

ENGLISH

User manual



Table of contents:

1. PRECAUTIONS AND SAFETY MEASURES	2
1.1. Preliminary instructions	2
1.2. During use	3
1.3. After use	3
1.4. Definition of measurement (overvoltage) category	3
2. GENERAL DESCRIPTION	4
2.1. Measuring average values and TRMS values	4
2.2. Definition of true root mean square value and crest factor	4
3. PREPARATION FOR USE	5
3.1. Initial checks	5
3.2. Instrument power supply	5
3.3. Calibration	5
3.4. Storage	5
4. OPERATING INSTRUCTIONS	6
4.1. Instrument description	6
4.2. Description of function keys	7
4.2.1. HOLD/LOCK key	7
4.2.2. MAX/MIN/◀ key	7
4.2.3. Hz/→0←/▷ key	7
4.2.4. MODE key	7
4.2.5. STORE/RECALL key	8
4.2.6. RANGE/50V-1kV key	8
4.2.7. TEST key	8
4.3. Internal modes of the instrument	9
4.3.1. Deactivation of the Autobacklight function	9
4.3.2. Deactivation of the Auto power off function	9
4.3.3. AutoTest and Manual Test mode	9
4.3.4. HFR mode	9
4.3.5. SMOOTH mode	9
4.3.6. Integrity test on internal fuse	9
4.4. Measuring operations	10
4.4.1. DC Voltage measurement	10
4.4.2. AC Voltage and Frequency measurement	11
4.4.3. DC Current measurement	12
4.4.4. AC current and frequency measurement	13
4.4.5. Resistance measurement and continuity test	14
4.4.6. Diode test	15
4.4.7. Capacitance measurement	16
4.4.8. Temperature measurement	17
4.4.9. Insulation resistance measurement	18
5. MAINTENANCE	19
5.1. Replacing the batteries and the internal fuse	19
5.2. Cleaning the instrument	19
5.3. End of life	19
6. TECHNICAL SPECIFICATIONS	20
6.1. Technical characteristics	20
6.1.1. Electrical characteristics	23
6.1.2. Considered standards	23
6.1.3. General characteristics	23
6.2. Environment	23
6.2.1. Environmental conditions for use	23
6.3. Accessories	24
6.3.1. Standard accessories	24
6.3.2. Optional accessories	24
7. SERVICE	25
7.1. Warranty conditions	25
7.2. Service	25

1. PRECAUTIONS AND SAFETY MEASURES

The instrument has been designed in compliance with directive IEC/EN61010-1 relevant to electronic measuring instruments. For your safety and in order to prevent damaging the instrument, please carefully follow the procedures described in this manual and read all notes preceded by the symbol  with the utmost attention. Before and after carrying out the measurements, carefully observe the following instructions:

- Do not carry out any measurement in humid environments.
- Do not carry out any measurements in case gas, explosive materials or flammables are present, or in dusty environments.
- Avoid any contact with the circuit being measured if no measurements are being carried out.
- Avoid any contact with exposed metal parts, with unused measuring probes, circuits, etc.
- Do not carry out any measurement in case you find anomalies such as deformation, breaks, substance leaks, absence of display on the screen, etc.
- Pay special attention when measuring voltages higher than 20V, since a risk of electrical shock exists.

The following symbols are used in this manual:



Caution: observe the instructions given in this manual; an improper use could damage the instrument or its components



Presence of dangerous voltage ($\geq 30V$): electrical shock hazard



Double-insulated meter



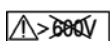
AC voltage or current



DC voltage or current



Connection to earth



When measuring insulation, do not apply between input terminals any voltage higher than 600V DC/ACrms

1.1. PRELIMINARY INSTRUCTIONS

- This instrument has been designed for use in environments of pollution degree 2.
- It can be used for **VOLTAGE** and **CURRENT** measurements on installations with CAT III 1000V and CAT IV 600V.
- Follow the normal safety rules devised to protect the user against dangerous currents and the instrument against incorrect use.
- Only the leads supplied with the instrument guarantee compliance with the safety standards. They must be in good conditions and be replaced with identical models, when necessary.
- Do not test circuits exceeding the specified voltage limits.
- Do not perform any test under environmental conditions exceeding the limits indicated in §§ 6.1.1 and 6.2.1.
- Check that the batteries are correctly inserted.
- Before connecting the test leads to the circuit to be tested, make sure that the switch is correctly set.
- Make sure that the LCD display and the switch indicate the same function.

1.2. DURING USE

Please carefully read the following recommendations and instructions:



CAUTION

Failure to comply with the Caution notes and/or Instructions may damage the instrument and/or its components or be a source of danger for the operator.

- Before activating the rotary switch, disconnect the test leads from the circuit under test.
- When the instrument is connected to the circuit under test, do not touch any unused terminal.
- Avoid measuring resistance if external voltages are present. Even if the instrument is protected, excessive voltage could cause a malfunction of the instrument.
- While measuring, if the value or the sign of the quantity being measured remain unchanged, check if the HOLD function is enabled.

1.3. AFTER USE

- When measurement is complete, set the rotary switch to OFF to turn off the instrument.
- If the instrument is not to be used for a long time, remove the batteries.

1.4. DEFINITION OF MEASUREMENT (OVERVOLTAGE) CATEGORY

Standard "CEI 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements" defines what measurement category, commonly called overvoltage category, is. § 6.7.4: Measured circuits, reads:

(OMISSIS)

Circuits are divided into the following measurement categories:

- **Measurement category IV** is for measurements performed at the source of the low-voltage installation
Examples are electricity meters and measurements on primary overcurrent protection devices and ripple control units.
- **Measurement category III** is for measurements performed on installations inside buildings.
Examples are measurements on distribution boards, circuit breakers, wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment, for example, stationary motors with permanent connection to fixed installation.
- **Measurement category II** is for measurements performed on circuits directly connected to the low-voltage installation.
Examples are measurements on household appliances, portable tools and similar equipment.
- **Measurement category I** is for measurements performed on circuits not directly connected to MAINS.
Examples are measurements on circuits not derived from MAINS, and specially protected (internal) MAINS-derived circuits. In the latter case, transient stresses are variable; for that reason, the standard requires that the transient withstand capability of the equipment is made known to the user.

2. GENERAL DESCRIPTION

Instrument HT701 carries out the following measurements:

- DC and AC TRMS voltage
- DC and AC TRMS current
- Resistance and Continuity test
- Insulation resistance with test voltage of 50, 100, 250, 500, 1000VDC
- AC voltage and current frequency
- Capacity
- Diode test
- Temperature with K-type probe

Each of these functions can be selected using the 8-position rotary switch, including an OFF position. The instrument is also equipped with function keys (see § 4.2) and an analogue graphic bar. The selected quantity appears on the LCD display with the indication of the measuring unit and of the enabled functions.

The instrument is also equipped with an automatic display backlighting function (Autobacklight) and with an Auto Power OFF function which automatically switches off the instrument approx. 20 minutes after the last time a function key was pressed or the rotary switch was turned. To switch on the instrument again, turn the rotary switch.

2.1. MEASURING AVERAGE VALUES AND TRMS VALUES

Measuring instruments of alternating quantities are divided into two big families:

- AVERAGE-VALUE meters: instruments measuring the value of the sole wave at fundamental frequency (50 or 60 Hz).
- TRMS (True Root Mean Square) VALUE meters: instruments measuring the TRMS value of the quantity being tested.

With a perfectly sinusoidal wave, the two families of instruments provide identical results. With distorted waves, instead, the rdgs shall differ. Average-value meters provide the RMS value of the sole fundamental wave; TRSM meters, instead, provide the RMS value of the whole wave, including harmonics (within the instrument's bandwidth). Therefore, by measuring the same quantity with instruments from both families, the values obtained are identical only if the wave is perfectly sinusoidal. In case it is distorted, TRMS meters shall provide higher values than the values read by average-value meters.

