / GRID/ GRID FIT | - |
| | MODE DIFF | 3.00 | 0.1 to 50.0 | dB |
| | THRESH | 20.00 | 0.1 to 99.9 | dB |
| | TEST BAND | 0.100 | 0.001 to 9.999 | nm |
| Peak Wavelength/Level | SW | ON | ON / OFF | - |
| XdB Width | SW | ON | ON / OFF | - |
| Center Wavelength | THRESH | 3.0 | 0.1 to 50.0 | dB |
| XdB stop-band | SW | ON | ON / OFF | - |
| | THRESH LVL | –10.00 | -90.00 to 30.00 | dB |
| XdB pass-band | SW | ON | ON / OFF | - |
| | THRESH | 3.0 | 0.1 to 50.0 | dB |
| | TEST BAND | 0.20 | 0.01 to 99.99 | nm |
| Ripple | SW | ON | ON / OFF | - |
| | TEST BAND | 0.20 | 0.01 to 99.99 | nm |
| Cross Talk | SW | ON | ON / OFF | - |
| | SPACING | 0.80 | 0.01 to 99.99 | nm |
| | TEST BAND | 0.20 | 0.01 to 99.99 | nm |

**App**

Appendix

**Analysis Algorithm**

• **Channel Detection, Nominal Wavelength**

Parameter

- ALGO
- THRESH
- MODE DIFF
- TEST BAND

Procedure

PEAK

| | |
|---|---|
| Channel: | Each mode peak detected via a mode search (except for the mode peaks at levels which are lower than the mode at the highest level by THRESH[dB] or less.) |
| Reference wavelength: | Wavelength of each mode peak. |
| Peak wavelength/level: | Wavelength and level of each mode peak. |

MEAN

| | |
|---|---|
| Channel: | Each mode peak detected via a mode search (except for the mode peaks at levels which are lower than the mode at the highest level by THRESH[dB] or less.) |
| Reference wavelength: | 3 dB center wavelength at each mode peak. |
| Peak wavelength/level: | Wavelength and level of each mode peak. |

GRID FIT

| | |
|---|---|
| Channel: | Modes within the range of grid wavelength ± (TEST BAND/2) among the mode peaks detected via a mode search (except for the mode peaks at levels which are lower than the mode at the highest level by THRESH[dB] or less.) If the number of relevant modes in one grid is more than one, only the mode at the highest level will be regarded as the channel. |
| Reference wavelength: | Grid wavelength nearest to each channel. |
| Peak wavelength/level: | Wavelength and level of the mode peak of each channel. |

GRID

| | |
|---|---|
| Channel: | A mode search is not be performed. All grid wavelengths within the range of analysis are used as channels. |
| Reference wavelength: | Grid wavelength of each channel |
| Peak wavelength/level: | Peak wavelength and peak level within the range of grid wavelength ± (TEST BAND/2) of each channel. |

**PEAK LVL/PEAK WL**

Parameter

- SW

Procedure

- WDM analysis is performed on the waveform data of an active trace, and channels are detected. However, the DISPLAY MASK parameter is not used.
- The mode peak wavelength (PEAK WL) of each channel of the active trace and its signal optical level (PEAK LVL) are determined.

**XdB Width**
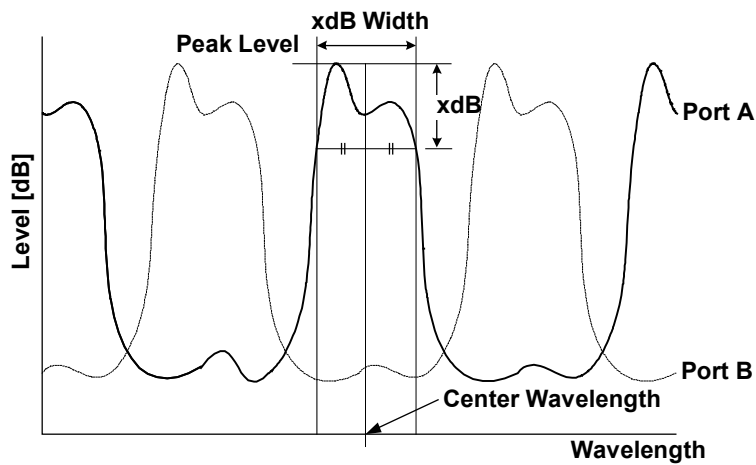


Parameter

- THRESH

Procedure

The width (xdB_Width), which is below the peak level LPi of each channel by the parameter THRESH_LEVEL both on the left and on the right, and its center wavelength are determined. The algorithm for analysis is the same as the algorithm THRESH of the spectrum width.

**XdB stop band**
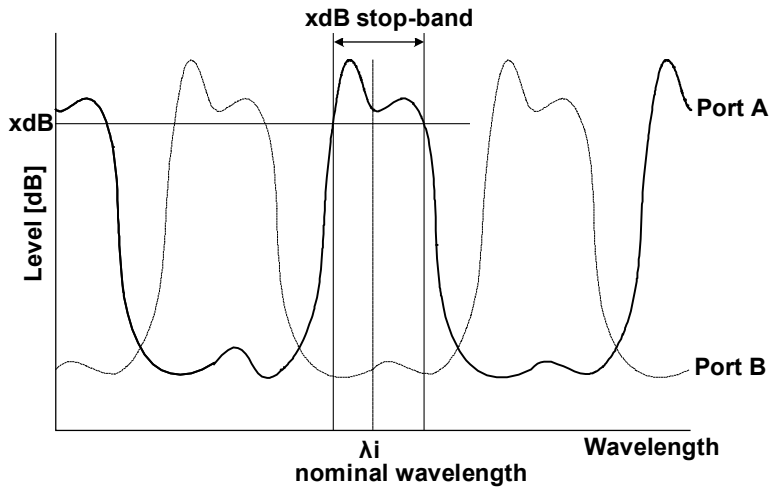


Parameter
 • THRESH

Procedure
 The width (xdB_stop-band) that centers on the reference wavelength λi of each channel and that is located below by the parameter THRESH_LEVEL both on the left and on the right is determined.

