User's Manual

AQ6373E
Optical Spectrum Analyzer

Thank you for purchasing the AQ6373E 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 2023
- 2nd Edition: February 2024

Manuals

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

Manuals Included with the Product

Manual Title	Manual No.	Description
AQ6373E Optical Spectrum Analyzer Getting Started Guide	IM AQ6373E-02EN	This manual is provided in print. This guide explains the handling precautions, installation procedure, basic operations, and specifications of this instrument.
AQ6373E Optical Spectrum Analyzer Request to Download Manuals	IM AQ6373E-73EN	Describes the manuals provided on the website.
Optical Spectrum Analyzer	IM AQ6360-92Z1	A document for China.
Safety Instruction Manual	IM 00C01C01-01Z1	A document for the EU.

Manuals Provided on the Website

Download the following manuals from our website.

Manual Title	Manual No.	Description
AQ6373E Optical Spectrum Analyzer User's Manual	IM AQ6373E-01EN	This manual. Explains all functions and operating procedures of the AQ6373E except remote control and program functions.
AQ6373E Optical Spectrum Analyzer Remote Control User's Manual	IM AQ6373E-17EN	Explains functions for controlling the instrument with communication commands and program functions.

For details on downloading manuals, see Request to Download AQ6373E Manuals (IM AQ6373E-73EN).

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

Online help

The User's Manual (IM AQ6373E-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 AQ6373E-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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App

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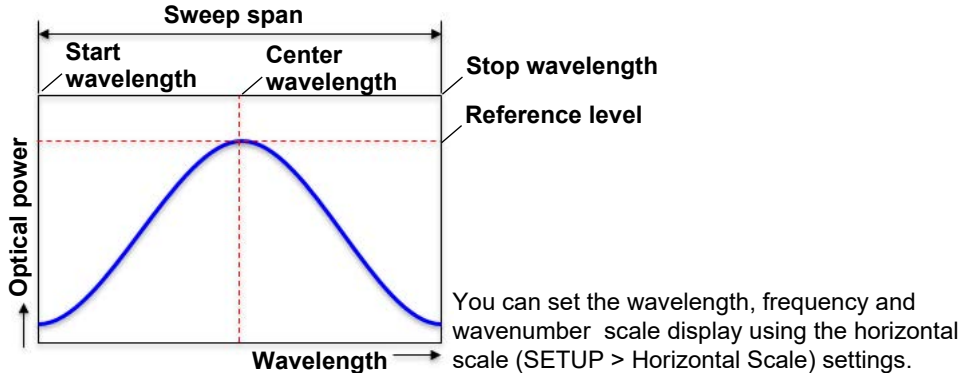
You can set the wavelength, frequency and wavenumber scale display using the horizontal scale (SETUP > Horizontal Scale) settings.

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).
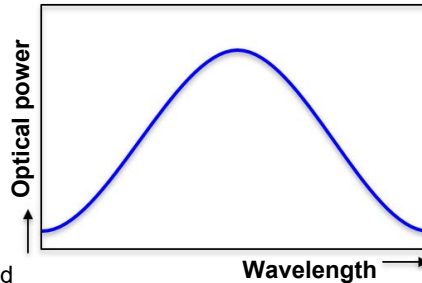
You can set the log and linear scale using the vertical scale (LEVEL) settings.
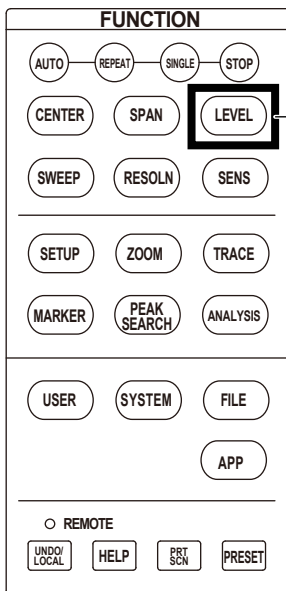
LEVEL
Set the reference level, log and linear scale, etc.

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: 0.01 nm (only high resolution model), 0.02 nm, 0.05 nm, 0.1 nm, 0.2 nm, 0.5 nm, 1 nm, and 2 nm.
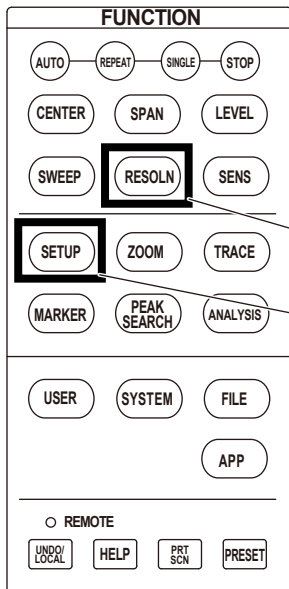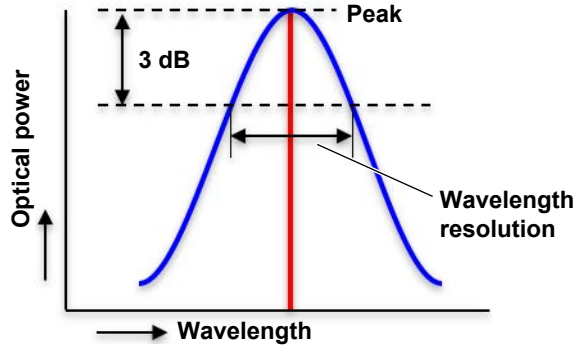
The RESOLN key is a shortcut key for displaying the Resolution menu of the SETUP menu. You can use either key to set the resolution.

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.
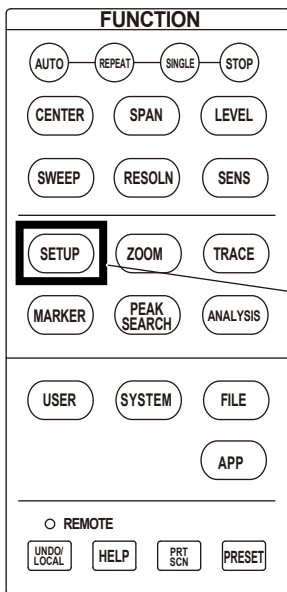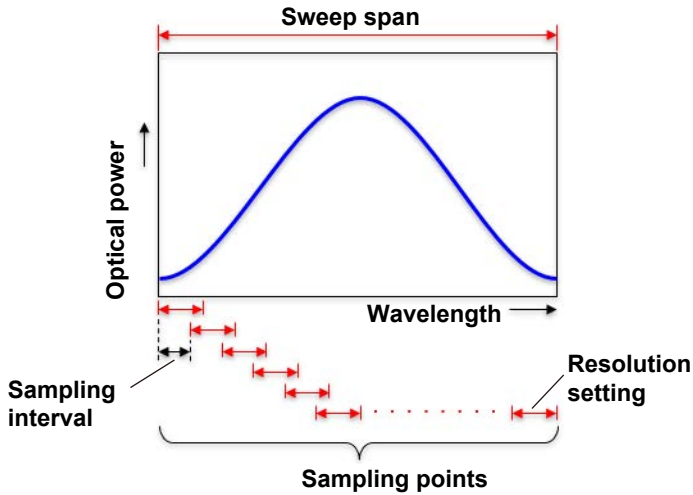
SETUP
Sampling points, sampling interval

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.

SENS
Measurement sensitivity

SETUP
Measurement sensitivity
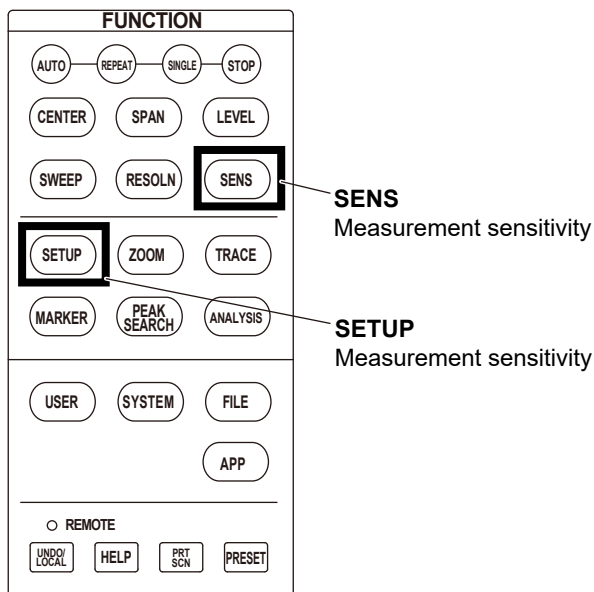
Correlation diagram between measurement sensitivity and sweep speed

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 ↑ — High ↓ Measurement sensitivity

Fast ↑ — Slow ↓ Sweep speed
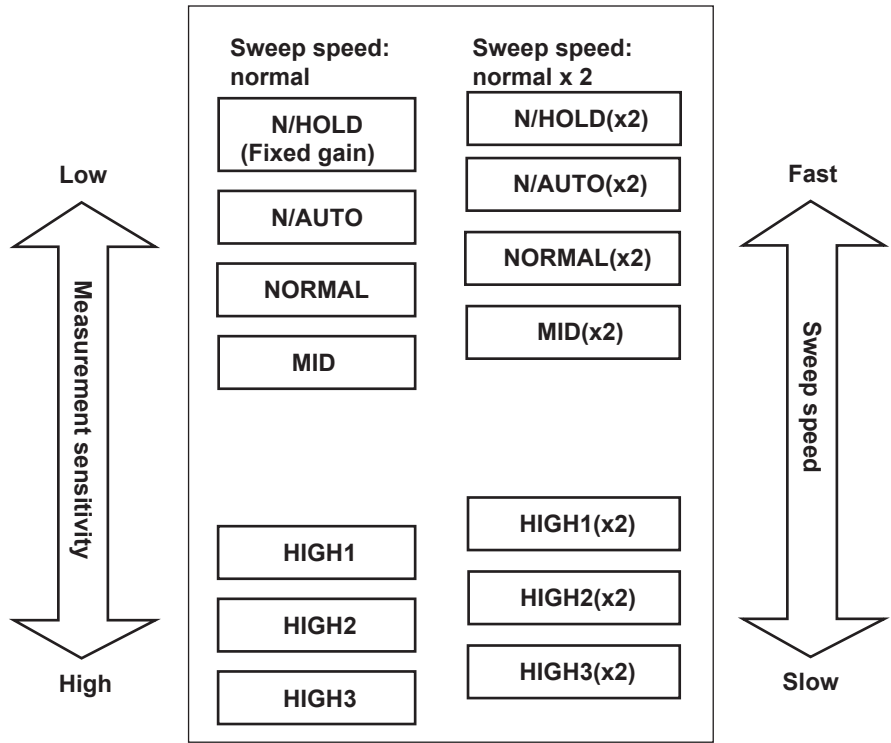
Noise reduction

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) and SMSR.

Sampling interval

Optical power ↑

Wavelength →

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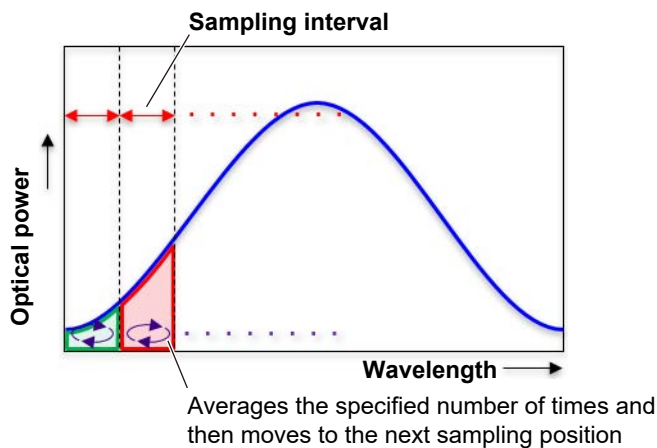
Roll-averaged measurement

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.
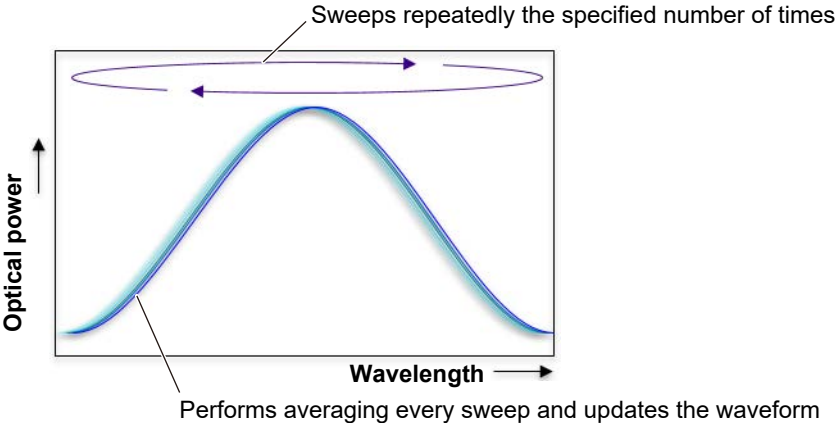
Sweeps repeatedly the specified number of times

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.
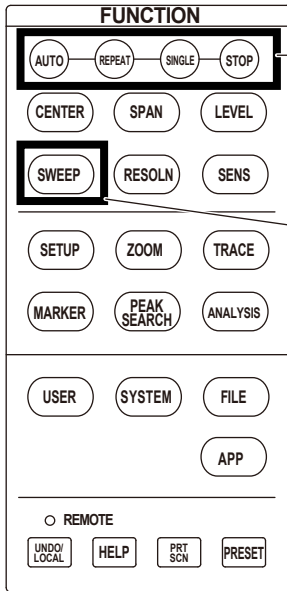
Press these keys to control sweeping directly.

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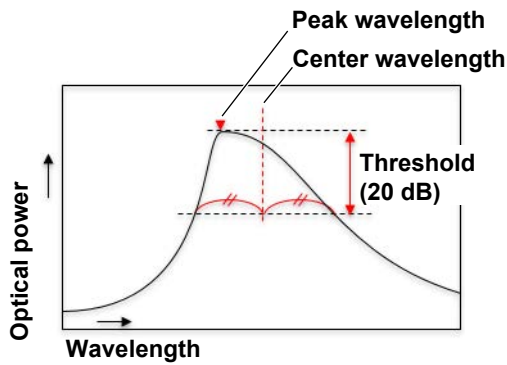
Auto setting of the center wavelength (Auto Center)

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, 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 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.

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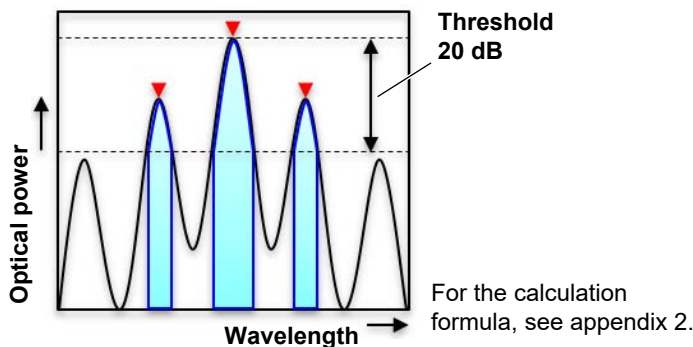
Level fluctuation measurement time (0nm Sweep Time)

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

"Level scale" in Features

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

Wavelength resolution (Resolution)

Set the wavelength resolution for measuring spectra. Select from each specified value of wavelength resolution.

Measurement sensitivity (Sensitivity)

Measurement sensitivity selection (Sensitivity Select)

Select the measurement sensitivity from the menu.
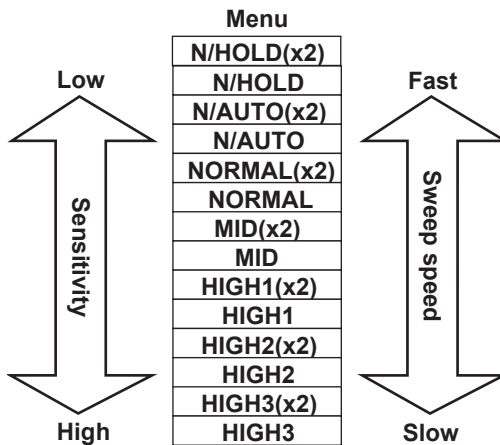
• The internal amplifier is set to fixed gain for N/HOLD. Otherwise, the internal amplifier is set to auto gain.
• (x2) indicates double speed mode.

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.

• **Using the CHOP mode (Chop Mode)**

This mode activates the internal chopper of the monochromator. Stray light specific to the monochromator is reduced by turning the chopper.

When CHOP MODE is set to SWITCH, measurements of better S/N can be made.

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

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:

When the resolution correction function is turned OFF

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

When the resolution correction function is turned ON

$$\frac{Span}{Setting\ resolution} \times 10 > Set\ number\ of\ samples\ -\ 1$$

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 Gate Setting menu, you need to set the gate mode sampling interval and signal logic.

Gate mode setting (Gate Setting)

- **Gate sampling interval (Gate Sampling Interval)**
  Set the sampling interval (average duration per sampling point).

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

- **Measurement delay (Measure Delay)**
  Sets the time required for the pulse light emission to stabilize.
  Data is not measured until the measurement delay has elapsed after the gate signal is input.

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.

Correcting the Wavelength Resolution (Resolution Correction)
Since the wavelength resolution function is set according to the monochromator slit width, the setting resolution and actual resolution may not match. If the resolution is set to 0.1 nm, the actual resolution will be 0.09 nm for a 1450 nm wavelength, and 0.07 nm for a 1550 nm wavelength.
If the Resolution Correction function is turned ON, measured data is processed by the software so that it matches the set resolution.

Fiber core size (Fiber Core Size)
If the core diameter of the fiber under test is 100 µm or less, choose Small. If larger than 100 µm, choose Large.

RESOLN key

"Wavelength resolution," 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).

SWEEP key

"Starting a measurement (sweep)," in Features

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," in Features

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.

Calculation result trace

Calculation result trace

Trace G

NORMALIZE, CURVE FIT, PEAK CURVE FIT
A, B, C

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

MARKER FIT

→ Trace A
→ Trace B
→ Trace E

Calculation result trace

Trace F

POWER/NBW
A, B, C, D, E

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

→ Trace A
→ Trace B
→ Trace D
→ Trace E

Calculation result trace

Trace C

LOG calculation
A+B, A-B, B-A

Linear calculation
A+B, A-B, B-A, 1-k(A/B), 1-k(B/A)

→ Trace A
→ Trace B

Calculation source trace

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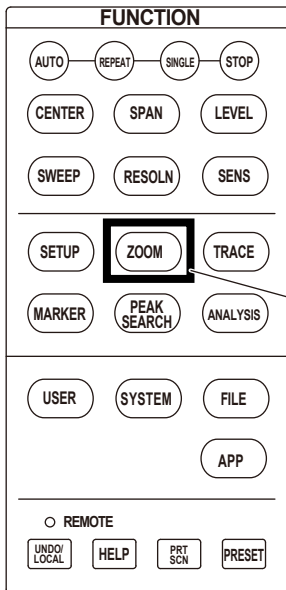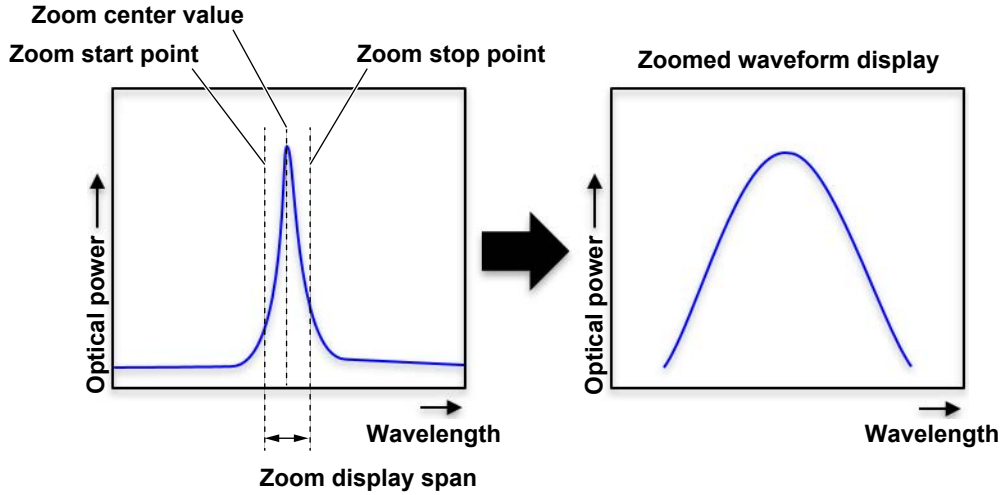
ZOOM
Zoom center value, Zoom display span,
zoom start point, zoom stop point

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.

Moving marker

Peak search

Searches for the next peak or the adjacent peak on the right of the peak value

Fixed marker

0001

Optical power

Wavelength

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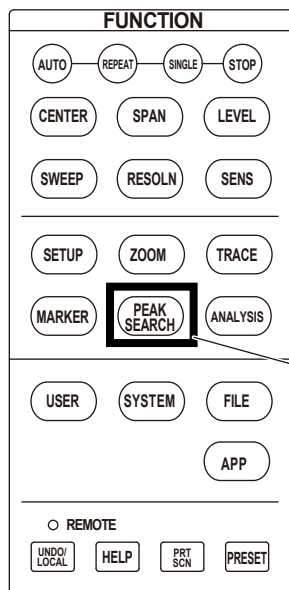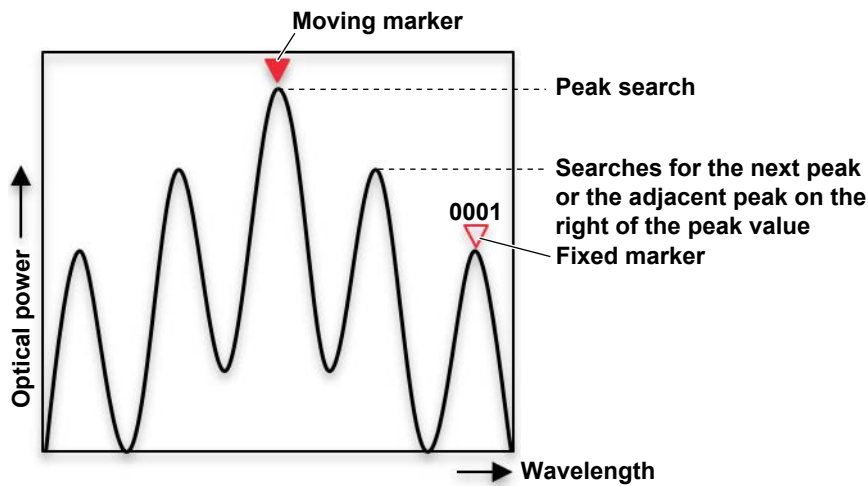
PEAK SEARCH
Peak search, bottom search, level order search, left and right search, fixed marker placement

Markers

You can set markers on the active trace waveform to display in the data area the wavelengths, frequencies or wavenumbers 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 spectral density marker

Integral marker

1

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
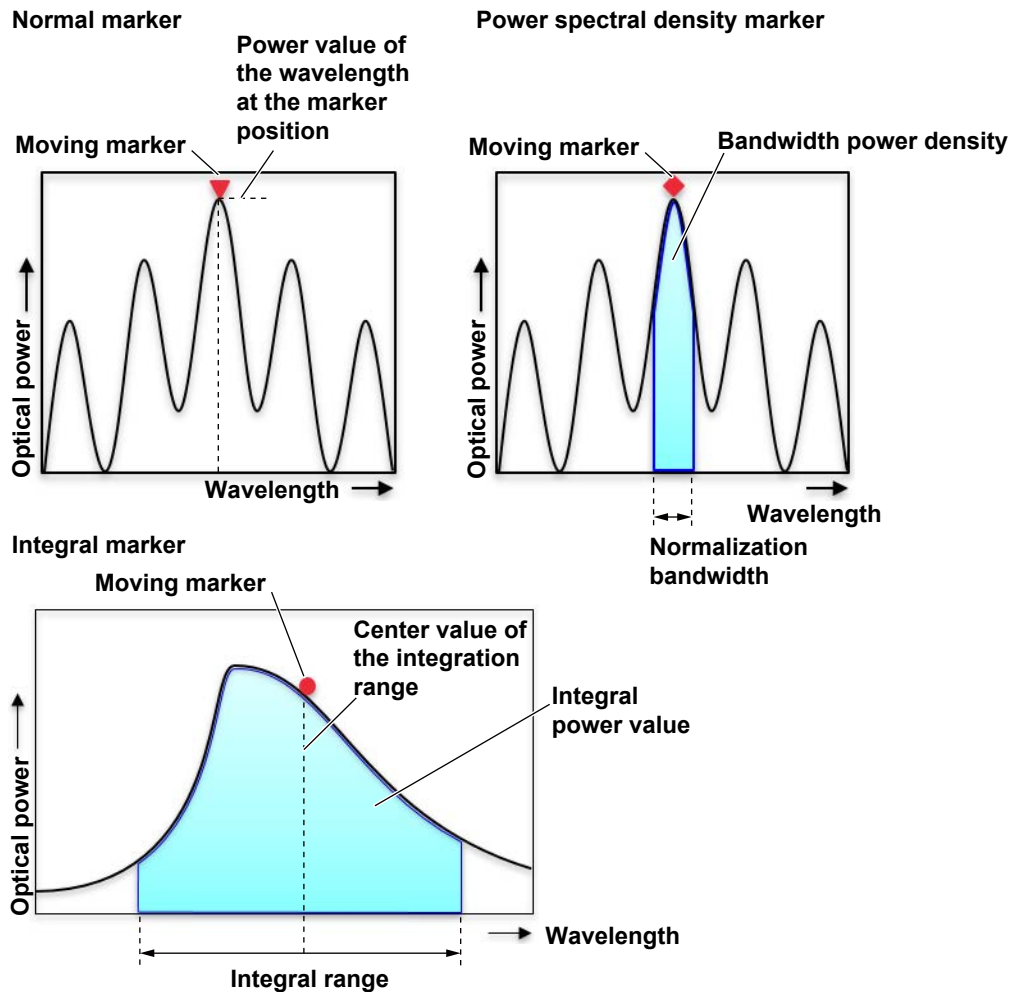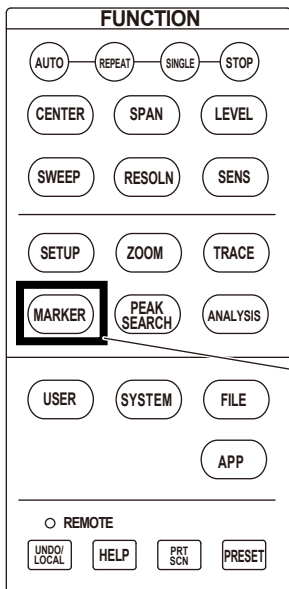
MARKER->Marker Setting
Normal marker, power spectral
density marker, integral marker

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.

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

$W_j(i)$: 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 wavelengthand, 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

```
// AQ6373E OPTICAL SPECTRUM ANALYZER //
TR A  ΔPK   :  552.9940nm        -14.93dBm          Δ-Δn:
TR A  Δ0001:  551.9740nm        -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**

Threshold (3 dB)   Spectral width (Δλ)

Optical power

Wavelength

Center wavelength (ΔC)
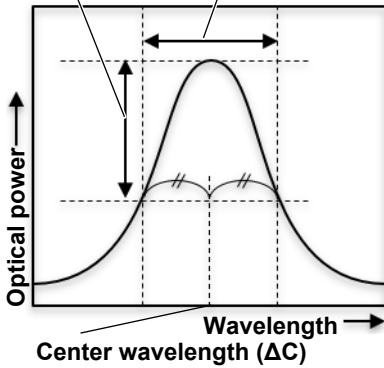
■ **NOTCH width search**

Spectral width (Δλ)

Optical power

Threshold (peak)

Center wavelength (ΔC)

Threshold (bottom)

Wavelength
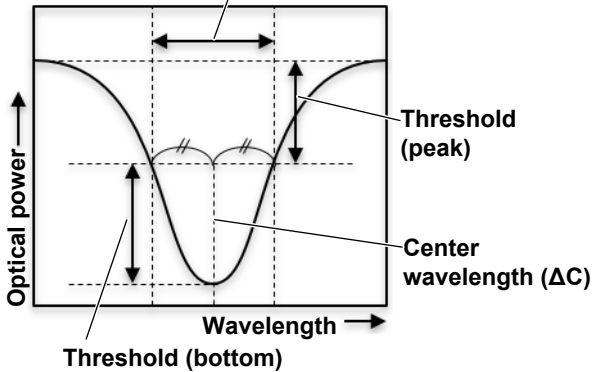
■ **ENVELOPE (envelope curve) method**

Spectral width (Δλ)   Threshold

Optical power

Envelope curve   Wavelength
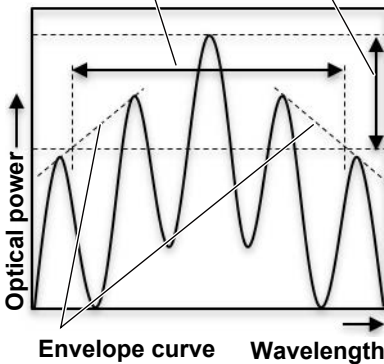
■ **RMS/PEAK RMS method**

Threshold
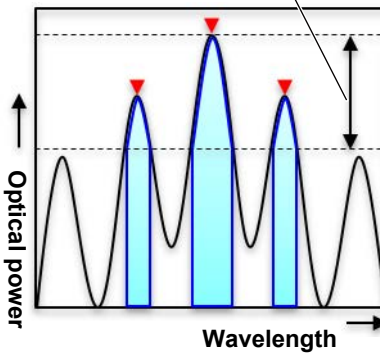
Optical power

Wavelength

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.

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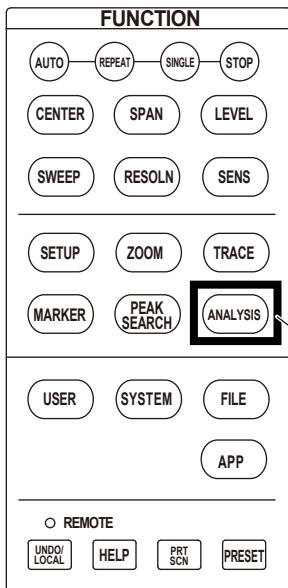
ANALYSIS -> Spec Width
Threshold (THRESH), envelope curve (ENVELOPE), RMS, peak RMS, notch (NOTCH)

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.
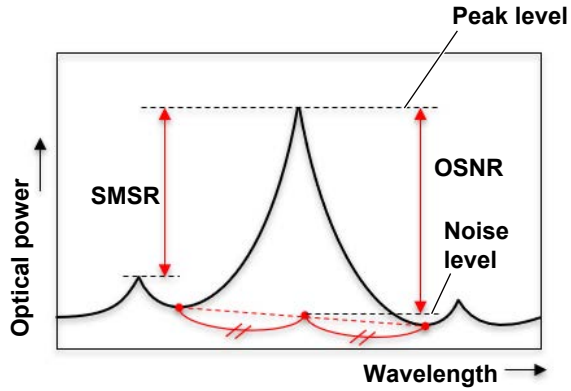
Note

The light source (DFB-LD) analysis also includes an SMSR.
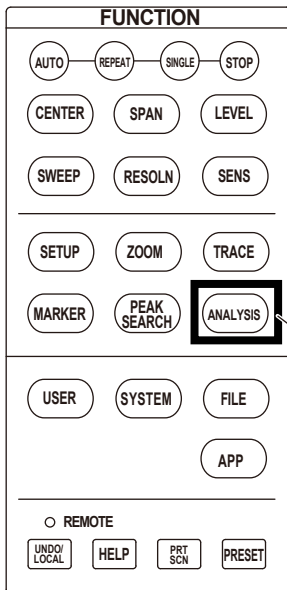
ANALYSIS -> Analysis 1
SMSR

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.

Wavelength line marker L1   **Wavelength line marker L2**

Integral range

Optical power

POWER value   **Wavelength**
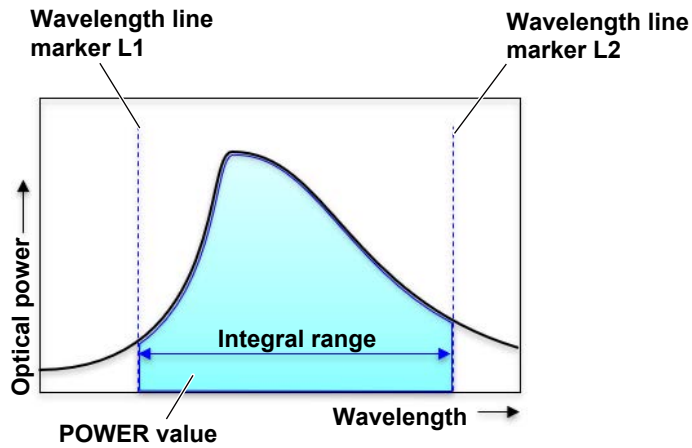
Note

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

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
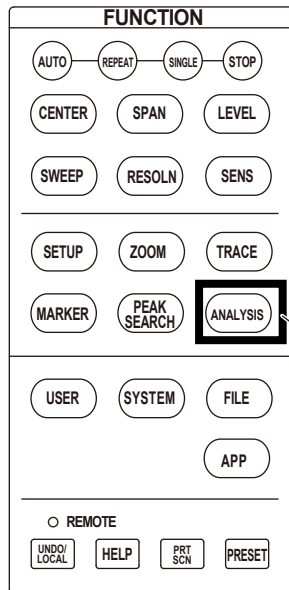
ANALYSIS -> Analysis 1
POWER

SSER/STSSER

SSER

SSER stands for Signal to Spontaneous Emission Ratio. It is the signal light to spontaneous emission light ratio, which is the difference in level between the mode peak and spontaneous emission light.

STSSER

STSSER stands for Signal to Total Source Spontaneous Emission Ratio. It is the signal light to total spontaneous emission light ratio, which is the difference in level between the mode peak and total spontaneous emission light.

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

Light source parameters including spectral line width, SMSR, power and SSER/STSSER explained earlier in this section, can be analyzed collectively.
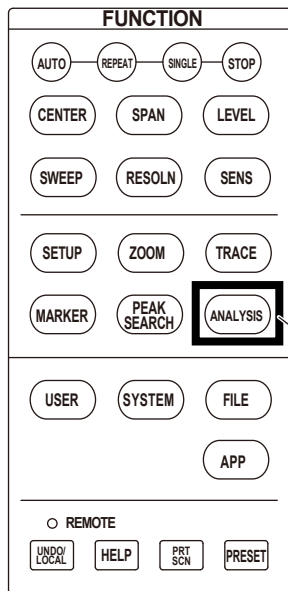
ANALYSIS -> Analysis 1
DFB-LD, FP-LD, LED, TLS

OSNR (WDM) signal spectral analysis

This function calculates the center wavelength (λ), level, noise, SNR, and other parameters of each channel from the measured spectral waveforms. For an explanation and calculation formula of each parameter, see appendix 4.
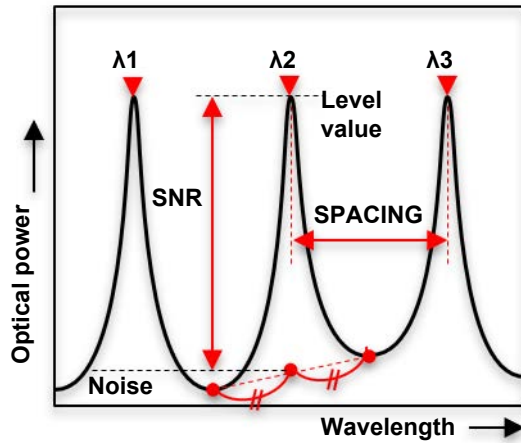
Analysis item	Description
No.1, No.2, ...	Channel number
WAVELENGTH	Center wavelength (λ) of the channel
LEVEL	Level value of the channel (difference between the peak level and noise level)
OFFSET WL	Relative wavelength to the wavelength of the reference channel (REF). Specify REF with a parameter.
OFFSET 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
MEAS WL	Center wavelength (λ) of the channel
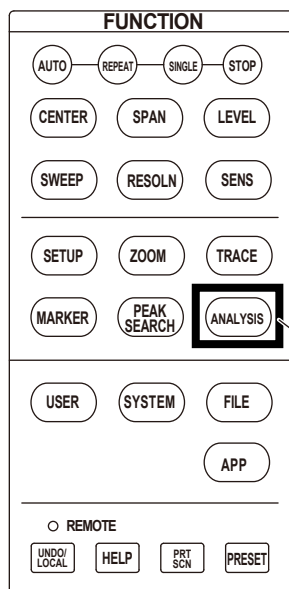
ANALYSIS -> Analysis 2
OSNR (WDM)

Chromaticity coordinate analysis (COLOR analysis)

The COLOR analysis function performs a color analysis of the active trace waveform using a color matching function, determines the chromaticity coordinates, and displays a chromaticity diagram. It can be used to check the color variation of the measured optical signal.
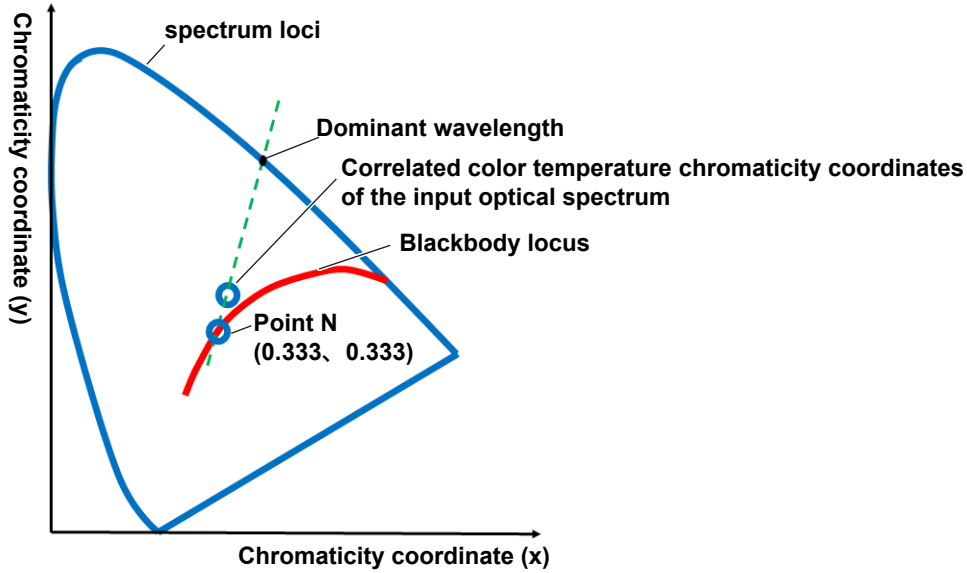
Analysis item	Description
DOMINANT WL	Dominant wavelength
COLOR TEMPERATURE	Correlated color temperature
DEVIATION	Deviation from the blackbody locus
x, y, z	Chromaticity coordinates (x, y, z)
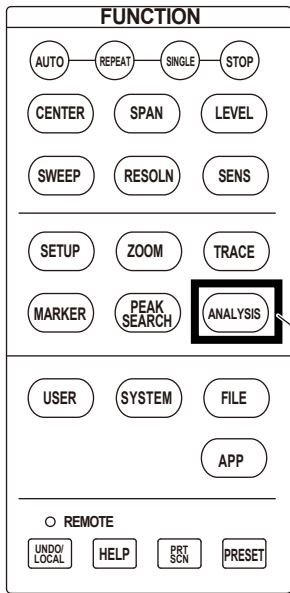
ANALYSIS -> Analysis 2
COLOR

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.

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
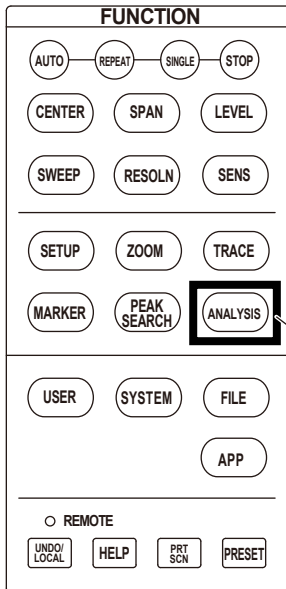
ANALYSIS -> Analysis 2
FILTER-PK, FILTER-BTM, WDM FIL-PK,
WDM FIL-BTM

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))

Optical power

Wavelength ➡
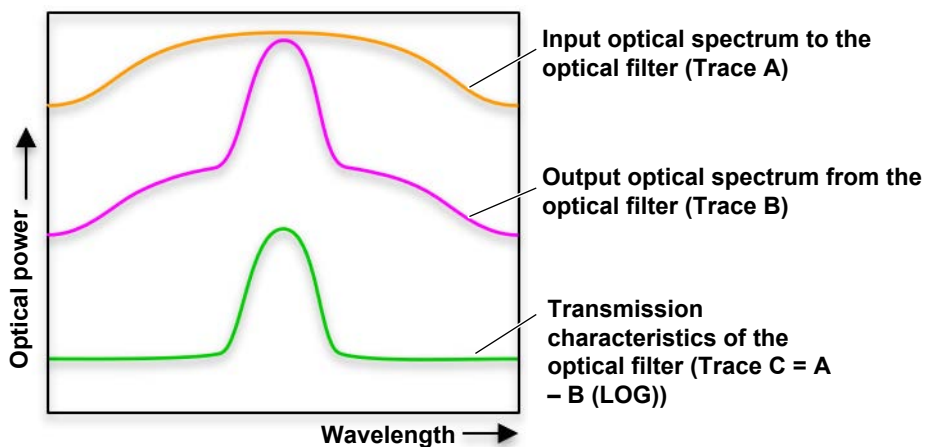
Single-channel filter characteristics

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
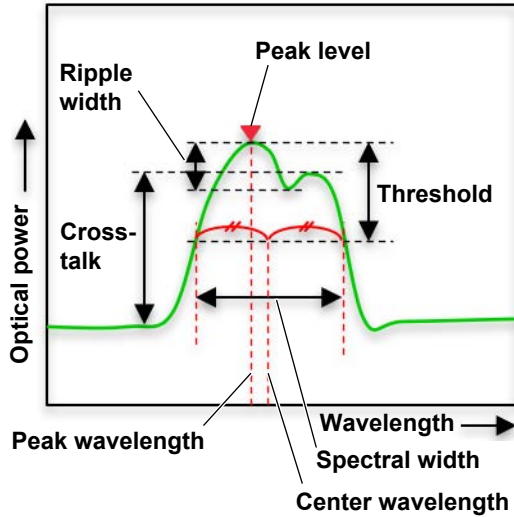
Analysis item	Description
PEAK WL	Peak wavelength
CENTER WL	Center wavelength
SPECTRUM WIDTH	Spectral width
RIPPLE WIDTH	Ripple width
CROSS TALK	Crosstalk

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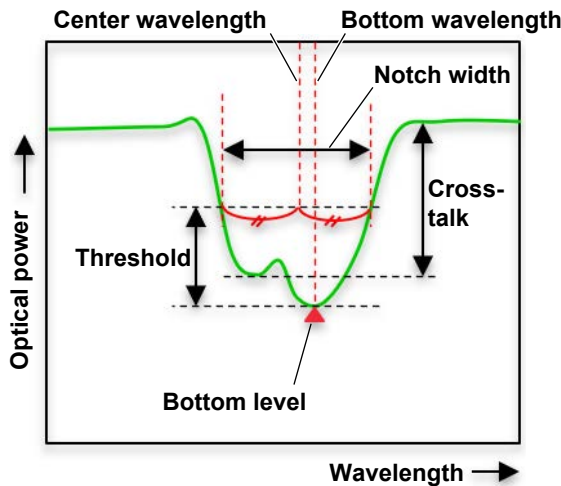
Analysis item	Description
BOTTOM LVL	Bottom level
BOTTOM WL	Bottom wavelength
CENTER WL	Center wavelength
NOTCH WIDTH	Notch width (displayed as SPEC WIDTH on the screen)
CROSS TALK	Crosstalk

Function menus

ANALYSIS key

**"Spectral width", "SMSR and OSNR", "POWER",
"Light source (DFB-LD, FP-LD, LED, TLS) spectral analysis ",
"OSNR (WDM) signal spectral analysis",
"Chromaticity coordinate analysis (COLOR 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 (λC) at a level that is lower than the level of the peak wavelength (λP) 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.
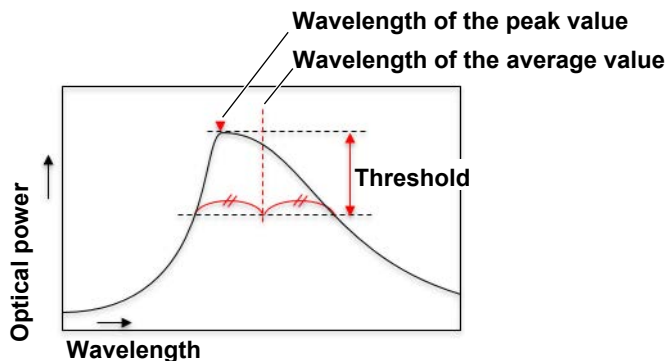
LED

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 OSNR (WDM) waveform, chromaticity coordinate analysis (COLOR analysis), 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.
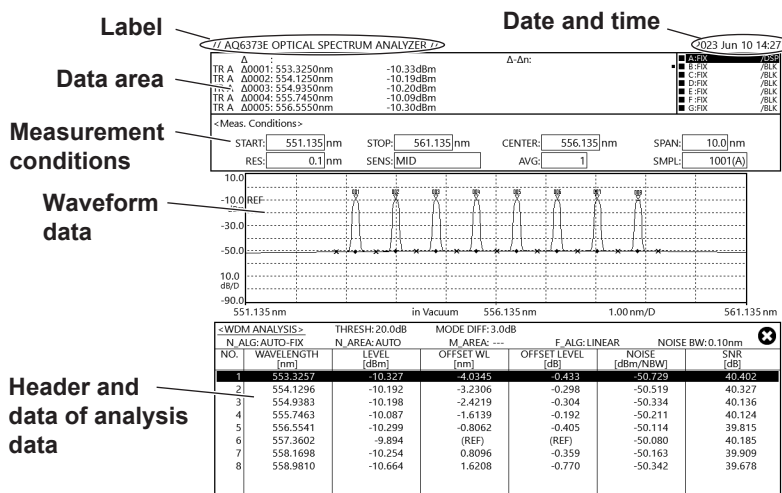
Function menus

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 AQ6373E 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 AQ6373E 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 *AQ6373E Getting Started Guide (IM AQ6373E-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
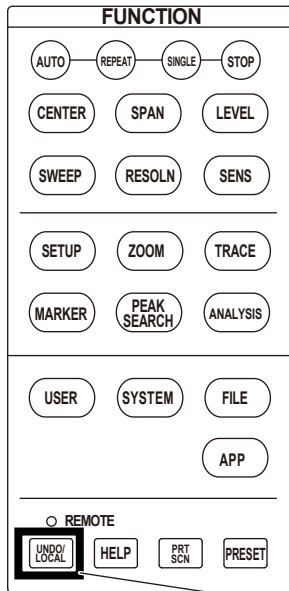
UNDO/LOCAL
UNDO, REDO

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
- Optical fiber end face check
- Programming
- Data logging
- Maintenance information export

WDM/FP-LD/DFB-LD/LED 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　　**Optical fiber cable**

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

End face of the optical fiber cable
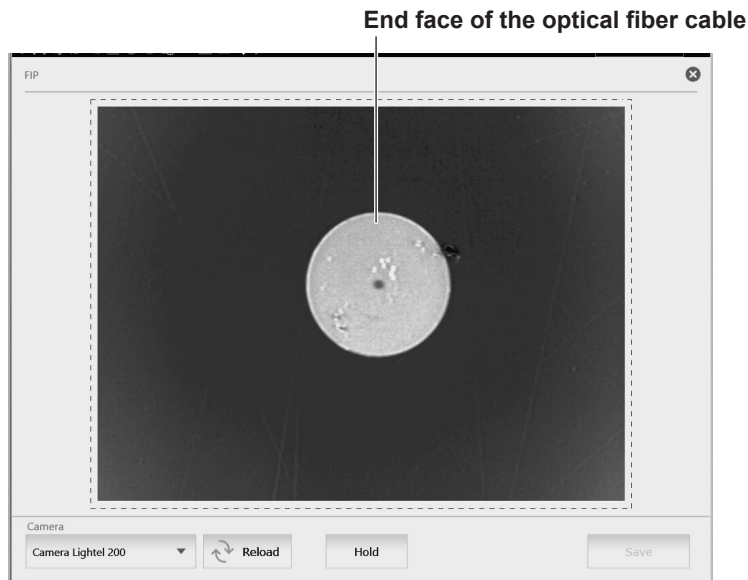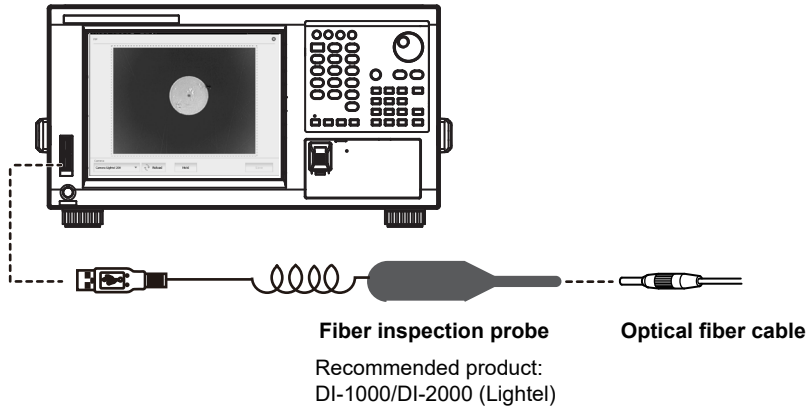
Programming (PROGRAM)

Program functions allow control of this device without the need for an external PC. The program function provides function commands that work equivalently to the keys in the FUNCTION section of the front panel. By assembling each command and creating a program with the program function, you can automate the operation of the function menu and parameters. For details about the program functions, see the separate user's manual, "Optical Spectrum Analyzer Remote Control".

Data Logging (DATA LOGGING)

The analysis data logging function measures and records WDM analysis, DFB-LD analysis, and peak data at regular intervals. The recorded data can be shown on the screen in tables or graphs. In addition, the contents in tables can be saved to a file in CSV format.
The following types of data are recorded for WDM analysis and peaks.
• WDM analysis: Wavelength, level, SNR (signal-to-noise ratio)
• Peak: Wavelength, level

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 analysis test", "Optical fiber end face check", "Maintenance information export (Support file builder)" "Programming (PROGRAM)", "Data logging (DATA LOGGING)" 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**.
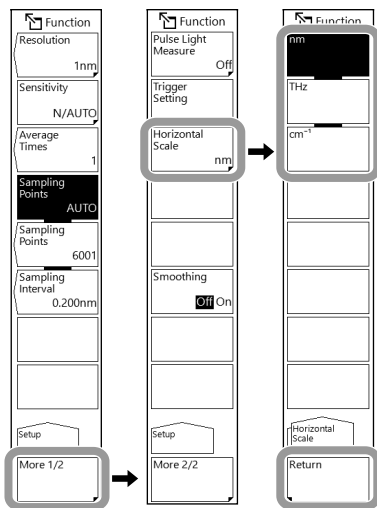
Setting the measured wavelength to wavelength in air or that in vacuum

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.
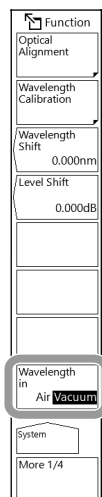
Note
- This function takes effect when a measurement is executed after the setting is changed. It is not applied to the waveform that has already been measured.
- When the setting is changed, in Air (in Air mode) or in Vacuum (in Vacuum mode) is displayed, respectively, at the bottom of the waveform 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.
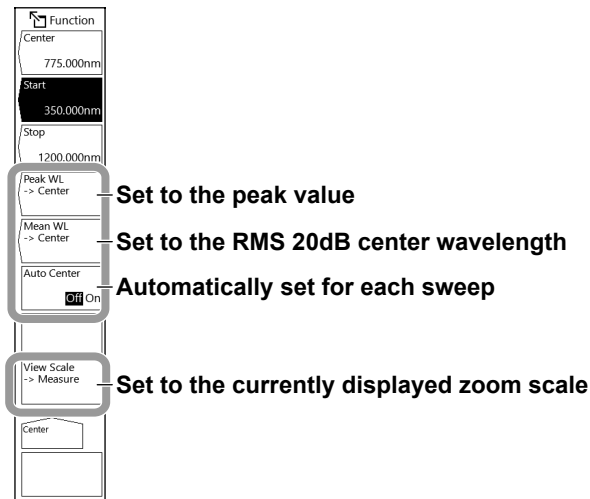
Menu	Description
Peak WL -> Center	**Set to the peak value**
Mean WL -> Center	**Set to the RMS 20dB center wavelength**
Auto Center Off On	**Automatically set for each sweep**
View Scale -> Measure	**Set to the currently displayed zoom scale**

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
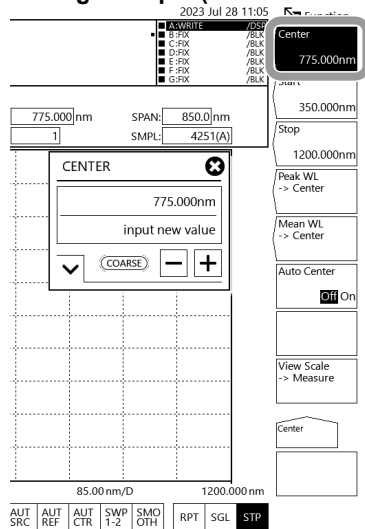- Setting the measurement sweep span to the span between line markers L1 and L2

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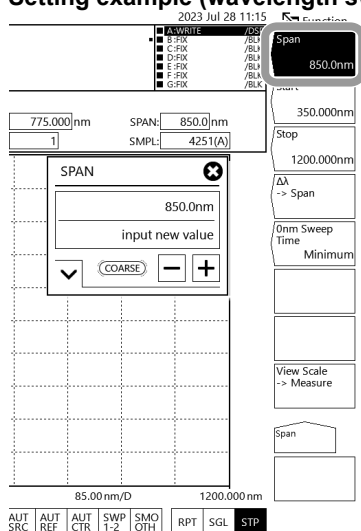
Note
- The assigned value is applied to the measurement conditions area.
- When a setting is changed, NEW appears in the measurement condition area.
- If you enter a value outside the setting range, the closest allowed value is assigned.

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

1. Press **SPAN**. The Span menu appears.
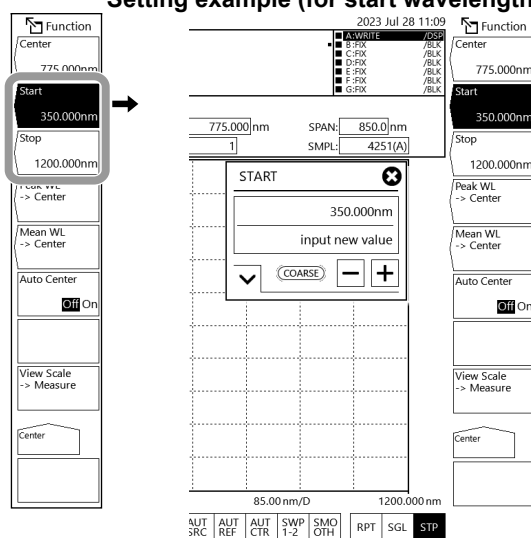
Setting the start wavelength (frequency or wavenumber)

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
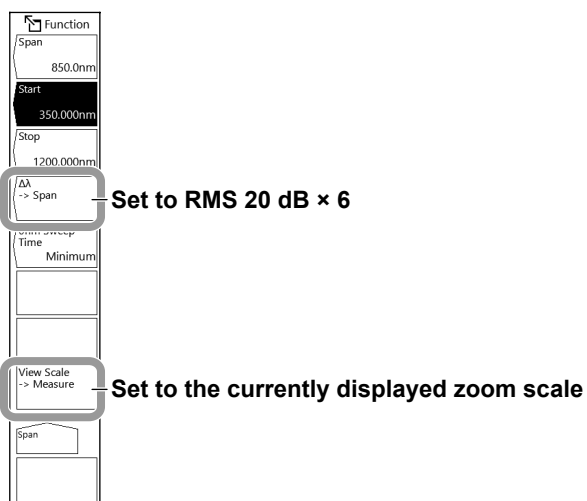
Setting the measurement sweep span to the span between line markers L1 and L2

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.
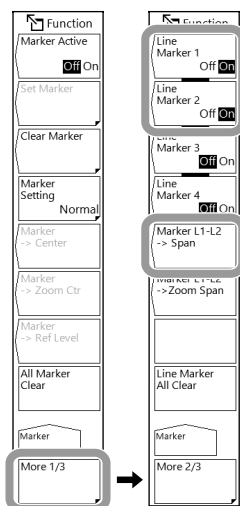
Note

- 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:

Display mode	Center	Start	Stop
Wavelength (nm)	350.000 to 1200.000	1.000 to 1200.000	350.000 to 1625.000
Frequency (THz)	250.0000 to 856.5000	60.0000 to 250.0000	250.0000 to 999.9000
Wavenumber (cm^{-1})	8334.000 to 28571.000	1000.000 to 28571.000	8334.000 to 38690.000

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}).

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, $\boxed{\substack{\text{AUT}\\\text{CTR}}}$ is highlighted at the bottom of the screen.
  The same is true for the center frequency and center wavenumber.

- **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)

Display mode	Sweep span	Start	Stop
Wavelength (nm)	0, 0.5 to 850.0	1.000 to 1200.000	350.000 to 1625.000
Frequency (THz)	0, 0.05 to 610.00	10.0000 to 856.5000	250.0000 to 999.9000
Wavenumber (cm^{-1})	0, 0.5 to 20238.0	1000.000 to 28571.000	8334.000 to 38690.000

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}).

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

Setting the Measurement Conditions

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
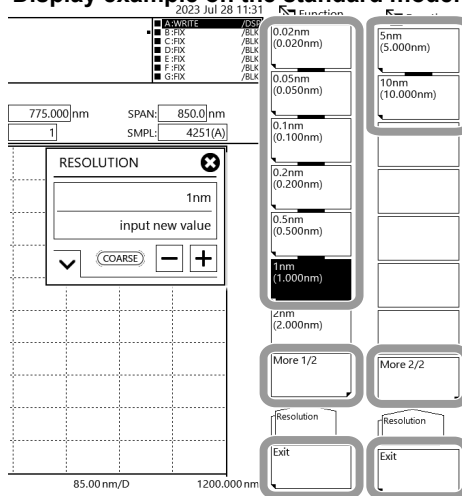
Note ───────────────────────────────

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.

Correcting the Resolution

1. Press **SETUP**. A setup menu is displayed.

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

3. Tap **Resolution Correction**. Each time you tap, the value switches between ON and OFF.
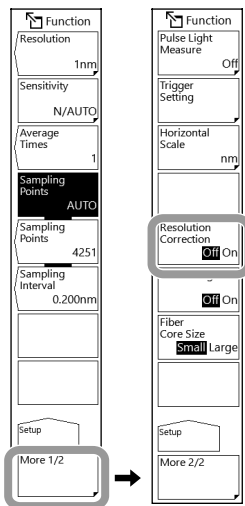
Note

- Since the wavelength resolution function is set according to the monochromator slit width, the setting resolution and actual resolution may not match. For this instrument, if the resolution is set to 0.1 nm, the actual resolution will be 0.1 nm for a 450 nm wavelength, and 0.07 nm for a 850 nm wavelength.
- If the Resolution Correction function is turned ON, measured data is processed by the software so that it matches the set resolution. The Resolution Correction function is available when the resolution is set between 0.1nm

  and 10.0 nm. The Resolution Correction function is only available when the horizontal axis is in wavelength mode. It cannot be used in Frequency mode.

Explanation

Wavelength resolution (frequency and wavenumber)

The available resolution settings are as follows:

Standard model (suffix code -10)

Display mode	Settings
Wavelength	0.02 nm, 0.05 nm, 0.1 nm, 0.2 nm, 0.5 nm, 1 nm, 2 nm, 5 nm, 10 nm
Frequency	4 GHz, 10 GHz, 20 GHz, 40 GHz, 100 GHz, 200 GHz, 400 GHz, 1000 GHz, 2000 GHz
Wavenumber	0.05 cm^{-1}, 0.1 cm^{-1}, 0.25 cm^{-1}, 0.5 cm^{-1}, 1 cm^{-1}, 2.5 cm^{-1}, 5 cm^{-1}, 10 cm^{-1}, 25 cm^{-1}

High Resolution model (suffix code -20)

Display mode	Settings
Wavelength	0.01 nm, 0.02 nm, 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 -00)

Display mode	Settings
Wavelength	0.1 nm, 0.2 nm, 0.5 nm, 1 nm 2 nm, 5 nm
Frequency	20 GHz, 40 GHz, 100 GHz, 200 GHz, 400 GHz, 1000GHz
Wavenumber	0.25 cm^{-1}, 0.5 cm^{-1}, 1 cm^{-1}, 2.5 cm^{-1}, 5 cm^{-1}, 10 cm^{-1}

Conditions that do not cause UNCAL

Sampling intervals that do not cause UNCAL (see section 2.3) vary depending on the setting resolution and the setting of the resolution correction function.

For example, to prevent UNCAL from occurring at a resolution of 0.05 nm and with the resolution correction function turned off, 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.

Resolution Setting of 0.01 nm

This setting is valid when the measured wavelength range is 350 nm to 600 nm. You can set 0.01 nm in other wavelength bands, but the resolution is the same effective resolution value as when set to 0.02 nm.

Resolution Setting of 10 nm

This setting is valid when the measured wavelength range is 470 to 1200 nm. You can set 10 nm in other wavelength bands, but the resolution is the same effective resolution value as when set to 5 nm. Also, the effective resolution when set to 10 nm is approximately 8 nm even at the widest.

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*.
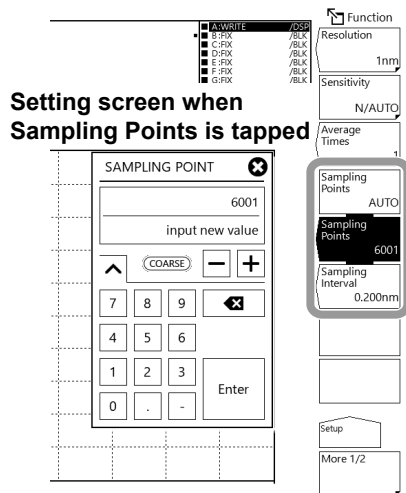
Note

* 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.

2.4 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
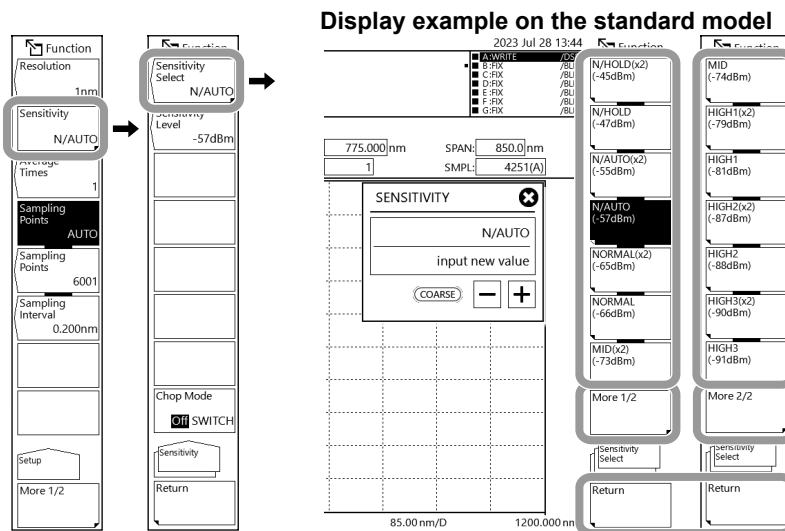
Setting the measurement sensitivity by entering the measurement level directly

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**.
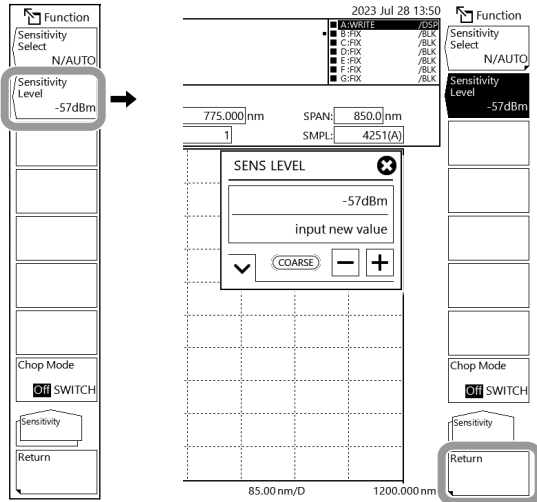
Note

- The specified measurement sensitivity is applied to the measurement conditions area.
- When the measurement sensitivity is changed, NEW appears in the measurement condition area.
- There are pulse light measurement and average times settings that are not selectable for those with (x2) displayed in Measurement Sensitivity. If any of these values is specified when (x2) is selected, a warning message will be displayed, and the settings will be changed automatically. For details, see "Example of changes made automatically when you tap measurement sensitivity (x2)" in the explanation. For details on measurement sensitivity, see section 2.4. For details on average times, see section 2.7.

Setting CHOP MODE

3. Tap **Chop Mode** to select Off or SWITCH.

