MH-10

Digital micro-ohmmeter

User's Guide

∀
Safety Precautions

- This equipment should be operated only by qualified and duly trained people, closely observing the corresponding safety regulations and instructions contained in the present User Guide.

- It should be checked that the item to be measured is voltage free.

- Before starting with the measurements, be sure that the battery is well charged and that the line voltage is between specified limits.

- Do not connect or disconnect the test leads during the measurement.

- There are no adjustable parts or parts that can be replaced by the user within the equipment. Taking out the Control Panel in order to have an access to the internal parts may be dangerous as there are high voltages inside, capable of causing fatal accidents.

- Cleaning of this instrument should be carried out using a soft cleaning anti-static liquid, after verifying that it doesn't attack the plastic parts used in the case and in the Control Panel of this equipment.

This equipment should be used only by a trained and competent person, strictly applying suitable safety rules.

Used symbols

∀   Caution, refer to User Guide.

Equipment complies with current EU Directives.

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Description

The MH-10 micro-ohmmeter is a portable, microprocessor controlled instrument, used to accurately measure very low contact resistances of breakers and switches, busbars, transformers and engines windings, etc, with test currents from 1 mA to 10 A, both in the laboratory and out in the field.

- Kelvin architecture (four-terminal method).
- Digital reading, alphanumeric display.
- Up to 4 ½ digits readings.
- Powered by rechargeable battery or mains supply.
- 1 $\mu\Omega$ Resolution.
- 200 Ω Maximum reading.

Operating principle

This device uses the Kelvin Bridge architecture, with four terminals, avoiding testing leads resistance to cause error during measurement. The operator may choose test current and the reading is obtained by comparison through internal high-stability standards. The result appears in the alphanumeric display that is very easy to read.

Operating instructions

Control panel
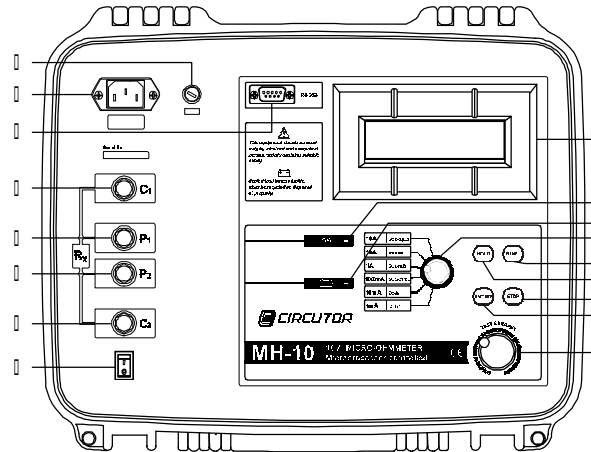
!- **FUSE**

∀- **POWER CORD** connector

#- **ON/OFF** switch

∃- Battery charge **LED**

%- Current terminal **(C+)**

&- Potential terminal **(P+)**

∋- Potential terminal **(P-)**

(- Current terminal **(C-)**

)- **RS-232** output

∗-   **ALPHANUMERIC DISPLAY** that shows both the measured resistance value and user's messages

+- **START** switch

,- **STOP** switch

—- **HOLD** switch. It retains the last measurement in the display

.- **BATTERY.** Switch to measure the battery charge condition.

/- **TEST CURRENT** control

0- Scale and test **CURRENT SELECTOR**

1- **ON** led

Mains supply

MH-10 is manufactured in different versions, to be compliant with the mains supply specifications in the destination country. Please, check the value indicated in the Control Panel in order to be sure that it is appropriate for the local A.C. supply.