**XdB pass-band**
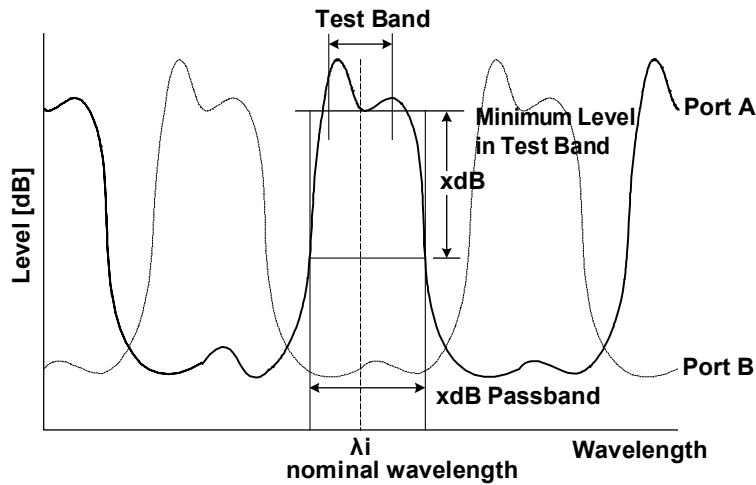


Parameter
 • THRESH
 • TEST BAND

Procedure
 • A bottom search is performed within the range of parameter Test_Band/2 by centering on reference wavelength λi of each channel and obtain the bottom level (LBi).
 • The width (xdB_pass-band) that is below the bottom level LBi obtained in the above procedure by the parameter THRESH _LEVEL is determined.

**Ripple**
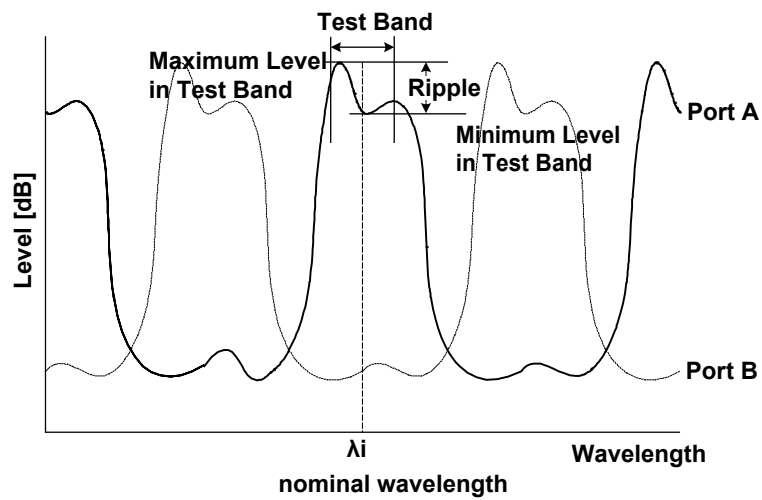


Parameter

- TEST BAND

Procedure

- A peak search and bottom search are performed within the range of parameter Test_ Band/2 by centering on the reference wavelength $\lambda i$ of each channel, and the peak level $(LP'i)$ and the bottom level $(LB'i)$ are determined.
- The peak level $(LP'i)$ and bottom level $(LB'i)$ obtained in the above procedure are used to obtain the ripple from the following equation:
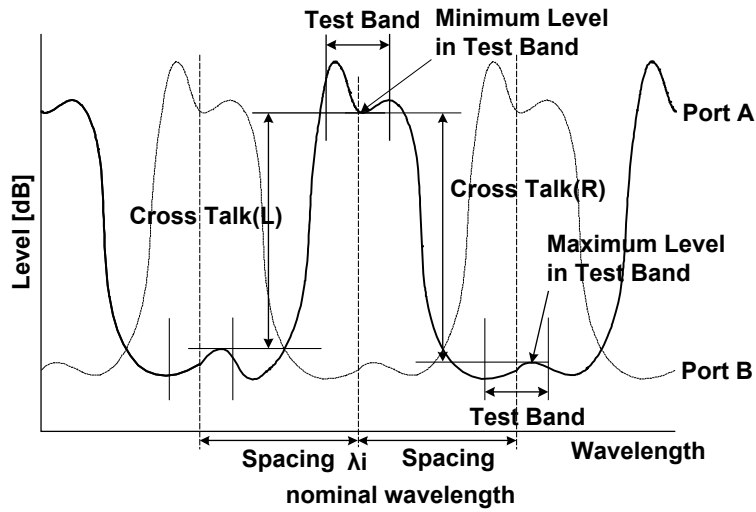
    Ripple = $LP'I - LB'i$

**App**

**Appendix**

**Cross Talk**



Parameter
- SPACING
- TEST BAND

Procedure
- A bottom search is performed within the range of parameter Test_Band/2 by centering on reference wavelength ($\lambda i$) of each channel and obtain the bottom level (LBi).
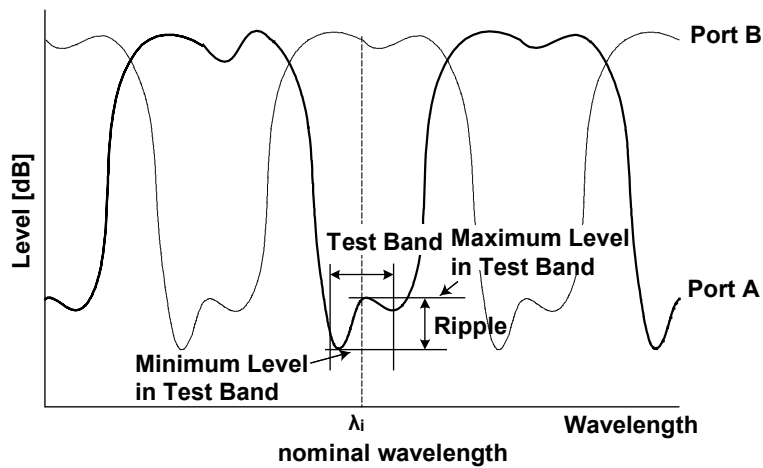- A peak search is performed within the range of parameter Test_Band/2 while centering on the point ($\lambda i - \lambda SP$) that is obtained by subtracting the parameter SPACING from the reference wavelength $\lambda i$ of each channel. Then, the peak level (LPLi) is determined.
- A peak search is performed within the range of parameter Test_Band/2 while centering on the point ($\lambda i + \lambda SP$) that is obtained by adding the parameter SPACING to the reference wavelength $\lambda i$ of each channel. Then, the peak level (LPRi) is determined.
- The values obtained in the above procedure are used to obtain the left and right cross talks (XTLi, XTRi) of each channel from the following equations:

