User's Manual

Model 735201
TB200
OPTICAL POWER METER

YOKOGAWA
Yokogawa Meters & Instruments Corporation

IM 735201-01E
3rd Edition

Foreword

Thank you for purchasing the TB200 Optical Powermeter. This user's manual contains useful information about the functions and operating procedures of the TB200 and lists the handling precautions of the instrument. To ensure correct use, 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.

Notes

The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. Display contents illustrated in this manual may differ slightly from what actually appears on your screen.
In this manual, the descriptions are based on Windows 2000.
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Revisions

- First Edition July, 2005
- Second Edition September, 2005
- Third Edition November, 2010

3rd Edition : November 2010 (YK)

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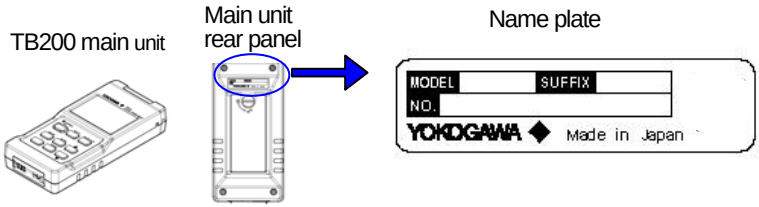
Checking the Contents of the Package

After opening the package, check the following items before beginning use. If any of the contents are incorrect, missing, or appear to be abnormal, please contact your Yokogawa dealer or representative.

TB200 Main Unit

Check that the model and suffix code on the name plate on the rear of the instrument match those of your order. Please have the instrument number (NO.) ready when contacting your dealer or representative.



Models and Suffix Codes

Model	Suffix Code	Description
735201		
Power cord	- M	AC adapter PSE Conforming (2 pin)
	- C	AC adapter UL/CSA compliant (UL2P)
	- F	AC adapter VDE compliant (CEE-C2)
	- G	AC adapter AS compliant (AS2P)
	- J	AC adapter BS compliant (BS2P) angle
With/without sensor head	- CA0	Without sensor head (when ordering main unit only)
	- CA1	With sensor head (405 nm, 1 wavelength calibration) Inaccuracy under standard conditions: ±2.5%
	- CA3	With sensor head (405/660/785 nm, 3 wavelength calibration), inaccuracy under standard conditions 405 nm：±2.5% 660 nm：±3.0% 785 nm：±3.0%
Options	/PR	Protector (with stand)

Standard Accessories

The following accessories come standard.

Product Name	Model	Qty.	Note
AC adapter	SU2007A	1	
Power cord	-	1	
UM connector protective cap	-	1	Attached to TB200 main unit
User's manual	IM735201-01E	1	This manual
Sensor head	735201	1	When purchasing together with the TB200
Software （TB200 Utility）	-	1	Available on the sensor head accessory CD.
Sensor protective cap	-	1	Attached to the sensor head

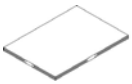
Note) The model when purchasing the sensor head by itself is 735221.

AC adapter

Power cord

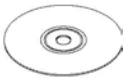
UM connector protective cap
(on the TB200 main unit)

User's manual
(this document)



Sensor head
(when purchased together

Software
（TB200 Utility）



Sensor protective cap
(on sensor head)

Options (Sold Separately)

The following options are available for purchase separately.

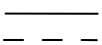
Name	Model	Notes
Sensor head	735221	Model when ordering only the sensor head
Protector	SU2002A	Protector with stand
Soft carrying case	SU2006A	

Safety Precautions

To ensure safe and correct operation of the instrument, you must take the safety precautions given below. The instrument's protective functions may not work if used in a manner not described in this manual. Yokogawa bears no responsibility for, nor implies any warranty against damages occurring as a result of failure to take these precautions.

The following safety symbols and wording is used in this manual.

Warning: Handle with care. Refer to the user's manual or service manual. This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use. The same symbol appears in the corresponding place in the manual to identify those instructions.



Direct current

Alternating current

The following precautions must be taken to prevent potentially fatal accidents.

WARNING

Use the Correct Power Supply

Check that the supply voltage of the instrument matches that of the power supply to be used before turning the power ON.

Use the Correct AC Power Cord and Adapter

To prevent electric shock or fire when using the AC adapter, only use the dedicated AC adapter and power cord supplied with the instrument.

Also do not use the power cord and AC adapter that came with the instrument on any other device.

Do Not Use Near Flammable Gases

Never use the instrument in locations with flammable or explosive gases or vapors. Doing so is extremely dangerous.

Do Not Remove the Case

Only qualified Yokogawa technicians may remove the case.

Handle the Item under Test Properly

The instrument measures devices that emit lasers. To prevent exposure to radiation from lasers, operate the item under test strictly according to the device's user's manual. Also, take care when handling the lens and other optical devices as doing so can cause damage to the eye.

To prevent fire or electric shock, do not insert or drop metallic objects into the opening.

When connecting to commercial power, connect directly to a dedicated outlet.

Do not use extension cords as they can overheat and cause fires.

Do Not Place the Power Cord on or Near Heaters

Heat can degrade the insulating coating resulting in fires or electric shock.

Do Not Damage or Modify the Power Cord

=> Fire or electric shock can result.

Do Not Use Extension Cords or Splitters

=> Cables can overheat, causing fires.

Do Not Bend, Twist, or Forcibly Pull the Cable

=> Fire or electric shock can result.

Do Not Plug or Unplug the Power Cord with Wet Hands

=> Electric shock can result.

Insert the Power Plug Completely and Securely into the Outlet

=> If metal or other objects are allowed to contact the power supply plug, fire or electric shock can result.

Safety Precautions

Do not remove the case. The instrument's internal components carry high voltages and are extremely dangerous.
For internal inspection or adjustment, contact your nearest YOKOGAWA dealer.

If there are any symptoms of trouble such as strange smells or smoke coming from the instrument, turn the power OFF immediately, and remove the battery pack or the power cord from the outlet. If such an irregularity occurs, contact your YOKOGAWA dealer.

Nothing should be placed on the power cord. The cord should be kept away from any heat sources. When unplugging the power cord from the outlet, never pull by the cord itself. Always hold and pull by the plug. If the power cord is damaged, contact your dealer for replacement.

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.

Be sure to unplug the power cord from the outlet during lightning storms.
=> Fire, electric shock, or malfunction can result.

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.

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.

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.

When handling parts that open and close, such as when changing the battery, take care not to pinch or injure your finger.

See below for operating environment limitations.

CAUTION

This product is a Class A (for industrial environments) product. Operation of this product in a residential area may cause radio interference in which case the user will be required to correct the interference.

General Handling Precautions

Take care not to damage the instrument by dropping it.

Unplug During Periods of Extended Non-Use

Unplug the power cord from the outlet. Remove the dry cells. Failure to remove the battery pack during long periods of non-use can cause the battery fluid to leak into the instrument, causing damage.

Do not place any other instrument or anything containing liquid on top of the instrument. Doing so can lead to malfunction.

Since the LCD screen is very vulnerable and can be easily scratched, do not allow any sharp objects near it. Also never expose it to vibrations and shocks.

Do Not Install the Instrument in Any of the Following Places

- Humid or dusty areas
- On an unstable surface
- In direct sunlight or in locations such as automobiles where the temperature can become high
- In a location where it may become vibrated or shocked
- Near sources of heat such as heating appliances

The IEC61010-1 pollution degree and overvoltage category of the instrument are as follows.

- Pollution degree 2

  Pollution degree refers to the degree of adherence by a solid, liquid, or vapor that reduces the withstand voltage or surface resistance factor. It is a number that expresses the degree to which an instrument or one of its components may become poluted while being used.

  Pollution degree 2 applies to normal indoor atmospheres. It applies only to normal or non-conductive pollution, but conductivity may occur temporarily depending on concentrations.

- Overvoltage category II

  Overvoltage category (installation category) is a number that defines excessive voltage, and includes regulations for impulse withstand voltage.

  Overvoltage category II applies to electrical equipment that is powered by a fixed installation such as a distribution board.

CAUTION

- Read this section before using the instrument for the first time.
- If this instrument is used in a manner not specified in this manual, the protective features provided by the instrument may be impaired.

Safety Markings

Safety Markings

The following markings are used in this manual.

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 attentions 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 proper operation of the instrument.

Bolded Characters

Bold characters and symbols used in the Procedure sections indicate the text and symbols on the keys of the instrument.
Items set in boldface mainly refer to controls on the instrument and other devices, or on-screen interface elements such as menu commands with which the user interacts.

Contents

1.1 Names and Functions of Parts

Sensor Connector

Connects to the sensor head.

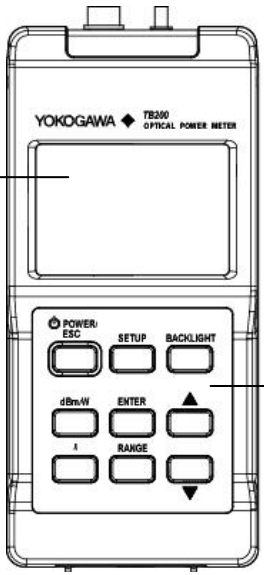
⇒See p. 2-4

Analog Out Terminal

(UM Connector)

Outputs a voltage according to the sensor head output.

=> See p. 1-7 and 1-8



Display

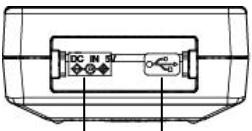
Displays measured results and various settings.

=> See p.1-4 and p.1-5

Keys

Nine keys for operating the instrument.

=> See p.1-2 and p.1-3



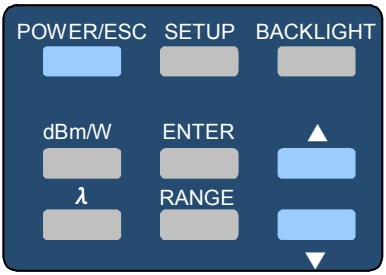
AC Adapter Terminal

For connecting the AC adapter.

USB Terminal

For connecting the USB cable.