Measurement

1. Before turning the equipment on, connect the test leads to the item to be measured and to the front panel terminals.

ELEMENT TO BE MEASURED
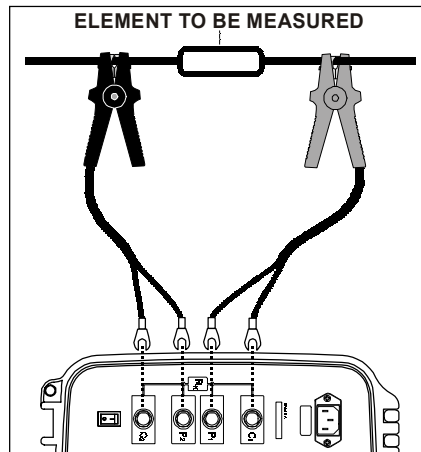
The alligator clamps in the drawings are only for illustration. The supplied clamps could be different than what's shown in the drawing.

2. Using the **CURRENT SELECTOR**0, choose the range and the current to be used.

3. Choose the power supply to use. If you are going to use the battery, advance to the following point. If you are going to use the mains supply, plug the power cord into the connector$\forall$.

4. Switch the equipment on using the **ON/OFF**#.

5. The *PRESS START* message will appear showing that measurement can be started. Press the **START**+ switch. Depending on the position of the **TEST CURRENT**/ control the *LOW CURRENT* message will turn up.

6. Turning the **TEST CURRENT**/ control clockwise increases the current. Adjust this control until obtaining the desired value or until the current indicator (bar-graph) indicates 100%. The bar-graph will show the test current value as a percentage of the nominal value selected by using the **CURRENT SELECTOR**0.

7. The lowest current for measuring is 10 % of the scale nominal value. It is important to consider that the measurement errors increase while test current decreases. The error is specified for test currents higher than 80%.

8. The **DISPLAY**∗ will show the resistance value measured and the corresponding unit (Ω [ohms], mΩ [milli-ohms] or $\mu\Omega$ [micro-ohms]).

9. That value can be retained in the display by pressing the **HOLD**− key. Pressing this key again, the value will be erased.

10. Press the **STOP**, switch in order to finish the measurement.

11. Finally, when finishing measurements, turn the equipment off using the **ON/OFF**# switch.

Precaution: Do not connect or disconnect the test leads during the measurement.

Messages

CIRCUTOR MH-10

When turning the equipment on using the **ON/OFF**# switch, this introductory message appears for a while. During that time, the equipment carries out some functional checking.

WAIT...

This message appears each time the equipment needs to adjust any parameter in order to optimize the readings.

PRESS START

The equipment is ready to start a measurement, thus the operator has to press the **START**+ button.

LOW CURRENT

It shows that the test current is not enough to carry out the reading. It appears at the beginning of each test and it keeps on being there up to the operator rotates the **TEST CURRENT**/ control clockwise, as necessary for the test current to be higher than 10 % of the nominal current in the scale. The inappropriate connection of the cables may cause a difficult circulation of test current. If this message keeps on being displayed, please check that the current cables are connected appropriately.

OVERRANGE

It indicates that the measured resistance is higher than the maximum value readable in the selected scale.

H

Indicates that the value is the one retained in the memory when pressing the **HOLD**− button.

BAT

It shows that the battery is quite discharged. The available energy is enough to work during a few minutes only. It is necessary the battery to be recharged.

Some notes about accuracy

In order to obtain the specified accuracy, the operator has to adjust the test current to a value higher than the 80% of the nominal value. If it were necessary, it is possible to use a lower current, but by doing this the accuracy will be affected.

MH-10 has an auto-compensation system that automatically eliminates the error produced by internal offset. Thus, it is not necessary to carry out measurements by reversing the polarity in order to compute the average value. Nevertheless, if the operator suspect that there is a difference of temperature between the contact points that would can generate thermoelectric voltages, it is necessary to carry out two measurements by reversing the current cables and so, the circulation sense of the current through the resistance under measurement. The resistance value to be measured will be the average between the values in one sense and in the contrary (direct and inverse current).

