ENGLISH

User manual

Version EN 2.00 - 29/11/2017

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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 symbol ⚠ with the utmost attention.
Before and after carrying out 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 in the instrument 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.

In this manual, and on the instrument, the following symbols are used:


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


Double-insulated meter


AC voltage or current


DC voltage or current


Connection to earth

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 IV 600V and CAT III 1000V.
- We recommend following the normal safety rules devised by the procedures for carrying out operations on live systems and using the prescribed PPE to protect the user against dangerous currents and the instrument against incorrect use.
- In case the lack of indication of the presence of voltage may represent a danger for the operator, always carry out a continuity measurement before carrying out the measurement on the live system, in order to confirm the correct connection and condition of the leads.
- 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 § 6.2.1.
- Check that the battery is correctly inserted.
- Make sure that the LCD display and the rotary 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 being measured.
- When the instrument is connected to the circuit being measured, do not touch any unused terminal.
- Do not measure resistance in case external voltages are present; even if the instrument is protected, an excessive voltage may cause malfunction.
- 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 switch 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 "IEC/EN61010-1: 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

The instrument carries out the following measurements:

- DC/AC/AC+DC TRMS Voltage
- DC/AC voltage with low impedance (LoZ)
- DC/AC/AC+DC TRMS Current
- DC/AC/AC+DC TRMS Current with transducer clamps
- AC, AC+DC TRMS current
- 4-20mA% display
- Resistance and Continuity test
- Diode test
- Capacity
- Frequency
- Duty Cycle
- Temperature with K-type probe
- Data Logger function and display of graphs of measured data

Each of these functions can be selected by means of the appropriate switch. The instrument is also equipped with function keys (see § 4.2), analogue bargraph and LCD TFT high-contrast color display. The instrument is also equipped with an Auto Power OFF function which automatically switches off the instrument after a certain (programmable) idling time.

2.1. MEASURING AVERAGE VALUES ANDTRMS 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 readings 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 instruments 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 of 1A intensity, circulating on a resistor, dissipates the same energy that, during the same time, would be 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

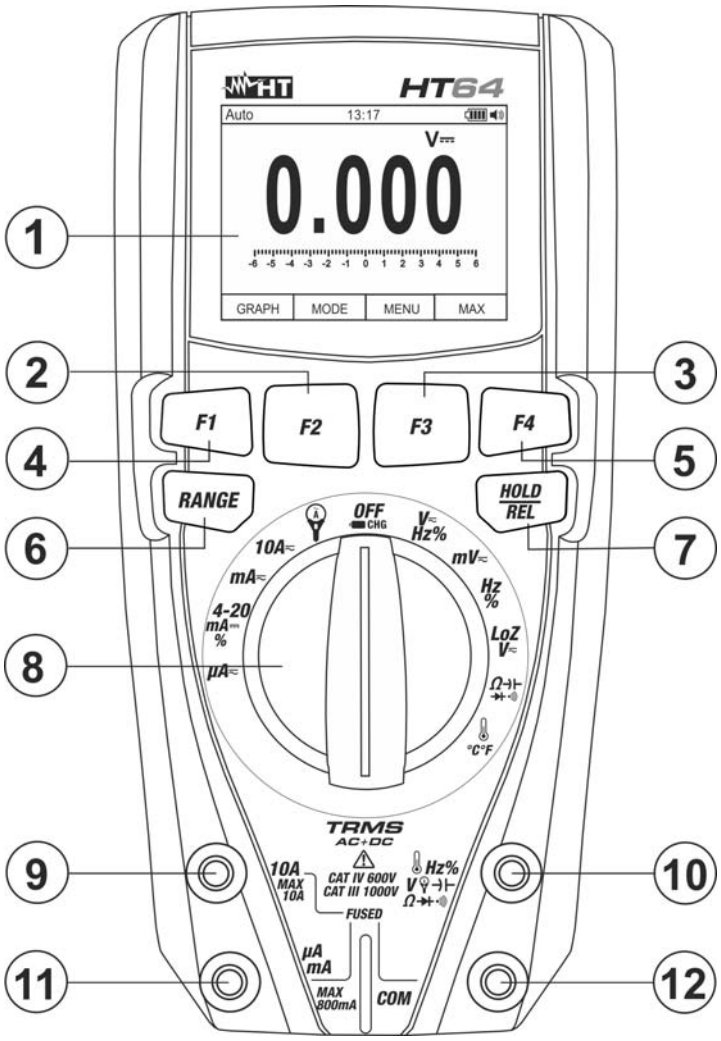
The instrument is powered by 1x7.4V rechargeable Li-ION battery included in the package. When the battery is flat, the symbol "  " appears on the display. For battery recharge, please refer to § 6.1.

3.3. STORAGE

In order to guarantee precise measurement, after a long storage time, wait for the instrument to come back to normal condition (see § 7.1.3).

