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■ Precautions for Safe Use of the Instrument

When handling the instrument, ALWAYS observe all of the cautionary notes on safety given below. Yokogawa M&C Corporation is not at all liable for damage resulting from misuse of this product by the user that is contrary to these cautionary notes.

Various symbols are used on the instrument and in this manual to ensure the product is used safely and to protect operators and property from possible hazards or damage. The following safety symbols are used where appropriate. Read the explanations carefully and familiarize yourself with the symbols before reading the text.

The instrument and this manual use the following safety symbols:

Danger! Handle with Care.

 This symbol indicates that the operator must refer to an explanation in the User's Manual in order to avoid the risk of personal injury or death and/or damage to the instrument.



Double Insulation

This symbol indicates double insulation.

AC Voltage/Current



This symbol indicates AC voltage or current.



DC Voltage/Current

This symbol indicates DC voltage or current.



DC/AC Voltage/Current

This symbol indicates DC/AC voltage or current.



Ground

This symbol indicates ground (earth)

WARNING

Indicates that there is a possibility of serious personal injury or loss of life if the operating procedure is not followed correctly and describes the precautions for avoiding such injury or loss of life.

CAUTION

Indicates that there is a possibility of serious personal injury or damage to the instrument if the operating procedure is not followed correctly and describes the precautions for avoiding such injury or damage.

NOTE

Draws attention to information essential for understanding the operation and features.

WARNING

- Never make measurement on a circuit above 600V AC or 600V DC.
- Do not use the instrument in an atmosphere where any flammable or explosive gas is present.
- Do not attempt to make measurement in the presence of flammable gases, fumes, vapor or dust. Otherwise, the use of the instrument may cause sparking, which can lead to an explosion.
- Avoid using the instrument if it has been exposed to rain or moisture or if your hands are wet.
- Do not exceed the maximum allowable input of any measurement range.
- Never open the battery compartment cover when making measurement.
- Do not use the instrument if there is any damage to the casing or when the casing is removed.
- Do not turn the Function Selector switch with plugged in test leads connected to the circuit under test.
- Do not install substitute parts or make any modification to the instrument. Return the instrument to Yokogawa M&C or your distributor for repair or re-calibration.
- Always switch off the instrument before opening the battery compartment cover for battery replacement.

WARNING

To avoid damage to the instrument or electric shock!
The restrictions on the maximum voltage level for which the CL235 testers can be used, depend on the over-voltage categories specified by the safety standards. These category specifications are formulated to protect operators against transient impulse voltage in power lines.

Function	Maximum Allowable Input
~ A, == A	OVERVOLTAGE CATEGORY III AC 600A rms / DC 1000A Measuring circuit voltage : AC 600V rms DC 600V
~ V, == V	AC 600V rms/DC 600V
Input terminal-to-ground voltage	AC 600V rms/DC 600V

Over-voltage category I (CAT.I):

Signal level, special equipment or parts of equipment, telecommunication, electronic etc., with smaller transient over-voltages than CAT.II.

Over-voltage category II (CAT.II)

Local level, appliance, portable equipment etc., with smaller transient over-voltages than CAT.III.

Over-voltage category III (CAT.III):

Distribution level, fixed installation, with smaller transient over-voltages than CAT.IV.

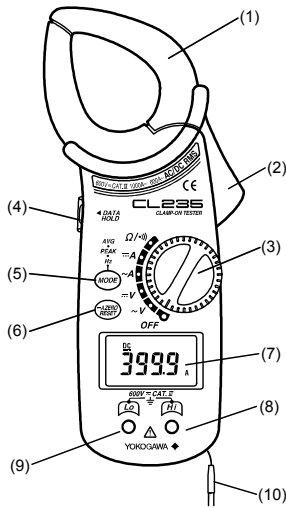
 CAUTION

- Always make sure to insert each plug of the test leads fully into the appropriate terminal on the instrument.
 - Make sure to remove the test leads from the instrument before making current measurement.
 - Be sure to set the Function Selector switch to the "OFF" position after use. When the instrument will not be in use for a long period of time, Place it in storage after removing the battery.
 - Use a damp cloth and detergent for cleaning the instrument. Do not use abrasives or solvents.
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NOTE

- Radiation immunity affects the accuracy of CL235 testers under the conditions specified in IEC801-3:1993.
- If equipment generating strong electromagnetic interference is located nearby, the testers may malfunction.

