
**User's
Manual**

**701931
Current Probe**

Thank you for purchasing the Current Probe (Model 701931).

This instruction manual contains useful information about the instrument's functions and operating procedures as well as precautions that should be observed during use. To ensure proper use of the instrument, please read this manual thoroughly before beginning operation.

After reading the manual, keep it in a convenient location for quick reference whenever a question arises during operation.

List of Manuals

The following manuals are provided for the Current Probe (Model 701931).

Manual Title	Manual No.	Notes
701931 Current Probe User's Manual	IM 701931-01E	This manual.
701931 Current Probe User's Manual	IM 701931-92	Document for China
701931 Current Probe User's Manual	IM 701931-93Z2	Document for Korea

The "E" and "Z2" in the manual numbers are the language codes.

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

Document No.	Description
PIM113-01Z2	List of worldwide contacts

Revisions

- 1st Edition: August, 2003
- 2nd Edition: September, 2004
- 3rd Edition: November, 2005
- 4th Edition: October, 2013
- 5th Edition: October, 2014
- 6th Edition: November, 2015
- 7th Edition: January, 2016
- 8th Edition: October, 2017

Checking the Contents of the Package

If the wrong instrument or accessories have been delivered, or if some accessories are missing or defective, contact the dealer from which you purchased them.

Current Probe (Model 701931) Main Body

Accessories

- User's manuals 1 set
- Carrying case

Safety Precautions

This probe meets the requirements as given in the IEC-61010.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. If this instrument is used in a manner not specified in this manual, the protection provided by this instrument may be impaired. Also, YOKOGAWA assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on this instrument.



To avoid injury, death of personnel or damage to the instrument, the operator must refer to an explanation in the User's Manual or Service Manual.



Both direct and alternating current.



Do not apply around or remove from HAZARDOUS LIVE conductors.

Important Information for Users

In order to ensure safe operation and to obtain maximum performance from the unit, observe the cautions listed below.



WARNING

Connection with Power Supply and Protective Grounding

Connect the power supply to the probe power supply terminal of a waveform measuring instrument such as YOKOGAWA DL/DLM series, or use the Power Supply (Model 701934).

Connecting the Probe to the Item under Test

- If you need to touch the circuit with your hand, first cut the power to the circuit and confirm that it is not carrying any voltage.
- To avoid short circuits and personal injury when the clamp is open or measurement is being performed, do not apply the clamp to any bare conductors.

Restrictions on the Measuring Instrument

Read and observe all warnings and precautions relating to electrical safety for the measuring instrument being connected to the probe.

Do Not Operate When Wet

To prevent electric shocks, do not allow the unit to become wet and do not use the unit when your hands are wet.

Do Not Operate Near Flammable Materials

Do not operate the probe in the presence of flammable or explosive liquids or vapors.

Do Not Use When Removed from the Case

To avoid electric shock or fire, never use the probe if the case has been removed.

* Do not exceed the following levels: 30 Vrms, 42.4 Vpeak, and 60 VDC.



CAUTION

- Do not subject the unit to vibrations or shocks during transport or handling. Be especially careful to avoid dropping the unit.
- Do not store or operate the unit where it will be exposed to direct sunlight, high temperature, high humidity, or condensation. If exposed to such conditions, the unit may become damaged, the insulation may deteriorate, and the unit may no longer satisfy its specifications.
- Before using the unit, inspect it and check the operation to make sure that it was not damaged due to poor storage or transport conditions. If damage is found, contact your dealer or YOKOGAWA representative.

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- This instrument is not waterproof or dustproof. Do not use the unit in a wet or dusty environment.
 - The sensor head is a precision assembly including a molded component, a ferrite core, and a Hall effect element. It may be damaged if subjected to sudden changes in ambient temperature, or mechanical strain or shock, and therefore great care should be exercised in handling it.
 - The matching surfaces of the sensor head are precision ground, and should be treated with care. If these surfaces are scratched, performance may be impaired.
 - If there is any type of dust or dirt on the matching surfaces of the sensor head, measurements may be affected. Wipe it away gently with a soft cloth.
 - In order to avoid damaging the sensor cables do not bend or pull the sensor cable or power supply cable.
 - Current sensors can be damaged by static electricity. Be careful not to apply static electricity to current sensors. Below are some ways you could apply static electricity.
 - Touching the sensor head with an object charged with static electricity
 - Touching the sensor head with an object whose electric potential is different
 - A user charged with static electricity touching the core surface when cleaning the matching surfaces of the sensor head
(When cleaning the surfaces, take static electricity measures such as wearing an antistatic wrist strap.)
 - Gently wipe dirt from the surface of the unit with a soft cloth moistened with a small amount of water or mild detergent. Do not try to clean the unit using cleaners containing organic solvents such as benzene, alcohol, acetone, ether, ketones, thinners, or gasoline. They may cause discoloration or damage.
 - When the power is ON, keep the core section of the sensor closed, except when clamping it onto the conductor to be measured. The facing surface of the core section can be scratched while it is open.