    XTLi = LBi – LPLi
    XTRi = LBi – LPRi

# WDM FILTER BOTTOM analysis function

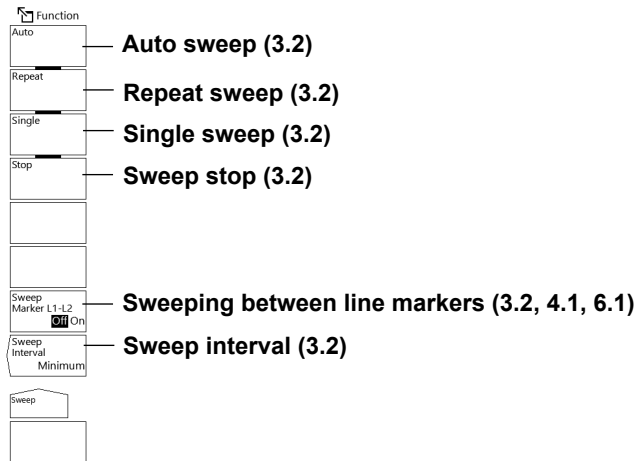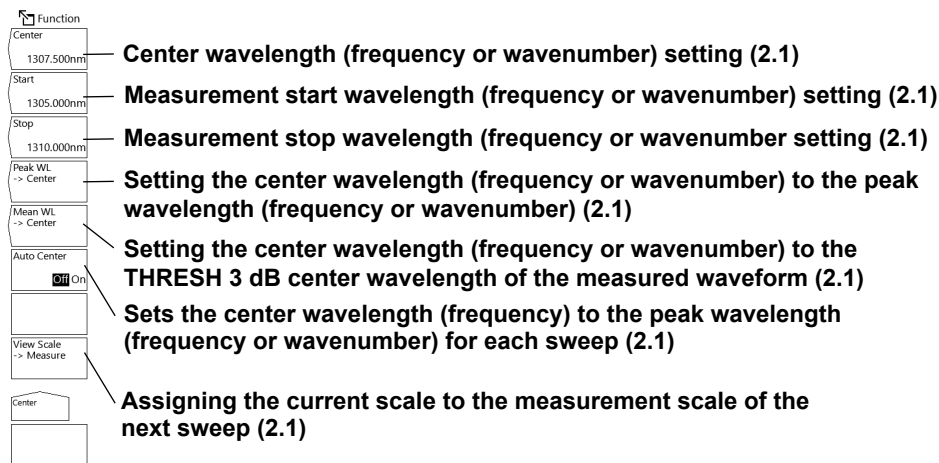This function analyzes collectively multiple items for each channel via the measured waveforms of multi-channel optical filters. Unlike the FILTER BOTTOM analysis, filter analysis is possible on multi-mode waveforms.

### Analysis item

| Analysis Item | Description |
|---|---|
| Nominal Wavelength | Reference wavelength/frequency of each channel. |
| Bottom Wavelength/Level | Peak wavelength/frequency and level of each channel. |
| xdB Notch Width/Center Wavelength | xdB notch width of each channel and its center wavelength/frequency. |
| xdB stop-band | Wavelength width/frequency width across xdB of each channel. |
| xdB Elimination band | Elimination band xdB from the bottom within the test band of each channel. |
| Ripple | Max-min level (flatness) within the test band of each channel. |
| Cross Talk | Difference in level from the position xnm away from each channel. |

### Parameters

| Item | Parameter | Default | Range | Unit |
|---|---|---|---|---|
| Channel detection, Nominal Wavelength | ALGO | NOTCH(B) | BOTTOM/NOTCH(P)/NOTCH(B)/GRID/GRID FIT | - |
| | MODE DIFF | 3.0 | 0.1 to 50.0 | dB |
| | THRESH LEVEL | 20.0 | 0.1 to 99.9 | dB |
| | TEST BAND | 0.100 | 0.001 to 9.999 | nm |
| Bottom Wavelength/ Level | SW | ON | ON/OFF | - |
| XdB Notch Width Center Wavelength | SW | ON | ON/OFF | - |
| | ALGO | NOTCH(B) | NOTCH(P)/NOTCH(B) | - |
| | THRESH LEVEL | 3.0 | 0.1 to 50.0 | dB |
| XdB stop-band | SW | ON | ON/OFF | - |
| | THRESH LEVEL | -10.000 | -90.000 to 30.000 | dB |
| XdB Elimination band | SW | ON | ON/OFF | - |
| | THRESH LEVEL | 3.0 | 0.1 to 50.0 | dB |
| | TEST BAND | 0.20 | 0.01 to 99.99 | nm |
| Ripple | SW | ON | ON/OFF | - |
| | TEST BAND | 0.20 | 0.01 to 99.99 | nm |
| Cross Talk | SW | ON | ON/OFF | - |
| | SPACING | 0.80 | 0.01 to 99.99 | nm |
| | TEST BAND | 0.20 | 0.01 to 99.99 | nm |

**App**

**Appendix**

**Analysis Algorithm**

- **NOMINAL WAVELENGTH**

  Parameter

  - ALGO
  - MODE DIFF
  - THRESH
  - TEST BAND

  Procedure

  BOTTOM

  | | |
  |---|---|
  | Channel: | Each mode bottom detected by a mode search |
  | | (except for the mode bottoms at levels which are above the mode at the lowest level by THRESH[dB] or more.) |
  | Reference wavelength: | Wavelength of each mode bottom. |
  | Bottom wavelength/level: | Wavelength/level of each mode bottom. |

  NOTCH(B)

  | | |
  |---|---|
  | Channel: | Each mode bottom detected by a mode search |
  | | (except for the mode bottoms at levels which are above the mode at the lowest level by THRESH[dB] or more.) |
  | Reference wavelength: | 3 dB-center wavelength with each mode bottom as the reference (ALGO=BOTTOM). |
  | Bottom wavelength/level: | Wavelength and level of each mode peak. |

  NOTCH(P)

  | | |
  |---|---|
  | Channel: | Each mode peak detected via a mode search |
  | | (except for the mode bottoms at levels which are above the mode at the lowest level by THRESH[dB] or more.) |
  | Reference wavelength: | 3 dB-center wavelength with each mode bottom as the reference (ALGO=PEAK). |
  | Bottom wavelength/level: | Wavelength/level of each mode bottom. |

  GRID FIT

  | | |
  |---|---|
  | Channel: | Modes within the range of grid wavelength ± (TEST BAND/2) among the mode bottoms detected via a mode search (except for the mode bottoms at levels which are above the mode at the lowest level by THRESH[dB] or more.) |
  | | If the number of relevant modes in one grid is more than one, only the mode at the lowest level will be regarded as the channel. |
  | Reference wavelength: | Grid wavelength nearest to each channel. |
  | Bottom wavelength/level: | Wavelength and level of the mode bottom of each channel. |

  GRID

  | | |
  |---|---|
  | Channel: | A mode search is not be performed. All grid wavelengths within the range of analysis are used as channels. |
  | Reference wavelength: | Grid wavelength of each channel |
  | Peak wavelength/level: | Bottom wavelength and bottom level within the range of grid wavelength ± (TEST BAND/2) of each channel. |

- **BOTTOM WL/BOTTOM LVL**

  Parameter

  - SW

  Procedure

  - The wavelength $\lambda'i$ of the mode bottom of each channel and its signal optical level LBi are determined.

- **XdB_NOTCH_WIDTH/CENTER WAVELENGTH**

  Parameter
  - SW
  - ALGO
  - THRESH

  Procedure
  - The xdB notch width (xdB_Notch_Width) of each channel and its center wavelength/frequency (Center_Wavelength) are determined according to the settings of the parameter ALGO.