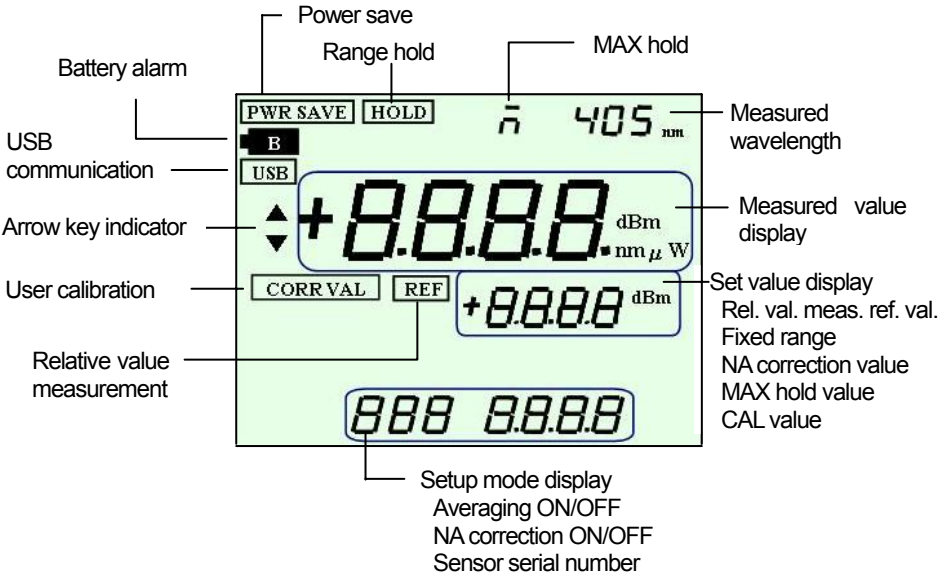
Keys



POWER/ESC	Power supply and escape key
This key turns the power ON and OFF. Press the key to start the instrument with the power save function set. If you hold down the button until the power save indicator "**PWR SAVE**" disappears, the instrument starts with the power save function disabled. To turn the instrument OFF, hold down the key until the LCD display goes out. You can press the key once during operation to return to normal measurement mode (ESC function).	
BACKLIGHT	Backlight key
Press this key to turn ON the backlight. Press again to turn it OFF.	
dBm/W	Unit selection key
This key switches the units for absolute value measurement mode (dBm or W). Each time you press the key, the selected units change as follows: dBm display => W display (switches automatically between mW, μW, and nW) => mW display (fixed) => dBm display Also, if you hold down the **ENTER** key while pressing this key, the instrument enters relative value measurement mode. The measured value at the moment the key is pressed is set as the reference value for relative value measurement. The instrument enters relative value measurement mode (and displays the difference in the measured value from the reference value) from the next measurement thereafter. Every time the key is pressed, the reference value is updated. In relative value measurement mode, this key switches to absolute value measurement mode. (Related keys: **ENTER**)	
λ	Wavelength key
Press this key to enter a mode for entering wavelength settings. Change values using the **UP** and **DOWN** keys, then press the **ENTER** key to enter the selection.	
RANGE	Range hold key
Press this key to fix the measuring range. Press it again to release the range. Press the **UP** and **DOWN** keys to change the range.	

SETUP	Setup mode key
Press this key to change to the Setup mode, in which various settings can be entered. In absolute value measurement mode, measurement conditions can be entered in the following order: Averaging setting, max hold setting, NA correction coefficient setting, sensor serial number display. (Related keys: **UP/DOWN**, **ENTER**)	
ENTER	Entry key
Enters various kinds of selectable settings. (Related keys: **UP/DOWN**, **SETUP**, **dBm/W**)	
▲, ▼	Selection keys (UP/DOWN)
Use these keys to turn items ON and OFF, and to enter values. Press once to change the selection UP or DOWN. Hold down to quickly scroll UP or DOWN through the selections. (Related keys: **SETUP**, **ENTER**)	

Screens



Power save	PWR SAVE
"**PWR SAVE**" is displayed when the power save function is set.	
Battery alarm	B
The indicator above blinks when the remaining battery charge is too low to provide sufficient power for operation. Change the batteries or connect the AC adaptor. During alarms, resuming is disabled.	
Range fixing	HOLD
The "**HOLD**" indicator is displayed when range switching is held.	
USB communication	USB
The "**USB**" indicator is displayed when in USB mode.	
MAX hold	$\bar{n}$
The mark above is displayed when the MAX hold function is set.	
Wavelength setting	"**405 nm**"
Displays the set wavelength (nm).	

Arrow key indicators	“▲” “▼”
Displayed when various kinds of selectable settings are available.	
Measured value display	“**+8.8.8.8.dBm nmμW**”
Displays the measured value and its units. Messages appearing during errors and entry of settings are also displayed here. (Related keys: dBm/W)	
Correction value setting	**CORR VAL**
The “**CORR VAL**” indicator is displayed when the correction value has been set using the user calibration function.	
Relative value measurement	**REF**
The “**REF**” indicator is displayed when in relative value measurement mode.	
Setting value display	“**8.8.8.8**”
The reference value is displayed when in relative value measurement mode. Also displays setting values and selection messages.	
Setup mode display	“**8 8 8 8.8.8.8**”
Displays NA correction ON/OFF and the sensor serial number.	

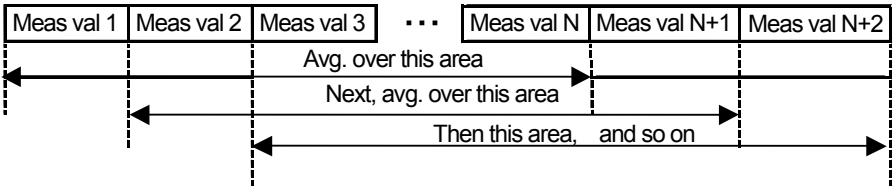
1.2 List of Functions

Function	Overview/Description
Optical power level measurement	Displays the optical power level of the light received by the sensor head in the display.
Range setting	Sets the range automatically according to the level of received light. You can specify a fixed range. The setting range is -30 dBm to +20 dBm
Auto zero set	Automatically sets zero when the power is turned ON. The user need not set zero manually.
Wavelength sensitivity correction	The wavelength sensitivity can be corrected in the range from 400 to 850 nm (in 1 nm steps). Accurate measurements can be obtained by matching with the wavelength of the light source being measured.
Relative value measurement	You can set a reference value and display the change in level relative to the reference value (units: dB).
Absolute value measurement unit switching	You can switch the displayed units between dBm and W. When W is selected, mW, uW, or nW is automatically selected and displayed according to the optical power. You can also fix the displayed units at mW.
Averaging	Averages measured values internally and displays them. The number of measured data values averaged is fixed at 20. A moving average is taken every measurement interval.[1]
Max hold	Displays the maximum value during measurement.
NA (aperature) correction	When measuring at high NA, you can correct error due to angular incidence characteristics of the sensor. The setting range is 0.500 to 2,000 (in 0.001 steps). However, the correction value must be selected from the NA correction coefficient table in appendix 1.
Sensor head S/N display	Displays the serial number of the sensor head connected to the instrument.
User calibration	Adds setting values displayed in normal measurement mode and displays them. The available setting range is -10 dB to +10 dB.
Backlight	Turning the backlight ON allows you to see the display in the dark.

Power save (only when using a battery)	When running on dry cells, the power turns OFF automatically if a key is not pressed within ten minutes.
Battery alarm (only when using a battery)	The battery indicator blinks when the battery runs low.
Resume[2]	The settings that were active when the power was turned OFF are saved and restored the next time the power is turned ON (if shutdown successfully). The function is disabled when the battery alarm indicator is displayed. In this case, the instrument saves the settings that were last active when the power was turned OFF normally.
Analog output[3]	Outputs an analog voltage for each range according to the measured value.
USB communication	Lets you edit settings and acquire measured values via USB (keys cannot be used for control when using this function).

1. Moving average

   Averages measured values from a determined number of measurements. The average value is updated at all times as the most recent values are loaded and the oldest ones are discarded.



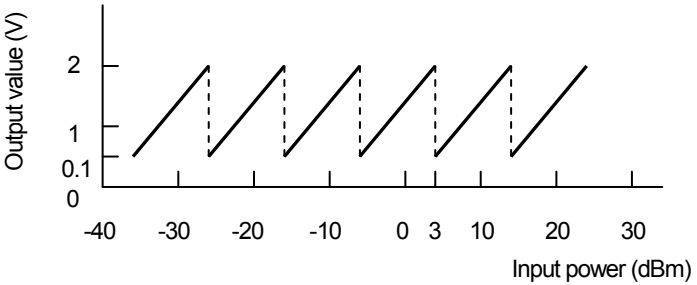
N : No. of measurements（for this instrument, N =20）

2. The settings that are saved by the Resume function are as follows.

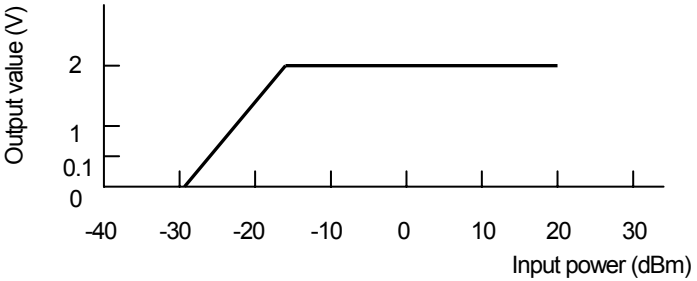
- Absolute value/relative value setting mode
- Relative measurement value
- Measurement wavelength
- Last set detail wavelength
- Displayed units
- Averaging ON/OFF
- Turning MAX Hold ON/OFF
- Range AUTO/HOLD
- Range info. (only with range hold)
- NA correction value ON/OFF
- Last set NA correction value
- CAL setting ON/OFF
- Last set CAL value

3. Analog Out

You can convert measured results to voltages of 0–2 V and output them. Output values can be input to another device such as a recorder for comparison and trend analysis. At each measuring range, the output value is the voltage from 0 to 2 V that is proportional to the input value. With a fixed range, the output value is under range at approximately 0.1 V and over range at approximately 2 V. When an overrange occurs, a voltage of 2 V or over can be output from the analog out terminal. Since with auto-switching the measuring range changes from approximately 0.1 V to approximately 2 V, the output values are non-continuous.



Analog out when using automatic ranging



Analog out when using fixed measuring range (-20 dB)

2.1 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 during Use

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) Do not disassemble the device.
7) Do not peer into the ends of the optical fiber, the beams as they travel through the air, the optical connector, or other parts connected to the light source. Doing so can result in injury to the eyes from lasers. Take appropriate caution when handling.
8) Incidence of excessive or highly concentrated light outside of the optical power measuring range can damage the sensor element.
9) When the optical power is expressed as an average the value appears low, but the instantaneous power can be quite high. Take extra precaution with low duty, high-cusp pulses.
10) If the surface of the sensor is soiled with dirt or grime, clean the end with specialized optical connector cleaner or a dust-resistant cloth.
11) If any plastic parts become soiled, wipe with a soft and dry cloth.
12) When not using the instrument, attach the cap to protect the sensor from dirt, grime, and other foreign particles.
13) To prevent damage when attaching or removing the optical input connector cap, take care not to rub the connector against the cap.
14) Never insert or remove the sensor head while the power is ON.
15) Do not connect anything to the connectors (sensor head, analog out terminal, etc.) other than the specified product. Damage can result.
16) The sensor head contains optical components that are easily scratched. Take care not to scratch or crack any part of the sensor head.
17) Only turn ON the power if the sensor head is attached.

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) Always operate the instrument in a way that is appropriate for the type of batteries you are using.

Cautions When Using the AC Adapter

Use the AC adapter that came with the instrument, and the country-specific power cable that was packaged together with the AC adapter. Connect a power supply that meets the specifications of the AC adapter.
To use the cable and adapter, insert the power cable firmly into the inlet on the AC adapter, and connect the output cable firmly to the AC adapter terminal on the instrument. Also, only use these items indoors. Use them in the same temperature range as is required for the instrument. Note that the safety standard for the AC adapter specifies an operational temperature of 0–40°C. Never use an AC adapter or power cable other than the dedicated ones available for use with this instrument, as damage can result.

Precautions When Using the CD

This CD contains software, and is for use in a computer only. Do not play this on an audio CD player as the high volume may damage your hearing or audio speakers.

Precautions When Discarding the Instrument

Treat the instrument as general industrial waste, separate from household waste, and dispose of the instrument according to relevant local laws.