Note

- Accurate measurement may be impossible in locations subject to strong external magnetic fields, such as near transformers and high-current conductors, or in locations subject to strong external electric fields, such as near radio transmission equipment.
 - Depending on the current frequency that is measured, oscillation may occur, but this has no effect on measurements.
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Sales in Each Country or Region

Waste Electrical and Electronic Equipment



Waste Electrical and Electronic Equipment (WEEE), Directive

(This directive is valid only in the EU.)

This product complies with the WEEE directive marking requirement. This marking indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category

With reference to the equipment types in the WEEE directive, this product is classified as a “Monitoring and control instruments” product.

When disposing products in the EU, contact your local Yokogawa Europe B.V. office.

Do not dispose in domestic household waste.

Authorized Representative in the EEA

Yokogawa Europe B.V. is the authorized representative of Yokogawa Test & Measurement Corporation for this product in the EEA. To contact Yokogawa Europe B.V., see the separate list of worldwide contacts, PIM 113-01Z2.

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

Describes precautions that should be observed to prevent serious injury or death to the user.

CAUTION

Describes precautions that should be observed to prevent minor or moderate injury, or damage to the instrument.

Note

Provides important information for the proper operation of the instrument.

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Chapter 1 701931 Current Probe

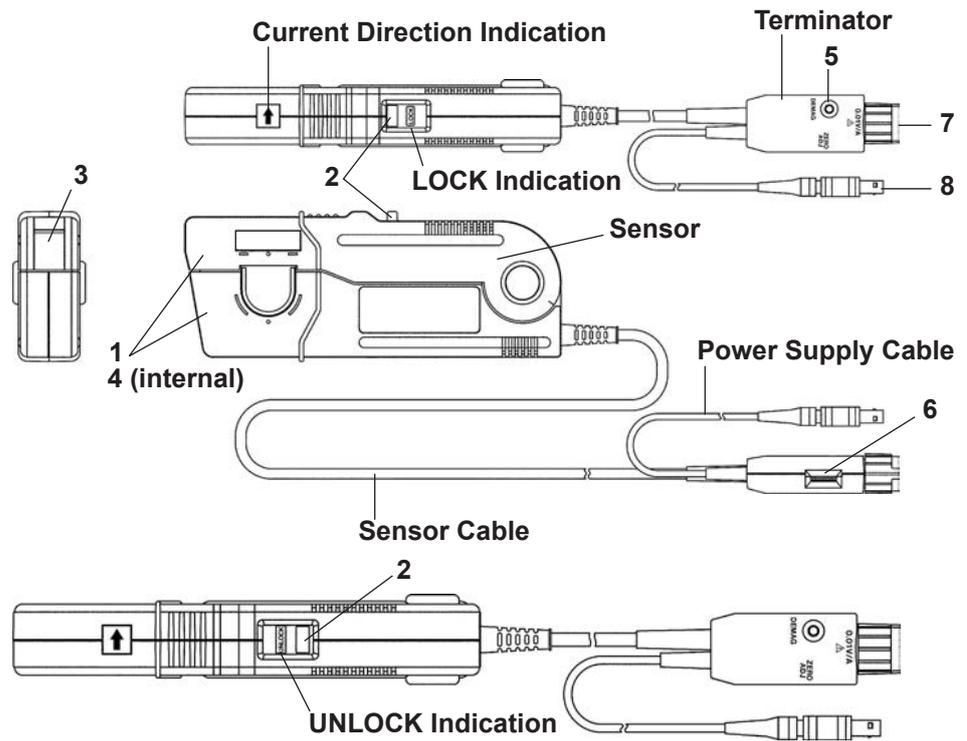
Product Overview

This unit can be directly connected to a BNC input connector of a waveform measuring instrument such as YOKOGAWA DL/DLM series, and by clamping it to a conductor to be measured, allows the current waveform to be easily captured.