  **NOTCH(B)**
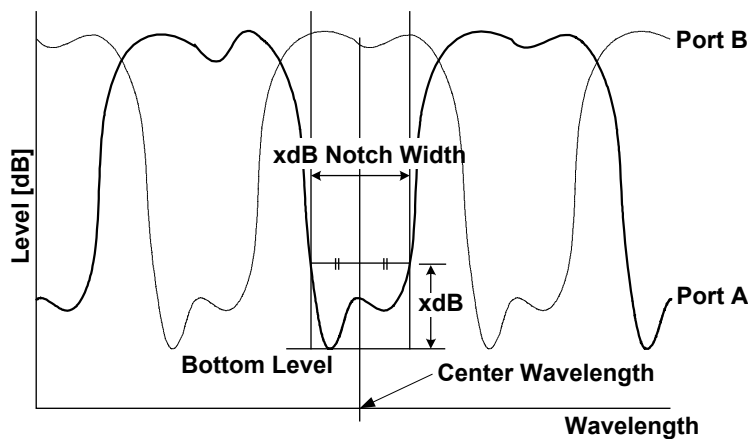


  The width (xdB_Notch_Width) between the two points, which are above the bottom level of each channel by the parameter THRESH_LEVEL, and its center wavelength (Center_Wavelength) are determined.

  **NOTCH(P)**
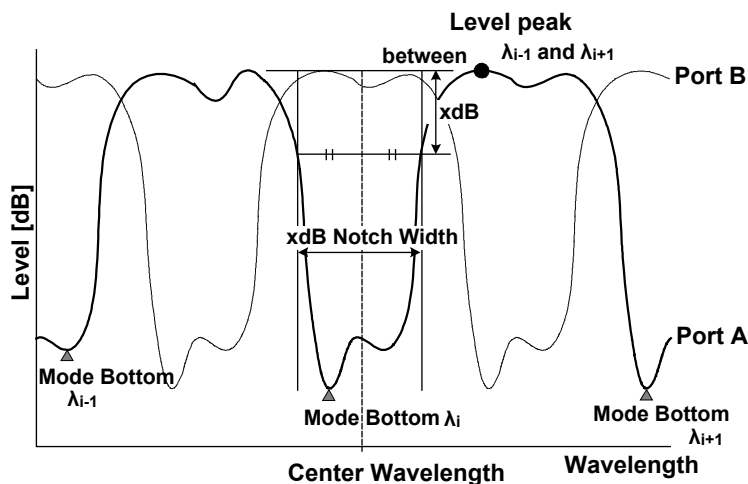


  The width (xdB_Notch_Width) between the two points, which are below the higher point of either the left peak level or the right peak level of each channel by the parameter THRESH_LEVEL, and its center wavelength/frequency (Center_Wavelength) are determined.

• **XdB_STOP-BAND**
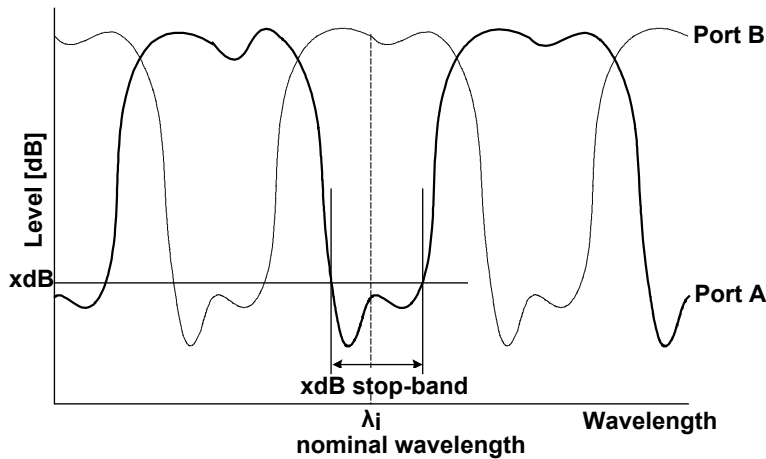


Parameter
• THRESH

Procedure
• The width (xdB_stop-Band) that centers on the nominal wavelength $\lambda i$ of each channel and that is located below by the parameter THRESH_LEVEL both on the left and on the right is determined.

• **XdB_ELIMINATION BAND**
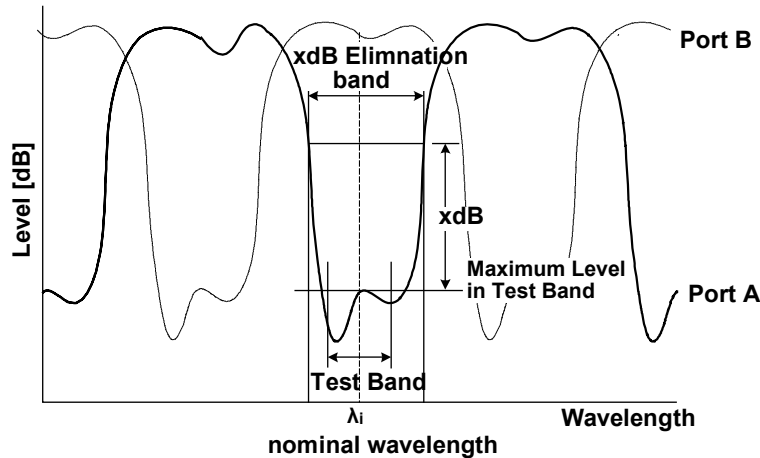


Parameter
• THRESH
• TEST BAND

Procedure
• A peak search is performed within the range of the parameter Test_Band/2 by centering on the nominal wavelength $\lambda i$ of a channel, and the peak level (LPi) is determined.
• The width (xdB_Elimination_Wavelength) that is above the peak level LPi obtained in the above procedure by the parameter THRESH_LEVEL both on the left and on the right is determined.

• **RIPPLE**



Parameter

• TEST BAND

Procedure

**1.** A peak search and bottom search are performed within the range of parameter Test_ Band/2 by centering on the reference wavelength λi of each channel, and the peak level (LP'i) and the bottom level (LB'i) are determined.