```
┌─────────────────┐
│ ⌐ Function      │
├─────────────────┤
│ Sensitivity     │
│ Select      MID │
├─────────────────┤
│ Sensitivity     │
│ Level           │
│         -74dBm  │
├─────────────────┤
│                 │
├─────────────────┤
│                 │
├─────────────────┤
│                 │
├─────────────────┤
│                 │
├─────────────────┤
│ Chop Mode       │
│ ▐Off▌ SWITCH    │
├─────────────────┤
│ Sensitivity     │
├─────────────────┤
│ Return          │
└─────────────────┘
```

Note

- When CHOP MODE is set to SWITCH, "/SW" is added in the corresponding sensitivity menu.
  MID(x2)/SW, MID/SW, HIGH1(x2)/SW, HIGH1/SW, HIGH2(x2)/SW, HIGH2/SW, HIGH3(x2)/SW, HIGH3/SW
- If Chop mode is changed to SWITCH when pulse light measurement sampling is set to Gate Mode, a warning message will appear, and pulse light measurement will be turned off automatically.

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)	HIGH1	HIGH2(x2)	HIGH2

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

HIGH3(x2)	HIGH3

- 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.

Example of changes made automatically when you tap measurement sensitivity (x2)
Settings are changed automatically to those suitable for measuring at measurement sensitivity (x2). Be sure to check the settings after changes are made.

Item	Setting	
	Before change	After change
	Peak Hold	
Pulse Light Measure	Ext Trigger Mode	OFF
	Gate Mode	
Average times (Average Times)	2 or more	1

CHOP mode

When the CHOP mode is set to SWITCH, measurements are made while reducing the stray light in the monochromator, which is generated according to the intensity of the input light power. The measurement time is doubled, but a wide dynamic range can be measured.

You can set SWITCH when the following measurement sensitivity is selected.

MID(x2), MID, HIGH1(x2), HIGH1, HIGH2(x2), HIGH2, HIGH3(x2), HIGH3

CHOP mode feature

CHOP mode	Features	Advantages	Disadvantages
Off	The stray light component is also measured.	Measurement time is shorter than when CHOP mode is set to SWITCH.	Since the stray light component is also measured, low level components are inaccurate when the power of the light source is high.
SWITCH	Two sweeps are made in one measurement. Only the stray light component is measured in the first sweep, and high dynamic measurement is possible by subtraction. Stray light suppression ratio: 80 dB (Typ.) or more	A measurement can be made in a short time with the stray light removed.	If the measurement time is long, the measurement is affected by variation in the measured light source over time.

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*.
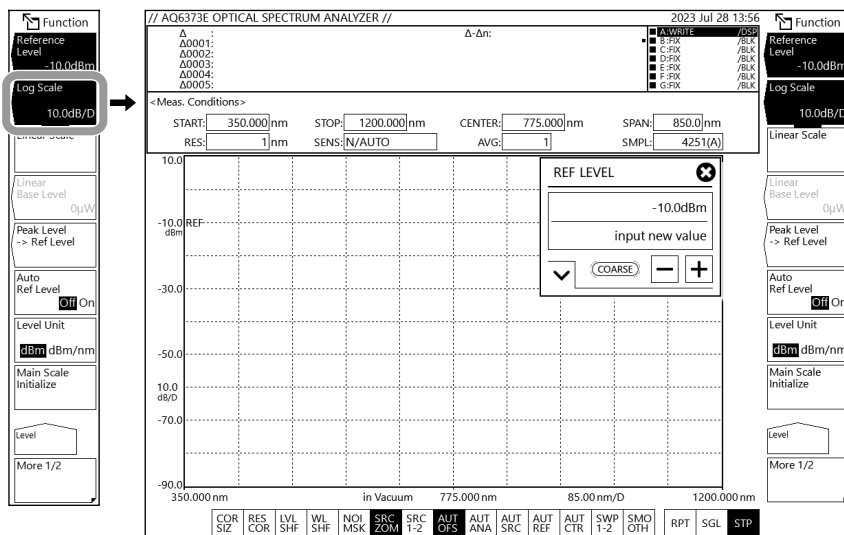
Changing to the linear scale display

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*.
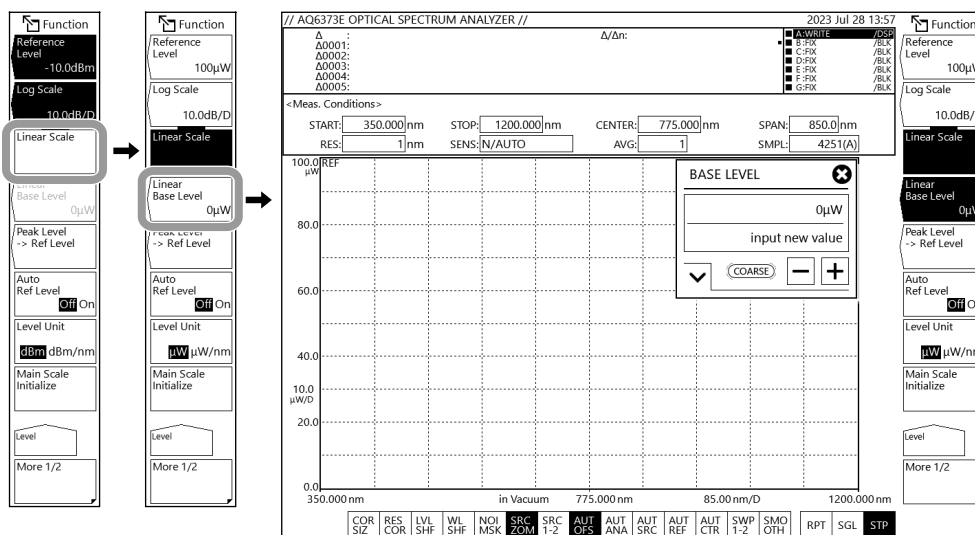
Setting the vertical scale unit

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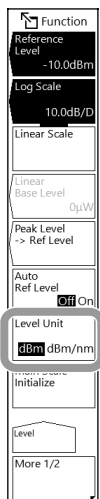
The units that you can select vary depending on the specified horizontal scale unit, vertical scale, and reference level unit.

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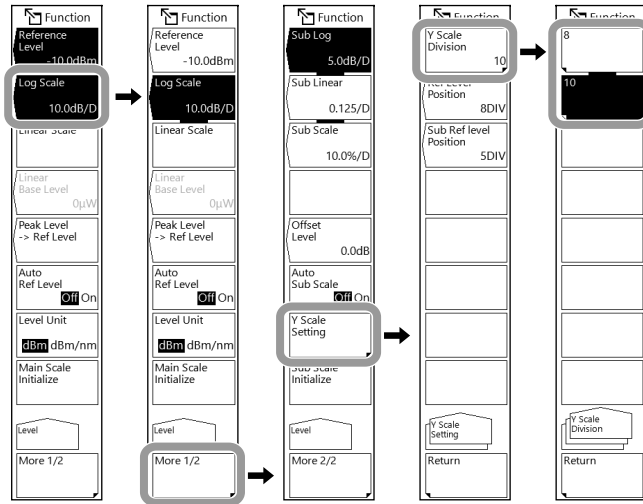
Setting the reference level position on the screen (for log scale)

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).
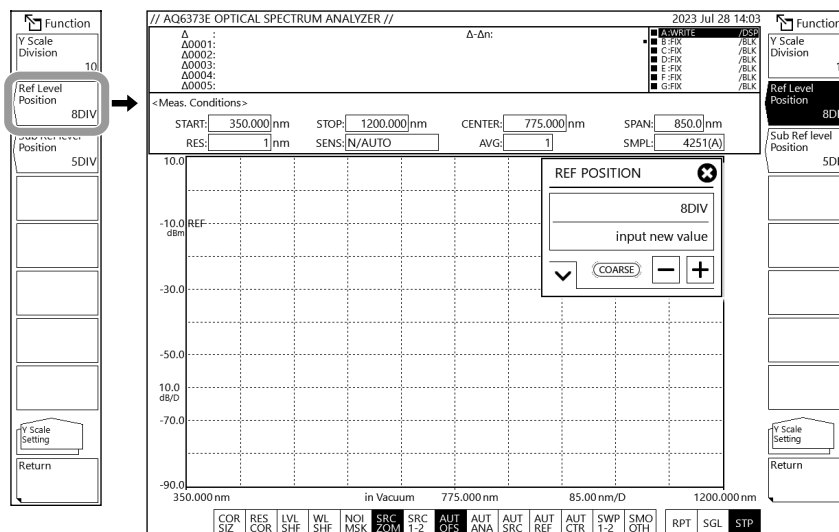
Setting the reference level

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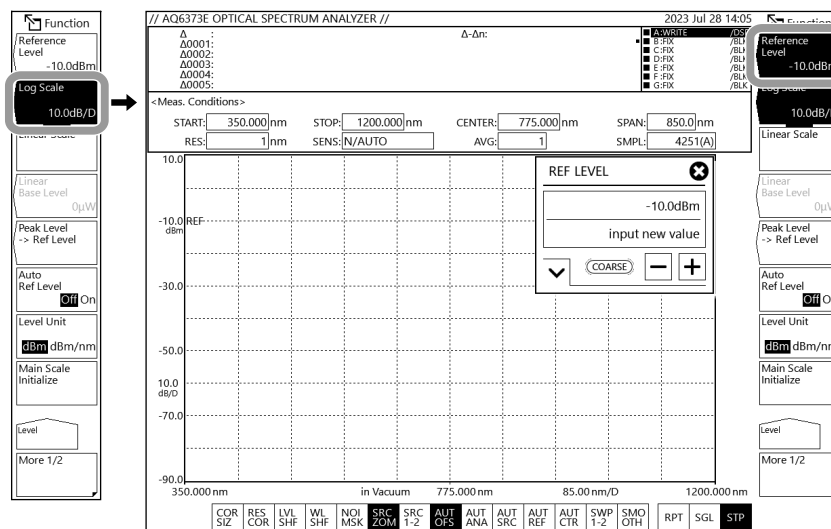
Note
    The vertical scale setting is applied to the waveform display in real-time.

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.
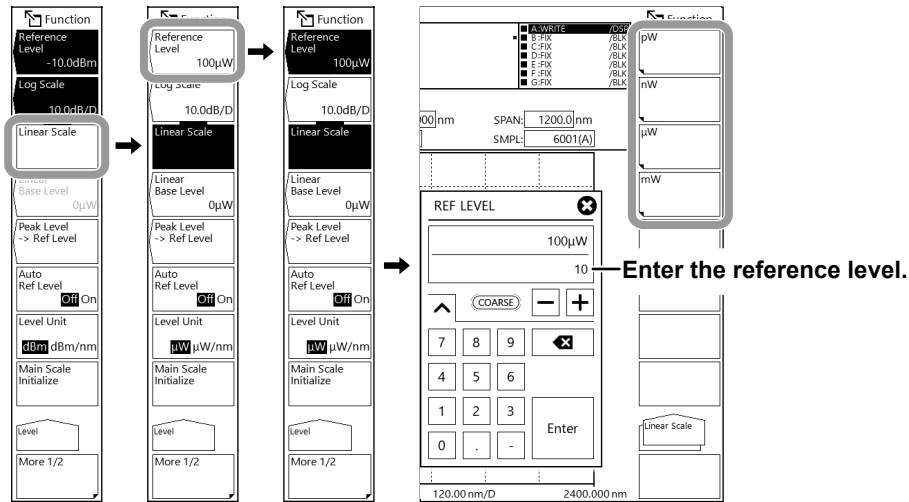
Note

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, ┌AUT REF┐ at the bottom of the screen will be highlighted.
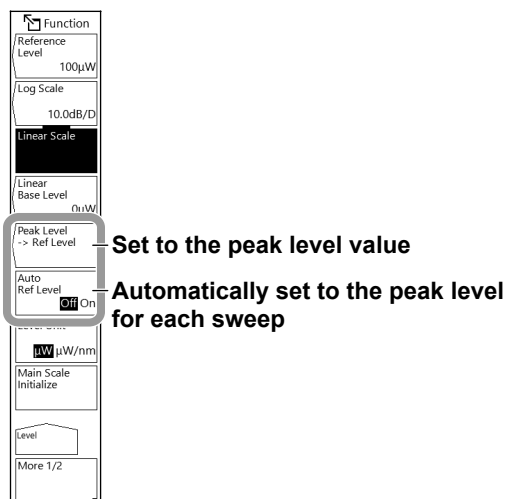
Function
Reference Level 100µW
Log Scale 10.0dB/D
Linear Scale
Linear Base Level 0µW
Peak Level -> Ref Level — **Set to the peak level value**
Auto Ref Level Off On — **Automatically set to the peak level for each sweep**
Level Shift µW µW/nm
Main Scale Initialize
Level
More 1/2

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.

Function
Marker Active Off On
Set Marker
Clear Marker
Marker Setting Normal
Marker -> Center
Marker -> Zoom Ctr
Marker -> Ref Level
All Marker Clear
Marker
More 1/3

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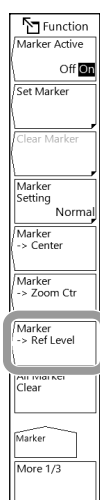
If the measurement sensitivity is set to N/HOLD, we recommend that you use the level scale at 5 dB/DIV or less.

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.
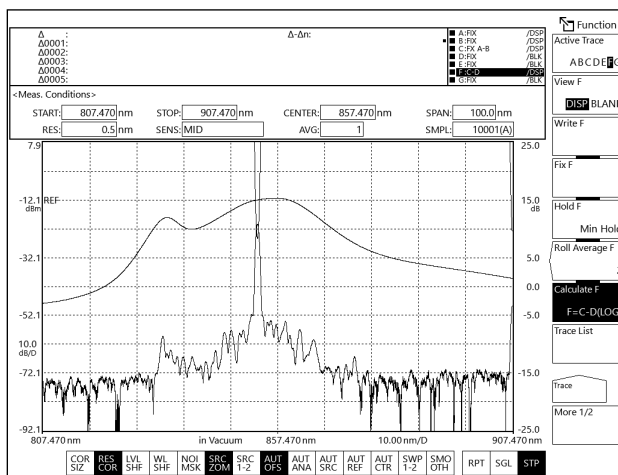
Auto scaling the sub scale

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

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

3.   Tap **Auto Sub Scale Off On** to select On or Off.
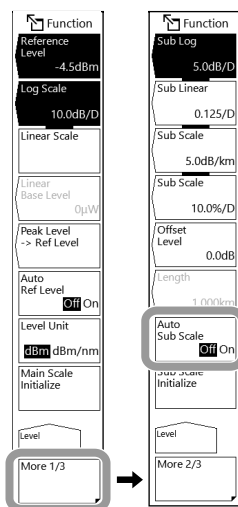
Log display of the sub scale

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*.
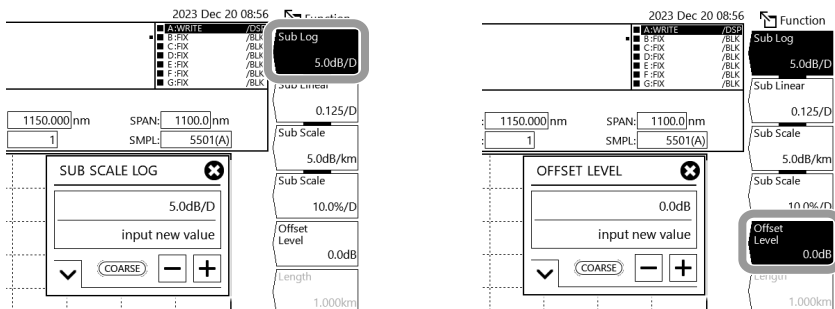
Setting the REF position

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

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**.
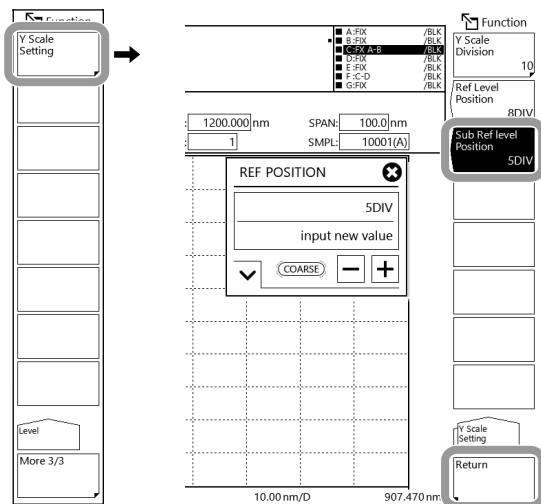
Note

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*.
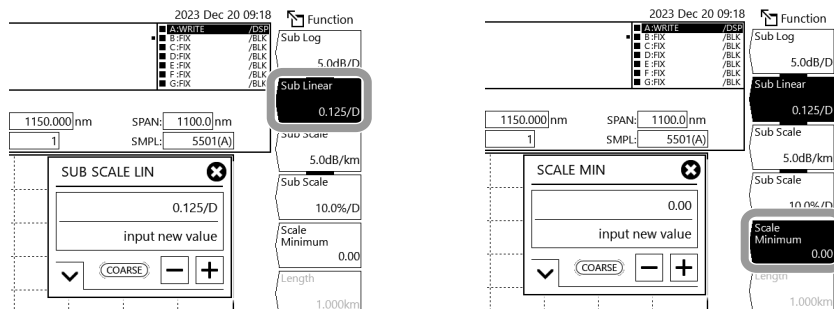
# Setting the sub scale unit to dB/km

3. Tap **Sub Scale** (dB/km). The sub scale unit changes to dB/km. At the same time, the SUB SCALE setting window appears.

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

When displaying the loss characteristics of the optical fiber per unit of length (km)

5. Continuing on from step 4, tap the **Length**. The optical fiber length setting window appears.

6. Enter the optical fiber length 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** (%/D). 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*.
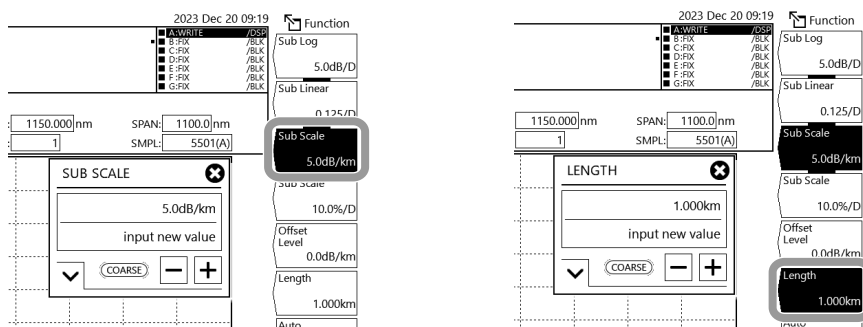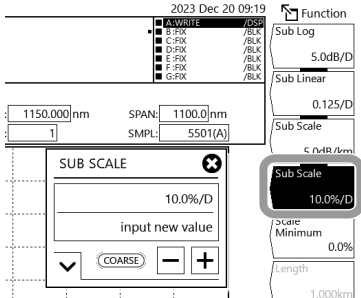

Initializing the sub scale

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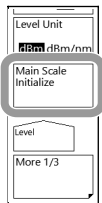
Explanation

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 or dB/km.

The selectable ranges are as follows:

dB/D: 0 dB/D to ±99.9 dB/D

dB/km: 0 dB/km to ±99.9 dB/km

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 (Sub Scale **.*dB/km)

This soft key sets the sub scale to dB/km.

Selectable range: 0.1 dB/km to 10.0 dB/km

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.

Length of the optical fiber (Length)

Sets the length of the optical fiber. This soft key is valid when the sub scale is set to dB/km.)

Selectable range: 0.001 km to 99.999 km

You can set it in steps of 0.1. When you tap COARSE, you can set it in steps of 1-2-5.

Sub scale unit %/D (Sub Scale **.*%/D)

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*.
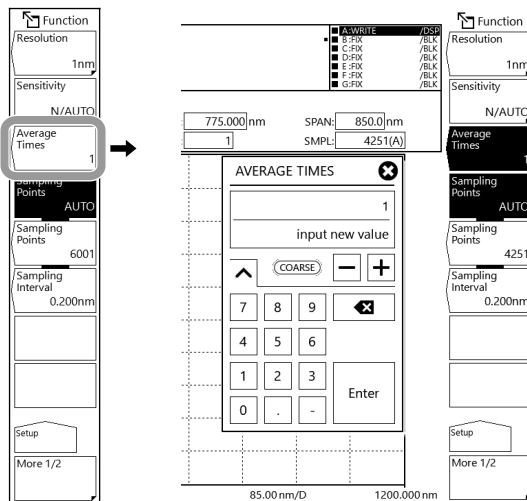

### Setting smoothing

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

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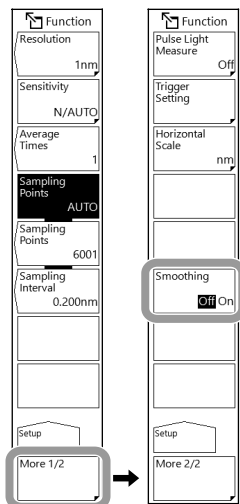
Explanation

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**
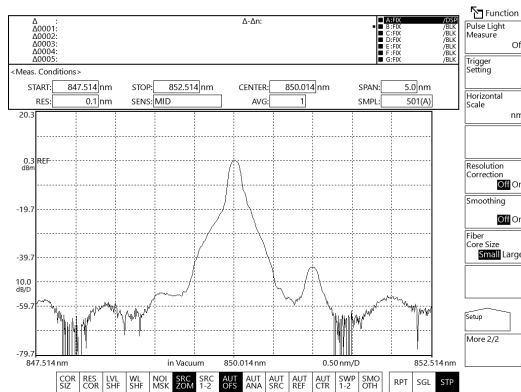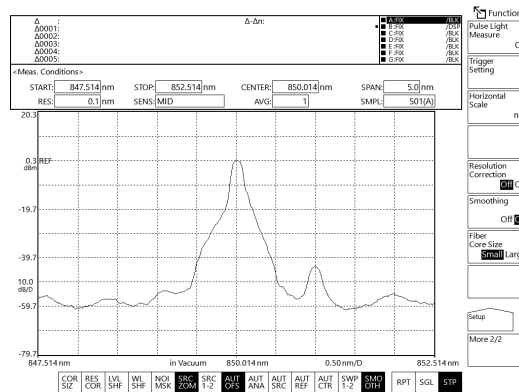
3.1   Measurement Precautions

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, the instrument can use large core size optical fibers of up to 800 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

The maximum wavelength resolution for the instrument is 0.01 nm, which is only obtainable when using a single-mode optical fiber with a core diameter of 9.5 μm or less, and when measuring within a measurement wavelength range of 350 nm to 600 nm.
As shown in Table, the maximum wavelength resolution decreases when outside of this measurement wavelength range or when optical fibers with thicker core diameters are used. Setting a resolution value finer than those shown in the table below will simply result in an inaccurate measurement level without improving resolution.
Optical fibers with a thick core diameter are especially useful for inputting spatial light for measurement, but they have poor resolution. Choose the best type of optical fiber for your particular 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 bonding an LED to the optical input connector. It is important to note that optical spectrum measurements taken through such inputs are completely unreliable.
For spatial light measurements, input the spatial light to the optical fiber and from the optical fiber to the 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	Core Size Setting
Type	Core diameter			
SM	5	0.02	Yes[*]	SMALL
	9.5	0.02	No	SMALL
GI	50	0.05	No	SMALL
	62.5	0.05	No	SMALL
SI	50	0.05	No	SMALL
	80	0.10	No	SMALL
	100	0.20	No	SMALL
	200	0.50	No	LARGE
	400	1.00	No	LARGE
	800	2.00	No	LARGE

*   Calibrated at 850 nm.

3

Measuring the Optical Spectrum

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)
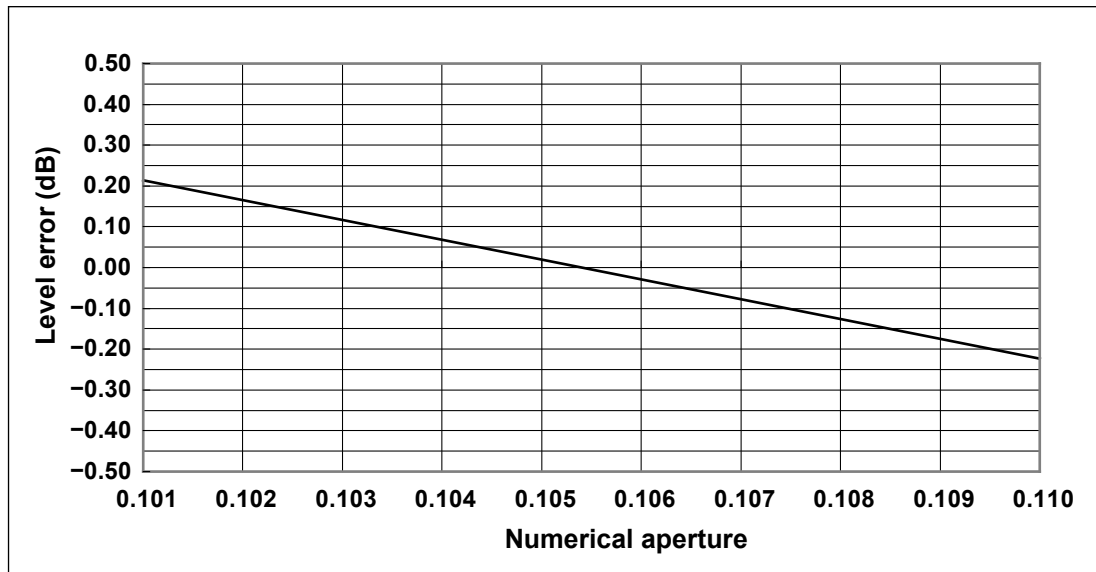
Absolute level accuracy

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).

Brightness of the installation location

The instrument's shielding specifications indicate use in common office or factory environments (with illumination of 300 to 1000 lx). Therefore, depending on the illumination in the installation location, the instrument may receive some ambient light which can affect measurements of light with small level measurement values. In such cases, turn lights around the instrument Off to reduce inaccuracies.

Monochromator stray light

Selecting CHOP MODE

The instrument has a newly designed, high-performance monochromator. Depending on the measurement conditions, stray light at a level 30 to 50 dB below the original spectrum, as well as other stray light specific to the monochromator may occur in wavelength areas 100 to 200 nm from the peak wavelength. If this stray light is likely to have a severe impact on measurements, the sensitivity can be set to HIGH 1–3 and CHOP MODE can be set to CHOP or SWITCH in order to reduce the effects of the stray light.

Waveform when CHOP mode is disabled
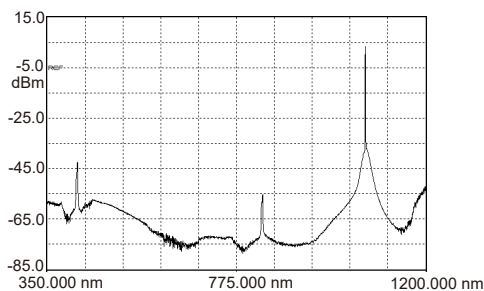
Waveform when CHOP mode is enabled
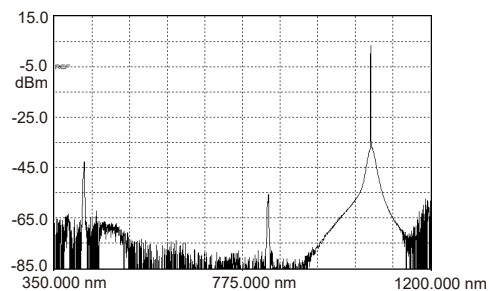
CHOP mode feature

CHOP mode	Feature	Advantages	Disadvantages
Disabled	The stray light component is also measured. Stray light suppression ratio: 40 dB or more	Measurement time is shorter than when CHOP mode is set to SWITCH.	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. 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.

Selecting FIBER CORE SIZE

When LARGE is selected, the stray light increases.
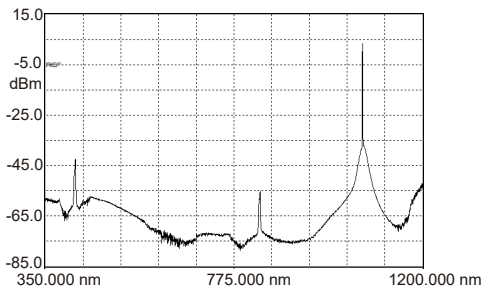
Waveform with CORE SIZE SMALL
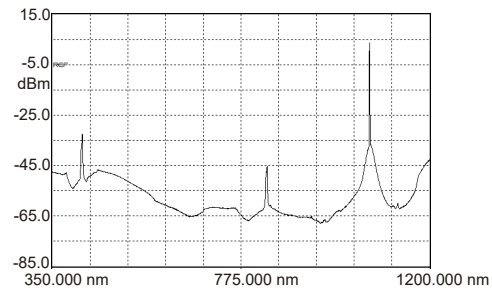
CORE SIZE set to LARGE

Waveforms when set to high resolution

When the resolution is set high (to 0.01 nm or 0.02 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 type of spike occurs due to characteristics of the optical block and is not an indication of any problem. Even if such spikes occur, satisfactory performance in terms of resolution, dynamic range, and the like can be ensured. These spikes will disappear if the resolution is set to a coarser value.
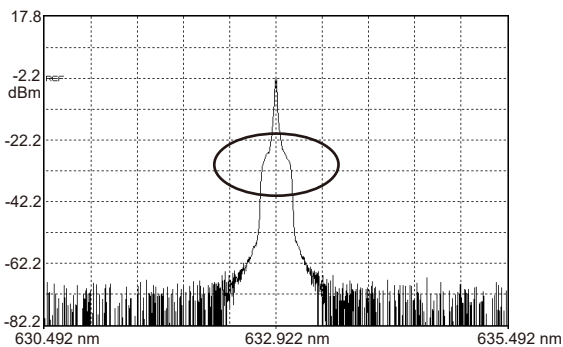
Switching the diffraction order or high order optical cut filter during a sweep

There are times when the diffraction order or high order optical cut filter is switched from the sweep interval. All switching is performed automatically. When sweeping a range including a switching point, the sweep pauses after reaching (measuring) the switching point, then the filter/order is switched, the sweep parameter (grating speed, etc.) is calculated, and sweeping resumes.

Switching of the Diffraction Order

The instrument can measure wider bandwidths by changing the diffraction order according to the wavelength to be measured. The instrument switches between second and first order diffracted light for its measurements. The division of orders is shown in the figure below.

• **Resolution Setting of 0.02 to 10 nm**

Second order light

First order light

350 nm

Order switching point
A: 450 nm or 480 nm
B: 470 nm or 500 nm

1200 nm
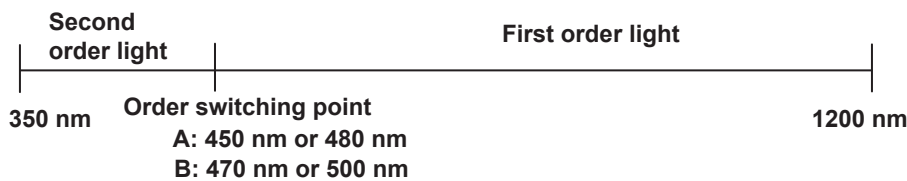
A: Switches at 450 nm when the center wavelength is set to 460 nm or higher
B: Switches at 470 nm when the center wavelength is set to less than 460 nm
or
A: Switches at 480 nm when the center wavelength is set to 490 nm or higher
B: Switches at 500 nm when the center wavelength is set to less than 490 nm

• **Resolution Setting of 0.01 nm**

Second order light

First order light

350 nm

Order switching point
580 nm or 600 nm

1200 nm
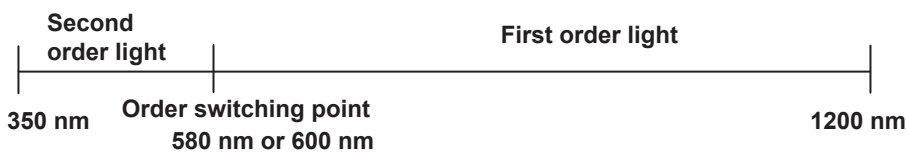
Switches at 580 nm when the center wavelength is set to 590 nm or higher
Switches at 600 nm when the center wavelength is set to less than 590 nm

When the order is switched, the effective resolution changes. Thus, when measuring a light source having an optical spectrum with a wide wavelength range, the measurement level becomes discontinuous at the point where the order is switched, and steps can occur. To keep these steps as far as possible from the center of the screen, the switching point changes according to the center wavelength setting as shown in the figure above.

These waveform steps caused by the changes in effective resolution can be corrected by using the following functions.

• Power Spectral Density Display function <See section 4.8 for the operating procedure>
When the Power Spectral Density Display function is ON, the level axis shows the power spectral density per nanometer. That is, it is corrected to be able to obtain a constant measured value regardless of the setting resolution. In this case, the waveform steps are eliminated because the change in effective resolution occurring at the order switching point is also corrected to power spectral density per nanometer.

3

Measuring the Optical Spectrum

- Resolution Correction function <See section 2.2 for the operating procedure>
  When the Resolution Correction function is ON, measured data is processed by the software so that the set resolution of each wavelength matches the effective resolution. In this case, the waveform steps are eliminated because the amount of change in effective resolution occurring at the order switching point is also corrected so that the effective resolution is constant at each wavelength.

Switching High Order Optical Cut Filters

The instrument uses optical filters to cut orders of light that are higher and lower than the orders to be measured. Therefore, the higher and lower orders of light not to be measured are kept to lower levels than those in the correct optical spectrum.

There are three types of optical filters. Because the filter is switched for each wavelength band, there is a maximum of two filter switching locations during a single sweep. The filter switching wavelengths are shown in the table.

Filter Switching Wavelengths

Filter switching point	Switching wavelength
1	450 nm when the center wavelength is set to 460 nm or higher
	470 nm when the center wavelength is set to less than 460 nm
	or
	480 nm when the center wavelength is set to 490 nm or higher
	500 nm when the center wavelength is set to less than 490 nm
2	690 nm when the center wavelength is set to 695 nm or higher
	700 nm when the center wavelength is set to less than 695 nm

It is impossible to completely eliminate the unwanted higher and lower orders of light by using optical filters. The formation of "false" spectra from the unwanted higher and lower orders is suppressed, but not entirely. Therefore it is important to know where "false" spectra (hereinafter ghost spectra) can appear.

- **Notes for Resolution Setting of 0.01 nm (-20 model only)**
  As mentioned earlier, unwanted higher and lower orders of light are suppressed by optical filters. However, note that in the following wavelength ranges, the suppression effect by optical filters is not obtained and ghosts may appear larger than the correct spectrum.

Range strongly affected by ghosting

350 nm   580 nm or 600 nm   1200 nm

A：450 nm or 470 nm
B：470 nm or 500 nm

The following figure contains a graph showing the relationship between wavelengths as they appear on screen and their actual wavelengths. The horizontal axis represents the wavelength as displayed on screen, and the vertical axis represents the actual wavelength. The lines on the graph show the correspondence between displayed and actual wavelengths. The bold line is the correct optical spectrum correspondence (naturally, the displayed and actual wavelengths match), and the other lines show the correspondences with the high and low order light–induced ghost spectra. The numbers appearing next to the thin lines indicate how much the ghost is suppressed relative to the correct optical spectrum. Note that these values are approximate, and are not guaranteed. For example, when a 400 nm light is input, if a horizontal line is drawn from 400 nm on the vertical axis, a wavelength is displayed at points where the line crosses one of the lines on the graph. From this you can see that a ghost can appear at 800 nm in addition to the correct optical spectrum at 400 nm. Also, you can see that this ghost is suppressed down to a level of 40 dB or lower relative to the correct optical spectrum.

Resolution Setting of 0.02 to 10 nm
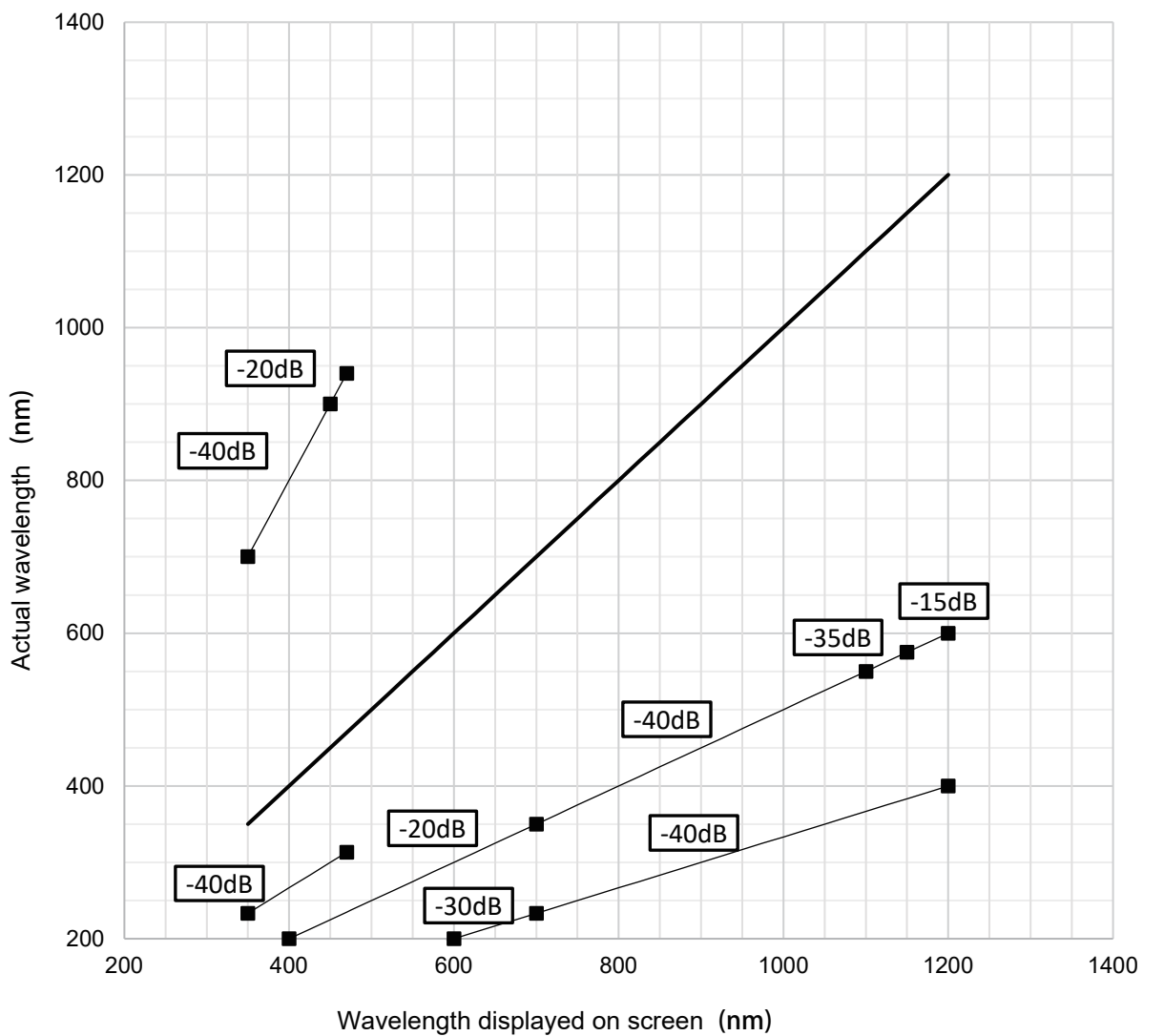
However, when the resolution setting is 0.01 nm (-20 model only), the spectra in the 450 nm to 600 nm range are strongly affected by ghosting and may be displayed at levels 10 dB or more higher than the correct spectrum. Note that when inputting a broadband light source or laser containing light in the 900 nm to 1200 nm band and measuring with a resolution setting of 0.01 nm, a ghost will appear in the 450 nm to 600 nm range. In particular, select a resolution setting of 0.02 nm to 10 nm, as the following cases may result in incorrect measurements.

Example 1: When measuring second harmonic generation with the fundamental wave between 900 nm and 1200 nm at a resolution setting of 0.01 nm, if the fundamental and second harmonic waves are input simultaneously, the second harmonic spectrum cannot be measured correctly because the ghost of the fundamental wave overlaps the measured waveform of the second harmonic wave.

Example 2: When measuring a broadband light source that includes 900 nm to 1200 nm with a resolution setting of 0.01 nm, the light spectrum in this range will be inaccurate because ghosting due to light from 900 nm to 1200 nm will be superimposed in the 450 nm to 600 nm range.

Resolution Setting of 0.01 nm (-20 model only)
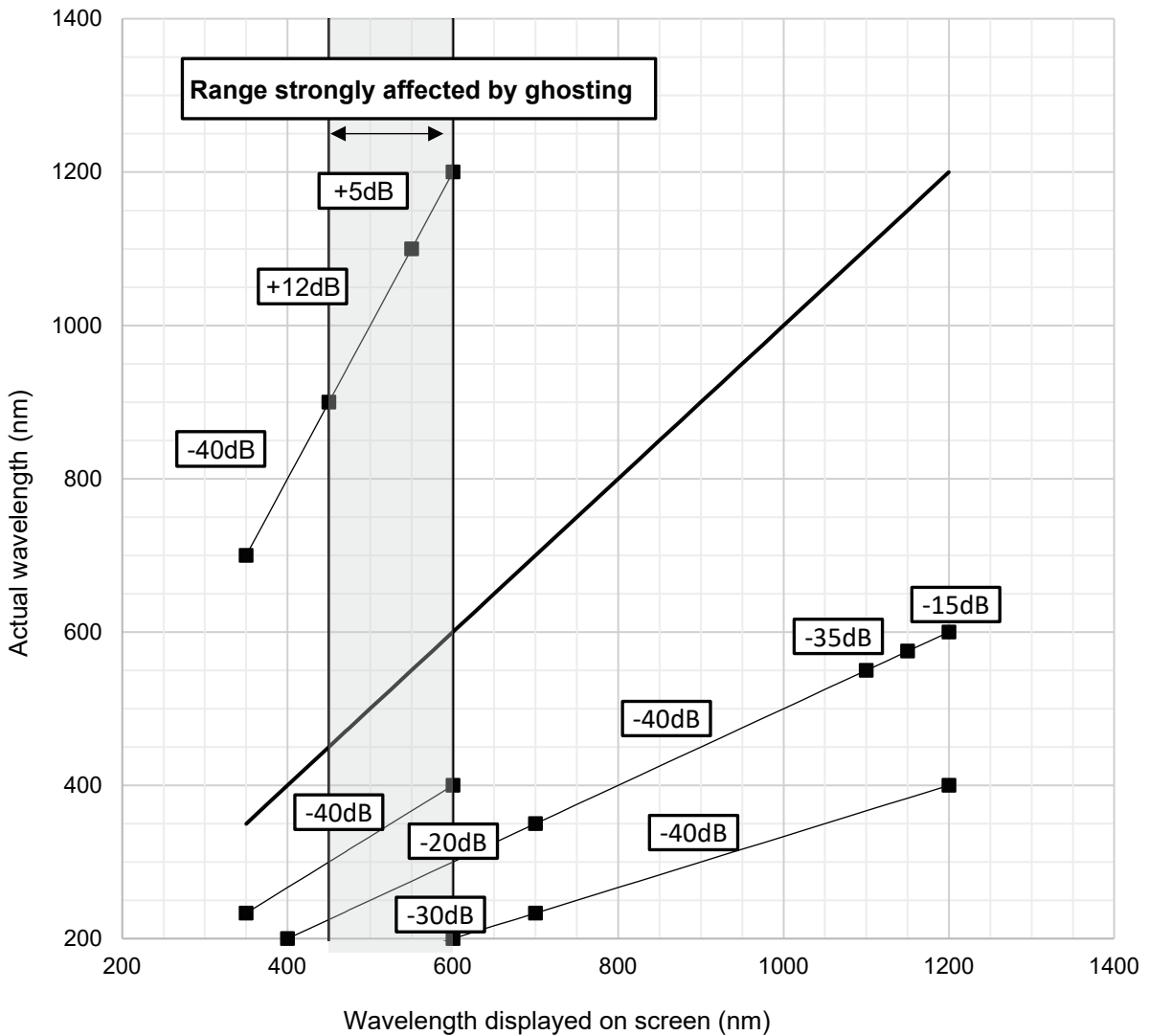
The figure below shows the waveform when an LD light source with a wavelength of 980 nm is input. The appearance of ghosts differs between the resolution settings of 0.01 nm and 0.02 nm to 10 nm due to the difference in the relationship between the diffraction order switching point and the optical filter switching point, as shown in the figure below. When the resolution setting is 0.02 nm to 10 nm, the ghosting is suppressed, whereas when the resolution setting is 0.01 nm, a ghost appears about 12 dB higher than the actual input light. If you are unable to determine whether a spectrum measured at a resolution setting of 0.01 nm is a ghost or not, it is recommended to check the measured spectrum at a resolution setting of 0.02 nm.

Resolution Setting of 0.02 nm

Resolution Setting of 0.01 nm

3
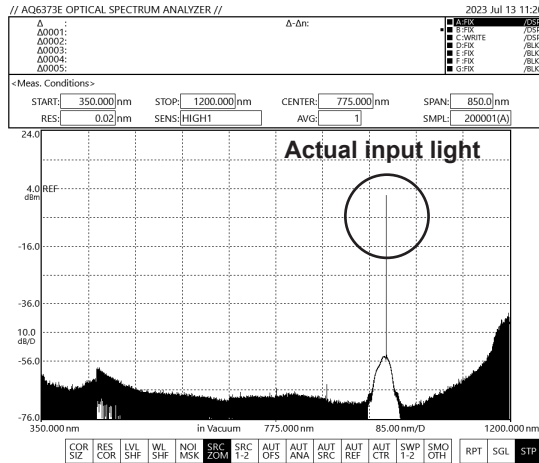
Measuring the Optical Spectrum
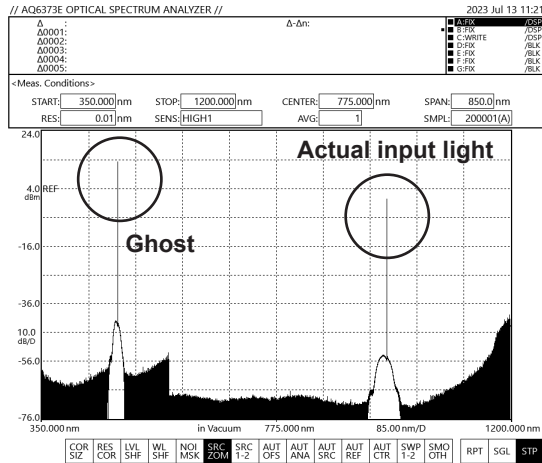
3.2 Continuous Light Measurement (CW)