Features

- Highly accurate current detection
- Easy current measurement
- Wideband frequency characteristics; DC to 2 MHz
- Wide clamp permits measurement of high current levels
- Easy protect function during excessive input

Names of Parts



Description of Parts

1 Clamp

The part which clamps to the conductor to be measured.

2 Clamp Lever

The lever for opening and closing the clamp. Make sure to open or close the clamp only by using the clamp lever.

3 Clamp Lock

Locks the clamp in place when it is closed.

4 Sensor Head

This clamps the conductor being measured, and carries out the actual current measurement. It is a precision assembly including a molded component, a ferrite core, and a Hall effect element. It may be damaged if subjected to sudden changes in ambient temperature, or mechanical strain or shock, and therefore great care should be exercised in handling it.

5 Demagnetizing Switch (DEMAG)

If the core has been magnetized by switching the power ON and OFF, or by an excessive input, this switch demagnetizes it. Always carry out demagnetizing before measurement. The demagnetizing process takes about three seconds. During demagnetizing, a demagnetizing waveform is output.

6 Zero Adjustment Dial (ZERO ADJ)

Use the zero adjustment dial to correct for the effect of a voltage offset or temperature drift on the unit. When performing measurements, always carry out a zero adjustment after demagnetizing.

7 Output Connector

The current waveform of the measured conductor is output at a constant rate (0.01 VA in conjunction with the waveform measuring instrument with an input impedance of 1 M Ω .)

Connect to the BNC input connector of the waveform measuring instrument.

Note

- The output of this unit is terminated internally. Use a high-impedance input to the measuring instrument. With an input impedance of 50 Ω , accurate measurement is not possible.
 - If using BNC-banana plug or similar adapters to connect to input terminals other than BNC connectors, make sure the polarity is correct.
 - Turn the clamp lever until it clicks, and check that it is locked securely.
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8 Power Plug

Connect the power plug to the receptacle on the Power Supply (Model 701934) to supply power to the sensor and terminator.

Measurement Procedure

Notes on Use



WARNING

Connection with Power Supply

Connect the power supply to the probe power supply terminal of a waveform measuring instrument such as YOKOGAWA DL/DLM series, or use the Power Supply (Model 701934).

Connecting the Probe to the Item under Test

- If you need to touch the circuit with your hand, first cut the power to the circuit and confirm that it is not carrying any voltage.
- To avoid short circuits and personal injury when the clamp is open or measurement is being performed, do not apply the clamp to any bare conductors.
- Be careful not to damage the insulation surface while taking measurements.
- Read and observe all warnings and precautions relating to electrical safety for the measuring instrument being connected to the probe.

Do Not Operate When Wet

To prevent electric shocks, do not allow the unit to become wet and do not use the unit when your hands are wet.

Do Not Operate Near Flammable Materials

Do not operate the probe in the presence of flammable or explosive liquids or vapors.

Do Not Use When Removed from the Case

To avoid electric shock or fire, never use the probe if the case has been removed.

* Do not exceed the following levels: 30 Vrms, 42.4 Vpeak, and 60 VDC.