**2.** The peak level (LP'i)and bottom level (LB'i) obtained in step 1 is used to obtain the ripple (Ripple) from the following equation:
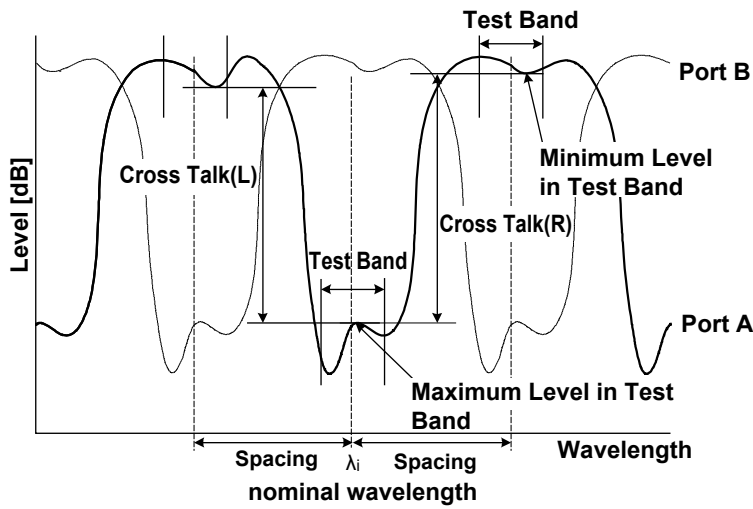
Ripple = LP'i – LB'i

**App**

**Appendix**

- **CROOS TALK**



Parameter
- SPACING
- TEST BAND

Procedure
- A peak search is performed within the range of parameter Test_Band/2 while centering on the reference wavelength λi of each channel, and the peak level (LP"i) is determined.
- A bottom search is performed within the range of parameter Test_Band/2 while centering on the point (λi−λSP) that is obtained by subtracting the parameter Spacing (λSP) from the reference wavelength λi of each channel. Then, the bottom level (LPLi) is determined.
- A bottom search is performed within the range of parameter Test_Band/2 while centering on the point (λi+λSP) that is obtained by subtracting the parameter Spacing (λSP) from the reference wavelength λi of each channel. Then, the bottom level (LPRi) is determined.
- The values obtained in the above procedure are used to obtain the left and right cross talks (XTLi, XTRi) of each channel from the following equations:

    XTLi = LP"i − LPLi
    XTRi = LP"i − LPRi

# Appendix 7   Function Menu Tree Diagram

The menu structure of the instrument is illustrated below. Some menus have been omitted.

## SWEEP

Function

Auto ——— **Auto sweep (3.2)**

Repeat ——— **Repeat sweep (3.2)**

Single ——— **Single sweep (3.2)**

Stop ——— **Sweep stop (3.2)**

Sweep Marker L1-L2 Off On ——— **Sweeping between line markers (3.2, 4.1, 6.1)**

Sweep Interval Minimum ——— **Sweep interval (3.2)**

Sweep

## CENTER

Function

Center 1307.500nm ——— **Center wavelength (frequency or wavenumber) setting (2.1)**

Start 1305.000nm ——— **Measurement start wavelength (frequency or wavenumber) setting (2.1)**

Stop 1310.000nm ——— **Measurement stop wavelength (frequency or wavenumber setting (2.1)**

Peak WL -> Center ——— **Setting the center wavelength (frequency or wavenumber) to the peak wavelength (frequency or wavenumber) (2.1)**

Mean WL -> Center ——— **Setting the center wavelength (frequency or wavenumber) to the THRESH 3 dB center wavelength of the measured waveform (2.1)**

Auto Center Off On ——— **Sets the center wavelength (frequency) to the peak wavelength (frequency or wavenumber) for each sweep (2.1)**

View Scale -> Measure ——— **Assigning the current scale to the measurement scale of the next sweep (2.1)**

Center

## SPAN

Function

Span 5.0nm ——— **Sweep span setting (2.1)**

Start 1305.000nm ——— **Measurement start wavelength (frequency or wavenumber) setting (2.1)**

Stop 1310.000nm ——— **Measurement stop wavelength (frequency or wavenumber) setting (2.1)**

Δλ -> Span ——— **Setting the sweep span to RMS 20dB width of the measured waveform × 6 (2.1)**

0nm Sweep Time Minimum ——— **Setting the screen range measurement time for 0 nm sweep (6.9)**

View Scale -> Measure ——— **Assigning the current scale to the measurement scale of the next sweep (2.1)**

Span

## LEVEL

**LEVEL (1/2)**



**LEVEL (2/2)**
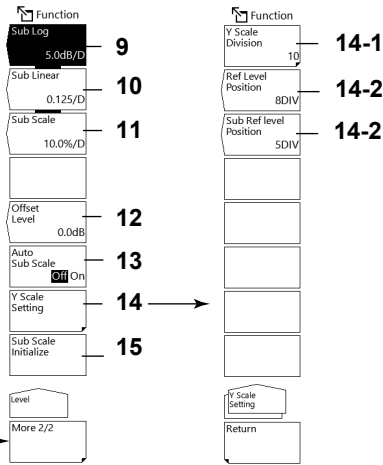


| 1 | Reference level setting (2.5) |
| 2 | LOG scale setting (2.5) |
| 3 | Linear scale setting (2.5) |
| 4 | Linear scale bottom settings (2.5) |
| 5 | Setting the peak level to the reference level (2.5) |
| 6 | Automatic setting of reference level (2.5) |
| 7 | Vertical scale unit setting (2.5) |
| 8 | Main scale initialization |
| 9 | Setting the sub scale to LOG (2.6) |
| 10 | Setting the sub scale to LINEAR (2.6) |
| 11 | Setting the sub scale to % (2.6) |
| 12 | Linear sub scale bottom setting or offset level setting for LOG (2.6) |
| 13 | Automatic scaling of sub scale (2.6) |
| 14 | Vertical scale setting (2.5) |
|  | 14-1 Number of divisions in the level axis (2.5) |
|  | 14-2 Reference level position on the screen (2.5) |
|  | 14-3 Reference level position on the sub scale (2.6) |
| 15 | Sub scale initialization |

# SETUP

SETUP (1/2)
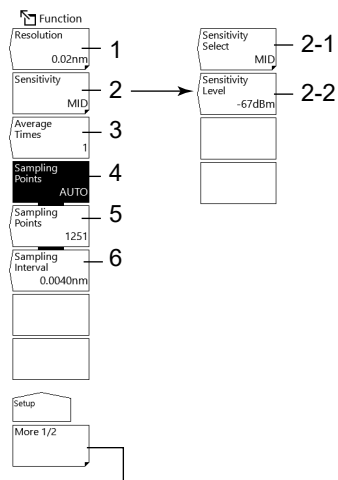


SETUP (2/2)
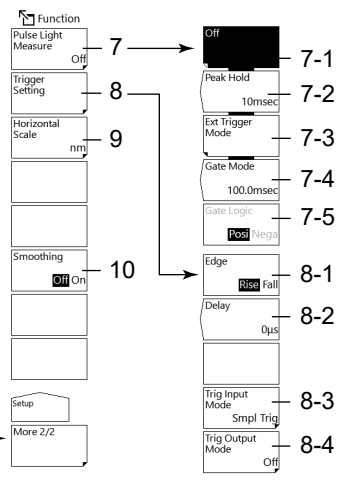


1　　　　Measurement resolution setting (2.2)

2　　　　Measurement sensitivity settings (2.4)

　　　　2-1　Measurement sensitivity selection (2.4)

　　　　2-2　Measurement sensitivity level setting (2.4)