2.2 Connection Procedure

Connecting the AC Adapter

Connect the AC adapter output terminal to the instrument's AC adapter terminal after opening the cap.

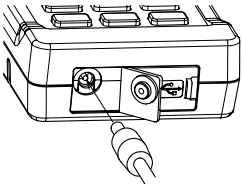


Figure 2-1 AC Adaptor Output Terminal

Installing the Batteries

When using 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 twenty-four hours when using alkaline AA batteries (performance may vary depending on the operating conditions).

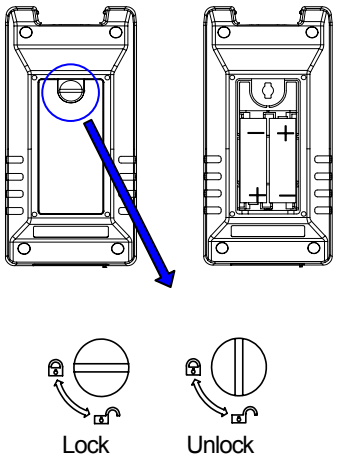


Figure. 2-2 Installing the batteries

Connecting the Sensor Head

Connect the sensor head connector to the sensor connector terminal on the instrument. Align the connector tab with the groove, then push in. The connector head cannot be connected if the tab is not properly aligned.

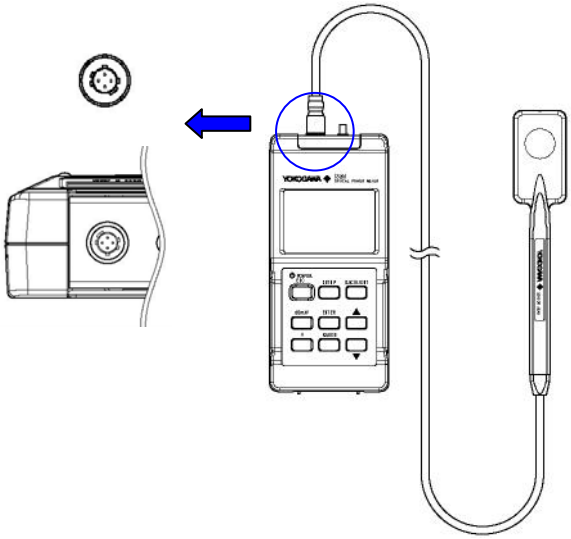


Figure 2-3 Sensor head connection diagram

CAUTION

- To remove the sensor head, hold and pull by the connector
- Do not pull by the cable itself as it can break.

2.3 Turning the Power Supply ON and OFF

When Using the AC Adapter

When the power is OFF, press **POWER/ESC** key.
The instrument starts up in normal measurement mode.

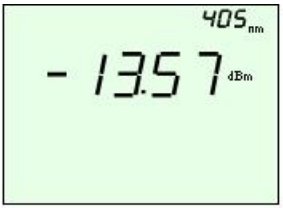


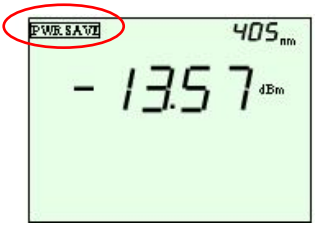
Figure 2-4 Example of the normal measurement mode screen

WARNING

Never use an AC adapter or power cable other than the dedicated ones available for use with this instrument, as damage can result.

When Using Batteries

When the power is OFF, press POWER/ESC.
The instrument starts up in normal measurement mode.
"**PWR SAVE**" is displayed in the upper left part of the screen.



Indicates that the power save function is operating. The power turns OFF if no key is pressed for ten minutes.

Figure 2-5 Display example in power save mode

Note

- To start up with the power save function OFF, make sure the power is turned OFF, then hold down the **POWER/ESC** key until the "**PWR SAVE**" display goes out.
- This instrument features a zero adjust function (zero point adjustment) that automatically removes the offset within the circuits. Thus, no zero adjustment by the user is necessary

Starting Up in USB Mode

When the instrument is connected to a PC with a USB cable, the instrument enters USB mode when the power is turned ON. It also enters this mode if the cable is connected after the power is turned ON. Therefore, if a USB cable is connected while the instrument is in normal measurement mode, it switches to USB mode automatically. In USB mode, all keys are disabled except for the **POWER** and **BACKLIGHT** keys.
The "**USB**" indicator is displayed when the instrument starts up in USB mode or switches to that.

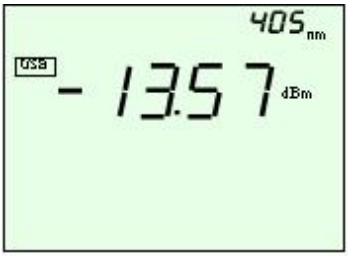


Figure 2-6 Display example in USB mode

Turning the Power OFF

1. Hold down the power key until the LCD display goes out.
2. Attach the sensor head protective cap.
3. When using the AC adapter, turn the instrument OFF with the power key before disconnecting the adapter.

3.1 Entering Measurement Conditions

The following three measurement condition parameters can be set.

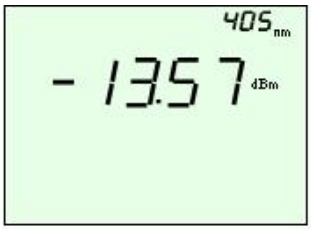
1) Wavelength setting (typical value, or switching of the wavelength in 1 nm steps)
2) NA setting
3) Averaging setting

The conditions set here are stored until the next time you enter settings, even if the power is turned OFF (Resume function.See p.1-7).

If you make a mistake, you can press the **ESC** or **SETUP** key.	
ESC key:	Return to normal measurement mode.
SETUP key:	Cancel setting and advance to the next setting.

The setting procedures described all start from the initial screen in normal measurement mode.

The initial screen in normal measurement mode.



Same screen as when first starting up. Confirm that the screen shows the initial settings, then begin the procedure for entering measurement conditions.

Figure 3-1 Example of the initial screen in normal measurement mode.

3.1.1 Setting the Wavelength

You can set the correction wavelength for the sensor head to match the used wavelength. The sensor element has wavelength sensitivity characteristics. To obtain accurate measurements, the instrument is set to a wavelength that matches the wavelength of the measured light.

Choosing a Typical Wavelength

1. Perform the operation from the initial screen in normal measurement mode (Figure 3-1).
2. Press the **λ** key. The wavelength setting screen appears.。

Figure 3-2 Wavelength setting screen

3. Each time you press the **UP** key, the displayed wavelength cycles through the following options: "**405**", "**660**", "**785**", "**Prev Val**", "**Usr**", "**405**", and so on. Pressing the **DOWN** key cycles in the reverse order.
   (Note: *Previous value* refers to the wavelength most recently set.)
4. After selecting a wavelength, press the **ENTER** key. The typical wavelength setting is finalized.

Setting to an Arbitrary Wavelength. (Can Be Set in Units of 1 nm).

5. After setting the wavelength display to "**USr**", press the **ENTER** key.
   The detail wavelength setting screen appears.

Figure 3-3 Detail wavelength setting screen

6. Press the **UP** or **DOWN** key. Change the wavelength in units of 1 nm. The available setting range is 400 to 850 nm.
7. Press the **ENTER** key. The detail wavelength settings are finalized.

3.1.2 Setting the NA (Numerical Aperture) Correction Coefficient

You can set the NA correction coefficient and correct the angle dependency of the light accepted by the sensor head resulting from the aperture.

1. Perform the operation from the initial screen in normal measurement mode (Figure 3-1).
2. Press the **SETUP** key. The setup mode screen appears.
3. Press the **SETUP** key two more times. The NA correction coefficient setting ON/OFF screen appears.

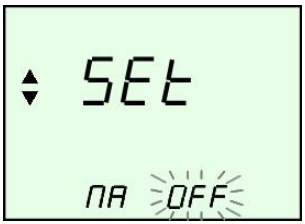


Figure 3-4 Display example of the NA correction coefficient setting ON/OFF screen

4. Each time you press the **UP** or **DOWN** key, "**ON**" or "**OFF**" blinks. Select "**ON**".
5. Press the **ENTER** key. The NA correction coefficient blinks.

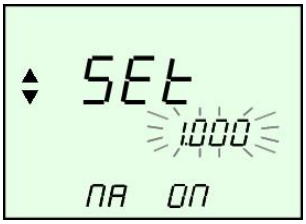


Figure 3-5 Example of a display while setting the NA correction coefficient

6. Press the **UP** or **DOWN** key to change the value. Determine the value from the NA correction coefficient table (see appendix 1).
7. Press the **ENTER** key. The sensor serial number reference screen appears (see Figure 5-1). The NA correction coefficient setting is finalized.

8. Press the **ENTER** key. The instrument returns to the normal measurement mode screen.

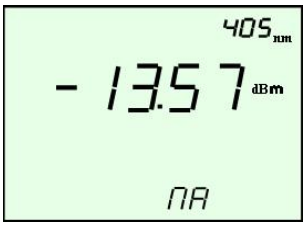


Figure 3-6 Example of the display in normal measurement mode when the NA correction coefficient setting is enabled.

Note

- The NA correction coefficient differs depending on the NA and RIM of the light source you are using.
- Select a coefficient from the NA correction coefficient table in appendix 1 according to the conditions matching the light source.

NA

Stands for *numerical aperture*, and is a number that determines the light-condensing characteristics of a lens.
The larger the NA, the more the beam is concentrated, allowing higher-density recording.

3.1.3 Entering Averaging Settings

1. Perform the operation from the initial screen in normal measurement mode (Figure 3-1).
2. Press the **SETUP** key. The averaging setting screen appears.

Figure 3-7 The averaging setting screen

3. Each time you press the **UP** or **DOWN** key, "**ON**" or "**OFF**" blinks. Select "**ON**".
4. Press the **ENTER** key. The MAX hold setting screen appears (see Figure 3-13). The averaging settings are finalized.
5. Press the **ENTER** key three times. The instrument returns to the normal measurement mode screen.

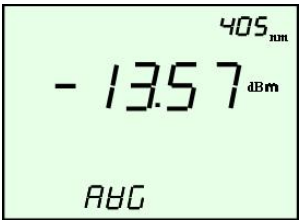


Figure 3-8 Normal measurement mode screen when the averaging setting is enabled

Note

- Averaging is performed on the instrument using a serial addition averaging method.
  The specified number of data from the measured values are averaged and the result is displayed. After measurement begins, it is possible that fewer than the specified number of data are measured.