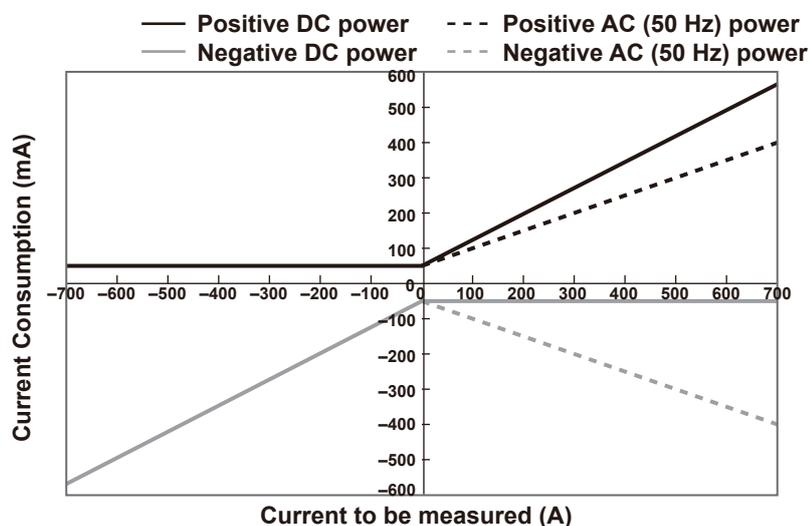
Preparations for Measurement



CAUTION

When using the Current Probe (Model 701931), you can only connect as many active probes simultaneously to the Power Supply (Model 701934) or the YOKOGAWA instruments probe power supply connector as allowed depending on the current value of the conductor.

The current consumption of the Current Probe (Model 701931) is dependent upon the measured current value. Do not let each active probe's total current consumption exceed the current regulated by the Power Supply (Model 701934) or the YOKOGAWA instruments probe power supply connector (see figure below).



Current consumption vs. current to be measured (typical)

For the probe power rating of each model, please refer to “Relationship between the current being measured and probe's current consumption” link of the following website.

<http://tmi.yokogawa.com/products/oscilloscopes/current-probes>

1. Have the Power Supply (Model 701934), and oscilloscope or recorder for waveform measurement ready.
2. Turn the power switch OFF and connect the power cord.
3. Connect the power plug of the 701931 to the power receptacle of the 701934.
4. Turn the 701934 power switch ON, and check that the front panel power indicator lights.

Note

The output of this unit is terminated internally. Use a high-impedance input to the measuring instrument. With an input impedance of 50 Ω , accurate measurement is not possible. When power is supplied to the 701931, a demagnetizing waveform might be generated

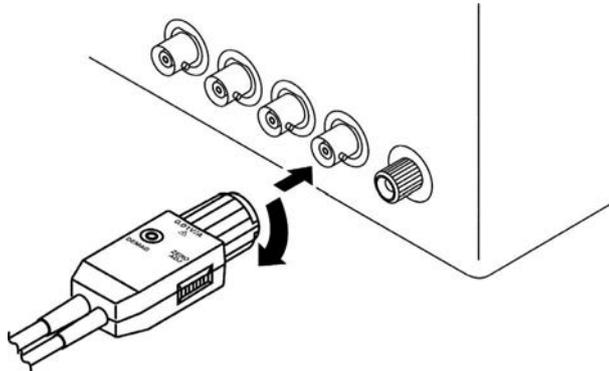
Demagnetizing and Zero Adjustment



CAUTION

- When disconnecting the output connector, be sure to release the lock before pulling the connector. Forcibly pulling the connector without releasing the lock, or pulling on the cable will result in damage to the terminator.
 - If using BNC-banana plug or similar adapters to connect to input terminals other than BNC connectors, make sure the polarity is correct.
 - Do not demagnetize when the clamp is connected to a conductor. Doing so might damage the components of the circuit being measured.
 - Do not begin supplying power to the 701931 after the clamp has been connected to a conductor. Doing so might damage the components of the circuit being measured.
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1. With the waveform measurement instrument input at ground, adjust the trace to the zero position.
2. Set the input coupling of the waveform measurement instrument to DC.
3. Connect the output connector of the 701931 to the input connector of the waveform measurement instrument. Turn the clamp lever until it clicks, and check that it is locked securely.



4. Without clamping the conductor to be measured, press the clamp lever until the **LOCK** indication appears (and the **UNLOCK** indication disappears), and then check that the clamp is properly closed.
5. Press the demagnetizing switch (DEMAG) on the terminator.
6. Turn the zero adjustment dial on the terminator to adjust the trace to the zero position.

