

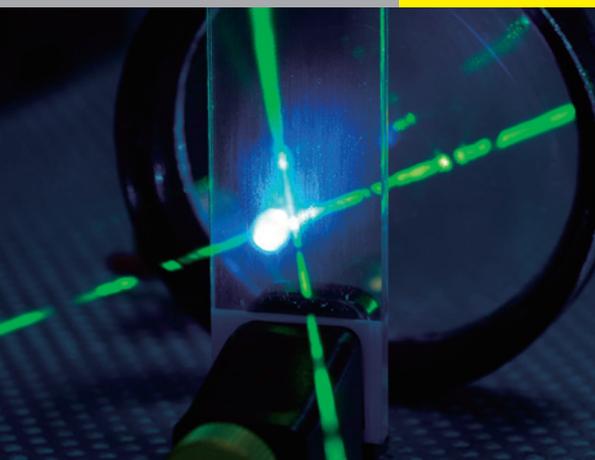


Next generation optical performance

AQ6380 Optical Spectrum Analyzer

Precision Making

Bulletin AQ6380-01EN



Global growth in mobile broadband access changes the way people live, work and collaborate.

The increasing number of mobile users and the expansion of communication services such as IoT and cloud will drive exponential growth in data traffic.

The communication technologies such as 5G and wavelength division multiplexing (WDM) are continually being developed, deployed and further improved. There's a challenging task at hand to develop and test the quality and performance of new optical devices and components used with great precision.

Equipped with a state-of-the-art monochromator, Yokogawa's AQ6380 offers the performance required by engineers and scientists to develop and improve speed, bandwidth and quality of optical transceivers and components used for the next generation of communication networks.

Performance – Excellent optical wavelength resolution, accuracy and close-in dynamic range specifications allow optical signals in close proximity to be clearly separated and accurately measured.

Productivity – Smart technology and functionality such as an intuitive touchscreen, automated wavelength calibration, optimized sweep speed and dedicated application allow users to operate the OSA efficiently to keep pace with the ever-evolving optical technology.

Expertise – For more than 40 years, our R&D and product specialist teams have been listening to the needs of OSA users to continuously provide them with innovative and effective solutions for their measuring challenges.

Unparalleled optical performance

Sharper, Deeper, and more precise

- High wavelength resolution: 5 pm
- High wavelength accuracy: ± 5 pm
- Wide close-in dynamic range: 65 dB
- High stray-light suppression: 80 dB

Fast measurement

Even with high resolution and high sample count

- New sensitivity mode "RAPID" increases measurement speed.

Automated wavelength calibration

- Fully automated periodical wavelength calibration with a built-in light source
- Semi-automated wavelength calibration with an external light source

Gas purging mechanism

- Reduction of the influence of water vapor absorption spectrum shown around 1380 nm



Large touchscreen LCD

- Inheriting the easy-to-use operability proven by many users
- Touchscreen makes operations even more intuitive.



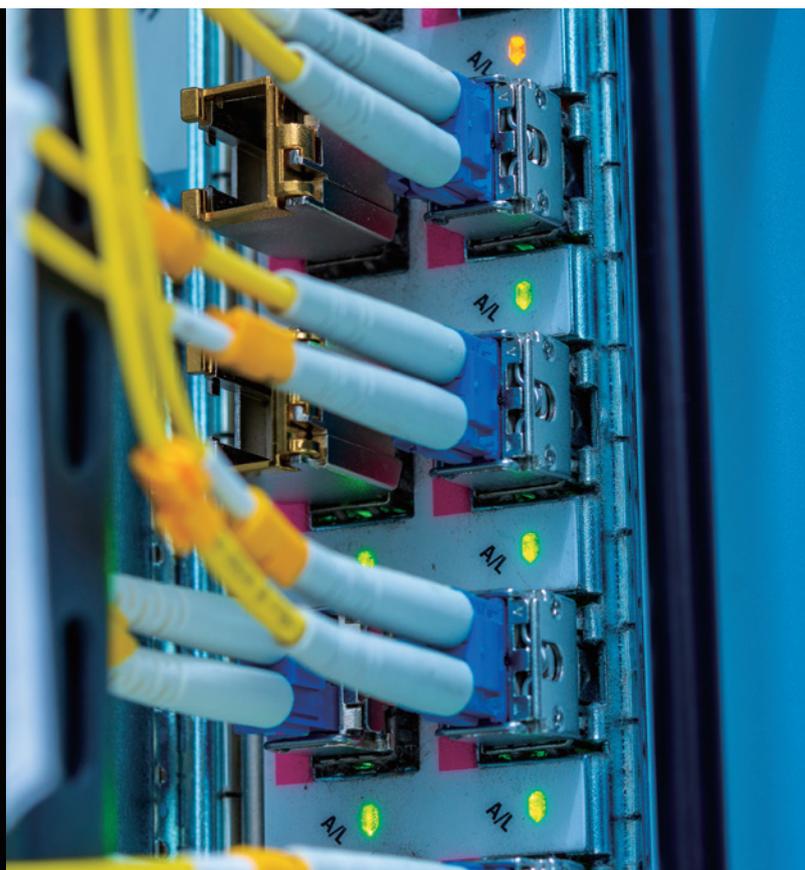
DUT oriented test apps (APP)

Make a complicated test process straight ahead

- Pre-installed test apps
- New apps and custom apps can be added.