Battery condition

The charge condition of the battery can be verified before or during the resistance measurement. In order to achieve that, the operator has to press the **BATTERY**. key while the equipment is turned on. The bar-graph shows remaining charge as a percentile value. If during measurement the charge of the battery achieves a critical level, the display will show the **BAT** message notifying that the charge level is low. After a few minutes the measurement will be automatically interrupted in order to preserve the battery from a deep discharge that is prejudicial for its expected useful life.

Battery and charger

Battery description

The **CIRCUTOR MH-10** micro-ohmmeter uses a sealed, rechargeable, lead-acid, 12V - 7Ah battery. At the end of the useful life, that battery has to be recycled or disposed of properly in order to take care of the environment.

Battery charger

The built-in battery charger is always active when the equipment is connected to the mains supply, even if the **ON/OFF**# switch is turned off.

Charging procedure:

- Check that the **ON/OFF**# key is OFF.
- Connect the equipment to the mains supply.
- The indicator ∃ will keep on lightning with a red light up to completing the charge. At that point, it will change to a green light, being like this up to the equipment disconnection from the mains supply.

RS-232 output
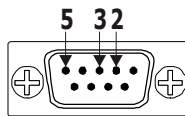
The equipment has an RS-232) output in the control panel that can be used to register measurements in a serial printer or data collector. The outputs are the following ones:

Pin 2: Rx ; Pin 3: Tx ; Pin 5: Gnd;
Rate: 4800 bps
8 bits - no parity – 1 stop bit (8,n,1)

Note: In order to assure the compatibility with most printers available in the market, the resistance units are shown with the following symbols:

uR = micro-ohm
mR = milli-ohm
R = ohm

Cleaning

Cleaning of this instrument should be carried out using a soft cleaning anti-static liquid, after verifying that it doesn't affect the plastic parts used in the case and in the Control Panel of this equipment.

∀ Replacement fuse

To check the instrument **FUSE**!, remove it with a screw driver. If the fuse is ruptured replace it by another with the following specifications:

Fuse Schurter, model SPT 5x20 (Time-lag) 5A/250V. High breaking capacity H.

Technical specifications

Test currents	: 1 mA - 10 mA - 100 mA - 1 A - 10 A. Each current may be continuously adjustable from 0 to 100%.
Resistance ranges	: 0-2000 $\mu\Omega$ @ 10 A 0-20 mΩ @ 10 A 0-200 mΩ @ 1 A 0-2000 mΩ @ 100 mA 0-20 Ω @ 10 mA 0-200 Ω @ 1 mA
Resolution	: 1 $\mu\Omega$ @ 10 A
Output voltage	: Up to 10 Vc.c. @ 1 A (open circuit)
Measurement principle	: Four-terminal, Kelvin-type.
Basic accuracy	: ±0,2 % of reading ± 2 digits
Advanced features	: Digital direct reading of very low resistances in the alphanumerical display, with up to 4½ digits. Very fast and accurate measurements.
Serial data output	: RS-232 @ 4800 bps. Suitable for data collection in an external serial printer, computer or data-logger.
Environmental protection	: IP54 with closed lid.

Safety class	:	Meets the requirements of IEC61010-1/1990, IEC 61010-1/1992 amendment 2
E.M.C	:	In accordance with IEC 61326-1
Electrostatic immunity	:	In accordance with IEC 1000-4-2
Power supply	:	Internal battery powered. Rechargeable battery, sealed lead, 12V - 7Ah or mains.
Built-in battery charger	:	MH-10 is manufactured in different versions, to be compliant with the mains supply specifications in the destination country. Please, check the value indicated in the Control Panel in order to be sure that it is appropriate for the local A.C. supply.
Operating temperature range	:	-5°C to 50°C
Storage temperature range	:	-25°C to 65°C
Humidity range	:	95% RH (non condensing)
Maximum altitude	:	3000m
Weight	:	Approx. 8,8 kg (including battery and accessories)
Dimensions	:	378 x 308 x 175mm

Accessories

• Combined current and potential leads with alligator clips 1,8m. (2)
• Charger Power cord.
• RS-232 cable.
• Operating instructions.
• Protective bag, for instrument and cable