2.2. DEFINITION OF TRUE ROOT MEAN SQUARE VALUE AND CREST FACTOR

The root mean square value of current is defined as follows: *"In a time equal to a period, an alternating current with a root mean square value with an intensity of 1A, circulating on a resistor, dissipates the same energy that, during the same time, would have been dissipated by a direct current with an intensity of 1A"*. This definition results in the numeric expression:

$$G = \sqrt{\frac{1}{T} \int_{t_0}^{t_0+T} g^2(t) dt}$$

The root mean square value is indicated with the acronym RMS.

The Crest Factor is defined as the relationship between the Peak Value of a signal and its

RMS value: $CF (G) = \frac{G_p}{G_{RMS}}$ This value changes with the signal waveform, for a purely

sinusoidal wave it is $\sqrt{2} = 1.41$. In case of distortion, the Crest Factor takes higher values as wave distortion increases.

3. PREPARATION FOR USE

3.1. INITIAL CHECKS

Before shipping, the instrument has been checked from an electric as well as mechanical point of view.

All possible precautions have been taken so that the instrument is delivered undamaged.

However, we recommend generally checking the instrument in order to detect possible damage suffered during transport. In case anomalies are found, immediately contact the forwarding agent.

We also recommend checking that the packaging contains all components indicated in § 6.3.1. In case of discrepancy, please contact the Dealer.

In case the instrument should be returned, please follow the instructions given in § 7.

3.2. INSTRUMENT POWER SUPPLY

The instrument is supplied with four 1.5V AA IEC LR6 alkaline batteries, included in the package.

In order to prevent compromising its charge, the battery is not inserted in the instrument. For battery installation, follow the instructions given in § 5.1

When the batteries are flat, the symbol  appears on the display. To replace/insert the batteries, see § 5.1.

3.3. CALIBRATION

The instrument has the technical specifications described in this manual. The instrument's performance is guaranteed for 12 months.

3.4. STORAGE

In order to guarantee precise measurement, after a long storage time under extreme environmental conditions, wait for the instrument to come back to normal condition (see the environmental specifications contained in § 6.2.1 before use).

4. OPERATING INSTRUCTIONS

4.1. INSTRUMENT DESCRIPTION

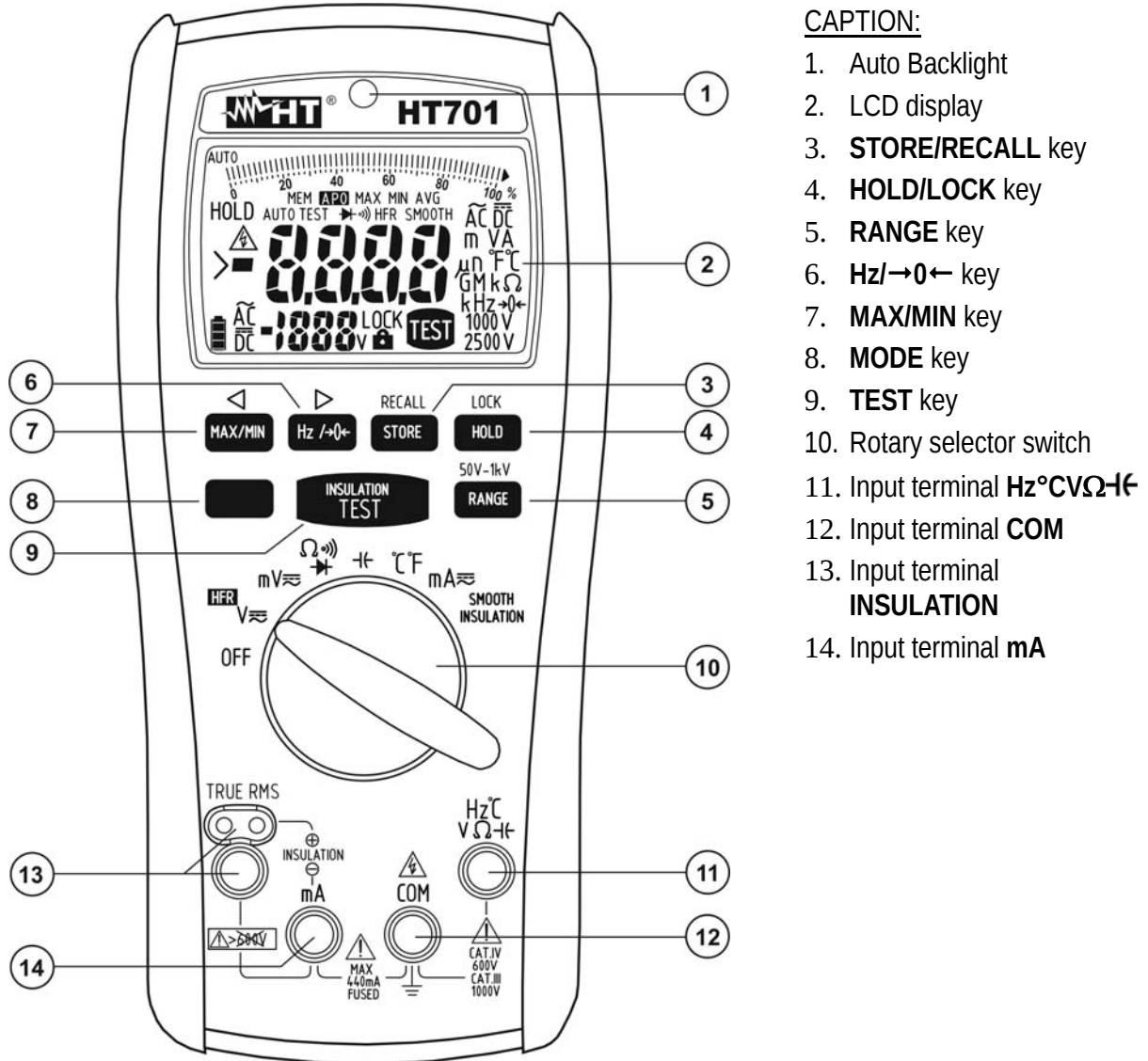


Fig. 1: Instrument description

4.2. DESCRIPTION OF FUNCTION KEYS

The following § describes the functions of the different keys. When pressing a key, the display shows the symbol of the activated function and the buzzer sounds.

4.2.1. HOLD/LOCK key

Pressing the **HOLD/LOCK** key:

- in any function, except for the insulation measurement, keeps the value of the measured quantity shown on the display. The message "HOLD" appears on the display. Press the **HOLD** key again, the **MODE** key, the **RANGE** key or turn the rotary switch to exit the function.
- When measuring insulation (see § 4.4.9), pressing the **HOLD/LOCK** key allows blocking the test voltage set and carrying out a continuous measurement. The symbols "🔒" and "LOCK" appear on the display. Press the **TEST** key to exit the function.

4.2.2. MAX/MIN/◁ key

Pressing the **MAX/MIN/◁** key:

- in any function, except for insulation measurement, activates the detection of Maximum, Minimum and Average (AVG) values of the quantity being tested. Both values are constantly updated, as soon as the instrument measures a higher (MAX) or lower (MIN) value. The display shows the symbol associated with the selected function: "MAX" for maximum value and "MIN" for minimum value. The flashing symbol "MAX MIN" shows the current value on the display. The symbol "AVG" shows on the display the value of the average between the maximum and the minimum value currently shown on the display. Press and hold the **MAX/MIN/◁** key for 2 seconds, the **MODE** key, the **RANGE** key or turn the rotary switch to exit the function.
- In "RECALL" function (recalling the data saved in the memory on the display – see § 4.2.5), the ◁ key allows selecting the memory cell before the one currently shown on the display.