Excellent adaptability to various applications

- Lasers and optical transceivers (PEAK, SMSR, OSNR)
- Optical amplifiers (Gain, Noise figure)
- Broadband light
- Passive optical components;
Optical fibers, optical filters, FBG (Fiber Bragg Grating), ROADM (Reconfigurable Optical Add-Drop Multiplexer), WSS (Wavelength Selective Switch)



Unparalleled optical performance

Sharper, Deeper, and more precise

5 pm high wavelength resolution

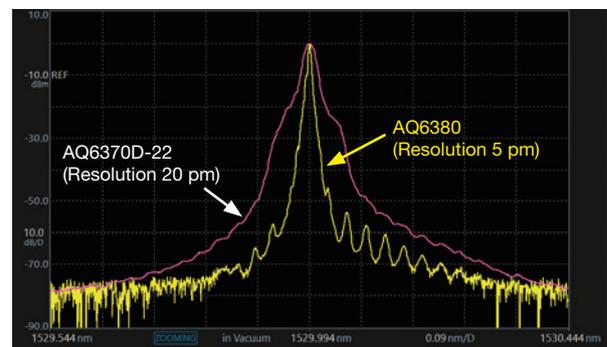
The AQ6380 achieves a wavelength resolution of 5 pm. It enables to separate closely allocated DWDM channels and modulation side peaks of optical transceivers.



Modulated spectrum of 10G optical transceiver

65 dB wide close-in dynamic range

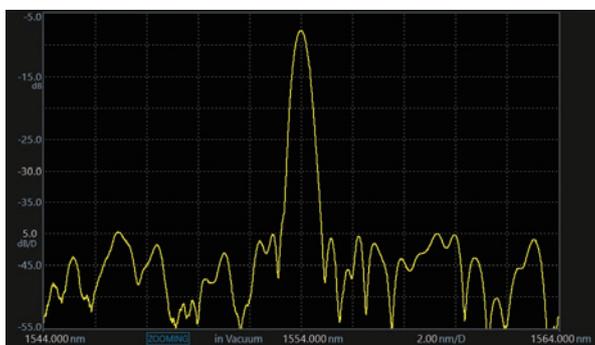
The AQ6380 monochromator has sharper spectral characteristics than ever, so signals in close proximity such as the residual longitudinal modes of external cavity laser can be clearly separated and accurately measured.



Spectrum of External Cavity Laser

Wide wavelength range and variable resolution support various applications

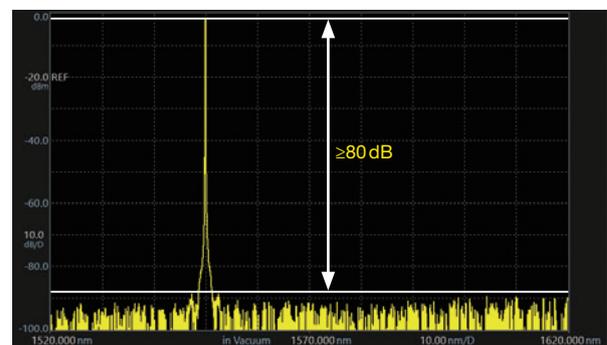
The AQ6380 has a wavelength band of 1200 to 1650 nm, so one unit can meet diversifying wavelength measurement needs. Moreover, the wavelength resolution can be varied from 5 pm to 2 nm, supporting a wide range of applications from narrowband peak/notch measurements to wideband spectral measurements. In addition, the increased resolution often contributes to the improvement of measurement speed and measurement accuracy of low power signals.



Transmission spectrum of optical filter

80 dB stray light suppression

Stray light is optical noise caused by the diffuse reflection of incident light inside a monochromator. In situations such as laser SMSR measurement where multiple optical spectra with different levels are measured at the same time, the stray light may interfere with the measurement; therefore, high stray light suppression performance is required. The AQ6380 provides high dynamic range measurements with excellent stray light suppression performance of 80 dB. In addition, due to the measurement principle, no spurious noise is generated.