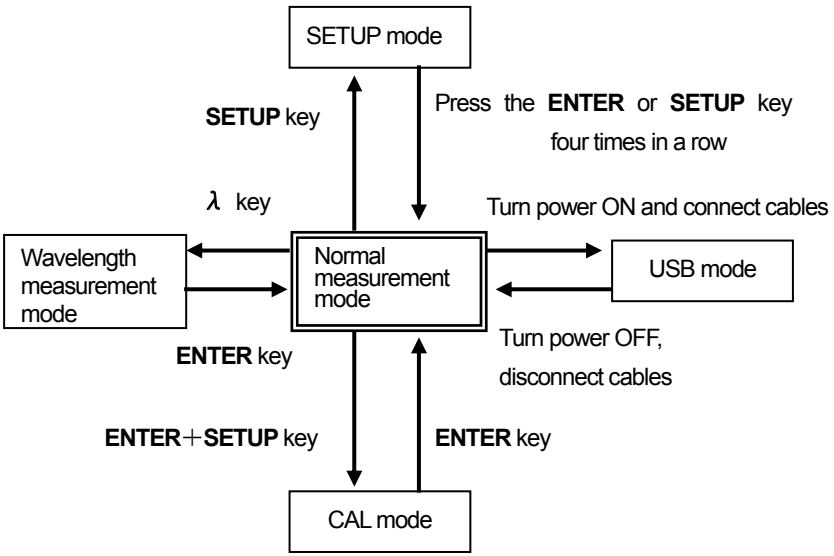
3.2 Modes

This instrument has five modes as shown in the table. When the power is turned ON, the instrument starts up in normal measurement mode. You can press the appropriate key to transition from normal measurement mode into the other modes. When a USB cable is connected, the instrument switches to USB mode automatically. When USB is disconnected, the instrument returns to normal measuring mode.

3.2.1 List of Modes

Mode	Functions Included	Entering the Mode
Normal measurement mode	Optical power measurement. Absolute value measurement. Relative value measurement. Range fixing. Switching the display units to dBm/W.	Power ON
Setup mode	Averaging setting. MAX hold setting. NA setting. Sensor serial number display.	Press the **SETUP** key.
Wavelength setting mode	Setting the measured wavelength.	Press the **λ** key
CAL setting mode	User calibration function setting.	Press **ENTER** + **SETUP**
USB mode	Remote control. Uploading the sensor head specific data to the TB200 from the PC.	Turn power ON and connect cable.

3.2.2 Diagram of Relationship between Modes



3.3 Absolute Value Measurement

3.3.1 Measuring Optical Power

When the power to the instrument is turned ON, measurement begins.
The optical power level is displayed in the measured value display area.

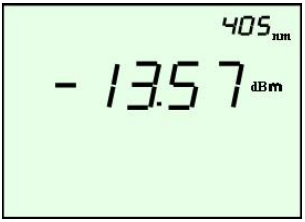
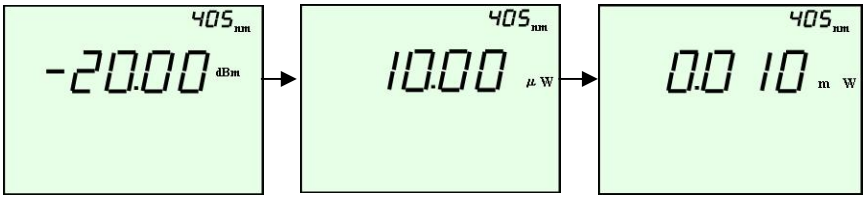


Figure 3-9 Example of an optical power measurement screen

3.3.2 Changing Units

Each time you press the **dBm/W** key, the display cycles through the following options: "**dBm**" -> "**W**" (auto units) -> "**mW**" (fixed units) -> "**dBm**".



dBm display W display (auto) mW display (fixed)

Figure 3-10 Display example of unit settings

Note

- If the units are dB, differential measurement (relative value measurement mode) is indicated.
- Press the dBm/W key to switch to optical power measurement (absolute value measurement mode).

3.3.3 Fixing the Measuring Range (Range Hold)

You can fix the measuring range (range hold). This is useful when using the analog out function.

1. Perform the operation from the initial screen in normal measurement mode (Figure 3-1).
2. Press the **RANGE** key. The "**HOLD**" display and current range value blink for five seconds.

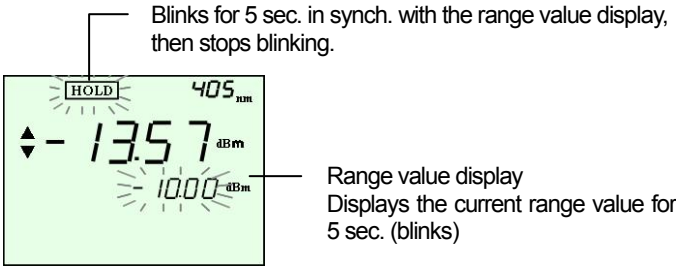


Figure 3-11 Example of the range value display during range hold

3. After blinking, "**HOLD**" is displayed, and the range value is no longer displayed. The fixed range setting is finalized. The instrument enters range hold mode.

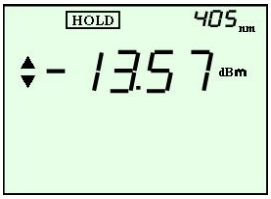


Figure 3-12 Example of the display when in range hold mode

To Change the Range Value

4. Press the **UP** or **DOWN** key while in range hold mode. The range goes up or down.
5. The range blinks for five seconds in the area shown in Figure 3-11, then the original screen returns (if REF is set, the REF value is displayed again).

Note

- If the measuring range is fixed and the incoming light exceeds the measuring range, the measured value blinks. If the upper limit of the range is exceeded, "▲" is displayed. If the lower limit is not exceeded "▼" is displayed.
- Press the **RANGE** key again to return to AUTO mode.

3.3.4 Displaying Maximum Values (MAX Hold)

1. Perform the operation from the initial screen in normal measurement mode (Figure 3-1).
2. Press the **SETUP** key. The setup mode screen appears.
3. Press the **SETUP** key once again. The MAX hold setting ON/OFF screen appears.

Figure 3-13 Max hold setting screen

4. Each time you press the **UP** or **DOWN** key, "**ON**" or "**OFF**" blinks. Select "**ON**".
5. Press the **ENTER** key. The screen changes to the NA correction coefficient setting screen (see Figure 3-4). The MAX hold setting is finalized.
6. Press the **ENTER** key two times. The instrument returns to the normal measurement mode screen.

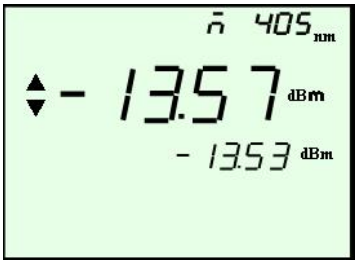


Figure 3-14 Normal measurement mode screen when the MAX hold setting is enabled

Note

- The MAX hold and REF functions cannot be used at the same time on the instrument.
- If you turn ON the REF function while the MAX hold function is enabled, MAX hold is cancelled and the REF function is enabled.

3.3.5 Measuring after Setting the CAL Value

You can add an arbitrarily set user calibration value (CAL value) to the values displayed in normal measurement mode. The available setting range is -10 dB to +10 dB. The active power range and the setting range for the relative value measurement reference value is shifted by the value of CAL. The ON status of the user calibration function and the CAL value are saved even when the power is turned OFF. Use for the correction made when performing calibration.

1. Perform the operation from the initial screen in normal measurement mode (Figure 3-1).
2. Press the **SETUP** key while holding down the **ENTER** key. The CAL setting ON/OFF screen appears. However, it does not appear when in relative measurement mode. The transition only occurs from absolute value measurement mode. If you transition to CAL setting mode, "**CAL**" is displayed, and the display to the lower right of "**CAL**" blinks.
3. Each time you press the **UP** key, the display to the lower right of "**CAL**" cycles through the following options: "**OFF**", "**Prev Val**", "**Usr**", "**OFF**". Pressing the **DOWN** key cycles in the reverse order.
4. After selecting a CAL value (previous value), press the **ENTER** key. The typical CAL setting is finalized.

Figure 3-15 Example of the CAL value setting screen

5. You can set an arbitrary CAL value in 0.01 dB steps.
   After setting the display to the lower right of "**CAL**" to "**USr**", press the **ENTER** key. The CAL detail setting screen appears.
6. Press the **UP** or **DOWN** key. The CAL value changes in steps of 0.01 dB. The available setting range is -10 dBm to +10 dBm

Figure 3-16 Example of the CAL value detail setting screen

7. Press the **ENTER** key. The instrument returns to normal measurement mode. The CAL detail setting is finalized.

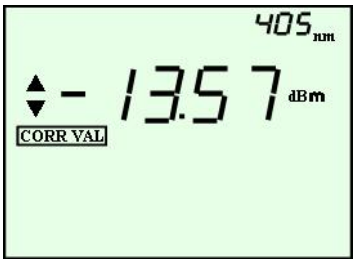


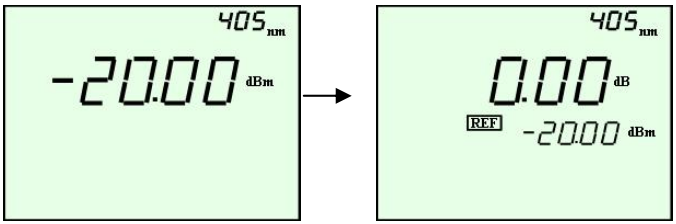
Figure 3-17 Example of the normal measurement mode screen when the CAL setting is enabled

3.4 Relative Value Measurement

Measuring the Optical Power Differential

You can display the difference (dB) from a reference value (REF).

1. In absolute value measurement mode, press the **dBm/W** key while holding down the **ENTER** key. The measured value at the time the key was pressed is set as the reference value, and relative measurement begins.
2. The units for relative measurement reference value are fixed at dBm. There is no W unit display.



Absolute value measurement mode When REF is set

Figure 3-18 Example of display in absolute value measurement mode when setting the reference (REF)

Note

- To return to absolute value measurement, press the **dBm/W** key.
- Each time you press the **dBm/W** key while holding down the **ENTER** key, the reference value is updated.
- Only measured values can be set as the reference value. Arbitrary values cannot be specified.

4.1 USB Communication Function

You can control the instrument using USB. You can read data and enter various parameters from the PC. Also, a DLL and sample software are available on the TB200 Utility CD in order to install the TB200 dedicated USB driver and easily create control software. The following provides the USB communication specifications and explains how to install the driver.

USB Communication Specification

Item	Specification
USB standard	Conforms to USB Version 1.1
Connector type	B
Remote control function	Provided (bulk transfer)
USB driver	TB200 dedicated driver comes standard (for Windows 2000/XP)
USB cable length*	2 m or less (shielded type)

* Attach a ferrite core (TDK: ZCAT1325-0530A or equivalent) to one end of the USB cable, close to the instrument's USB connector.

Driver/DLL Specifications and Operating Environment

Item	System Requirements
OS	Windows 2000/XP
Languages	Microsoft Visual C++ 6.0 Microsoft Visual Basic 6.0
RAM	32 MB or more
Interface	Windows 2000/XP with TB200 dedicated USB driver installed.
Send delimiter (TB200 -> PC)	CR+LF
Receive delimiter (PC -> TB200)	CR+LF or LF only

CAUTION

During USB communications, do not turn the power to the PC and TB200 OFF.
The driver and DLL are not guaranteed to be compatible with all PCs, hubs, and other hardware.

4.2 Installing USB Drivers

Install the USB driver on the PC. Use the TB200 Utility CD that comes standard. Follow the on-screen instructions.

Preparation

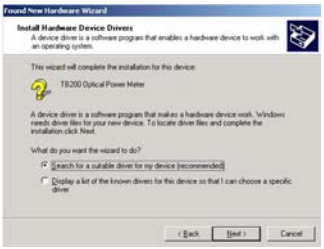
Turn the instrument ON, then connect the instrument to the PC using a USB cable (insert the cable connector completely and firmly into the receptacle). The instrument automatically enters USB mode, and USB is displayed (see section 2.2 and figure 2-6).