4. NOMENCLATURE

4.1. DESCRIPTION OF THE INSTRUMENT



CAPTION:

1. LCD display
2. Function key **F2**
3. Function key **F3**
4. Function key **F1**
5. Function key **F4**
6. **RANGE** key
7. **HOLD/REL** key
8. Rotary selector switch
9. Input terminal **10A**
10. Input terminal Hz% V
11. Input terminal **mAµA**
12. Input terminal **COM**

Fig. 1: Description of the instrument

4.2. DESCRIPTION OF FUNCTION KEYS

4.2.1. HOLD/REL key

Pressing the **HOLD/REL** key freezes the value of the measured quantity on the display. After pressing this key, the message "Hold" appears on the display. Press the **HOLD/REL** key again to exit the function. To save the vale on the display, see § 4.3.3.
Press and hold the **HOLD/REL** key for a long time in order to activate/deactivate relative measurement. The instrument zeroes the display and saves the displayed value as a reference value which subsequent measurements will be referred to (see § 4.3.4). The symbol "Δ" appears on the display. This function is not active in position . Press and hold the **HOLD/REL** key again to exit the function.

4.2.2. RANGE key

Press the **RANGE** key to activate the manual mode and to disable the Autorange function. The message "Manual" appears on the upper left part of the display instead of "AUTO". In manual mode, press the **RANGE** key to change measuring range: the relevant decimal point will change its position. The **RANGE** key is not active in positions , , **Hz%**, **°C°F**, **mV**, **10A** and **4-20mA%**. In Autorange mode, the instrument selects the most appropriate ratio for carrying out measurement. If a reading is higher than the maximum measurable value, the indication "**O.L**" appears on the display. Press and hold the **RANGE** key for more than 1 second to exit the manual mode and restore the Autorange mode.

4.2.3. Function keys F1, F2, F3, F4

Use keys **F1**, **F2**, **F3** and **F4** to manage the instrument's internal functions (see § 4.3).

4.2.4. LoZ feature

This mode permits to perform the AC/DC voltage measurement with a low input impedance in way to avoid the wrong readings due to stray voltage in capacitive coupled.

CAUTION

Inserting the instrument between phase and ground conductors, the RCDs protection devices can be tripping out during the test. For phase-PE voltage measurement after a RCD device preliminarily connect the test leads between phase and neutral cables at least for 5s, then perform the phase-PE measurement to avoid unexpected trips-out

4.2.5. LEAD message at display

From instrument switch off (**OFF**), in the **10A, µA** and **mA** positions a short sound is emitted and a "LEAD" message is shown for a while to indicate an advise of using test leads for the current measurements.

4.3. DESCRIPTION OF INTERNAL FUNCTIONS

4.3.1. Description of the display

CAPTION:

1. Indication of Automatic/Manual mode
2. Indication of the system's time
3. Indication of battery charge level and activation/deactivation of key tone (not associated with continuity test)
4. Indication of measuring unit
5. Indication of measuring result
6. Analogue bargraph
7. Indications associated with function keys **F1**, **F2**, **F3**, **F4**

Fig. 2: Description of the display

4.3.2. AC+DC Voltage and Current measurement

The instrument is capable of measuring a possible presence of overlapping alternating components on a generic voltage or current direct waveform. This can be useful when measuring typical impulsive signals of non-linear loads (e.g. welding machines, electric ovens, etc.).

1. Select position **V⎓Hz%**, **10A⎓**, **mA⎓**, **µA⎓** or
2. Press the **F2** key selecting the ""**V~+⎓**" or "**A~+⎓**" modes (see Fig. 3)
3. Follow the instructions shown in § 5.1 or § 5.9

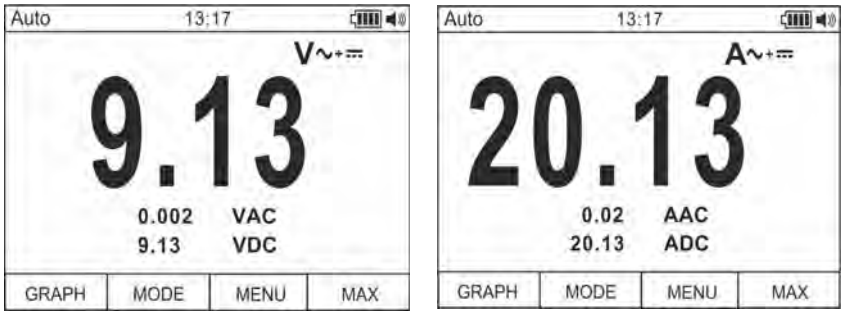


Fig. 3: AC+DC voltage or current measurement description

4.3.3. HOLD function and saving

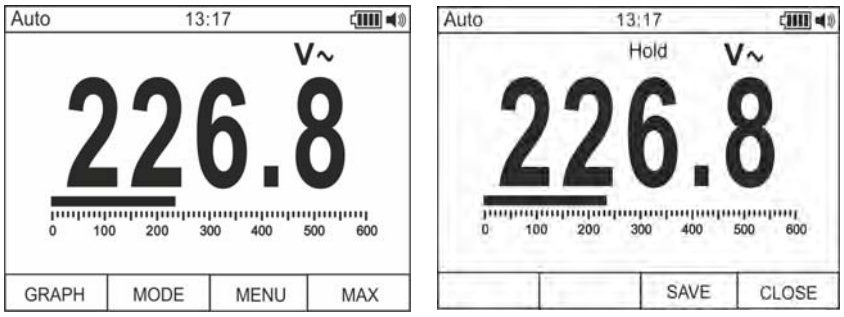


Fig. 4: Saving the value frozen on the display

1. Press the **HOLD/REL** key again to freeze the result. The message "Hold" appears on the display.
2. Press the **F3** key to save the data in the instrument's memory.
3. Enter the General menu to display the saved result (see § 4.3.7)