Stray light suppression performance

±5 pm wavelength accuracy

The AQ6380 offers ±5 pm in the C band to meet the most stringent accuracy requirements. It also offers ±10 pm in the S and L bands and ±50 pm over the entire wavelength range. With such an accuracy, some applications may not require an optical wavelength meter anymore.

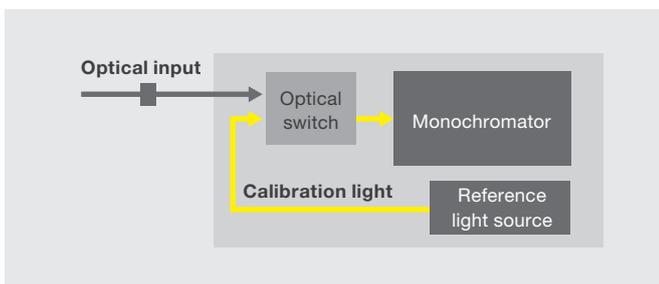
Periodic self-wavelength calibration using the built-in wavelength reference light source ensures long-term stability for each measurement.

Automated wavelength calibration maintains high accuracy

Ambient temperature change, vibrations, and shock affect the measurement accuracy of high precision products such as optical spectrum analyzers.

The AQ6380 can deliver the high precision measurements in long term with the wavelength calibration and alignment adjustment functions using the built-in light source.

- Wavelength calibration with the internal light source can be performed fully automatically and regularly without an external fiber cord.
- It also supports wavelength calibration using an external light source. Calibration can be performed by setting the exact wavelength of the external light source.



Mechanism of the wavelength calibration with internal light source

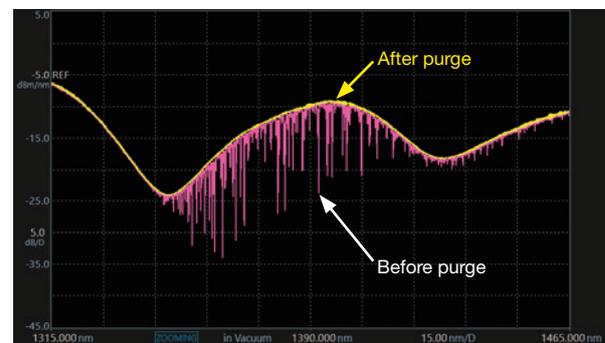
Single mode fiber input

The AQ6380's optical input uses a PC-type single-mode fiber, achieving an optical return loss of 30 dB or more even when a PC-type optical plug is connected. Thus, it reduces the impact on measurements of reflection-sensitive optical devices.

Gas purging mechanism for minimizing the water vapor absorption

In the near-infrared wavelength range, there are wavelength regions where strong light absorption is observed due to the influence of water vapor in the air. In the measurement of the optical spectrum analyzer, there is a wavelength band in which the light absorption characteristics of water vapor inside the monochromator are noticeably detected. Such phenomena can interfere with accurate optical spectrum measurements in the applicable wavelength band.

The AQ6380 is equipped with a purge mechanism that replaces the air inside the monochromator with nitrogen or dry air by continuously supplying it through dedicated ports on the back panel. Therefore, it can realize accurate optical spectrum measurements without being affected by the light absorption phenomenon of water vapor.



Effect of purging



Purge gas ports (input and output)

Improve measurement efficiency and productivity

Up to 20x faster measurement

By a new sensitivity mode “RAPID” specialized for CW light, the measurement speed is up to 20 times faster than our conventional model.

Comparison with our conventional model

Model	Measurement time	SENS setting
AQ6380	0.23 s	RAPID1 (avg. 3)
AQ6370D	5.4 s	NORM_AUTO

Examples at span 100 nm, resolution 20 pm, sampling intervals 2 pm, noise level approx. -60 dBm

New sensitivity settings to optimize the measurement time

The setting of sensitivity is one of the factors that greatly affect the measurement time. The AQ6380 has 2 modes and 19 sensitivity settings, so measurement time can be shortened by selecting the optimum sensitivity according to the type of optical signal and the minimum sensitivity requirement.

The measurement sensitivity can also be set numerically. The appropriate sensitivity setting is automatically selected when entering the required minimum sensitivity value.

RAPID: Sensitivity mode for fast measurement specialized for CW light

TRAD: Traditional sensitivity mode that supports both CW light and pulsed light

RAPID mode

SENS setting	Sensitivity (dBm)
RAPID1	-55
RAPID2	-60
RAPID3	-65
RAPID4	-70
RAPID5	-75
RAPID6	-77

TRAD mode

SENS setting	Sensitivity (dBm)
N/HOLD	-61
N/AUTO (2x)	-58
N/AUTO	-60
NORMAL (2x)	-63
NORMAL	-65
MID (2x)	-68
MID	-70
HIGH1 (2x)	-78
HIGH1	-80
HIGH2 (2x)	-83
HIGH2	-85
HIGH3 (2x)	-88
HIGH3	-90

Note. The sensitivity is a reference value at 1550 nm, not a guaranteed value.