* USB cable: shielded cable of 2 m or more in length.

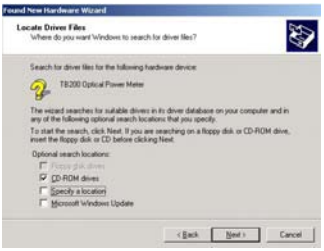
Installation

1. Place the enclosed TB200 Utility CD in the CD-ROM drive.
2. Turn the instrument ON, then connect the instrument to the PC using a USB cable (insert the cable connector completely and firmly into the receptacle). The Found New Hardware Wizard is displayed.

3. Click **Next**
4. Select **Search for a suitable driver for my device**. Click **Next**.



5. Select **CD-ROM drives**. Click **Next**.



6. Click **Next**.

7. Click **Finish**. The installation is complete

4.3 List of Commands

The following describes the commands available on the TB200.
The TB200 offers ASCII character strings in addition to input and output commands. Also, the return values for setting commands and query commands are separate, so there is no need to send commands and queries separately.

Command Notation Conventions and Meanings
1) Commands begin with a colon (:).
2) <wsp> means, *enter a space.*
3) <Value> means, *enter value here*.
4) ON|OFF means, *enter either ON or OFF*.

Command List

No.	Function	Command	Description	Parameters	Response
1	Data request	:READ:POW?	Returns the current measured value.	None	Returns the current measured value in Float format. The units are the same as those during setting. ERR#: See error list.
2	Data request with status	:READ:POW:STAT?	Returns the current measured value and range status.	None	Returns the current measured value in Float format. <Range status> Over Range Under Range In Range Average ERR#: See error list.
3	Max value data request	:READ:MAX?	Returns the current maximum measured value.	None	Returns the current maximum measured value in Float format. The units are the same as those during setting. ERR#: See error list.
4	Wavelength setting	:SENS:POW:WAV<wsp><Value>	Sets the wavelength	400-850 (1 step) Units: nm	OK: Setting complete ERR#: See error list.
5	Check the set wavelength	:SENS:POW:WAV?	Returns the set wavelength.	None	Set as a three digit integer. The units are fixed at nm. ERR#: See error list.
6	NA correction function enable/ disable setting	:SENS:CORR:NA:STAT<wsp> ON|OFF	Turns NA correction function ON and OFF	ON: Enabled OFF: Disabled	OK: Setting complete ERR#: See error list.

No.	Function	Command	Description	Parameters	Response
7	Check NA correction function setting status	:SENS:CORR:NA:STAT?	Returns the NA correction function setting status.	None	ON: Enabled OFF: Disabled ERR#: See error list.
8	Set NA correction Value	:SENS:CORR:NA:VAL<wsp><Value>	Sets the NA correction value. Sets the data internally regardless of the NA correction function ON/OFF.	0.500-2.000 :0.001step	OK: Setting complete ERR#: See error list.
9	Check NA correction value	:SENS:CORR:NA:VAL?	Returns the currently set NA correction value. Returns the setting status of the data internally regardless of the NA correction function ON/OFF.	None	Decimal place 3 digits *.** ERR#: See error list.
10	Setting the measuring range	:SENS:POW:RANG<wsp><Value>	Sets the measuring range.	AUTO +20 dBm +10 dBm 0 dBm -10 dBm -20 dBm -30 dBm	OK: Setting complete ERR#: See error list.
11	Check measuring range	:SENS:POW:RANG?	Returns the status of the current measuring range setting.	None	AUTO +20 dBm +10 dBm 0 dBm -10 dBm -20 dBm -30 dBm ERR#: See error list.
12	Set units of measure-ment	:SENS:POW:UNIT<wsp><Value>	Sets the units for the measured value.	0: dBm 1: mW / µW / nW auto switching 2: mW fixed display	OK: Setting complete ERR#: See error list.
13	Check units of measure-ment	:SENS:POW:UNIT?	Returns the unit setting status of measured values.	None	0: dBm 1: mW/µW/nW auto switching 2: mW fixed display ERR#: See error list.

No.	Function	Command	Description	Parameters	Response
14	Relative value measure-ment setting	:SENS:POW:REF:STAT <wsp>ON|OFF	Switches between relative and absolute measurement.	ON: Relative value measurement: dB Absolute value measurement (dBm)	OK: Setting complete ERR#: See error list.
15	Check relative setting	:SENS:POW:REF:STAT?	Returns the relative/absolute value measurement status.	None	ON: Relative value measurement: dB OFF: Absolute value measurement: dBm ERR#: See error list.
16	Check relative measure-ment reference value	:SENS:POW:REF:VAL?	Returns the relative measurement reference value.	None	***.** (symbol, 2-digit integer, 2-digit decimal). units are dBm. ERR#: See error list.
17	User CAL function enable/ disable setting	:SENS:CORR:CAL:STAT <wsp>ON|OFF	Turns user CAL function ON and OFF	ON: User CAL ON status OFF: User CAL OFF status	OK: Setting complete ERR#: See error list.
18	Check user CAL function setting status	:SENS:CORR:CAL:STAT?	Returns the user CAL function setting status.	None	ON: User CAL ON status OFF: User CAL OFF status ERR#: See error list.
19	Set user CAL value	:SENS:CORR:CAL:VAL<wsp><Value>	Sets the user CAL value	***.** (symbol, 2-digit integer, 2-digit decimal). The units are dB Range: integer from -10.00 to +10.00, first 0 or + can be omitted	OK: Setting complete ERR#: See error list.
20	Check user CAL value	:SENS:CORR:CAL:VAL?	Returns the user CAL value.	None	***.** (symbol, 2-digit integer, 2-digit decimal). units are dB. Range: -10.00 to +10.00. ERR#: See error list.
21	Set averaging	:SENS:POW:AVG<wsp>ON|OFF	Sets up averaging.	ON: Averaging ON OFF: Normal measurement	OK: Setting complete ERR#: See error list.
22	Check averaging setting	:SENS:POW:AVG?	Returns the averaging setting status.	None	ON: Averaging ON OFF: Normal measurement ERR#: See error list.

No.	Function	Command	Description	Parameters	Response
23	Max. value measure-ment mode setting	:SENS:POW: MAX<wsp> <Value>	Sets the maximum value measurement mode.	ON: Max. value measurement mode ON + reset max measurement value. OFF: Normal measurement	OK: Setting complete ERR#: See error list.
24	Check max value measure-ment mode	:SENS:POW: MAX?	Returns the maximum value measurement mode setting status.	None	ON: Max. value measurement mode ON OFF: Normal measurement
25	Get main unit (735201) information	:SYST:IDN?	Returns main unit information	None	<maker>, <model>, <serial no.>, <firmware ver.>, <options> ERR#: See error list.
26	Get sensor head (735221) information	:SYST:HEAD: IDN?	Returns sensor head information.	None	<maker>, <model>, <serial no.> ERR#: See error list.
27	Execute zero set	:SYST:ZERO	Executes an electrical ZERO.	None	OK: Concluded successfully ERR#: See error list. ZERO set can take up to 5 or 6 seconds. The response occurs after execution finishes.
28	Reset	:SYST:RST	Resets the setting conditions to their factory defaults. Installed sensor head information and wavelength data are not deleted.	None	OK: Concluded successfully ERR#: See error list.

Note

- The command system conforms with SCPI. However only short (and not long) form is supported.
- Since spaces are used as separators, unneeded spaces inserted into commands result in syntax errors.
  Commands are case insensitive.

Communication Errors

If a communication error occurs in remote control, a string comprising “ERR” plus a number is sent.

Error List

Error Number	Description	Cause
ERR1	Command syntax error	Command not correct.
ERR2	Command execution error	Parameters out of range. Appears when in a mode that precludes execution of the command
ERR3	System abnormality error	Memory damaged, or other hardware related trouble.

4.4 Sample Program

A DLL is provided to make creation of measurement programs easier.

4.4.1 Installing the DLL

The DLL is included on the TB200 Utility CD included with the sensor head.
For instructions on use, consult the ReadMe.txt file for the DLL.

4.4.2 Sample Software

The project file for the sample software that uses TB200.DLL is included on the TB200 Utility CD.
This section describes how to use these sample programs.

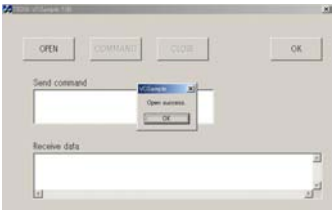
Note

All DLLs and sample softwares in the CD that comes with the sensor head are the same regardless of the sensor head.

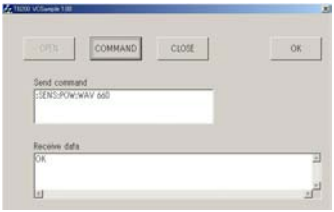
For Visual C++

1. Place the TB200 Utility CD in the CD-ROM drive.
2. Copy the TB200.dll and VCSample.exe files from the VCSample folder on the TB200 Utility CD to the same folder on the PC you are using.
3. Double-click **VCSample.exe**. The file opens.

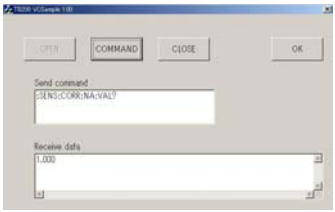
4. Click **Open**. "**Open success**" is displayed. Click **OK** (in the popup screen).



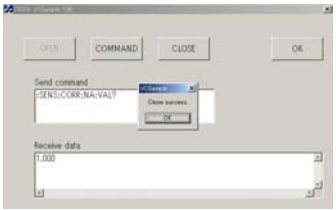
5. Enter measurement conditions. After inputting the send command, click **Command** (in the operation example, the wavelength is set).
   When settings are complete, "**OK**" is displayed.



You can also display the currently set value and measured value. After inputting the send command, click **Command** (in the operation example, the set NA value is displayed).



6. Click **Close** to exit. "**Close success**" is displayed. Click **OK (**in the popup screen).

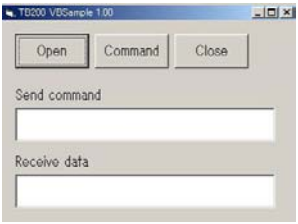


7. To close the sample program, click **OK**.

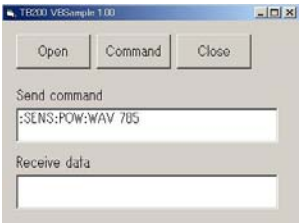
For Visual Basic (VB)

1. Place the TB200 Utility CD in the CD-ROM drive.
2. Copy the TB200.dll and VBSample.exe files from the VBSample folder on the TB200 Utility CD to the same folder on the PC you are using.
3. Double-click **VBSample.exe**. The file opens.

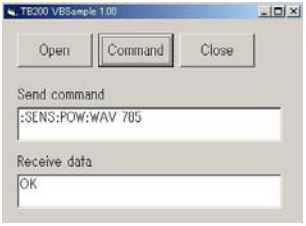
4. Click **Open**. "**Open success**" is displayed.
   Click **OK** in the popup screen.