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**.)
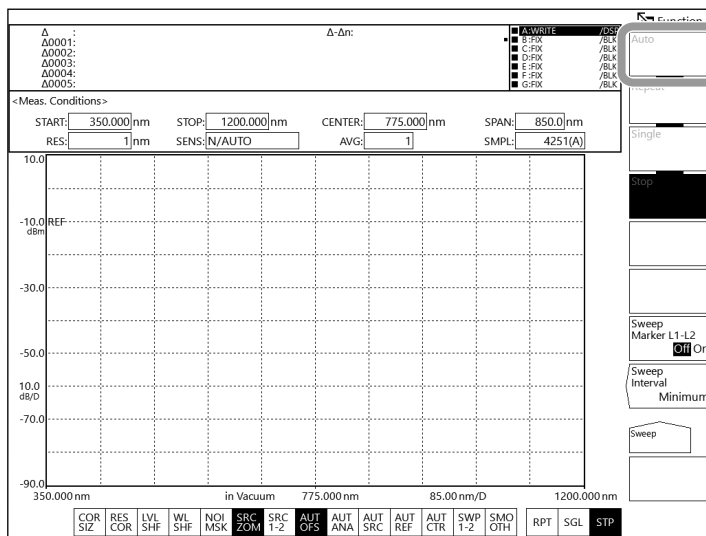
Starting a measurement (sweep)

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**.)
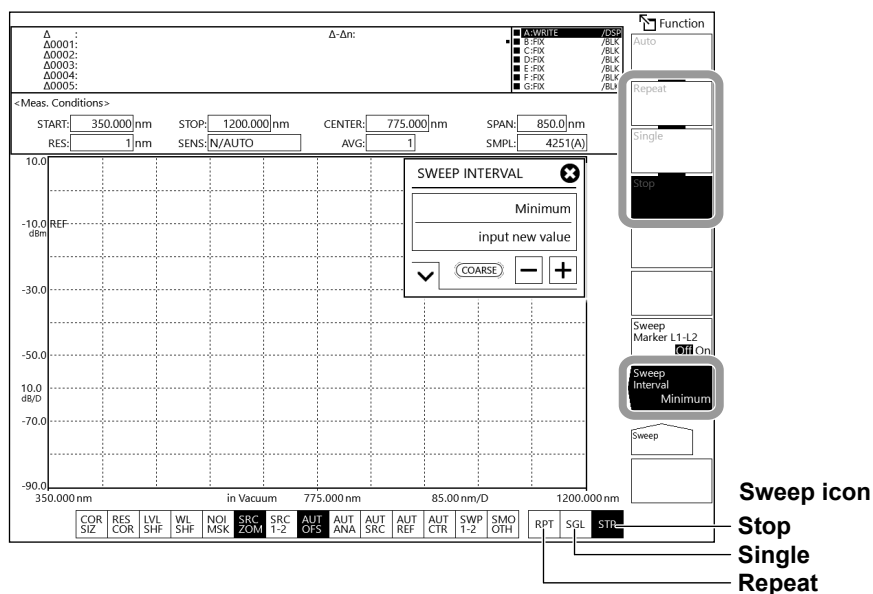
Note
- You can also start and stop sweeping by clicking the sweep icon at the bottom of the screen.
- During a sweep, a sweep bar indicating the current sweep status is displayed below the horizontal axis.
- During a sweep, the sweep progress from the start wavelength to the sweep wavelength is indicated 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
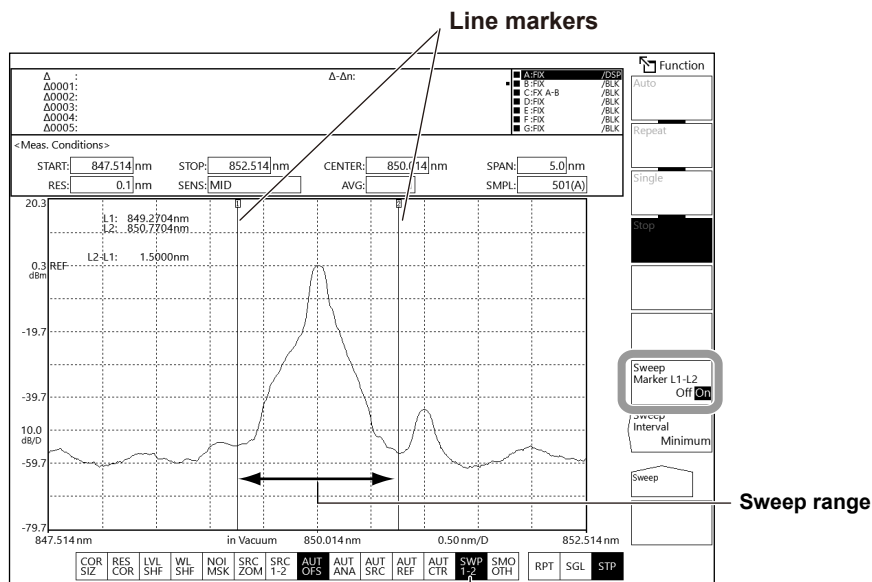
Highlighted when Sweep Marker L1-L2 is On

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
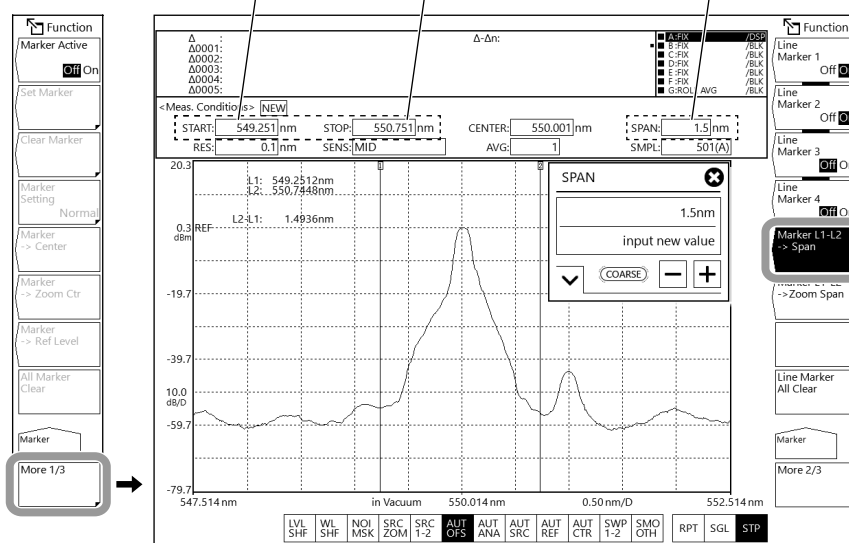
Explanation

Auto measurement

The wavelength range of input light that can be auto-measured is 350 nm to 1200 nm.

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*.
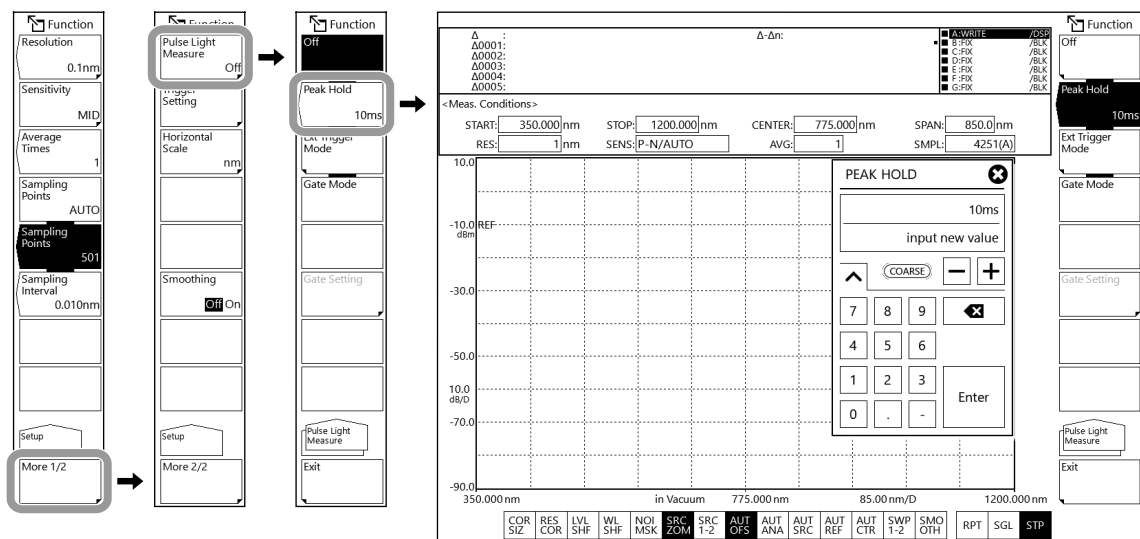
Displaying the measured waveform

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**.

5. Tap **Gate Setting**.

6. Tap **Gate Sampling Interval**. A SAMPLE INTERVAL setting window appears.

7. 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*.
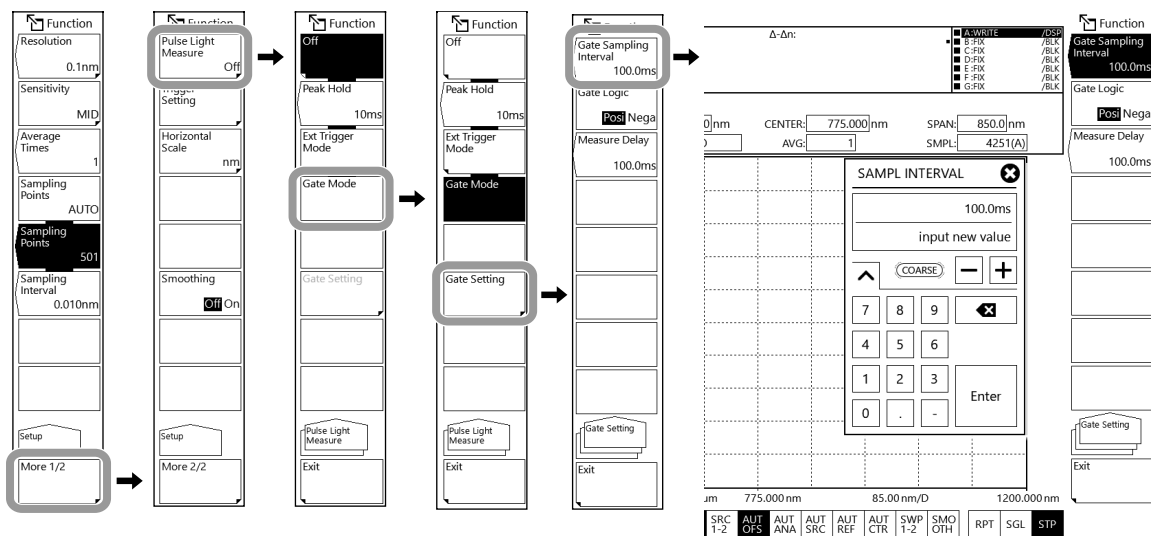
Note

- 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

8. Continuing from step 7, tap **Gate Logic**. Each time you tap, the value switches between Posi and Nega.

Setting the measurement delay

9. Continuing from step 8, tap **Measure Delay**. A MEASURE DELAY setting window appears.
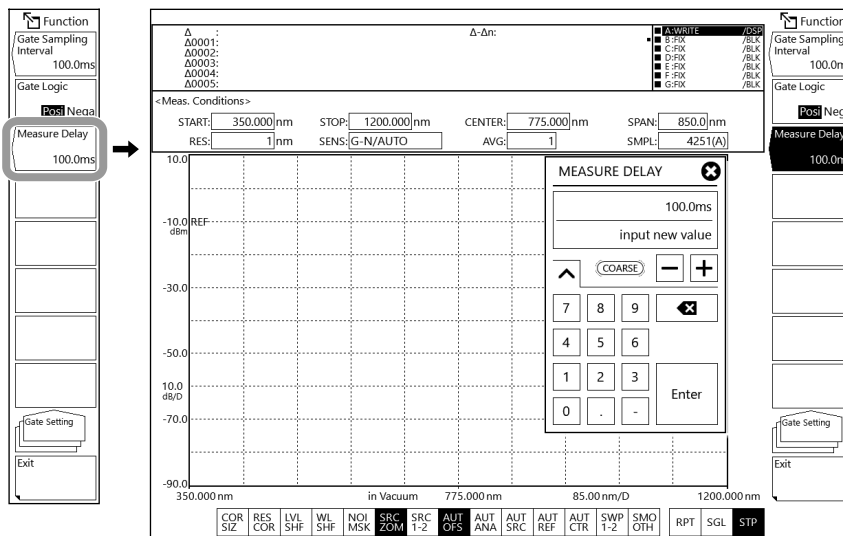
Measurement using external trigger mode

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/AUTO(x2)	N/AUTO
	NORMAL(x2)	NORMAL
	MID(x2)	MID
	HIGH1(x2)	HIGH1
	HIGH2(x2)	HIGH2
	HIGH3(x2) *	HIGH3 *

* Measurement sensitivity available on the standard and high resolution 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/AUTO(x2)	N/AUTO
	NORMAL(x2)	NORMAL
	MID(x2)	MID
	HIGH1(x2)	HIGH1
	HIGH2(x2)	HIGH2
	HIGH3(x2) *	HIGH3
Chop mode	SWITCH	Off
Average times (Average Times)	2 or more	1

* Measurement sensitivity available on the standard and high resolution 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	Off	N/HOLD	P-N/HOLD	E-N/HOLD	Peak: 100 µs Ext: 50 µs
N/AUTO		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		HIGH1	P-HIGH1	E-HIGH1	10 ms
HIGH2		HIGH2	P-HIGH2	E-HIGH2	50 ms
HIGH3		HIGH3	P-HIGH3	E-HIGH3	200 ms
MID	SWITCH	MID/SW	P-MID/SW	E-MID/SW	3 ms
HIGH1		HIGH1/SW	P-HIGH1/SW	E-HIGH1/SW	10 ms
HIGH2		HIGH2/SW	P-HIGH2/SW	E-HIGH2/SW	50 ms
HIGH3*		HIGH3/SW	P-HIGH3/SW	E-HIGH3/SW	200 ms

* Measurement sensitivity available on the standard and high resolution 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		10 MHz
N/AUTO		1 MHz
NORMAL		200 kHz
MID	Off	50 kHz
HIGH1		10 kHz
HIGH2		2 kHz
HIGH3		500 Hz
MID		50 kHz
HIGH1	SWITCH	10 kHz
HIGH2		2 kHz
HIGH3*		500 Hz

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

* Measurement sensitivity available on the standard and high resolution models

Gate sampling measurement

Gate sampling can be used to measure data only when the gate signal is active during sweeping. It can be used for spectrum measurement of recirculating transmission experiments. Applying an external signal (gate signal) synchronized with the pulse light emission to the instrument enables efficient measurement of pulse light as many samples can be taken within one pulse signal. In gate sampling measurement, the optical spectrum is sampled by sweeping multiple times in one measurement. Measurement stops automatically when all sampling is completed.

The conditions for measurable gate signals are as follows:

Trad mode: minimum pulse width: 100 μs, pulse cycle: 1000 ms or less

[Trad mode]
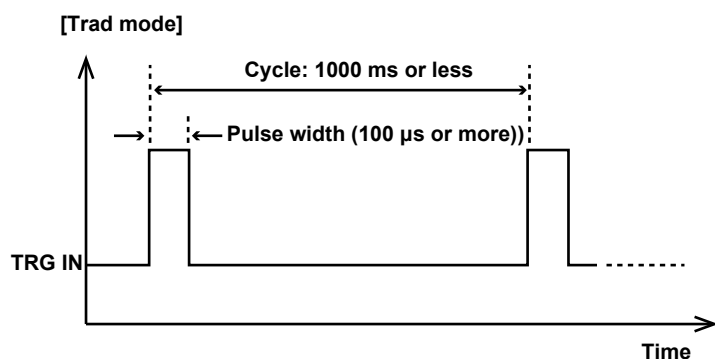
To use the gate function, follow the steps below.

1. Set the pulse light measurement mode to Gate Mode.

2. Select the sensitivity setting based on the pulse width of the input trigger signal.

3. Set the gate sampling interval based on the selected sensitivity setting.

4. Press the **SINGLE** key. Measurement starts, and multiple sweeps are performed. Measurement stops automatically when all sampling is completed.

Gate sampling interval

Set the sampling interval (average duration per sampling point).
You can set the value between 0.1 ms and 1000.0 ms (in 0.1 ms steps).
An appropriate gate sampling interval must be set according to the measurement sensitivity.
For how to select the measurement sensitivity and gate sampling interval time, see the following setting example .

• Sensitivity setting example

Set the sensitivity according to the pulse light conditions to be measured by referring to the following table.

Sensitivity setting	Sensitivity indication on the screen	Corresponding pulse width (min.)	Required optical power off time
N/HOLD	G-N/HOLD	100 μs	None
N/AUTO	G-N/AUTO	300 μs	None
NORMAL	G-NORMAL	1 ms	None
MID	G-MID	3 ms	None
HIGH1	G-HIGH1	10 ms	None
HIGH2	G-HIGH2	50 ms	None
HIGH3	G-HIGH3	200 ms	None

- Gate sampling interval setting example

Set the suggested gate sampling interval according to the set sensitivity by referring to the following table.

Sensitivity setting	Suggested gate sampling interval
G-N/HOLD	50 µs
G-N/AUTO	100 µs
G-NORMAL	300 µs
G-MID	1 ms
G-HIGH1	3 ms
G-HIGH2	15 ms
G-HIGH3	60 ms

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.

Measurement delay

Set the time during which data is not measured after the gate signal is input.

Set the time required for the pulse light emission to stabilize.

You can set the value between 0.1 ms and 1000.0 ms (in 0.1 ms steps).

You cannot specify a value that is less than or equal to the set gate sampling interval.

However, a longer measurement delay increases the number of sweeps and thus the measurement time. Set the smallest possible value.

- Measurement example (for Gate Logic Posi)
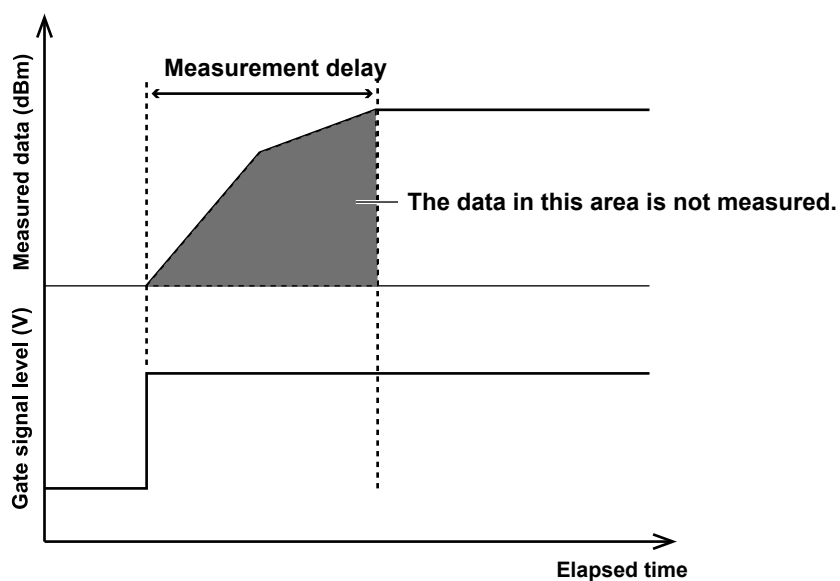
Note

- Repeat sweep is disabled (grayed out) during Gate Mode.
- 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.
- When the resolution correction feature is on, waveforms are corrected when a measurement is completed.

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.
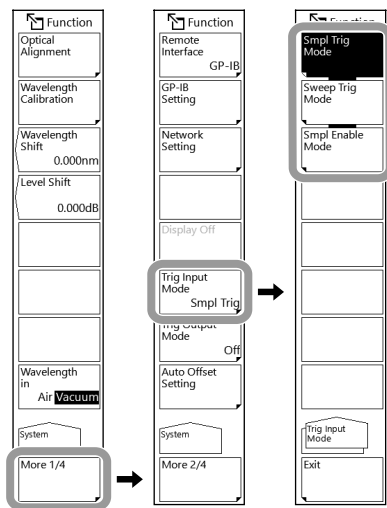
Note

- 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.
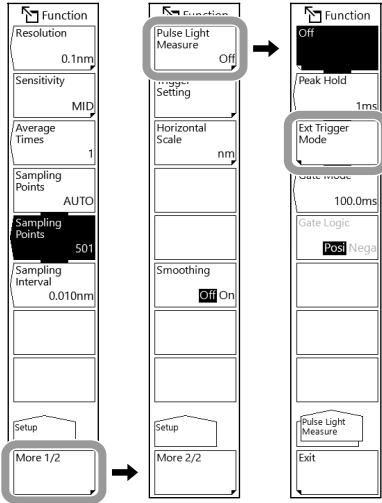
Setting the trigger conditions (for Smpl Trig)

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*.
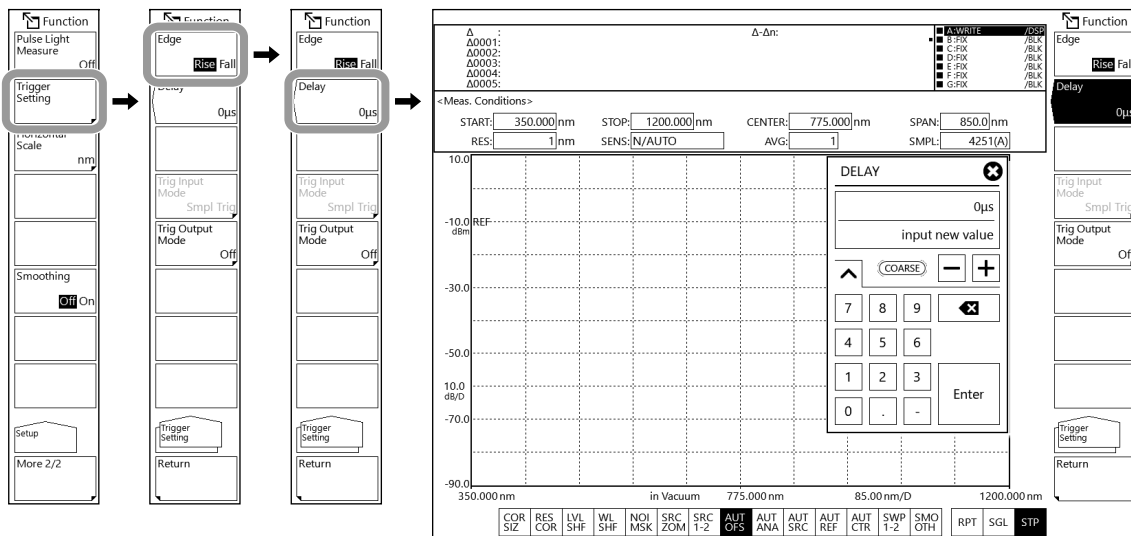
Note

- 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	Off	N/HOLD	P-N/HOLD	E-N/HOLD	Peak: 100 µs Ext: 50 µs
N/AUTO		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		HIGH1	P-HIGH1	E-HIGH1	10 ms
HIGH2		HIGH2	P-HIGH2	E-HIGH2	50 ms
HIGH3*		HIGH3	P-HIGH3	E-HIGH3	200 ms
MID	SWITCH	MID/SW	P-MID/SW	E-MID/SW	3 ms
HIGH1		HIGH1/SW	P-HIGH1/SW	E-HIGH1/SW	10 ms
HIGH2		HIGH2/SW	P-HIGH2/SW	E-HIGH2/SW	50 ms
HIGH3*		HIGH3/SW	P-HIGH3/SW	E-HIGH3/SW	200 ms

* Measurement sensitivity available on the standard and high resolution 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	70 ms
HIGH2	100 ms
HIGH3*	300 ms

* Measurement sensitivity available on the standard and high resolution 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**.
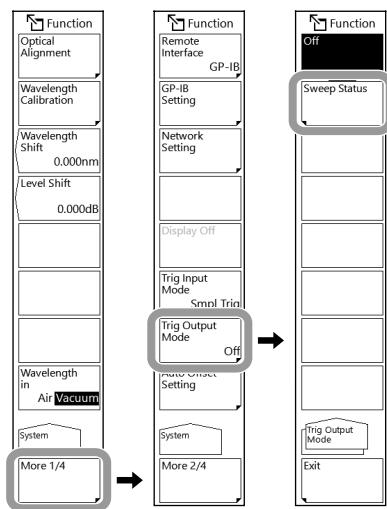
Note

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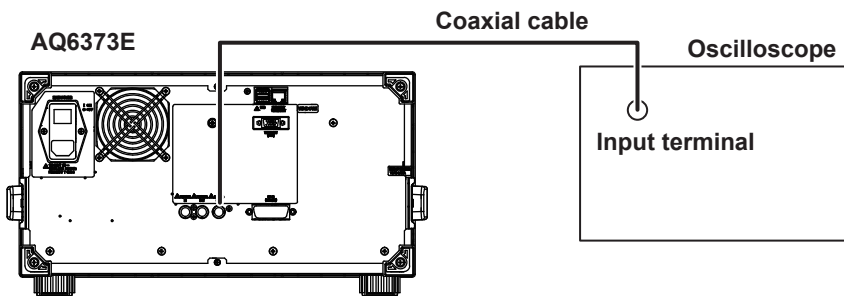
1. Press **SETUP**. The Setup menu appears.

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.
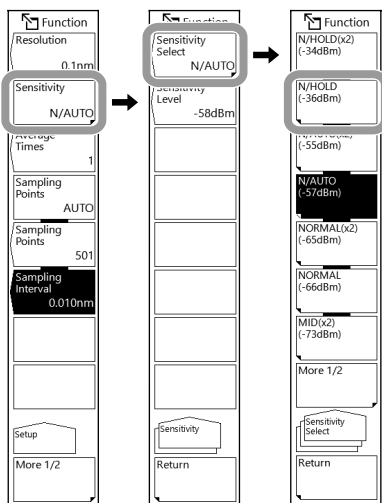
5. Press **REPEAT** or **SINGLE**. Sweeping will begin, and analog voltage will be output.
    (You can also do the same by tapping **Repeat** or **Single** on the Sweep menu that appears when you press **SWEEP**.)

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	+2 V or more
Bandwidth	10 kHz or more
Load	1 kΩ or more

3

Measuring the Optical Spectrum

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

Zoom Center — Set the zoom center wavelength.
Zoom Span — Set the sweep span to be displayed.
Zoom Start — Set the zoom start wavelength.
Zoom Stop — Set the zoom stop wavelength.
Peak -> Zoom Ctr — Sets the center wavelength of the zoom display to the peak wavelength
Initialize — Initializes the display scale
The overview window shows the zoom area (Zoom Area) with a dotted frame.
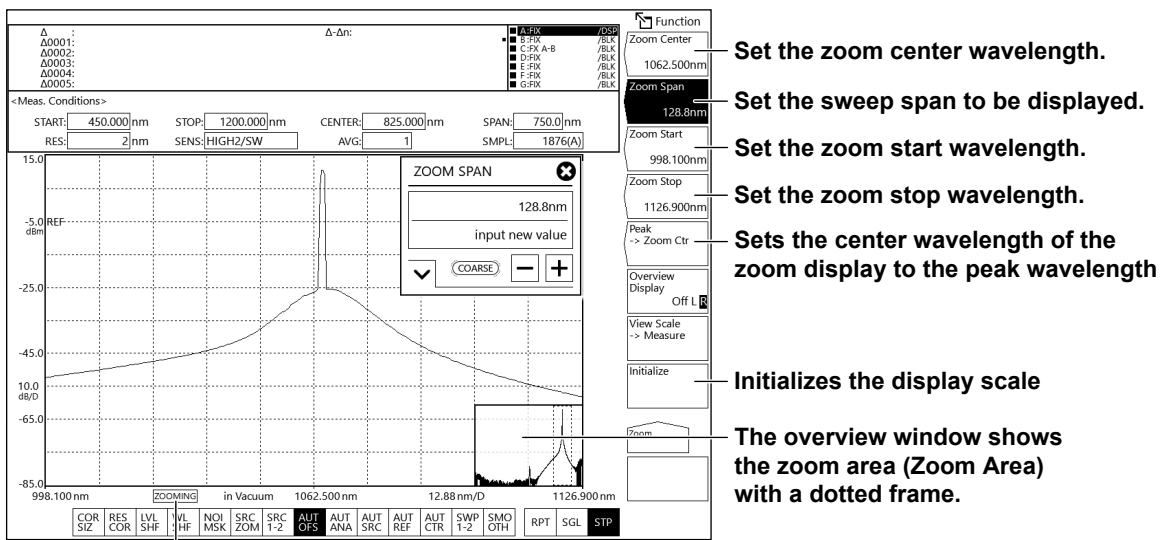
ZOOMING appears when the display scale is changed (when the waveform is zoomed).

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.
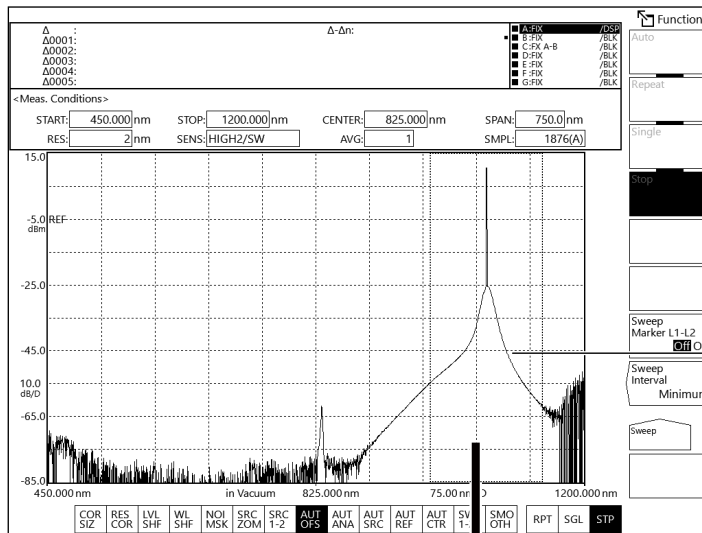
Drag the mouse in the waveform display area to set the zoom area.

Zoom
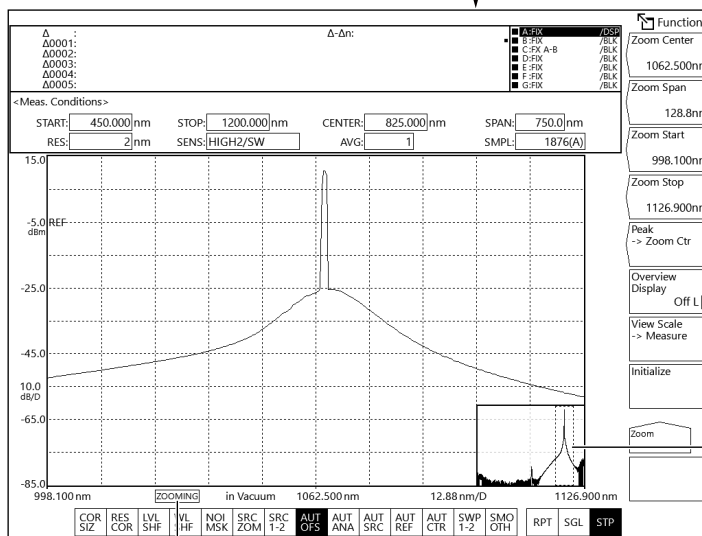
The overview window shows the zoom area (Zoom Area) with a dotted frame.

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.

4

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
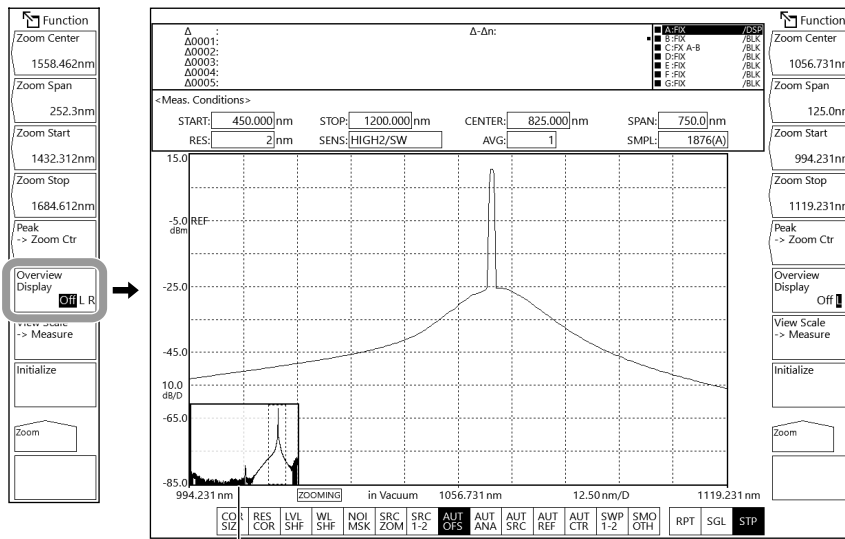
Overview window

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:

Display mode	Zoom center	Display sweep span	Zoom start	Zoom stop
Wavelength (nm)	1200.000 to 1200.000	0.1 to 850.0	1.000 to 1199.950	350.050 to 1625.000
Frequency (THz)	250.0000 to 856.5000	0.01 to 610.00	10.0000 to 856.4950	250.0050 to 999.9000
Wavenumber (cm^{-1})	8334.000 to 28571.000	0.1 to 20238.0	1000.000 to 28570.950	8334.050 to 38690.000

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}).

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Displaying Optical Spectral Waveforms

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**
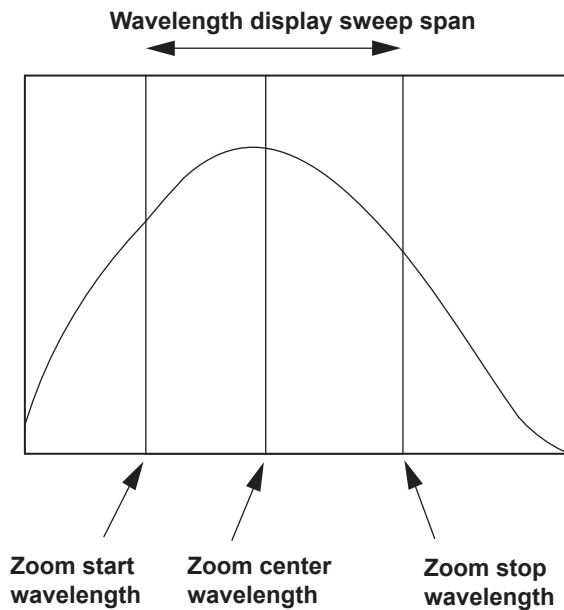
Note

- 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.
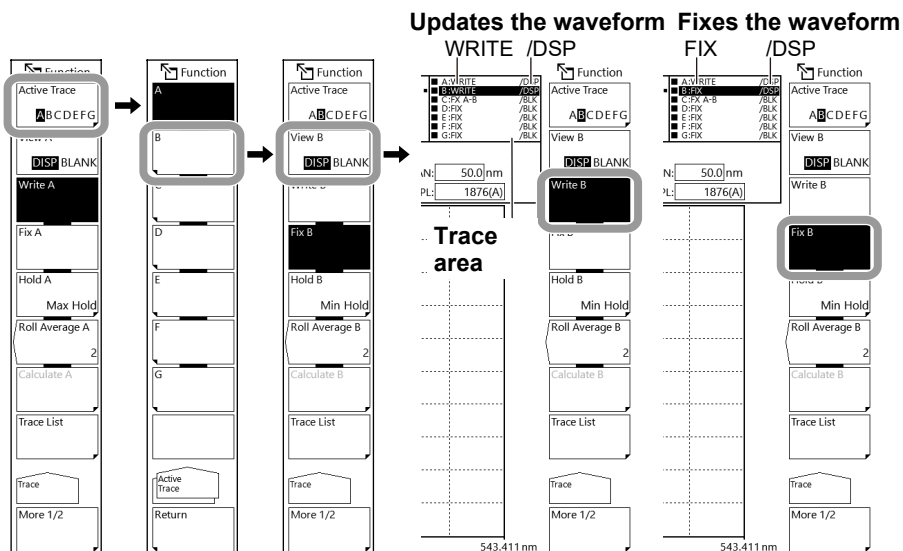
Note

- 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
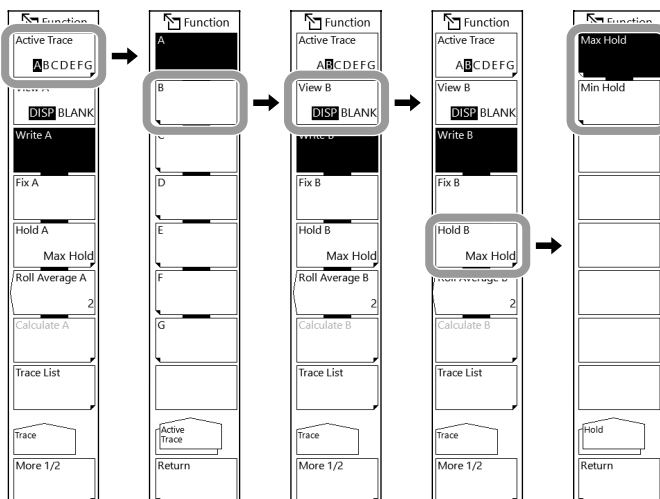
Selecting a trace to average

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.
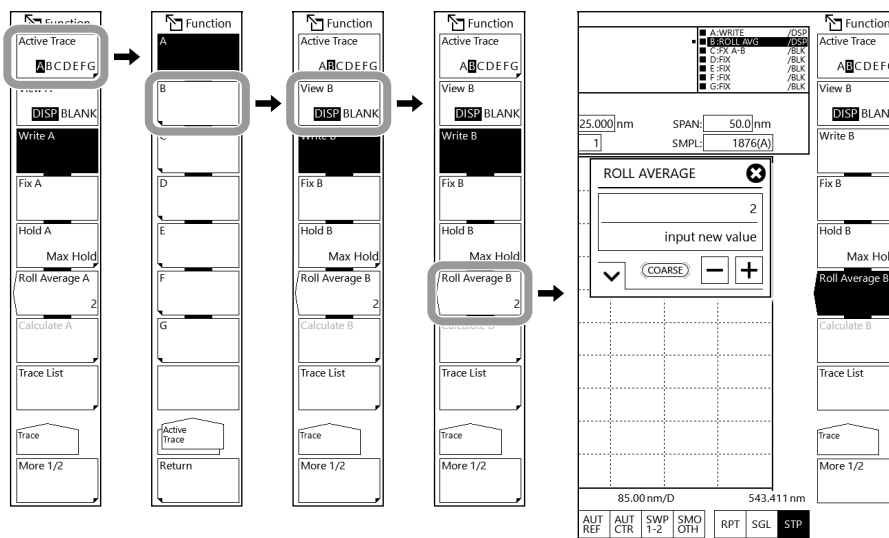
Note
You can set the average times between 2 and 100.

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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Displaying Optical Spectral Waveforms

4.5 Calculating the Waveform Display

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.
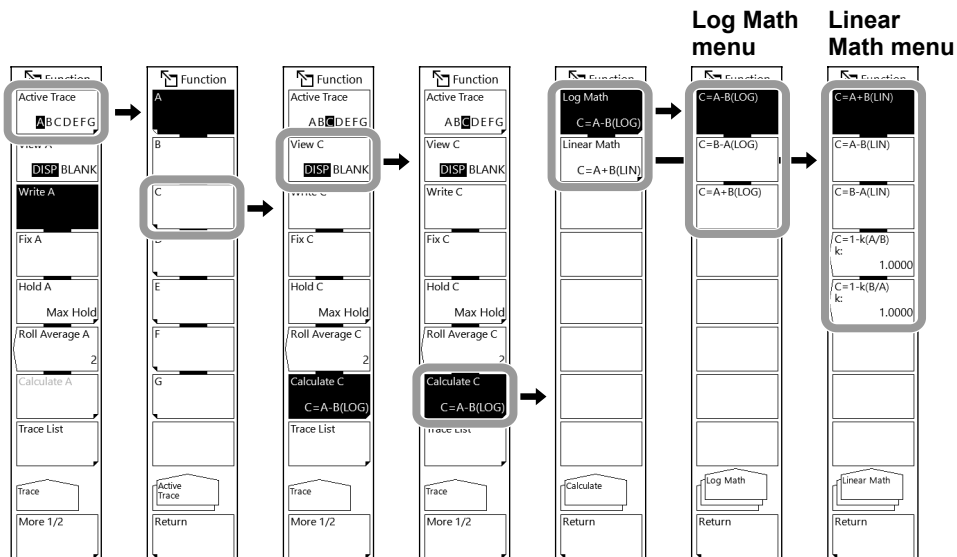
Note

- 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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Displaying Optical Spectral Waveforms

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)
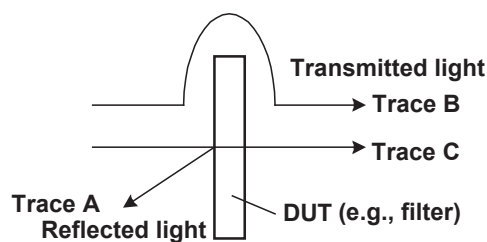
(2) Estimating the reflectivity (Trace C) from the transmitted light spectrum (Trace A)

Reflected light spectrum (Trace C) = 1 − k(Trace A/Trace B)
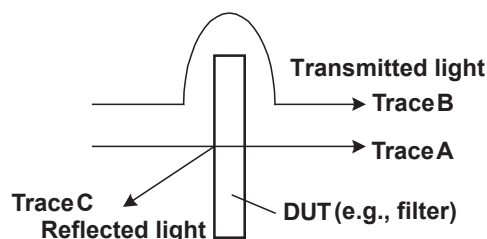
The value of k is an absorption coefficient which is used in determining the DUT reflectivity and transmission efficiency. Different algorithms are used depending on whether transmission efficiency or reflectivity is estimated, so the k value also varies accordingly. The following equation can be used 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

$$kr = (Pin − Pout)/Pre$$

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Displaying Optical Spectral Waveforms

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.

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**.
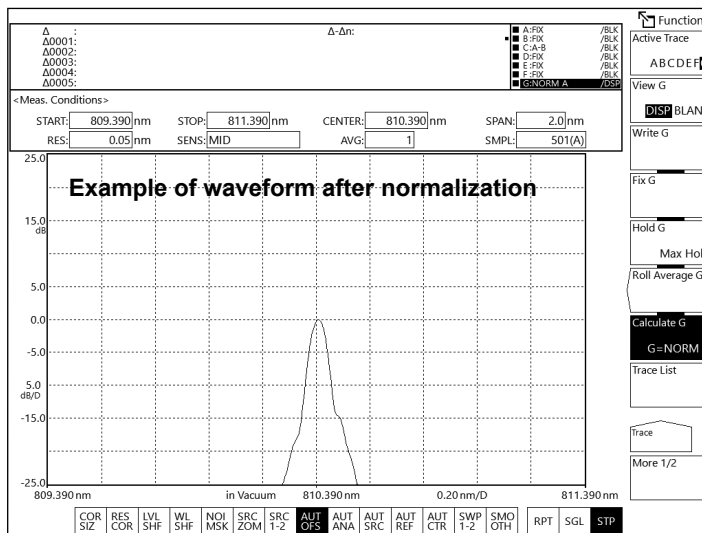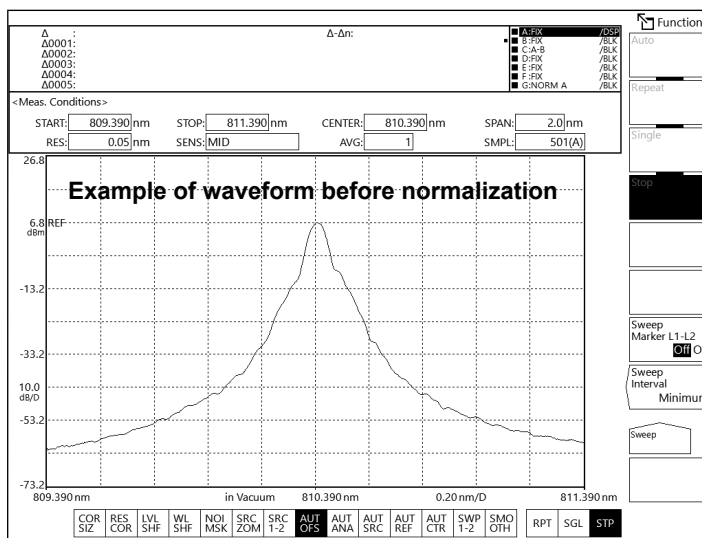
Note

- 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**.
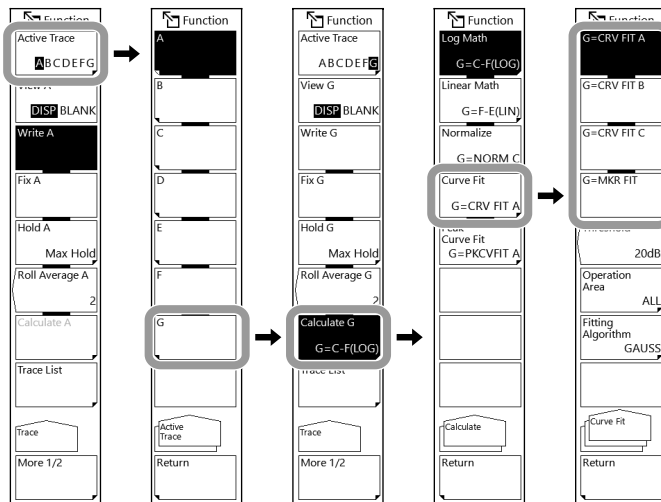
Note

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
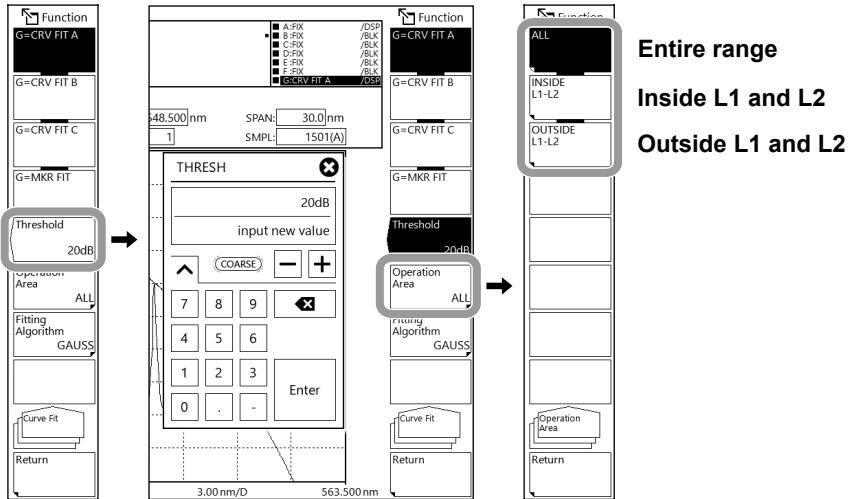
Note

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.
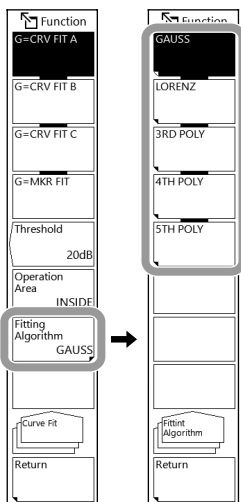
Note

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

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Displaying Optical Spectral Waveforms
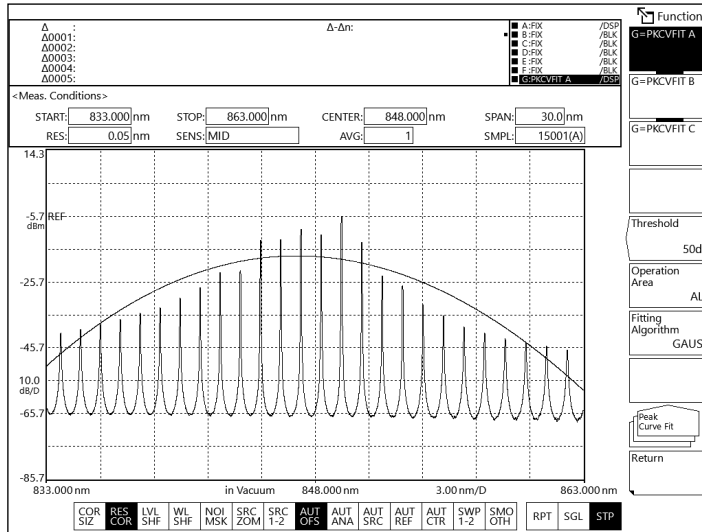
Explanation

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)
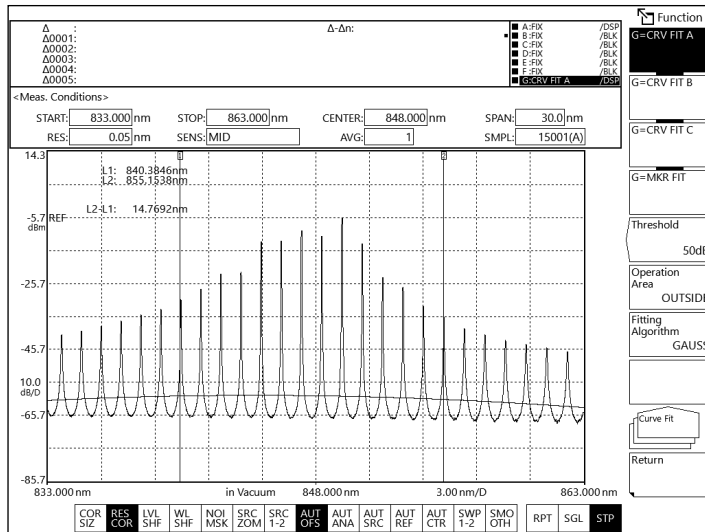
Example of a marker-fitted waveform (data range: ALL)
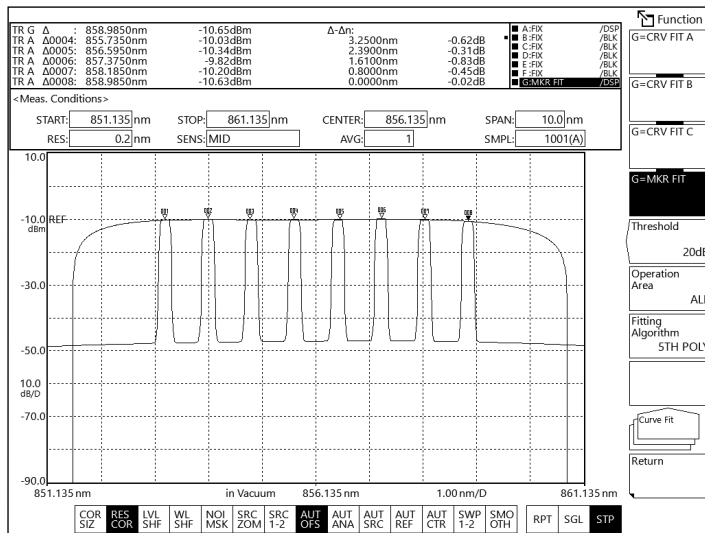
Peak curve fit target range

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
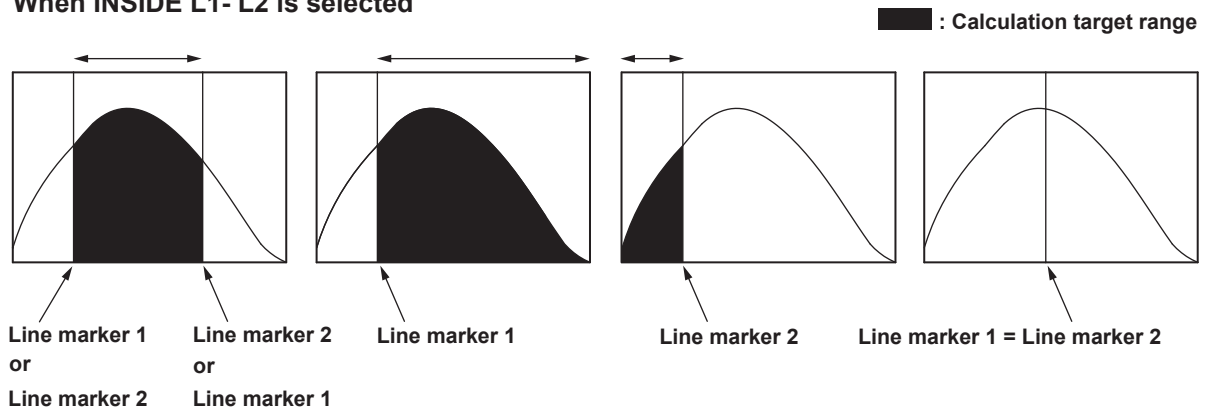
When OUTSIDE L1- L2 is selected
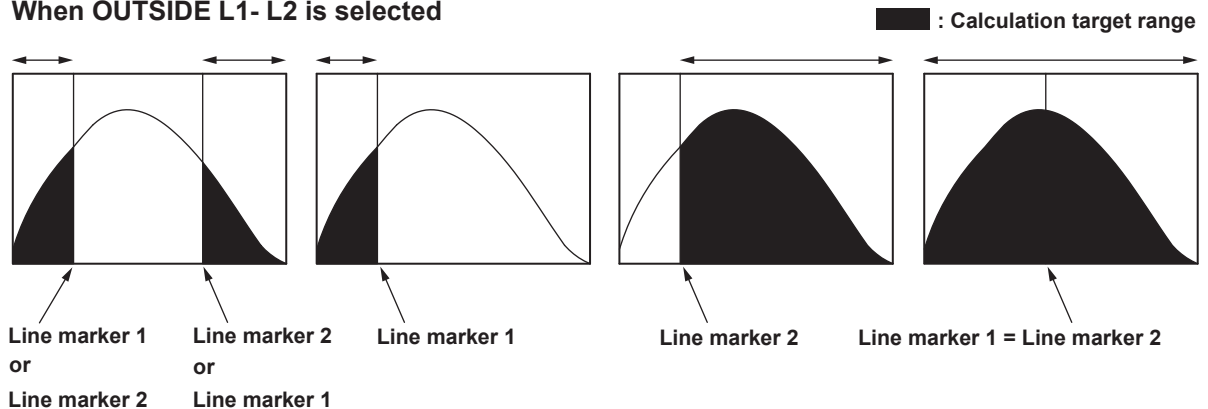
Curve fitting algorithm

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*.
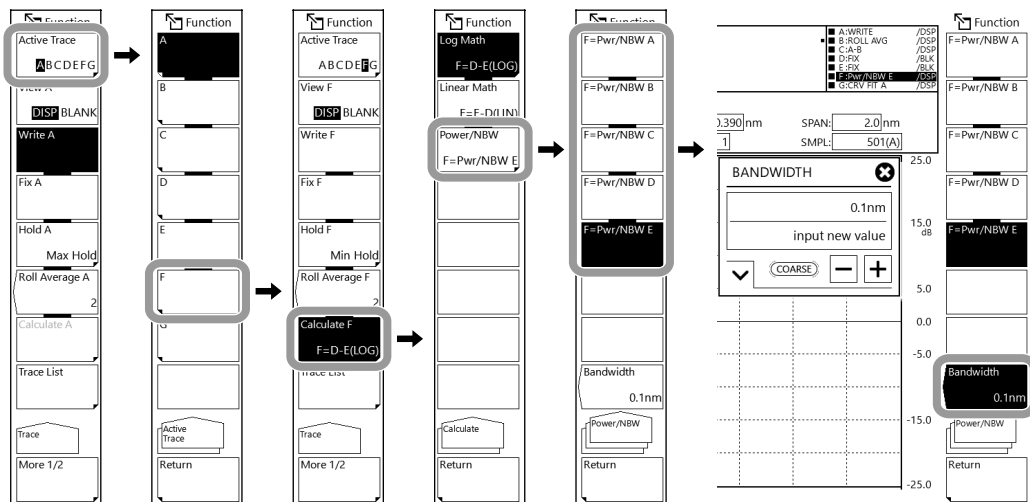
Explanation

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

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.
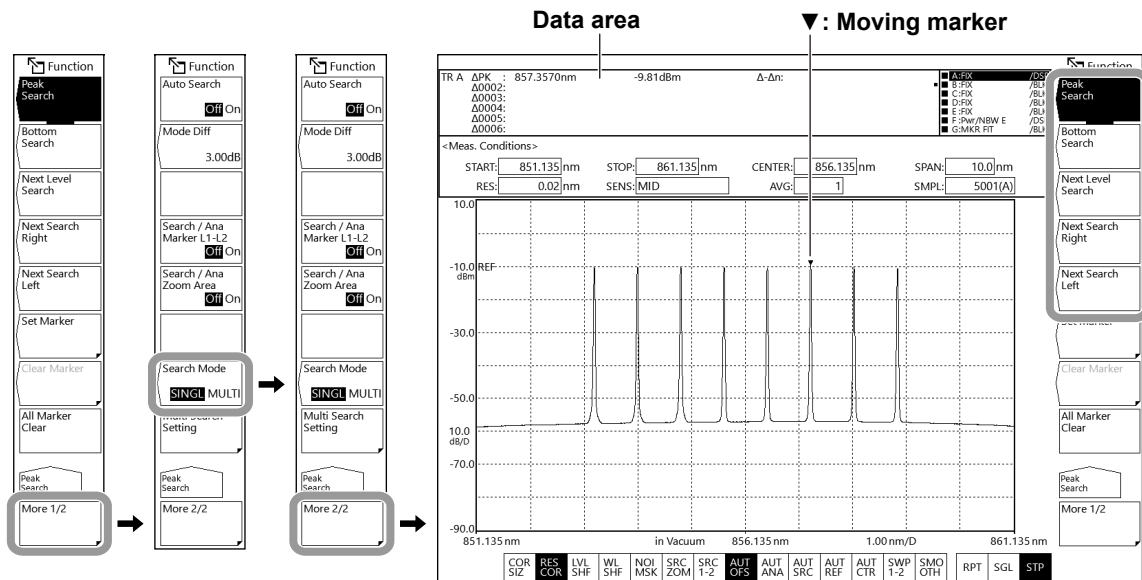
Note
• If the active trace is not set to DISP, you cannot use the moving marker.
Set View @ DISP BLANK under Trace to DISP.

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*.
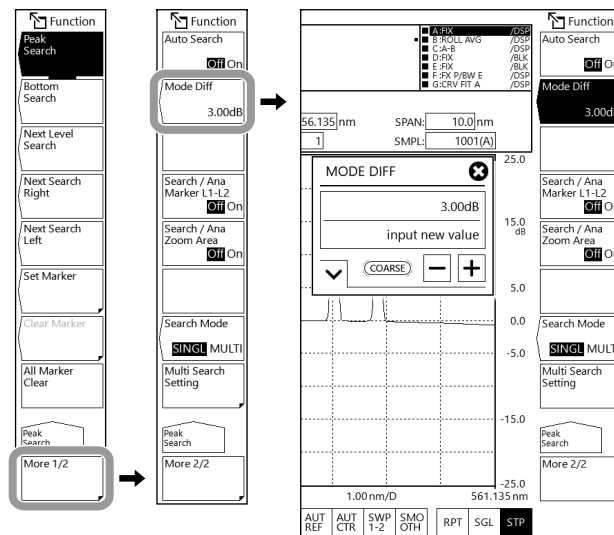
Searching for the next peak/bottom level

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.
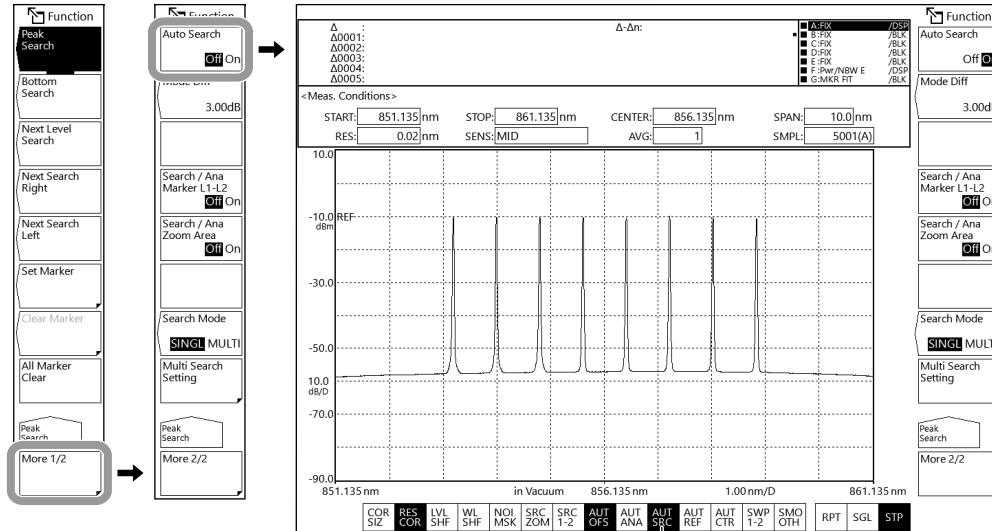
Highlighted when Auto Search is sele

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.
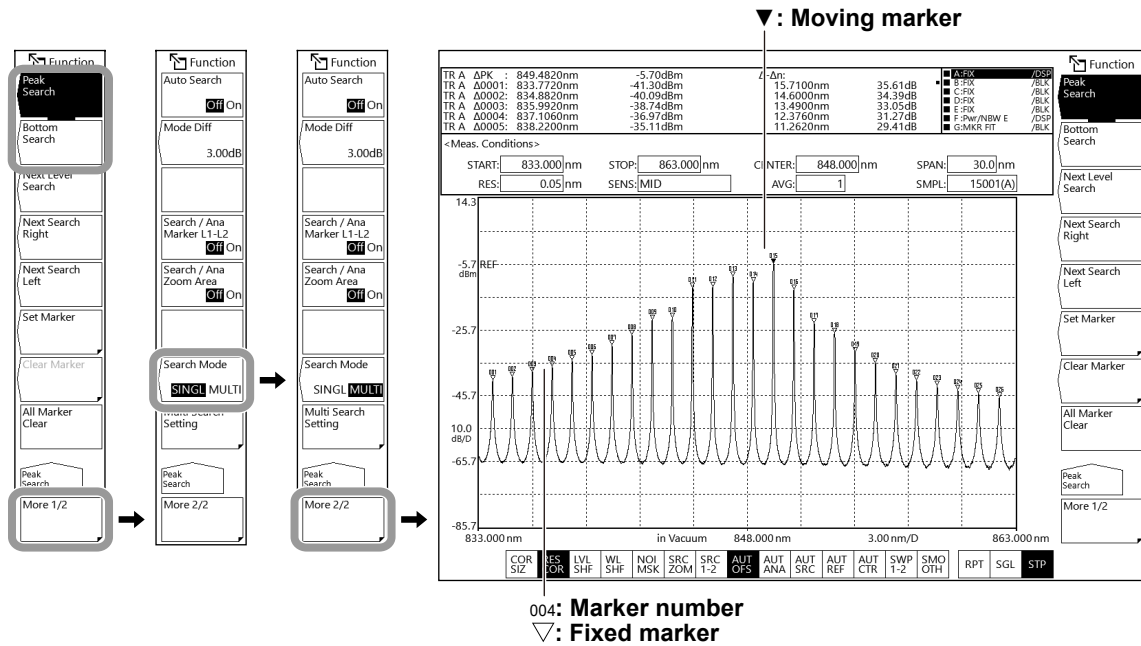
▼: Moving marker

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.

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Displaying Optical Spectral Waveforms

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 $\boxed{\substack{\text{SRC} \\ \text{1-2}}}$ is highlighted at the bottom the screen.

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.

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Displaying Optical Spectral Waveforms

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.
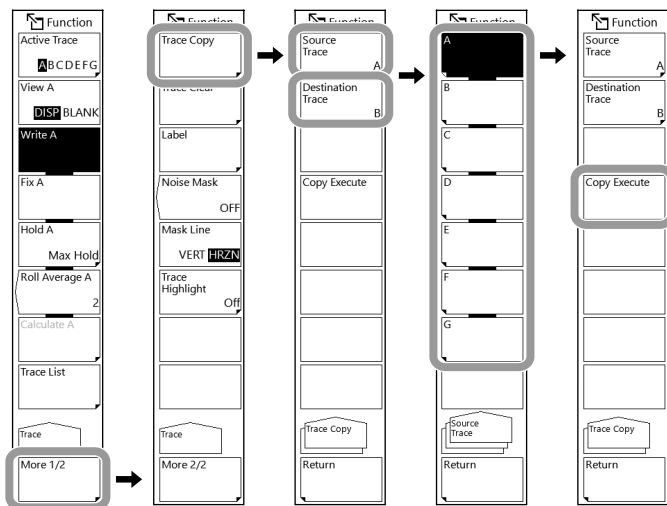
Note

- 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**.
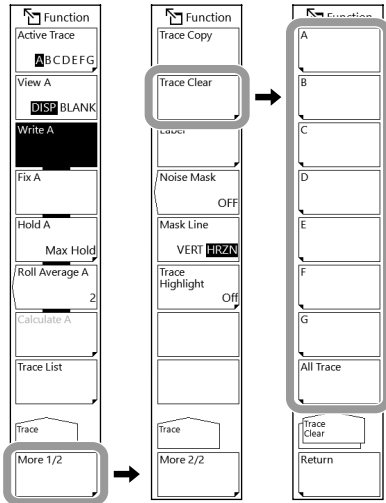
Displaying the trace list

1. Press **TRACE**. The Trace menu appears.

2. Tap **Trace List**. A trace list is displayed.

4

Displaying Optical Spectral Waveforms
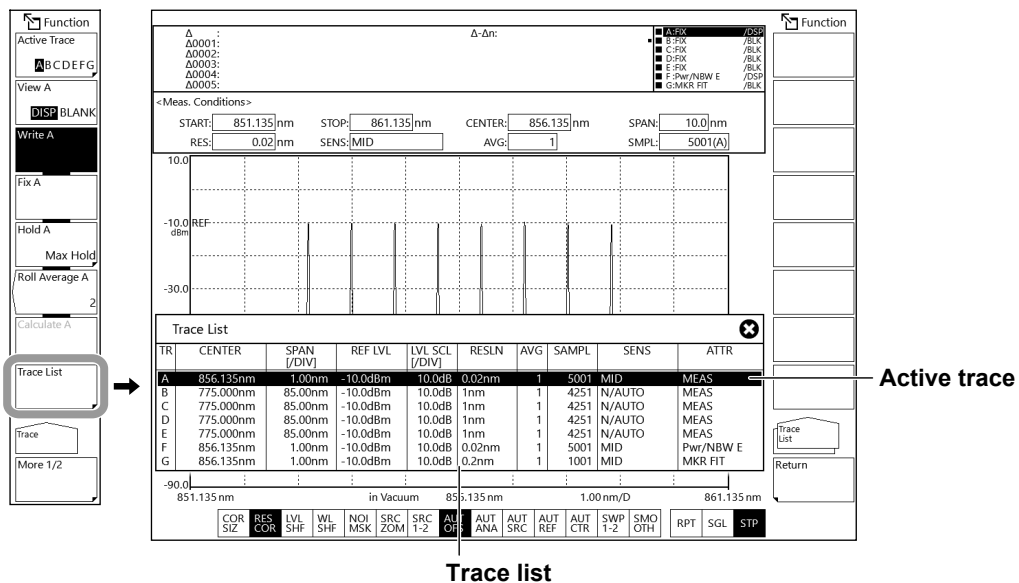
4.11 Noise Mask

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.

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.
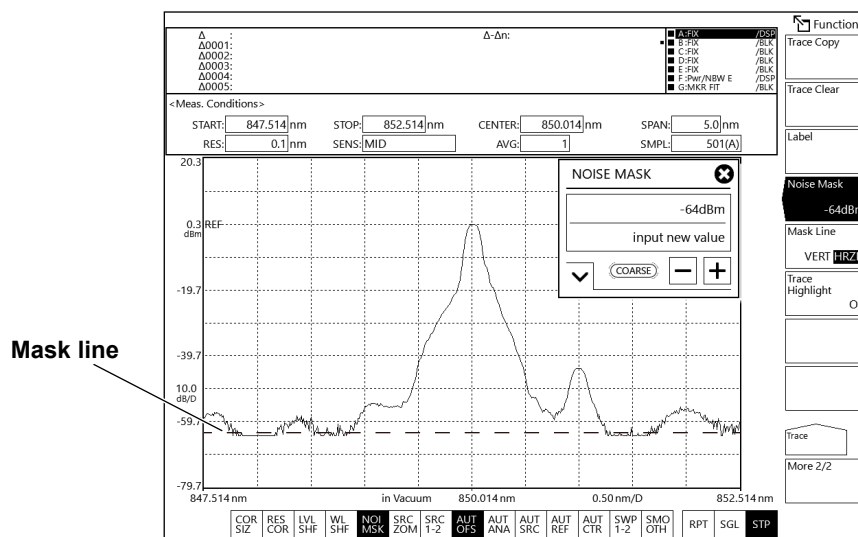
Mask line

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
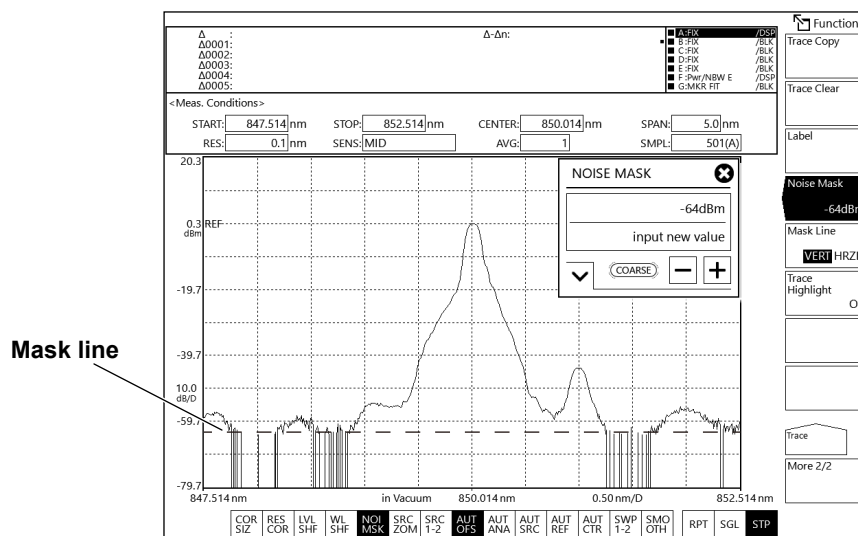
4.12 Highlighting the Waveform Display

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.
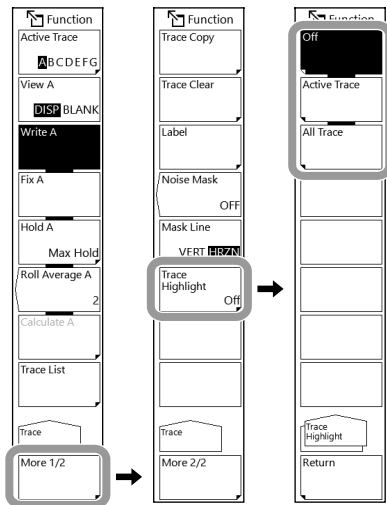
5.1 Wavelength and Level Values of an Optical Spectrum

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.
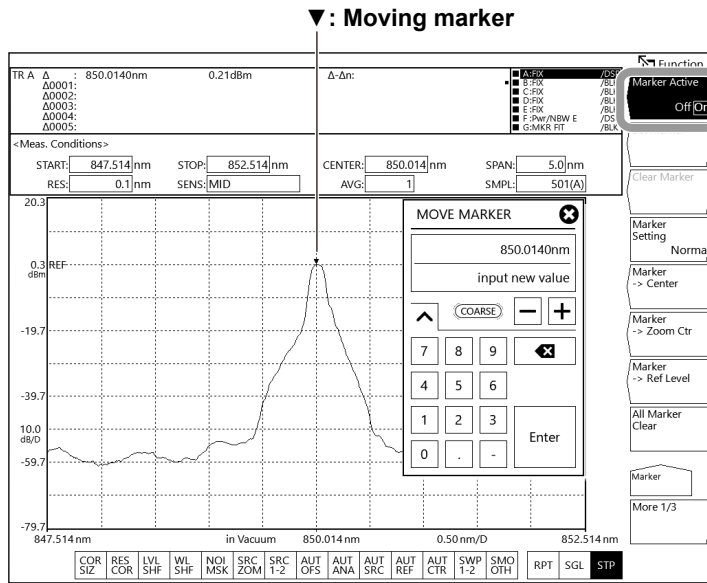
▼: Moving marker

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.
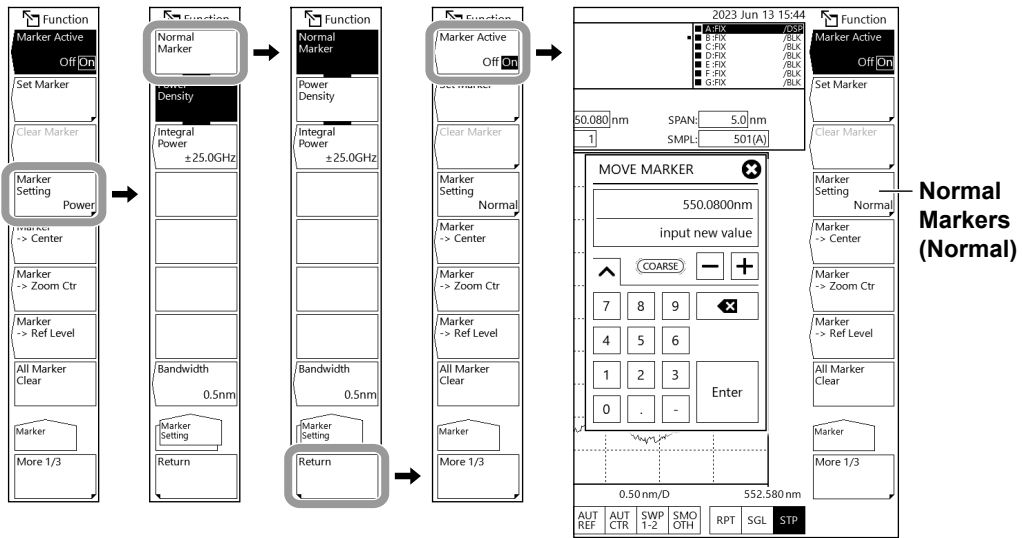
Note

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
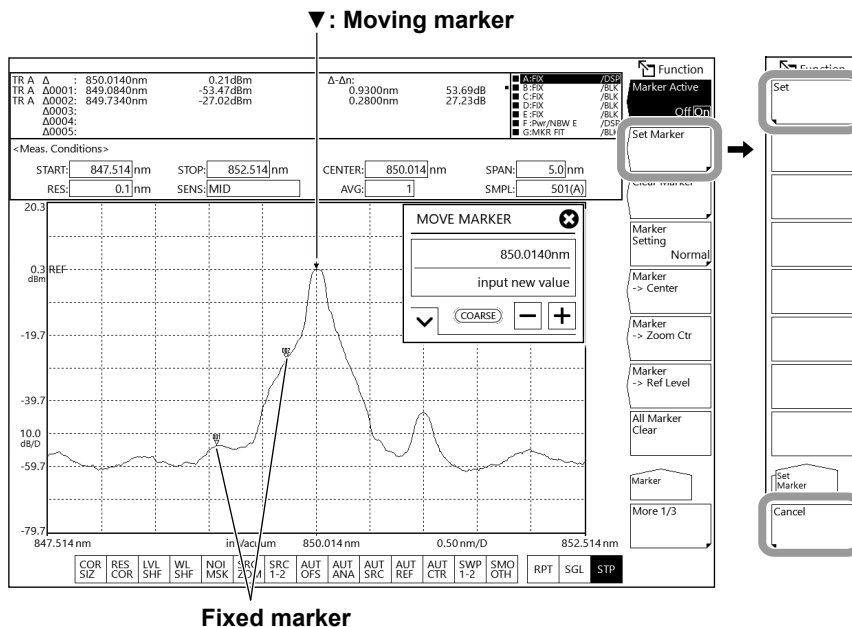
Clearing a fixed marker

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.
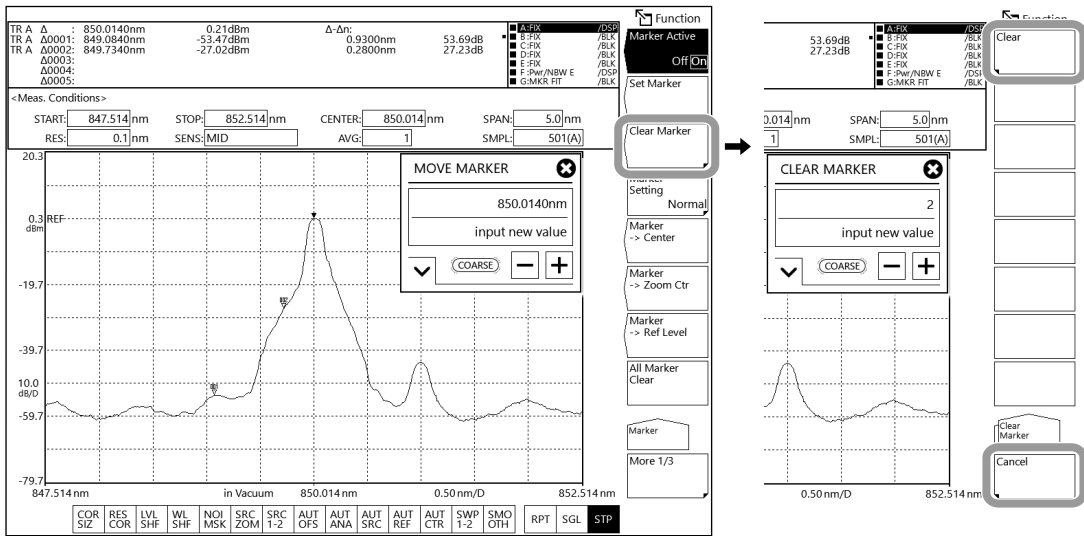
Clearing all markers

9. Tap **All Marker Clear**. The moving marker and all fixed markers are cleared.
The Marker Active settings is also set to Off.
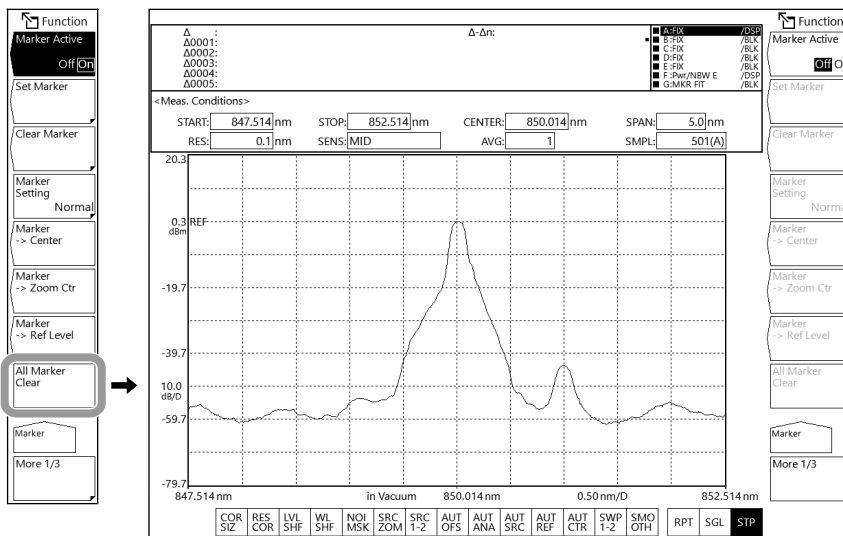
Using the moving marker to set the center wavelength to be measured, the zoom center wavelength, and the reference level

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."
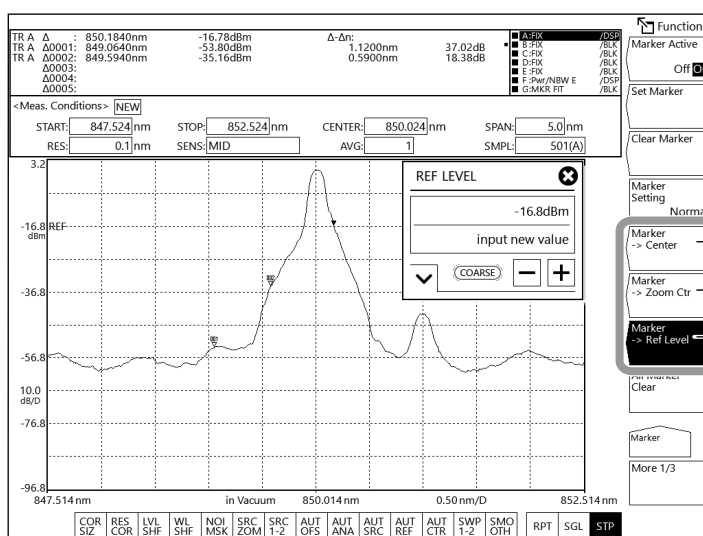
Sets the measurement center wavelength to the moving marker wavelength

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**.
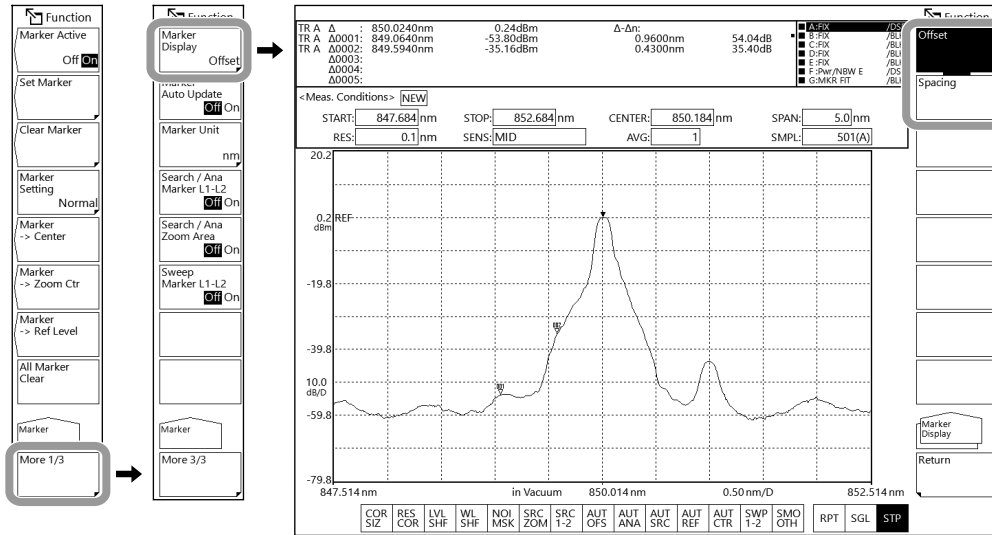
Note

- 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.
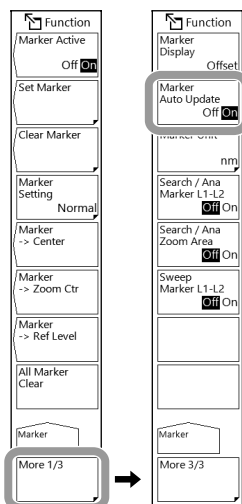
Setting the unit of marker values

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.
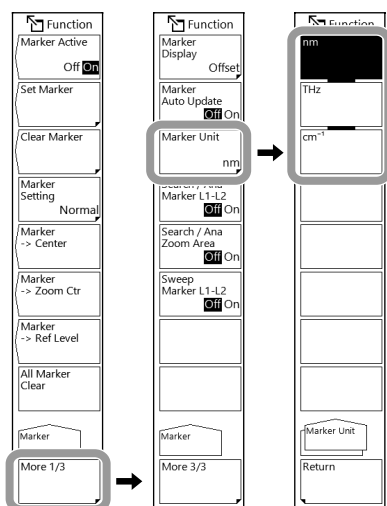
Note

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.

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
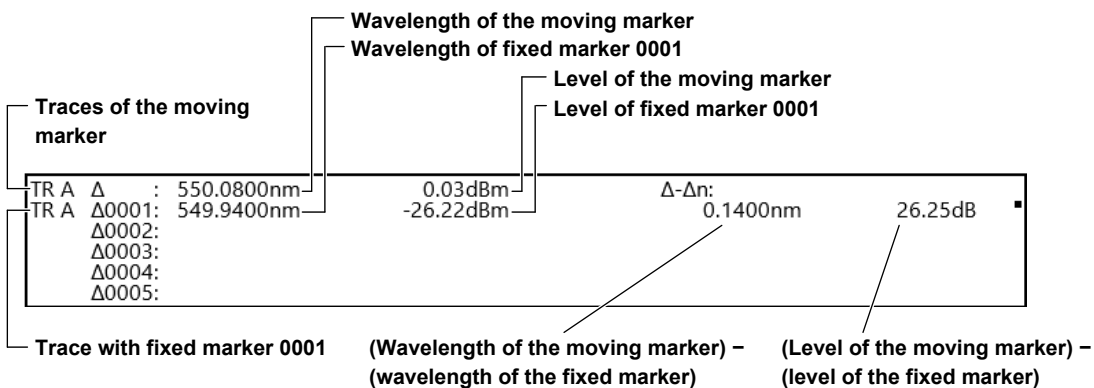
Marker display

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.
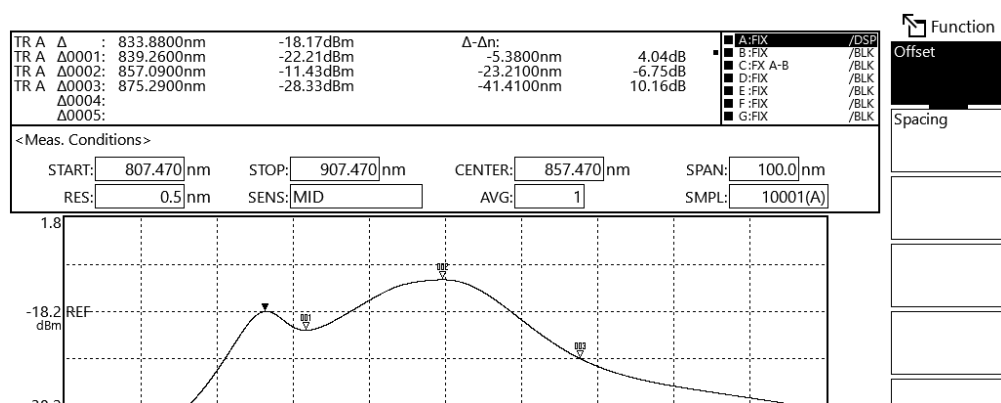
When a fixed marker is positioned and the moving marker is set to a wavelength value of −210 dBm, the level difference is set to −210.00 dB, regardless of the fixed marker's level.

Spacing

This soft key sets the difference value display as the difference between each marker and the next marker.

5

Displaying Measured Values and Calculated Values Using Markers
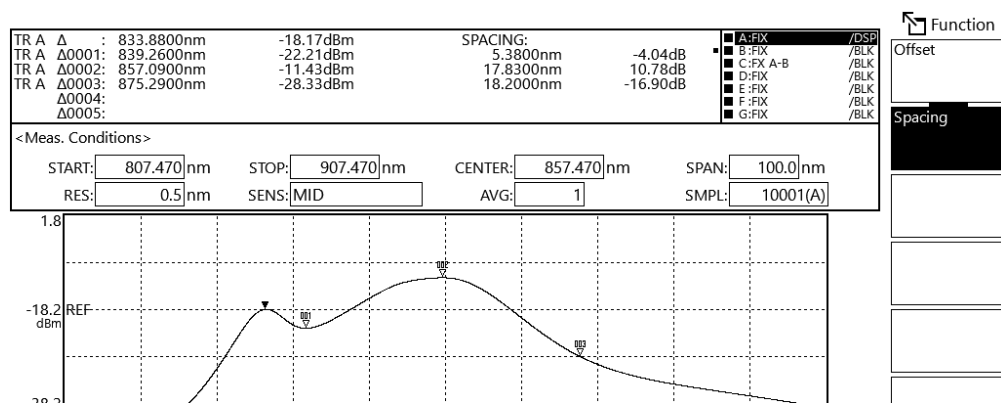
5.2 Wavelength/Level Difference between Optical Spectra

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.
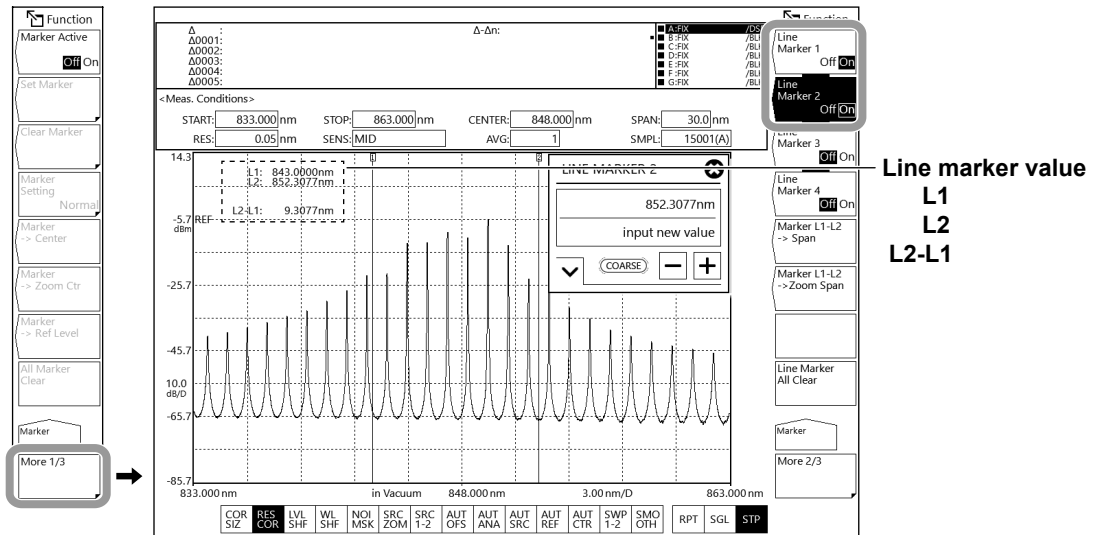
Note
- You cannot set wavelength line markers if the active trace measurement data span is 0 nm.
- Line marker values are displayed in the upper left of the waveform area. When both wavelength line markers 1 and 2 are displayed, the wavelength difference (L2−L1) is shown below the marker values.

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
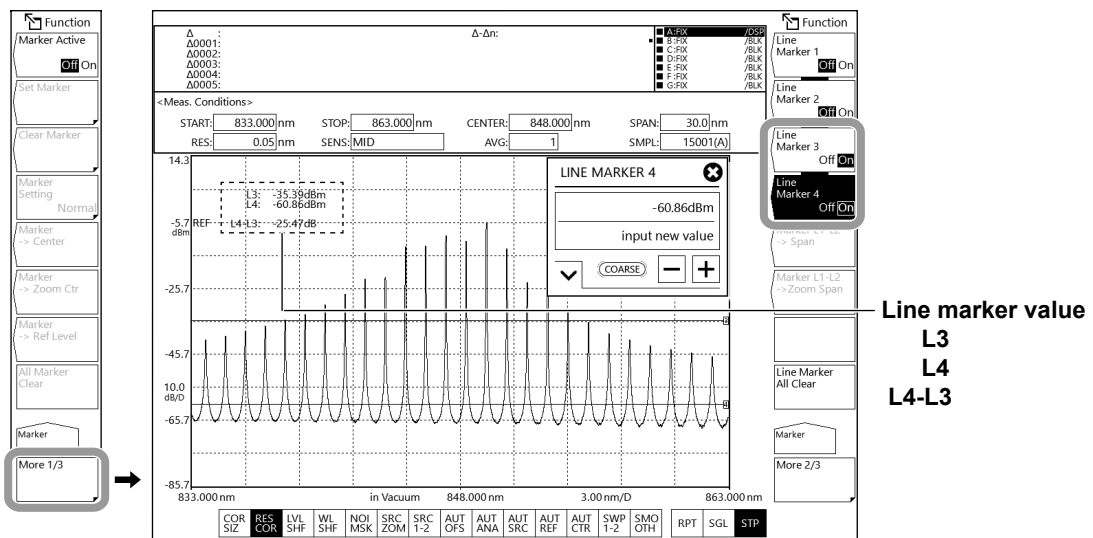
Note

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.

5

Displaying Measured Values and Calculated Values Using Markers

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.
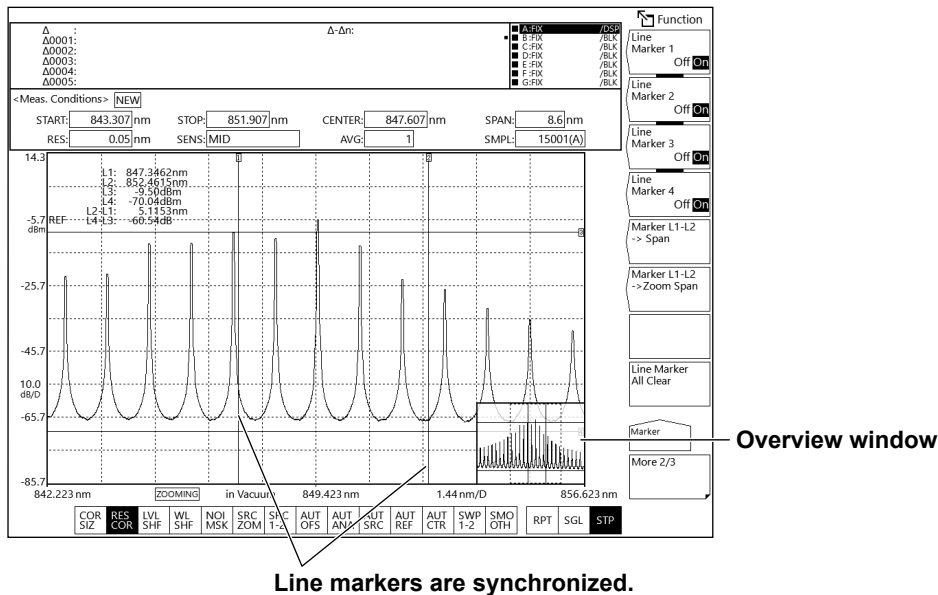
5.3 Power Spectral Density

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
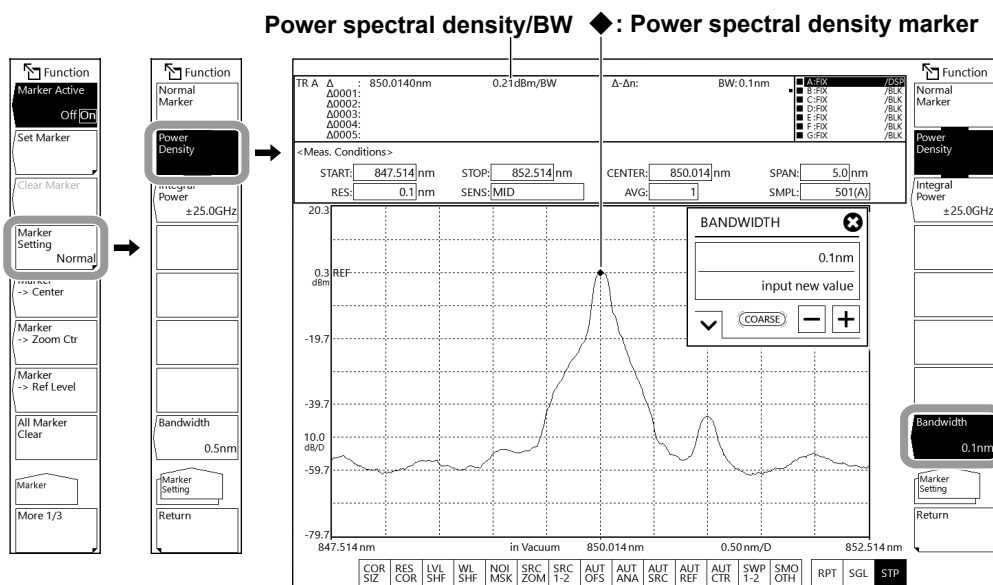
Note

- 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
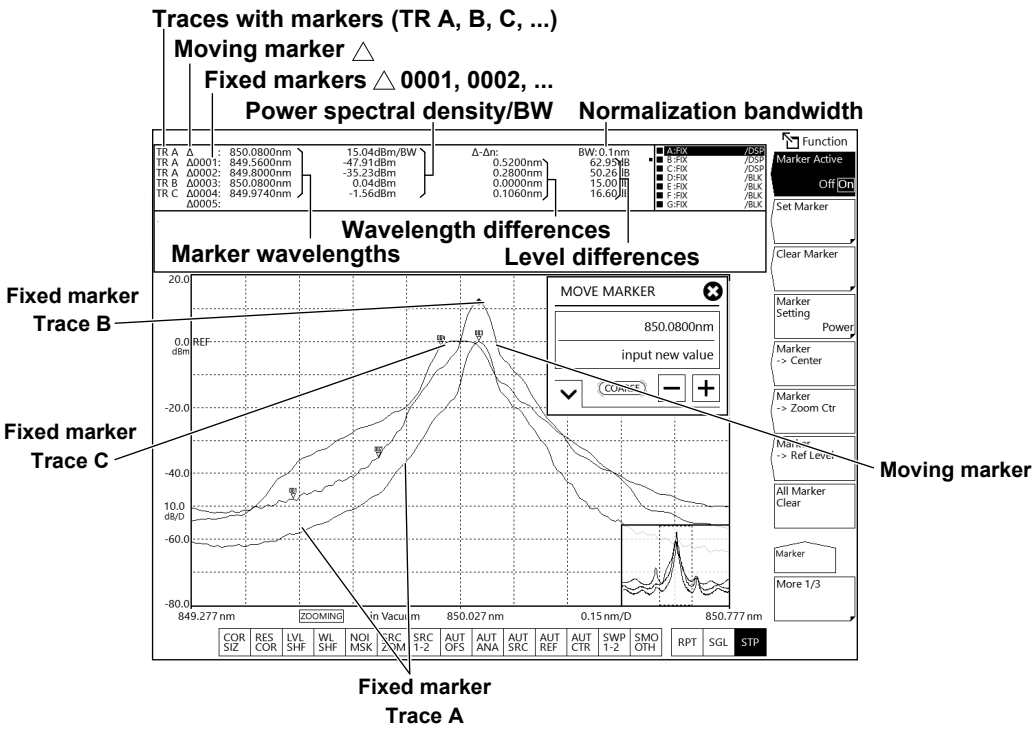
Note

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.

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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
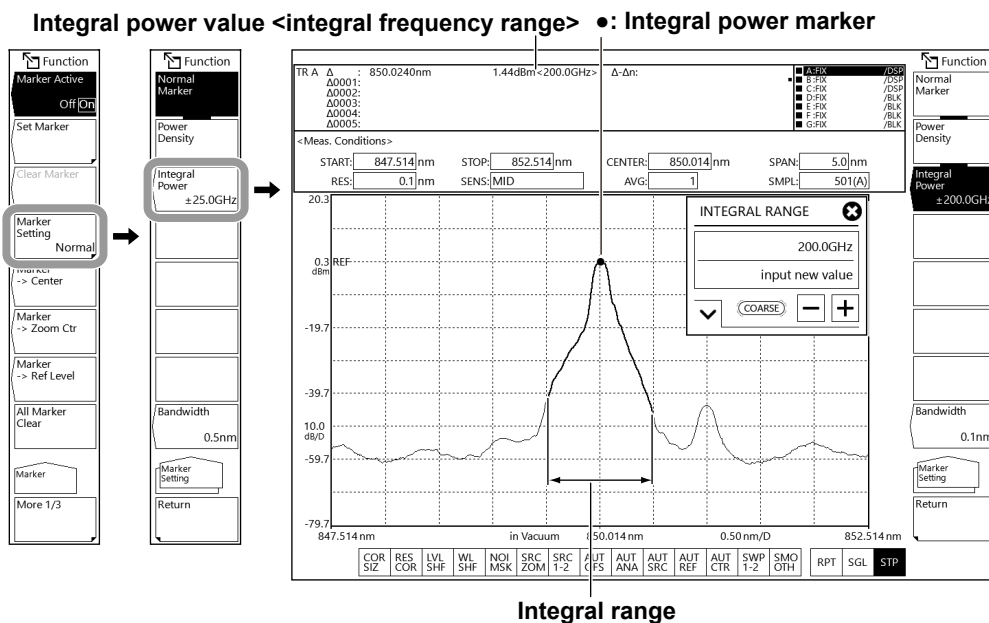
Note

- 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.

5

Displaying Measured Values and Calculated Values Using Markers

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
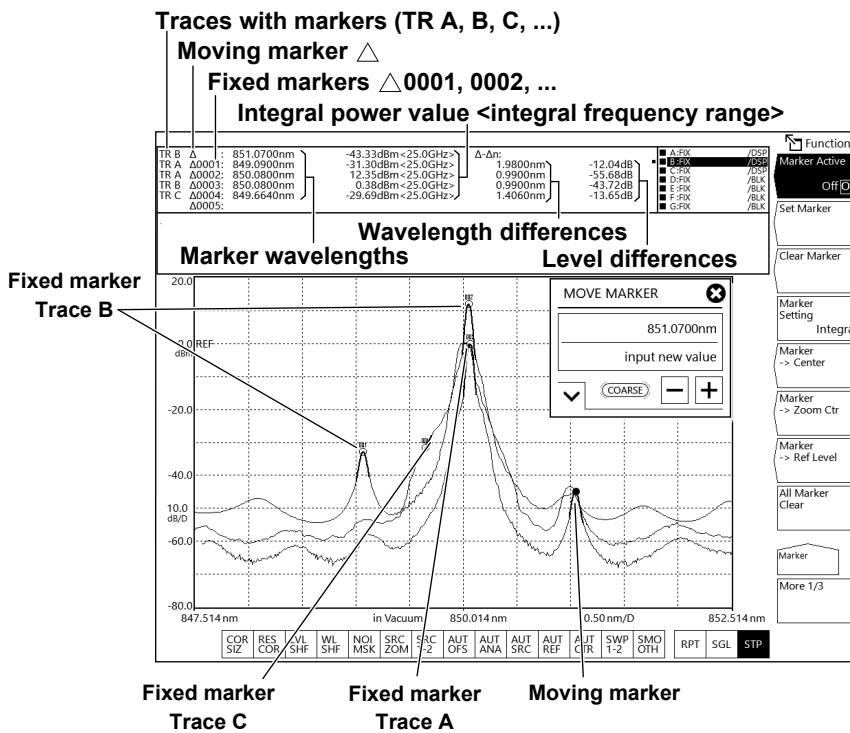
Note

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.

6

Analyzing Optical Spectral Waveforms
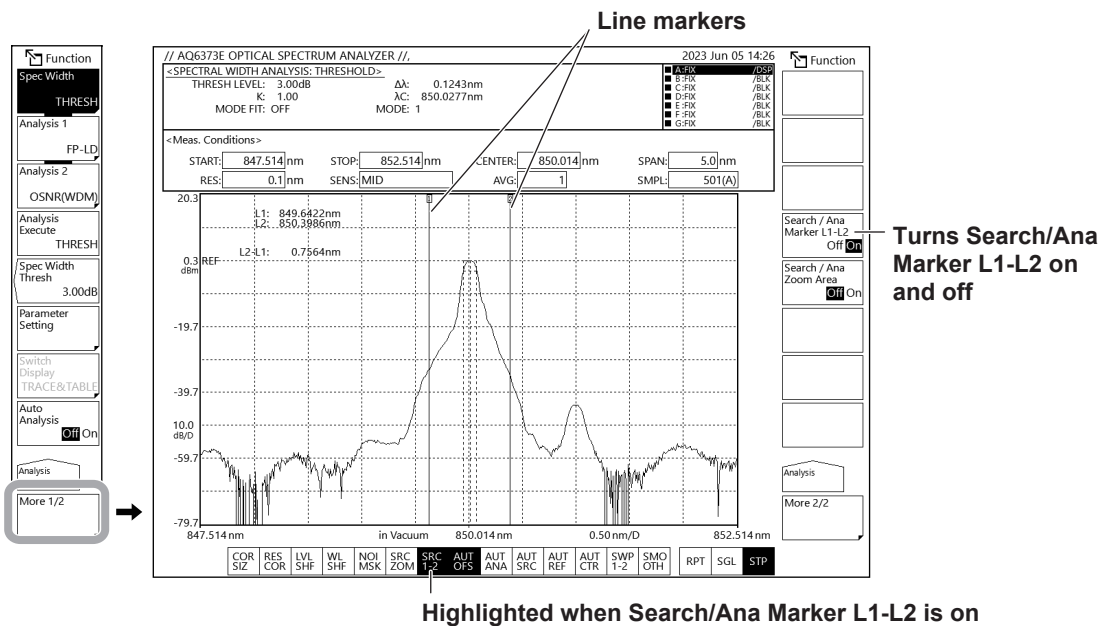
Analysis in the zoom area

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
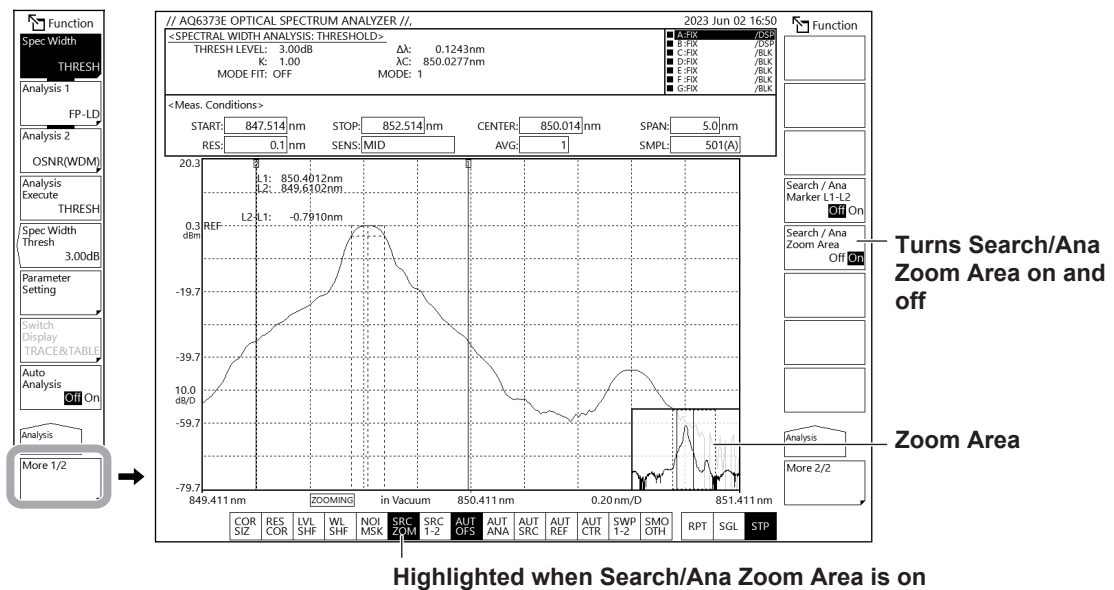
Explanation

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.

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
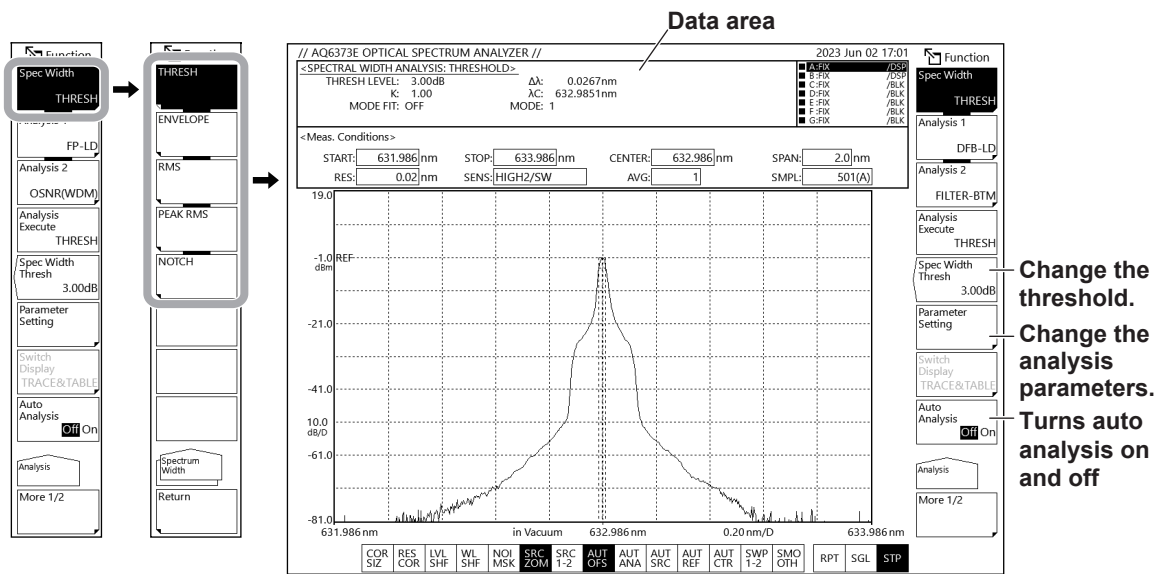
Changing the analysis parameters

4. Continuing from step 3, tap **Parameter Setting**. A Parameter Setting window appears.

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, $\boxed{\substack{\text{AUT} \\ \text{ANA}}}$ 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:     0.0267nm
                K:  1.00          λC:   632.9851nm
        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.

6.3 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.

Change the analysis parameters.

Turns auto analysis on and off
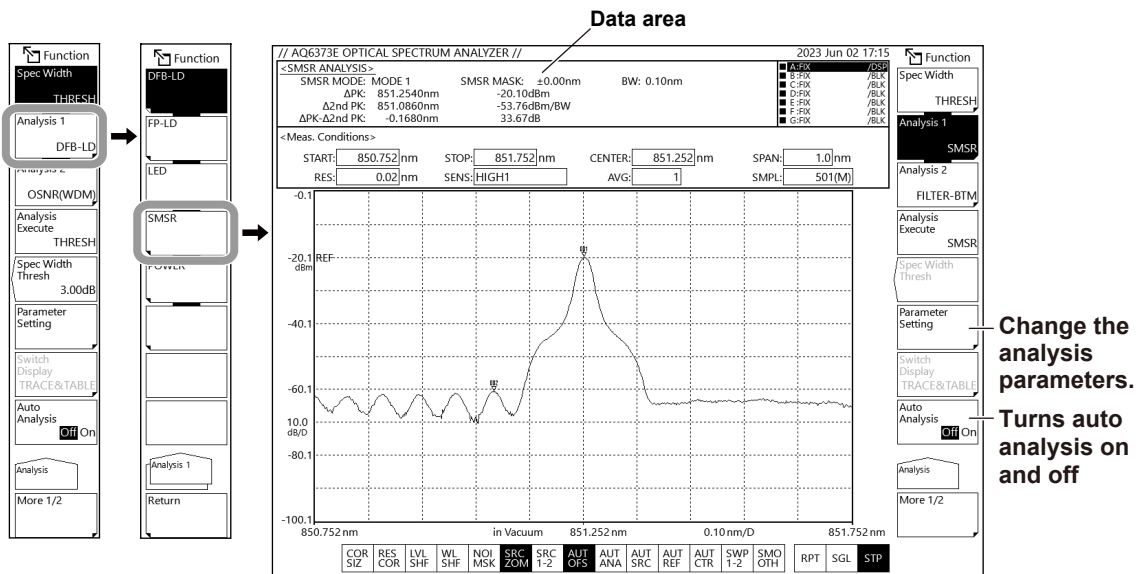
Changing the analysis parameters

4. Continuing from step 3, tap **Parameter Setting**. An SMSR measurement parameter setting screen appears.
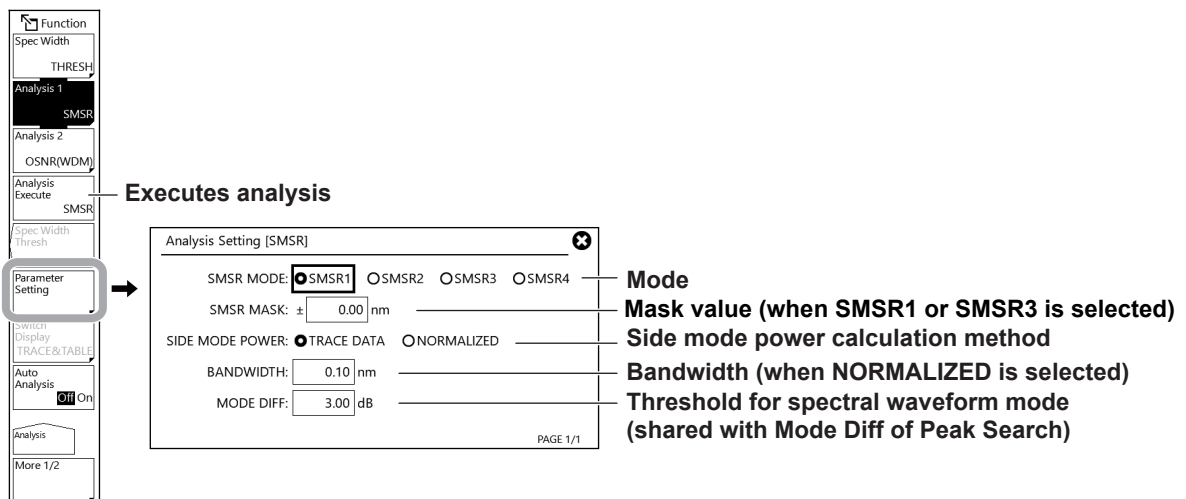
Executes analysis

Analysis Setting [SMSR]

SMSR MODE: ●SMSR1 ○SMSR2 ○SMSR3 ○SMSR4 — **Mode**

SMSR MASK: ±   0.00 nm — **Mask value (when SMSR1 or SMSR3 is selected)**

SIDE MODE POWER: ●TRACE DATA ○NORMALIZED — **Side mode power calculation method**

BANDWIDTH: 0.10 nm — **Bandwidth (when NORMALIZED is selected)**

MODE DIFF: 3.00 dB — **Threshold for spectral waveform mode (shared with Mode Diff of Peak Search)**

PAGE 1/1

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.
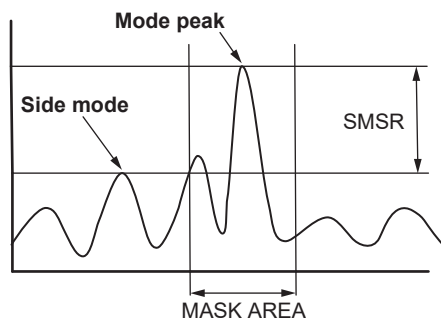
SMSR Mode

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:   ±0.00nm        BW: 0.10nm
        ΔPK:    851.2540nm             -20.10dBm
     Δ2nd PK:  851.0860nm             -53.76dBm/BW
  ΔPK-Δ2nd PK:  -0.1680nm             33.67dB
```