4.2.3. Hz/→0←/▷ key

Pressing the **Hz/→0←/▷** key:

- in functions "V~", "mV~" and "mA~" allows selecting voltage or current frequency measurement. The symbol "Hz" is shown on the display. Press the key again or turn the rotary switch to exit the function.
- In functions "H₀" and "Ω" (for values < approx. 3Ω - e.g.: short-circuited test leads) it allows measuring the quantity to be tested. The symbol "→0←" appears on the display, initially steady. When pressing the key, the symbol "→0←" flashes and the value of the quantity being tested is saved as offset for the following measurements. The display shows the relative value, obtained as: relative value (displayed) = current value – offset. Press the **Hz/→0←/▷** key, the **MODE** key, the **RANGE** key or turn the rotary switch to exit the function.
- In "RECALL" function (recalling the data saved in the memory on the display – see § 4.2.5), the ▷ key allows selecting the memory cell after the one currently shown on the display.

4.2.4. MODE key

The **MODE** key allows:

- Selecting the functions on the rotary switch, highlighted in orange.
- Quitting sub-functions selected on the instrument.
- Switching from AutoTest mode to Manual mode (see § 4.3.3).
- Deleting the internal memory of the instrument (see § 4.2.5)

4.2.5. STORE/RECALL key

The **STORE/RECALL** key carries out the following operations:

- Simply pressing the key allows saving the value on the display in the memory. The symbol “MEM” flashes for a second and the considered memory location is immediately indicated on the display. Each measuring function has its own dedicated memory space for a maximum of 100 available locations for each of them.
- Pressing and holding the key for 2 seconds allows recalling the data saved in the internal memory on the display. The symbol “MEM” and the indication of the last memory location are shown on the display together with the measurement result. Press the keys ◀ or ▶ to select the desired memory location. Press and hold the keys ◀ or ▶ for 2 seconds to rapidly select the memory locations.
- Press and hold the **MODE** key for 2 seconds to delete the whole instrument memory. The message “nOnE” is shown on the display and the indication of the memory location is taken back to “0”. As an alternative, press and hold the **STORE/RECALL** key while switching on the instrument.
- Press the **STORE/RECALL** key again or turn the rotary switch to exit the function.

4.2.6. RANGE/50V-1kV key

Pressing the **RANGE/50V-1kV** key allows the following operations:

- Manual selection of the measuring range of the different functions (except for positions ∇ , ∇), °C and °F and insulation measurement). The symbol “AUTO” disappears from the display and the cyclic pressure of the key modifies the position of the decimal point on the display. Press and hold the **RANGE** key for 2 seconds or turn the rotary switch to exit the function and restore the symbol “AUTO” on the display.
- Selecting the test voltage in insulation measurement (see § 4.4.9) among the following values: **50V**, **100V**, **250V**, **500V** and **1000VDC**. The symbols of the selected voltages are shown at the bottom of the display on the right.
- Quitting sub-functions selected on the instrument.

4.2.7. TEST key

Pressing the **TEST** key allows activating the insulation resistance measurement on the instrument (see § 4.4.9).

4.3. INTERNAL MODES OF THE INSTRUMENT

4.3.1. Deactivation of the Autobacklight function

The instrument has a display backlighting function (see Fig.1 – part 1) which activates automatically in conditions of poor visibility. The function deactivates automatically after a few seconds. To manually disable the function, proceed as follows:

1. Switch off the instrument (OFF).
2. Turn the rotary switch in any position, keeping the **MAX/MIN** key pressed until the display has completely turned on.
3. Switch off and then on again the instrument to enable the function.

4.3.2. Deactivation of the Auto power off function

In order to preserve internal batteries, the instrument switches automatically off 20 minutes after it was last used. The symbol "APO" appears on the display when this function is active. When the instrument must be used for long periods of time, it may be useful to deactivate the Auto Power Off function as follows:

1. Switch off the instrument (OFF).
2. Turn the rotary switch in any position, keeping the **MODE** key pressed until the display has completely turned on. The symbol "APO" disappears.
3. Switch off and then on again the instrument to enable the function.

4.3.3. AutoTest and Manual Test mode

In measuring functions "**V**", "**mV**" and "**mA**" it is possible to use the following two modes:

- AutoTest → it allows the automatic detection of AC or DC measurement of voltage or current. The message "AUTOTEST" is shown on the display. This is the mode set whenever the instrument is switched on.
- Manual Test → it allows manually setting the AC or DC measurement of voltage or current.

Press the **MODE** key to switch from AutoTest mode to Manual mode. The message "AUTOTEST" disappears from the display and the modes "DC" or "AC" can be selected by pressing the **MODE** key again. Press and hold the **MODE** key for 2 seconds to go back to the AutoTest mode, or switch off and then on again the instrument.

4.3.4. HFR mode

In measuring function "**V~**", when pressing the **MODE** key in Manual mode, it is possible to select "HFR" (High Frequency Reject) measurement. In this case, the AC voltage measurement is carried out considering a maximum signal frequency of 500Hz, and this allows eliminating different harmonic components from it.

Press the **MODE** key to exit the "HFR" mode.

4.3.5. SMOOTH mode

In insulation resistance measuring mode, by pressing the **MODE** key it is possible to select the "SMOOTH" mode, which enables a greater stability of the result displayed. Press the **MODE** key to exit the "SMOOTH" mode.

4.3.6. Integrity test on internal fuse

The instrument allows testing the status of the internal fuse as follows:

1. Insert a test lead into input terminal **H_z°CVΩH_z**.
2. Turn the rotary switch to **Ω**  . Press the **MODE** key to select diode test (symbol " " on the display).
3. Insert the test lead into input **mA**. With indication of a result typically <2V → Fuse OK. With indication "**OL**" → the fuse must be replaced.

4.4. MEASURING OPERATIONS

4.4.1. DC Voltage measurement



CAUTION

The maximum input DC voltage is 1000 V. Do not measure voltages exceeding the limits given in this manual. Exceeding voltage limits could result in electrical shocks to the user and damage to the instrument.

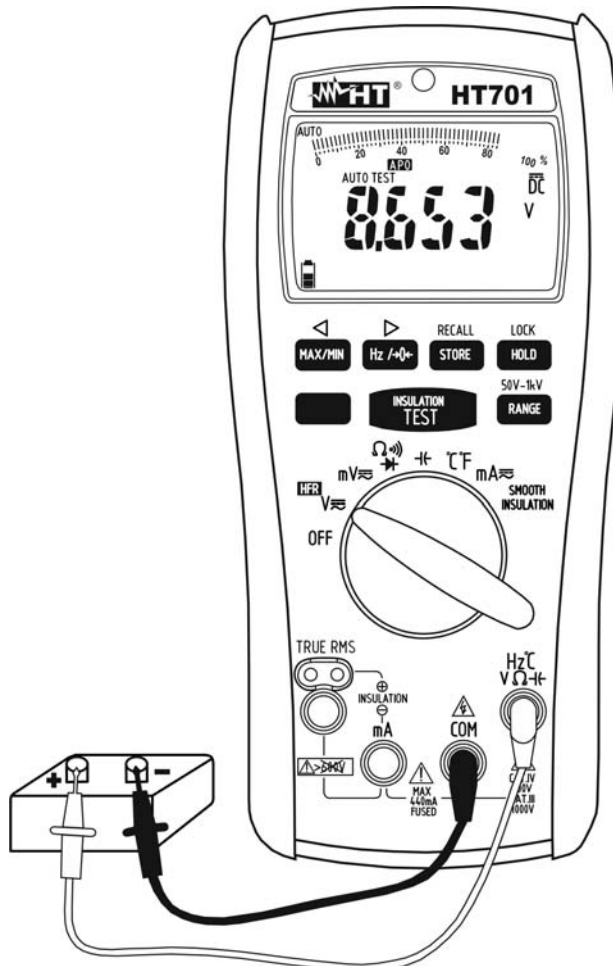


Fig. 2: Use of the instrument for DC voltage measurement

1. Select positions $V\sim$ or $mV\sim$
2. If necessary, press the **MODE** key for manually selecting DC measurement (see § 4.3.3).
3. Use the **RANGE** key for manually selecting the measuring range (see § 4.2.6) or use Autorange selection. If voltage value is unknown, select the highest range
4. Insert the red cable into input lead **Hz°C VΩ~** and the black cable into input lead **COM**
5. Position the red lead and the black lead respectively in the points with positive and negative potential of the circuit to be measured. The display shows the value of voltage.
6. If the display shows the message "OL", select a higher range.
7. When symbol "-" appears on the instrument's display, it means that voltage has the opposite direction with respect to the connection in Fig. 2
8. For using the HOLD function, see § 4.2.1, for measuring MAX/MIN/AVG values see § 4.2.2 and for saving the result, see § 4.2.5

4.4.2. AC Voltage and Frequency measurement

CAUTION



The maximum input AC voltage is 1000Vrms. Do not measure voltages exceeding the limits given in this manual. Exceeding voltage limits could result in electrical shocks to the user and damage to the instrument.

