
**User's
Manual**

**Model SU1004A
AQ2160-01
Optical Powermeter**

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1. Foreword

Thank you for purchasing the AQ2160-01 Optical Powermeter. This user's manual contains useful information about the instrument's functions and operating procedures and lists important handling precautions. To ensure proper use of the instrument, please read this manual thoroughly before beginning operation. After reading this manual, keep it in a convenient location for quick reference in the event a question arises during operation.

2. Features of the Instrument

The AQ2160-01 is an optical powermeter for measuring optical signal power, and is ideal for performing checks on newly installed optical fibers¹. The instrument supports wavelengths of 850 nm, 1310 nm, and 1550 nm, and features a backlight, power saving function, and battery charge indicator. Compact, lightweight, and battery-driven, the unit is a powerful tool in the field.

1. Supports single mode: (9/125 μm) and multimode: OM3 (50/125 μm), OM4 (62.5/125 μm). Supports SC or FC optical connectors (please specify a connector type when ordering).
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3. Warranty

Prior to shipment, all Yokogawa products must pass strict testing based on the Yokogawa Quality Assurance System. However, should any damage occur during manufacturing or shipping that becomes evident during normal use, please contact the sales office at our headquarters or your nearest Yokogawa representative. Should this product experience any malfunction during the warranty period (within one year from the day of delivery) Yokogawa shall replace the product free of charge. However, this warranty is invalid for malfunction or damage resulting from user error, rework or modifications performed by the user, or natural disasters, even during the warranty period.

4. Checking the Contents of the Package

Please check the items listed below before using the instrument. If some items are missing or otherwise inconsistent with the contents description, please contact your dealer or nearest Yokogawa representative. The package includes the AQ2160-01 Optical Powermeter plus the standard accessories listed in the table below (we recommend that you save the packaging box for future transport of the instrument).

- List of Standard Accessories

No.	Product Name	Qty.
1	User's manual	1
2	AA dry cells (alkaline)	2
3	Neck strap	1
4	Carrying pouch	1

The following options are available for purchase separately. For inquiries and ordering, please contact the dealer from which you purchased the instrument.

- Options (Sold Separately)

No.	Name	Model	Specifications
1	Protector	SU2002A	(for the AQ2160)
2	AC adapter	SU2007A-M -C -F -G -J	PSE conforming type (2-pin) UL/CSA standard type (UL2P) VDE standard type (CEE-C2) AS standard type (AS2P) BS standard type (BS2P) angle
3	Soft carrying case	SU2006A	

5. Safety Symbols

This section describes various symbols that appear in the manual and on the instrument. These symbols convey information necessary for correct operation of the instrument, and for preventing injury to the user and other personnel, and accidents involving, or damage to equipment. Always heed the information provided by these symbols when operating the instrument. If this instrument is used in a manner not specified in this manual, the protective features provided by the instrument may be impaired. Also, Yokogawa assumes no liability for the customer's failure to comply with these requirements.

- The following describes levels of damage that can occur as a result of incorrect operation.

 DANGER	Indicates actions or situations that are likely to result in imminent death or serious injury.
 WARNING	Indicates actions or situations that can lead to death or serious injury.
 CAUTION	Indicates actions or situations that can lead to loss of data, or physical damage to instruments.

- The following explains warning symbols that must be adhered to.

	Prohibited (indicates prohibition of a particular action).	
	Indicates that disassembly is prohibited.	
	Indicates that handling with wet hands is prohibited.	
	Required (indicates something that must be done).	
		Indicates that the power plug must be removed from the outlet.



Read the manual thoroughly, and follow the instructions given.



If “Caution,” “Warning,” or “Danger” is indicated in the user’s manual, follow the corresponding instructions.



DANGER

	When using an AC power supply for this instrument, always use the AC adapter that came with the instrument. Never use the AC adapter with any other instrument. Doing so could result in damage or injury. => Fire, electric shock, or malfunction can result.
	Do not use a power supply other than the one specified. Also, do not use with power supply voltages other than those indicated by this manual. => Fire, electric shock, or malfunction can result.
	When connecting the instrument to commercial power, connect directly to a dedicated power outlet. Do not use extension cords as they can overheat and cause fire.
	Do not bring the power cord near any hot objects. => The coating on the cord can deteriorate, causing fire or electric shock.