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

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
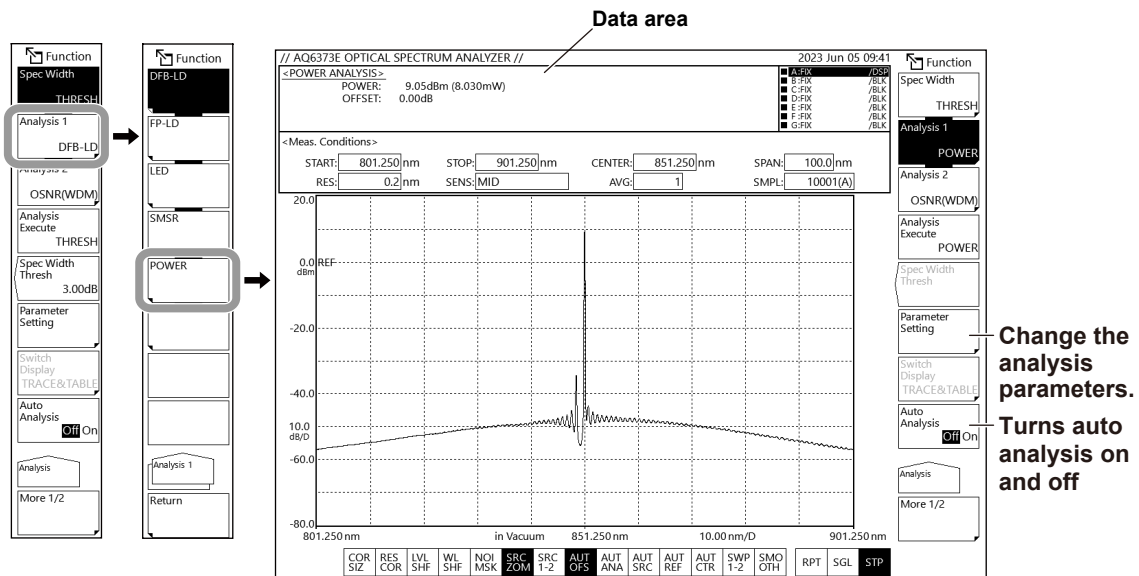
Changing the analysis parameters

4. Continuing from step 3, tap **Parameter Setting**. A POWER measurement parameter setting screen appears.
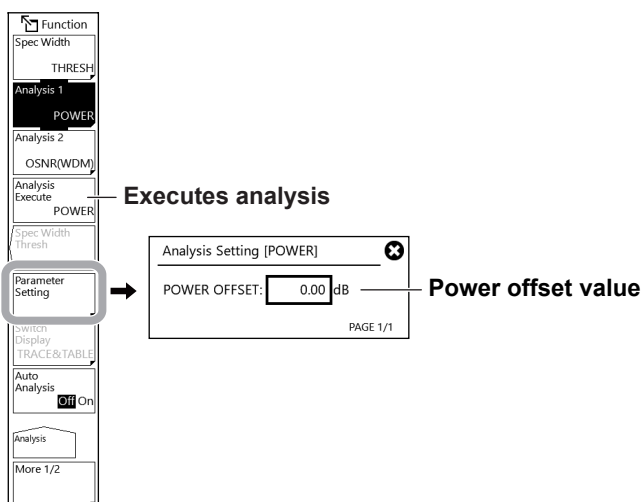
Executes analysis

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**

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
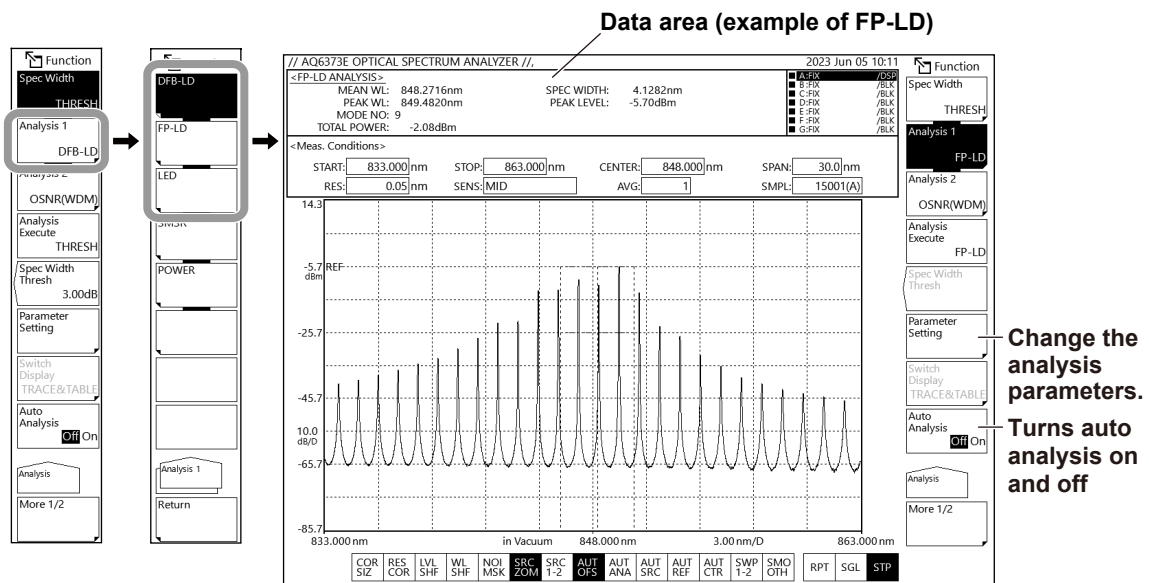
Changing the analysis parameters

4. Continuing from step 3, tap **Parameter Setting**. A window appears for setting the DFB-LD, FP-LD, and LED measurement parameters.