1. Instrument Layout

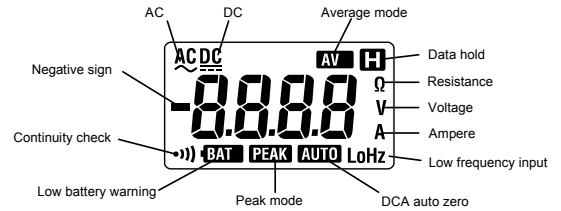


- (1) Transformer Jaws : Pick up current flowing through the conductor.
- (2) Open/Close Lever : Operates the transformer jaws. Press to open the Transformer Jaws.
- (3) Function Selector Switch : Selects function. It is also used to turn power on.
- (4) Data Hold Button : Freezes the display reading. "H" is shown on the display when Data Hold is enabled.

- (5) Mode Selector Button : Selects measuring mode. Press this switch to cycle through measuring modes. The instrument is in the normal (NOR) after it is powered up. In any mode, pressing this switch for more than one second returns the instrument to the NOR mode.

~ A / ~ V (ACA/ACV)	Display	== A / == V (DCA/DCV)	Display	Ω / ●)) (Resistance/Continuity)	Display
Normal		Normal		Resistance	Ω
↓		↓		↓	
Average	AVG	Average	AVG	↓	
↓		↓		↓	
Peak	PEAK	Peak	PEAK	Continuity check	●))
↓					
Frequency	Hz				

- (6) Button : Used for zero adjustment on DCA and resistance ranges. On DCA range, "AUTO" is shown on the display to indicate auto-zeroing is completed. This switch is also used to reset the display reading in the Peak mode.
- (7) LCD Display : Field effect type of liquid crystal display with maximum counts of 3999. Function symbols and decimal point are displayed according to selected function and mode.



- (8) Hi Terminal : Accepts the red test lead for voltage or resistance measurement.
- (9) Lo Terminal : Accepts the black test lead for voltage or resistance measurement.
- (10) Safety Hand Strap : Prevents the instrument from slipping off the hand during use.

2. Measurement

2.1 Preparation for Measurement

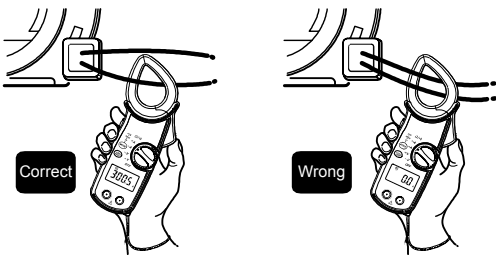
CAUTION

- The jaw section is a delicate, precision sensor. Do not subject the jaw to unreasonably strong shock, vibration, or force when using it.
- If dust gets into the tops of the jaws, remove it immediately. Do not close the jaws when dust is trapped in its joints as the sensor may break.
- Please check that the range and mode are set to the desired position before measurement.

2.2 DC Current Measurement

WARNING

- Do not make measurement on a circuit above 600VDC. This may cause shock hazard or damage to the instrument or equipment under test.
- Do not make measurement with the test leads plugged into the instrument.



- (1) Set the Function Selector switch to the "== A" position. "DC" should be shown on the upper left corner of the display.
- (2) With the transformer jaws closed and without clamping them onto the conductor, press the button for about one second to zero adjust the display. When zero adjustment is completed, "AUTO" appears on the display.
- (3) Press the open/close lever to open the transformer jaws and clamp them onto the conductor under test, then take the reading on the display. The most accurate reading will be obtained by keeping the conductor at the center of the transformer jaws.

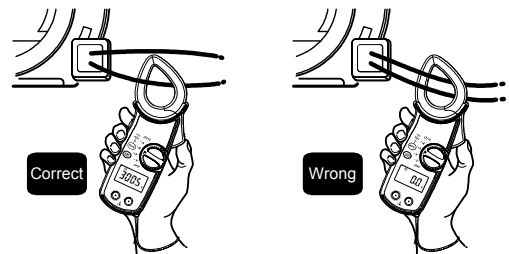
NOTE

- During current measurement, keep the transformer jaws fully closed. Otherwise, accurate measurement cannot be made. The maximum measurable conductor size is approx. 33mm in diameter.
- When the current flows from the upside (the display side) to the underside of the instrument, the polarity of the reading is positive and vice versa.
- Turning the Function Selector switch to a position other than DCA cancels the zero adjustment.