Backward compatible remote interface for easy upgrade of test system

The AQ6380 makes it easy to build an automated measurement system using a remote-control interface (Ethernet or GP-IB).

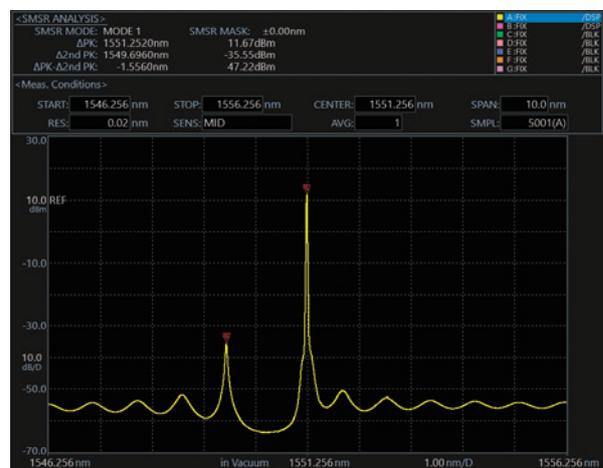
The remote command set conforms to the Standard Commands for Programmable Instruments (SCPI) compatible with AQ6370 series and AQ6319 as well as proprietary AQ6317-compatible commands. Thus, the existing measurement system can be easily upgraded.

Built-in analysis functions eliminate post-processing tasks

The AQ6380 has built-in analysis functions to characterize optical spectrum from a variety of optical systems and devices, such as WDM system, DFB-LD, EDFA, and filters. The automatic calculation of the major parameters of the device under test will contribute to its fast characterization.

Analysis functions include:

- DFB-LD
- FP-LD
- LED
- Spectral width (peak/notch)
- SMSR
- Optical power
- WDM (OSNR)
- EDFA (Gain and NF)
- Filter (peak/bottom)
- WDM filter (peak/bottom)



Example of SMSR analysis

DUT-oriented test apps (APP) simplifies the test process

Application (APP) mode transforms a versatile OSA into a machine dedicated to a device under test (DUT). APP mode provides a DUT-specific user interface that navigates the user from configuration settings to test result output without the user being aware of the wide variety of OSA settings.

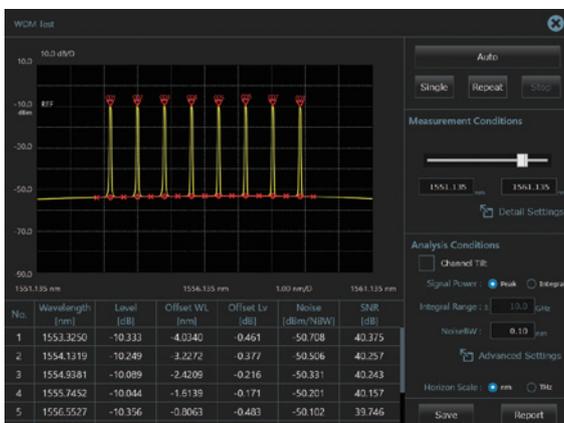
Basic process of test applications



The AQ6380 comes pre-installed with several basic applications such as WDM testing, DFB-LD testing, and FP-LD testing. In addition, the application can be downloaded from the Yokogawa website and added to the AQ6380 for use.



APP menu window



WDM test application

OSA Viewer enables emulation and remote control on a PC

You can emulate and remote control the AQ6380 using PC application software called the OSA viewer, which is included in the AQ6370 Viewer.

The OSA Viewer has a user interface and analysis capabilities, allowing R&D and production users to easily view and analyze AQ6380 waveforms on their remote PC or laptop.

Main functions:

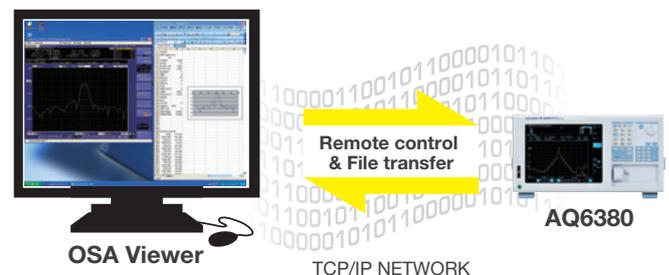
- Display and analysis of waveform data
- Real-time remote control of AQ6380
- File transfer with AQ6380

Real-time remote control

- The AQ6380 can be remotely controlled by connecting directly or over the network.
- The screen image on the AQ6380 is displayed in real time on the PC screen. Thus, you can operate it as if you were using the AQ6380 directly.
- Data files saved on the AQ6380 can be transferred to your PC during remote control.