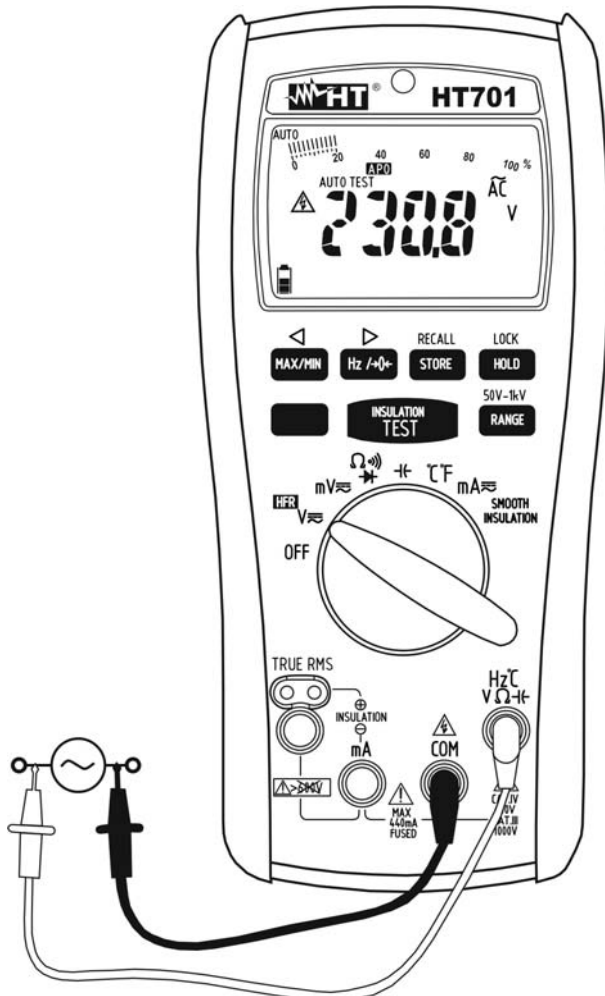


Fig. 3: Use of the instrument for AC voltage measurement

1. Select positions $V\sim$ or $mV\sim$
2. If necessary, press the **MODE** key for manually selecting AC measurement (see § 4.3.3) or HFR measurement (see § 4.3.4).
3. Use the **RANGE** key for manually selecting the measuring range (see § 4.2.6) or use Autorange selection. If voltage value is unknown, select the highest range.
4. Insert the red cable into input lead **Hz~CV~Ω~H~** and the black cable into input lead **COM**
5. Position the red lead and the black lead respectively in the points of the circuit to be measured (see Fig. 3). The display shows the value of voltage.
6. If the display shows the message "OL", select a higher range.
7. Press the **Hz/→0←** key to display the frequency measure of AC voltage. The symbol "Hz" is shown on the display.
8. For using the HOLD function, see § 4.2.1, for measuring MAX/MIN/AVG values see § 4.2.2 and for saving the result, see § 4.2.5

4.4.3. DC Current measurement



CAUTION

The maximum input DC current is 400mA. Do not measure currents exceeding the limits given in this manual. Exceeding current limits could result in electrical shocks to the user and damage to the instrument.

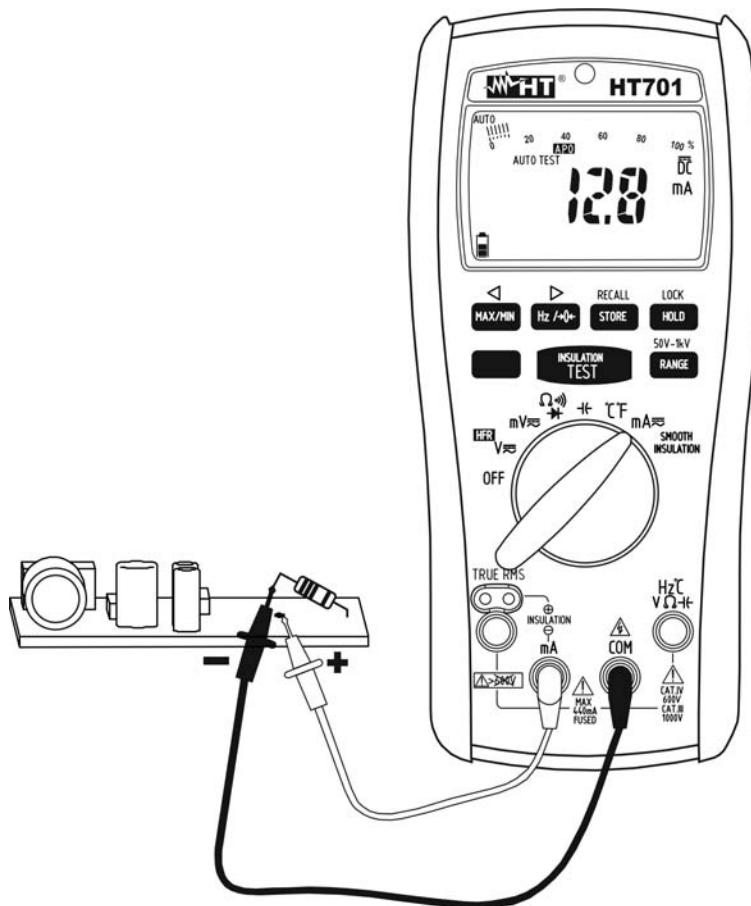


Fig. 4: Use of the instrument for DC current measurement

1. Cut off power supply from the circuit to be measured
2. Select the **mA** position.
3. If necessary, press the **MODE** key for manually selecting DC measurement (see § 4.3.3).
4. Use the **RANGE** key for manually selecting the measuring range (see § 4.2.6) or use Autorange selection. If current value is unknown, select the highest range.
5. Insert the red cable into the input terminal **mA** and the black cable into the input terminal **COM**.
6. Connect the red lead and the black lead in series to the circuit whose current you want to measure, respecting polarity and current direction (see Fig. 4)
7. Supply the circuit to be measured. The display shows the value of current.
8. If the display shows the message “OL”, the maximum measurable value has been reached
9. When symbol “-” appears on the instrument’s display, it means that current has the opposite direction with respect to the connection of Fig. 4
10. For using the HOLD function, see § 4.2.1, for measuring MAX/MIN/AVG values see § 4.2.2 and for saving the result, see § 4.2.5

4.4.4. AC current and frequency measurement

CAUTION



The maximum input AC current is 400mA. Do not measure currents exceeding the limits given in this manual. Exceeding current limits could result in electrical shocks to the user and damage to the instrument.