3　　　　Average times setting (2.7)

4　　　　Automatic sampling points setting (2.3)

5　　　　Manual sampling points setting (2.3)

6　　　　Sampling interval setting (2.3)

7　　　　Pulse light measurement settings (3.3)

　　　　7-1　Pulse light measurement OFF (3.3)

　　　　7-2　Peak hold time setting (3.3)

　　　　7-3　External trigger mode setting (3.3)

　　　　7-4　Gate mode setting (3.3)

　　　　7-5　Gate signal logic setting (3.3)

8　　　　Trigger condition settings (3.4)

　　　　8-1　Edge setting (3.4)

　　　　8-2　Delay setting (3.4)

　　　　8-3　Trigger input mode setting (3.4)

　　　　8-4　Trigger output mode setting (3.5)

9　　　　Horizontal scale unit setting (2.1)

10　　　　Smoothing (2.7)

App

Appendix

# ZOOM

Function

| Zoom Center | |
| 1307.500nm | — **Setting the center wavelength (frequency or wavenumber) of the zoom display (4.1)** |
| Zoom Span | |
| 5.0nm | — **Setting the span of the zoom display (4.1)** |
| Zoom Start | |
| 1305.000nm | — **Setting the start point of the zoom display (4.1)** |
| Zoom Stop | |
| 1310.000nm | — **Setting the stop point of the zoom display (4.1)** |
| Peak -> Zoom Ctr | — **Setting the peak position to the center of the zoom display (4.1)** |
| Overview Display    Off L R | — **Setting the display position of the overview (4.1)** |
| View Scale -> Measure | — **Setting the size of the overview (4.1)** |
| Initialize | — **Initializing the display scale (4.1)** |

Zoom

# FILE

Function

| Save | — 1 | Trace | — 3-1 |
| Load | — 2 | All Trace | — 3-2 |
| Item Select    Trace | — 3 → | Graphics | — 3-3 |
| Auto File Name  Num Date | — 4 | Setting | — 3-4 |
| | | Data | — 3-5 |
| Remove USB Storage | — 5 | | |
| File Operation | — 6 | | |

File

Item Select

Return

1        Saving data (7.2 to 7.6)

2        Loading data (7.2, 7.3, 7.5)

3        Setting the target item(7.2 to 7.6)

4        Setting the method of assigning file names (7.2 to 7.6)

5        Removing the USB storage device (7.1)

6        File operation (7.7)

## TRACE(More 1/2)
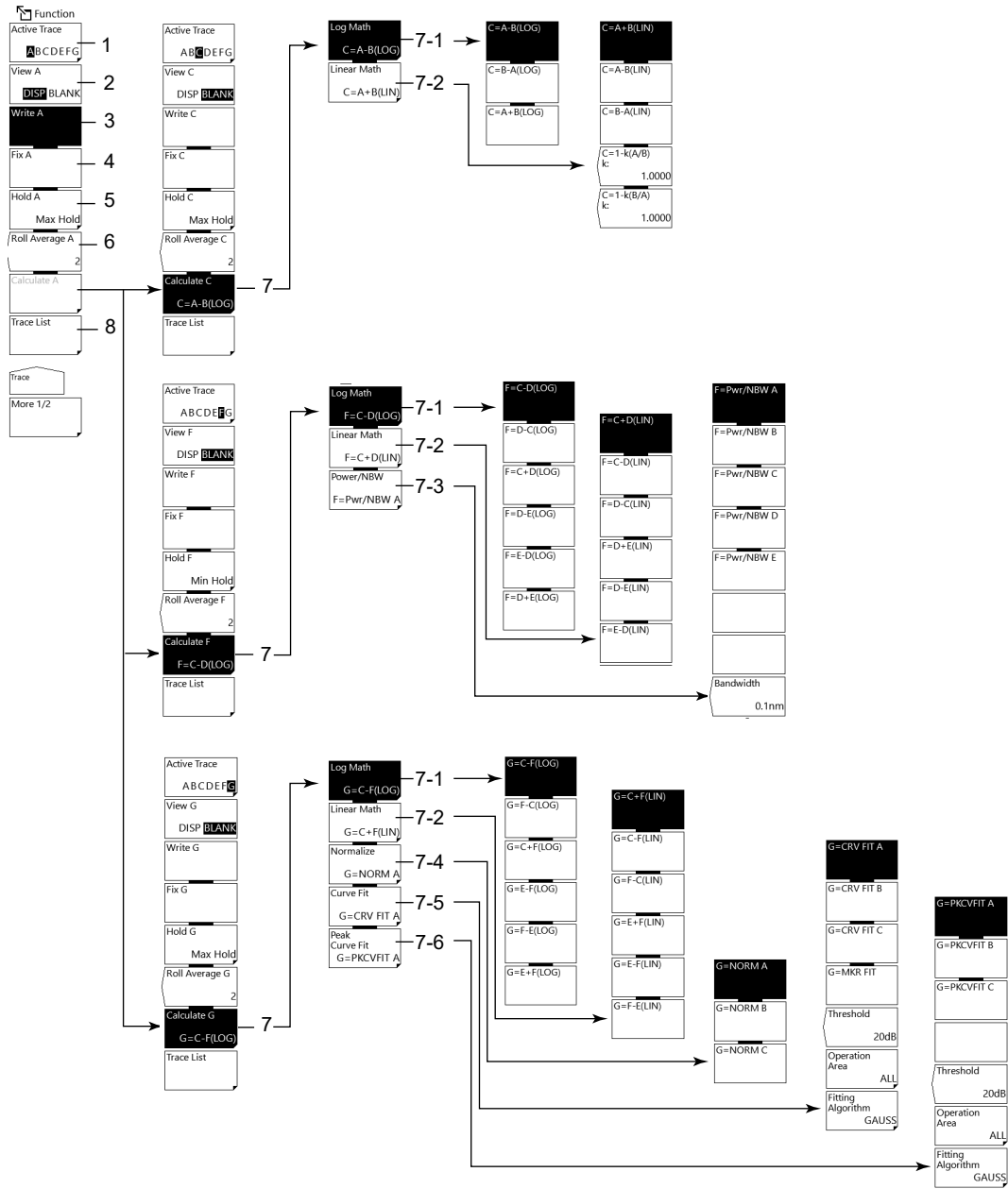


1       Active tray setting (4.2)

2       Show/hide active trace setting (4.2)

3       Setting active trace to write mode (4.2)

4       Setting active trace to fixed mode (4.2)

5       Setting active trace to MAX/MIN hold mode (4.3)

6       Setting active trace sweeping to average mode (4.4)

7          Trace-to-trace calculation settings (trace C, F, G only) (4.5)

      7-1   Trace-to-trace calculation in LOG (4.5)

      7-2   Trace-to-trace calculation in LIN (4.5)

      7-3   Power spectral density display (trace F only) (4.8)

      7-4   Trace normalization (trace G only) (4.6)

      7-5   Trace curve fitting (trace G only) (4.7)