Use cases

- R&D: Execution of evaluation, analysis of measured data, optimization of test conditions on remote production lines, and troubleshooting
- Production: Collection and analysis of measurement results of remote production lines



Note. The OSA Viewer is optional.

User-friendly multi touch operation and connectivity

Proven design and operability

The AQ6380 has an easy-to-use front-panel design and intuitive operability based on Yokogawa's 40 years user experience. The intuitive user interface is highly valued by the users in areas such as R&D and manufacturing testing.

Large touchscreen LCD

The high-resolution, responsive 10.4-inch multi-touch capacitive touchscreen makes device operation even simpler and more intuitive. You can change measurement conditions, perform analysis, change the optical spectrum view as if you were operating a tablet device. In the optical spectrum view, the waveform view can be zoomed or shifted by a simple tap and drag.



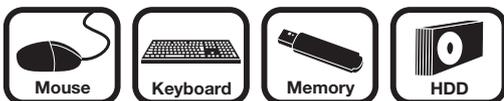
Enhanced function keys

The AQ6380 has greatly improved operability by adding frequently used keys to the hardware keys on the front panel, such as the sweep control (Auto/Single/Repeat/Stop), resolution setting, and sensitivity setting. The function keys can also be popped up on the display for touch operation.



USB ports

The AQ6380 has USB ports that are compatible with a USB storage device, mouse and keyboard. The file feature allows users to save data and screenshots to internal memory or USB storage for use in creating test reports. By connecting a mouse or keyboard to the USB port, you can comfortably operate the AQ6380 as if you were operating a PC.



Data access through LAN

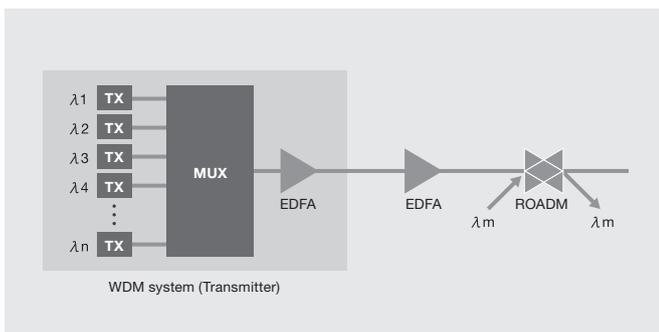
The standard LAN port allows convenient access to files stored in the internal memory as well as ability to remotely update the firmware from a PC.

Measurement applications

WDM transmission systems

To test a multi-channel, narrowly spaced WDM system, high spectral measurement performance is required to test the system's internal circuit boards, such as laser modules and optical transceivers, and the system's final output signal. This includes simultaneous peak and OSNR measurements.

AQ6380's wide close-in dynamic range allows accurate OSNR measurement of DWDM transmission systems. The built-in WDM analysis function analyzes the measured waveform and shows peak wavelength, peak level, and OSNR of WDM signals up to 1024 channels simultaneously.



Example of DWDM OSNR analysis

Lasers/optical transceivers

Testing of optical components used in WDM transmission systems such as laser devices, laser modules, and optical transceivers also requires high accuracy.

These applications may include:

- Modulated signal measurement of optical transceivers and transponders.
- Measurement of all channels of optical transceivers with WDM technology beyond 100 G

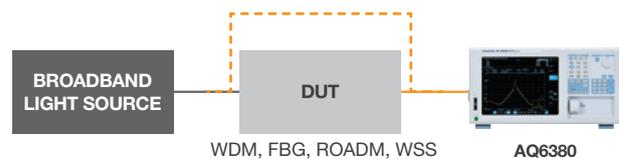
The AQ6380's sharp spectral characteristics and high stray-light suppression performance enable to visualize and accurately measure spectral peaks in close proximity.



Example of DFB-LD analysis

Passive components (FBG/WSS)

In conjunction with a broadband light source such as ASE, SLD, or Super Continuum (SC) light source, the AQ6380 can simply perform evaluation of passive devices such as WDM filters, FBG, ROADM, and WSS. Superb optical characteristics of the AQ6380 enable higher resolution and wider dynamic range measurements. The built-in optical filter analysis function simultaneously reports peak/bottom wavelength, level, crosstalk, and ripple width.