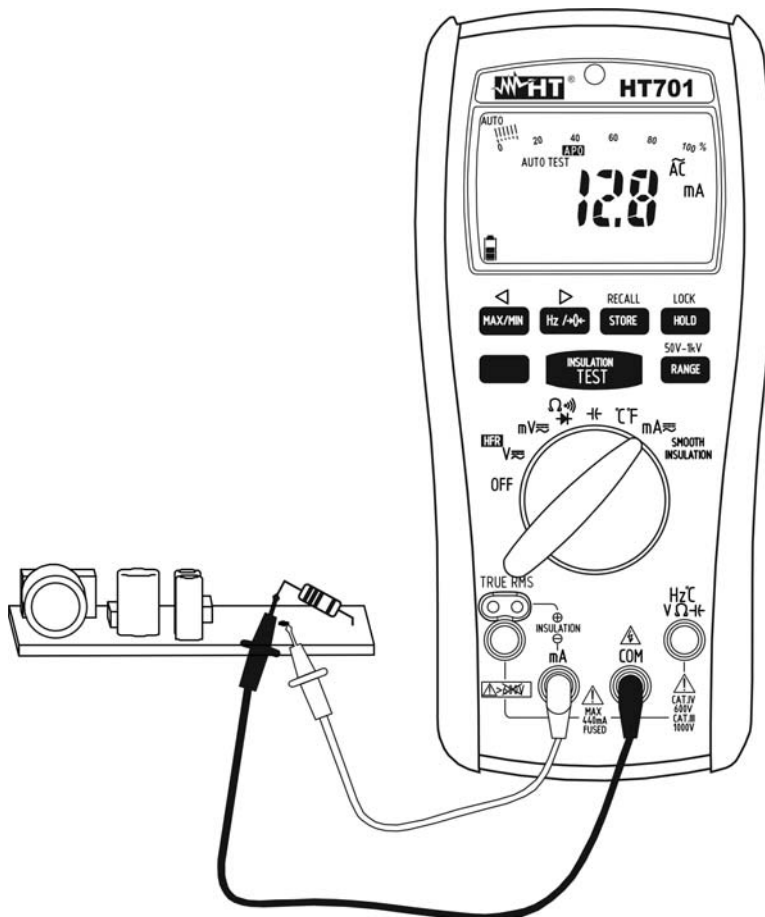


Fig. 5: Use of the instrument for AC current measurement

1. Cut off power supply from the circuit to be measured.
2. Select the **mA** position.
3. If necessary, press the **MODE** key for manually selecting AC measurement (see § 4.3.3).
4. Use the **RANGE** key for manually selecting the measuring range (see § 4.2.6) or use Autorange selection. If current value is unknown, select the highest range.
5. Insert the red cable into the input terminal **mA** and the black cable into the input terminal **COM**
6. Connect the red lead and the black lead in series to the circuit whose current you want to measure (see Fig. 5)
7. Supply the circuit to be measured. The display shows the value of current.
8. If the display shows the message "**OL**", the maximum measurable value has been reached.
9. Press the **Hz/→0←** key to display the frequency measure of AC current. The symbol "Hz" is shown on the display.
10. For using the HOLD function, see § 4.2.1, for measuring MAX/MIN/AVG values see § 4.2.2 and for saving the result, see § 4.2.5

4.4.5. Resistance measurement and continuity test

CAUTION



Before attempting any resistance measurement, cut off power supply from the circuit to be measured and make sure that all capacitors are discharged, if present.

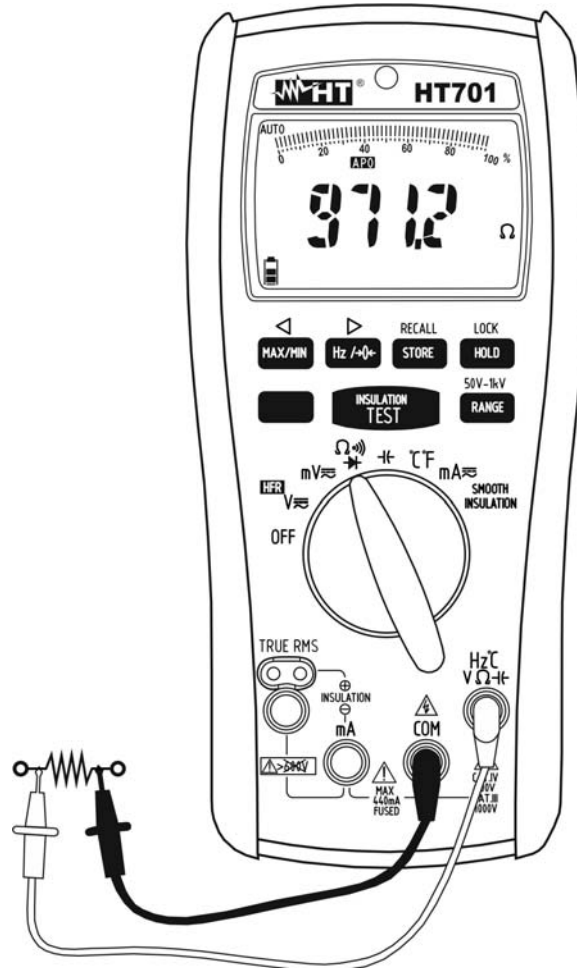


Fig. 6: Use of the instrument for resistance measurement and continuity test

1. Select the Ω position. The symbol “MΩ” is shown on the display.
2. Use the **RANGE** key for manually selecting the measuring range (see § 4.2.6) or use Autorange selection. If resistance value is unknown, select the highest range.
3. Insert the red cable into input lead **Hz CV Ω** and the black cable into input lead **COM**
4. Short-circuit the leads and, if necessary, press the **Hz/→0←** key to activate the Relative measurement (see § 4.2.3). The symbol “→0←” flashes and the value on the display is zeroed
5. Position the test leads in the desired points of the circuit to be measured (see Fig. 6). The display shows the value of resistance
6. If the display shows the message “OL”, select a higher range
7. Press the **MODE** key to select the Continuity test. The symbol “•” is shown on the display. Insert the red and black cables as instructed for resistance measurement. The buzzer activates for resistance values <30Ω
8. For using the HOLD function, see § 4.2.1, for measuring MAX/MIN/AVG values see § 4.2.2 and for saving the result, see § 4.2.5

4.4.6. Diode test



CAUTION

Before attempting any diode test, cut off power supply from the circuit to be measured and make sure that all capacitors are discharged, if present.

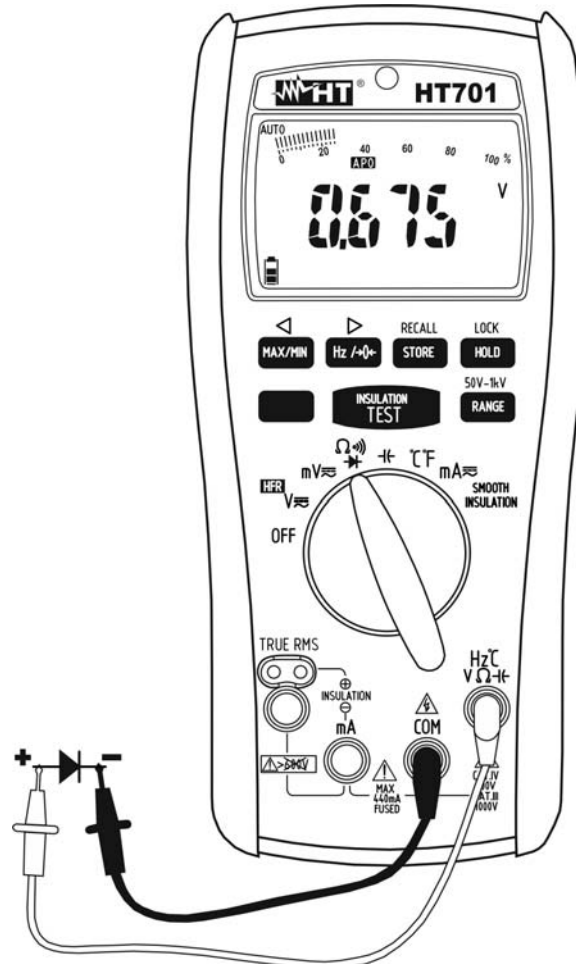


Fig. 7: Use of the instrument for diode test

1. Select the $\Omega \rightarrow \rightarrow \rightarrow$ position.
2. Press the **MODE** key to select the Diode Test. The symbol " $\rightarrow \rightarrow \rightarrow$ " is shown on the display.
3. Insert the red cable into input lead **Hz°C V Ω Hz** and the black cable into input lead **COM**.
4. Position the leads at the ends of the diode to be tested, respecting the indicated polarity (see Fig. 7). The value of directly polarized threshold voltage is shown on the display. For a good P-N junction, the instrument must show a value between 0.4 and 0.9V. If threshold value is equal to 0mV, the P-N junction of the diode is short-circuited.
5. If the instrument shows the message "**OL**", the terminals of the diode are reversed with respect to the indication given of Fig. 7 otherwise, the P-N junction of the diode is damaged
6. For using the HOLD function, see § 4.2.1, for measuring MAX/MIN/AVG values see § 4.2.2 and for saving the result, see § 4.2.5

4.4.7. Capacitance measurement

CAUTION



Before carrying out capacitance measurements on circuits or capacitors, cut off power supply from the circuit being tested and let all capacitance in it be discharged.