Executes analysis
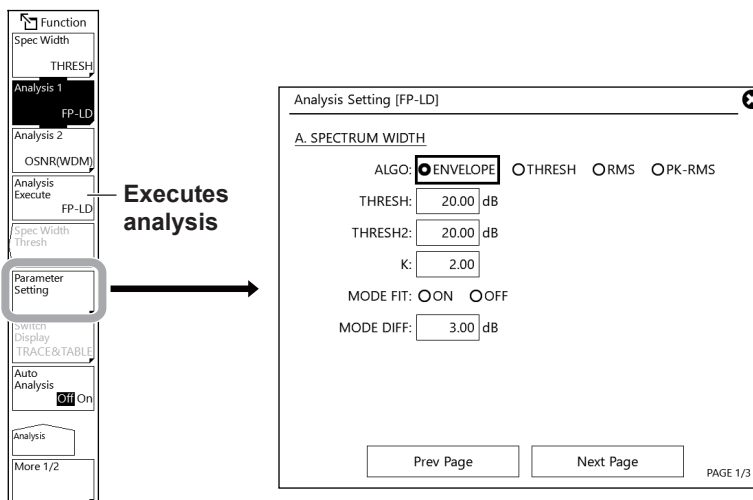
DFB-LD

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




            [ Prev Page ]      [ Next Page ]
                                              PAGE 1/4
```

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




            [ Prev Page ]      [ Next Page ]
                                              PAGE 2/4
```

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



            [ Prev Page ]      [ Next Page ]
                                              PAGE 3/4
```

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
            [ Prev Page ]      [ Next Page ]
                                              PAGE 4/4
```

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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
          Prev Page            Next Page
                                          PAGE 3/3
```

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
          Prev Page            Next Page
                                          PAGE 2/2
```

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 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:  849.4820nm       PK LEVEL:    -5.70dBm      σ:      1.7455nm
20.00dB WIDTH:   9.1086nm         CTR WL:   847.2286nm    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:  848.2716nm       SPEC WIDTH:      4.1282nm
     PEAK WL:  849.4820nm       PEAK LEVEL:     -5.70dBm
     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:  848.2787nm       SPEC WIDTH:      0.0500nm
     PEAK WL:  849.4820nm       PEAK LEVEL:     -5.70dBm
   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   TLS

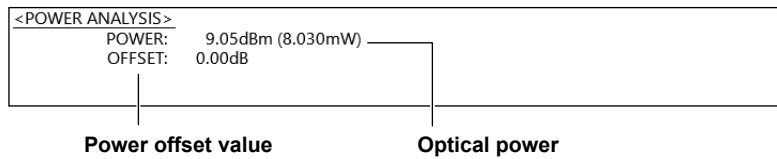Light source parameters can be analyzed from the measured waveform of TLS.

1. Press **ANALYSIS**. The ANALYSIS menu appears.

2. Tap **Analysis 1**. A menu appears for selecting the analysis function.

3. Tap **TLS** 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

Change the analysis parameters.

Turns auto analysis on and off
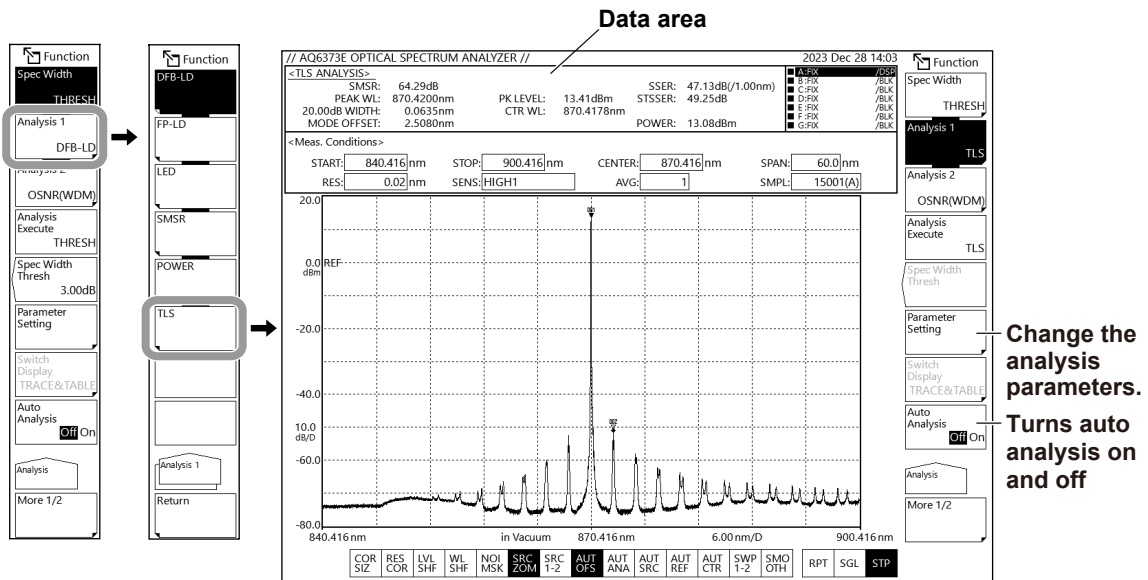
Changing the analysis parameters

4. Continuing from step 3, tap **Parameter Setting**. A window appears for setting the TLS measurement parameters.

Set the XdB center / width (Page 1/3).

Analysis Setting [TLS]

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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Function
Spec Width
    THRESH
Analysis 1
    TLS
Analysis 2
    OSNR(WDM)
Analysis
Execute
    TLS — **Executes analysis**
Spec Width
Thresh
Parameter
Setting
Switch
Display
TRACE&TABLE
Auto
Analysis
    Off On
Analysis
More 1/2

Set the SMSR and power (Page 2/3).

Analysis Setting [TLS]

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

C. POWER

SPAN:	0.40 nm

Prev Page   Next Page   PAGE 2/3
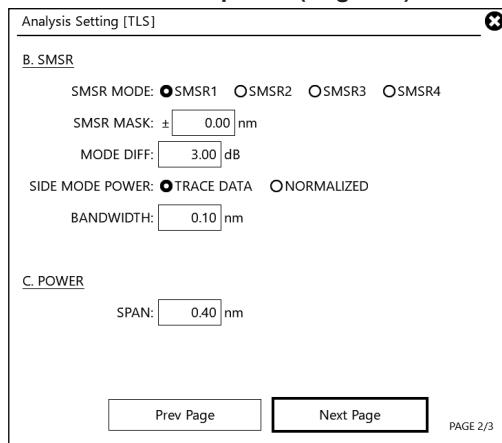
Set the SSER / STSSER (Page 3/3).
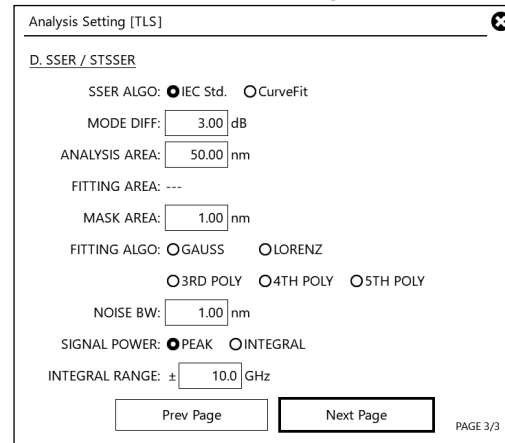
Analysis Setting [TLS]

D. SSER / STSSER

SSER ALGO:	●IEC Std. ○CurveFit
MODE DIFF:	3.00 dB
ANALYSIS AREA:	50.00 nm
FITTING AREA:	---
MASK AREA:	1.00 nm
FITTING ALGO:	○GAUSS ○LORENZ
	○3RD POLY ○4TH POLY ○5TH POLY
NOISE BW:	1.00 nm
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 TLS 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 TLS analysis algorithm and parameters, see appendix 3, "Details of Analysis Functions."

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Analyzing Optical Spectral Waveforms

Explanation

Result display

Analysis results are displayed in the data area.

Example with SMSR MODE set to SMSR2

```
<TLS ANALYSIS>
        SMSR:    64.29dB                            SSER:   47.13dB(/1.00nm)
     PEAK WL:   870.4200nm    PK LEVEL:  13.41dBm  STSSER:  49.25dB
 20.00dB WIDTH:   0.0635nm      CTR WL:  870.4178nm
  MODE OFFSET:    2.5080nm                          POWER:  13.08dBm
```

PK LEVEL: peak level
CTR WL: center wavelength

SSER: Signal to Spontaneous Emission Ratio
STSSER: Signal to Total Source Spontaneous Emission Ratio
POWER: Optical 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

6.7 OSNR(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 **OSNR(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.

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).


```
Function
Spec Width
        THRESH
Analysis 1
        ITLA
Analysis 2
        OSNR(WDM)
Analysis
Execute
OSNR(WDM)          Executes
                   analysis
Spec Width
Thresh
Parameter
Setting
Switch
Display
TRACE&TABLE
Auto
Analysis
        Off On
Analysis
More 1/2
```

Analysis Setting [OSNR(WDM)]

A. CHANNEL DETECTION SETTING

THRESH LEVEL: 20.0 dB

MODE DIFF: 3.0 dB

DISPLAY MASK: ●OFF ○ 0.0 dBm

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Set the interpolation (Page 2/3).

Analysis Setting [OSNR(WDM)]

B. INTERPOLATION SETTING

NOISE ALGO: ●AUTO-FIX ○MANUAL-FIX

○AUTO-CTR ○MANUAL-CTR ○PIT

NOISE AREA: AUTO

MASK AREA: ---

FITTING ALGO: ○LINEAR ○GAUSS ○LORENZ

○3RD POLY ○4TH POLY ○5TH POLY

NOISE BW: 0.10 nm

DUAL TRACE: ○ON ●OFF

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Set the display and other settings (Page 3/3).
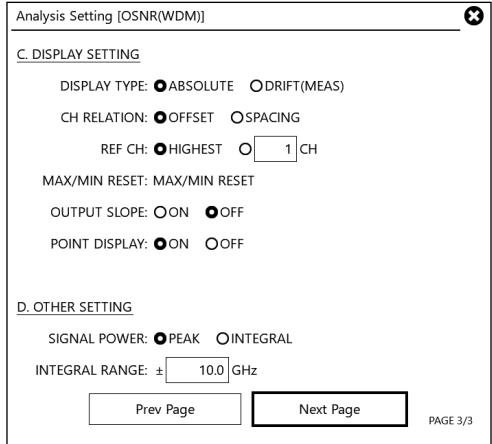
Analysis Setting [OSNR(WDM)]

C. DISPLAY SETTING

DISPLAY TYPE: ●ABSOLUTE ○DRIFT(MEAS)

CH RELATION: ●OFFSET ○SPACING

REF CH: ●HIGHEST ○ 1 CH

MAX/MIN RESET: MAX/MIN RESET

OUTPUT SLOPE: ○ON ●OFF

POINT DISPLAY: ●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 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."

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 A Δ0001:	853.3250nm	-10.32dBm	
TR A Δ0002:	854.1250nm	-10.12dBm	
TR A Δ0003:	854.9350nm	-10.22dBm	
TR A Δ0004:	855.7450nm	-10.03dBm	
TR A Δ0005:	856.5550nm	-10.34dBm	

     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	853.3264	-10.322	-4.0339	-0.501	-50.738	40.416
2	854.1290	-10.123	-3.2314	-0.302	-50.525	40.402
3	854.9391	-10.217	-2.4213	-0.396	-50.341	40.124
4	855.7463	-10.030	-1.6141	-0.209	-50.214	40.184
5	856.5544	-10.341	-0.8059	-0.520	-50.117	39.776
6	857.3604	-9.821	(REF)	(REF)	-50.086	40.265
7	858.1690	-10.197	0.8087	-0.376	-50.169	39.972
8	858.9811	-10.634	1.6207	-0.813	-50.350	39.716

Center wavelength — **Signal level** — **Wavelength difference from the reference channel** — **Level difference from the reference channel** — **Noise power** — **Power noise SN ratio**

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Analyzing Optical Spectral Waveforms

6.8 Chromaticity Coordinate Analysis (COLOR analysis)

Procedure

From the measured waveform, you can determine the following values and display a chromaticity diagram.

- Chromaticity coordinates (x, y, z)
- Dominant wavelength
- Correlated color temperature
- Deviation from the blackbody locus

JIS Z 8701 is used for the chromaticity diagram peripheral coordinate data (spectrum locus).

1. Press **ANALYSIS**. The ANALYSIS menu appears.

2. Tap **Analysis 2**. A menu appears for selecting the analysis function.

3. Tap **COLOR**. 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 chromaticity diagram are displayed.

TABLE: Only the chromaticity diagram is displayed.

TRACE: Only the waveform is displayed.

Data area

Chromaticity diagram

Switches the screen

Explanation

Chromaticity measurement

The COLOR analysis function performs a color analysis of the active trace waveform using a color matching function, determines the chromaticity coordinates, and displays a chromaticity diagram.

The color of light is determined by the correlation between the spectral radiance of the light source and the spectral luminous efficacy of the eye of the person viewing the light.

According to the CIE (international commission on illumination), the spectral responsivity of the human eye is defined by three color matching functions: x (λ), y (λ), and z (λ). The outputs when measuring a light source via these light matching functions are expressed as X, Y, and Z, which are called the tristimulus values.

The instrument measures the spectral distribution using a monochromator to determine the tristimulus values employing JIS Z 8701. The chromaticity coordinates x, y, and z can be determined from the tristimulus values. There are two color matching functions:

CIE 1931 based on a 2-degree field of view, and CIE 1964 based on a 10-degree field of view. The instrument uses the color matching function based on the 2-degree field of view.

Chromaticity diagram

This is a diagram that expresses the characteristics of color through chromaticity coordinates and spectrum loci.

Chromaticity coordinates

This is the numerical rendering of the characteristics of a light source's color according to the spectral luminous efficacy of the human eye. It is determined from the tristimulus values.

Dominant wavelength

Like the chromaticity coordinates, this is a numerical rendering of the characteristics of an input optical spectrum's color according to the spectral luminous efficacy of the human eye. If a straight line connecting point N (0.333, 0.333) of the chromaticity coordinates of the achromatic color of a chromaticity diagram and point C of the chromaticity coordinates of the input optical spectrum is extended, the dominant wavelength is the point at which the line intersects with the spectrum locus. It is the wavelength that represents the color of the measured spectrum, and is sometimes called the main wavelength.

Color temperature

This is a representation of the light source color in terms of the temperature of the blackbody emitting the closest color to the light source.

Based on chromaticity coordinates, this instrument determines correlated color temperature and deviation from blackbody locus based on JIS Z 8725, "Methods for determining distribution temperature and colour temperature or correlated colour temperature of light sources."

Result display

Analysis results are displayed in the data area and chromaticity diagram.

```
<COLOR ANALYSIS>
        DOMINANT WL:   582.3678nm          x :  4.268E-01
   COLOR TEMPERATURE:     3148K             y :  4.004E-01
            DEVIATION: 1.256E-05            z :  1.728E-01
```

Dominant waveform length   **Chromaticity coordinates**
Color temperature
Deviation from the blackbody locus

Dominant waveform length

Chromaticity coordinates

Color temperature
Deviation from the blackbody locus
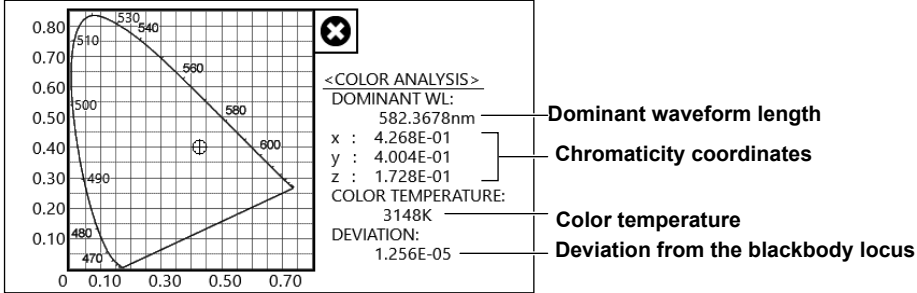
6.9   Optical Filter Characteristics Measurement

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:

FILTER-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).

Executes analysis

Analysis Setting [FILTER-PK]   ✕

A. PEAK LEVEL

      SW: ●ON ○OFF

B. PEAK WAVELENGTH

      SW: ●ON ○OFF

Prev Page   Next Page   PAGE 1/4

Set the center wavelength (Page 2/4).

Analysis Setting [FILTER-PK]   ✕

C. CENTER WAVELENGTH

    SW: ●ON ○OFF

    ALGO: ●THRESH ○RMS

    THRESH LEVEL: 3.00 dB

    K: 1.00

    MODE FIT: ○ON ●OFF

    MODE DIFF: 3.00 dB
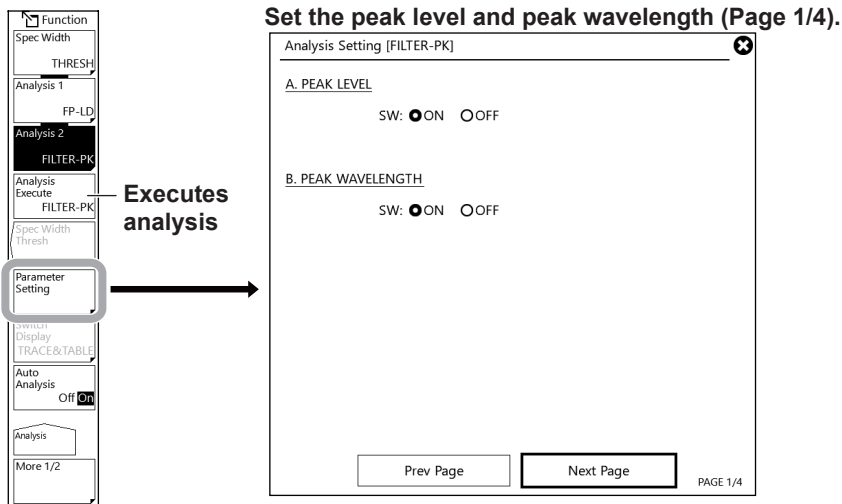
Prev Page   Next Page   PAGE 2/4
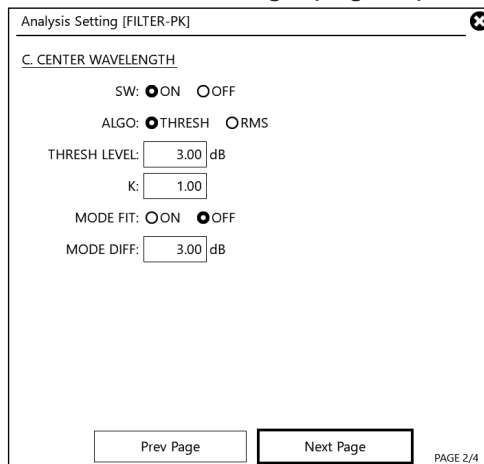
Set the spectral width and ripple width (Page 3/4).

Analysis Setting [FILTER-PK]   ✕

D. SPECTRUM WIDTH

    SW: ●ON ○OFF

    ALGO: ●THRESH ○RMS

    THRESH LEVEL: 3.00 dB

    K: 1.00

    MODE FIT: ○ON ●OFF

    MODE DIFF: 3.00 dB

E. RIPPLE WIDTH

    SW: ●ON ○OFF

    THRESH LEVEL: 3.00 dB

    MODE DIFF: 0.500 dB

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Set the crosstalk (Page 4/4).
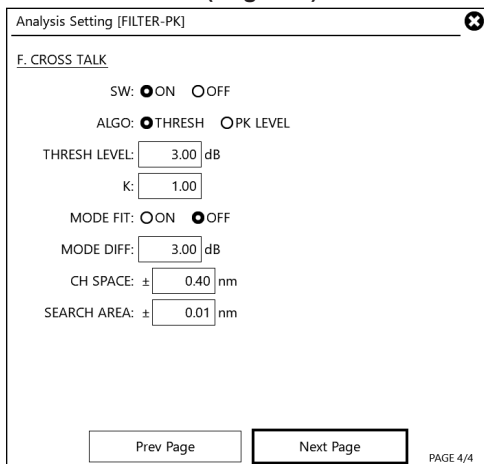
Analysis Setting [FILTER-PK]   ✕

F. CROSS TALK

    SW: ●ON ○OFF

    ALGO: ●THRESH ○PK LEVEL

    THRESH LEVEL: 3.00 dB

    K: 1.00

    MODE FIT: ○ON ●OFF

    MODE DIFF: 3.00 dB

    CH SPACE: ± 0.40 nm

    SEARCH AREA: ± 0.01 nm

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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 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.

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."

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
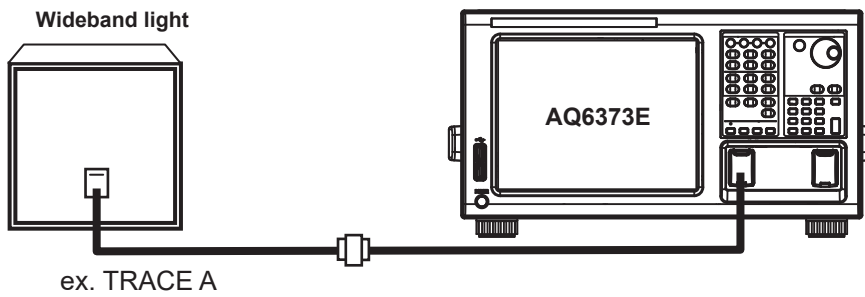
ex. TRACE A

Spectrum measurement after passing through the filter

ex. TRACE B
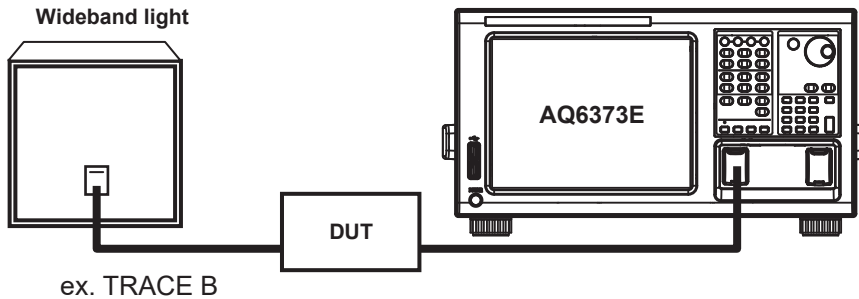
Writing to trace A the waveform of the light source input to the optical filter

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**.
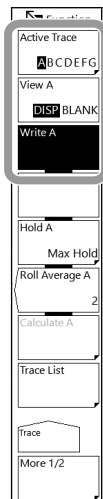
3. Tap **View A** to select **DISP.**

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.

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Analyzing Optical Spectral Waveforms

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.
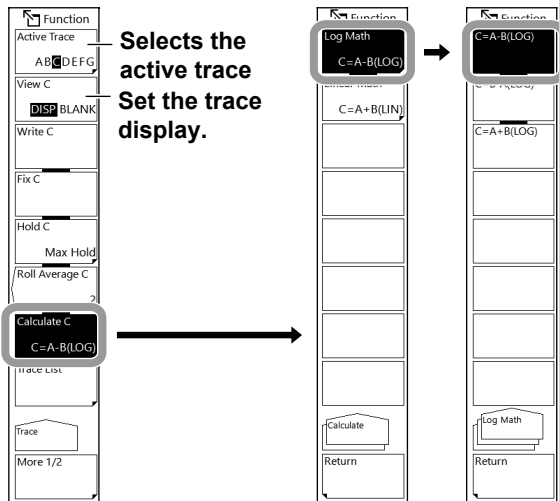
Explanation

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.

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Analyzing Optical Spectral Waveforms

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."

6.10 Measurement of Level Fluctuations in Single-Wavelength Light (0 nm Sweeping)

Procedure

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 (632.992 nm) is input to an optical fiber.

Setting the center wavelength to 632.992 nm

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

2. Tap **Center**. A center wavelength setting window appears.
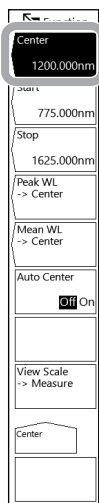
3. Enter 632.992 nm on the window.

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.
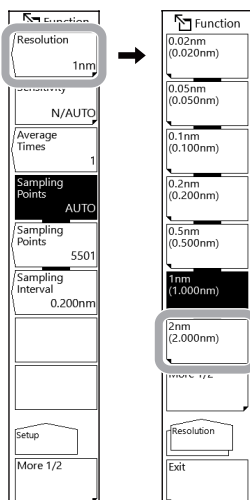
6. Tap **2nm** on the resolution selection menu, or enter 2 nm on the resolution setting window.

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.

Set the sweep span.
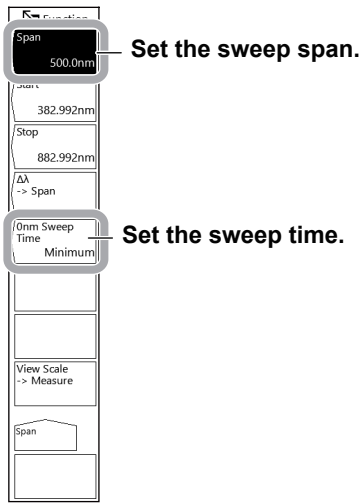
Set the sweep time.

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 632.992 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.

Explanation

The following figure shows the configuration for applying the spatial light of an He-Ne gas laser (632.992 nm) into an optical fiber.
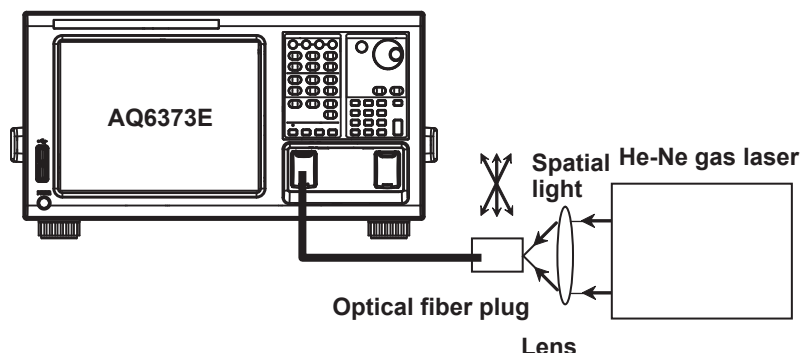
The sweep span is set to 0 nm, the center wavelength is fixed, and the level of a single wavelength of light is measured.

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.

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Analyzing Optical Spectral Waveforms

6.12 Analysis Data Logging

Procedure

The analysis data logging function measures and records WDM analysis, DFB-LD analysis, and peak data at regular intervals and displays the data in tables and graphs on the screen. The contents in the table and the optical spectrum data of each measurement can be saved to files.

Logging Screen
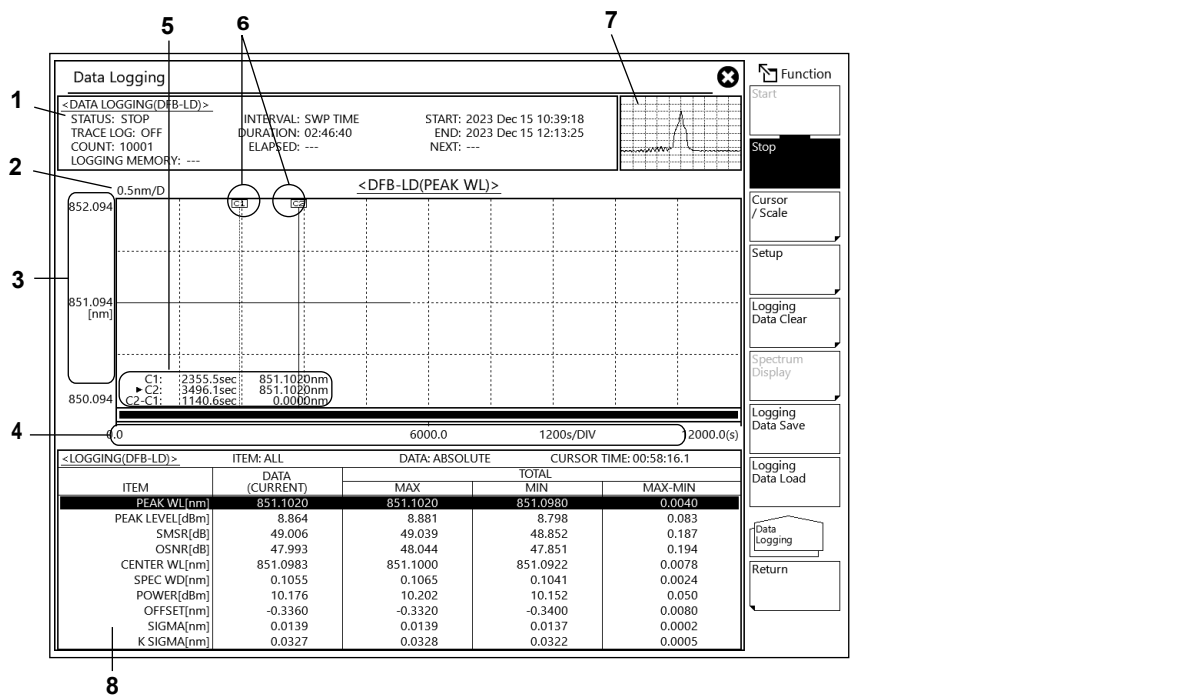
Number	Function
1	Parameter display area
2	Wavelength scale (per division)
3	Displays different scales depending on the displayed item, such as wavelength, power, and SNR.
4	Time scale
5	Cursor information (C1, C2, C2-C1)
6	Cursors (C1, C2)
7	Thumbnail area. Displays the waveform data at the current cursor position.
8	Logging data list

Setting the Data Logging Conditions

1. Press **APP**. The APP menu appears.

2. Double-tap **Data Logging**, or tap the **Data Logging** icon and then tap **Execute**. A Data Logging application menu will appear.

3. Tap the **Setup**. The Setup menu appears.

Changing the Logging Parameters

4. Tap the **Logging Parameter**. The logging parameter setting window appears.
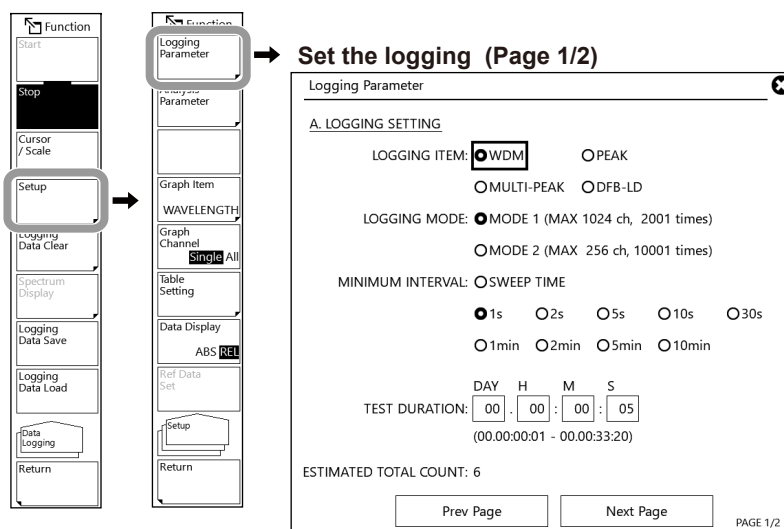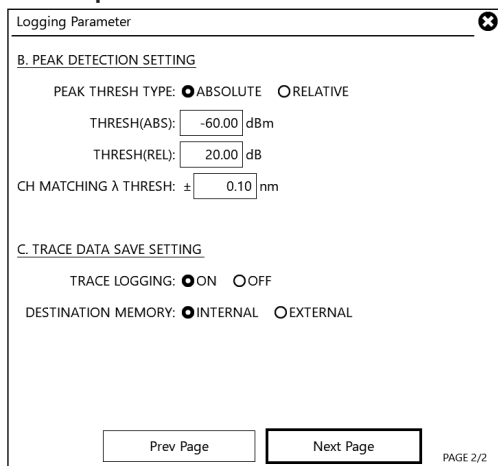
5. Set the logging parameters on the setting window.

   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 logging parameter setting window will close.

Note

The Logging Parameter cannot be used while logging measurement is in progress.

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Analyzing Optical Spectral Waveforms

Changing the Analysis Conditions

• **When the Logging Item of Logging Parameter Is WDM**

4. Tap the **Analysis Parameter**. The analysis parameter setting window appears.

Set the channel detection (Page 1/4)

Analysis Setting [WDM]

A. CHANNEL DETECTION SETTING

THRESH LEVEL: 20.0 dB

MODE DIFF: 3.0 dB

DISPLAY MASK: ● OFF ○ 0.0 dBm

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Function
Logging Parameter
Analysis Parameter
Graph Item
WAVELENGTH
Graph Channel
Single All
Table Setting
Data Display
ABS REL
Ref Data Set
Setup
Return

Set the interpolation (Page 2/4)

Analysis Setting [WDM]

B. INTERPOLATION SETTING

NOISE ALGO: ● AUTO-FIX ○ MANUAL-FIX
○ AUTO-CTR ○ MANUAL-CTR ○ PIT

NOISE AREA: AUTO

MASK AREA: ---

FITTING ALGO: ○ LINEAR ○ GAUSS ○ LORENZ
○ 3RD POLY ○ 4TH POLY ○ 5TH POLY

NOISE BW: 0.10 nm

DUAL TRACE: ○ ON ● OFF

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Set the display (Page 3/4)
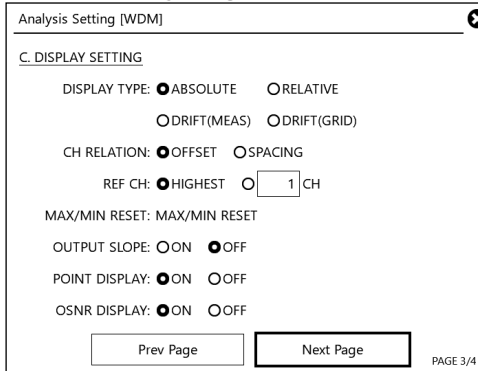
Analysis Setting [WDM]

C. DISPLAY SETTING

DISPLAY TYPE: ● ABSOLUTE ○ RELATIVE
○ DRIFT(MEAS) ○ DRIFT(GRID)

CH RELATION: ● OFFSET ○ SPACING

REF CH: ● HIGHEST ○ 1 CH

MAX/MIN RESET: MAX/MIN RESET

OUTPUT SLOPE: ○ ON ● OFF

POINT DISPLAY: ● ON ○ OFF

OSNR DISPLAY: ● ON ○ OFF

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Set the other (Page 4/4)
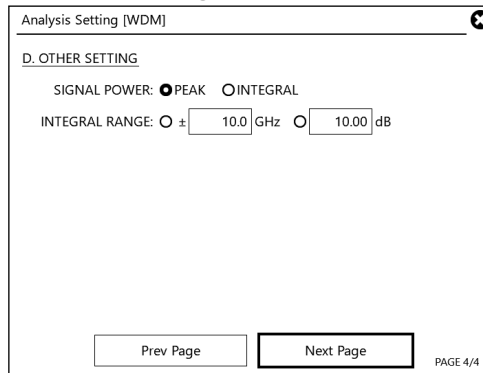
Analysis Setting [WDM]

D. OTHER SETTING

SIGNAL POWER: ● PEAK ○ INTEGRAL

INTEGRAL RANGE: ○ ± 10.0 GHz ○ 10.00 dB

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5. Set the logging 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 logging parameter setting window will close.

- **When the Logging Item of Logging Parameter Is PEAK or MULTI-PEAK**

4. Tap the **Analysis Parameter**. The analysis parameter setting menu appears.
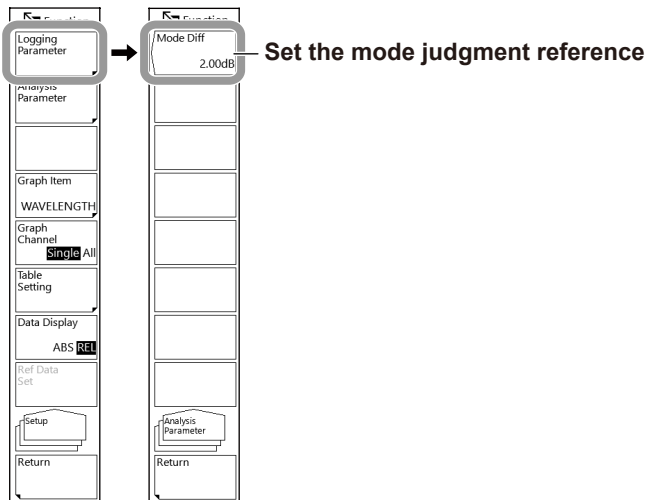
Set the mode judgment reference

5. Set the logging 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.

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Analyzing Optical Spectral Waveforms

- **When the Logging Item of Logging Parameter Is DFB-LD**

4. Tap the **Analysis Parameter**. The analysis parameter setting window appears.

Set the -XdB center/width (Page 1/4)

Function
Logging Parameter
Analysis Parameter
Graph Item
WAVELENGTH
Graph Channel
Single All
Table Setting
Data Display
ABS REL
Ref Data Set
Setup
Return

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 の設定 (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

Prev Page   Next Page   PAGE 3/4

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: PIT

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

Prev Page   Next Page   PAGE 4/4

5. Set the logging 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 logging parameter setting window will close.

The settings for analysis conditions here are shared with those for DFB-LD in Section 6.5. The settings that you specify here will also be applied to the DFB-LD analysis conditions.

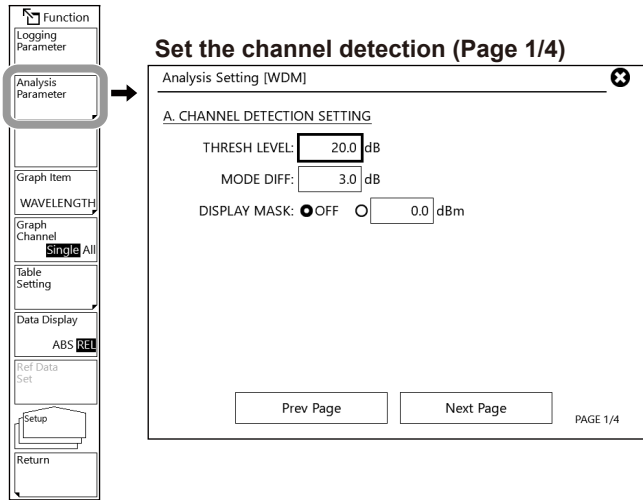## Executing and Stopping Data Logging

1. Press **APP**. The APP menu appears.

2. Double-tap **Data Logging**, or tap the **Data Logging** icon and then tap **Execute**. A Data Logging application menu will appear.

3. Tap Start. Data logging starts. If previous logging data exists, a message will appear asking if you want to clear the logging data and start data logging.

4. Tap OK to clear existing logging data and start logging.
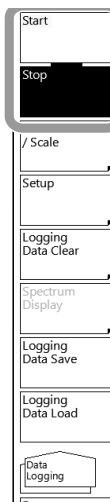
5. To stop logging, tap Stop.

Note

- When TRACE LOGGING is ON, the AQ6380 checks the amount of free space in the temporary trace data storage space before starting to log. If there is insufficient free memory space, a warning will appear.
  WARNING 151: Disk space is not enough for logging
  If this happens, reduce the number of waveform data values (sampling point) or reduce the logging time to decrease the waveform data size.
- If there is no existing logging data, the confirmation message for deleting the data will not appear, and data logging will begin immediately.
- Only the Stop is valid while data logging is in progress.
  If you tap a menu other than the Stop, a confirmation message for stopping the data logging will appear. If you do not want to stop data logging, tap the NO.

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Analyzing Optical Spectral Waveforms

- **Displaying the measured waveform during data logging on the Screen**
  If necessary, you can view the measured waveform during data logging.

4. Tap the Spectrum Display. The waveform of the data being logged appears on the screen (normal spectrum waveform display).
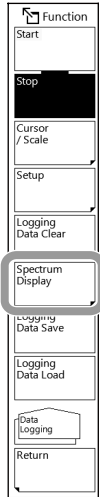
To return to the logging screen, tap Return.

Note
You cannot use the Spectrum Display when data logging is stopped.

Setting the Display Method

1. Press **APP**. The APP menu appears.

2. Double-tap **Data Logging**, or tap the **Data Logging** icon and then tap **Execute**. The Data Logging application menu appears.

3. Tap **Setup**. The Setup menu appears.
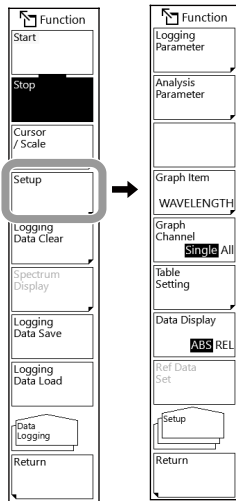
Selecting the Data to Graph

4. Tap **Graph Item**. A screen appears for selecting the data to be graphed.

   The data that you can specify varies depending on the Logging Item setting.
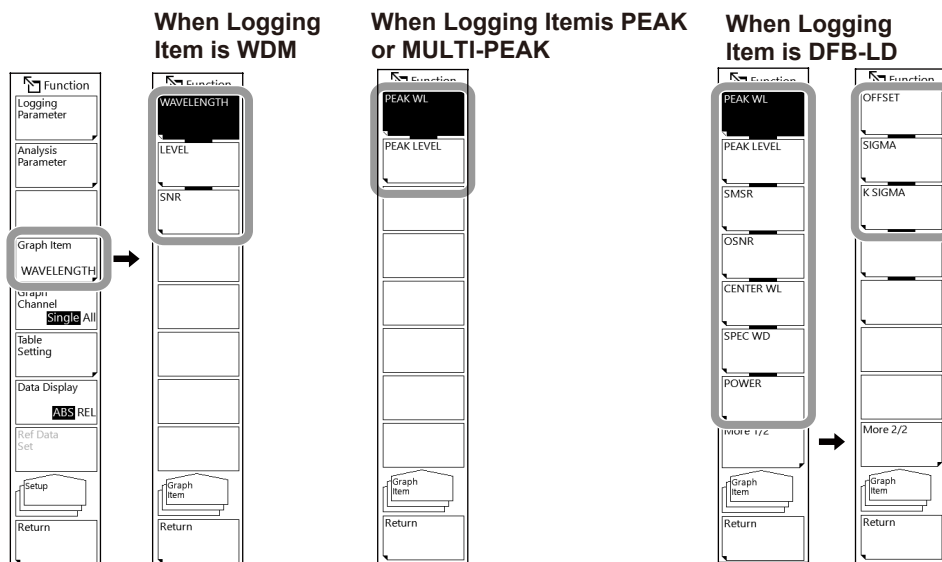
When Logging Item Is WDM

Wavelength: Displays the wavelength graph

Level: Displays the level graph

SNR: Displays a graph of SNR values

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Analyzing Optical Spectral Waveforms

When Logging Item Is MULTI-PEAK

Peak WL: Displays the peak wavelength graph

PeakLevel: Displays the peak level graph

When Logging Item Is DFB-LD

Peak WL: Displays the peak wavelength graph

PeakLevel: Displays the peak level graph

SMSR: Displays a graph of side mode suppression ratios

OSNR: Displays a graph of signal-to-noise ratios

Center WL: Displays the center wavelength graph

Spec WD: Displays the spectral width graph of the center wavelength based on the -XdB
              WIDTH (Center WL/SPWD) parameter

Power: Displays the total power graph

Offset: Displays the mode offset graph

Sigma   Displays the spectral width (σ) graph of the center wavelength based on the RMS
              parameter

K Sigma: Displays the spectral width (σ) graph of the center wavelength based on the RMS
              parameter

Selecting Whether to Display the Graph of a Single Channel or That of All Channels (when Logging Item is WDM or Multi-Peak)

4. Tap **Graph Channel**. Select SINGLE or ALL.
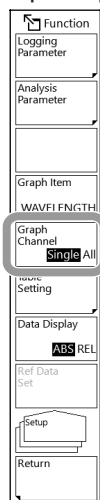
Setting the Table Data Display Mode

4. Tap **Table Setting**. The Table Setting menu appears.

5. Tap **Table Mode**. Select CURR (display current values) or SUMM (display a summary).

6. If you selected SUMM (display a summary), tap **Summary Type**. Select MAXMIN (maximum/minimum) or AVG (average, standard deviation).

Table Mode settings

Summary Type settings
(when Table Mode is SUMM)
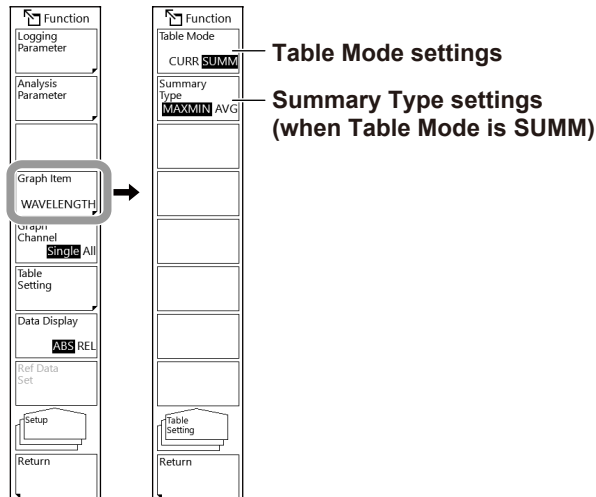
Displaying Table Data in Absolute or Relative Values

4. Tap **Data Display**. Select ABS (absolute values) or REL (relative values).

5. If you selected REL (relative values) in step 4, set the reference value.

Set cursor C1 or C2 to the reference value position according to the cursor operation explained on the next page in advance.

Tap **Ref Data Set**. The reference value is set to the measured value at the current cursor position.

The current cursor is indicated by ▶ in the cursor value display.

Data Display settings

Reference value setting
(when Data Display is REF)

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Analyzing Optical Spectral Waveforms
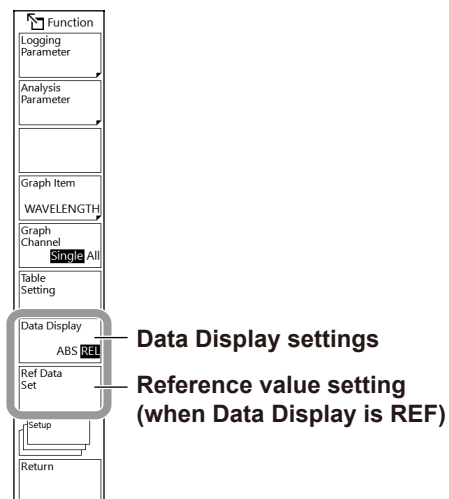
Viewing the Data Logging Results by Using the Cursor or by Zooming In or Out of the Graph

1. Press **APP**. The APP menu appears.

2. Double-tap **Data Logging**, or tap the **Data Logging** icon and then tap **Execute**. The Data Logging application menu appears.

3. Tap **Cursor/Scale**. The Cursor/Scale menu appears.

Function	Function	
Start	Cursor Select C1 C2	**Select the target cursor.**
Stop	Cursor Off	**Turns the cursor off**
Cursor / Scale	X Zoom In	**Zooms in horizontally**
Setup	X Zoom Out	**Zooms out horizontally**
Logging Data Clear	Y Zoom In	**Zooms in vertically**
Spectrum Display	Y Zoom Out	**Zooms out vertically**
Logging Data Save	Zoom Initialize	**Initializes zoom**
Logging Data Load	Trace Data Recall	**Load waveform data.**
Data Logging	Cursor / Scale	
Return	Return	

Setting the Cursor Position

4. Tap **Cursor Select** to select C1 or C2. A screen appears for setting the cursor position.

The cursor you select here becomes the current cursor, which will be used as a reference for zooming in or out of the graph and for the relative value display.

5. Set the cursor position on the setting display.

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

Zooming In or Out of the Graph

6. Tap **X Zoom In**, **X Zoom Out**, **Y Zoom In**, or **Y Zoom Out** to zoom in or out of the graph.

Tap **Zoom Initialize** to return to the original graph.

Loading the Waveform Data of the Logging Data into the Specified Trace (only when the TRACE LOGGING parameter is set to ON)

4. Tap **Trace Data Recall**. The Trace Data Recall menu appears.

5. Tap the trace you want to load. The waveform data at the current cursor position (cursor C1 or C2) is loaded into the selected trace, and the menu returns to the previous level.

6. Tap **Return** to return to the APP menu. The trace of the loaded waveform data is displayed.

Note

You cannot use the TRACE DATA RECALL soft key in the following situations.
- If data logging has not been executed and no data exists
- If the TRACE LOGGING parameter is set off and no waveform data exists.

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Analyzing Optical Spectral Waveforms

Saving, Loading, or Deleting the Data Logging Results

1. Press **APP**. The APP menu appears.

2. Double-tap **Data Logging**, or tap the **Data Logging** icon and then tap **Execute**. The Data Logging application menu appears.

— **Delete data logging results.**

— **Save data logging results.**

— **Load data logging results.**
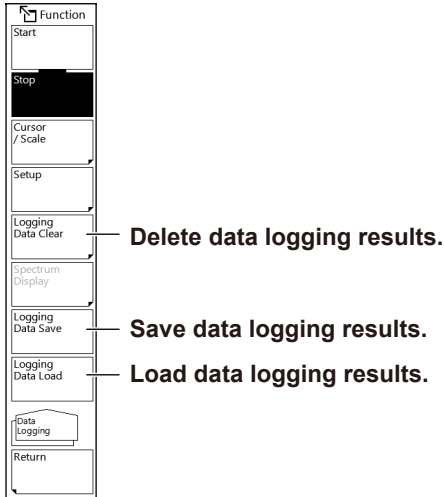
Saving Data Logging Results

3. Tap **Logging Data Save**. A screen appears for saving data.

4. Save the data logging results on the screen. For the screen operation procedure, see section 7.2.

Loading Data Logging Results

3. Tap **Logging Data Load**. A screen appears for loading data.

4. Load the data logging results on the screen. For the screen operation procedure, see section 7.2.

Deleting Data Logging Results

3. Tap **Logging Data Clear**. The Logging Data Clear menu appears.

4. Tap Execute. The logging data results are deleted.

Explanation

Parameter Display

Trace saving on (saved) or off (not saved)

Data logging execution status: LOGGING (logging), STOP (stopped)

What is being logged: WDM, PEAK, DFB-LD

Measurement interval

Measurement start time (START), measurement end time (END), Next measurement time (NEXT)

<DATA LOGGING (WDM)>

STATUS: LOGGING   INTERVAL: 5s

TRACE LOG：OFF   DURATION：13:53:20

COUNT: 15   ELAPSED：00:01:11

LOGGING MEMORY：---

START: 2014 Apr 1 10: 00: 00

END: 2014 Apr 2 10: 00: 00

NEXT: 2014 Apr 1 11: 00: 00

Storage area for logging waveform data

**Measurement count:
Number of measurements completed since logging was started**

Specified measurement time

Elapsed time since logging was started

Table Data Display

Current Display

Displays the current analysis data (list of all analysis items) in a table.