	Do not impair, damage, or attempt to modify the power cord. => Fire or electric shock can result.
	Never place spent batteries in fire. => Explosion, fire, or burns can result.
	Do not insert or drop any metal objects into any openings on the instrument, or inside the instrument. => Fire, electric shock, or malfunction can result.
	The sensor element of this instrument contains indium gallium arsenide (InGaAs). InGaAs powder and vapor is hazardous. Therefore, never incinerate, destroy, break, grind, or apply chemicals to the instrument. Keep separate from general industrial or household waste, and dispose of the instrument according to relevant local laws.



WARNING

	Do not plug too many cords into a single power supply outlet. => Heating of the cables or fire can result.
	Never bend, twist, or pull cables forcefully. => Fire or electric shock can result.
	If the power cord becomes damaged, have it replaced immediately by the dealer from which you purchased the instrument. => Otherwise fire or electric shock can result.
	Never plug in or unplug the power cord with wet hands. => Electric shock can result.
	Insert the power plug securely into the power outlet. => If metal or other objects are allowed to contact the plug, fire or electric shock can result.
	When unplugging the power cord always pull by the plug, never pull by the cord itself. => Pulling the power cord can cause damage leading to fire or electric shock.
	Always unplug the power cord from the outlet, and check that all externally connected wires and cables are removed before moving the instrument. => Otherwise, the cords can become damaged, causing fire or electric shock.

	<p>For safety, always unplug the power cord from the outlet during periods of extended non-use. Also, be sure to unplug the power cord from the outlet during lightning storms. => Fire, electric shock, or malfunction can result.</p>
	<p>Do not use batteries that are not specified for this instrument. Also, do not use old and new batteries at the same time. => Explosion or leakage of the batteries can result, causing fire, injury, or contamination of the surrounding area.</p>
	<p>Check the polarity of the batteries (plus/minus orientation) before installing them. => Incorrect orientation can result in explosion or leakage of the batteries, causing fire, injury, or contamination of the surrounding area.</p>
	<p>Do not bring the instrument into areas with high humidity or large amounts of dust. => Electric shock or malfunction can result.</p>
	<p>Do not place the instrument on unstable or inclined surfaces. => Physical damage can result if the instrument tips over or falls to the ground.</p>
	<p>Do not place the instrument in areas with frequent vibration or physical shock. => Physical damage can result if the instrument tips over or falls to the ground.</p>
	<p>Never place containers holding liquids or metallic objects on top of the instrument. => If water or metal objects spill onto or enter the instrument, fire, electric shock, or malfunction can result.</p>
	<p>Do not allow water or condensation to contact the instrument. => Fire, electric shock, or malfunction can result.</p>
	<p>If you detect any abnormal conditions such as smoke or unusual odors or failure of the screen to display, this may indicate the possibility of fire, electric shock, or malfunction. Immediately turn OFF the power switch and remove the power plug from the outlet, confirm that the abnormality ceases, and contact the dealer from which you purchased the instrument. Do not attempt to repair the instrument yourself, as doing so can be very dangerous.</p>

	If you accidentally drop or damage the instrument, turn OFF the power switch, remove the power plug from the outlet, and contact the dealer from which you purchased the instrument.
	If the instrument experiences an abnormality, do not attempt to repair the instrument yourself. => Electric shock or damage can result. Also, any repairs conducted without authorized consent will not be covered by the product warranty.
	Never disassemble or rework the instrument. => Fire, electric shock, or malfunction can result.
	The light buffer, optical connector, and other items that connect to the light source can emit dangerous lasers. Take care not to injure your eyes.



CAUTION

	Do not place the instrument in direct sunlight or areas of high temperatures. => The internal temperature of the instrument can rise, causing malfunction.
	Do not swing the instrument by its strap. => Damage or injury can result.
	When placing the strap around your neck, take care not to choke or strangle yourself.
	When handling parts that open and close, such as when changing the battery, take care not to pinch or injure your fingers.