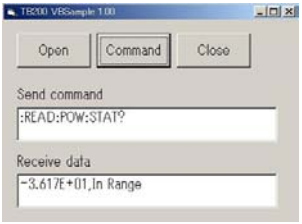
5. Enter measurement conditions. After inputting the send command, click **Command** (in the operation example, the wavelength is set).



When settings are complete, "**OK**" is displayed.

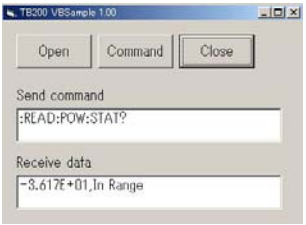


You can also display the currently set value and measured value. After inputting the send command, click **Command** (in the operation example, the current measured value is displayed).



6. Click **Close** to exit. "**Close success**" is displayed. Click **OK** in the popup screen**.**

7. To close the sample program, click the **Close** button " **X** ".



5.1 Uploading Sensor Specific Data

In order to satisfy sensor head operating characteristics, sensor specific data is uploaded. This data is included in the TB200 Utility CD that comes with the sensor head. Upload the data using your PC and USB cable. Note that if you selected the combined calibration option at the time of purchase (suffix code -CA1 or -CA3), the sensor specific data (calibration data) has already been loaded into the TB200 Optical Powermeter, so this step is not necessary.

In the following cases, sensor-specific data must be uploaded before starting measurement.

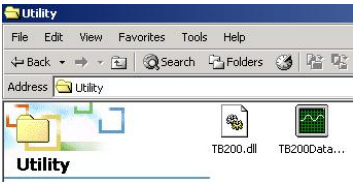
- When using a sensor head purchased by itself as an add-on.
- If the suffix code printed on the name plate on the rear panel of the TB200 is -CA0.

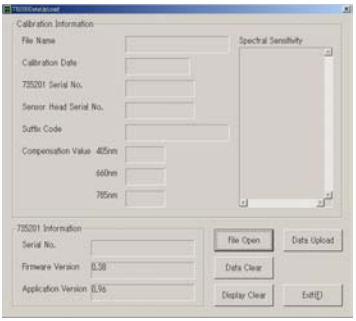
Preparation

1. Install the USB driver (included) on the PC (see section 4.2 for the installation procedure).
2. Turn the instrument ON, then connect the instrument to the PC using a USB cable (insert the cable connector completely and firmly into the receptacle). The instrument automatically enters USB mode, and USB is displayed (see section 2.3).

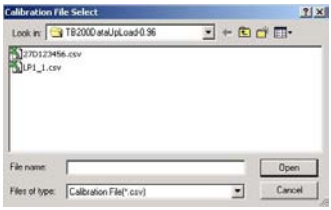
Upload Procedure

1. Place the TB200 Utility CD in the CD-ROM drive.
2. Choose **My Computer** > **CD-ROM** > **Utility**.
3. Double-click the **TB200DataUpLoad.exe** file in the Utility folder. The TB200DataUpLoad screen is displayed.

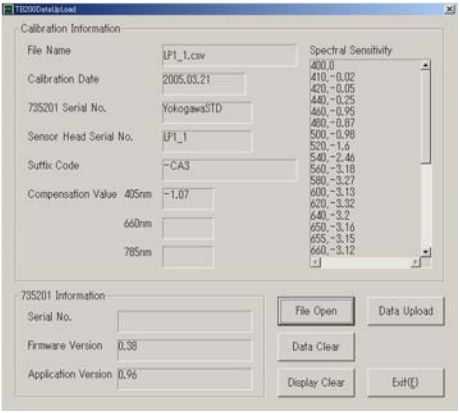




4. Click **File Open**. The Calibration File Select screen opens.



5. Select a data file from the Calibration Data folder. Click **Open**.
6. Click **Data Upload**. The upload finishes.



7. Click **Exit**.
   Remove the USB cable. The instrument enters normal measurement mode (use a safe procedure for removing the USB connection from the PC side).

Note

- The uploaded correction data is unique to the sensor head.
- When replacing it with a different sensor head, you must upload the correction data for the new sensor head.

5.2 Displaying the Sensor Head Serial Number

The sensor head serial number of the calibration data currently stored in the instrument is displayed.
Check whether it matches the serial number of the sensor head to be used.
This is only a mode for checking the number, and it cannot be edited. The last six digits of the serial number are displayed

1. Perform the operation from the initial screen in normal measurement mode (Figure 3-1).
2. Press the **SETUP** key. The setup mode screen appears.
3. Press the **SETUP** key three more times. The sensor head serial number is displayed.

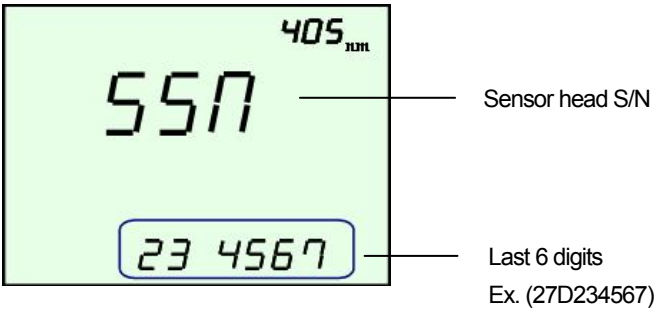
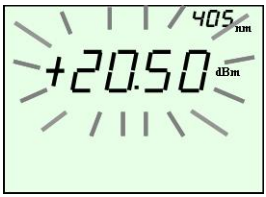


Figure 5-1 Sensor head serial number reference screen

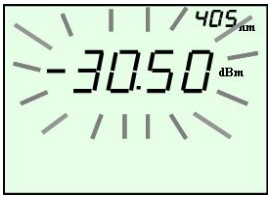
6.1 Error Messages



Overrange Error

The display blinks if the measured optical power level exceeds the maximum measurable value.
It also blinks if, when using range hold, the value exceeds the range upper limit.
Always note the measurable values of each range

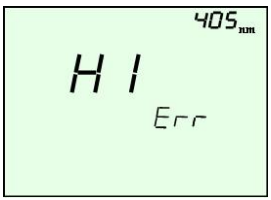
Figure 6-1 Overrange error



Underrange Error

The display blinks if the measured optical power level falls below the minimum measurable value.
It also blinks if, when using range hold, the value falls below the range lower limit.
Always note the measurable values of each range.

Figure 6-2 Underrange error

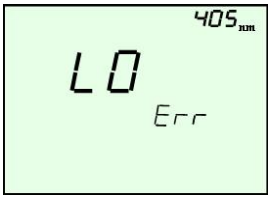


Reference Value Out of Range Error

Displayed when the measured value used for setting or updating the relative measurement reference value is outside the valid range.
The high or low level error display appears for one second, then the unit returns to the previous measurement mode.

Figure 6-3 High level error

Exceeded the upper limit: high level error



Fell below the lower limit: low level error.

Figure 6-4 Low level error

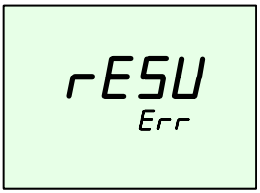


Figure 6-5 Resume error

Resume Error

If the Resume value was not saved successfully, the Resume error appears the next time the instrument is started.

To cancel a resume error, press the **ENTER** key or turn the power OFF and restart. The normal measurement mode screen appears.

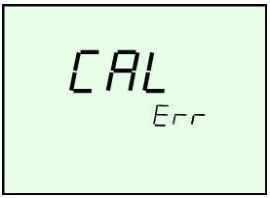


Figure 6-6 CAL value setting error

CAL Value Setting Error

This is displayed if calibration data was not input or was lost. Upload sensor specific data (calibration data) via USB (see section 5.1).

Note that if you selected the combined calibration option at the time of purchase (suffix code -CA0), the sensor specific data (calibration data) has already been loaded into the TB200 Optical Powermeter.

6.2 Troubleshooting

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

Cannot take measurements

Immediately after turning the power ON, the measured value blinks and measurements cannot be taken.

-> Is range hold selected (the hold indicator is displayed)?

Press the RANGE key. This clears the range hold.

(Example of possible problem: When using the previous value, the range is held at a high level resulting in a continuous measured value of “under error.”)

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

1) Are the correct batteries installed?
   -> Use only AA alkaline dry cells.
   -> Check the polarity/orientation of the batteries.
2) Is there charge remaining in the batteries?
3) 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.)
4) Is the power cord for the AC adapter connected correctly?
5) Are you using the dedicated AC adapter that came with the instrument?
   -> Never use an AC adapter or power cable other than the dedicated ones available for use with this instrument, as damage can result.

Normal measured values are not displayed.

1) Do the instrument’s measurement conditions match the light being measured?
   -> Edit the measurement conditions using the SETUP key.
2) Is CORR VAL blinking?
   -> Turn the user calibration function OFF during normal measurement.
3) Is the sensor head connector connected correctly?
   -> Check the connections. Align the connector tab with the groove, then push all the way in.
   If the connection is not sound, measurements will be inaccurate.

Cannot transfer data via USB.

1) Did you install the USB driver on the PC?
   -> Use the accessory TB200 UTILITY CD.
2) Is the USB cable properly connected?
3) Are you using the dedicated AC adapter?

6.3 Periodic Calibration

Periodic Calibration

1) Periodic calibration maintains the normal performance of the instrument over long periods of time, and is an effective means of quickly identifying any malfunctions that may occur.
2) The sensor head uses an optical filter based on glass material. If the optical filter is subjected to high powered near-infrared light of approximately 400 nm for long durations, reduced transmissivity may result. Additionally, the sensitivity of the sensor may be reduced by a few percent due to any reductions in the transmissivity. For precise measurements, it is recommended to calibrate the instrument periodically (every six months).

7.1 Specifications

TB200 Optical Power Meter: 735201

Environmental Conditions

Item	Environmental Condition
Operation-guaranteed temperature/humidity conditions	Body: 5 to 40°C (ambient temperature), 20 to 80% (no condensation)
Storage temperature/humidity	-20 to +60°C (ambient temperature), 20 to 80% (no condensation)

Electrical Specifications

Item	Specification
Display	7-segment, 4-digit, w/ backlight
Display resolution	0.01 dB (When W unit is selected, floating point w/ 4 digits past decimal point)
Unit display	Absolute value: dBm, mW, µW, nW Incremental value: dB
Wavelength setting range	400 to 850 nm
Wavelength sensitivity compensation increment	1 nm
Range selection	AUTO／HOLD
NA compensation range	0.500 to 2.000 (0.001 increments)
Optical power display range	1 µW (-30 dBm) to 100 mW (+20 dBm)
Measurement interval	Approx. 100 msec
Backlight	Lights when backlight key is pressed, and goes out when key is pressed again.
Analog output	0 to 2 V connector: UM connector (made by Hirose Electric)
Interface	USB (B connector)
Sensor head	Model: 735221 (Model name of sensor head becomes 735201 when -CA1 or -CA3 integrated calibration is selected. However, its performance is the same.)
Power supply	AC adapter (rated input voltage: 100 to 240 V, 50/60 Hz, 0.24 to 0.13 A) 7 VA AA alkali dry cell (operation time: approx. 24 hours)
Accessories	User's Manual, AC adapter, UM connector protective cap
Safety, EMC Note)	Safety: EN61010-1, (Out of conformance since December 1, 2010.) EMC: EN61326-1 ClassA, Table2 (for use in industrial locations)Pollution degree 2, Overvoltage category II

Note) Applies to products with CE marks. For all other products, contact your nearest YOKOGAWA dealer.