4.3.4. Relative measurement

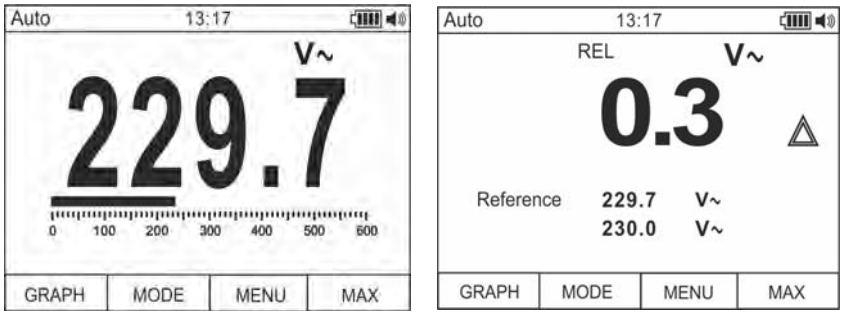


Fig. 5: Relative measurement

1. Press and hold the **HOLD/REL** key to enter relative measurement (see Fig. 5 – right side). The message "REL" and symbol "Δ" appear on the display.
2. Press the **F4** key to enter the General menu, save the measured result and display it (see § 4.3.7).

4.3.5. Saving MIN/MAX/AVERAGE and PEAK values

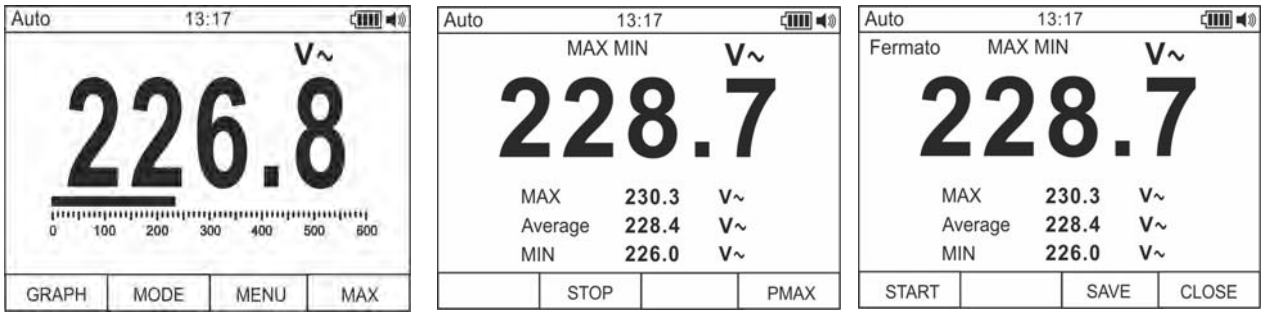


Fig. 6: Saving MIN/MAX/AVERAGE values

1. Press the **F4** key to enter the measuring mode of MAX, MIN and Average values of the quantity to be measured (see Fig. 6 – central part). The message "MAX MIN" appears on the display.
2. The values are automatically updated by the instrument, which emits a short beep whenever the actually displayed values are exceeded (higher for MAX value, lower for MIN value).
3. Press the **F2** key to stop detecting the values and the **F1** key to start measuring again.
4. Press the **F3** key to save the measured result (see Fig. 6 – right side) and display it (see § 4.3.7).

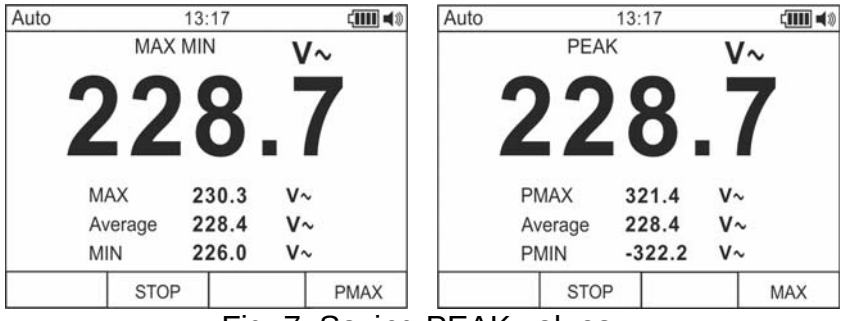


Fig. 7: Saving PEAK values

5. Press the **F4** key to enter the measuring mode of Peak values of the quantity to be measured (see Fig. 7 – right side). The message "PEAK" appears on the display and the values are updated in the same way as for the MAX/MIN function.
6. Press the **F2** key to stop detecting the values and the **F1** key to start measuring again.
7. Press the **F3** key to save the result and display it (see § 4.3.7).