      7-6   Trace peak curve fitting (trace G only) (4.7)

8          Trace condition list display (4.10)

## TRACE(More 2/2)
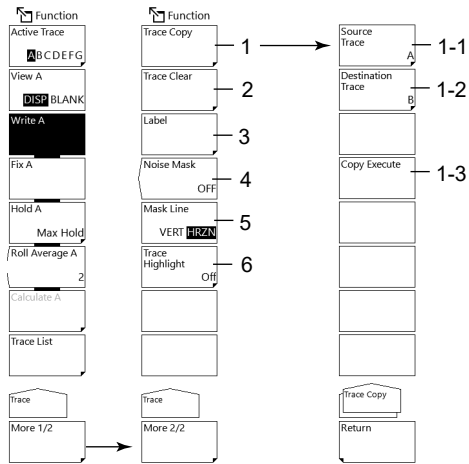


1          Copy trace (4.10)

      1-1   Copy source trace setting (4.10)

      1-2   Copy target trace setting (4.10)

      1-3   Execute copy (4.10)

2          Trace clearing (4.10)

3          Label character input (IM AQ6375E-02EN)

4          Noise mask setting (4.11)

5          Mask line setting (4.11)

6          Trace highlighting (4.12)

# MARKER
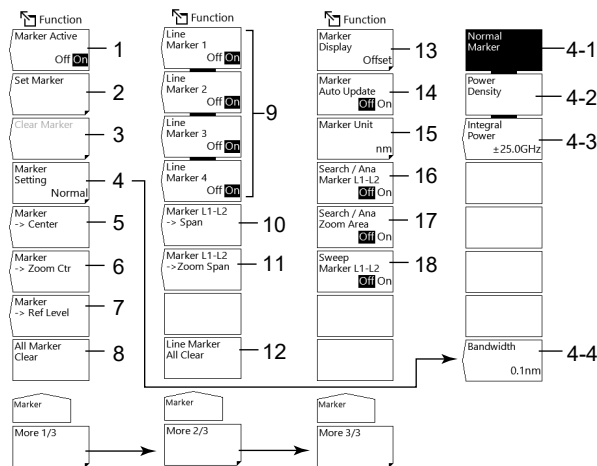


1        Moving marker display on/off (5.1)

2        Setting moving markers to fixed markers (5.1)

3        Clearing fixed markers (5.1)

4        Marker type selection (5.1, 5.3, 5.4)

    4-1  Normal marker (5.1)

    4-2  Power spectral density marker (5.3)

    4-3  Integral power marker (5.4)

    4-4  Normalization bandwidth setting (5.3)

5        Setting the moving marker wavelength (frequency or wavenumber) to measurement center (5.1)

6        Setting the moving marker wavelength (frequency or wavenumber) to display scale center (5.1)

7        Setting the moving marker level to reference level (5.1)

8        Clear all displayed moving and fixed markers (5.1)

9        Line markers on/off (5.2)

10       Setting the measurement span to between line markers L1 and L2 (5.2)

11       Setting the zoom span to between line markers L1 and L2 (5.2)

12       Clearing all displayed line markers (5.2)

13       Marker display settings (5.1)

14       Setting whether to automatically update the fixed marker's level values when updating active trace (5.1)

15       Marker value units setting (5.1)

16       Setting the peak search, bottom search, and analysis function ranges to between line markers L1 and L2
         (For both the PEAK SEARCH and ANALYSIS menus) (4.9, 6.1)

17       Setting the peak search, bottom search, and analysis function ranges to within the zoom span
         (For both the PEAK SEARCH and ANALYSIS menus) (4.1, 6.1)

18       Sweep between line markers (3.2)

**App**

Appendix

## PEAK SERACH
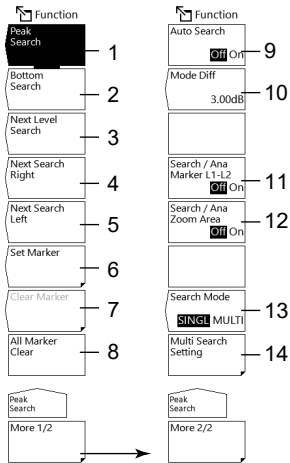


| | |
|---|---|
| 1 | Executing a peak search (4.9) |
| 2 | Executing a bottom search (4.9) |
| 3 | Moving the moving marker from the current position to the next peak/bottom value (4.9) |
| 4 | Moving the moving marker from the current position to the next peak/bottom value to the right (4.9) |
| 5 | Moving the moving marker from the current position to the next peak/bottom value to the left (4.9) |
| 6 | Setting moving markers to fixed markers (4.9) |
| 7 | Clearing fixed markers (4.9) |
| 8 | Clearing all displayed moving and fixed markers (4.9) |
| 9 | Turning on/off peak/bottom search each sweep (4.9) |
| 10 | Setting the minimum peak/bottom difference of the mode judgment reference (4.9) |
| 11 | Setting the peak search, bottom search, and analysis function ranges to between line markers L1 and L2 (For both the MARKER and ANALYSIS menus) (4.9, 6.1) |
| 12 | Setting the peak search, bottom search, and analysis function ranges to within the zoom span (For both the MARKER and ANALYSIS menus) (4.9, 6.1) |
| 13 | Switching between the single and multi peak/bottom searches (4.9) |
| 14 | Setting the threshold and sort order of the multi search (4.9) |

# ANALYSIS
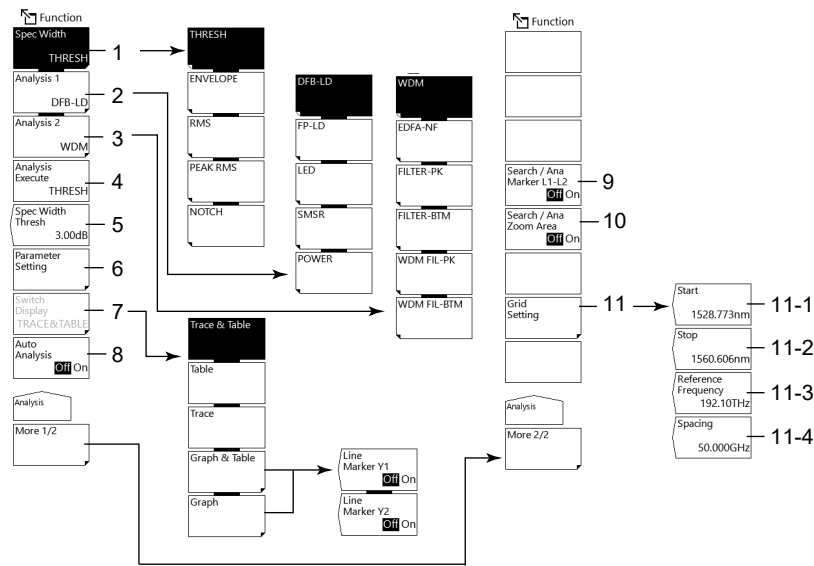


1          Spectrum width analysis algorithm settings/execution (6.2)

2          Analysis function settings (6.3 to 6.5)

           (DFB-LD, FP-LD, LED, SMSR, POWER)