Sensor Head for TB200: 735221

Environmental Conditions

Item	Environmental Condition
Operation-guaranteed temperature/humidity	0 to +60°C (ambient temperature), 20 to 80% (no condensation)
Storage temperature/humidity	-20 to +60°C (ambient temperature), 20 to 80% (no condensation)

Electrical/Optical Characteristics

Item	Specification
Wavelength range	400 to 850 nm
Light-receiving element	Si-PD
Received light power range	1 µW (-30 dBm) to 100 mW (+20 dBm) Note 1)
Max. light receiving level	+20 dBm (100 mW) Note 1)
Max. power density	5 mW/mm^2 Note 1)
Uncertainty at reference conditions	±4% Note 2)
Input type	Spatial light
Accessories	TB200 Utility CD Note 3) Sensor protective cap

Note 1) Condition: λ= 405 nm

Note 2) Reference conditions:

(1) Reference temperature: 23 °C ±3 °C

(2) Reference wavelength: λ= 405 nm (Add 0.5% when the wavelength is in the range of 400 to 420 nm.)

(3) Reference power: 1 mW

(4) Reference beam shape: Distribution: Gaussian distribution, Radiated NA : 0.2, diffused light (50GI fiber output)

(5) Spectral width: 1 nm or less

(6) Light receiving position: Mechanical center

(7) Wavelength setting error: Within _0.5 nm

(8) Not including secular changes of measuring equipment

(9) Uncertainty inclusion coefficient: k = 2

* Uncertainty when only sensor head is sold. For details on uncertainty when the integrated calibration option is applied, refer to the “Remarks” column of the Model and Suffix Code table.

Note 3) Compensation values for this sensor head are provided in the TB200 Utility CD.
These performance values are for when this data is uploaded to the TB200 Optical Power Meter for use.

Combined Calibration Specifications

The sensor head (735221) and TB200 Optical Powermeter (735201) are calibrated together. If you selected the combined calibration option at the time of purchase, the electrical/optical characteristics of the sensor head are as given below (suffix code -CA1 or -CA3). The sensor head calibration data is written to the TB200 Optical Powermeter (735201), and the model of the sensor head becomes that of the main unit (735201).

Electrical/Optical Characteristics (With the Combined Calibration Option)

Item	Specification
Wavelength range	400 to 850 nm
Light-receiving element	Si-PD
Received light power range	1 µW (-30 dBm) to 100 mW (+20 dBm) Note 1)
Max. light receiving level	+20 dBm (100 mW) Note 1)
Max. power density	5 mW/mm^2 Note 1)
Uncertainty at reference conditions	±2.5 %(405 nm)±3.0 %(660 nm 785 nm) Note 2)
Input type	Spatial light
Accessories	TB200 Utility CD Note 3) Sensor protective cap

Note 1) Condition: λ= 405 nm

Note 2) Reference conditions:

(1) Reference temperature: 23 °C ±3 °C

(2) Reference wavelength: λ= 405 nm (Add 0.5% when the wavelength is in the range of 400 to 420 nm.)
660 nm calibration option: λ= 660 nm
785 nm calibration option: λ= 405 nm

(3) Reference power: 1 mW

(4) Reference beam shape: Distribution: Gaussian distribution, Radiated NA: 0.2, diffused light (50GI fiber output)

(5) Spectral width: 1 nm or less

(6) Light receiving position: Mechanical center

(7) Wavelength setting error: Within _0.5 nm

(8) Not including secular changes of measuring equipment

(9) Uncertainty inclusion coefficient: k = 2

* Uncertainty when only sensor head is sold. For details on uncertainty when the integrated calibration option is applied, refer to the “Remarks” column of the Model and Suffix Code table.

Note 3) Compensation values for this sensor head are provided in the TB200 Utility CD.
These performance values are for when this data is uploaded to the TB200 Optical Power Meter for use.

Accessories

Accessory	Description
TB200 Utility CD	USB driver for Windows 2000/XP
	API
	Calibration data
	Calibration data upload tool

7.2 External Dimensions

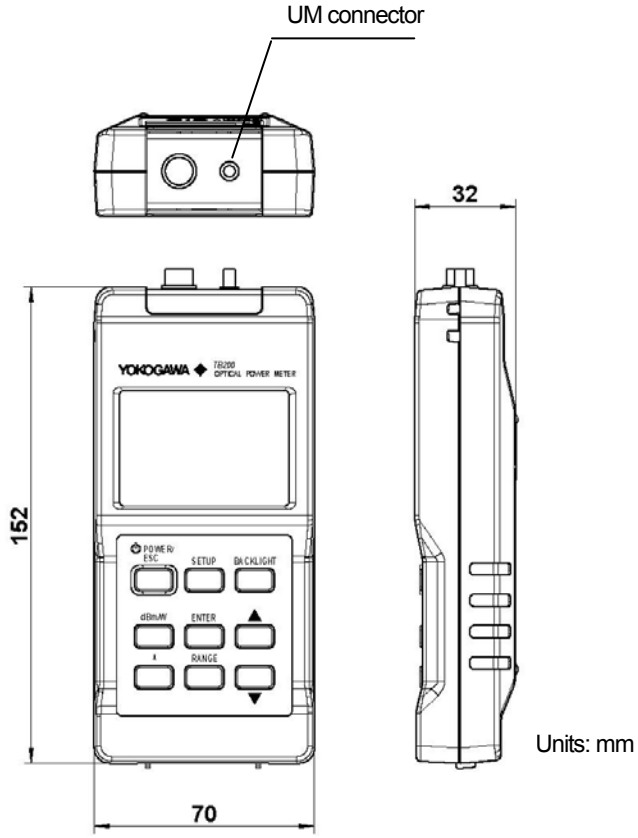
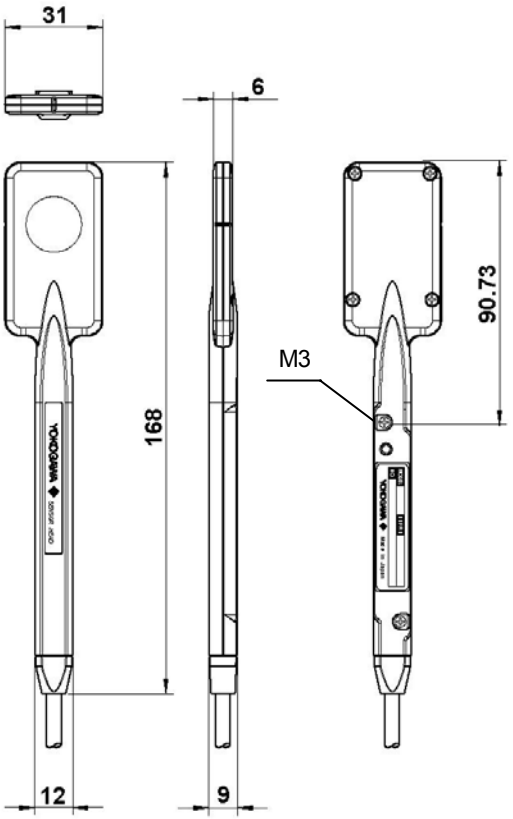


Figure 7-1 TB200 Optical Powermeter's external dimensions



Units: mm

Figure 7-2 Sensor head's external dimensions

Appendix 1 Table of NA Correction Coefficients

Use this table when setting the numerical aperture (see section 3.1.2). You can correct the angle dependency of the light accepted by the sensor head resulting from the aperture. This section includes seven different NA correction coefficient tables based on wavelength and NA. Contact your nearest Yokogawa representative if none of the correction tables below match your conditions.
The horizontal axis is S polarization (perpendicular to the plane of polarization) and the vertical axis is P polarization (parallel to the plane of polarization).

Wavelength: 405 nm, NA = 0.65

RIM	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30%	1.148	1.148	1.149	1.149	1.149	1.15	1.15	1.15	1.15	1.151	1.151	1.151	1.151	1.151
35%	1.153	1.153	1.153	1.153	1.154	1.154	1.154	1.154	1.155	1.155	1.155	1.155	1.155	1.155
40%	1.157	1.157	1.157	1.157	1.158	1.158	1.158	1.158	1.158	1.158	1.159	1.159	1.159	1.159
45%	1.161	1.161	1.161	1.161	1.161	1.161	1.162	1.162	1.162	1.162	1.162	1.162	1.162	1.162
50%	1.164	1.164	1.164	1.165	1.165	1.165	1.165	1.165	1.165	1.165	1.165	1.165	1.165	1.165
55%	1.167	1.167	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168	1.168
60%	1.17	1.171	1.171	1.171	1.171	1.171	1.171	1.171	1.171	1.171	1.171	1.171	1.171	1.171
65%	1.173	1.173	1.173	1.174	1.174	1.174	1.174	1.174	1.174	1.174	1.174	1.174	1.174	1.174
70%	1.176	1.176	1.176	1.176	1.176	1.176	1.176	1.176	1.176	1.176	1.176	1.176	1.176	1.176
75%	1.179	1.179	1.179	1.179	1.179	1.179	1.179	1.179	1.179	1.179	1.179	1.179	1.179	1.178
80%	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181	1.181
85%	1.184	1.184	1.183	1.183	1.183	1.183	1.183	1.183	1.183	1.183	1.183	1.183	1.183	1.183
90%	1.186	1.186	1.186	1.186	1.186	1.186	1.185	1.185	1.185	1.185	1.185	1.185	1.185	1.185
95%	1.188	1.188	1.188	1.188	1.188	1.188	1.187	1.187	1.187	1.187	1.187	1.187	1.187	1.187

Wavelength: 405 nm, NA = 0.85

RIM	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30%	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.302	1.301	1.301
35%	1.312	1.312	1.312	1.312	1.312	1.312	1.311	1.311	1.311	1.311	1.311	1.311	1.311	1.31
40%	1.321	1.321	1.321	1.321	1.321	1.32	1.32	1.32	1.32	1.32	1.319	1.319	1.319	1.319
45%	1.33	1.33	1.329	1.329	1.329	1.328	1.328	1.328	1.328	1.327	1.327	1.327	1.327	1.326
50%	1.338	1.337	1.337	1.337	1.336	1.336	1.336	1.335	1.335	1.335	1.334	1.334	1.334	1.333
55%	1.345	1.345	1.344	1.344	1.343	1.343	1.343	1.342	1.342	1.341	1.341	1.341	1.34	1.34
60%	1.352	1.352	1.351	1.351	1.35	1.35	1.349	1.349	1.348	1.348	1.347	1.347	1.347	1.346
65%	1.359	1.358	1.358	1.357	1.356	1.356	1.355	1.355	1.354	1.354	1.353	1.353	1.353	1.352
70%	1.365	1.364	1.364	1.363	1.362	1.362	1.361	1.361	1.36	1.36	1.359	1.359	1.358	1.358
75%	1.371	1.37	1.37	1.369	1.368	1.368	1.367	1.366	1.366	1.365	1.365	1.364	1.364	1.363
80%	1.377	1.376	1.375	1.374	1.374	1.373	1.372	1.372	1.371	1.37	1.37	1.369	1.369	1.368
85%	1.382	1.381	1.381	1.38	1.379	1.378	1.377	1.377	1.376	1.376	1.375	1.374	1.374	1.373
90%	1.388	1.387	1.386	1.385	1.384	1.383	1.382	1.382	1.381	1.38	1.38	1.379	1.379	1.378
95%	1.393	1.392	1.391	1.39	1.389	1.388	1.387	1.387	1.386	1.385	1.384	1.384	1.383	1.383