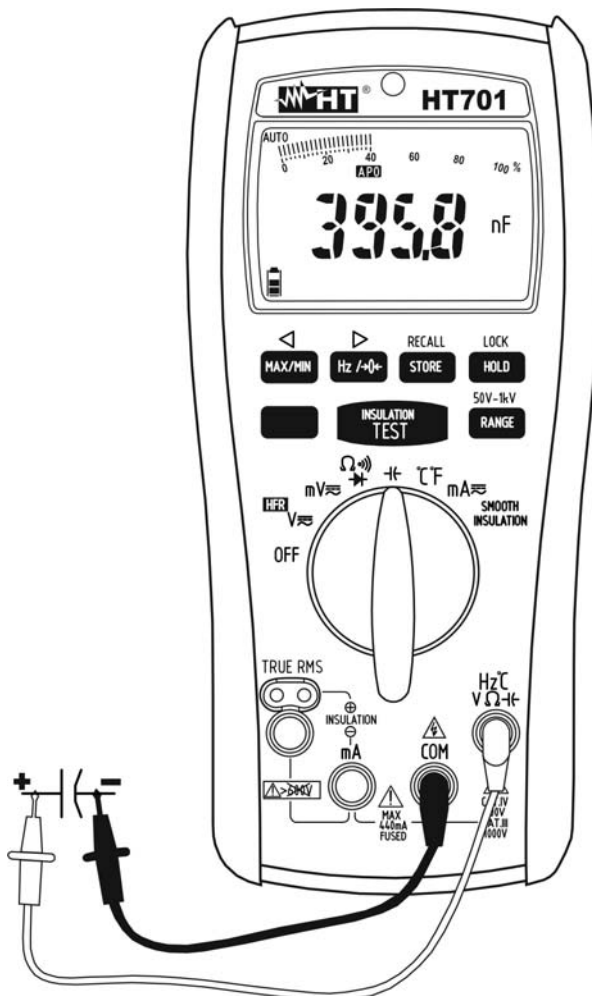


Fig. 8: Use of the instrument for Capacitance measurement

1. Select the Hf position.
2. If necessary, press the $\text{Hz}/\rightarrow 0 \leftarrow$ key to activate the Relative capacitance measurement (see § 4.2.3). The symbol " $\rightarrow 0 \leftarrow$ " flashes and the value on the display is zeroed.
3. Use the **RANGE** key for manually selecting the measuring range (see § 4.2.6) or use Autorange selection. If the value of capacitance is unknown, select the highest range.
4. Insert the red cable into input lead $\text{Hz}^\circ\text{CV}\Omega\text{Hf}$ and the black cable into input lead **COM**
5. Position the leads at the ends of the capacitor to be tested, respecting, if necessary, the positive (red cable) and negative (black cable) polarity on the capacitor to be tested (see Fig. 8). The display shows the value of capacitance.
6. The message "**OL**" indicates that the value of capacitance exceeds the maximum measurable value.
7. For using the HOLD function, see § 4.2.1, for measuring MAX/MIN/AVG values see § 4.2.2 and for saving the result, see § 4.2.5

4.4.8. Temperature measurement

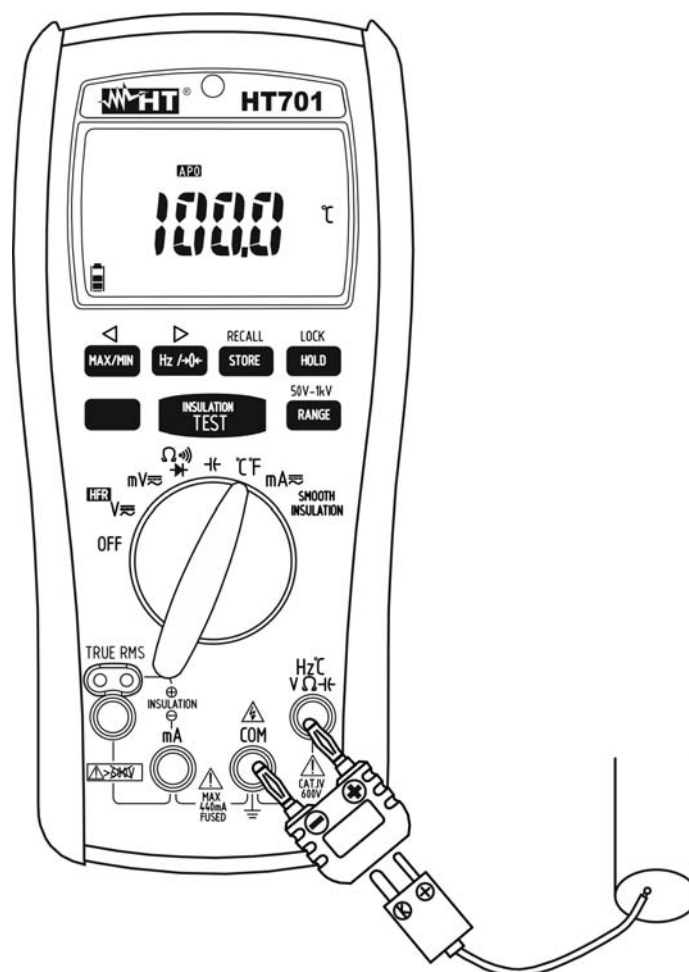


Fig. 9: Use of the instrument for Temperature measurement

1. Select the **°C°F** position.
2. Press the **MODE** key to select measurement in °C or °F.
3. Insert the provided adapter into the input terminals **Hz °C V Ω Hz** and **COM**, respecting the red and black colours found on it (see Fig. 9)
4. Connect the provided K-type wire probe or one of the optional probes (see § 6.3.2) to the instrument by means of the adapter, respecting the positive and negative polarity on the probe's plug. The display shows the value of temperature.
5. The message **"OL"** indicates that the value of temperature exceeds the maximum measurable value.
6. For using the HOLD function, see § 4.2.1, for measuring MAX/MIN/AVG values see § 4.2.2 and for saving the result, see § 4.2.5

4.4.9. Insulation resistance measurement



CAUTION

- Check that no voltage is present at the ends of the circuit to be tested before carrying out an insulation measurement.
- During the whole test, make sure that the applied voltage cannot be accessed by third parties and adequately arrange the system by disconnecting everything that must not be included in the test.