6. Specifications

* AQ2160-01 Optical Powermeter Specifications

Wavelengths	850 nm, 1310 nm, 1550 nm
Ref. wavelength	1310 nm
Sensor element	InGaAs (ϕ 1 mm)
Compatible fibers	SM (9/125 μ m), GI (50/125 μ m), GI (62.5/125 μ m) fiber
Input type	SC or FC connector (specify when ordering)
Power range	-70 dBm—+5 dBm
Noise level	-60 dBm
Accuracy ¹	\pm 5%
Meas. value display	7-segment, 4-digit display with backlight
Displayed units	dBm (absolute value)
Range	Automatic
Meas. mode	CW light
Meas. interval	Approximately 330 ms
Resolution	0.01 (>-60 dBm), 0.1 (\leq -60 dBm)
Backlight	While Backlight key is depressed, and approx. five seconds after it has been released.
Power save	Power save function turns the power off automatically if no key is pressed for ten minutes (function can be turned OFF).
Battery check	Low battery indicator
Resume function ²	Restores the settings active when the power was last turned OFF.
Power supply	Two AA batteries (alkaline dry cells or nickel metal-hydride rechargeable batteries). AC adapter (AC 100–240 V, 50/60 Hz, optional) ³
Operating environment	Operating temperature: 0—+50°C Storage temperature: -25—+70°C Relative humidity: 85% or less (no condensation)
Weatherproofing	Conforms to JIS C 0920 (drip-proof) TYPE I and IEC 60529 Ipx1 (the drip test, when the optical and DC connector caps are attached)
Dimensions and weight	Approximately 152 (H) x 70 (W) x 32 (D) mm and approximately. 270 g (incl. batteries)
Safety, EMC	Safety: EN61010-1 (Out of conformance since December 1, 2010.) EMC: EN61326-1 ClassB, Table2 (for use in industrial locations)

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1. $T_a = 23 \pm 5^\circ\text{C}$, at reference conditions (@ 1310 nm, -20 dBm).
 2. Do not remove the batteries or unplug the AC adapter during operation. Also, the Resume function is not guaranteed to work when the low battery indicator is displayed.
 3. When connecting to the AQ2160-01, use a temperature range of 0–+50 °C. However, the safety standard for the AC adapter specifies an operational temperature of 0–40°C.)

7. Periodic Calibration

Periodic calibration is an effective way to maintain the normal functionality of the instrument over long periods of time, and to enable quick identification of any problems. It is recommended to perform calibration of the instrument once per year.

8. Names and Functions of Parts

■ Optical Input Connector

For inputting optical power. Remove the connector cap before making connections. Supports both SC and FC optical connectors.

■ Power Key

- Turning the Power ON
When running on battery power, press the key to start up with the Power save function enabled. Hold the key down until the Power save indicator goes out to disable the function. When powered by the AC adapter, the instrument starts up with Power save disabled.
- Turning the Power OFF
Hold down the power key until the display goes out.

■ Strap Attachment Hole

For attaching the neck strap and connector cap lead (one hole on each side of the unit)

■ Display

Displays measured data and various other items. (see page 10)

■ Wavelength Switching Key

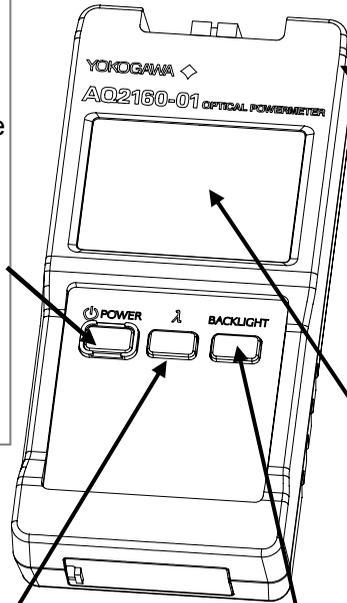
Switches the measurement wavelength. Press repeatedly to scroll through the following options: 850 nm→1310 nm→1550 nm→850 nm

■ Backlight Key

- Turning ON
When OFF, press the key to turn it ON for approximately five seconds. Hold the key down to keep the light ON indefinitely.
- Turning OFF
When the backlight is lit under battery power, the light goes out approximately five seconds after releasing the key. When powered by AC adapter, it stays ON until you press the key again.