2.3 AC Current Measurement

WARNING

- Do not make measurement on a circuit above 600VDC. This may cause shock hazard or damage to the instrument or equipment under test.
- Do not make measurement with the test leads plugged into the instrument.



- (1) Set the Function Selector switch to the "~ A" position. "AC" should be shown on the upper left corner of the display.
- (2) Press the open/close lever to open the transformer jaws and clamp them onto a single conductor and take the reading on the display. The most accurate reading will be obtained by keeping the conductor at the center of the transformer jaws.

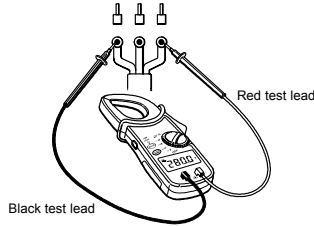
NOTE

- During current measurement, keep the transformer jaws fully closed. Otherwise, accurate measurements cannot be taken. Maximum conductor size is 33mm in diameter.
- Zero adjustment is not necessary in AC current measurement. There is no polarity in the reading either.
- When the current under test measures 3% of the full scale or less, or the frequency of the current is low, "LoHz" is indicated on the display.

2.4 DC Voltage Measurement

⚠ WARNING

Do not make measurement on a circuit above 600VDC. This may cause shock hazard or damage to the instrument or equipment under test.

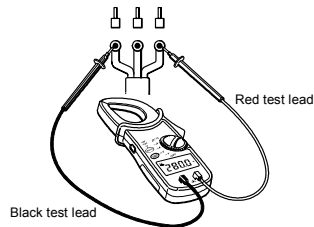


- (1) Set the Function Selector switch to the " $\text{---} \text{V}$ " position. "DC" should be shown on the upper left corner of the display.
- (2) Plug the red test lead into the Hi terminal and the black test lead into Lo terminal.
- (3) Connect the tip of the red and black test leads to the positive (+) and negative (-) sides of the circuit under test respectively. Take the reading on the display.

2.5 AC Voltage Measurements

⚠ WARNING

Do not make measurement on a circuit above 600VAC. This may cause shock hazard or damage to the instrument or equipment under test.



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2.7 Continuity Check (400Ω range fixed)

The continuity check mode is enabled by pressing the button on resistance range. " \bullet)" and " Ω " is indicated on the display to show the instrument in the continuity check mode. The buzzer beeps, if the resistance under test is 20Ω or less.

⚠ WARNING

Never use the instrument on an energized circuit.

- (1) Set the Function Selector switch to the " Ω / \bullet)" position.
- (2) Plug the red test lead into the Hi terminal and the black test lead into the Lo terminal. Check that "OL" (over indication) is indicated on the LCD display.
- (3) With the tip of the test leads shorted together, press the button to offset the resistance of the test leads.
- (4) Press the button once to enter from the normal mode to the continuity check mode. " \bullet)" should be indicated on the display.
- (5) Connect the tip of the test leads to the circuit under test. If the resistance is 20Ω or less, the buzzer beeps.

2.8 Frequency Measurement

- On ACA or ACV range, the frequency of the current or voltage under test can be counted and shown on the display.
- In the frequency measurement mode, " Hz " is indicated on the display.
- Trigger threshold is 10% of full scale.

⚠ WARNING

- Never use the instrument on a high voltage circuit above 600VAC. This may cause electrical shock hazard and damage to the instrument or the circuit under test.
- Do not make current measurement with the test leads plugged into the instrument.

- (1) Set the Function Selector switch to the " \sim A" or " \sim V" position.
- (2) Press the three times to enter from the normal mode to the frequency measurement mode. " Hz " should be indicated on the display.
- (3) Follow instructions for ACA or ACV measurement and take the frequency reading.

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- (1) Set the Function Selector switch to the " \sim V" position. "AC" should be shown on the upper left corner of the display.
- (2) Plug the red test lead into Hi terminal and the black test lead into the Lo terminal.
- (3) Connect the tip of the red and black test leads to the circuit under test and take the reading on the display.

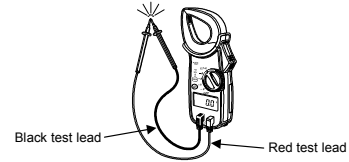
NOTE

When the reading of input voltage is 3% of full scale or less in the circuit under test or the frequency of voltage is low, symbol "LoHz" is indicated on the display.

2.6 Resistance Measurement

⚠ WARNING

Never use the instrument on an energized circuit.