Specifications

Items	Specifications	
Applicable fiber	SM (9.5/125 μm)	
Wavelength range	1200 to 1650 nm	
Span	0.1 to 450 nm, 0 nm	
Wavelength accuracy ^{*1,*3}	±0.005 nm (1520 to 1570 nm), ±0.01 nm (1450 to 1520 nm, 1570 to 1620 nm), ±0.05 nm (full span)	
Wavelength linearity ^{*1,*3}	±0.004 nm (1520 to 1570 nm), ±0.008 nm (1450 to 1520 nm, 1570 to 1620 nm)	
Wavelength repeatability ^{*1}	±0.002 nm (1 minute)	
Wavelength resolution setting ^{*1}	0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2 nm, and arbitrary resolutions (0.01 to 2 nm in 0.01 nm steps)	
Resolution bandwidth accuracy ^{*1,*4}	±5% (1450 to 1620 nm, resolution: 0.1 to 2 nm)	
Number of sampling	101 to 200001, AUTO	
Min. sampling resolution	0.0005 nm (0.5 pm)	
Level sensitivity setting ^{*5}	TRAD mode	NORM_HOLD, NORM_AUTO, NORMAL, MID, HIGH1, HIGH2, HIGH3
	RAPID mode	RAPID1 to 6
Level sensitivity ^{*1,*6}	TRAD mode	-85 dBm (1200 to 1600 nm, sensitivity: HIGH3)
	RAPID mode	-72 dBm (1200 to 1600 nm, sensitivity: RAPID6)
High dynamic range mode	SWITCH (sensitivity: MID, HIGH1-3, and RAPID4-6)	
Maximum safe input power ^{*1,*2}	+25 dBm (total input power)	
Maximum input power ^{*1,*2}	+20 dBm (per channel, full range)	
Level accuracy ^{*1,*2}	±0.5 dB (1310 & 1550 nm, input level: -20 dBm, sensitivity: MID, HIGH1-3, and RAPID4-6)	
Level linearity ^{*1,*2}	±0.05 dB (input level: -50 to +10 dBm, sensitivity: HIGH1-3)	
Level flatness ^{*1,*2}	±0.2 dB (1520 to 1570 nm, 1570 to 1620 nm)	
Polarization dependency ^{*1,*2}	±0.2 dB (1550 nm)	
Close-in dynamic range ^{*1,*7}	RES 0.005 nm	60 dB (peak ±0.1 nm), 45 dB (peak ±0.05 nm)
	RES 0.02 nm	65 dB (peak ±0.2 nm), 55 dB (peak ±0.1 nm)
Stray-light suppression ratio ^{*7,*8,*10}	80 dB	
Optical return loss ^{*9,*10}	30 dB	
Optical input connector	FC/PC or SC/PC	
Measurement time ^{*10}	0.2 s (sensitivity: RAPID1, span: 100 nm, number of sampling: 100001, number of averaging: 1)	
Built-in light source	Wavelength reference light source dedicated to auto-calibration (-L1)	
Warm-up time	Minimum 1 hour	
Electrical interface	Ethernet, GP-IB, USB, VGA output, analog output, trigger input, trigger output	
Remote control ^{*11}	Interfaces: Ethernet (TCP/IP) and GP-IB, Commands: SCPI (IEEE488.2) and AQ6317 series compatible commands (IEEE488.1)	
Purge gas input/output terminal	Outer diameter 1/4 nylon tube (inch size)	
Date storage	Internal storage: 512 M bytes or more, External storage: USB storage (memory and HDD), Format: FAT32, File type: CSV (text), binary, BMP, PNG, and JPEG	
Display ^{*12}	10.4-inch color LCD (capacitive touchscreen, resolution: 1024 × 768 pixels)	
Dimensions	Approx. 426 (W) × 221 (H) × 459 (D) mm (excluding protector and handle)	
Weight	Approx. 25 kg (55 lbs.)	
Power requirements	100 to 240 VAC, 50/60 Hz, 100 VA or less	
Environmental conditions	Performance guarantee temperature: +20 to +26°C, Operating temperature: +5 to +35°C, Storage temperature: -10 to +50°C, Ambient humidity: 20 to 80%RH (no condensation)	
Safety standards		EN 61010-1
	Laser safety	EN 60825-1: 2014, IEC 60825-1: 2007, GB 7247.1-2012 Class 1
EMC	Emission	EN 61326-1 Class A, EN 55011 Class A Group 1, EN 61000-3-2, EN 61000-3-3, RCM EN 55011 Class A Group 1, Korea Electromagnetic Conformity Standard
	Immunity	EN 61326-1 Table 2
Recommended calibration period	1 year	



Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated June 24, 2007
4-9-8 Myojin-cho, Hachioji-shi, Tokyo 192-8566, Japan

Note. All specifications are valid under the following conditions unless otherwise stated:
23°C ±3°C, after warming up for 1 hour or more, pulsed light measurement mode off, high dynamic range mode off, horizontal scale: wavelength, and vertical scale: absolute power.