■ AC Adapter Terminal

Open the cap to connect the AC adapter (optional)

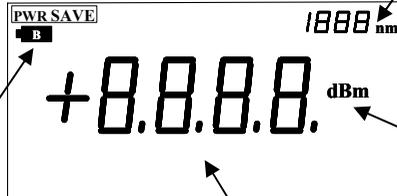


■ Power Save Setting

Displayed when the Power save function is enabled (see “Power key,” page 9)
Related key:  Power

■ Wavelength Setting

Displays the set wavelength (in nm). Related key: wavelength switching



■ Units

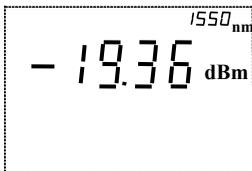
Displays the units of the measured values (dB)m

■ Low Battery Indicator

Blinks when the remaining battery charge is too low to provide sufficient power for operation. If the low battery indicator blinks, change the batteries immediately.

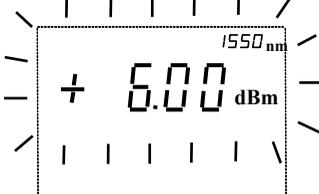
■ Measured Value/Error Display

Displays measured values and over/underrange errors (see Examples).



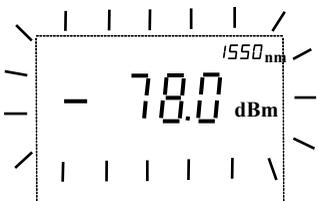
■ Display Examples

● Measured Value Display
In the 1550 nm wavelength range, displays -19.36 dBm.



● Overrange Error

If the optical power level being measured exceeds the measurable range, the plus sign value blinks indicating an overrange.



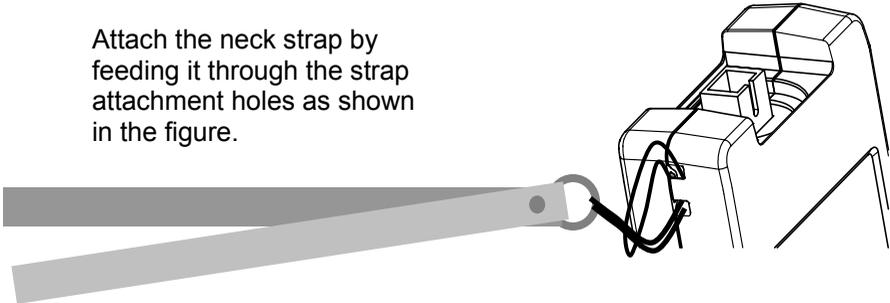
● Underrange Error

If the optical power level being measured falls below the measurable range, the minus sign value blinks indicating an underrange.

9. Attaching the Neck Strap

■ Attaching the Neck Strap

Attach the neck strap by feeding it through the strap attachment holes as shown in the figure.



Do not swing the instrument by its strap. Damage or injury can result. Also, when placing the strap around your neck, take care not to choke or strangle yourself.

10. Operating Procedure

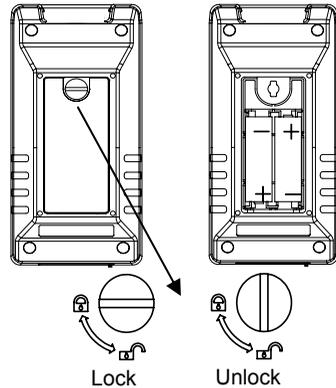
■ Installing the Batteries

Turn the screw on the rear panel with a coin or other flat object to remove the cover, then install the batteries.

Turning the screw locks/unlocks the cover as shown in the figure.



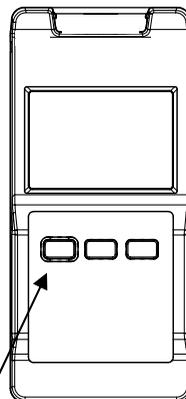
Insert two AA batteries into the holder following the polarity markings. Always close the cover after installing batteries.



If the low battery indicator blinks, you must change the batteries immediately. The instrument runs for approximately forty hours when using alkaline AA batteries (depending on operating conditions).

■ Turning ON the Power

- **Starting Up in Power Save Mode**
Press the key to start the instrument with the power save function ON.
- **Starting Up without Power Save Mode**
If you hold down the key until the power save indicator (PWR SAVE) disappears, the instrument starts with the power save function disabled.