Note

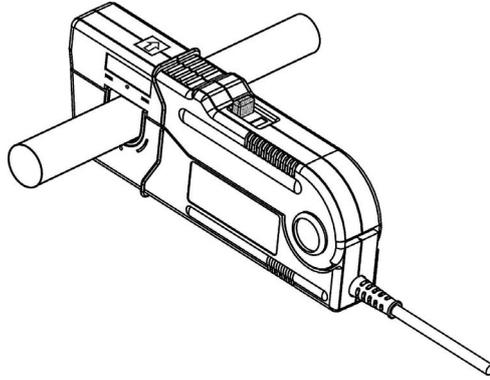
- The output of this unit is terminated internally. Use a high-impedance input to the measuring instrument. With an input impedance of 50 Ω , accurate measurement is not possible.
 - Oscillation may occur when you execute DEMAG, but this has no effect on measurements.
 - The positive side of the waveform that is generated when you execute DEMAG may not be symmetrical to the negative side, but this has no effect on measurements.
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CAUTION

- The maximum continuous input range is based on heat that is internally generated during measurement. Never input current in excess of this level. Doing so may result in damage to the probe.
 - The maximum continuous input range varies according to the frequency of the current being measured. See page 1-10, "Product Specifications."
 - If excess current is input, generated heat activates a built-in safety function that blocks normal output. If this happens, remove the input immediately (remove the sensor from the conductor being measured, or reduce the input current to zero). Wait until the sensor has had sufficient time to cool before resuming operation.
 - Heat generated by an input current whose frequency is 1 kHz or higher is mainly due to self-heating of the sensor head. In this case, the protection function is not activated. Therefore, be careful of burns, short circuits, and other accidents or sensor damage and the like caused by the temperature increase.
 - If you continuously input a current even if it is below the maximum current value established by the maximum continuous input range, the self-heating of the sensor may cause the safety function of the instrument to activate in order to prevent damage to the instrument.
 - At high ambient temperatures, the built-in safety circuit may activate at current input levels below the rated continuous maximum.
 - Continuous input of current exceeding the rated maximum, or repeated activation of the safety function may result in damage to the unit.
 - The specifications indicating the maximum input range lists the maximum peak current at $700 A_{peak}$ when non-continuous in addition to the continuous maximum input range. This indicates an upper waveform response limit of $700 A_{peak}$. Use the sensor at the RMS current input levels that is within the rated continuous maximum.
 - Open the clamp only by using clamp lever.
 - To maintain the probe accuracy within the specifications and to verify that correct measurement results are being obtained, periodic calibration is necessary. The calibration period varies depending on your operating environment and the frequency of use. We recommend that you set a calibration period according to the frequency of use and ask us to calibrate it periodically.
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1. Check that the system is safe, and that the preparations described in the preceding section have been carried out.
 2. Pull the sensor opening lever so that the sensor head opens.
 3. Align the sensor so that the current direction indication corresponds to the direction of current flow through the conductor to be measured, and clamp so that the conductor is in the center of the sensor aperture.

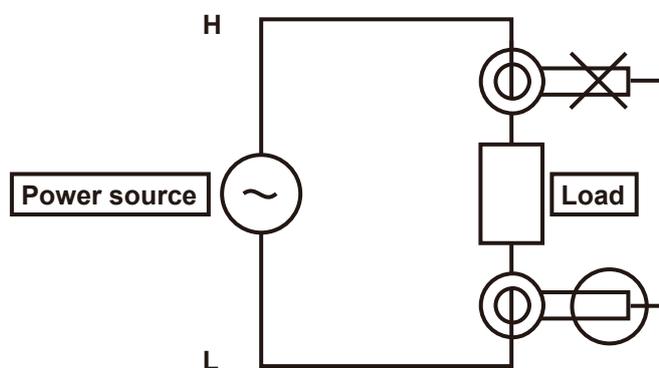


4. Press the clamp lever on the sensor head until the **LOCK** indicator appears (and the **UNLOCK** indication disappears), and check that the opening lever is firmly locked and the clamp is securely closed.
5. It is now possible to monitor the current waveform. The output voltage rate of the 701931 is 0.01 V/A. Convert the voltage sensitivity of the waveform observation instrument to current sensitivity. For example, if the voltage sensitivity is 10 mV/DIV, the current sensitivity is 1 A/DIV.