ABS (absolute value) display   **Measurement time of the displayed data**

<LOGGING(WDM)> ITEM: ALL	DATA: ABSOLUTE	CURSOR TIME: 00:00:04
CH	WAVELENGTH [nm]	LEVEL [dBm]	SNR [dB]
1	1528.3740	-45.965	6.835
2	1529.2809	-0.056	54.840
3	1530.1929	-33.203	21.170
4	1531.0526	-48.012	3.672

REL (relative value) display

REF data time

<LOGGING(WDM)> ITEM: ALL			DATA: RELATIVE		CURSOR TIME: 00:00:04
	REF DATA (0s)			DELTA (CURRENT)	
CH	WL[nm]	LVL[dBm]	SNR[dB]	WL[nm]	LVL[dB]	SNR[dB]
1	1528.3716	-47.378	6.453	0.0024	1.413	0.382
2	1529.2806	-1.143	55.005	0.0003	1.087	-0.165
3	1530.1930	-34.204	21.219	-0.0001	1.002	-0.049
4	1531.0507	-49.051	3.903	0.0019	1.038	-0.232

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Analyzing Optical Spectral Waveforms

Summary Display

Displays the current analysis data and the analysis data of MAX, MIN, MAX-MIN values from the start of data logging to the current.

The summary display can display just one of the analysis items that you choose.

CH	WAVELENGTH[nm] (CURRENT)	TOTAL		
		MAX[nm]	MIN[nm]	MAX-MIN[n
1	1528.3740	1528.3740	1528.3716	0.0024
2	1529.2809	1529.2810	1529.2708	0.0102
3	1530.1929	1530.1941	1530.1929	0.0012
4	1531.0526	1531.0526	1531.0507	0.0019

<LOGGING(WDM)> ITEM: WAVELENGTH DATA: ABSOLUTE CURSOR TIME: 00:00:04

REL (relative value) display

<LOGGING(WDM)> ITEM: WAVELENGTH DATA: RELATIVE CURSOR TIME: 00:00:04

CH	REF WL[nm] (0s)	DELTA WL[nm] (CURRENT)	TOTAL		
			MAX[nm]	MIN[nm]	MAX-MIN
1	1528.3716	0.0024	0.0024	0.0000	0.00
2	1529.2806	0.0003	0.0004	-0.0098	0.01
3	1530.1930	-0.0001	0.0011	-0.0001	0.00
4	1531.0507	0.0019	0.0019	0.0000	0.00

Summary Display (AVG)

Displays the current analysis data and the analysis data of average and standard deviation values from the start of data logging to the current.

The summary display can display just one of the analysis items that you choose

<LOGGING(WDM)> ITEM: WAVELENGTH DATA: ABSOLUTE CURSOR TIME: 00:00:04

CH	WAVELENGTH[nm] (CURRENT)	TOTAL	
		AVERAGE[nm]	SIGMA[nm]
1	1528.3740	1528.3735	0.0010
2	1529.2809	1529.2792	0.0037
3	1530.1929	1530.1932	0.0004
4	1531.0526	1531.0522	0.0007

REL (relative value) display

<LOGGING(WDM)> ITEM: WAVELENGTH DATA: RELATIVE CURSOR TIME: 00:00:04

CH	REF WL[nm] (0s)	DELTA WL[nm] (CURRENT)	TOTAL	
			AVERAGE[nm]	SIGMA[nm
1	1528.3716	0.0024	1528.3735	0.0010
2	1529.2806	0.0003	1529.2792	0.0037
3	1530.1930	-0.0001	1530.1932	0.0004
4	1531.0507	0.0019	1531.0522	0.0007

Logging Parameters

LOGGING ITEM

Selects the logging item.

- **WDM**

  Records the WL (channel center wavelength), LEVEL (channel level (peak level – noise level)), SNR (channel signal-to-noise ratio) of WDM analysis.

- **MULTI-PEAK, PEAK**

  Records the WL (peak center wavelength) and LEVEL (peak level).

- **DFB-LD**

  Records all DFB-LD analysis items listed in appendix 3.

- **LOGGING MODE**

  If you want to log many channels, use MODE1.

  If you want to log many values, use MODE2.

  The AQ6380 automatically detects the number of channels.

  MODE1: Up to 1024 channels can be logged. The maximum number log entries is 2001.

  MODE2: The maximum number log entries is 10001. Up to 256 channels can be logged.

- **MINIMUM INTERVAL**

  Sets the logging interval (the time duration from the start of a measurement to the start of the next measurement). Set the logging interval in seconds.

  Setting range: SWEEP TIME, 1 s, 2 s, 5 s, 10 s, 30 s, 1 min, 2 min, 5 min, 10 min

  In a single measurement, if the sweep time is longer than the measurement interval due to the sweep conditions, the logging interval is set to SWEEP TIME. If this happens, a warning appears. (WARNING 153: Sweep time exceeds the set interval) If this message appears, check the logging interval.

- **TEST DURATION**

  Sets the total logging duration of one test.

  The setting range depends on the LOGGING MODE setting (maximum logging count) and logging interval. The minimum logging duration is the logging interval. The logging interval for SWEEP TIME is 1 seconds.

Note

If the auto offset function is on, auto offset is executed at regular intervals even during logging. When auto offset is progress, logging measurement is paused. When an auto offset is performed at a time when logging measurement would normally occur, a warning appears.

(Warning 152 Logging was skipped for Auto zeroing)

If this message appears, check the auto offset function setting or logging interval setting as necessary.

- **ESTIMATED TOTAL COUNT**

  Displays the estimated measurement count during logging.

- **PEAK THRESH TYPE**

  Sets how the threshold for detecting the data logging mode (peak or bottom) is specified. Modes whose level is greater than equal to the threshold specified here are logged.

  ABS: Specifies the threshold using an absolute value (peak level)

  REL: Specifies the threshold using a relative value (difference from the highest peak level)

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Analyzing Optical Spectral Waveforms

- **THRESH(ABS)**

  The absolute value threshold. You can set this when PEAK THRESH TYPE is set to ABS.

  Selectable range: +20.00 to -100.00 dBm

- **THRESH(REL)**

  The relative value threshold. You can set this when PEAK THRESH TYPE is set to REL.

  Selectable range: 0.01 to 99.99 dB

- **CH MATCHINGλ THRESH**

  Sets the effective range from the center wavelength of data for determining whether the peak of the analysis data of the logging item is the same as that of the analysis data measured the last time.

  If the analysis data during measurement is within the effective range, it will be logged as the same peak.

  If it is not, the AQ6380 assumes that the previous peak has disappeared and a new peak has appeared and adds a new peak.

  Selectable range: 0.1 nm to 10 nm. You must enter the wavelength even when the display mode is set to frequency.

Example: Center wavelength 1550.9180 nm

This peak is assumed to have disappeared.

Example: Center wavelength 1552.9180 nm

This peak is assumed to be different from the peak of the first measurement and is acquired as a new peak.

λ THRESH
1st measurement

λ THRESH
nth measurement

Channel matching range (e.g. λ THRESH = ±1.00 nm)
1549.9180 nm to 1551.9180 nm
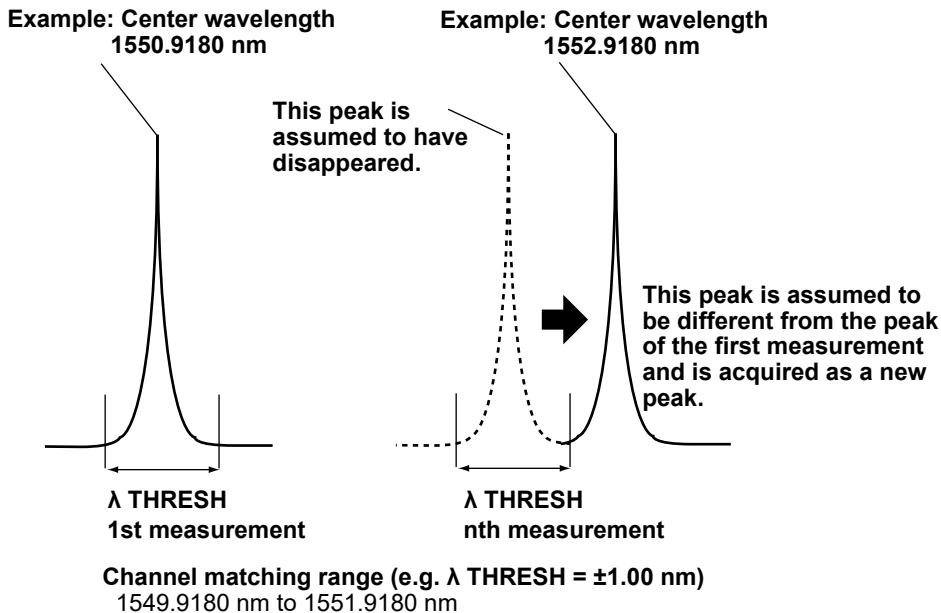
Note

For the following logging items, CH MATCHINGλ TERESH cannot be used.
- DFB-LD
- PEAK

- **TRACE LOGGING**

  When this setting is on, the trace waveform is also saved when logging data is saved. This waveform data is saved temporarily to a single file in the internal memory or USB storage medium.

  Temporary save directory

  Internal memory (INTERNAL): \INT\AQLOGDAT\LOGTMP.LG8

  USB storage medium: \EXT\AQLOGDAT\LOGTMP.LG8

  If you restart data logging, the files and directories in the temporary save directory will be deleted.

  For instructions on how to save the temporarily saved waveform data to a normal file, see section 8.10.

- **DESTINATION MEMORY**

  Selects where the temporary trace waveform data will be saved to.

  INTERNAL: Internal memory

  EXTERNAL: USB storage medium

  If the size of waveform data will be large, use the USB storage medium.

Note

- If you also want to save trace waveforms when logging is in progress (TRACE LOGGING = ON), the temporary storage area must have sufficient free space for saving waveform data of all logging measurements.
  If there is insufficient free memory space at the start of logging, a warning will appear.
  (Warning 151 Disk space is not enough for logging)
  If this happens, reduce the number of waveform data values (SAMPLING POINT) or reduce the logging time to decrease the waveform data size.
- Temporary saved data (LOGTMP.LG8) cannot be loaded as a logging file.
  If you want to load it, save it to a normal logging file.

Cursors

If you turn on the cursors, cursor values will appear in the lower right of the graph area.

Cursor C1 and C2 will appear simultaneously. The value of C2 – C1 will appear below the cursor values.

Scales

The horizontal and vertical scales are automatically set according to the logging parameter conditions and logging data values.

Zooming is performed in 1-2-5 steps.

Example: The horizontal scale settings change like this: 5 s/div, 2 s/div, 1 s/div

The vertical scale settings change like this: 500 nm/div, 200 nm/div, 100 nm/div

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Analyzing Optical Spectral Waveforms

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
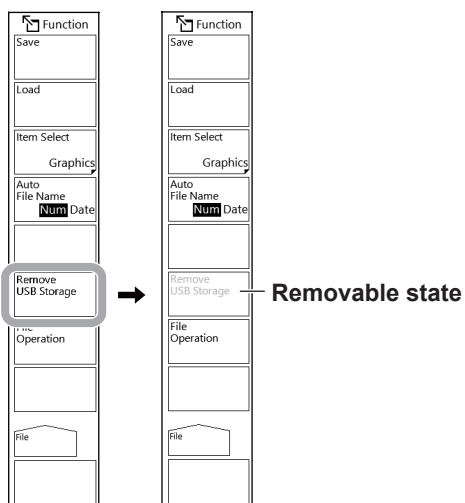
Note
For handling storage devices, follow the instruction manual supplied with the storage device.

7

Saving and Loading Data

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.

French

⚠️ **ATTENTION**

Ne retirez pas le périphérique de stockage USB et ne coupez pas l'alimentation lorsque l'indicateur d'accès au périphérique de stockage USB clignote. Cela pourrait endommager le périphérique de stockage USB ou corrompre ses données.

Avant de retirer un périphérique de stockage USB, assurez-vous de suivre la procédure de la section 7.1 pour que le périphérique de stockage USB soit prêt à être retiré.

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).
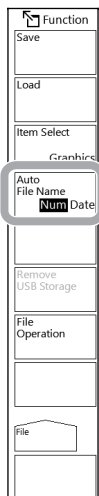
Note

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.
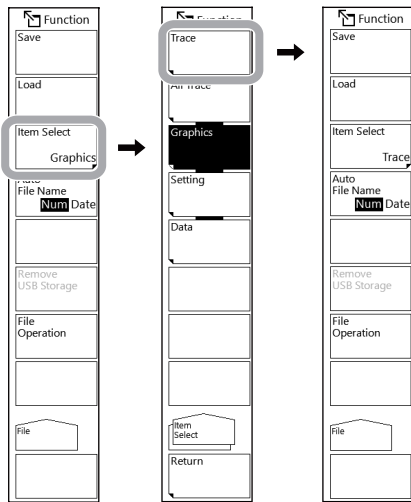
Selecting the trace to save, save destination, and data format

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.

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 (.WXE) 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**
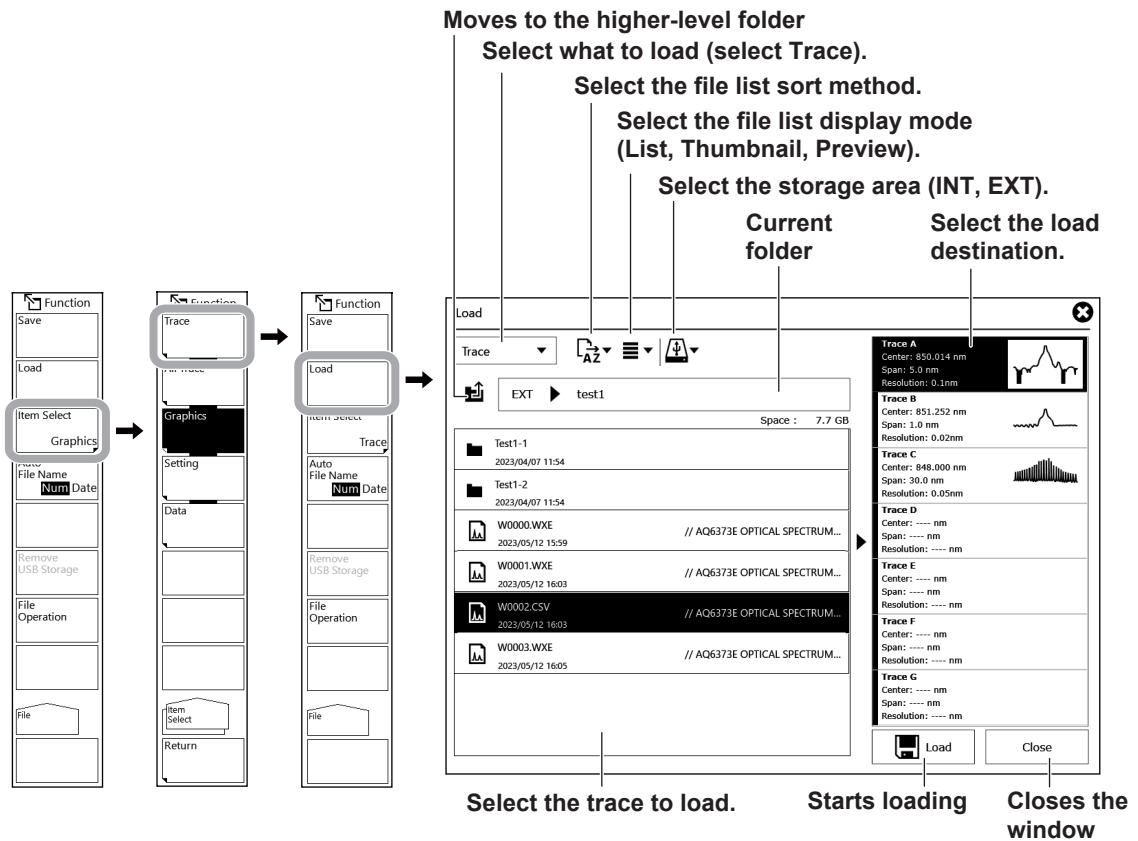
Loading the File

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 .WXE.

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 .WXE)

                    XXXX is a serial number from 0000 to 9999.

When Auto File Name is set to DATE

    File name: WyyyyMMdd_hhmmss.CSV (or .WXE)

                    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.

```
73ECSV                                           ⎫
// AQ6373E OPTICAL SPECTRUM ANALYZER //,         ⎬  Header block
40                                               ⎭
"CTRWL", 856.135000
"SPAN",  10.000000
"START WL", 851.135000
"STOP WL", 861.135000
"WLFREQ", 0
"REFL",-10.0
"LSCL",10.0
"RESLN",0.200
"CUSTOM RES",0
"AVG",   1
"SMPLAUTO",     0
"SMPL",      1001
"SMPLINTVL",0.0100
"MID"
"SENS LEVEL",-70.0                                   Measurement condition parameters
"MEAS"                                               (fixed to 40 lines)
"LSUNT",0
"NMSKH","OFF"
"RESCOR",1
"SMOOTH",0
"FIBERTYPE",0
"MEASWL",1
"MODELNAME",AQ6373E
"CHGPT",        0
"NEBWCAL0", 9976
"NEBWCAL1", 9976
"NEBWCALWL",1551
"RESCAL0_0",  9166
"RESCAL0_1",   153
"RESCAL0_2",-238162
"RESCAL1_0",  10000
"RESCAL1_1",     0
"RESCAL1_2",     0
"CORESIZE",0

 [TRACE DATA]                                     Measurement data block start header
851.1350, -48.694                                ⎫
851.1450, -48.689                                ⎬  Measurement data block
       ⋮                                              Sample points of waveform data
 861.1350, -48.460                               ⎭
```

Header block

73ECSV	File header
// AQ6373E 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: AUTO, 1: MANUAL, 2: SMPL INTERVAL)	
"SMPL", 1001	Number of measured sampling points	
"SMPLINTVL",0.02	Measurement sampling interval	
"HIGH1"	Measurement sensitivity	
("GATE LOGIC")	Gate signal logic	
	Saved only when gate mode is enabled	
	POSI or NEGA (POSI: 0, NEGA: 1)	
("MEASURE DELAY",100)	Measure delay time	
	Saved only when gate mode is enabled	
"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: HORIZONTAL)	
"RESCOR",0	Software resolution correction (0: OFF, 1: ON)	
"SMOOTH",0	Smoothing (0: OFF, 1: ON)	
"FIBERTYPE"	Fiber connector type (0: Normal, 1: Angled)	
"MEASWL",1	Wavelength in air or vacuum (0: AIR, 1: VACUUM)	
"MODELNAME",AQ6373E	Model name	
"CHGPT",0	Point where the order of diffraction changes from 2nd to 1st.	
	(if the order of diffraction does not change,	
	-1: measure all using 2nd order light,	
	0: measure all using 1st order light)	
"NEBWCAL0", 0	Parameter for internal computation (for manufacturer adjustment)	
"NEBWCAL1", 0	Parameter for internal computation (for manufacturer adjustment)	
"NEBWCALWL", 0	Parameter for internal computation (for manufacturer adjustment)	
"RESCAL0_0", 10529	Parameter for internal computation (for manufacturer adjustment)	
"RESCAL0_1", -86	Parameter for internal computation (for manufacturer adjustment)	
"RESCAL0_2", 54335	Parameter for internal computation (for manufacturer adjustment)	
"RESCAL1_0", 10333	Parameter for internal computation (for manufacturer adjustment)	
"RESCAL1_1", 95	Parameter for internal computation (for manufacturer adjustment)	
"RESCAL1_2", -6046	Parameter for internal computation (for manufacturer adjustment)	
"CORESIZE",0	Fiber core size	
	(0: Standard mode, 1: Large core size fiber mode)	

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
DB/km	"REFL",***.*	Reference level
	"SSKM",**.*	Level scale
	"OFSKM",***.*	Offset level
	"LENG",**.***	Optical fiber length
%	"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.

• **When Chop Mode is set to Off**

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	"NORM_HLD"	"P-NORM_HLD"	"E-NORM_HLD"	"G-NORM_HLD"
N/AUTO(x2)	"NORM_AUT(x2)"	-	-	-
N/AUTO	"NORM_AUT"	"P-NORM_AUT"	"E-NORM_AUT"	"G-NORM_AUT"
NORMAL(x2)	"NORMAL(x2)"	-	-	-
NORMAL	"NORMAL"	"P-NORMAL"	"E-NORMAL"	"G-NORMAL"
MID(x2)	"MID(x2)"	-	-	-
MID	"MID"	"P-MID"	"E-MID"	"G-MID"
HIGH1(x2)	"HIGH1(x2)"	-	-	-
HIGH1	"HIGH1"	"P-HIGH1"	"E-HIGH1"	"G-HIGH1"
HIGH2(x2)	"HIGH2(x2)"	-	-	-
HIGH2	"HIGH2"	"P-HIGH2"	"E-HIGH2"	"G-HIGH2"
HIGH3(x2)	"HIGH3(x2)"	-	-	-
HIGH3	"HIGH3"	"P-HIGH3"	"E-HIGH3"	"G-HIGH3"

7

Saving and Loading Data

• When Chop Mode is set to Switch

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	"NORM_HLD"	"P-NORM_HLD"	"E-NORM_HLD"	"G-NORM_HLD"
N/AUTO(x2)	"NORM_AUT(x2)"	-	-	-
N/AUTO	"NORM_AUT"	"P-NORM_AUT"	"E-NORM_AUT"	"G-NORM_AUT"
NORMAL(x2)	"NORMAL(x2)"	-	-	-
NORMAL	"NORMAL"	"P-NORMAL"	"E-NORMAL"	"G-NORMAL"
MID(x2)	"MID(x2)_SW"	-	-	-
MID	"MID_SW"	"P-MID_SW"	"E-MID_SW"	"G-MID"
HIGH1(x2)	"HIGH1(x2)_SW"	-	-	-
HIGH1	"HIGH1_SW"	"P-HIGH1_SW"	"E-HIGH1_SW"	"G-HIGH1"
HIGH2(x2)	"HIGH2(x2)_SW"	-	-	-
HIGH2	"HIGH2_SW"	"P-HIGH2_SW"	"E-HIGH2_SW"	"G-HIGH2"
HIGH3(x2)	"HIGH3(x2)_SW"	-	-	-
HIGH3	"HIGH3_SW"	"P-HIGH3_SW"	"E-HIGH3_SW"	"G-HIGH3"

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.

French

⚠ ATTENTION

Ne retirez pas le périphérique de stockage USB et ne coupez pas l'alimentation lorsque l'indicateur d'accès au périphérique de stockage USB clignote. Cela pourrait endommager le périphérique de stockage USB ou corrompre ses données.
Avant de retirer un périphérique de stockage USB, assurez-vous de suivre la procédure de la section 7.1 pour que le périphérique de stockage USB soit prêt à être retiré.

Saving all trace data

Selecting the format of files saved automatically with file names

1.　Press **FILE**. The FILE menu appears.

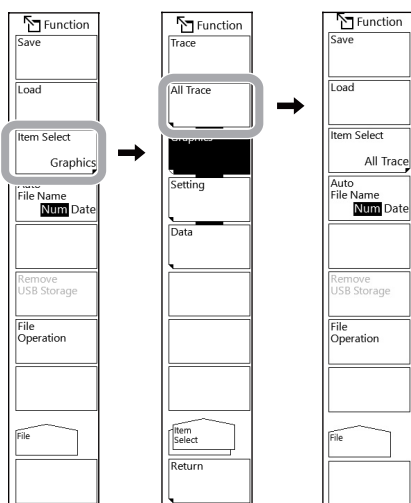*2.*　Tap **Auto File Name**. Select Num (serial number) or Date (date).

Note
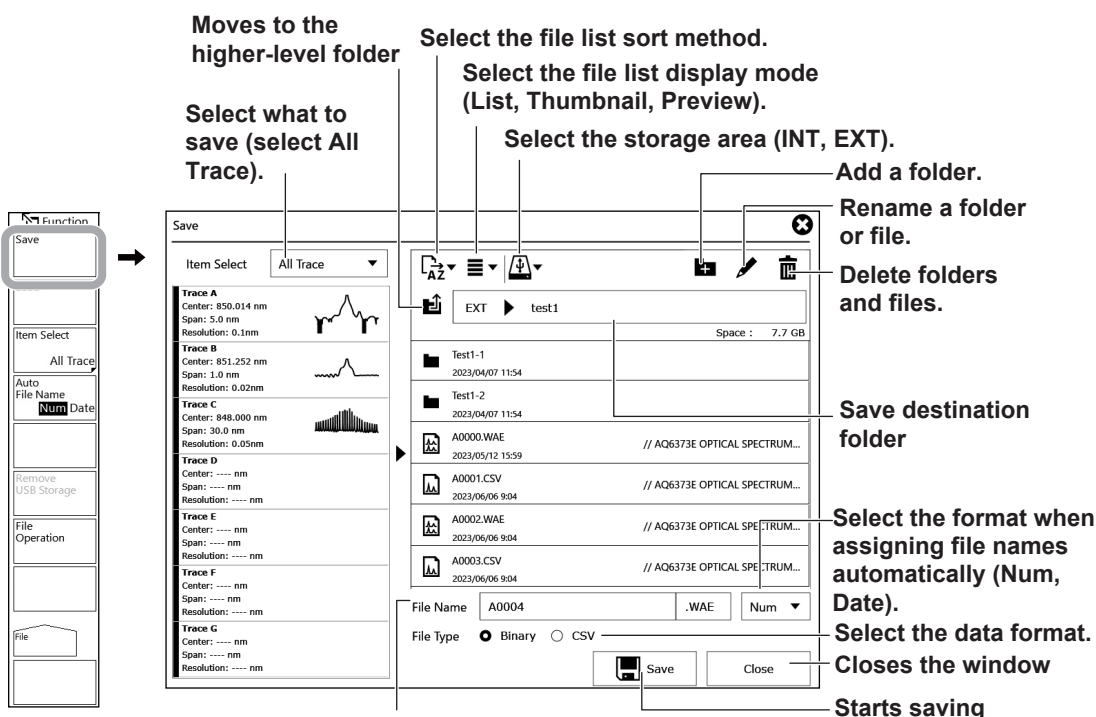You can also set this on the Save window, described later.

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**.
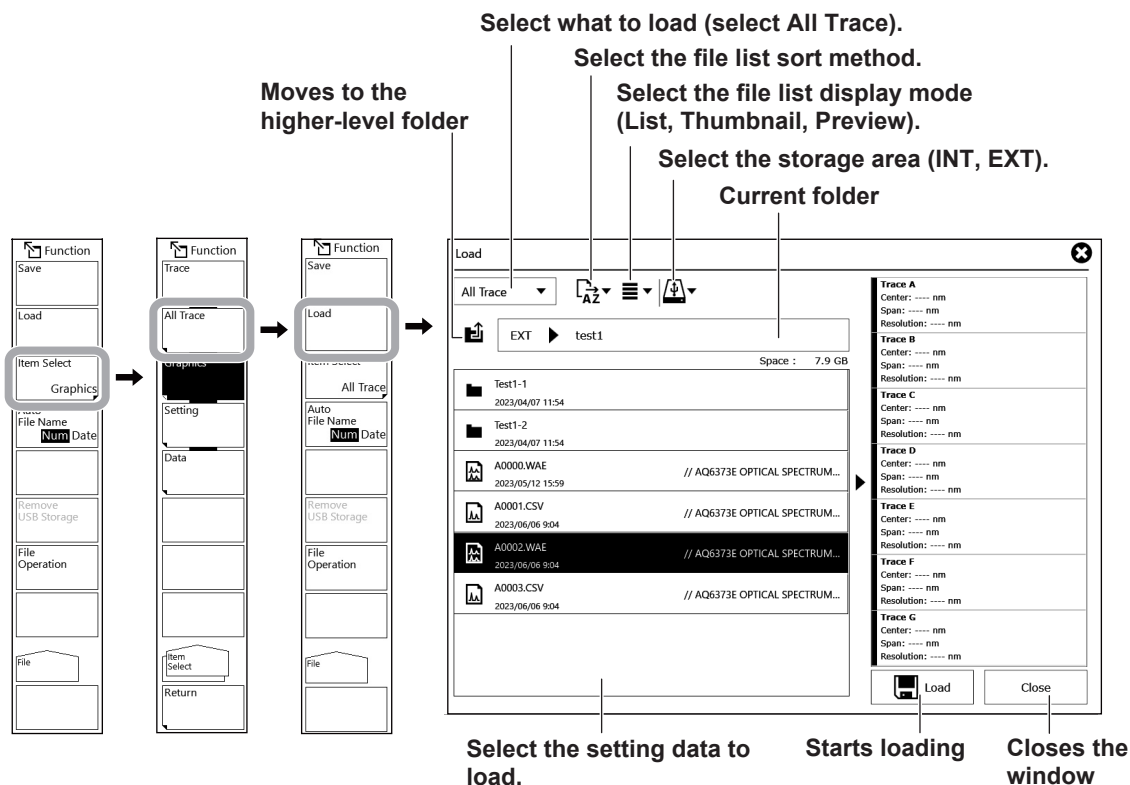
The file name will be entered.

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 (.WAE) 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.
Select the file list display mode (List, Thumbnail, Preview).
Moves to the higher-level folder
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 .WAE.

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 .WAE)

                        XXXX is a serial number from 0000 to 9999.

When Auto File Name is set to Date

    File name: AyyyyMMdd_hhmmss.CSV (or .WAE)

                        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.

```
73ECSVG                                                    ] Header
//AQ6373E OPTICAL SPECTRUM ANALYZER //
[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

73ECSVG   File header

// AQ6373E 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 frequency values.

Waveforms measured in Wavenumber mode are also saved as wavenumber 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.

French

⚠ ATTENTION

Ne retirez pas le périphérique de stockage USB et ne coupez pas l'alimentation lorsque l'indicateur d'accès au périphérique de stockage USB clignote. Cela pourrait endommager le périphérique de stockage USB ou corrompre ses données.
Avant de retirer un périphérique de stockage USB, assurez-vous de suivre la procédure de la section 7.1 pour que le périphérique de stockage USB soit prêt à être retiré.

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.
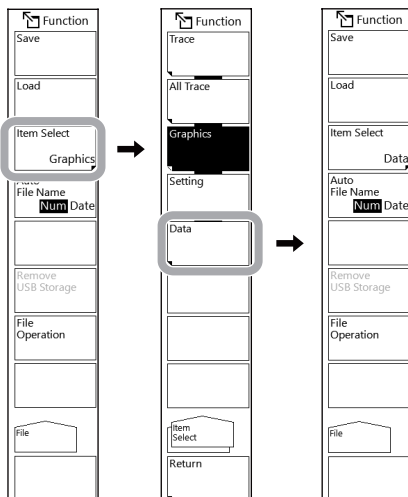
Note

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.
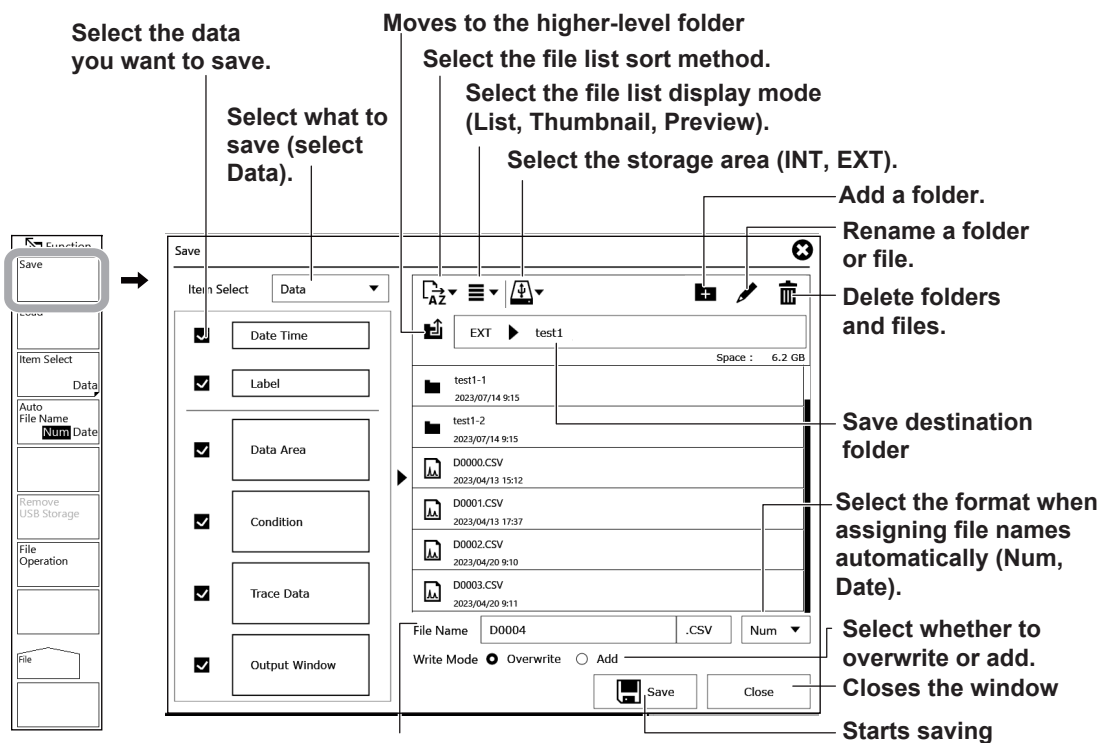
File name
Serial number (Num): Dxxxx (xxxx: serial number)
Date (Date): DyyyyMMdd_hhmmss
(yyyy: year, MM: month, dd: day, hh: hour, mm: minute, ss: second)
When assigning a specific file name, enter the file name.

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**.
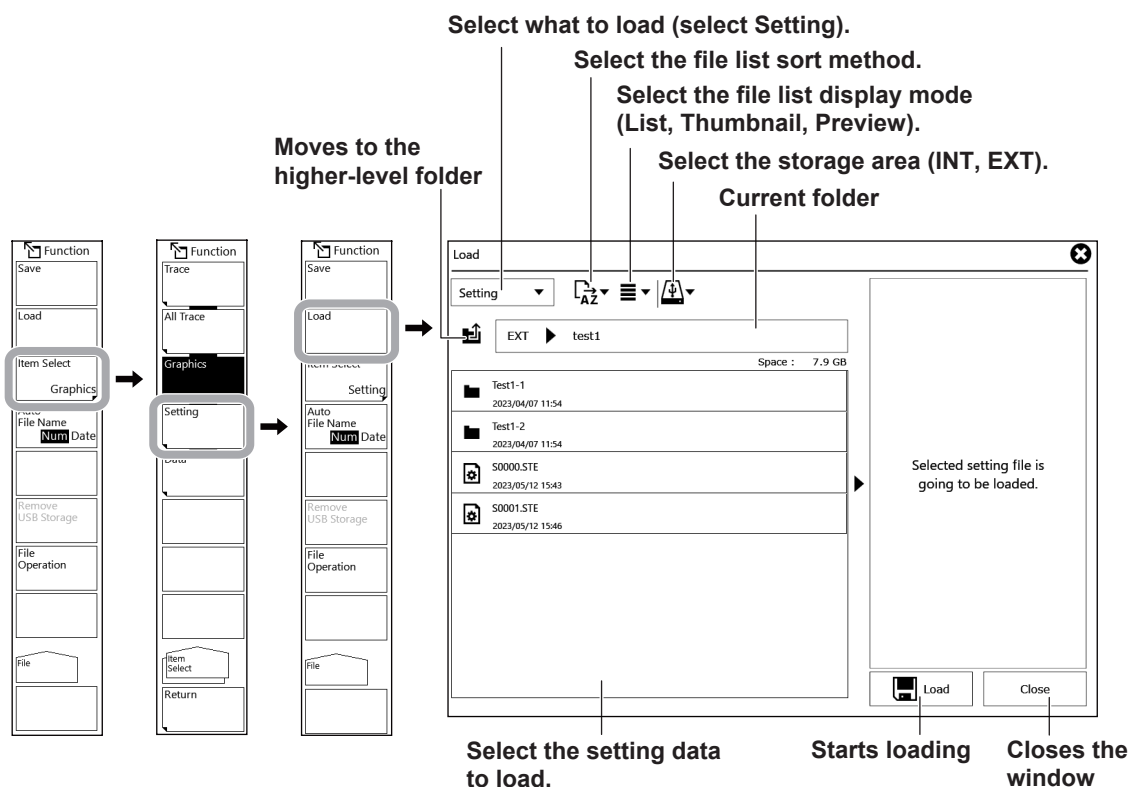
The file name will be entered.

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
Output Window	OFF	Data exported to the output window of the program function

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.