4.3.6. Creating and saving graphs of measurements

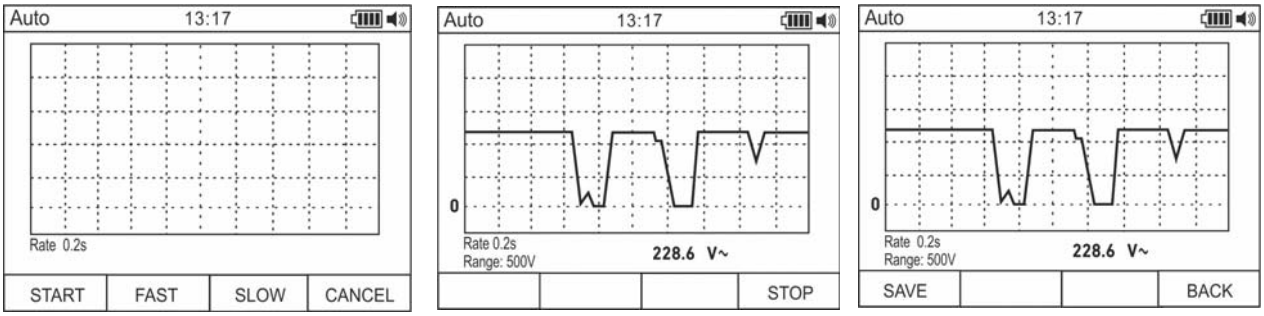


Fig. 8: Creating and saving a graph of measurements

1. Press the **F1** key to enter the section for creating a graph of the quantity to be measured (see Fig. 8 – left side).
2. Press the **F2 (Fast)** or **F3 (Slow)** key to set the sampling interval the instrument will use as a reference when creating the graph. You can choose among the following values: **0.2s, 0.5s, 1.0s, 2.0s, 5.0s, 10s**
3. Press the **F1** key to start creating the graph. The measuring range (automatically inserted by the instrument) and the real-time value are displayed by the instrument (see Fig. 8 – central part).
4. Press the **F4** key to end the graph.
5. Press the **F1** key to save the graph in the instrument's memory or the **F4** key to start a new graph (see Fig. 8 – right side).

4.3.7. Instrument general menu

1. With a measurement on the display (see Fig. 9 – left side), press function key **F3** to enter the instrument's general menu. The screen (see Fig. 9 – right side) is shown on the display.

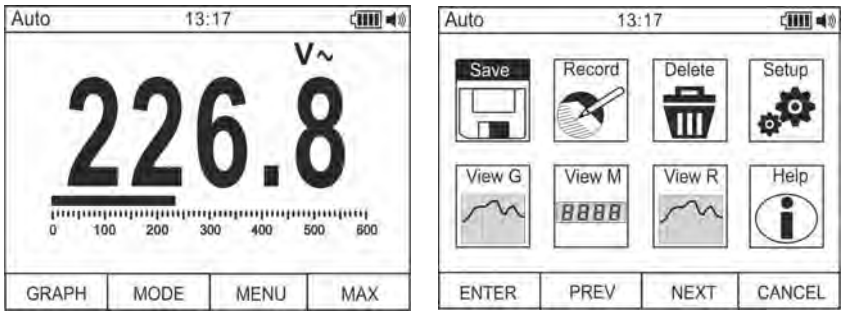


Fig. 9: Instrument general menu

<u>Saving measurements</u>

2. Press the **F1 (ENTER)** key to save the measurement.

<u>Recording data (Logger)</u>

3. Use the **F2** or **F3** key to select symbol "Record" and press the **F1** key (see Fig. 10 – left side).

Fig. 10: Setting data recording

4. Use the **F2** or **F3** key to select:
   - Setting of recording duration, from **1min** to **23h:59min**
   - Setting of sampling interval from **1s** to **59min**:**59s**
5. Press the **F1** key to enable the editing functions and the **F2 (+)** and **F3 (>>)** keys to carry out the desired settings.
6. Press the **F1 (OK)** key to confirm the settings or the **F4 (CANCEL)** key to go back to editing (see Fig. 10 – right side).
7. Press the key **F4 (CLOSE)** to go back to the main screen
8. Select the option "Start Recording" and press the **F1** key. The following screen appears on the display