- (1) Set the Function Selector switch to the " Ω / \bullet)" position. The " Ω " should be shown on the upper right corner of the display.
- (2) Plug the red test lead into the Hi terminal and the black test lead into the Lo terminal. Check that "OL" (over indication) is indicated on the LCD display.
- (3) With the tip of the test leads shorted together, press the button to offset the resistance of the test leads.
- (4) Connect the tip of the test leads to the circuit under test and take the reading on the display.

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2.9 Peak Measurement

- In the PEAK mode, the display shows current or voltage's crest in effective value. (For example, when the current or voltage is sinusoidal, the reading equals the crest value divided by the square root of two.) The display reading is constantly updated with a maximum crest.
- In this mode, "PEAK" is indicated on the display.
- Response time is 200ms in DC measurement and 500ms in AC measurement.

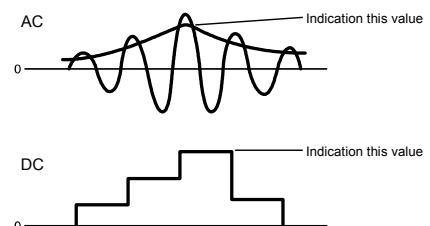
⚠ WARNING

- Never use the instrument on a circuit above 600V AC/DC. This may cause electrical shock hazard and damage to the instrument or the circuit under test.
- Do not make measurement with the test leads plugged into the instrument.

- (1) The PEAK mode is available on DCA, ACA, DCV and DCA ranges. Set the Function Selector switch to the " $\text{---} \text{A}$ ", " \sim A", " $\text{---} \text{V}$ " or " \sim V" position.

Note: Only on DCA range, press the button for about one second to zero adjust the reading with the transformer jaws closed.

- (2) Press the button twice to enter from the normal mode to the PEAK mode. "PEAK" should be shown on the display.
- (3) Follow instructions for DCA, ACA, DCV or ACV measurement.
- (4) For accurate reading, press the button to reset the reading after clamping onto the conductor or making test lead connections to the circuit under test. Then proceed to measurement.



NOTE

- In AC measurement, reading are calibrated in RMS values.
- In DC measurement, the Peak mode is available only for positive reading.
- In the Peak measurement mode, measuring range is fixed at Hi.

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2.10 Average Measurement

- (1) Set the Function Selector switch to the "A", "A", "V" or "V" position.
- (2) Press the **MODE** button once to enter from the normal mode to the Average mode. "AVG" should be indicated on the display.
- (3) Follow instructions for ACV, DCV, ACA or DCA measurement.
- (4) The display shows a running average of six readings over an interval of about 2 seconds.

3. Other Functions

3.1 Sleep Function

This is a function to prevent the instrument from being left powered on in order to conserve battery life. This function causes the instrument to enter the Sleep (powered-down) mode about 30 minutes after the last switch or button operation.

To exit the Sleep mode, turn the Function Selector switch back to "OFF", then to any other operation, or press any button.

The current is consumed a little in the Sleep mode.

3.2 Data Hold Function

This is a function used to freeze the measured value on the display. Press the Data Hold button to freeze the reading. The reading will be held regardless of subsequent variation in input. "H" is shown on the upper right corner of the display while the instrument is in the Data Hold mode.

To exit the Data Hold mode, press the Data Hold button again.

NOTE

If the instrument in the Data Hold mode goes into "sleep", it will return to the normal mode.

3.3 LoHz Function

In ACV or ACA range, if frequency of the voltage or current under test is 40Hz or lower, the display indicates "LoHz" and sample rate is automatically switched from the normal 3 times/sec to 2 times/sec to reduce fluctuation of the reading.

"LoHz" is also indicated where input is 3% of full scale or less.

3.4 Optional Accessories

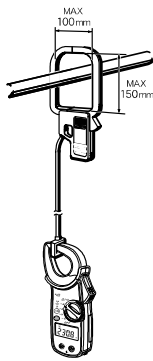
Clamp Adapter Model 99025 (For AC current measurement only)

Clamp Adapter Model 99025 is designed to increase the measuring capability of a clamp meter. With the use of the Clamp Adapter, you can not only extend current range over 3000A, but also clamp on a large bus-bar or conductor.

- (1) Set the Function Selector switch to the "A" position.
- (2) As shown in the figure below, clamp Model CL235 onto the pickup coil of Model 99025.
- (3) Clamp Model 99025 onto the bus-bar or conductor under test.
- (4) Take the reading on Model CL235 and multiply it by 10.