Note

- The output of this unit is terminated internally. Use a waveform measurement instrument with an input impedance of at least 1 M Ω .
- Immediately after powering on, this unit may be subject to an appreciable offset drift due to the effect of self-heating. To counteract this, allow the unit to warm up for about 30 minutes before carrying out measurement.
- When performing continuous measurements, be aware that the offset voltage drifts depending on factors such as the ambient temperature.
- Under certain circumstances, oscillation may occur if the probe is connected to the Power Supply (Model 701934) while the power supply is ON. In such cases, oscillation can be stopped and operation restored to normal by opening and closing the clamp with the clamp lever.
- Depending on the measured current value or its frequency, resonant sounds may be generated from the clamp. Unless there is dirt or foreign matter on the matching surfaces of the sensor head, this will have no effect on measurement.
- The reading may be affected by the position within the clamp aperture of the conductor being measured. The conductor should be in the center of the clamp aperture.
- When carrying out measurement, press the clamp lever until the **LOCK** indication appears (and the **UNLOCK** indication disappears), and check that the clamp is properly closed. If the clamp is not properly closed, accurate measurement will not be possible.

- At high frequencies, common mode noise may affect measurements taken on the high voltage side of circuits. If this occurs, reduce the frequency range of the waveform measuring instrument, or clamp onto the low-voltage side of the circuit, as appropriate.



- Directly after powering ON, the demagnetizing waveform appears in the output; this is not a malfunction.
- Accurate measurement may be impossible in locations subject to strong external magnetic fields such as transformers and high-current conductors, or in locations subject to strong external electric fields such as radio transmission equipment.

Specifications

Product Specifications

Accuracy is guaranteed at $23 \pm 3^{\circ}\text{C}$ ($73^{\circ}\text{F} \pm 5^{\circ}\text{F}$) after the power has been on for 30 minutes.

Band width*	DC to 2 MHz (–3 dB) (Typical characteristics shown in the next page, Fig.1)
Rise Time*	175 ns or less
Maximum Continuous Input Range	500 A (Derating according to frequency shown in the next page, Fig.2)
Maximum Peak Current Value	Non-Continuous 700 A
Output Voltage Rate*	0.01 V/A
Amplitude Accuracy*	To 500 A: $\pm 1\%$ rdg. ± 5 mV 500 A to 700 A peak: $\pm 2\%$ rdg. (DC, and 45 to 66 Hz)
Noise*	Equivalent to 25 mArms or less (for 20 MHz band measuring instrument)
Input Impedance	(Typical characteristics shown in the next page, Fig.3)
Temperature Coefficient for Sensitivity*	$\pm 2\%$ or less (within a range of 0 to 40°C or 32 to 104°F when inputting 50 Hz, 500 A)
Propagation delay (typical)	57 ns
Maximum Rated Power	7.2 VAm _{max} (at the maximum continuous input range)
Rated Supply Voltage	± 12 V ± 0.5 V
Operating Temperature and Humidity Range	0 to 40°C (32 to 104°F), 80% RH or less (no condensation)
Storage Temperature and Humidity Range	-10 to 50°C (14 to 122°F), 80% RH or less (no condensation)
Location for Use	Indoor, altitude up to 2000 m (6562 feet)
Effect of External Magnetic Fields	Equivalent to a maximum of 800 mA (in a DC or 60 Hz, 400 A/m magnetic field)
Diameter of Measurable Conductors	ϕ 20 mm
Guaranteed accuracy period	1 year (up to 10000 open and close operations)
Cable Lengths	Sensor Cable: Approx. 2 m (78.7"). Power Supply Cable: Approx. 1 m (39.4")
External Dimensions	Sensor: Approx. 176 (W) \times 69 (H) \times 27 (D) mm. Approx. 6.93" (W) \times 2.72" (H) \times 1.06" (D) Terminator: Approx. 27 (W) \times 55 (H) \times 18 (D) mm. Approx. 1.06" (W) \times 2.17" (H) \times 0.71" (D)
Mass	Approx. 520 g. Approx. 18.3 oz.
Accessories	User's manual, carrying case

* In conjunction with a waveform measuring instrument with an input impedance of $1\text{ M}\Omega \pm 1\%$

Applicable Standards

Safety	EN61010
EMC Emissions	EN61326-1 Class B EN55011 Class B, Group 1 EMC Regulatory Arrangement in Australia and New Zealand EN 55011 Class B, Group 1
Immunity	EN61326-1 Table 1 (Basic immunity requirement)