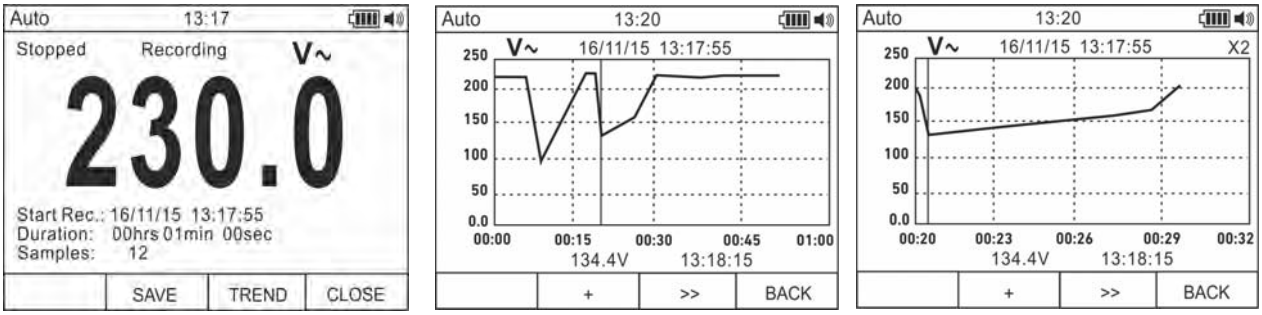


Fig. 11: Starting data recording

9. The instrument shows the remaining time and the number of samples taken in real time, and the message "Stopped" at the end of recording (see Fig. 11 – left side). Press the **F4 (STOP)** key to stop recording at any time.
10. Press the **F2** key to save recorded data in the internal memory and view it again on the display
11. Press the **F3 (TREND)** key to display the trend of recording (see Fig. 11 – central part).
12. Press the **F4 (>>)** key to move the cursor on the graph and the **F2 (+)** key to activate the Zoom function of the graph, increasing resolution (symbol "Xy" where y=max zoom dimension appears at the top of the display on the right side) (see Fig. 11 – right side). You can zoom X1 for **at least 15 measuring points**, X2 for **at least 30 measuring points**, X3 for **at least 60 measuring points** and so on for maximum **6 zooming operations.**
13. Press the **F4 (BACK)** key to go back to the previous screen.

<u>Deleting the instrument's memory</u>

14. Use the **F2** or **F3** key to select symbol "Delete" and press the **F1** key (see Fig. 12 – left side).

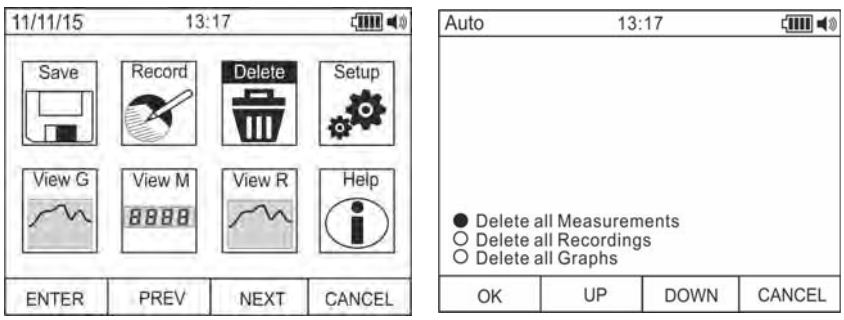


Fig. 12: Deleting the internal memory

15. Use the **F2** or **F3** key to select the options:

- **Delete all Measurements** → all snapshots (measurements) are deleted
- **Delete all Recordings** → all recordings are deleted
- **Delete all Graphs** → all graphs are deleted.

16. Press the **F1 (OK)** key to carry out the selected operation (a confirmation message is shown by the instrument).

General settings of the instrument

17. Use the **F2** or **F3** key to select symbol "Setup" and press the **F1** key (see Fig. 13 – left side).

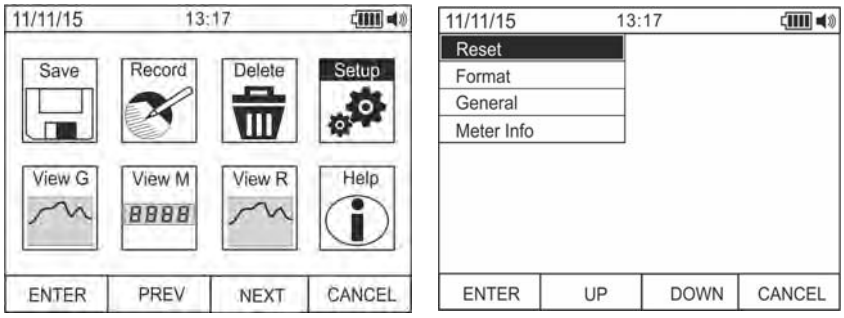


Fig. 13: General settings of the instrument

18. Use the **F2** or **F3** key to select the options:

- **Reset** → restores the instrument's default conditions.
- **Format** → allows activating the key tone, setting the format of date/time and of the displayed numbers (decimal comma or point).
- **General** → allows setting the system's date/time, defining the Auto Power OFF interval, the background colour and the display's font colour and type, and choosing the system's language.
- **Meter Info** → provides information on the internal Firmware version and on the memory's available space.

19. Press the **F1 (ENTER)** key to carry out the selected operation or the **F4 (CANCEL)** key to go back to the measuring screen.