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NOTE

For the detailed specification, refer to the Clamp Adapter User's Manual.

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4. Battery Replacement

! WARNING

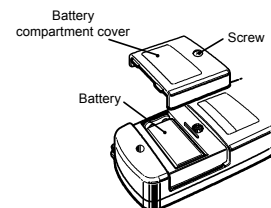
To avoid electric shock hazard, make sure to set the Function Selector switch to "OFF" and remove the test leads from the instrument before trying to replace battery.

! CAUTION

Make sure to install battery in correct polarity as indicated in battery compartment.

If the battery voltage becomes too low for the instrument to operate normally, "BATT" is shown on the display. Then, replace the battery. Note that when the battery is completely exhausted, the display blanks without "BATT" shown.

- (1) Set the Function Selector switch to the "OFF" position.
- (2) Unscrew and remove the battery compartment on the bottom of the instrument.
- (3) Replace the battery observing correct polarity. Use a new 6F22 (Alkaline) or 6LR61 (Manganese) 9V battery.
- (4) Re-place and screw the battery compartment cover.



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5. Specifications

■ Instrument Specifications

- Measuring Ranges and Accuracy (at 23±5°C, 45 to 75% relative humidity)

DC Current $\overline{\text{---}}\text{A}$

Measuring Range (Auto-ranging)	Accuracy
0 to 399.9A	±1.0% rdg ±5dgt
150 to 1000A	

Auto-ranging

Lo : 0 to 399.9A (Shifts to Hi at 399.9A)

Hi : 150 to 1000A (Shifts to Lo at 150A. At 1020A or above, "OL" is shown.)

AC Current $\sim\text{A}$ (Crest factor (CF): 3.0)

Measuring Range (Auto-ranging)	Accuracy
0 to 399.9A	±1.5% rdg ±5dgt (50/60Hz)
150 to 600A	±3.5% rdg ±5dgt (40 to 1kHz)

Conversion method : AC coupled, true rms responding, calibrated to the rms

Auto-ranging

Lo : 0 to 399.9A (Shifts to Hi at 399.9A)

Hi : 150 to 600A (Shifts to Lo at 150A. At 620A or above, "OL" is shown.)

DC Voltage $\overline{\text{---}}\text{V}$ (Input impedance: 2M Ω)

Measuring Range (Auto-ranging)	Accuracy
0 to 39.99V	±1.0% rdg ±5dgt
15.0 to 399.9V	
150 to 600V	

Auto-ranging

Lo : 0 to 39.99V (Shifts to Mid at 39.99V)

Mid : 15.0 to 399.9V (Shifts to Lo at 15.0V and to Hi at 399.9V)

Hi : 150 to 600V (Shifts to Mid at 150V. At 620V or above, "OL" is shown.)

AC Voltage $\sim\text{V}$ Input impedance: 2M Ω (Crest factor (CF): 3.0 or less)

Measuring Range (Auto-ranging)	Accuracy
0 to 39.99V	±1.5% rdg ±5dgt (50/60Hz)
15.0 to 399.9V	
150 to 600V	±3.5% rdg ±5dgt (40 to 1kHz)

Conversion method : AC coupled, true rms responding, calibrated to the rms

Auto-ranging

Lo : 0 to 39.99V (Shifts to Mid at 39.99V)

Mid : 15.0 to 399.9V (Shifts to Lo at 15.0V and to Hi at 399.9V)

Hi : 150 to 600V (Shifts to Mid at 150V. At 620V or above, "OL" is shown.)

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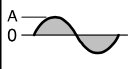
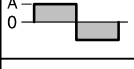

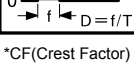
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*Effective Value (rms)

Most alternating currents and voltages are expressed in effective values, which are also referred to as RMS (Root-Mean-Square) values.

The effective value is the square root of the average of square of alternating current or voltage values.

Many clamp meters using a conventional rectifying circuit have "RMS" scales for AC measurement. The scales are, however, actually calibrated in terms of the effective value of a sine wave though the clamp meter is responding to the average value. The calibration is done with a conversion factor of 1.111 for sine wave, which is found by dividing the effective value by the average value. These instruments are therefore in error if the input voltage or current has some other shape than sine wave.