```
73EDAT2
// AQ6373E OPTICAL SPECTRUM ANALYZER //
2023 May 10 16:44
<DFB-LD ANALYSIS>
      SMSR:  43.21dB          OSNR:  40.12dB(/0.10nm)
    PEAK WL:  851.2680nm   PK LEVEL: -20.02dBm    SD:  0.0127nm
 20.00dB WIDTH:   0.1036nm    CTR WL: 851.2693nm   KSD:  0.0298nm
   MODE OFFSET:  -0.1700nm              POWER:  -18.31dBm
"CTRWL",851.264000
"SPAN",1.000000
"REFL"[dBm],-20.0
"LSCL",10.0
"RESLN",0.020
"AVG",1
"SMPL",501
"HIGH1"
"NMSK",OFF
 850.7640, -67.119
 850.7660, -67.789
 850.7680, -68.225
          ⋮
```

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.

French

⚠ ATTENTION

Ne retirez pas le périphérique de stockage USB et ne coupez pas l'alimentation lorsque l'indicateur d'accès au périphérique de stockage USB clignote. Cela pourrait endommager le périphérique de stockage USB ou corrompre ses données.

Avant de retirer un périphérique de stockage USB, assurez-vous de suivre la procédure de la section 7.1 pour que le périphérique de stockage USB soit prêt à être retiré.

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).

> *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.
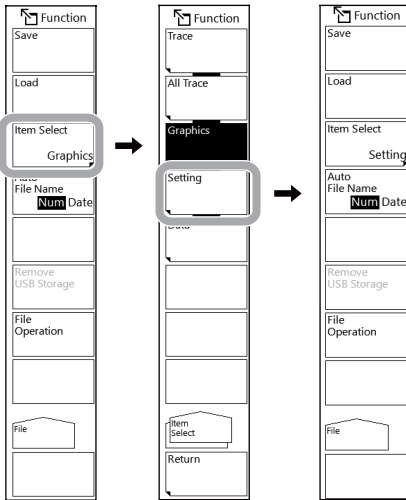
Selecting the save destination

5 Tap **Save**. A Save window appears.

6. In the file list, open the folder you want to save setting data in.

Moves to the higher-level folder

Select what to save (select Setting)

Select the file list sort method.

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 folder

Select the format when assigning file names automatically (Num, Date).

Closes the window

Starts saving
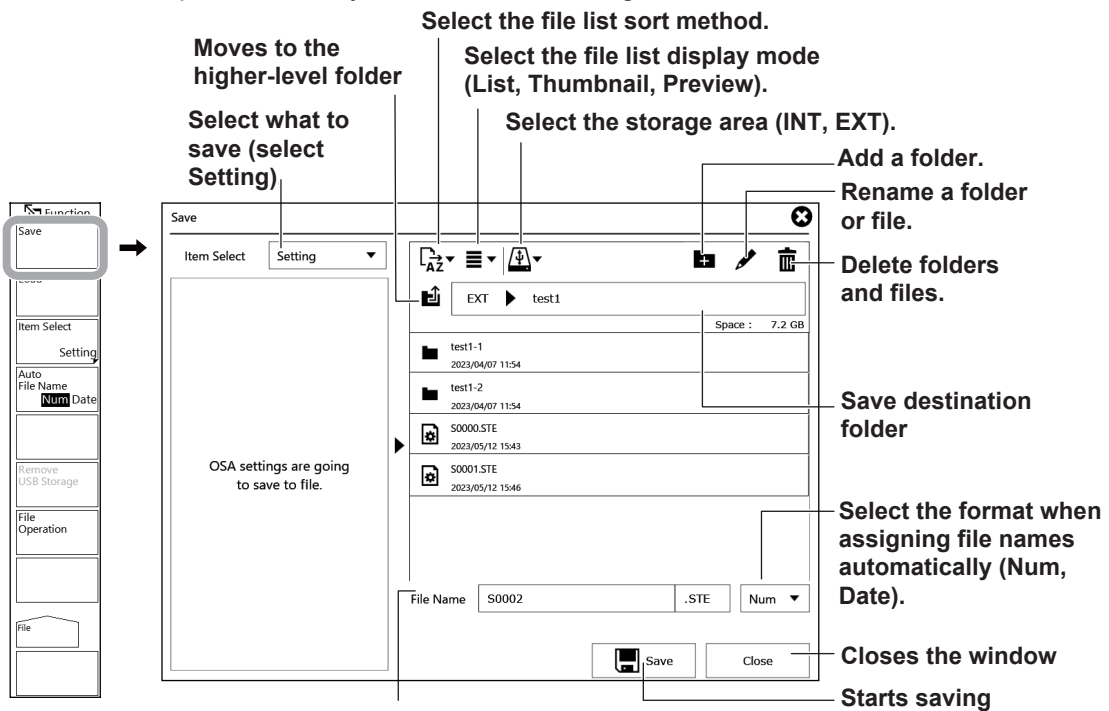
File name
Serial number (Num): Sxxxx (xxxx: serial number)
Date (Date): SyyyyMMdd_hhmmss
(yyyy: year, MM: month, dd: day, hh: hour, mm: minute, ss: second)
When assigning a specific file name, enter the file name.

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

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 .STE 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.STE

        XXXX is a serial number from 0000 to 9999.

When Auto File Name is set to Date

  File name: SyyyyMMdd_hhmmss.STE

        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.

Settings That Can Be Saved

Settings (table of default settings) appearing in the explanation of section 9.9 can be saved.

Settings and values that cannot be saved are indicated in the notes column in the table of default settings.

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.

French

⚠️

ATTENTION

Ne retirez pas le périphérique de stockage USB et ne coupez pas l'alimentation lorsque l'indicateur d'accès au périphérique de stockage USB clignote. Cela pourrait endommager le périphérique de stockage USB ou corrompre ses données.

Avant de retirer un périphérique de stockage USB, assurez-vous de suivre la procédure de la section 7.1 pour que le périphérique de stockage USB soit prêt à être retiré.

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.
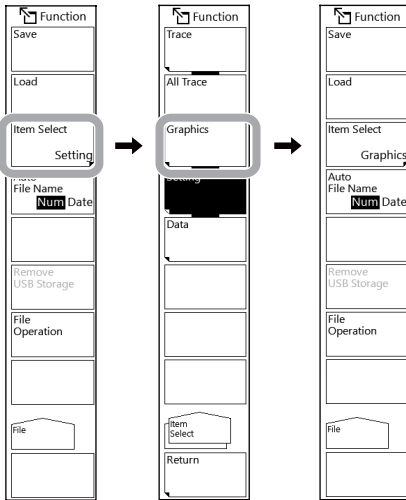
Selecting the data format, color mode, and save destination

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.

French

> ⚠️ **ATTENTION**
>
> Ne retirez pas le périphérique de stockage USB et ne coupez pas l'alimentation lorsque l'indicateur d'accès au périphérique de stockage USB clignote. Cela pourrait endommager le périphérique de stockage USB ou corrompre ses données.
> Avant de retirer un périphérique de stockage USB, assurez-vous de suivre la procédure de la section 7.1 pour que le périphérique de stockage USB soit prêt à être retiré.

Saving and Loading Data

Opening the file operation window

1. Press **FILE**. The FILE menu appears.

2. Tap **File Operation**.

A file operation window appears.
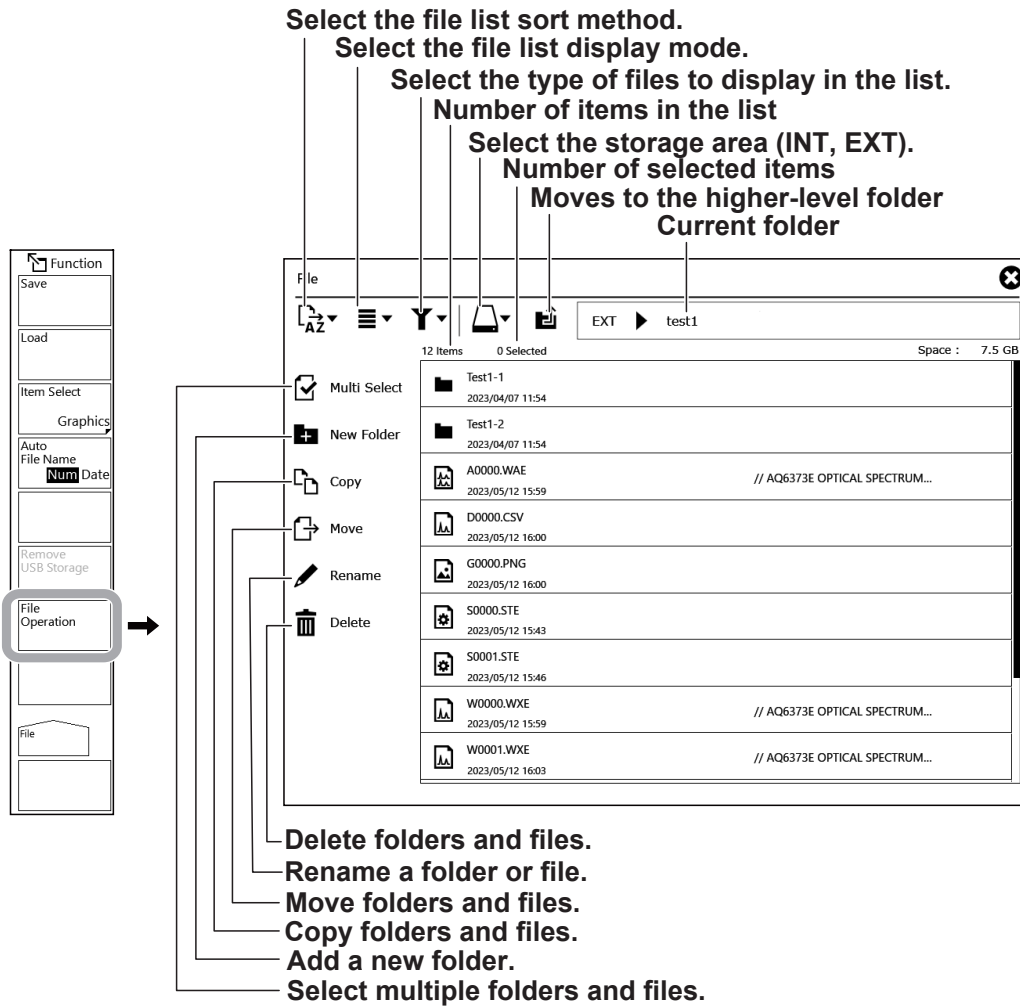
Selecting a file or folder

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.
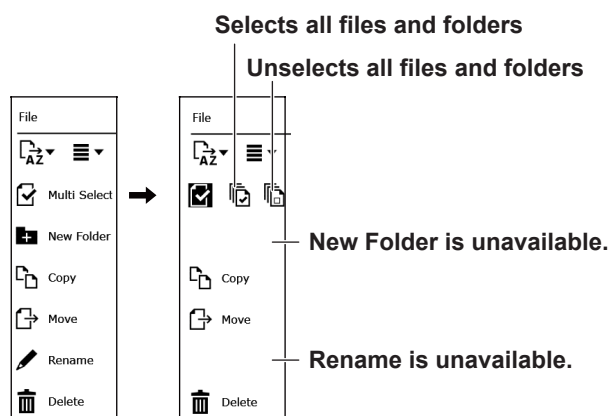
6. Tap the files or folders you want to select. All the files or folders you tap will be selected.

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
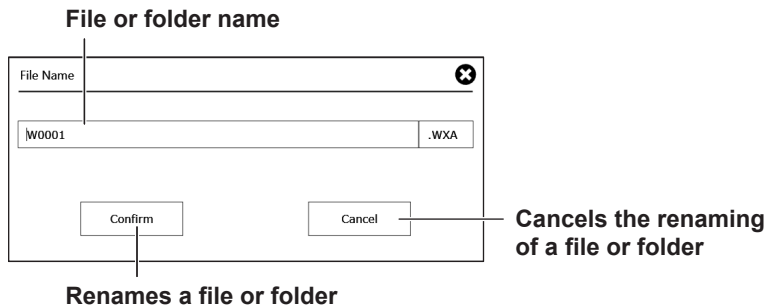
7. Double-tap the area showing the file name or folder name. A keyboard appears.

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.
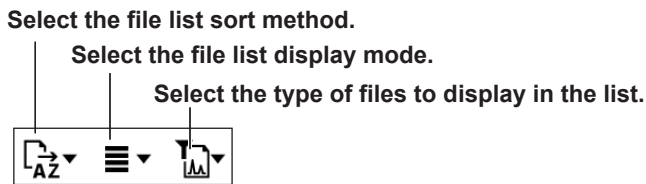
Changing the sort order

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)
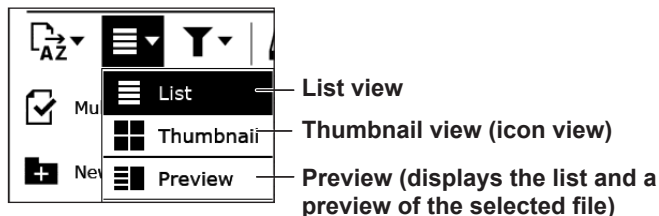
4.   Tap the display mode you want to apply. The display mode will change.

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
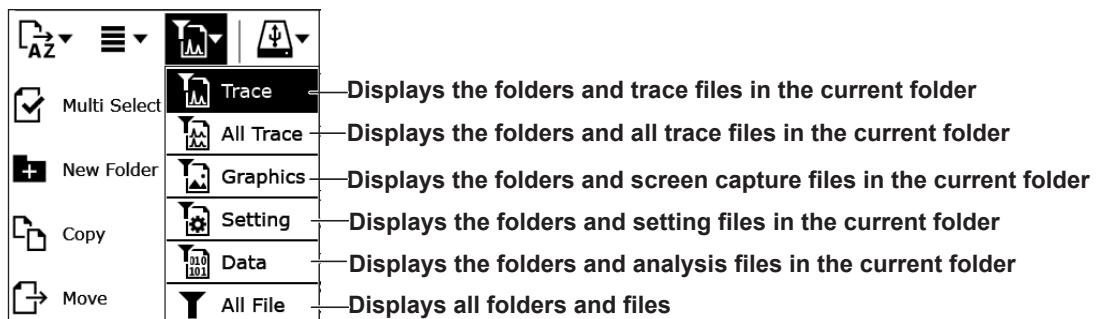
4.   Tap the type of file you want to list. The type of displayed files will change.

7

Saving and Loading Data

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 eight applications are preinstalled in the instrument.
- WDM Test
- FP-LD Test
- DFB-LD Test
- LED Test
- SCLaser Test
- FIP
- Support file builder
- Program function
- Data Logging

    Program is an application for creating programs to control this instrument from a PC.

    For operating instructions, see the separate Remote Control Manual (IM AQ6373E-17EN).

    For detail on data logging, see chapter 6.

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.
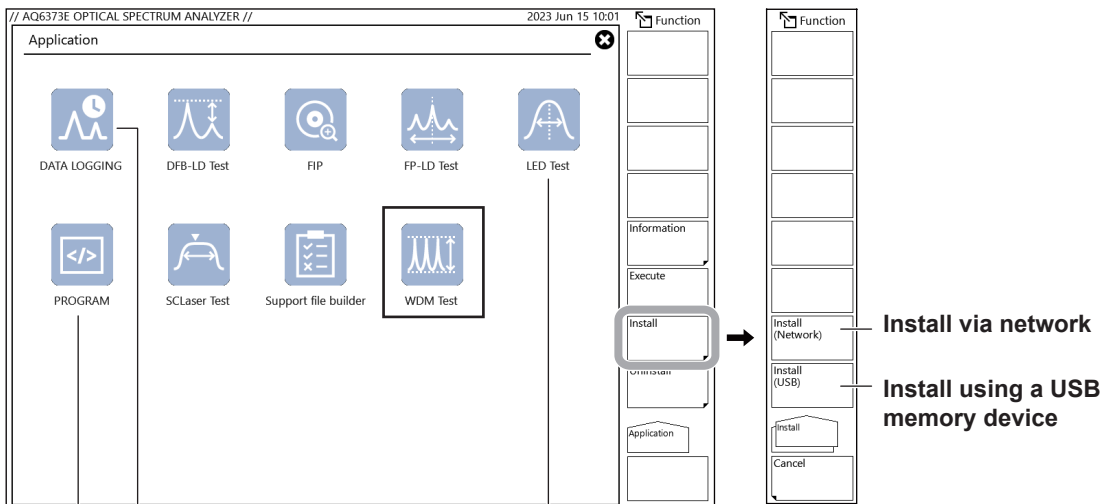
For operating instructions of DATA LOGGING, see chapter 6.

For operating instructions of PROGRAM, see the separate Remote Control Manual (IM AQ6374E-17EN).

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**.
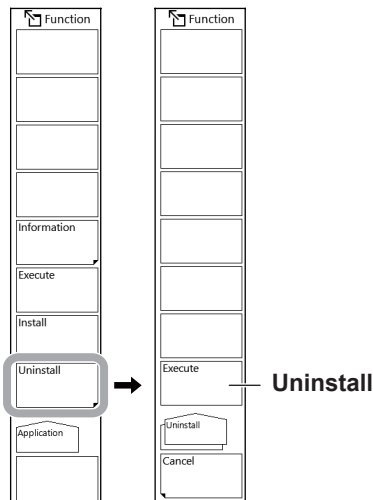
5. Tap **Yes (Reboot)**. The instrument will restart, and the application will be uninstalled.

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. However, Program and Data Logging cannot be uninstalled.

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.

WDM Test	⊗ ─── **Closes the window**

Auto ─── **Executes a sweep**
Single **Repeat** **Stop**

Measurement Conditions

855.000 nm   860.000 nm ─── **Measurement range (start wavelength, stop wavelength)**

⟐ Detail Settings ─── **Set advanced measurement conditions.**

Analysis Conditions

☐ Channel Tilt ─── **Displays channel tilt**
Signal Power ⦿ Peak ◯ Integra ─── **Optical signal power calculation method**
Integral Range ± 10.0 GHz ─── **Set the integral range.**
NoiseBW 0.10 nm ─── **Set the noise bandwidth.**
⟐ Advanced Settings ─── **Set advanced analysis conditions.**

Horizon Scale nm ▾ ─── **Horizontal scale unit**

Save **Report** ─── **Runs the report feature**

No.	Wavelength [nm]	Level [dBm]	Offset WL [nm]	Offset Lv [dB]	Noise [dBm/NBW]	SNR [dB]
1	855.1608	-20.569	-2.3386	-19.020	-50.925	30.356
2	855.9404	-13.823	-1.5590	-12.274	-54.279	40.456
3	856.7199	-8.404	-0.7795	-6.855	-53.835	45.431
4	857.4994	-1.549	(REF)	(REF)	-53.339	51.790
5	858.2815	-7.725	0.7821	-6.176	-53.678	45.953

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.

Sweep Settings	⊗

Band

855.000 nm   860.000 nm

Resolution   0.02 ▾ nm

Sampling Points   ⦿ Auto   ◯ Manual   1251

Sensitivity   MID ▾

Cancel   **Sweep** ─── **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

Analyzes with new conditions

Interporation Settings

Display Settings

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)

No.	Wavelengt [nm]	Level [dBm]	Offset WL [nm]	Offset Lv [dB]	Noise [dBm/NBW	SNR [dB]
1	855.1608	-20.569	-2.3386	-19.020	-53.909	33.340
2	855.9404	-13.823	-1.5590	-12.274	-57.261	43.438
3	856.7199	-8.404	-0.7795	-6.855	-56.816	48.412
4	857.4994	-1.549	(REF)	(REF)	-56.318	54.769
5	858.2815	-7.725	0.7821	-6.176	-56.654	48.929
6	859.0671	-19.070	1.5677	-17.521	-57.462	38.392

Deletes the selected waveforms and tables

Returns to the previous screen

Saves as image data

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.
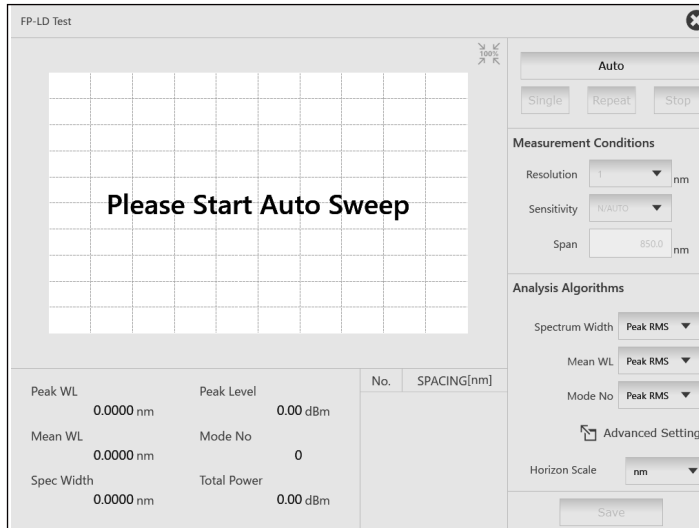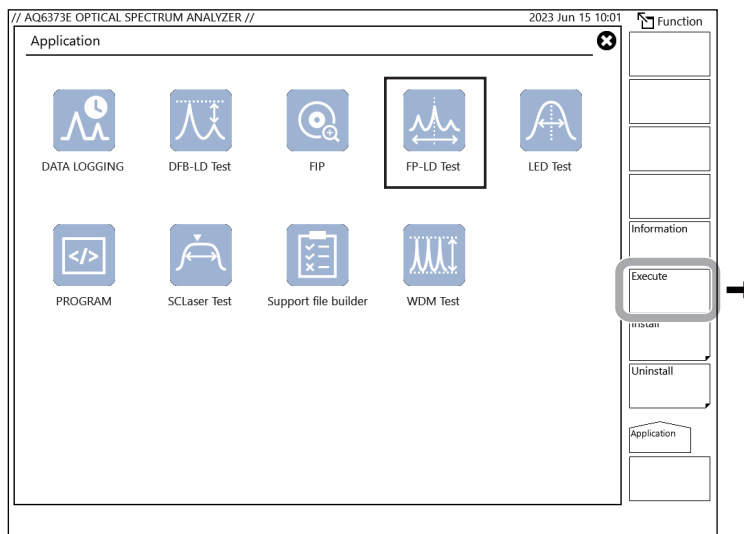
3. Tap **AUTO**. Waveforms are displayed.

Executes a sweep

Set the measurement conditions.
(Resolution, sensitivity, span)

Set the analysis conditions.
(Calculation algorithm)

Set advanced analysis conditions.

Horizontal scale unit

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.

8.5 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

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.

Width Analysis tab

SMSR tab

SMSR

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.
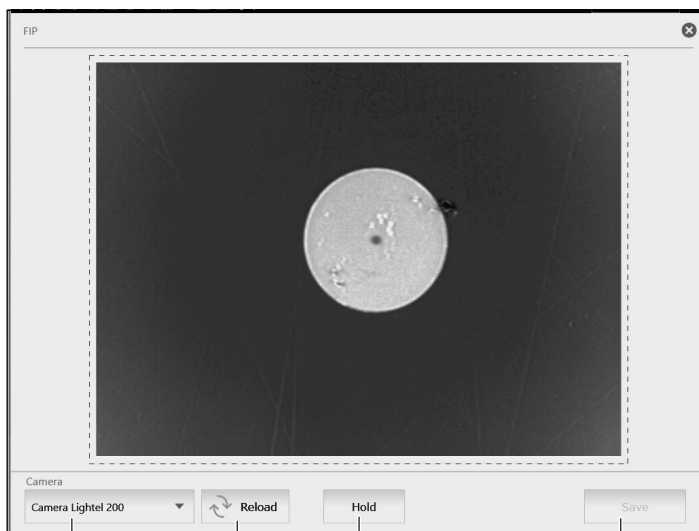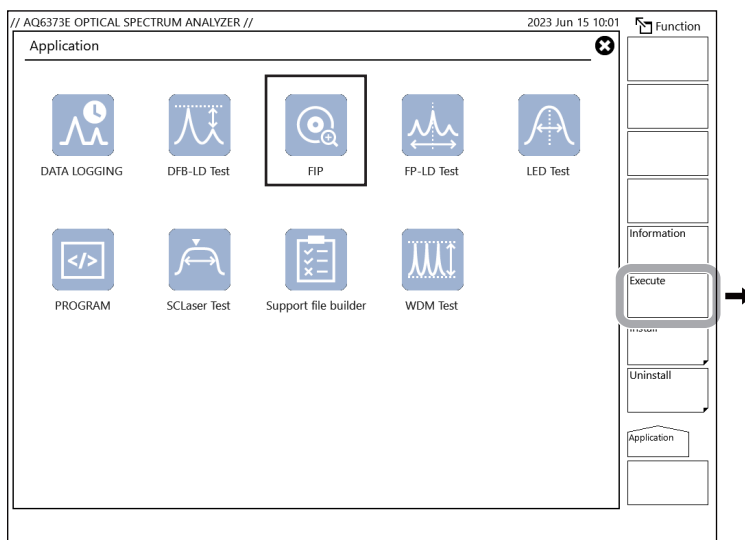
8.6 LED Test

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.
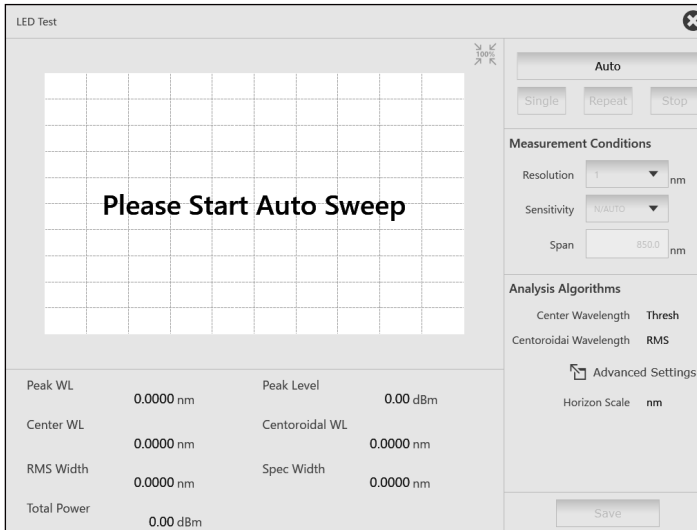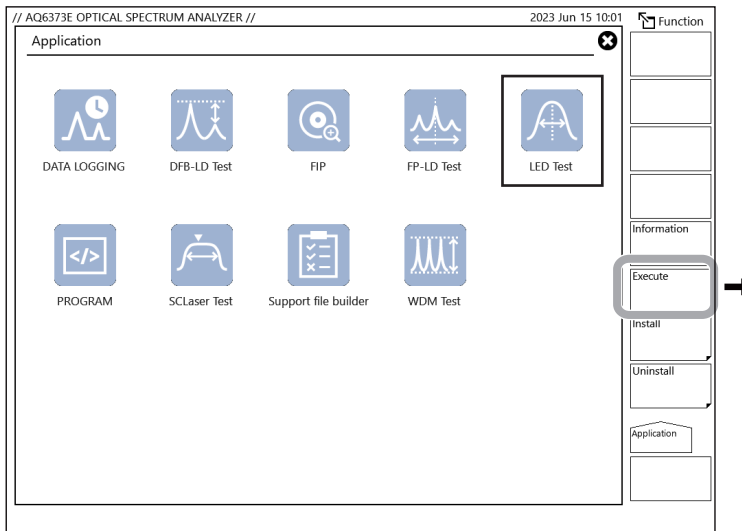
3. Tap **AUTO**. Waveforms are displayed.

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.

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Useful Applications
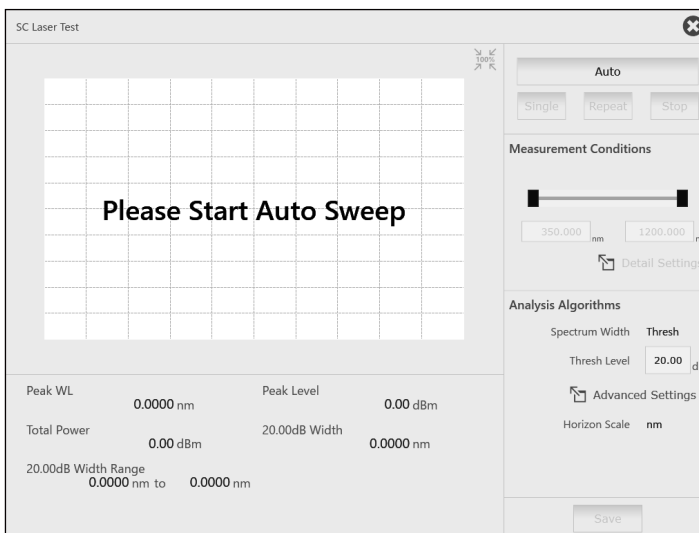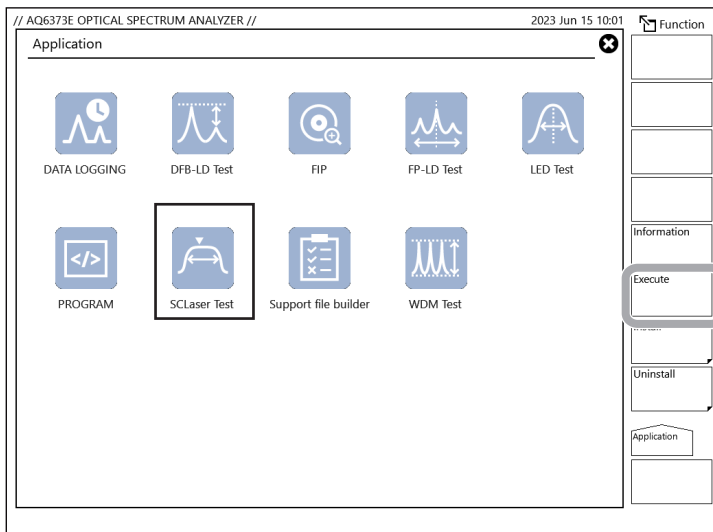
3. Tap **AUTO**. Waveforms are displayed.

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
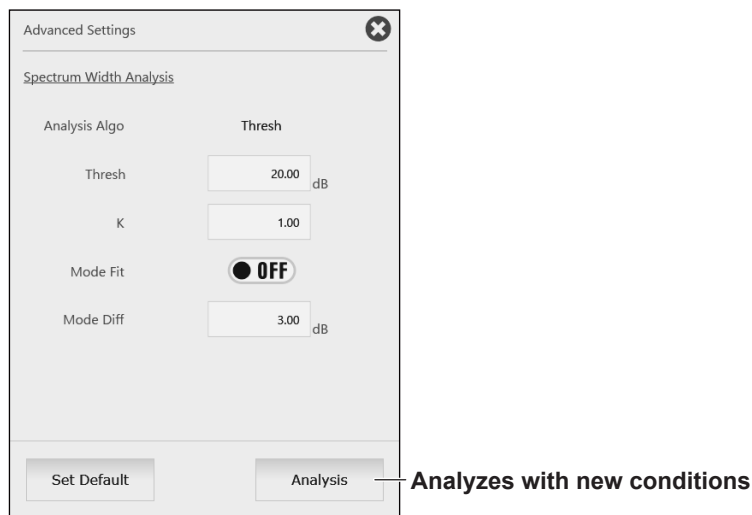
Useful Applications

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
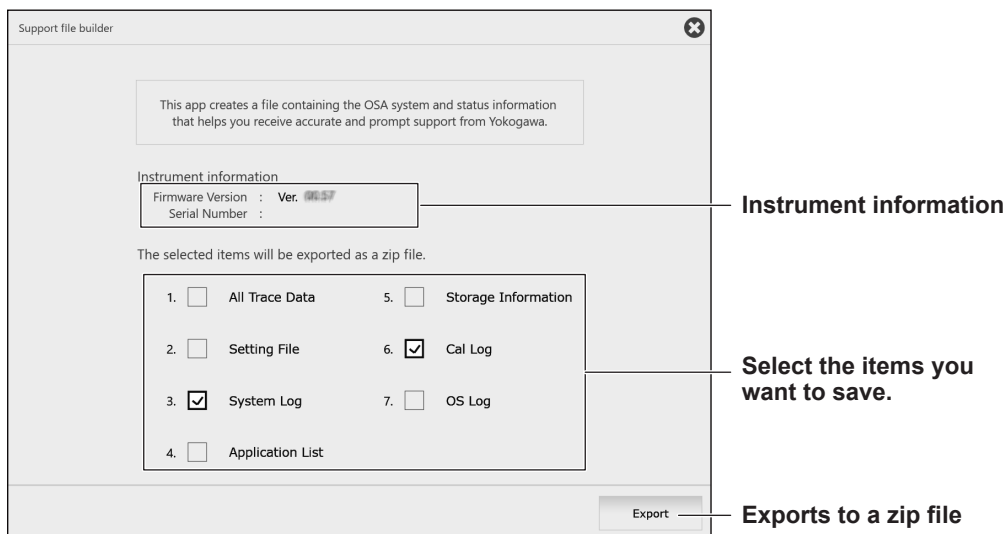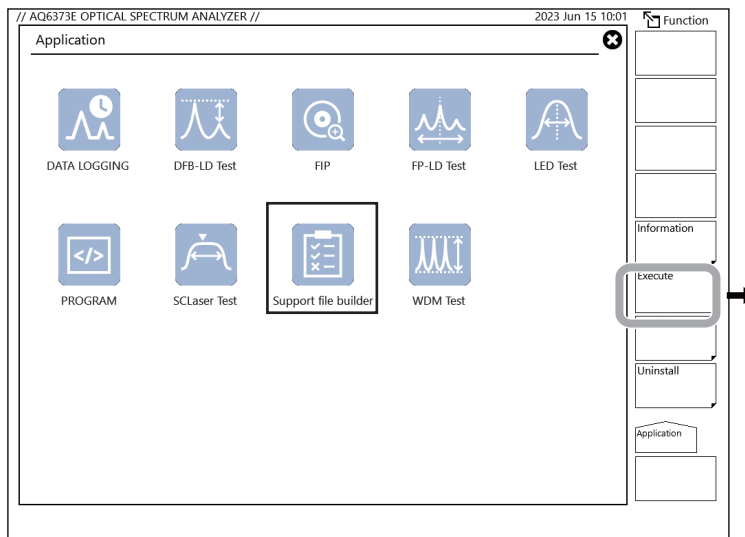
Exporting maintenance information

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.
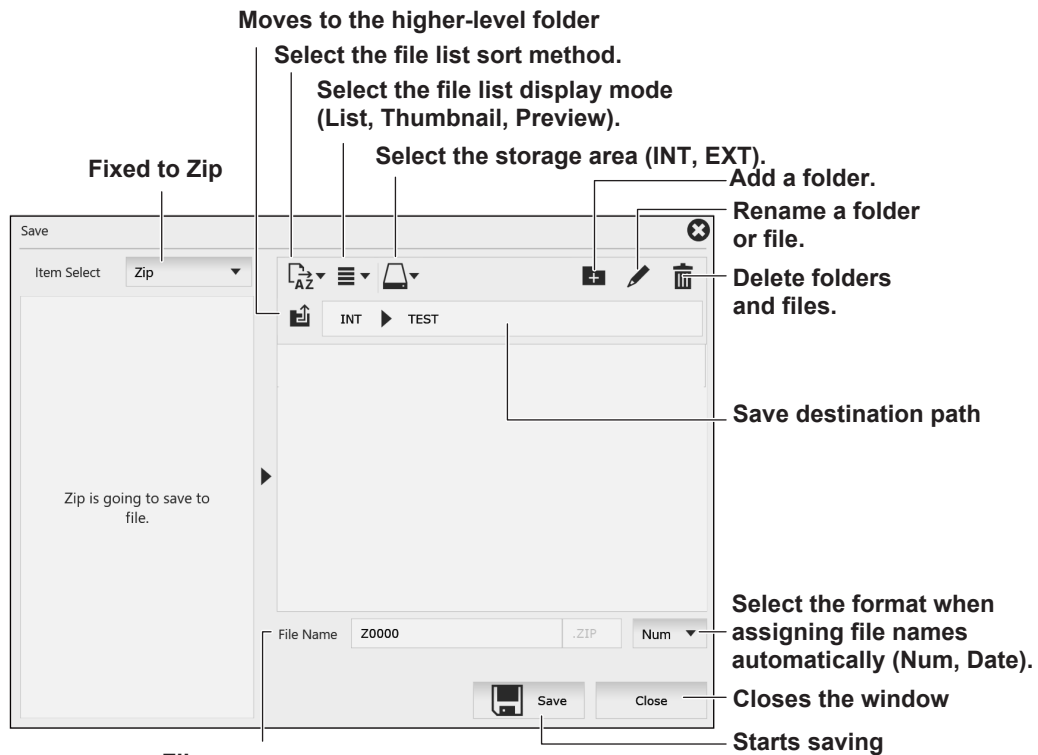
File name
Serial number (Num): Zxxxx (xxxx: serial number)
Date (Date): ZyyyyMMdd_hhmmss
(yyyy: year, MM: month, dd: day, hh: hour, mm: minute, ss: second)
When assigning a specific file name, enter the file name.

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.

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.
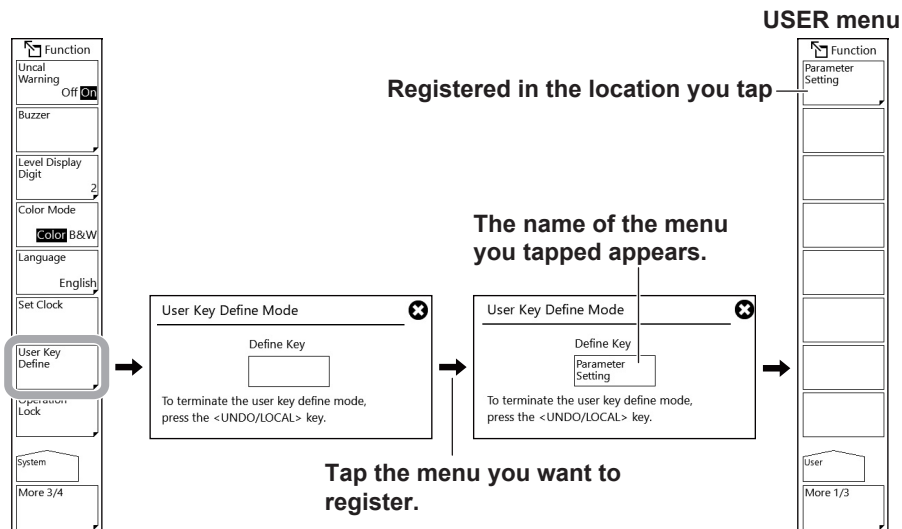
Note

- 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.

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.
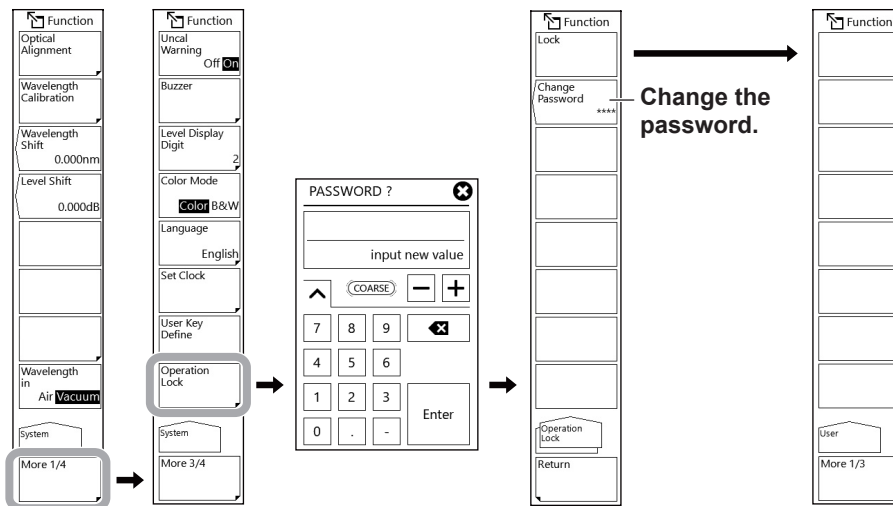
Note

- 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.
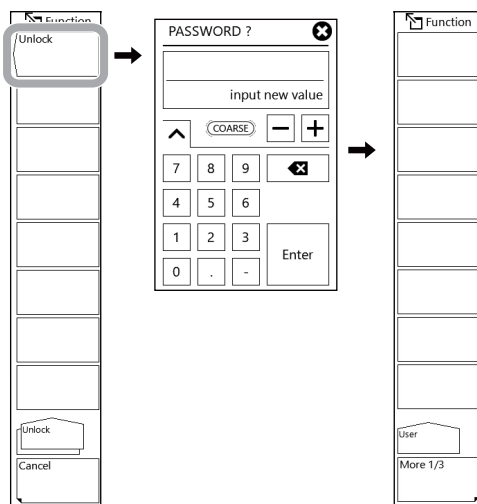
Note
Even when the keys are locked, you can still use the instrument remote commands as usual. However, you cannot unlock the keys when the instrument is in remote mode. In such a case, press UNDO/LOCAL to switch the instrument to local mode, and then unlock the keys. For details on switching between local and remote modes, see section 1.2 in the Remote Control User's Manual (IM AQ6373E-17EN).

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System Setup

9.3 Measurement Items

Alignment adjustment

⚠️ **WARNING**

The instrument has a built-in reference light source for alignment adjustments, and infrared light is always being output from the optical output connector. Never look into the optical output connector. Infrared light entering the eyes can cause severe injury and loss of vision.

French

⚠️ **AVERTISSEMENT**

Cet instrument dispose d'une source de lumière de référence intégrée pour les ajustements d'alignement. La lumière infrarouge est toujours émise depuis le connecteur de sortie optique. Ne regardez jamais directement dans le connecteur de sortie optique. La lumière infrarouge risquerait de gravement vous blesser ou de provoquer une perte de vision.

Connect the instrument's optical input connector and optical output connector using a 50/125 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.
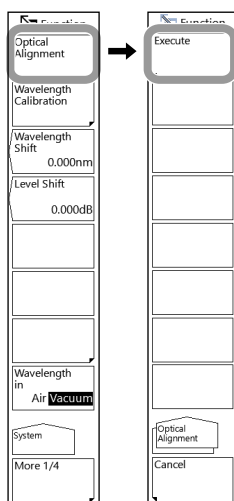
Note

- 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

This 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

Emission Line Light Source Type

• When the specified wavelength is different from that of the calibration light source

• If multiple emission lines are included in the calibration wavelength ±0.5 nm range

• 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 approximately -65 dBm (varies depending on the 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 5/125 µm SM (single mode) optical fiber.

SM optical fiber cable (5/125 µm)
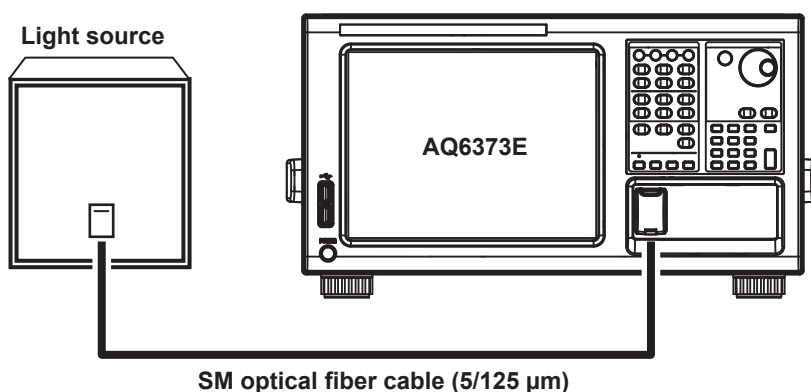
Note

• Use a 5/125 µm single mode optical fiber.

• If a large diameter core optical fiber must be used, choose one with a core diameter of 100 µm or less. Correct wavelength calibration may not be obtained when the core diameter is larger than 100 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:

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System Setup

• **Laser type**

Set the type of external light source (laser absorption line) and the calibration wavelength value.

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 350 nm and 1200 nm.

If you tap **Preset Cal Wavelength**, you can select from the preset wavelengths.

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.
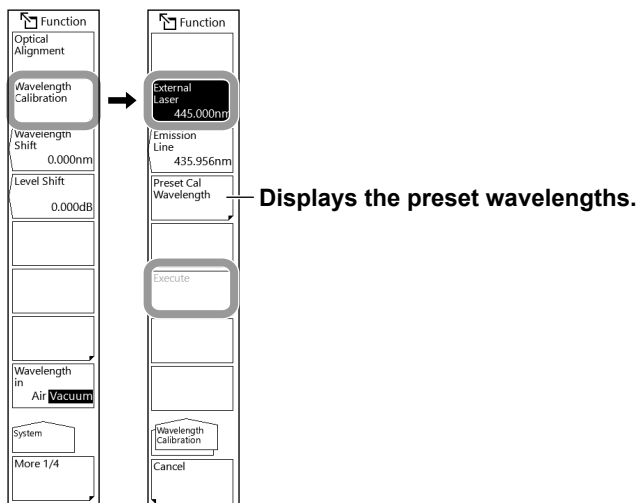
- **Emission line light source type**

4. Tap **Emission Line**. 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 350 nm and 1200 nm.

If you tap **Preset Cal Wavelength**, you can select from the preset wavelengths.

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
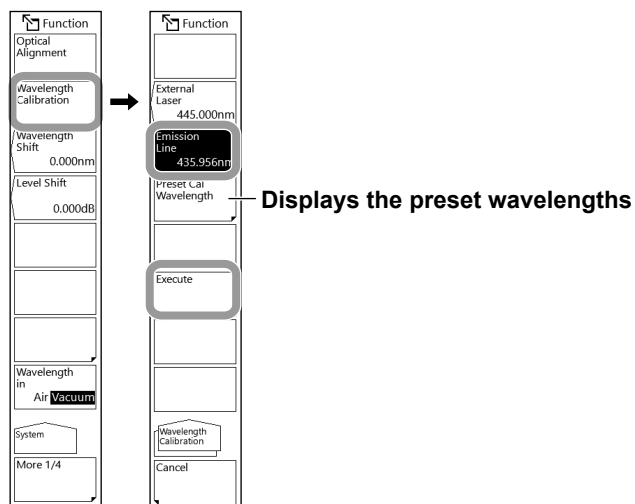
Note

- It is not necessary to perform calibration on multiple wavelengths. If calibration is performed on multiple wavelengths, only the results from the final calibration are applied.
- Preset Cal Wavelength displays either the wavelength in air or that in vacuum. Change the Wavelength in Air/Vacuum setting (section 2.1) according to your measurement conditions.

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System Setup

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.
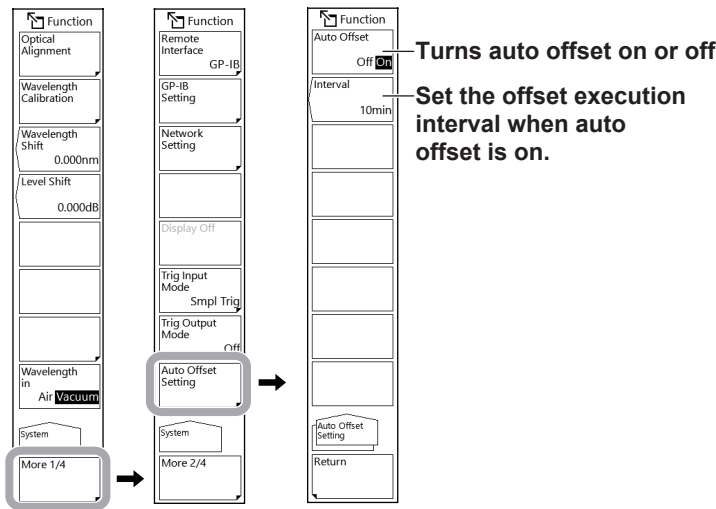
Note

- 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.
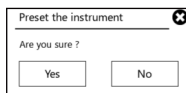
Explanation

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 external light source (laser beam, emission line light source).

The preset calibration wavelength values are the same regardless of the type of external light source. Depending on the measurement wavelength setting of the instrument, it will be displayed as wavelength in air or in vacuum.

Wavelength in air(AIR)	Wavelength in vacuum(VACUUM)
441.565 nm	441.690 nm
487.986 nm	488.123 nm
632.816 nm	632.991 nm
1152.274 nm	1152.589 nm
404.656 nm	404.770 nm
435.834 nm	435.956 nm
546.074 nm	546.226 nm
763.511 nm	763.721 nm
881.941 nm	882.183 nm
912.297 nm	912.547 nm
992.319 nm	992.591 nm

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

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System Setup

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
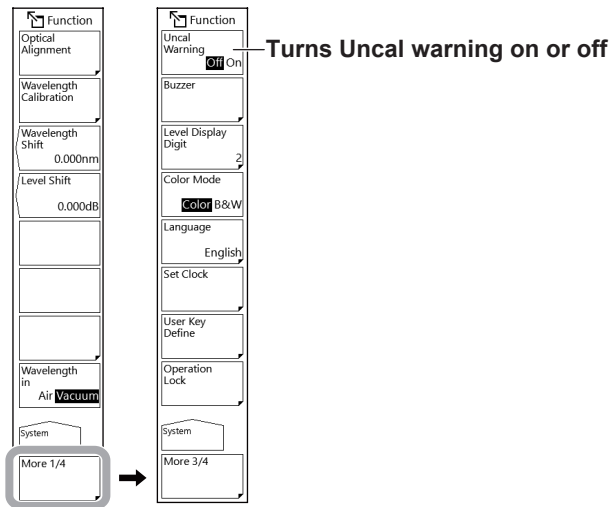
Turning the display off

This function temporarily turns the display off.

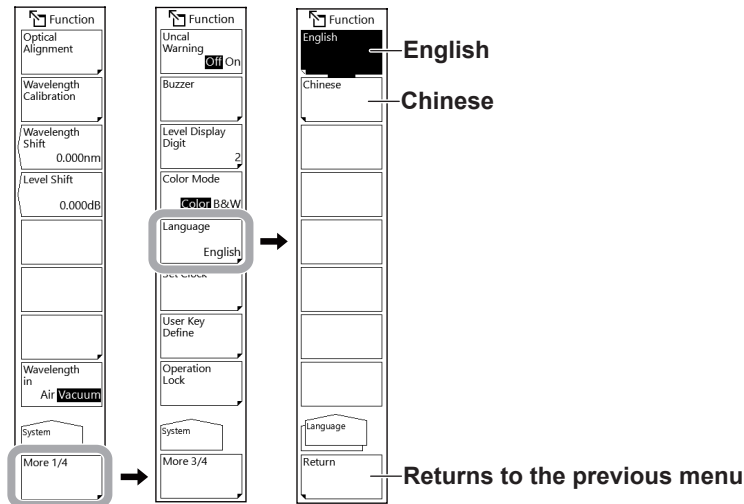*1.* Press **SYSTEM**. The SYSTEM menu appears.

2. Tap **Display Off**. The display turns off.

Turns off the display
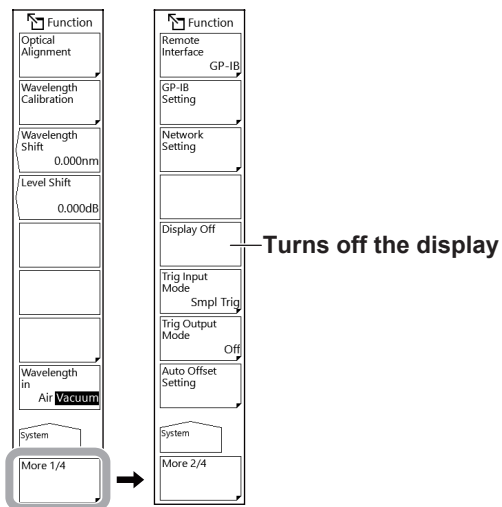
If you press a panel key or move the mouse, the display will turn on.

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.

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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.
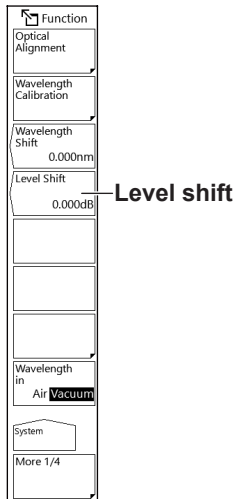
Level shift

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.

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, $\boxed{\substack{WL \\ SHF}}$ 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, $\boxed{\substack{LVL \\ SHF}}$ will appear highlighted at the bottom of the screen.

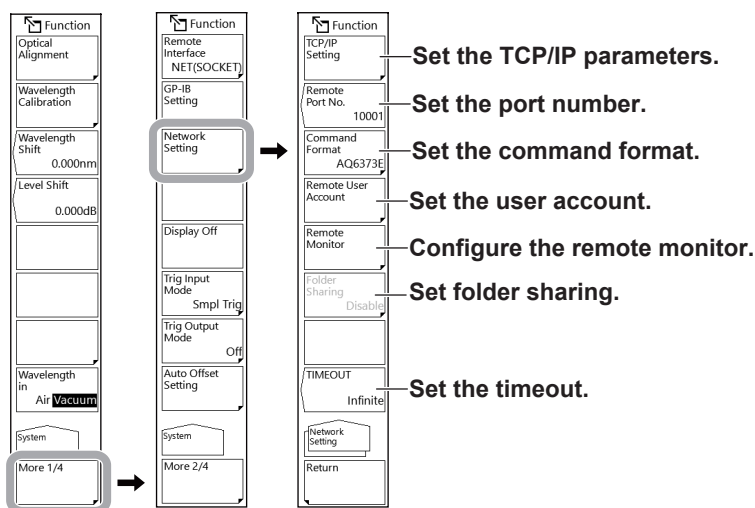## 9.5   Ethernet Communication

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.
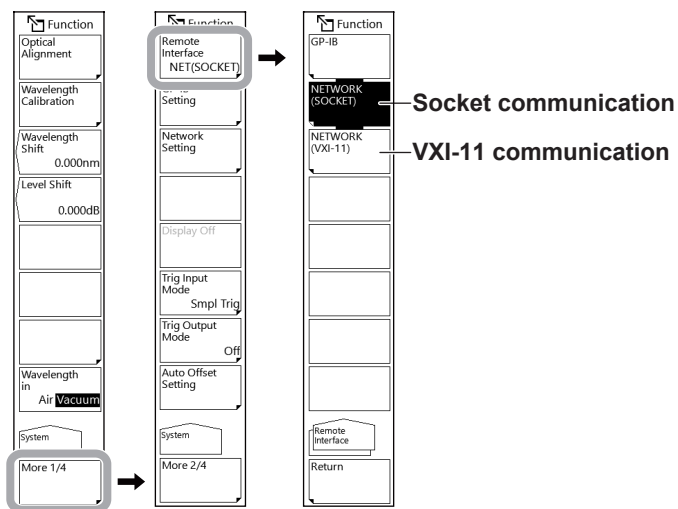
Configuring the network settings

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 AQ6373E — **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.

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**8.** When you finish setting all the items, tap **Done**.
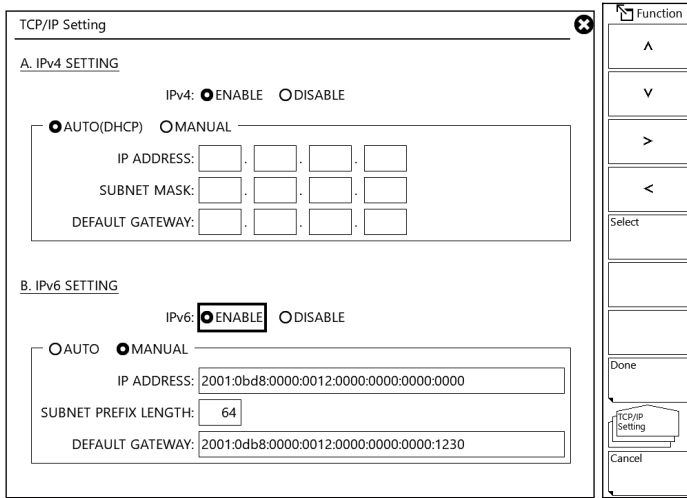
Setting the port number (not used with the VXI-11)

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.
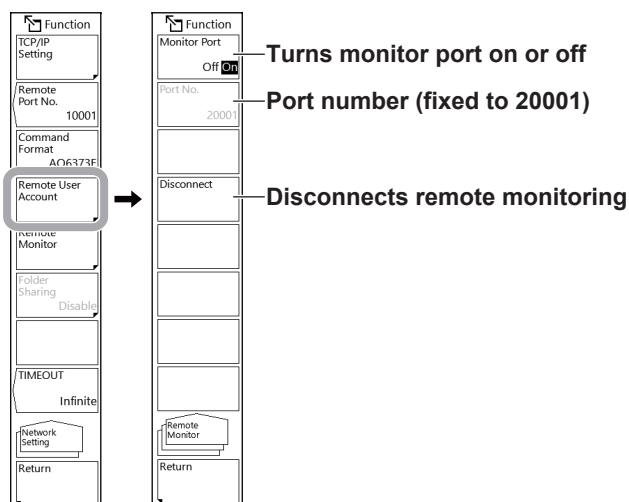
Setting the user account (not used with the VXI-11)

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.

Set the user name.

Set the password.
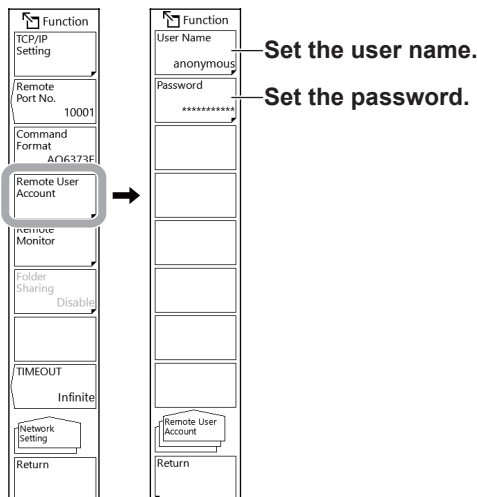
Configuring the Remote Monitor

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.

Function	**Function**
TCP/IP Setting	Monitor Port
	Off On ── **Turns monitor port on or off**
Remote Port No. 10001	Port No.
	20001 ── **Port number (fixed to 20001)**
Command Format AQ6373E	
Remote User Account	Disconnect ── **Disconnects remote monitoring**
Remote Monitor	
Folder Sharing Disable	
TIMEOUT Infinite	
Network Setting	Remote Monitor
Return	Return

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**. Directory sharing is enabled.

Tapping **Disable** will disable folder sharing.

Function	**Function**
TCP/IP Setting	Disable
Remote Port No. 10001	Read Only
Command Format AQ6373E	
Remote User Account	
Remote Monitor	
Folder Sharing Disable	
TIMEOUT Infinite	
Network Setting	Folder Sharing
Return	Return

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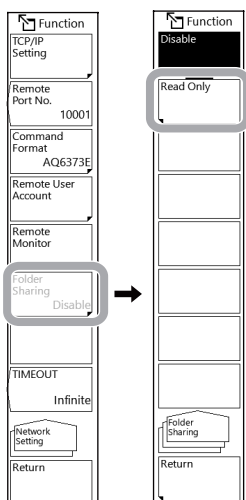
6. Connect your PC to the ETHERNET port on the rear panel of the instrument.

Ethernet Cable

PC
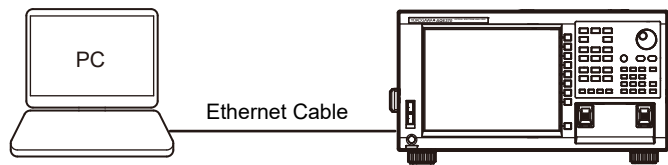
Connections

Connect a UTP (unshielded twisted-pair) cable or an STP (shielded twisted-pair) cable that is connected to another device to the ETHERNET port on the rear panel of the instrument.

AQ6373E
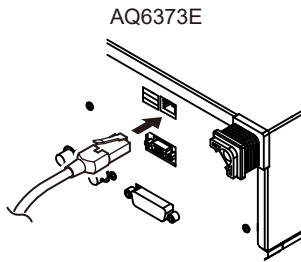
Note

• Be sure to use a straight cable through a hub when connecting a PC to the instrument.
• When using a UTP (straight) cable, make sure that it is a category 5 cable.

7. On your PC, run a Windows folder management program (e.g., File Explorer).

8. In the address bar, enter the IP address of the instrument.

If an authentication window appears, enter the following user name and password.

User name：user
Password：yokogawa

The User folder appears. This User folder is the shared folder.

Address bar

Shared folder
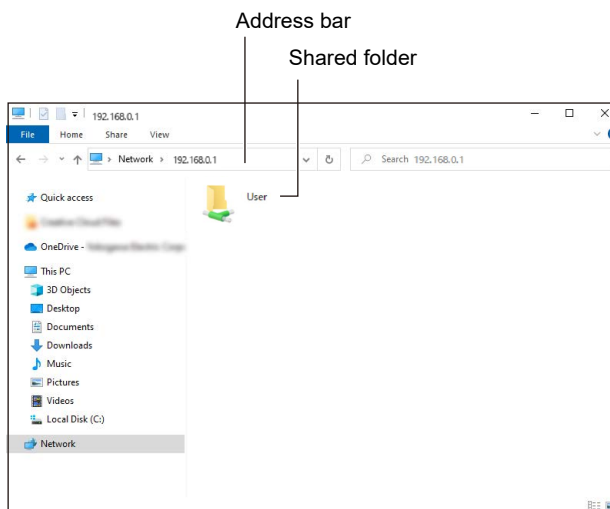
Setting the remote timeout (not used with the VXI-11)

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 Digest Algorithm).

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.

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).

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System Setup

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
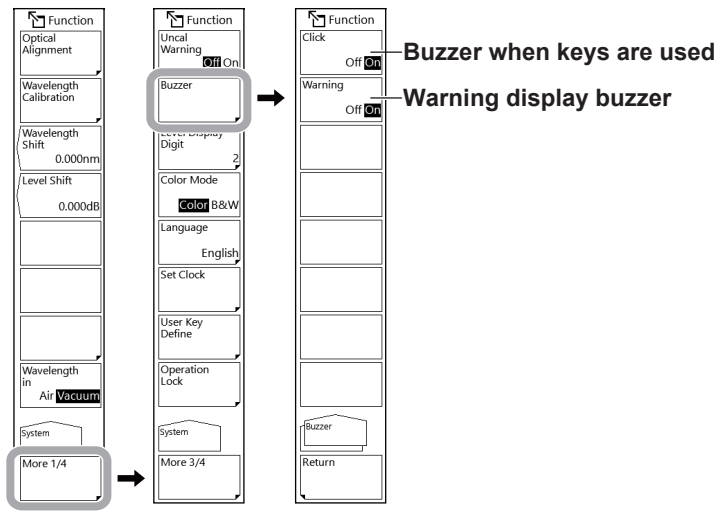
9.7 Displaying Manuals with the Help Feature

Procedure

1. Press **HELP**. An explanation appears for the displayed menu.

2. To finish, press any panel key.

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System Setup

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.
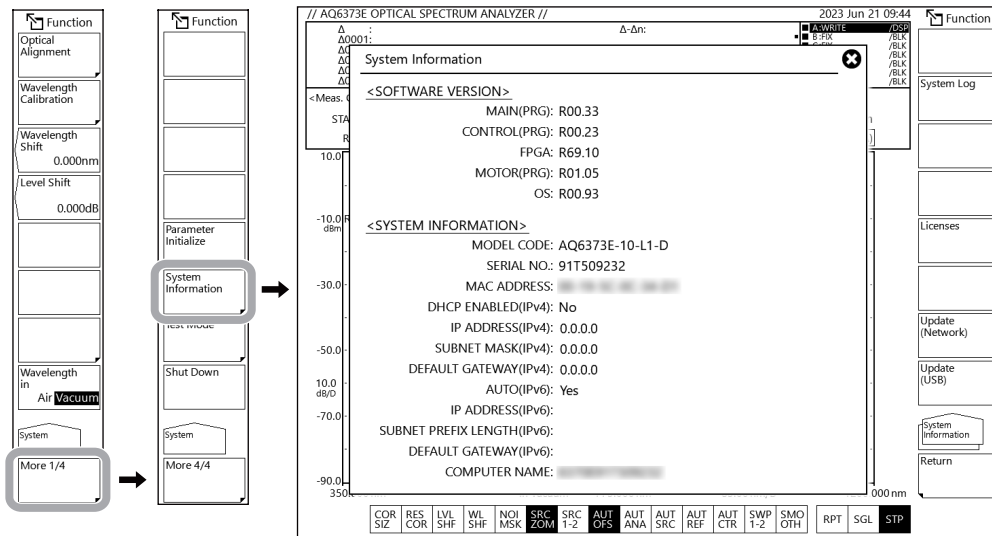
Displaying or clearing the system log and copying to USB memory

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.
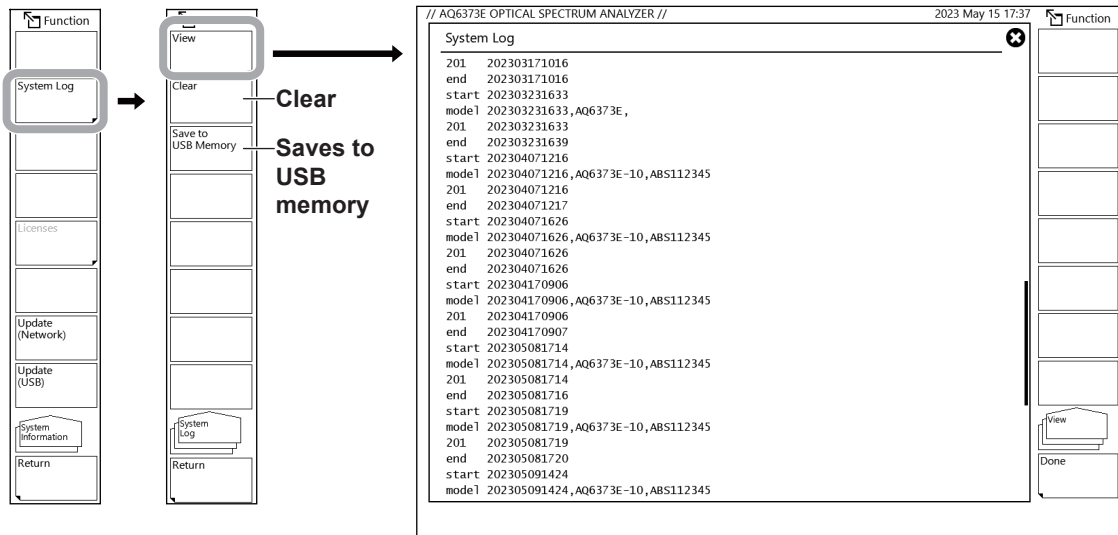
Clearing the system log

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.
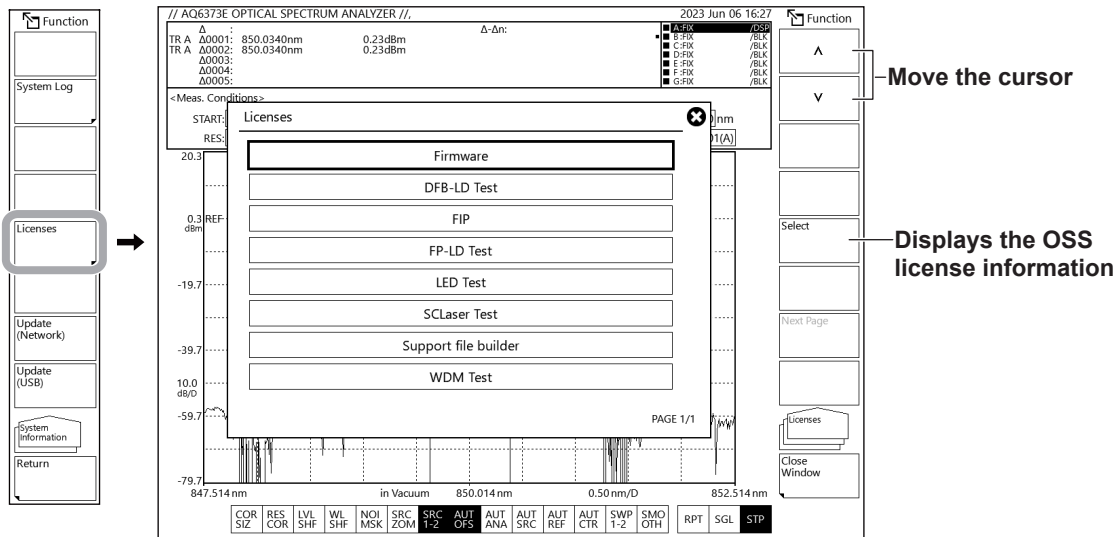
Explanation

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)

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.
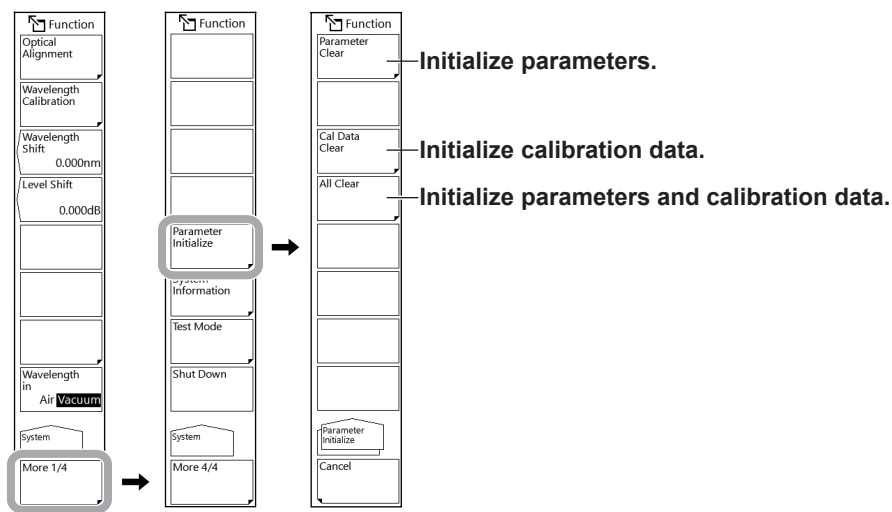
Explanation

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.

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System Setup

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

Function	Default value	Maximum value	Minimum value
Center (nm) (Center (THz)) (Center (cm^{-1}))	775.000 (553.1885) (18452.381)	1200.000 (856.5000) (28571.000)	350.000 (250.0000) (8334.000)
Start (nm) (Start (THz)) (Start (cm^{-1}))	350.000 (249.8270) (8333.381)	1200.000 (856.5000) (28571.000)	1.000 (10.0000) (1000.000)
Stop (nm) (Stop (THz)) (Stop (cm^{-1}))	1200.000 (856.5499) (28571.381)	1625.000 (999.9000) (38690.000)	350.000 (250.0000) (8334.000)
AUTO CENTER Off/On	Off	-	-

SPAN

Function	Default value	Maximum value	Minimum value
Span (nm) (Span (THz)) (Span (cm^{-1}))	850.00 (606.72) (20238.0)	850.00 (610.00) (20238.0)	0 / 0.5 (0/0.05) (0/0.5)
Start (nm) (Start (THz)) (Start (cm^{-1}))	350.000 (249.8270) (8333.381)	1200.000 (856.5000) (28571.000)	1.000 (10.0000) (1000.000)
Stop (nm) (Stop (THz)) (Stop (cm^{-1}))	1200.000 (856.5499) (28571.381)	1625.000 (999.9000) (38690.000)	350.000 (250.0000) (8334.000)
0nm Sweep Time	Minimum	50	Minimum

LEVEL

Function		Default value	Maximum value	Minimum value
Reference Level		-10.0 (Log) (100 µW (Linear))	30.0 (Log) (1000 mW (Linear))	-90.0 (Log) (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**.*dB/km		5.0, OFF	10.0	0.1
Sub Scale**.*%/D		10.0, Off	125.0	0.5
Offset Level		0.0	99.9	-99.9
Length		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	10 5(Limited model)	0.02 0.05(Limited model) 0.01(High resolution model)
Sensitivity	Sensitivity Select	N/AUTO	-	-
	Sensitivity Level (dBm)	Approx. –60 (varies depending on the instrument)	-48 (varies depending on the instrument)	-77 (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	0.001
Pulse Light Measure		Off	-	-
Gate Setting	Gate Sampling Interval	100.0	1000.0	0.1
	Gate Logic	Posi	-	-
	Measure Delay	100.0	1000.0	0.1
Trigger Setting	Edge (Rise/Fall)	RISE	-	-
	Delay (µs)	0	100000	0
	Trig Input Mode	Smpl Trig	-	-
	Trig Output Mode	Off	-	-
Horizontal Scale (nm/THz/cm⁻¹)		nm	-	-
Resolution Correction (Off/On)		Off	-	-
Smoothing (Off/On)		Off	-	-
Fiber Core Size (Small/Large)		Small	-	-

ZOOM

Function	Default value	Maximum value	Minimum value	Notes
Zoom Center (nm) (Zoom Center (THz))	775.000 (553.1885) (18452.381)	1200.000 (856.5000) (28571.000)	350.000 (250.0000) (8334.000)	The Center, Span, Start, and Stop values are not saved in the setup data file (STE extension).
Zoom Span (nm) (Zoom Span (THz))	850.000 (606.72) (20238.0)	850.0 (610.00) (20238.0)	0.1 (0.01) (0.1)	
Zoom Start (nm) (Zoom Start (THz))	350.000 (249.8270) (8333.381)	1199.950 (856.4950) (28570.950)	1.000 (10.0000) (1000.000)	
Zoom Stop (nm) (Zoom Stop (THz))	120.000 (856.5499) (28571.381)	1625.000 (999.9000) (38690.000)	350.050 (250.0050) (8334.050)	
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 (B, C, D, E, F, G: BLANK)	-	-
FIX			TRACE B/C/D/E/F/G	-	-
Hold			Max Hold (B, D, E: Min Hold 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)		
Calculate G	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			// AQ6373E OPTICAL SPECTRUM ANALYZER //	-	-
Noise Mask			OFF	-	-
Mask Line (VERT/HRZN)			HRZN	-	-
Trace Highlight			Off	-	-

MARKER

Function		Default value	Maximum value	Minimum value	Notes
Maker Active (Off/On)		Off	-	-	The Maker Active and Set Marker values are not saved in the setup data file (STE extension).
(Set Marker)	(Set)	1	1024	1	
(Marker Setting)		Normal Maker	-	-	-
Line Marker 1 (Off/On)		Off	WL=1200.0000 (FREQ=856.54988) (WNUM=28578.4286)	WL=350.0000 (FREQ=249.82705) (WNUM=8333.3333)	-
Line Marker 2 (Off/On)		Off	WL=1200.0000 (FREQ=856.54988) (WNUM=28578.4286)	WL=350.0000 (FREQ=249.82705) (WNUM=8333.3333)	-
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	Notes
Spec Width		THRESH	-	-	-
Analysis 1		DFB-LD	-	-	-
Analysis 2		OSNR(WDM)	-	-	-
Spec Width Thresh		3.00	50.00	0.01	-
(Switch Display)	TRACE&TABLE/TABLE/ TRACE/GRAPH&TABLE/ GRAPH	TRACE&TABLE	-	-	The Switch Display values are not saved in the setup data file(STE extension).
Auto Analysis (Off/On)		Off	-	-	-
Search/Ana L1-L2 (Off/On)		Off	-	-	-
Search/Ana Zoom Area (Off/On)		On	-	-	-

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
	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
	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
	POWER	SPAN	0.40	500.00	0.01
	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
TLS	-XdB CENTER/ WIDTH	ALGO (ENVELOPE/THRESH/RMS/PK-RMS)			-	-
		THRESH			50.00	0.01
		(THRESH2)			50.00	0.01
		K			10.00	1.00
		MODE FIT (ON/OFF)			-	-
		MODE DIFF			50.00	0.01
	SMSR	SMSR MODE (SMSR1/SMSR2/SMSR3/SMSR4)			-	-
		SMSR MASK			99.99	0.00
		MODE DIFF			50.00	0.01
		SIDE MODE POWER (TRACE DATA/ NORMALIZED			-	-
		(BANDWIDTH)			1.00	0.01
	POWER	SPAN			500.00	0.01
	SSER/STSSER	SSER ALGO (IEC Std./CurveFit)			-	-
		MODE DIFF			50.00	0.01
		ANALYSIS AREA			100.00	0.01
		(FITTING AREA)			100.00	0.01
		MASK AREA			100.00	0.01
		FITTING ALGO (GAUSS/LORENZ/3RD POLY/4TH POLY)			-	-
		BANDWIDTH			1.00	0.01
		SIGNAL POWER (PEAK/INTEGRAL)			-	-
				10.0	999.9	1.0

		Function		Default value	Maximum value	Minimum value
OSNR(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/ DRIFT(MEAS))		ABSOLUTE	-	-
		CH RELATION (OFFSET/ SPACING)		OFFSET	-	-
		REF CH		HIGHEST	1024	1
		OUTPUT SLOPE (ON/OFF)		OFF	-	-
		POINT DISPLAY (ON/OFF)		ON	-	-
		OSNR DISPLAY (ON/OFF)		ON	-	-
	OTHER SETTING	SIGNAL POWER (PEAK/ INTEGRAL)		PEAK	-	-
		(INTEGRAL RANGE)	GHz	10.0	999.9	1.0
			dB	-	99.99	0.01

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)	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)	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

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System Setup

FILE

	Function		Default value	Maximum value	Minimum value	Notes
Save	DRIVE INT/EXT		INT	-	-	The DRIVE value is not saved in the setup data file (STE extension).
	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			-

APP

			Function	Default value	Maximum value	Minimum value	Notes
Data Logging	Cursol/Scale			Cursol Select	C1 (Off)	-	-
	Setup	Logging Parameter	LOGGING ITEM	WDM	-	-	
			LOGGING MODE	MODE2	-	-	
			MINIMUM INTERVAL	1s	-	-	
			TEST DURATION	00.00:00:10	†	††	
			PEAK THRESH TYPE	ABSOLUTE	-	-	
			THRESH(ABS)	-60.00	+20.00	-100.00	
			THRESH(REL)	20.00	99.99	0.01	
			CH MATCHING λ				
			THRESH	0.10	1.00	0.01	
			TRACE LOGGING	OFF	-	-	
			DESTINATION MEMORY	INTERNAL	-	-	
		Analysis Parameter	See the WDM, PEAK, MULTI-PEAK, and DFB-LD columns of ANALYSIS.				
		Graph Channel	Single	-	-	
		Table Setting	Table Mode	CURR	-	-	
			(Summary Type)	(MAXMIN)	-	-	
		Data Display	ABS	-	-	

† 99.23:59:59 (when the MINIMUM INTERVAL is set to SWEEP TIME)
Maximum measurement count × minimum interval (when not set to SWEEP TIME)

†† MINIMUM INTERVAL value (the same as that for 1s when SWEEP TIME is used)