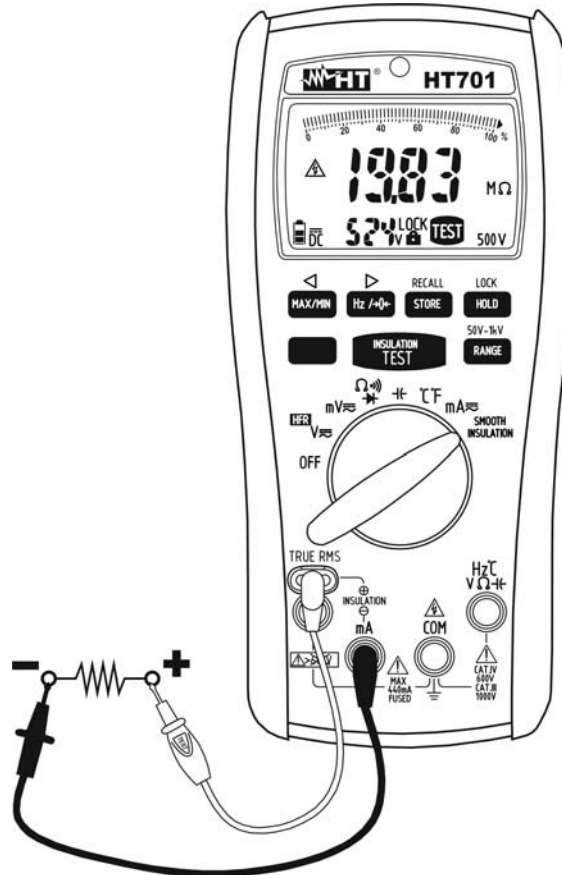


Fig. 10: Use of the instrument for Insulation measurement

1. Select the **INSULATION** position.
2. Press the **RANGE** key for manually selecting test voltage (see § 4.2.6).
3. If necessary, press the **MODE** key for selecting the “SMOOTH” mode (see § 4.3.5). The message “SMOOTH” is shown on the display.
4. If necessary, press the **HOLD/LOCK** key for selecting the “LOCK” mode (see § 4.2.1). The symbols “” and “LOCK” appear on the display.
5. Insert the red remote probe into input lead “⊕” and the black cable into input lead “⊖” (see Fig. 10).
6. Position the leads at the ends of the circuit to be tested, respecting positive and negative polarity (see Fig. 10). If necessary, use the alligator clips.
7. Press and hold the **TEST** key (with “LOCK” function deactivated) on the instrument or on the remote probe to start measuring. The symbols “TEST” and “”, further to the indication of test voltage, are shown on the display. Release the **TEST** key to stop measuring. The result, expressed in MΩ, is shown on the display
8. The message “> full scale MΩ” indicates that the measured value exceeds the full scale relevant to the selected test voltage.
9. To save the result, see § 4.2.5

5. MAINTENANCE



CAUTION

- Only expert and trained technicians should perform maintenance operations. Before carrying out this operations, make sure you have disconnected all cables from the input terminals
- Do not use the instrument in environments with high humidity levels or high temperatures. Do not expose to direct sunlight
- Always switch off the instrument after use. In case the instrument is not to be used for a long time, remove the battery to avoid liquid leaks that could damage the instrument's internal circuits

5.1. REPLACING THE BATTERIES AND THE INTERNAL FUSE

When the LCD displays the flat battery symbol “”, it is necessary to replace the batteries

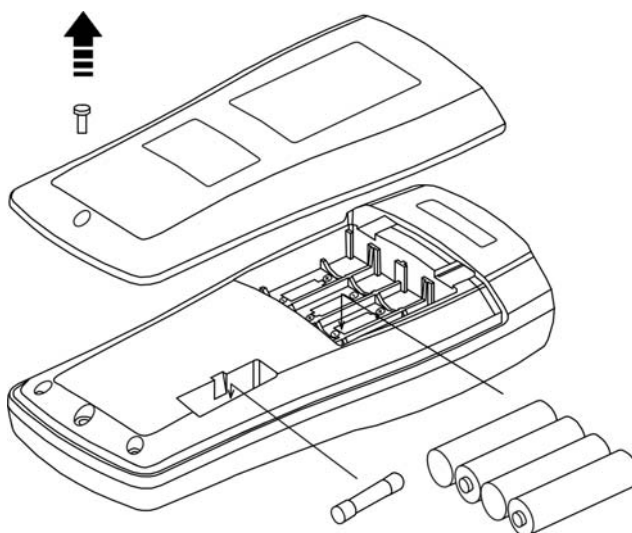


Fig. 11: Replacing the batteries and the internal fuse

Battery replacement

1. Remove the test leads from the instrument.
2. Remove the fastening screw and remove the battery compartment cover.
3. Remove the batteries and insert the same number of batteries of the same type (see § 6.1.3) respecting the correct polarity, then restore the battery compartment cover (see Fig. 11). Use the relevant containers for battery disposal.

Fuse replacement (see § 4.3.6)

1. Position the rotary switch to OFF and remove the cables from the input terminals.
2. Remove the fastening screw and remove the battery compartment cover.
3. Remove the damaged fuse, insert a fuse of the same type (see § 6.1.3) and close the battery compartment again.

5.2. CLEANING THE INSTRUMENT

Use a soft and dry cloth to clean the instrument. Never use wet cloths, solvents, water, etc.

5.3. END OF LIFE



WARNING: the symbol on the instrument indicates that the appliance and its accessories must be collected separately and correctly disposed of.

6. TECHNICAL SPECIFICATIONS

6.1. TECHNICAL CHARACTERISTICS

Accuracy is indicated as [% rdg + (number of dgt * resolution)] at 23°C±5°C, <80%RH

DC Voltage

Range	Resolution	Accuracy	Input impedance	Overload protection
100.00mV	0.01mV	±(0.08%rdg+3dgt)	10MΩ // <100pF	1000VDC/ACrms
1000.0mV	0.1mV	±(0.08%rdg+2dgt)		
10.000V	0.001V			
100.00V	0.01V			
1000.0V	0.1V			

AC TRMS Voltage

Range	Resolution	Accuracy (50÷60Hz)	Accuracy (60÷5KHz)	Overload protection
100.00mV	0.01mV	±(0.9%rdg+3dgt)	±(0.9%rdg+3dgt)	1000VDC/ACrms
1000.0mV	0.1mV			
10.000V	0.001V		±(1.9%rdg+3dgt)	
100.00V	0.01V			
1000.0V	0.1V		±(1.9%rdg+3dgt) (*)	

(*) In range: 60 Hz ÷ 1kHz

Input impedance: 10MΩ // < 100pF

For non-sinusoidal voltage, consider the following crest factors (CF):

1.4 ≤ CF < 2.0 → Add 1.0%rdg to accuracy

2.0 ≤ CF < 2.5 → Add 2.5%rdg to accuracy

2.5 ≤ CF ≤ 3.0 → Add 4.0%rdg to accuracy

AC TRMS Voltage – HFR mode

Range	Resolution	Accuracy (50÷60Hz)	Accuracy (60÷5KHz)	Overload protection
10.000V	0.001V	±(0.9%rdg+3dgt)	±(2.9%rdg+3dgt)	1000VDC/ACrms
100.00V	0.01V			
1000.0V	0.1V			

(*) In range: 60 Hz ÷ 500Hz

Input impedance: 10MΩ // < 100pF

Cutting frequency in HFR mode: 1kHz

For non-sinusoidal voltages, add the same errors as AC TRMS voltage

DC Current

Range	Resolution	Accuracy	Overload protection
100.00mA	0.01mA	±(0.2%rdg + 2dgt)	max 440mA
400.0mA	0.1mA		

AC TRMS Current

Range	Resolution	Accuracy (50÷5kHz)	Overload protection
100.00mA	0.01mA	±(1.5%rdg + 2dgt)	max 440mA
400.0mA	0.1mA		

For non-sinusoidal currents, add the same errors as AC TRMS voltage

Resistance

Range	Resolution	Accuracy	Max voltage open circuit	Overload protection
1000.0Ω	0.1Ω	±(0.5%rdg+2dgt)	Approx. 0.25V	1000VDC/ACrms
10.000kΩ	0.001kΩ			
100.00kΩ	0.01kΩ			
1000.0kΩ	0.1kΩ			
10.000MΩ	0.001MΩ			
40.00MΩ	0.01MΩ			