Waveform	Effective value V _{rms}	Average value V _{avg}	Conversion factor V _{rms} /V _{avg}	Reading errors for average sensing instruments	Crest factor CF
	$\frac{1}{\sqrt{2}} A$ ≈ 0.707	$\frac{2}{\pi} A$ ≈ 0.637	$\frac{\pi}{2\sqrt{2}}$ ≈ 1.111	0%	$\sqrt{2}$ ≈ 1.414
	A	A	1	$\frac{A \times 1.111 - A}{A} \times 100$ = 11.1%	1
	$\frac{1}{\sqrt{3}} A$	0.5 A	$\frac{2}{\sqrt{3}}$ ≈ 1.155	$\frac{0.5A \times 1.111 - \frac{A}{\sqrt{3}}}{\frac{A}{\sqrt{3}}} \times 100 = -3.8\%$	$\sqrt{3}$ ≈ 1.732
	$A\sqrt{D}$	$A \frac{f}{T}$ = A · D	$\frac{A\sqrt{D}}{AD} = \frac{1}{\sqrt{D}}$	$\frac{(1.111\sqrt{D} - 1)}{\frac{1}{\sqrt{D}}} \times 100\%$	$\frac{A}{\sqrt{AD}} = \frac{1}{\sqrt{D}}$

*CF(Crest Factor) is found by dividing the peak value by the effective value.

Examples:

DC: CF=1

Sine wave: CF=1.414

Square wave with a 1:10 duty ratio: CF=3

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Resistance Ω

Measuring Range (Auto-ranging)	Accuracy
0 to 399.9 Ω	±1.0% rdg ±5dgt
150 to 3999 Ω	

Auto-ranging

Lo : 0 to 399.9 Ω (Shifts to Hi at 400.0 Ω)

Hi : 150 to 3999 Ω (Shifts to Lo at 150 Ω . At 3999 Ω or above, "OL" is shown.)

Continuity Check $\bullet\text{))}$

Measuring Range	Accuracy
0 to 399.9 Ω	±1.0% rdg ±5dgt

The buzzer beeps when the resistance is 20 Ω or less.

Frequency

Measuring Range	Accuracy
10 to 3000Hz	±1.5% rdg ±5dgt

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■ General Specifications

- Operating System : Dual integration
- Measurement Function : AC current, DC current, AC voltage, DC voltage, resistance, continuity check, frequency
- Display : Liquid crystal display with maximum counts of 3999
- Overrange Indication : "OL" is shown on the display
- Response Time : Approx. 2 seconds.
- Sample Rate : Approx. 3 times per second.
- Temperature and Humidity for Guaranteed Accuracy : 23°C ±5°C, relative humidity up to 75% without condensation
- Operating Temperature and Humidity : 0 to 40°C, relative humidity up to 90% without condensation
- Storage Temperature and Humidity : -10 to 50°C, relative humidity up to 75% without condensation
- Effect of conductor position : Within 2% difference between maximum and minimum values to a 10 mm-dia conductor, at every part inside the jaws
- Power Source : 6F22 or 6LR61 9V battery
- Battery Life : Approx. 15 hours (continuity)
- Current Consumption : Approx. 15mA max.
- Sleep function : Automatically powered down in Approx. 30 minutes after the last switch operation (power consumption : Approx. 20 μ A)
- Withstanding Voltage : 5500V AC, 50/60Hz for 1 minute between electrical circuit and housing case or metal part of the jaws
- Insulation Resistance : 10M Ω or greater at 1000V between electrical circuit and housing case or metal part of the jaws
- Conductor Size : Approx. 33mm diameter max.
- Dimensions : Approx. 91(W) x 208(H) x 40(D) mm
- Weight : Approx. 450g (with battery)
- Safety Standard : IEC61010-1:1995
IEC61010-2-032:1994
AC/DC 600V CAT III, Pollution degree 2, indoor use
- EMC Standard : BS EN 55022:1995
- Radiation immunity : IEC801-3:1993
- Accessories : Test leads Model 98010 1set
6F22 or 6LR61 battery 1
Carrying case Model 93032 1
User's Manual 1
- Optional Accessories : Clamp adapter Model 99025

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6. Calibration and After-sales Service

Should any failure occur while you are using the tester, follow the instructions given below. If the tester still fails to operate correctly and needs repair, contact the vendor from whom you purchased the instrument or the nearest Yokogawa M&C sales office.

- Turn off the POWER switch once, then turn it back on again.
- If the tester does not turn on, replace the battery with a new one.

Calibration

It is recommended that the instrument be calibrated once every year.



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