Power key

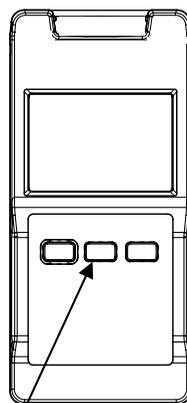
In Power save mode, the power turns OFF if no key is pressed for ten minutes. However, Power save mode is disabled when using the AC adapter.

- This instrument performs a zero adjustment when the power is turned ON.
For low level measurement (-50 dBm or less), in order to cancel out temperature changes and other effects, it is recommended to power cycle the instrument before measurement to perform the zero adjustment. The zero adjustment need not be performed while shielded from light.

■ Wavelength Setting

Set the wavelength of the light to be measured. Press the wavelength switching key repeatedly to scroll through the options as follows: 850 nm -> 1310 nm -> 1550 nm -> 850 nm.

The previous wavelength setting is stored even when the power is turned OFF (Resume function).



Wavelength

■ Connecting the Optical Connector

Remove the optical connector cap and insert the connector firmly and completely into the connector adapter. If the connection is not sound, measurements will be inaccurate.

- Optical Connector

An SC connector and FC connector are available. The desired connector is specified when ordering, and cannot be changed.



Always use an optical connector that matches the instrument. Also, clean the ends before making connections.

- Optical Fiber

The following optical fibers are supported.

Single mode: SM (9/125 μm)

Multimode: GI (50/125 μm), GI (62.5/125 μm)

- Ferrule

Supports PC and FLAT polish.

Performance is not guaranteed with angled PC.

* Regarding support for APC (angled PC) fiber

There are many kinds of angled PC connector polishes.

Performance is not guaranteed with angled PC connectors because the measured value depends on the shape of the tip. However, it should be noted that with single mode fiber, measured values using an eight-degree APC connector are nearly identical to those when using a PC connector.



When using a bare fiber adapter, make sure that it does not protrude beyond the ferrule end. Protruding fibers can damage the optical input section resulting in incorrect measurements.



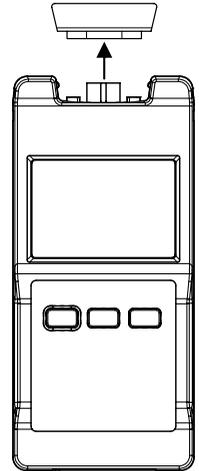
Incidence of excessive light outside of the optical power measuring range can damage the sensor element.



When not using the instrument, attach the optical input connector cap to protect the connector from dirt, grime, and other foreign particles.

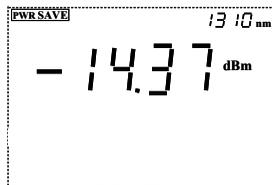


Looking at the optical fiber, end of the optical connector, or other items that connect to the light source can result in damage to the eyes from lasers. Never peer into these sections.



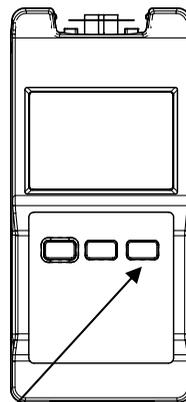
■ Reading the Measured Value

The figure on the right shows the instrument started up in Power save mode with the wavelength setting set to 1310 nm. The measured value displayed is -14.37 dBm.



■ Using the Backlight Function

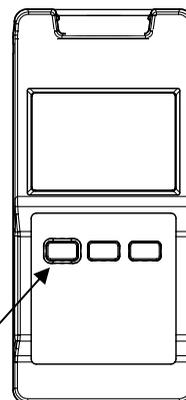
- **Turning the Backlight ON**
Press the key to turn ON the backlight for five seconds. Or, continue to hold down the key to keep the backlight illuminated indefinitely.
- **Turning the Backlight OFF**
When the backlight is lit under battery power, the light goes out approximately five seconds after releasing the key. When power by AC adapter, it stays ON until you press the key again.



Backlight Key

■ Turning the Power OFF

Remove the optical connector and attach the optical connector cap. To turn the instrument OFF, hold down the key until the LCD display goes out.



Power key

11. Handling Precautions

The following describes precautions that must be taken during use of the instrument. This instrument utilizes ultra-precision optical components. In order for performance to be guaranteed, please take note of the following.