*1: Using a 9.5/125 μm single mode fiber with a PC type connector, after optical alignment and wavelength calibration with built-in reference light source

*2: Wavelength resolution setting: ≥ 0.1 nm

*3: Resolution: 0.005 nm, number of sampling: AUTO, excluding sensitivity RAPID1 and NORM_HOLD

*4: After performing RBW calibration using a single longitudinal mode laser (wavelength: 1520 to 1560 nm, peak level: ≥ -20 dBm, level stability: ≤ 0.1 dBpp, and wavelength stability: ≤ ±0.001 nm), at the wavelength of RBW calibration

*5: TRAD mode: applicable for CW light and pulsed light measurement, RAPID mode: applicable for CW light measurement

*6: Resolution: 0.1 nm, number of sampling: AUTO

*7: 1523 nm, high dynamic range mode: SWITCH

*8: HeNe laser (1523 nm), wavelength resolution: 0.1 nm, 1520 nm to 1620 nm (except peak wavelength ±2 nm)

*9: Using Yokogawa's master single mode fiber with a PC connector

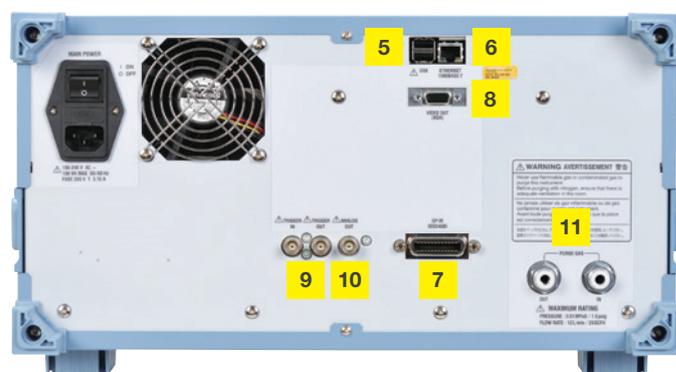
*10: Typical value

*11: Some AQ6317 series commands may not be compatible due to changes in specifications or functions.

*12: Liquid crystal display may include a few defective pixels (within 0.002% with respect to the total number of pixels including RGB). There may be a few pixels on the liquid crystal display that do not emit all the time or remains ON all the time. These are not malfunctioning.

Items	Functions	
Measurement	CW light, Pulsed light (Peak hold, External trigger, Gate sampling)	
	Sweep mode	Single, Repeat, Auto (Self-configuration), Sweep between line markers, 0 nm span sweep
	Condition setting	Center wavelength, Span, Number of sampling, Wavelength resolution, Sensitivity (TRAD & RAPID mode), High dynamic range mode, Number of averaging (1 to 999 times), Smoothing, Wavelength in Air/Vacuum
	Others	Sweep status output, Analog output
Display	Vertical scale	Level scale (0.1 to 10 dB/div. and linear), Level sub-scale (0.1 to 10 dB/div. and linear), Reference level, Division settings (8, 10), Percentage (%), Power spectral density (dB/nm), Noise mask
	Horizontal scale	Wavelength (nm), Frequency (THz), Trace zoom in/out
	Display items	Measurement conditions, trace, data table, label
Trace	7 independent traces, MAX/MIN hold, Calculation between traces, Normalizing, Roll averaging (2 to 100 times), Curve fit, Peak curve fit, Marker curve fit, Power spectral density (POWER/NBW) Trace copy, Trace clear, Trace Write/Fix setting, Trace Display/Blank setting	
Marker	Delta markers (Max. 1024 markers), Power spectral density marker, Power integral marker, Line markers	
Search	Peak search (single/multi), Bottom search (single/multi), Next peak/bottom search, Auto-search on/off, Search between wavelength line markers, Search in zoomed area	
Data analysis	Spectral width analysis (Threshold, Envelope, RMS, Peak-RMS, Notch), WDM (OSNR) analysis, EDFA-NF analysis, Filter analysis (peak/bottom), WDM filter analysis (peak/bottom), DFB-LD analysis, FP-LD analysis, LED analysis, SMSR analysis, Power analysis, Auto-analysis on/off, Analysis between wavelength line markers, Analysis in zoomed area	
Application	WDM test, DFB-LD test, LED test, FP-LD test, Fiber inspection, Application management (add/delete)	
Others	Optical alignment	Auto alignment adjustment with built-in light source
	Calibration	Auto wavelength calibration with built-in light source, Wavelength calibration with external light source, Resolution bandwidth (RBW) calibration with external light source

Interfaces



1 Touchscreen Display

Displays measurement conditions, spectral waveforms, and analysis results. Almost all operations are possible just by the touchscreen.