General settings of the instrument – Reset

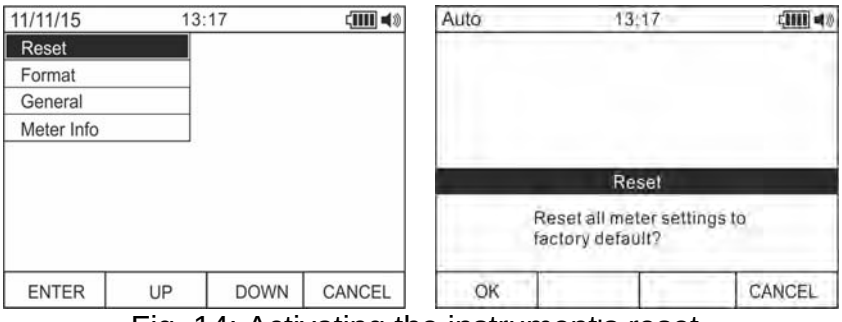


Fig. 14: Activating the instrument's reset

20. Press the **F1 (OK)** key to activate the Reset.
21. **The Reset operation do not deletes the instrument's internal memory**

General settings of the instrument – Format

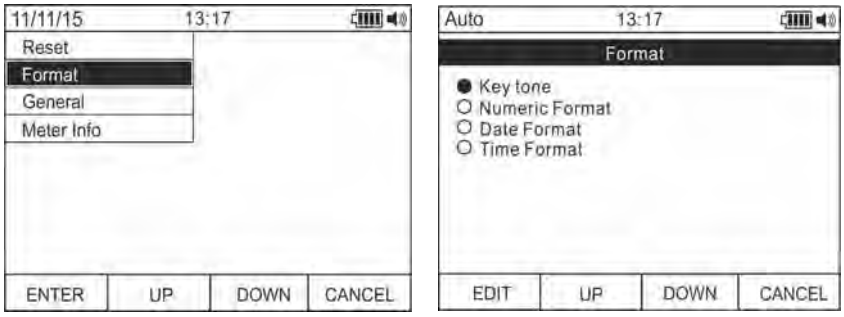


Fig. 15: Setting the Format Menu

22. Use the **F2** or **F3** key to select the options:

- **Key tone** → allows activating/deactivating the tone of the function keys.
- **Numeric Format** → allows defining the format of the numbers shown on the display among the options: **0.000** (decimal point) and **0,000** (comma)
- **Date Format** → allows defining the format of the system date between the options: **MM/DD/YY** and **DD/MM/YY**
- **Time Format** → allows defining the format of the system time between the options: **12 HOURS** and **24 HOURS**

23. Use the **F1 (EDIT)** key and the **F2** and **F3** keys for settings or the **F4** key to go back to the previous screen.

General settings of the instrument – Display

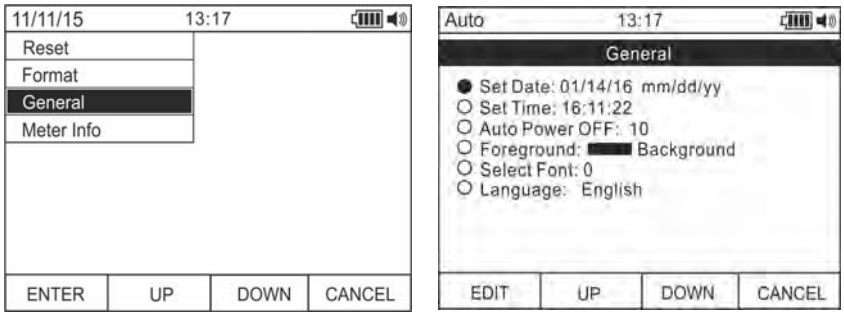


Fig. 16: Setting the Display Menu

24. Use the **F2** or **F3** key to select the options:

- **Set Date** → allows setting the system's date as defined in the Format menu.
- **Set Time** → allows setting the system's time as defined in the Format menu.
- **Auto Power OFF** → allows defining the instrument's auto power off interval when idling in the range: **5min ÷ 60min** with resolution 1min. Set value **00** to disable the function. Press the **F3** key to switch on the instrument again after it has automatically switched off.
- **Foreground** → allows defining the display's background colour and the colour of the font.
- **Select Font** → allows defining the type of font or the display among the available options (0, 1, 2).
- **Language** → allows selecting the system's language among the options: Italian, English, Spanish, German and French

General settings of the instrument – Instrument Info

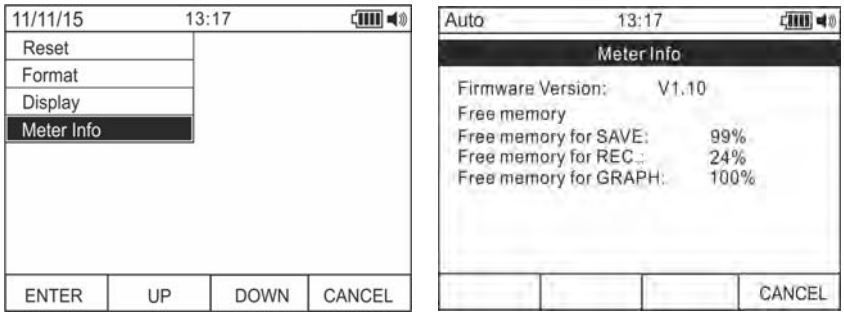


Fig. 17: Display of Menu Instrument Info

25. The instrument shows the following information:

- **Firmware version** → internal Firmware version
- **Free memory** → percentage values of the remaining free space in the memory for saving snapshots (SAVE), recordings (REC) and graphs (GRAPH).