■ Precautions When Using the Instrument

- 1) Do not drop or expose the instrument to excessive physical shock. The instrument is protected with plastic casing, but contains fragile optical components.
- 2) Do not place the instrument in direct sunlight, or in high-temperature or highly humid locations such as inside of a car for long periods of time.
- 3) Do not bring the instrument close to strong electromagnetic waves. Doing so can lead to malfunction.
- 4) Do not use the instrument and mobile phones simultaneously in the same vicinity.
- 5) The instrument is portable and can be used outdoors under battery power, but is not waterproof. Never operate the instrument in the rain.
- 6) Never disassemble the instrument.
- 7) An SC connector and FC connector are available for the instrument. Always use an optical connector that matches the instrument. Forcibly attaching a connector can damage the optical input section.
- 8) Looking at the optical fiber, end of the optical connector, or other items that connect to the light source can result in damage to the eyes from lasers.
- 9) Do not use an optical connector with an angled ferrule. Doing so can damage the optical input section.
- 10) Incidence of excessive light outside of the optical power measuring range can damage the sensor element. Be aware that especially with low duty, high-peak pulses, when the optical power is expressed as an average the value appears low, but the instantaneous power can be quite high.
- 11) If the optical connector attached to the optical input connector is damaged, dirty, or otherwise compromised, the instrument will be unable to perform as expected. At worst, this may cause damage to the instrument's optical connector.
- 12) When attaching the optical connector, take care not to damage the optical input end.
- 13) When not using the instrument, attach the optical input connector cap to protect the connector from dirt, grime, and other foreign particles.
- 14) If the optical input end or connector is soiled with dirt or grime, clean the end with commercially available optical connector cleaner.

■ Precautions When Using the Batteries

- 1) If the plus or minus terminal of the battery holder is dirty, contact with the battery will be weakened, possibly causing the power to cut out. If dirty, wipe the plus and minus terminals clean with a dry cloth.
- 2) Do not allow the batteries to come into contact with water (including rain water and sea water). Also, do not apply strong physical shocks.
- 3) Shorting the plus and minus terminals of the batteries with metal or other conductive objects causes a large current to flow that can damage the batteries and emit heat. Take care not to short the terminals when handling the batteries.
- 4) Disassembling the batteries or placing them in fire is extremely dangerous and must never be attempted.
- 5) Do not discard spent batteries together with general household waste. (unless your local laws permit doing so).
- 6) Check the polarity/orientation of the batteries carefully before inserting them into the battery holder. Incorrectly oriented batteries can result in damage to the instrument.
- 7) Remove the batteries during periods of extended non-use. Leakage from batteries can occur, resulting in damage to the instrument.
- 8) The instrument does not perform battery recharging. Please use a separate, dedicated charger for nickel metal-hydride rechargeable batteries.
- 9) Always operate the instrument in a way that is appropriate for the type of batteries you are using.

■ Cautions When Using the AC Adapter

- 1) Use the AC adapter that came with the instrument, and the country-specific power cable that was packaged together with the AC adapter.
- 2) Insert the power cable firmly into the inlet on the AC adapter, and connect a DC5V output cable firmly to the AC adapter terminal on the instrument.
- 3) Never use an AC adapter or power cable other than the dedicated ones available for use with this instrument, as damage can result.
- 4) Only use these items indoors. When connecting to the AQ2160-01, use a temperature range of 0–+50 °C (however, the safety standard for the AC adapter specifies an operational temperature of 0–40°C).

12. If You Suspect a Malfunction

The following should be checked if the instrument is not functioning as expected.

■ The instrument doesn't work even though the power is ON.

- 1) Are the correct batteries installed?
 - > Use only AA alkaline dry or nickel metal-hydride rechargeable batteries.
 - > Check the polarity/orientation of the batteries.
- 2) Is one or both of the batteries spent?
 - > Replace both batteries (at the same time).
Leakage can occur when using an old and new battery together, and can result in damage to the instrument.)
- 3) Is the power cord for the AC adapter (optional) connected correctly?
- 4) Are you using the dedicated AC adapter that came with the instrument?
 - > Never use an AC adapter or power cable other than the dedicated one available for use with this instrument, as damage can result.