2 Function Keys

Main operation menus and shortcuts for commonly used keys.

3 Data Entry

Numeric keypad, up/down keys, and rotary knob for easily and quickly setting various settings, such as measurement parameters, labels, cursor positions.

4 Optical Input

To enter the optical signal under test using an optical fiber cable. The type of input connector can be changed with the connector adapter (sold separately).

5 USB

Support a USB data storage device, mouse, and keyboard.

6 Ethernet (10/100/1000BASE-TX)

Network interface for remote control, data transfer, and firmware update.

7 GP-IB

Remote control interface

8 Video Output (VGA)

Output the instrument screen to an external monitor.

9 Trigger Input and Output

External trigger signal input for the pulsed light test or the recirculating loop experiment

10 Analog Output

Output an analog voltage according to the optical spectrum intensity for the stability test with oscilloscope, etc.

11 Purge Gas Input and Output

Supply and exhaust ports for purge gas circulation to reduce water vapor in the monochromator.

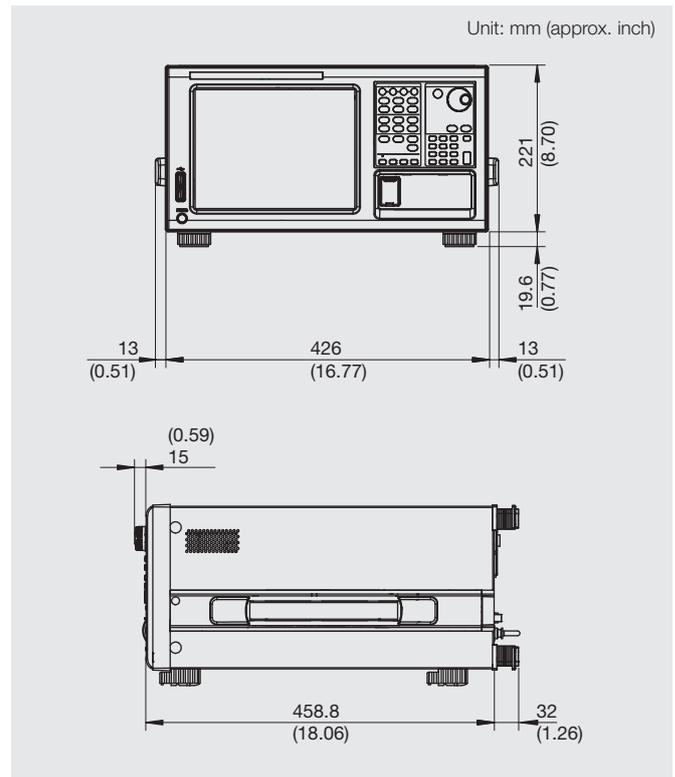
Model and suffix code

Model	Suffix	Descriptions
AQ6380		AQ6380 Optical Spectrum Analyzer
Spec code	-10	Standard model
Built-in light source	-L1	Wavelength reference source
Optical input connector	-FCC	FC/PC
	-SCC	SC/PC
Power cord	-D	UL/CSA standard and PSE compliant, 125 V
	-F	VDE/Korean standard, 250 V
	-R	Australian standard, 250 V
	-Q	British standard, 250 V
	-H	Chinese standard, 250 V
	-N	Brazilian standard, 250 V
	-T	Taiwanese standard, 125 V
	-B	Indian standard, 250 V
	-U	IEC Plug Type B, 250 V

Accessories (optional)

Product	Model	Descriptions
AQ6370 Viewer	735371	for AQ6380, AQ6360, and AQ6370 series
AQ9441 Connector Adapter	AQ9441-FC	FC type
	AQ9441-SC	SC type
Rack Mount Kit	751535-E5	Inch type

AQ9441 Connector Adapter (For optical input)



Yokogawa's approach to preserving the global environment

- Yokogawa's electrical products are developed and produced in facilities that have received ISO14001 approval.
- In order to protect the global environment, Yokogawa's electrical products are designed in accordance with Yokogawa's Environmentally Friendly Product Design Guidelines and Product Design Assessment Criteria.

This is a Class A instrument based on Emission standards EN61326-1 and EN55011, and is designed for an industrial environment. Operation of this equipment in a residential area may cause radio interference, in which case users will be responsible for any interference which they cause.

- Any company's names and product names mentioned in this document are trade names, trademarks or registered trademarks of their respective companies.

NOTICE

- Before operating the product, read the user's manual thoroughly for proper and safe operation.

YOKOGAWA

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YMI-N-MI-M-E01

The contents are as of August 2021. Subject to change without notice.
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[Ed: 01/b] Printed in Japan, 108(KP)

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