26. Press the **F4** key to go back to the previous screen

Recalling graphs to the display

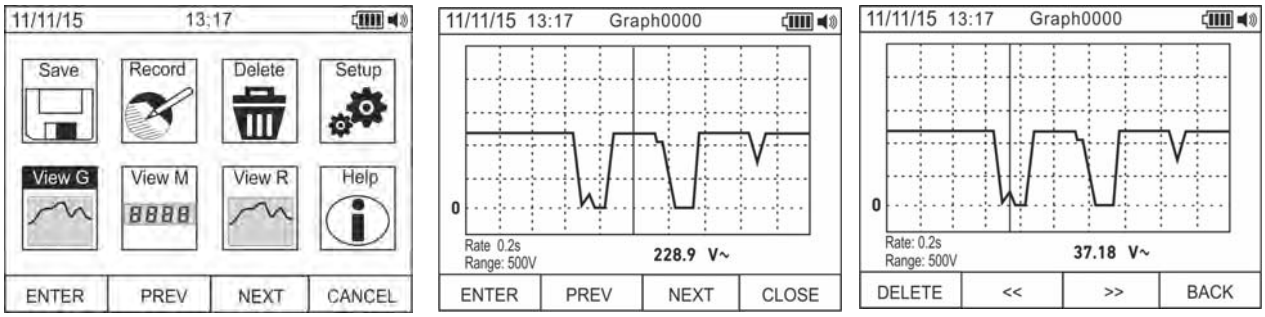


Fig. 18: Recalling graphs to the display

27. Use the **F2** or **F3** key to select symbol "View G" and press the **F1** key (see Fig. 18 – left side).
28. Use the **F2 (PREV)** or **F3 (NEXT)** keys to select the desired graph among the ones saved in the instrument's memory and press key **F1 (ENTER)** to open the graph (see Fig. 18 – central part).
29. Use the **F2 (<<)** or **F3 (>>)** keys to move the cursor within the graph in the two directions, observing the corresponding value at the bottom of the display (see Fig. 18 – right side).
30. Press the **F1 (DELETE)** key to delete the selected graph or the **F4 (BACK)** key to go back to the previous screen.

Recalling measured data (snapshots) on the display

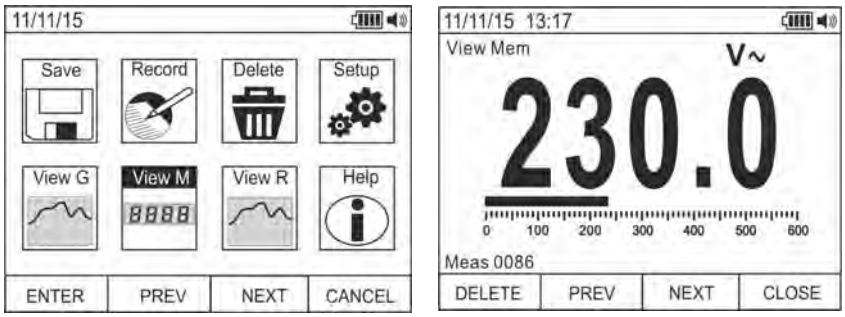


Fig. 19: Recalling measured data (snapshots) on the display

31. Use the **F2** or **F3** key to select symbol "View M" and press the **F1** key (see Fig. 19 – left side).
32. Use the **F2 (PREV)** or **F3 (NEXT)** key to select and view the desired measure among the ones saved in the instrument's memory (see Fig. 19 – right side). The measure reference appears at the bottom of the display on the right side.
33. Press the **F1 (DELETE)** key to delete the selected measure or the **F4 (CLOSE)** key to go back to main screen

Recalling recordings to the display

Fig. 20: Recalling recordings to the display

34. Use the **F2** or **F3** key to select symbol "View R" and press the **F1** key (see Fig. 20 – left side).
35. Use the **F2 (PREV)** or **F3 (NEXT)** key to select the desired recording among the ones saved in the instrument's memory (see Fig. 20 – central part). The recording reference appears at the bottom of the display.
36. Press the **F1 (TREND)** key to display the trend of recording.
37. Press the **F3 (>>)** key to move the cursor on the graph and observe the corresponding value at the bottom of the display.
38. Press the **F2 (+)** key to activate (if available) the zooming function of the graph.
39. Press the **F1 (DELETE)** key to delete the selected recording or the **F4 (BACK)** key to go back to the previous screen.