■ Normal measured values are not displayed.

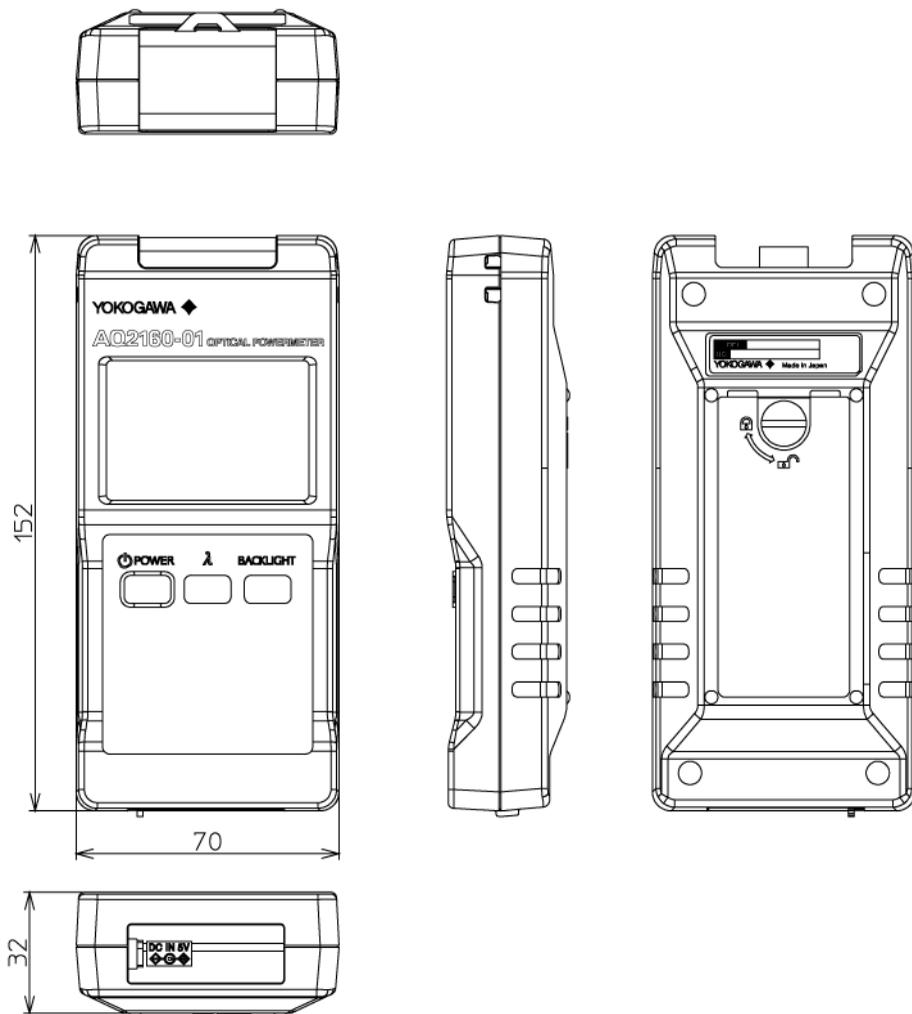
- 1) Does the instrument's wavelength setting match the wavelength being measured?
 - > Edit the wavelength setting using the wavelength switching key.
- 2) Is the optical connector (optical fiber) attached correctly?
 - > Check the connections. Insert the SC connector until it locks. For FC connectors, fasten the attachment ring all the way.
If the connection is not sound, measurements will be inaccurate.
- 3) Are the ends of the optical connector fibers damaged or dirty?
 - > Clean them with a dedicated optical connector cleaner. Using fibers with damaged ends can result in erroneous measurement.

■ When the instrument starts up, the backlight automatically blinks and does not stop.

The instrument's self-diagnostic function has detected an error.

-> Contact the dealer from which you purchased the instrument for repairs.

Do not attempt to repair the instrument yourself, as doing so can be very dangerous.



Outline drawing of the AQ2160-01 Optical Powermeter

Product Inquiry

For inquiries regarding YOKOGAWA's measurement instrument products, access "T&M Worldwide Network" on the Web page at the URL indicated below. Then, contact your nearest YOKOGAWA dealer or representative shown on the page.

<http://www.yokogawa.com/tm/>