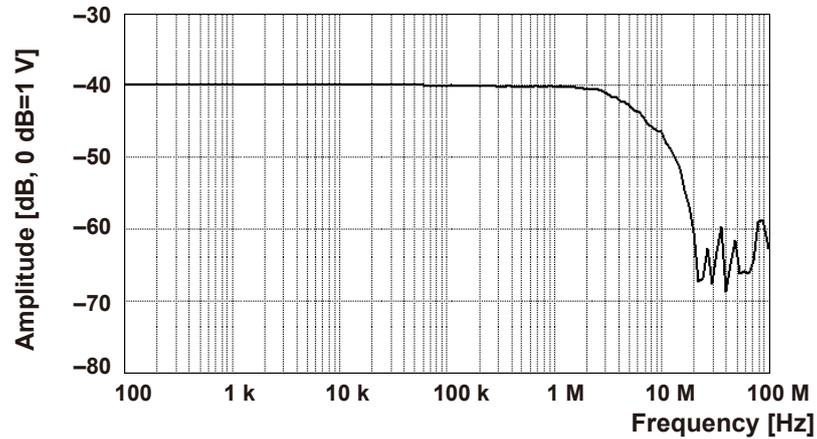


Figure 1 Frequency Characteristics (Typical Characteristics)

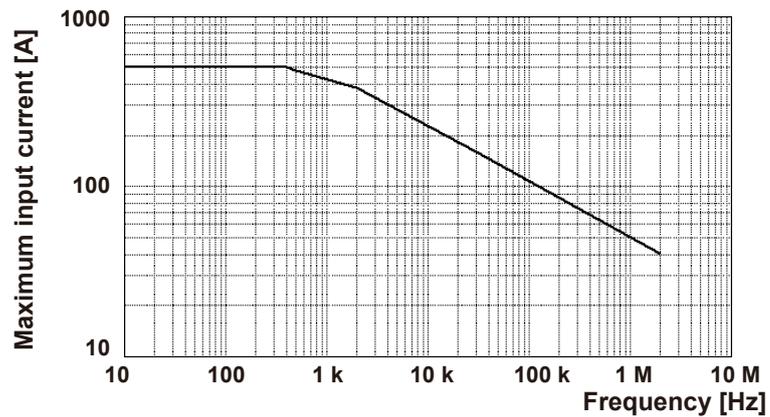


Figure 2 Derating According to Frequency

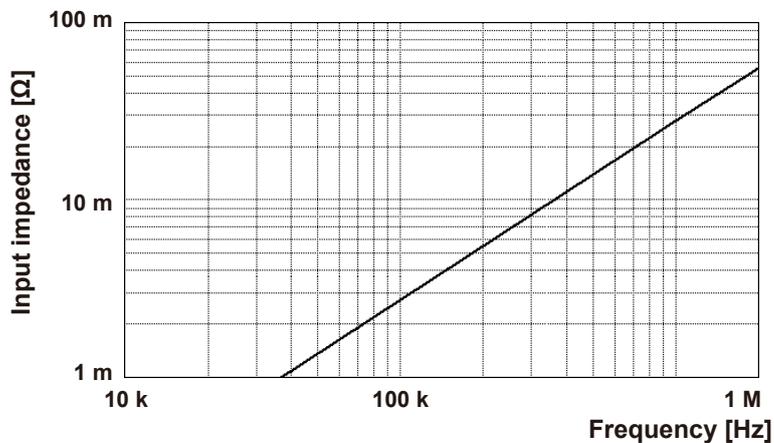


Figure 3 Input Impedance (Typical Characteristics)

Chapter 2 Malfunction? First, Investigate.

Corrective Action to be Taken in Case of an Abnormality

If maintenance service is required, or if the instrument still does not operate properly even after proper corrective action has been taken, contact your nearest YOKOGAWA dealer for repairs.

Symptom	Possible Cause	Corrective Action
Cannot make DC measurements (or at low frequencies up to few hundred Hertz) or the amplitude is small in the given frequency region.	Power is not turned ON.	Turn ON the power.
	The measurement instrument, such as an oscilloscope, is set to AC coupling.	Set the instrument to DC coupling.
	The sensor is not locked (it is not hooked securely).	Lock the sensor.
Cannot adjust to the zero level using the zero adjustment dial.	The sensor is magnetized.	Demagnetize the sensor before adjusting the zero level.
The amplitude is small across all frequencies.	The input impedance of the measurement instrument, such as an oscilloscope, is set to 50 Ω .	Set it to 1 M Ω .