3          Analysis function settings (6.5 to 6.8)

           (WDM, FILTER-PK, FILTER-BTM, WDM FIL-PK, WDM FIL-BTM)

4          Executing the specified analysis (6.2 to 6.8)

5          Spectrum width analysis threshold setting (6.2)

6          Analysis parameter settings (6.2 to 6.8)

7          Editing the ANALYSIS2 analysis results display screen (6.6 to 6.8)

8          Turning on/off automatic analysis each sweep (6.2 to 6.8)

9          Setting the peak search, bottom search, and analysis function ranges to between line markers L1 and L2

           (For both the MARKER and PEAK SEARCH menus) (4.9, 6.1)

10         Setting the peak search, bottom search, and analysis function ranges to within the zoom span

           (For both the MARKER and PEAK SEARCH menus) (4.9, 6.1)

11         Editing the grid table (6.10)

           11-1      Setting the grid start wavelength (frequency) (6.10)

           11-2      Setting the grid stop wavelength (frequency) (6.10)

           11-3      Setting the grid table reference wavelength (6.10)

           11-4      Setting the grid frequency spacing (6.10)

**App**

**Appendix**

## SYSTEM(More 1/4)
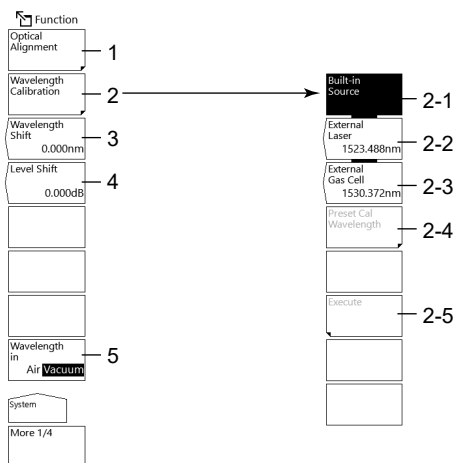


| 1 | Executing the monochromator alignment adjustment (see IM AQ6375E-02EN) |
|---|---|
| 2 | Wavelength calibration (IM AQ6375E-02EN) |

    2-1   Wavelength calibration using the internal reference light source

    2-2   Wavelength calibration using a laser type external reference light source

    2-3   Wavelength calibration using a gas cell type external reference light source

    2-4   Wavelength calibration setting for wavelength calibration using an external reference light source

    2-5   Executing wavelength calibration

| 3 | Setting the wavelength shift amount (value specified for the wavelength axis display value is added) (9.4) |
|---|---|
| 4 | Setting the level shift amount (value specified for the level axis display value is added) (9.4) |
| 5 | Air wavelength/vacuum wavelength mode (2.1) |

# SYSTEM(More 2/4)
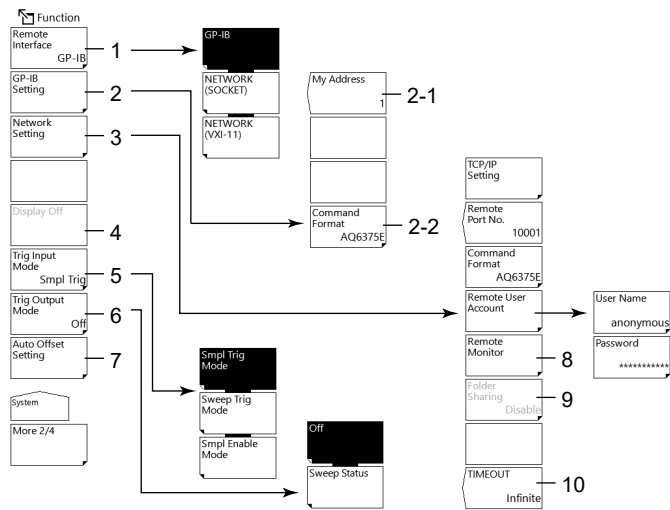


| 1 | Communication interface settings (see IM AQ6375E-17EN) |
|---|---|
| 2 | GP-IB interface settings (see IM AQ6375E-17EN) |
| | 2-1   Setting the GP-IB port address |
| | 2-2   Setting the command format |
| 3 | Setting the Ethernet interface (9.5) |
| 4 | Turning off the LCD display (9.4) |
| 5 | Trigger input mode setting (3.4) |
| 6 | Trigger output mode setting (3.5) |
| 7 | Auto offset ON/OFF (9.3) |
| 8 | Remote monitor (9.5) |
| 9 | Folder sharing setting (9.5) |
| 10 | Remote timeout setting (9.5) |

**App**

**Appendix**

# SYSTEM(More 3/4, More 4/4)



| 1 | UNCAL and warning On/Off (9.4) |
|---|---|
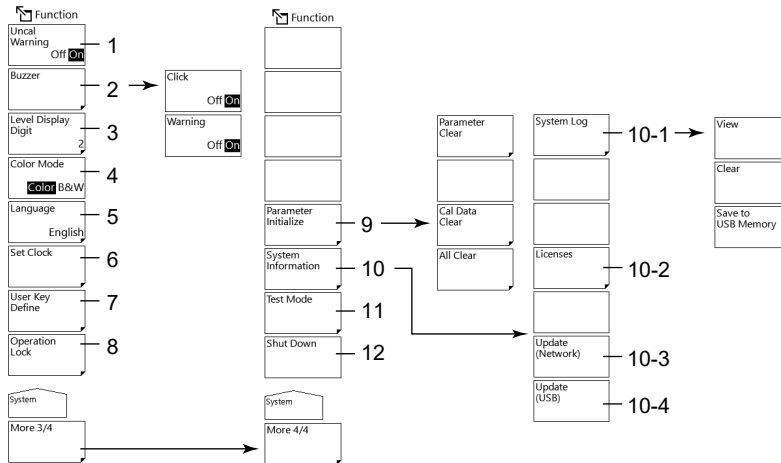
1        UNCAL and warning On/Off (9.4)

2        Buzzer settings (9.6)

3        Setting the number of level data digits (1.5)

4        Display color setting (1.5)

5        Language setting (1.5)

6        date and time settings (see IM AQ6375E-02EN)

7        User-defined menu registration(9.1)

8        Key lock (9.2)

9        Initializing the settings (9.9)

10       System information display (9.8)

         10-1 Displaying, clearing, and saving the system log to USB memory (9.8)

         10-2 Displaying the open source software (OSS) license

         10-3 Updating the firmware (via network) (see IM AQ6375E-02EN)

         10-4 Updating the firmware (USB memory) (see IM AQ6375E-02EN)

11       Service menu

12       System shutdown (see IM AQ6375E-02EN)

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