SYSTEM

Function			Default value	Maximum value	Minimum value	Notes
Wavelength Calibration	External Laser		632.991	1200.000	350.000	-
	(Emission Line)		435.956, OFF	1200.000	350.000	-
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		AQ6373E	-	-	-
Network Setting	TCP/IP Setting*	IPv4 SETTING	AUTO	-	-	The IP address, subnet mask, and default gateway values are not saved in the setup data file (STE extension).
		IPv6 SETTING	DISABLE	-	-	
	Remote Port No.		10001	65535	1024	
	Command Format		AQ6373E	-	-	
	Remote User Account*		anonymous	-	-	
	Remote Monitor	Monitor Port (Off/On)	On	-	-	
		Port No.	20001 (FIX)	-	-	
	Folder Sharing		Disable	-	-	The Folder Sharing value is not saved in the setup data file (STE extension).
	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	-	-	The Language value is not saved in the setup data file (STE extension) It will be initialized by Parameter Initialize > All Clear.
Set Clock	YR-MO-DY		On	-	-	The date and time settings are stored in the instrument but not in the setup data file (STE extension).
	MO-DY-YR		Off	-	-	
	DY-MO-YR		Off	-	-	

*: Will not be initialized.

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System Setup

Appendix 1 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 (THRESH1[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

Note

If "MODE FIT" is set to ON for one mode peak, the spectral width Δλ and the center wavelength λC will become as follows.

  Δλ=0.0000 nm

  λC = mode peak wavelength

Two or more mode peaks
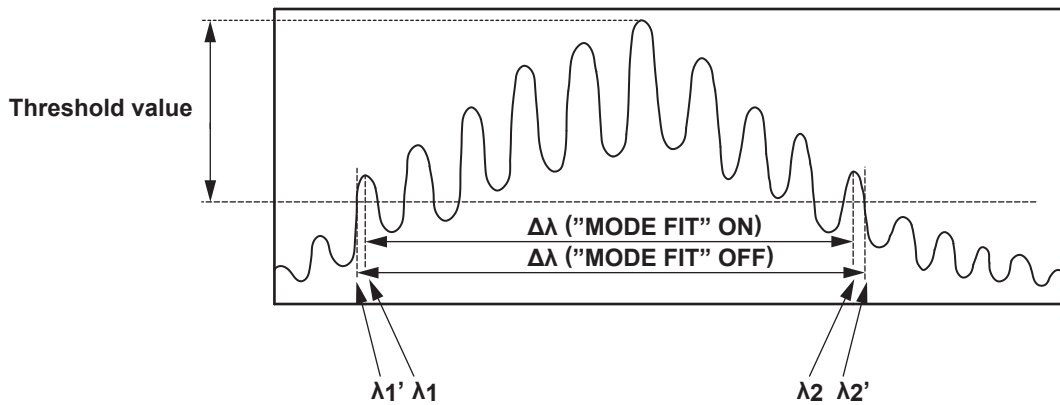
- If "MODE FIT" is ON, the wavelengths of the mode peaks, which are outermost from the threshold value (THRESH[dB]) among the mode peaks, are assigned to λ1 and λ2.
  If "MODE FIT" is OFF, the wavelengths, which are located outside λ1 and λ2, and which cross the line below the mode peak with the largest 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.

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
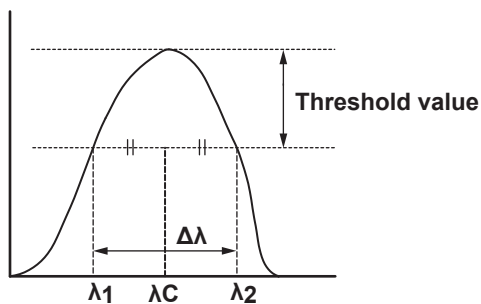
- A mode search is performed to obtain the mode peaks.
- Wavelengths, which cross the line below the mode peak by the threshold value (THRESH 1[dB]), are assigned to $\lambda 1$ and $\lambda 2$.
- New $\lambda 1$ and $\lambda 2$ are obtained by multiplying factor K to the original $\lambda 1$ and $\lambda 2$ 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 λC is determined from the following equation.
  $\lambda C=(\lambda 2+\lambda 1)/2$

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Two valid mode peaks
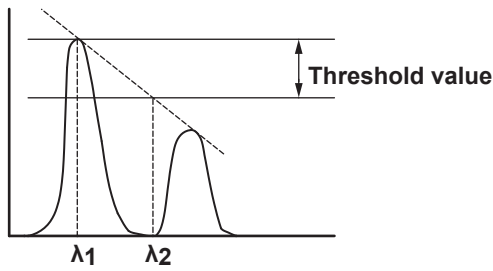
- The levels (LOG) of the two valid mode peaks are assigned to LG1 and LG2 in order from the left.

- $\lambda 1$ and $\lambda 2$ are determined using the following method.
- When $|LG2 - LG1| \leq$ threshold value (THRESH 1[dB]), λ 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 λC is determined from the following equation.
  $\lambda C = (\lambda 2 + \lambda 1)/2$

Three or more valid mode peaks
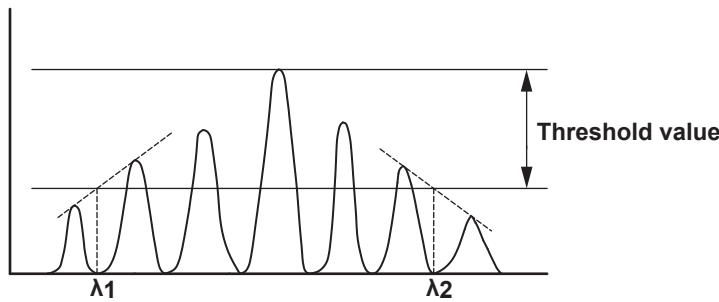
- The levels (LOG) of three or more valid mode peaks are assigned to LG1, LG2, . . ., LGn in order from the left. The level of the mode peak at the highest level is assigned to LGp.

- 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.
  $λC=(λ2+λ1)/2$

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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.

Peak level
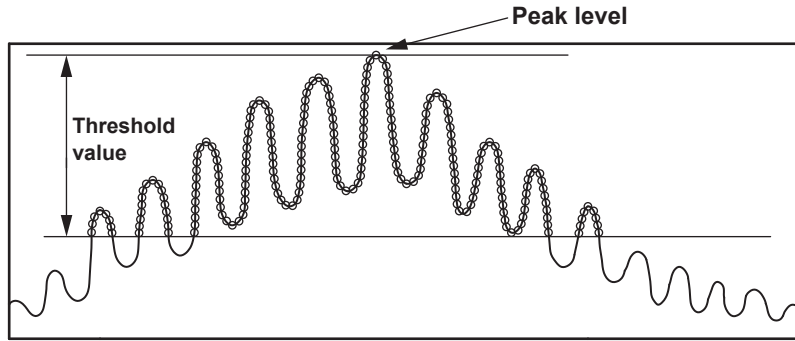
Threshold value

- 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.

$$\Delta\lambda = K \times \sqrt{\frac{\sum P_i \times (\lambda_i - \lambda_c)^2}{\sum P_i}}$$

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.
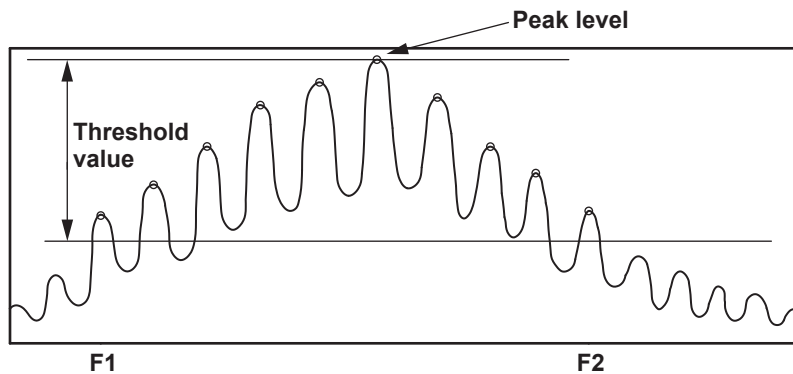
- The mode peaks lying between the threshold value TH and peak level, within the displayed waveform, are removed, and the spectrum width is determined by the following calculation. MODE NUM in the data area shows the number of mode peaks exceeding the threshold value TH.
- When the wavelength at each point is 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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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
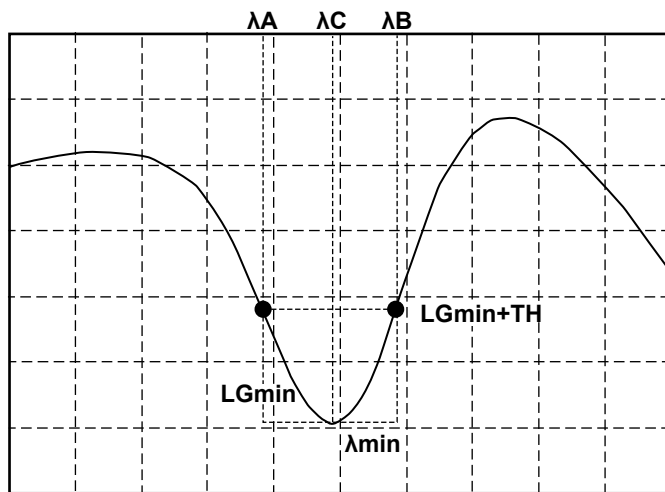
- The minimum level "LGmin" is obtained. The wavelength of this point assigned to λmin.
- The rightmost wavelength located on the left of λmin and that crosses the level (LOG) of |LGmin + threshold value (THRESH[dB])| is assigned to λA.
- Set the leftmost wavelength located on the right of λmin and that 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
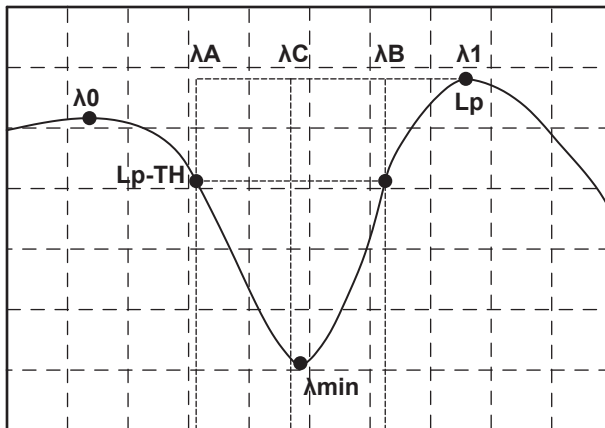
- The minimum level "LGmin" is obtained. The wavelength of this point assigned to λmin.
- LG0 at the peak level (LOG) on the left of LGmin is determined. The wavelength of this point assigned to λ0.
- LG1 at the peak level (LOG) on the right of LGmin is determined. The wavelength of this point assigned 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.
  $λC=(λA+λB)/2$

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Appendix 2   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, and SMSR 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.
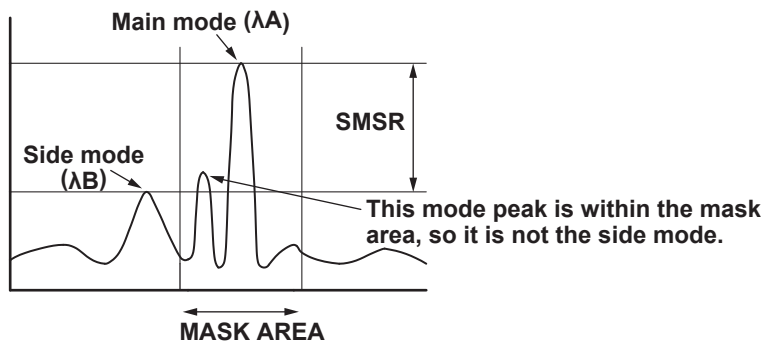
The analysis algorithm for the SMSR1 mode is as follows:

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

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

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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.

$$POWER = \frac{SPAN}{SAMPLE - 1} \times \sum \frac{Li}{Ri} + POWEROFFSET$$

POWER: Total power (mW)

SAMPLE: Number of sample points

Li: Optical power of each sample point (mW)

Ri: RMS wavelength resolution of each sample point

SPAN/(SAMPLE-1):   Sample interval (nm)

POWER OFFSET: Power correction value

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).

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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.

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.

TLS analysis algorithms

The following parameters for TLS light sources are analyzed collectively.

*   -XdB CENTER / WIDTH
*   SMSR
*   POWER
*   SSER / STSSER

The following table shows the details of TLS 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	-	-
	MODE DIFF	3.00	0.01 to 50.00	dB	Invalid when ALGO is RMS

Parameter	Abbreviation	Default value	Range	Unit	Description
SMSR	SMSR MODE	SMSR1	SMSR1 / SMSR2 / SMSR3 / SMSR4	-	Execution mode during SMSR measurement
	SMSR MASK	0.00	0.00 to 99.99	nm	Sets the mask range near the peak. Valid only when SMSR1 is selected. If SMSR MASK exceeds the SEARCH AREA setting, SMSR MASK = SEARCH AREA is assumed.
	MODE DIFF	3.00	0.01 to 50.00	dB	-
	SIDE MODE POWER	TRACE DATA	TRACE DATA/ NORMALIZED	-	Whether to normalize the SIDE MODE POWER value with the resolution bandwidth.
	BANDWIDTH	0.10	0.01 to 1.00	nm	Resolution bandwidth setting. Valid only when SIDE MODE NORM is ON.
POWER SPAN	SPAN	0.40	0.01 to 500.00	nm	-
SSER / STSSER	SSER ALGO	IEC Std.	IEC Std. or CurveFit	-	Selects the SSER analysis algorithm.
	MODE DIFF	3.00	0.01 to 50.00	dB	Minimum value for peak/bottom difference during mode detection.
	ANAYSIS AREA	50.00	0.01 to 100.00	nm	Analysis is performed within the peak±ANALYSIS AREA of the waveform.
	FITTING AREA	50.00	- / 0.01 to 100.00	nm	Performs curve fitting using data within the peak±FITTING AREA of the waveform. Valid only when ALGO is CurveFit.
	MASK AREA	1.00	0.01 to 100.00	nm	Specifies the wavelength range to exclude from analysis near main mode. MASK AREA shall be within the FITTING AREA and ANALYSIS AREA.
	FITTING ALGO	GAUSS	GAUSS / LORENZ / 3RD POLY / 4TH POLY / 5TH POLY	-	Selects the fitting algorithm when determining the noise spectrum. Valid only when ALGO is CurveFit.
	NOISE BW	1.00	0.01 to 1.00	nm	Sets the noise bandwidth during noise level normalization.

Parameter	Abbreviation	Default value	Range	Unit	Description
SSER / STSSER	SIGNAL POWER	PEAK	PEAK / INTEGRAL	-	Sets the signal power calculation method PEAK: peak level value 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 If the set value is Δf, the integral is calculated in the range of channel center wavelength ±Δf. Valid only when SIGNAL POWER is INTEGRAL.

For details on the TLS analysis algorithms, see the data calculation algorithms for spectrum widths, the SMSR analysis algorithms, and the POWER analysis algorithms.

SSER analysis algorithms

The algorithm differs depending on the SSER ALGO setting.
The analysis algorithms of each mode are described below.

IEC Std.

The largest mode peak is defined as the main mode, and the mode peaks in the ANALYSIS AREA excluding the MASK AREA are defined as side modes.
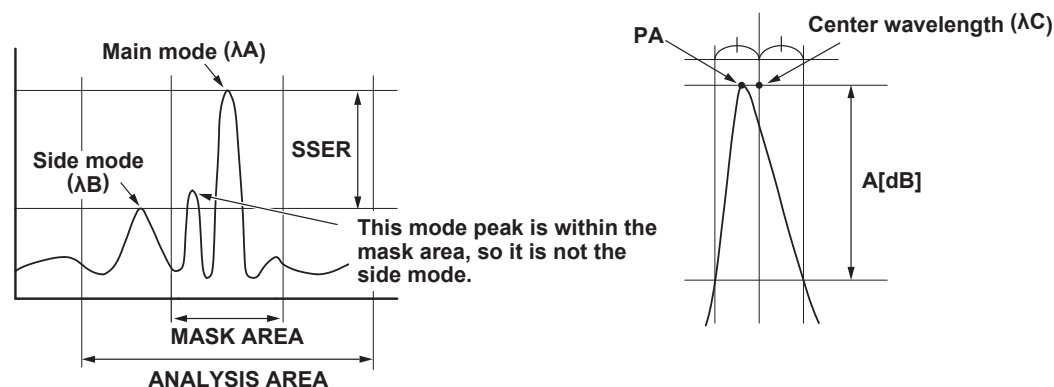
The analysis algorithm for the IEC Std. mode is as follows:

1. A mode search is performed to obtain the mode peaks.

2. The main mode point is assigned to PA. The wavelength of this point is assigned to λA.

3. The wavelength at the center of the two points A [dB] down from the main mode peak position (PA) to the left and right is the center wavelength of the mode peak, λC. (A [dB] is the smaller of 3 dB or the MODE DIFF setting.)

4. The main mode level LA [dBm] is determined.

   • When the SIGNAL POWER parameter is set to PEAK

   LA = mode peak level

   • When the SIGNAL POWER parameter is set to INTEGRAL

   LA = integrated power value at the center wavelength λC ±Δf of the mode peak [GHz].

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5. Determine the range from the ANALYSIS AREA and MASK AREA to search for the spontaneous emission light level.

6. Find the level of the maximum peak power (side mode) in the range determined in 4. Define this level as LB.

Define the wavelength at this point as λB.

Normalize LB by the actual resolution value RBi [nm] at λB.

Then, convert it to power per noise bandwidth NOISE BW [nm] using the formula below.

LB' [dBm] = LB [dBm] – 10 × Log(RBi[nm]) + 10 × Log(NOISE BW[nm])

7. Determine SSER using the formula below.

SSER [dB] = LA [dBm] - LB' [dBm]

CurveFit

The largest mode peak is defined as the main mode. The peak power in the curve-fit waveform created from the spectral data is defined as the noise power.
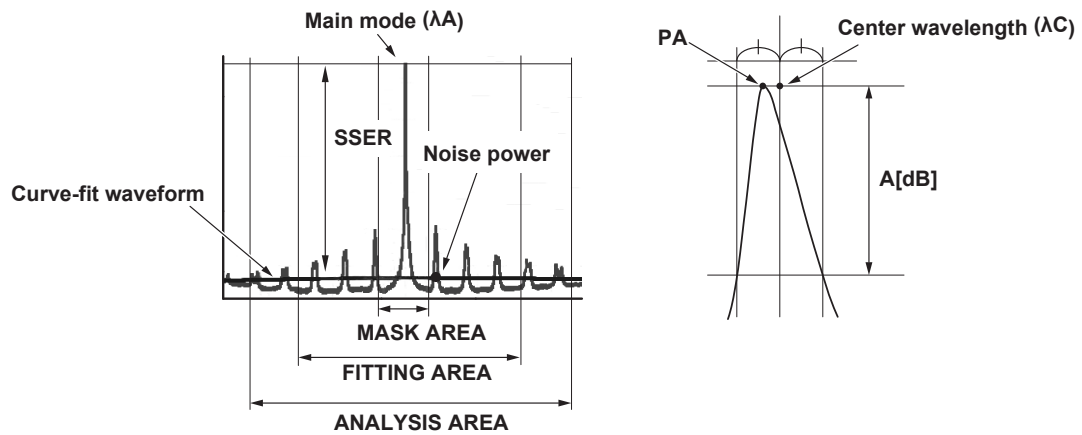
The analysis algorithm for the mode CurveFit is as follows:

1. A mode search is performed to obtain the mode peaks.

2. The main mode point is assigned to PA. The wavelength of this point is assigned to λA.

3. The wavelength at the center of the two points A [dB] down from the main mode peak position (PA) to the left and right is the center wavelength of the mode peak, λC. (A [dB] is the smaller of 3 dB or the MODE DIFF setting.)

4. The main mode level LA [dBm] is determined.

• When the SIGNAL POWER parameter is set to PEAK

LA = mode peak level

• When the SIGNAL POWER parameter is set to INTEGRAL

LA = integrated power value at the center wavelength λC ±Δf of the mode peak [GHz].

5. Determine the fitting range from the ANALYSIS AREA and MASK AREA to create a curve-fit waveform of the light source under test.

6. Create a curve-fit waveform from the fitting range data obtained in 5.

7. Let the maximum peak power (noise power) in the curve-fit waveform obtained in 6. be the level of spontaneous emission light, LB [dBm]. Define the wavelength at this point as λB.

Normalize LB by the actual resolution value RBi [nm] at λB.

Then, convert it to power per noise bandwidth NOISE BW [nm] using the formula below.

LB' [dBm] = LB [dBm] – 10 × Log(RBi[nm]) + 10 × Log(NOISE BW[nm])

8. Determine SSER using the formula below.

SSER [dB] = LA [dBm] - LB' [dBm]

STSSER analysis algorithms

The largest mode peak is defined as the main mode.
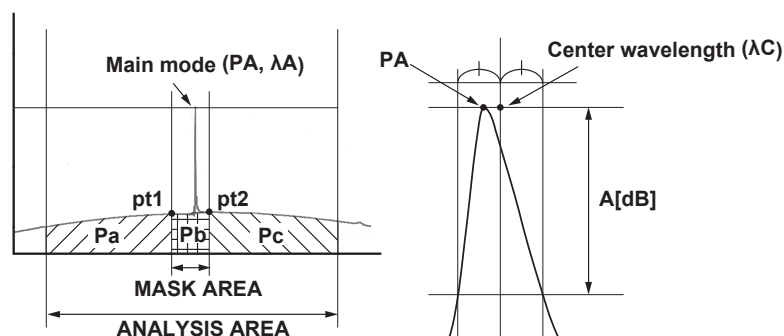
The analysis algorithm for the mode STSSER is as follows:

1. A mode search is performed to obtain the mode peaks.

2. The main mode point is assigned to PA. The wavelength of this point is assigned to λA.

3. The wavelength at the center of the two points A [dB] down from the main mode peak position (PA) to the left and right is the center wavelength of the mode peak, λC. (A [dB] is the smaller of 3 dB or the MODE DIFF setting.)

4. The main mode level LA [dBm] is determined.

• When the SIGNAL POWER parameter is set to PEAK

LA = mode peak level

• When the SIGNAL POWER parameter is set to INTEGRAL

LA = integrated power value at the center wavelength λC ±Δf of the mode peak [GHz].

5. Determine the power, LB, of spontaneous emission light according to the following procedure.

• Let Pa be the integrated spectral power from the left end of the ANALYSIS AREA to the left end of the MASK AREA.

• Let pt1 be the point of the spectrum at the left end of the MASK AREA and pt2 be the point of the spectrum at the right end of the MASK AREA. Connect pt1 to pt2 with a straight line, and let Pb be the integral power of the range bounded by the line, the horizontal axis, and MASK AREA.

• Let Pc be the integrated spectral power in the range from the right end of the MASK AREA to the right end of the ANALYSIS AREA.

Determine LB from the formula below.

LB = Pa + Pb + Pc

6. Determine STSSER using the formula below.

STSSER [dB] = LA [dBm] - LB [dBm]

Appendix 3   OSNR (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 λ_i of the channel
LEVEL: Level (peak level − noise level) L_i 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 LN_i of the channel
SNR: SNR value SN_i of the channel
MEAS WL: Center wavelength λ_i 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 MANUAL-FIX AUTO-CTR MANUAL-CTR 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. When N_ALGO is: • AUTO-FIX: "AUTO" • MANUAL-FIX: **.** • AUTO-CTR: "Between Ch" • MANUAL-CTR: "Between Ch" • 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.
				When N_ALGO is:
				• AUTO-FIX "–"
				• MANUAL-FIX
				  When F_ALGO is LINEAR: "–"
				  Other cases: Parameter value input
				• AUTO-CTR: "–"
				• MANUAL-CTR
				  When F_ALGO is LINEAR: "–"
				  Other causes: Parameter value input
				Limiter is applied during input to ensure NOISE AREA ≥ MASK AREA.
				• PIT "–"

FITTING ALGO	LINEAR	LINEAR GAUSS LORENZ 3RD POLY 4TH POLY 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. 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 DRIFT(MEAS)	-	Setting of the format to display wavelengths, levels, noises, and SNRs, which are the results of analyses. ABSOLUTE: Absolute values DRIFT(MEAS): Drift relative to a past measured wavelength
CH RELATION	OFFSET	OFFSET SPACING	-	Setting of the format to display wavelengths between channels and level relative values during DISPLAY: ABSOLUTE. This parameter is valid only when DISPLAY is set to ABSOLUTE. OFFSET: Offset values by using one arbitrary channel as the reference. SPACING: Offset values compared to an adjacent channel
REF CH	HIGHEST	HIGHEST ****	-	Setting of the reference channel when CH RELATION is set to OFFSET. This parameter is valid only when DISPLAY is set to ABSOLUTE and also when CH RELATION is set to OFFSET. HIGHEST: A channel with the highest level is used as the reference. ****: The ****th channel is used as the reference.
MAX/MIN RESET	—	—	-	Pressing the button resets MAX/MIN. 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.
OSNR DISPLAY	ON	ON/OFF	-	ON/OFF of the function that shows the noise and OSNR analysis results The channel level includes the noise when OFF is selected. When OSNR DISPLAY is OFF, the POINT DISPLAY parameter is turned off (can be changed). The red line indicating the noise is also hidden.

Other settings

Parameter	Default	Range	Unit	Description
SIGNAL POWER	PEAK	PEAK INTEGRAL	-	Setting of the signal power calculation method PEAK: Peak level value INTEGRAL: Level value obtained by integration The waveform in the integral range is displayed in blue, and INTEGRAL RANGE (IR) is displayed in the analysis conditions of the list of analysis results.
INTEGRAL RANGE	10.0 GHz or 10.00 dB	1.0 to 999.9 for GHz 0.01 to 99.99 for dB	GHz or dB	• Setting of the integral range for determining the signal optical power. Set the integral range by the difference from the frequency or peak (XdB lower position). • 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. (For dB, the position XdB down from the peak of each channel is detected, and integration is performed over that range.)

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Analysis Algorithm
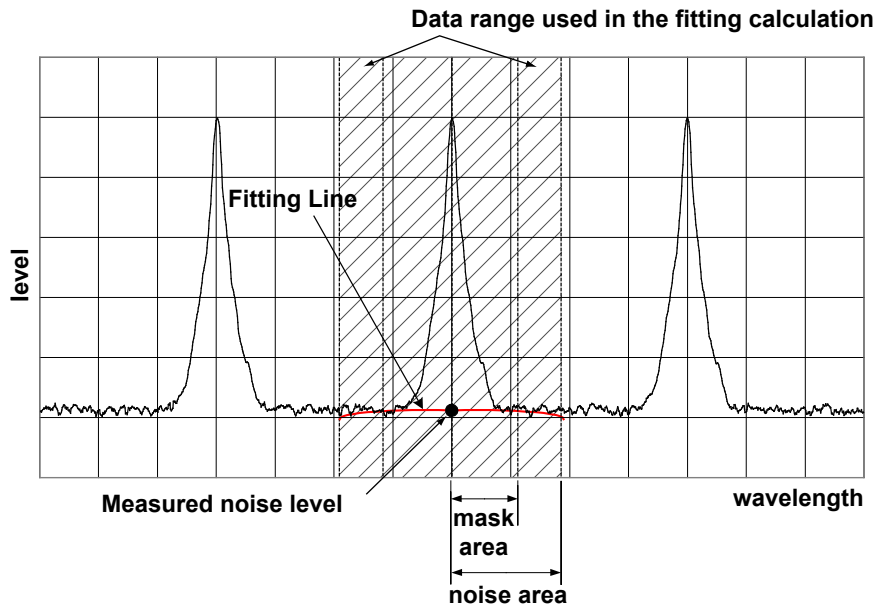
1. Channel detection is performed on the measured waveform data according to the following procedure.

   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"

   When the INTEGRAL RANGE unit is {GHz}

   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)

   When the INTEGRAL RANGE unit is {dB}

   The positions XdB down from the level at the wavelength of each mode peak are expressed as $λs$ and $λe$.

   LSi = Integrated power values in the range of $λs$ to $λe$

* If the position XdB down cannot be detected, the bottom of the mode on the left and the bottom of the mode on the right are detected, and LSi becomes the integrated power value in the range from the bottom of the mode on the left to the bottom of the mode on the right.

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.

When OSNR DISPLAY is ON

$$Li = LSi(linear) - LNi(linear)$$

When OSNR DISPLAY is OFF

$$Li = LSi(linear)$$

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=λ_i+NOISE AREA
  NA_Li = λ_i – NOISE AREA

  When the number of WDM channels "n" is 2 or more
  $\lambda N_1 = (3\lambda_1 - \lambda_2)/2$
  i=2,3,…,n
  $\lambda N_i = (\lambda_i - \lambda_{i-1})/2$
  $\lambda N_{n+1} = (3\lambda_n - \lambda_{n-1})/2$
  When the above values are calculated, the following results will be obtained.
  i=1,2,…,n
  NA_Li=λN_i
  NA_Ri=λN_{i+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 λ_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.

App

Appendix

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

App

Appendix
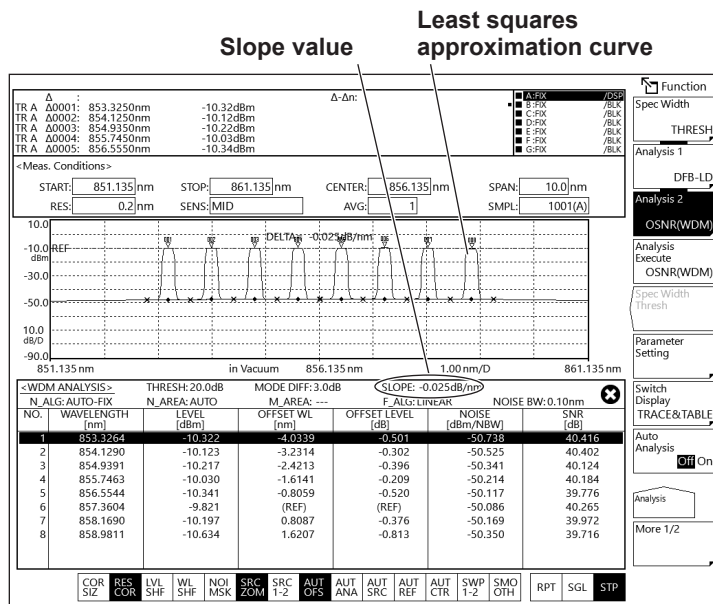
Items to be Displayed When DISPLAY is Set

ABSOLUTE

Results of analyses are displayed with absolute values.
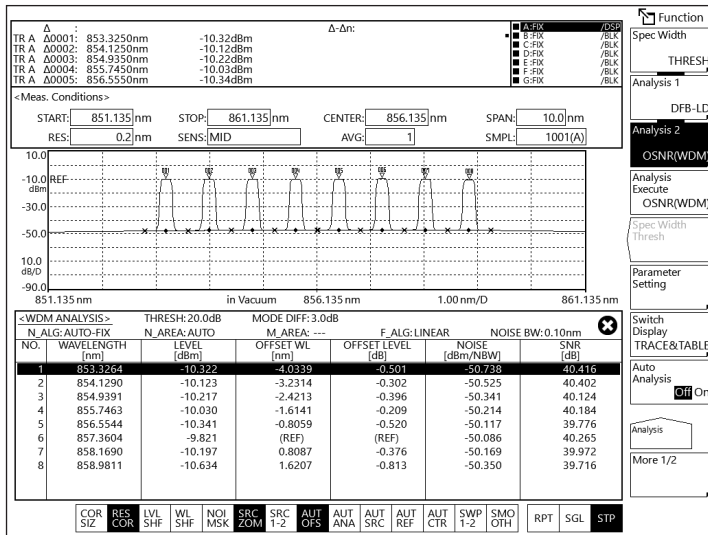
- **Explanations of displayed items**

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.)

DRIFT(MEAS)

Wavelengths measured previously are used as references to display wavelength/level changes (drifts).
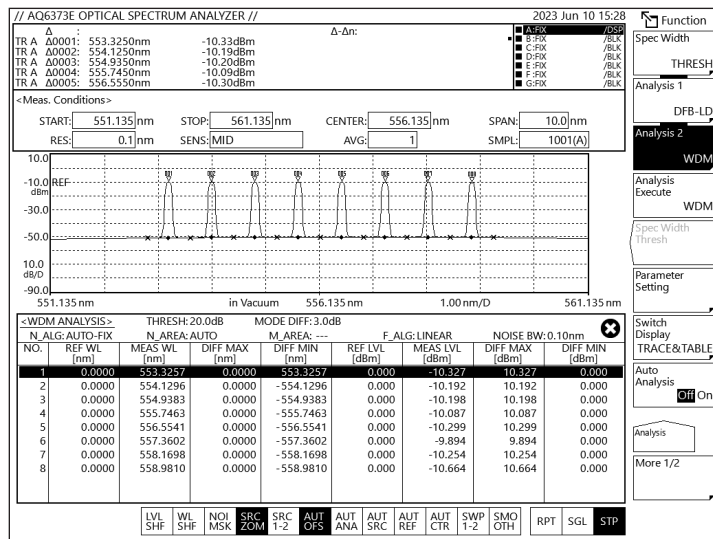
- **Explanations of displayed items**

NO:	Channel number
REF WL:	Reference wavelength of the channel (previous wavelength measured)
MEAS WL:	Center wavelength 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

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.

App

Appendix

Appendix 4   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.

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 : -	0.1 to 50.0	dB	Threshold value for channel detection. Valid only when ALGO is THRESH.
	K	THRESH : 1.00 PK LEVEL: -	1.00 to 10.00	-	Multiplying factor Valid only when ALGO is THRESH.
	MODE FIT	THRESH : OFF PK LEVEL: -	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: -	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.

App

Appendix

Description
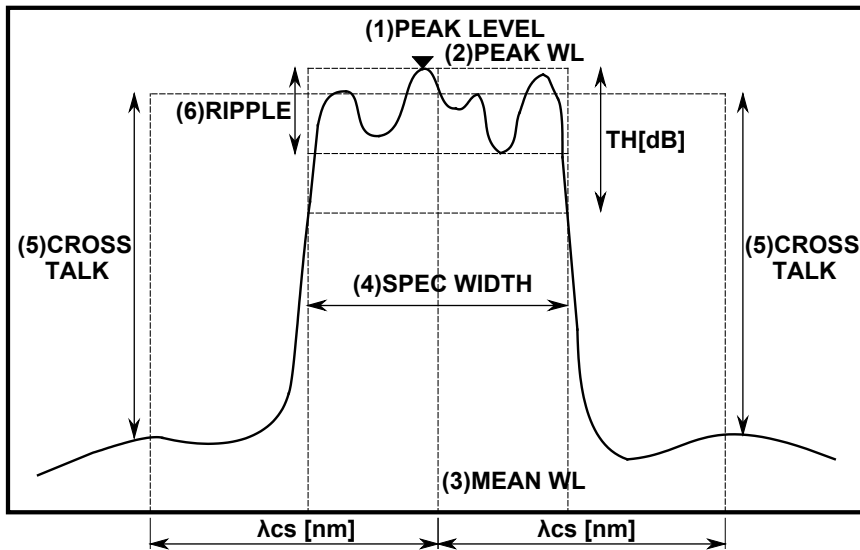
(1) Peak level (PEAK LEVEL)   value of the level at the waveform peak position

(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.

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	-	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	-	Minimum value of the peak/bottom difference during channel detection. 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
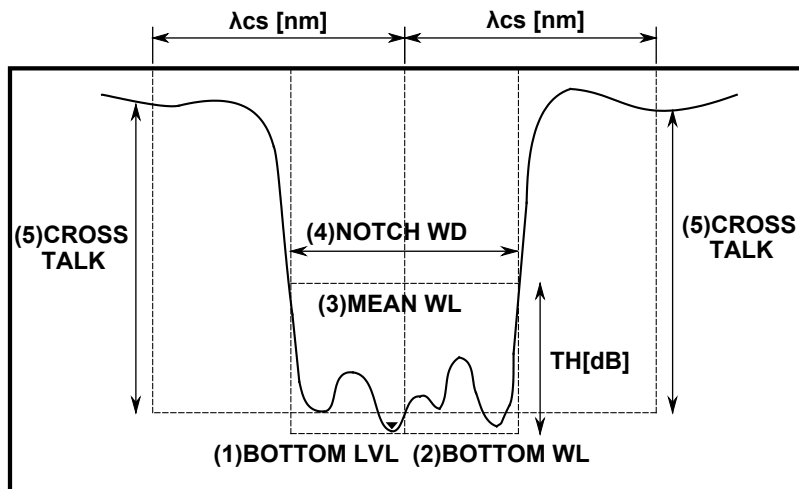
(1) Bottom level (BTM LVL)	Value of level at the waveform bottom position
(2) Bottom wavelength (BTM WL)	Value of wavelength at the waveform bottom position
(3) Center wavelength (MEAN WL)	Value of center wavelength at the threshold value TH
(4) Notch width (NOTCH WD)	Notch width at the threshold value 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.

Appendix 5   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 775.000nm — **Center wavelength (frequency or wavenumber) setting (2.1)**

Start 350.000nm — **Measurement start wavelength (frequency or wavenumber) setting (2.1)**

Stop 1200.000nm — **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 850.0nm — **Sweep span setting (2.1)**

Start 350.000nm — **Measurement start wavelength (frequency or wavenumber) setting (2.1)**

Stop 1200.000nm — **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

App

Appendix

LEVEL

LEVEL (1/3)   **LEVEL (2/3)**   **LEVEL (3/3)**

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 dB/km (2.6)
12	Setting the sub scale to % (2.6)
13	Linear sub scale bottom setting or offset level setting for LOG (2.6)
14	Setting the length of the optical fiber (2.6)
15	Vertical scale setting (2.5)
	15-1 Number of divisions in the level axis (2.5)
	15-2 Reference level position on the screen (2.5)
	15-3 Reference level position on the sub scale (2.6)
16	Sub scale initialization
17	Automatic scaling of sub scale (2.6)

SETUP

SETUP (1/2)

SETUP (2/2)
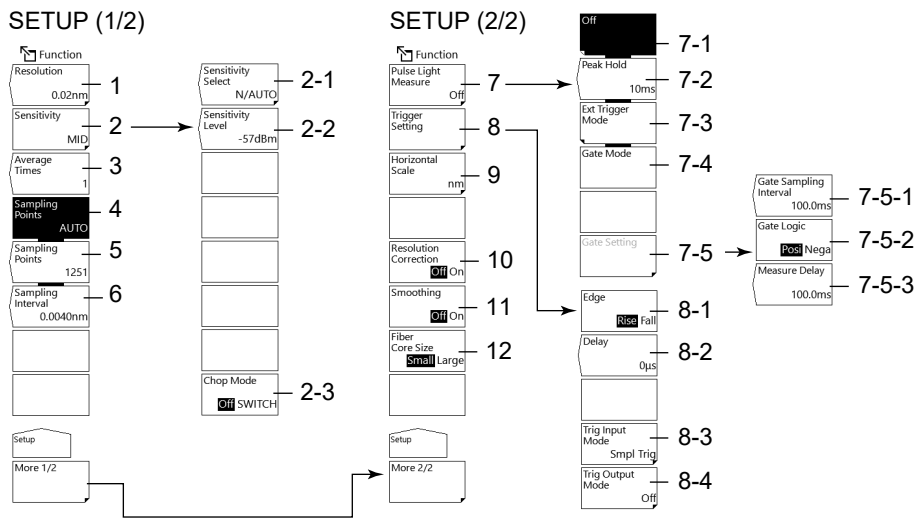
1　　Measurement resolution setting (2.2)
2　　Measurement sensitivity settings (2.4)
　　　2-1　Measurement sensitivity selection (2.4)
　　　2-2　Measurement sensitivity level setting (2.4)
　　　2-3　Setting the CHOP Mode (2.4)
3　　Average times setting (2.7)
4　　Automatic sampling points setting (2.3)
5　　Manual sampling 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 setting (3.3)
　　　　　　7-5-1　Gate sampling interval time setting (3.3)
　　　　　　7-5-2　Gate signal logic setting (3.3)
　　　　　　7-5-3　Measure delay 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　　Resolution Correction(2.2)
11　　Smoothing (2.7)
12　　Fiber Core Size (see IM AQ6373E-02EN)

App

Appendix

ZOOM

Function
| Zoom Center | — | **Setting the center wavelength (frequency or wavenumber) of the zoom display (4.1)** |

775.000nm
| Zoom Span | — | **Setting the span of the zoom display (4.1)** |

850.0nm
| Zoom Start | — | **Setting the start point of the zoom display (4.1)** |

350.000nm
| Zoom Stop | — | **Setting the stop point of the zoom display (4.1)** |

1200.000nm
| Peak -> Zoom Ctr | — | **Setting the peak position to the center of the zoom display (4.1)** |

| Overview Display | — | **Setting the display position of the overview (4.1)** |

Off L **R**
| View Scale -> Measure | — | **Assigning the current scale to the measurement scale of the next sweep (2.1)** |

Initialize — **Initializing the display scale (4.1)**

Zoom

FILE

Function

Save	— 1		Trace	— 3-1
Load	— 2		All Trace	— 3-2
Item Select	— 3	→	Graphics	— 3-3
Trace				
Auto File Name	— 4		Setting	— 3-4
Num Date			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)
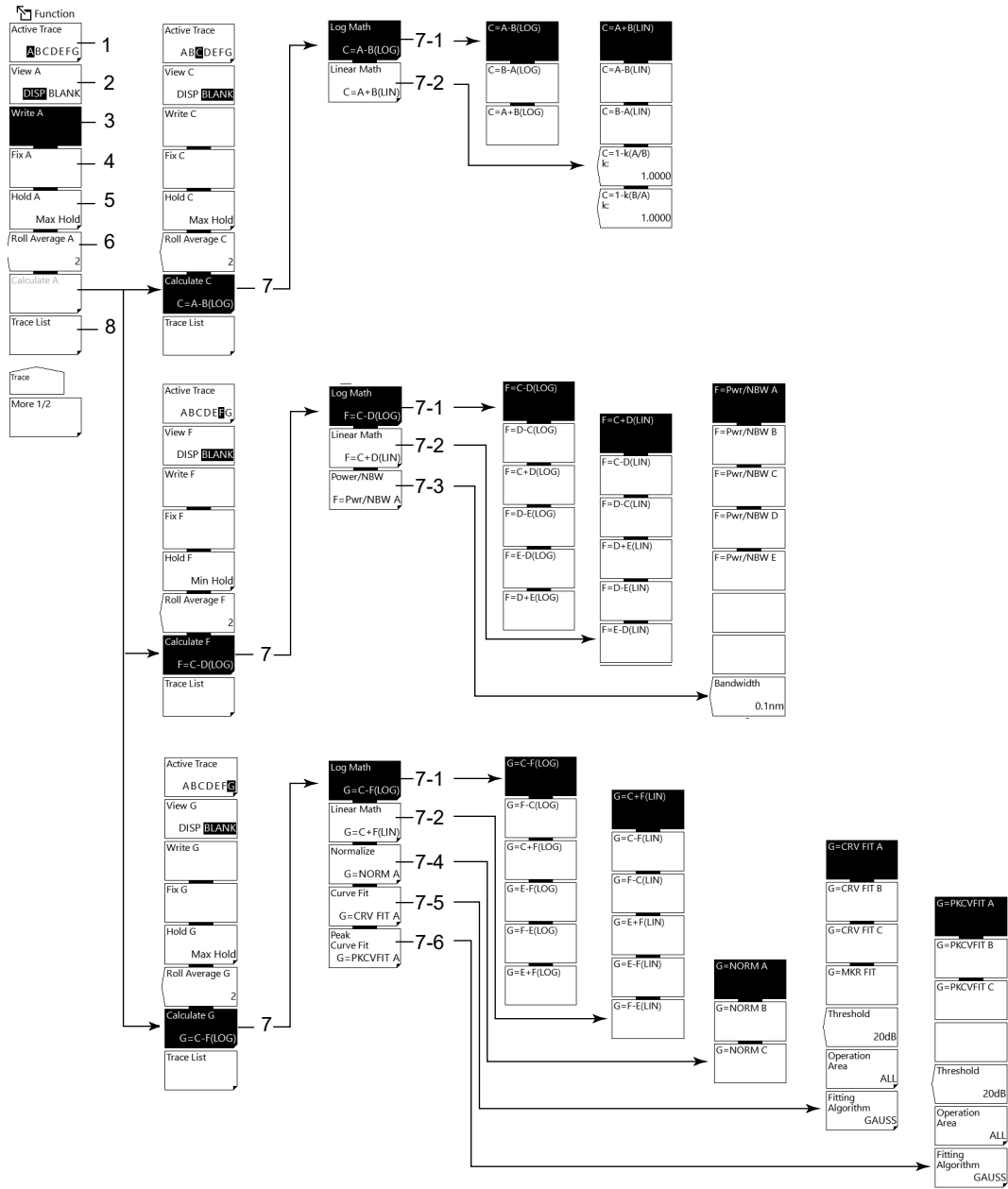
1   Active tray setting (4.2)
2   Show/hide active trace setting (4.2)
3   Setting active trace to write mode (4.2)
4   Setting active trace to fixed mode (4.2)
5   Setting active trace to MAX/MIN hold mode (4.3)
6   Setting active trace sweeping to average mode (4.4)

App

Appendix

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)
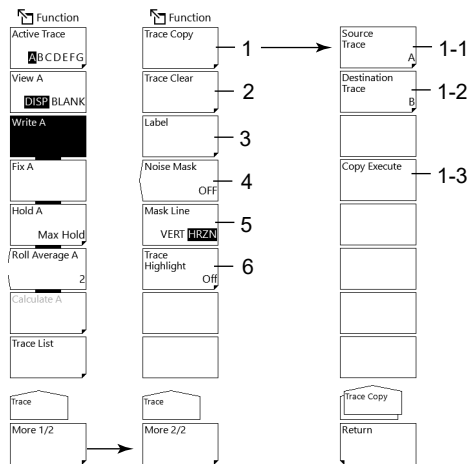
1   Copy trace (4.10)

        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 AQ6373E-02EN)

4   Noise mask setting (4.11)

5   Mask line setting (4.11)

6   Trace highlighting (4.12)

MARKER
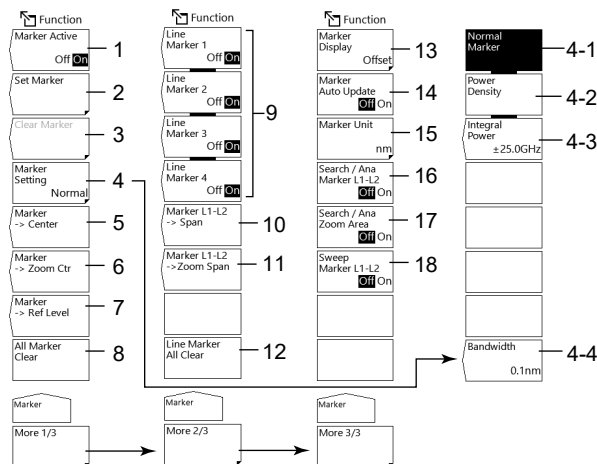
1   Moving marker display on/off (5.1)
2   Setting moving markers to fixed markers (5.1)
3   Clearing fixed markers (5.1)
4   Marker type selection (5.1, 5.3, 5.4)

    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)

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PEAK SERACH
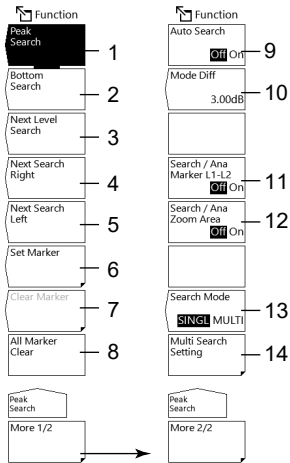
1   Executing a peak search (4.9)

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
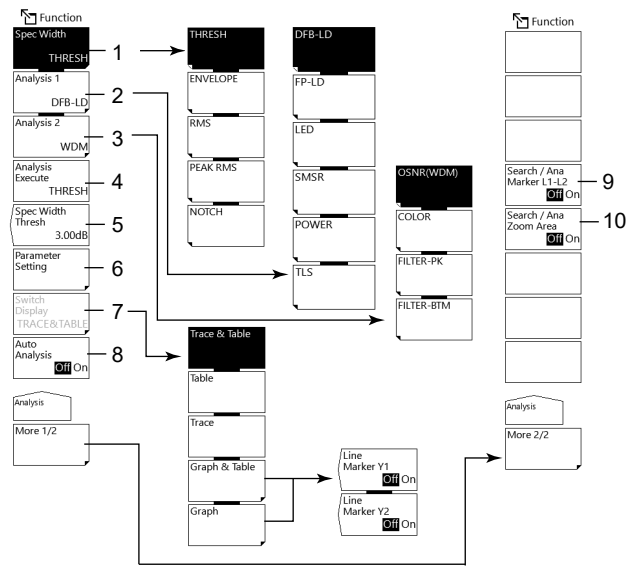
1   Spectrum width analysis algorithm settings/execution (6.2)

2   Analysis function settings (6.3 to 6.5)

           (DFB-LD, FP-LD, LED, SMSR, POWER, TLS)

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)

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SYSTEM(More 1/4)
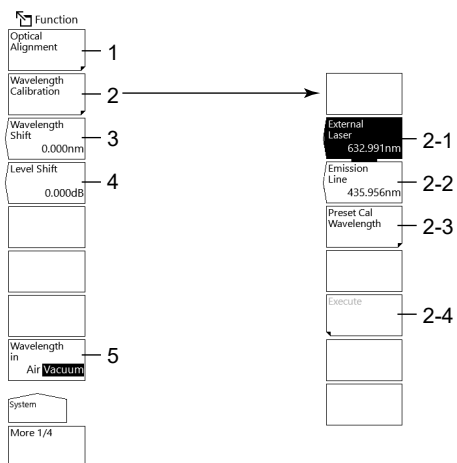
1   Executing the monochromator alignment adjustment (see IM AQ6373E-02EN)

2   Wavelength calibration (IM AQ6373E-02EN)

   2-1   Wavelength calibration using a laser type external reference light source

   2-2   Wavelength calibration using an emission line light source

   2-3   Wavelength calibration setting for wavelength calibration using an external reference light source

   2-4   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)
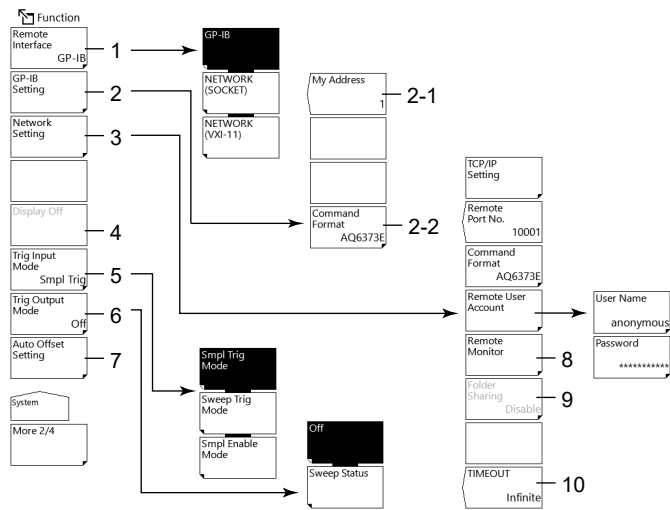
1   Communication interface settings (see IM AQ6373E-17EN)

2   GP-IB interface settings (see IM AQ6373E-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)

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SYSTEM(More 3/4, More 4/4)
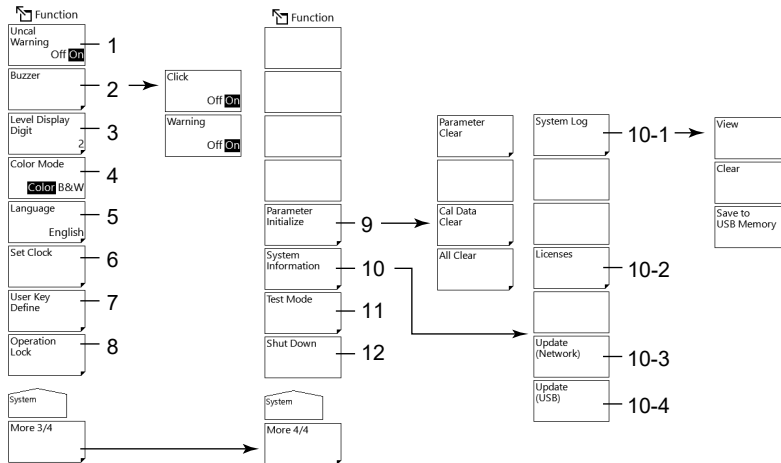
1	UNCAL and warning On/Off (9.4)
2	Buzzer settings (9.6)
3	Setting the number of level data digits (1.5)
4	Display color setting (1.5)
5	Language setting (1.5)
6	date and time settings (see IM AQ6373E-02EN)
7	User-defined menu registration(9.1)
8	Key lock (9.2)
9	Initializing the settings (9.9)
10	System 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 AQ6373E-02EN)

10-4 Updating the firmware (USB memory) (see IM AQ6373E-02EN)

11	Service menu
12	System shutdown (see IM AQ6373E-02EN)

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Function

Information — 1

Execute — 2

Install — 3

Uninstall — 4
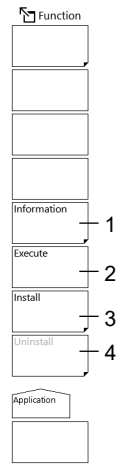
Application

1	Application information display (8.2)
2	Application execution (chapter 8)
3	Application installation (8.2)
4	Application uninstallation (8.2)

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