Wavelength: 660 nm, NA = 0.6

RIM	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30%	1.104	1.104	1.103	1.103	1.103	1.102	1.102	1.102	1.101	1.101	1.101	1.101	1.100	1.100
35%	1.108	1.108	1.107	1.107	1.106	1.106	1.106	1.105	1.105	1.105	1.104	1.104	1.104	1.104
40%	1.112	1.111	1.111	1.110	1.110	1.109	1.109	1.109	1.108	1.108	1.108	1.107	1.107	1.107
45%	1.115	1.114	1.114	1.113	1.113	1.112	1.112	1.112	1.111	1.111	1.111	1.110	1.110	1.110
50%	1.118	1.117	1.117	1.116	1.116	1.115	1.115	1.114	1.114	1.114	1.113	1.113	1.113	1.112
55%	1.121	1.120	1.119	1.119	1.118	1.118	1.117	1.117	1.117	1.116	1.116	1.115	1.115	1.115
60%	1.123	1.122	1.122	1.121	1.121	1.120	1.120	1.119	1.119	1.119	1.118	1.118	1.117	1.117
65%	1.126	1.125	1.124	1.124	1.123	1.123	1.122	1.122	1.121	1.121	1.120	1.120	1.120	1.119
70%	1.128	1.127	1.127	1.126	1.125	1.125	1.124	1.124	1.123	1.123	1.123	1.122	1.122	1.121
75%	1.130	1.129	1.129	1.128	1.127	1.127	1.126	1.126	1.125	1.125	1.125	1.124	1.124	1.123
80%	1.132	1.131	1.131	1.130	1.129	1.129	1.128	1.128	1.127	1.127	1.127	1.126	1.126	1.125
85%	1.134	1.133	1.133	1.132	1.131	1.131	1.130	1.130	1.129	1.129	1.128	1.128	1.128	1.127
90%	1.136	1.135	1.135	1.134	1.133	1.133	1.132	1.132	1.131	1.131	1.130	1.130	1.129	1.129
95%	1.138	1.137	1.136	1.136	1.135	1.134	1.134	1.133	1.133	1.132	1.132	1.131	1.131	1.131

Wavelength: 660 nm, NA = 0.65

RIM	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30%	1.125	1.125	1.124	1.123	1.123	1.122	1.122	1.121	1.121	1.121	1.120	1.120	1.119	1.119
35%	1.130	1.129	1.128	1.128	1.127	1.127	1.126	1.126	1.125	1.125	1.124	1.124	1.124	1.123
40%	1.134	1.133	1.133	1.132	1.131	1.131	1.130	1.130	1.129	1.129	1.128	1.128	1.127	1.127
45%	1.138	1.137	1.136	1.136	1.135	1.134	1.134	1.133	1.133	1.132	1.132	1.131	1.131	1.131
50%	1.142	1.141	1.140	1.139	1.139	1.138	1.137	1.137	1.136	1.136	1.135	1.135	1.134	1.134
55%	1.145	1.144	1.143	1.143	1.142	1.141	1.141	1.140	1.139	1.139	1.138	1.138	1.137	1.137
60%	1.148	1.147	1.146	1.146	1.145	1.144	1.144	1.143	1.142	1.142	1.141	1.141	1.140	1.140
65%	1.151	1.150	1.149	1.148	1.148	1.147	1.146	1.146	1.145	1.145	1.144	1.143	1.143	1.142
70%	1.154	1.153	1.152	1.151	1.150	1.150	1.149	1.148	1.148	1.147	1.147	1.146	1.146	1.145
75%	1.157	1.156	1.155	1.154	1.153	1.152	1.152	1.151	1.150	1.150	1.149	1.149	1.148	1.147
80%	1.159	1.158	1.157	1.156	1.155	1.155	1.154	1.153	1.153	1.152	1.151	1.151	1.150	1.150
85%	1.162	1.161	1.160	1.159	1.158	1.157	1.156	1.156	1.155	1.154	1.154	1.153	1.153	1.152
90%	1.164	1.163	1.162	1.161	1.160	1.159	1.159	1.158	1.157	1.157	1.156	1.155	1.155	1.154
95%	1.166	1.165	1.164	1.163	1.162	1.161	1.161	1.160	1.159	1.159	1.158	1.157	1.157	1.156

Wavelength: 785 nm, NA = 0.45

RIM	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30%	1.006	1.006	1.005	1.004	1.004	1.004	1.003	1.003	1.002	1.002	1.002	1.001	1.001	1.001
35%	1.007	1.006	1.006	1.005	1.005	1.004	1.004	1.004	1.003	1.003	1.002	1.002	1.002	1.001
40%	1.008	1.007	1.007	1.006	1.006	1.005	1.005	1.004	1.004	1.004	1.003	1.003	1.003	1.002
45%	1.009	1.008	1.007	1.007	1.006	1.006	1.005	1.005	1.005	1.004	1.004	1.004	1.003	1.003
50%	1.009	1.009	1.008	1.007	1.007	1.006	1.006	1.006	1.005	1.005	1.004	1.004	1.004	1.004
55%	1.010	1.009	1.009	1.008	1.007	1.007	1.007	1.006	1.006	1.005	1.005	1.005	1.004	1.004
60%	1.010	1.010	1.009	1.009	1.008	1.008	1.007	1.007	1.006	1.006	1.006	1.005	1.005	1.005
65%	1.011	1.010	1.010	1.009	1.009	1.008	1.008	1.007	1.007	1.006	1.006	1.006	1.005	1.005
70%	1.011	1.011	1.010	1.010	1.009	1.009	1.008	1.008	1.007	1.007	1.007	1.006	1.006	1.006
75%	1.012	1.011	1.011	1.010	1.009	1.009	1.009	1.008	1.008	1.007	1.007	1.007	1.006	1.006
80%	1.012	1.012	1.011	1.010	1.010	1.009	1.009	1.009	1.008	1.008	1.007	1.007	1.007	1.007
85%	1.013	1.012	1.011	1.011	1.010	1.010	1.009	1.009	1.009	1.008	1.008	1.008	1.007	1.007
90%	1.013	1.012	1.012	1.011	1.011	1.010	1.010	1.009	1.009	1.009	1.008	1.008	1.008	1.007
95%	1.014	1.013	1.012	1.012	1.011	1.011	1.010	1.010	1.009	1.009	1.009	1.008	1.008	1.008

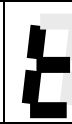
Wavelength: 785 nm, NA = 0.5

RIM	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30%	1.008	1.007	1.006	1.006	1.005	1.005	1.004	1.004	1.003	1.003	1.002	1.002	1.001	1.001
35%	1.009	1.008	1.007	1.007	1.006	1.006	1.005	1.005	1.004	1.004	1.003	1.003	1.002	1.002
40%	1.010	1.009	1.008	1.008	1.007	1.007	1.006	1.006	1.005	1.005	1.004	1.004	1.003	1.003
45%	1.011	1.010	1.009	1.009	1.008	1.007	1.007	1.006	1.006	1.005	1.005	1.005	1.004	1.004
50%	1.012	1.011	1.010	1.009	1.009	1.008	1.008	1.007	1.007	1.006	1.006	1.005	1.005	1.005
55%	1.012	1.011	1.011	1.010	1.009	1.009	1.008	1.008	1.007	1.007	1.007	1.006	1.006	1.005
60%	1.013	1.012	1.011	1.011	1.010	1.010	1.009	1.009	1.008	1.008	1.007	1.007	1.006	1.006
65%	1.014	1.013	1.012	1.011	1.011	1.010	1.010	1.009	1.009	1.008	1.008	1.007	1.007	1.007
70%	1.014	1.013	1.013	1.012	1.011	1.011	1.010	1.010	1.009	1.009	1.008	1.008	1.008	1.007
75%	1.015	1.014	1.013	1.013	1.012	1.011	1.011	1.010	1.010	1.009	1.009	1.009	1.008	1.008
80%	1.015	1.015	1.014	1.013	1.013	1.012	1.011	1.011	1.010	1.010	1.010	1.009	1.009	1.008
85%	1.016	1.015	1.014	1.014	1.013	1.012	1.012	1.011	1.011	1.010	1.010	1.010	1.009	1.009
90%	1.016	1.016	1.015	1.014	1.014	1.013	1.012	1.012	1.011	1.011	1.011	1.010	1.010	1.009
95%	1.017	1.016	1.015	1.015	1.014	1.013	1.013	1.012	1.012	1.011	1.011	1.011	1.010	1.010

Wavelength: 785 nm, NA = 0.55

RIM	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30%	1.010	1.009	1.008	1.007	1.007	1.006	1.005	1.005	1.004	1.004	1.003	1.003	1.002	1.002
35%	1.011	1.010	1.010	1.009	1.008	1.007	1.007	1.006	1.006	1.005	1.005	1.004	1.004	1.003
40%	1.013	1.012	1.011	1.010	1.009	1.008	1.008	1.007	1.007	1.006	1.006	1.005	1.005	1.004
45%	1.014	1.013	1.012	1.011	1.010	1.010	1.009	1.008	1.008	1.007	1.007	1.006	1.006	1.005
50%	1.015	1.014	1.013	1.012	1.011	1.010	1.010	1.009	1.009	1.008	1.008	1.007	1.007	1.006
55%	1.016	1.015	1.014	1.013	1.012	1.011	1.011	1.010	1.010	1.009	1.009	1.008	1.008	1.007
60%	1.016	1.015	1.014	1.014	1.013	1.012	1.012	1.011	1.010	1.010	1.009	1.009	1.008	1.008
65%	1.017	1.016	1.015	1.014	1.014	1.013	1.012	1.012	1.011	1.011	1.010	1.010	1.009	1.009
70%	1.018	1.017	1.016	1.015	1.014	1.014	1.013	1.013	1.012	1.011	1.011	1.010	1.010	1.009
75%	1.019	1.018	1.017	1.016	1.015	1.014	1.014	1.013	1.013	1.012	1.012	1.011	1.011	1.010
80%	1.019	1.018	1.017	1.017	1.016	1.015	1.015	1.014	1.013	1.013	1.012	1.012	1.011	1.011
85%	1.020	1.019	1.018	1.017	1.017	1.016	1.015	1.015	1.014	1.013	1.013	1.012	1.012	1.011
90%	1.021	1.020	1.019	1.018	1.017	1.016	1.016	1.015	1.015	1.014	1.013	1.013	1.012	1.012
95%	1.021	1.020	1.019	1.019	1.018	1.017	1.016	1.016	1.015	1.015	1.014	1.014	1.013	1.013

Appendix 2 Table of 7-Segment Display Characters

0	1	2	3	4	5	6	7
							
8	9	／					
							
A	B	C	D	E	F	G	H
							
I	J	K	L	M	N	O	P
							
Q	R	S	T	U	V	W	X
							
Y	Z