Continuity test

Range	Accuracy	Buzzer	Open circuit voltage	Overload protection
400.0Ω	±(0.5%rdg+2dgt)	<30Ω	Approx. 1.2V	1000VDC/ACrms

Diode test

Range	Accuracy	Test current	Open circuit voltage	Overload protection
2.000V	±(0.5%rdg+2dgt)	0.6mA	2.5V	1000VDC/ACrms

Frequency of AC Voltage and AC Current

Range	Resolution	Accuracy	Minimum duration of pulse	Overload protection
100.00Hz	0.01Hz	±(0.1%rdg+5dgt)	10μs	1000VDC/ACrms max 440mA
1000.0Hz	0.1Hz			
10.000kHz	0.001kHz			
100.00kHz	0.01kHz			

Signal sensitivity for frequency measure

Function	Range	Sensitivity (sinusoidal waveform)	
		10Hz ÷ 10kHz	10kHz ÷ 100kHz
AC mV	100.00mV	15.00mV	
	1000.0mV	150.0mV	
AC V	10.000V	1.500V	
	100.00V	3V	-
	1000.0V	30V	-
AC mA	100.00mA	15.00mA	-
	400.0mA	30mA	-

Capacitance

Range	Resolution	Accuracy	Measuring time	Overload protection
10.000nF	0.001nF	±(1.2%rdg+80dgt)	0.7s	1000VDC/ACrms
100.00nF	0.01nF	±(1.2%rdg+20dgt)		
1000.0nF	0.1nF	±(1.2%rdg+2dgt)		
10.000μF	0.001μF			
100.00μF	0.01μF			
1000.0μF	0.1μF			
10.000mF	0.001mF	±(1.2%rdg+20dgt)	3.75s	
40.00mF	0.01mF	±(1.2%rdg+80dgt)		
			7.5s	

Temperature with K probe

Range	Resolution	Accuracy	Overload protection
-200.0°C ÷ 0.0°C	0.1°C	±(1.0%rdg+2°C)	1000VDC/ACrms
0.0°C ÷ 1200.0°C		±(1.0%rdg+1°C)	
-328.0°F ÷ 32.0°F	0.1°F	±(1.0%rdg+36°F)	
32.0°F ÷ 2192.0°F		±(1.0%rdg+18°F)	

Insulation resistance

Test voltage	Measuring range	Accuracy	Overload protection
50V DC	2.000MΩ	±(1.5%rdg+5dgt)	600VDC/ACrms
	20.00MΩ		
	55.0MΩ		
100V DC	2.000MΩ		
	20.00MΩ		
	110.0MΩ		
250V DC	2.000MΩ		
	20.00MΩ		
	200.0MΩ		
	275MΩ		
500V DC	2.000MΩ		
	20.00MΩ		
	200.0MΩ		
	550MΩ		
1000V DC	2.000MΩ		
	20.00MΩ		
	200.0MΩ		
	2000MΩ		
	22.0GΩ	±(10%rdg+3dgt)	

Test voltage accuracy: +20%rdg, -0%rdg

Short-circuit current: 1mA

Minimum resistance (@ nominal current 1mA): 50kΩ (50V), 100kΩ (100V), 250kΩ (250V), 500kΩ (500V), 1MΩ (1000V)

Discharge time of measured object: <1s (C ≤ 1μF)

Maximum capacitive load: 1μF

Voltage detection on circuit: test inhibited for voltages ≥30V AC/DC on inputs

6.1.1. Electrical characteristics

Conversion:	TRMS
Sampling frequency:	3 times per second
Temperature coefficient:	0.15x(accuracy) /°C, <18°C or >28°C
NMRR Normal Mode Rejection Ratio:	> 50dB for DC quantities and 50/60Hz
CMRR Common Mode Rejection Ratio:	>100dB from DC up to 60Hz (DCV) > 60dB from DC, up to 60Hz (ACV)

6.1.2. Considered standards

Safety:	IEC/EN 61010-1 IEC/EN61557-1, IEC/EN61557-2
Insulation:	double insulation
Pollution level:	2
Overvoltage category:	CAT IV 600V, CAT III 1000V
Max operating altitude:	2000m (6561ft)

6.1.3. General characteristics

Mechanical characteristics

Size (with shell):	207 (L) x 95 (W) x 52 (H) mm (8 x 4 x 2 inch)
Weight (batteries included):	630g (22 ounces)

Power supply

Battery type:	4 x 1.5V alkaline type AA IEC LR6
Low battery indication:	symbol "⎓" with battery voltage < approx. 4.8V
Battery life:	approx. 80 hours 600 insulation test with new batteries at room temperature (1MΩ @ 1kV, duty cycle of 5s on and 25s off)
Auto Power Off	after 20 minutes of idleness (disabled)

Memory

Characteristics:	max. 100 locations for each function
------------------	--------------------------------------

Display

Characteristics:	5 LCD, 10000 points, decimal sign, analogue bargraph and autobacklight
Over range indication:	"OL" or "-OL"

6.2. ENVIRONMENT

6.2.1. Environmental conditions for use

Reference temperature:	23° ± 5°C (73 ± 41°F)
Operating temperature:	0° ÷ 50°C (32° ÷ 122°F)
Allowable relative humidity:	<80%RH
Storage temperature:	-20° ÷ 60°C (-4 ÷ 140°F) (batteries not fitted)
Storage humidity:	<80%RH (batteries not fitted)

This instrument satisfies the requirements of Low Voltage Directive 2006/95/EC (LVD) and of EMC Directive 2004/108/EC

6.3. ACCESSORIES

6.3.1. Standard accessories

- Pair of test leads
- Pair of alligator clips
- Remote probe for insulation measurement
- K-type wire probe + adapter
- Belt with magnetic end for fastening to metal surfaces
- Protection holster
- Batteries (not inserted)
- User manual

6.3.2. Optional accessories

Couple of test leads	Cod. 4413-2
K-type probe for air and gas temperature	Cod. TK107
K-type probe for semisolid substance temperature	Cod. TK108
K-type probe for liquid substance temperature	Cod. TK109
K-type probe for surface temperature	Cod. TK110
K-type probe for surface temperature with 90° tip	Cod. TK111

7. SERVICE

7.1. WARRANTY CONDITIONS

This instrument is warranted against any material or manufacturing defect, in compliance with the general sales conditions. During the warranty period, defective parts may be replaced. However, the manufacturer reserves the right to repair or replace the product.

Should the instrument be returned to the After-sales Service or to a Dealer, transport will be at the Customer's charge. However, shipment will be agreed in advance.

A report will always be enclosed to a shipment, stating the reasons for the product's return. Only use original packaging for shipment; any damage due to the use of non-original packaging material will be charged to the Customer.

The manufacturer declines any responsibility for injury to people or damage to property.

The warranty shall not apply in the following cases:

- Repair and/or replacement of accessories and battery (not covered by warranty).
- Repairs that may become necessary as a consequence of an incorrect use of the instrument or due to its use together with non-compatible appliances.
- Repairs that may become necessary as a consequence of improper packaging.
- Repairs which may become necessary as a consequence of interventions performed by unauthorized personnel.
- Modifications to the instrument performed without the manufacturer's explicit authorization.
- Use not provided for in the instrument's specifications or in the instruction manual.

The content of this manual cannot be reproduced in any form without the manufacturer's authorization.

Our products are patented and our trademarks are registered. The manufacturer reserves the right to make changes in the specifications and prices if this is due to improvements in technology.

7.2. SERVICE

If the instrument does not operate properly, before contacting the After-sales Service, please check the conditions of batteries and cables and replace them, if necessary.

Should the instrument still operate improperly, check that the product is operated according to the instructions given in this manual.

Should the instrument be returned to the After-sales Service or to a Dealer, transport will be at the Customer's charge. However, shipment will be agreed in advance.

A report will always be enclosed to a shipment, stating the reasons for the product's return. Only use original packaging for shipment; any damage due to the use of non-original packaging material will be charged to the Customer.