Help on line on the display

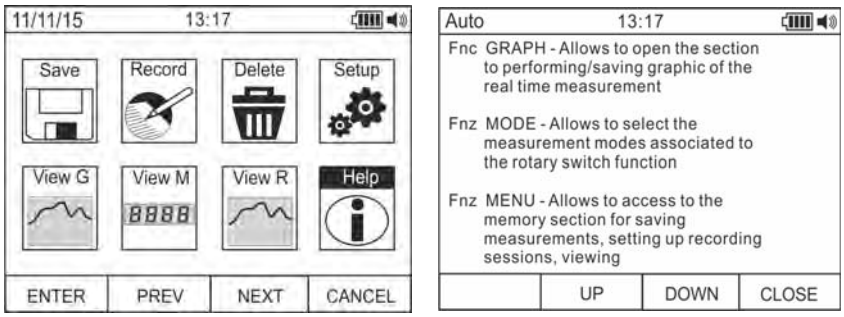


Fig. 21: Help on line on the display

40. Use the **F2** or **F3** key to select symbol "Help" and press the **F1** key (see Fig. 21).
41. Use the **F2 (UP)** or **F3 (DOWN)** to browse the pages of the context on-line help.
42. Press the **F4 (CLOSE)** key to go back to the main screen

5. OPERATING INSTRUCTIONS

5.1. DC, AC+DC VOLTAGE MEASUREMENT

CAUTION

The maximum input DC voltage is 1000V. 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.

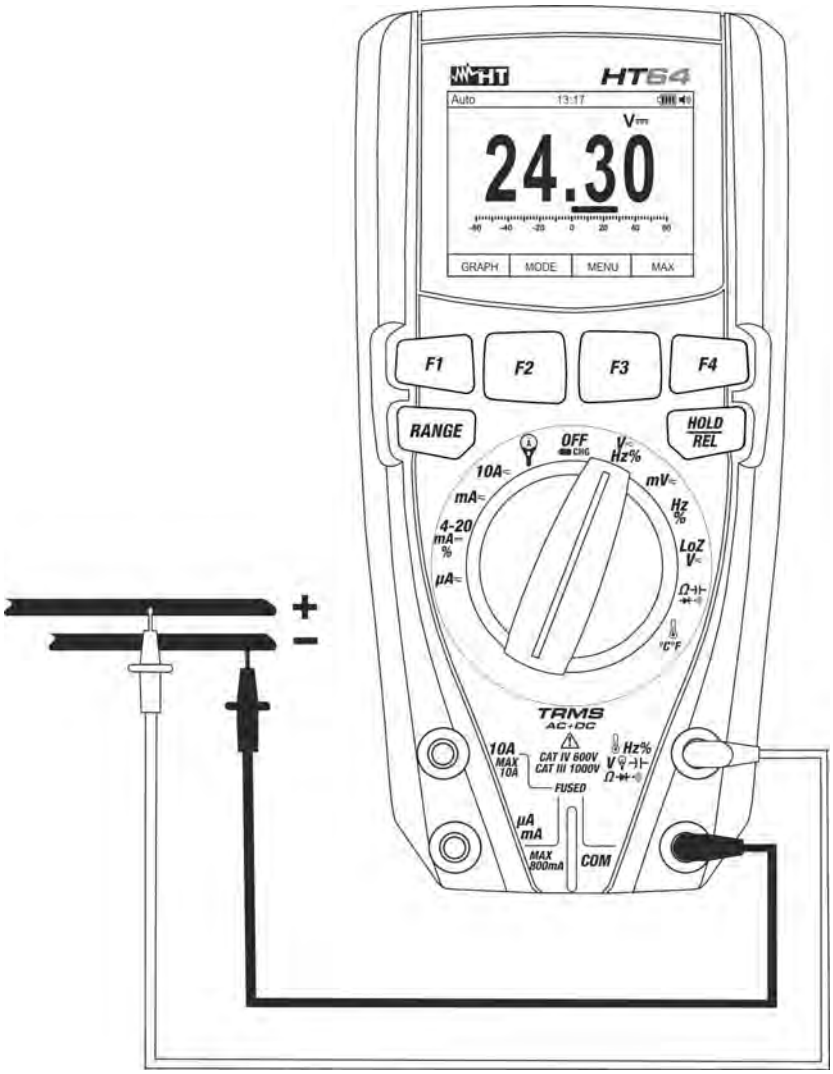


Fig. 22: Use of the instrument for DC voltage measurement

1. Select positions **V⎓Hz%** or **mV⎓**
2. Insert the red cable into input terminal **Hz%** **V** and the black cable into input terminal **COM**.
3. Position the red lead and the black lead respectively in the spots with positive and negative potential of the circuit to be measured (see Fig. 22). The display shows the value of voltage.
4. If the display shows the message "**O.L**", select a higher range.
5. When symbol "**-**" appears on the instrument's display, it means that voltage has the opposite direction with respect to the connection in Fig. 22.
6. To use the HOLD, RANGE and REL function, see § 4.2.
7. For AC+DC measurement, see § 4.3.2 and to use the internal functions, see § 4.3.

5.2. AC VOLTAGE MEASUREMENT

CAUTION

The maximum input AC voltage is 1000V. 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.

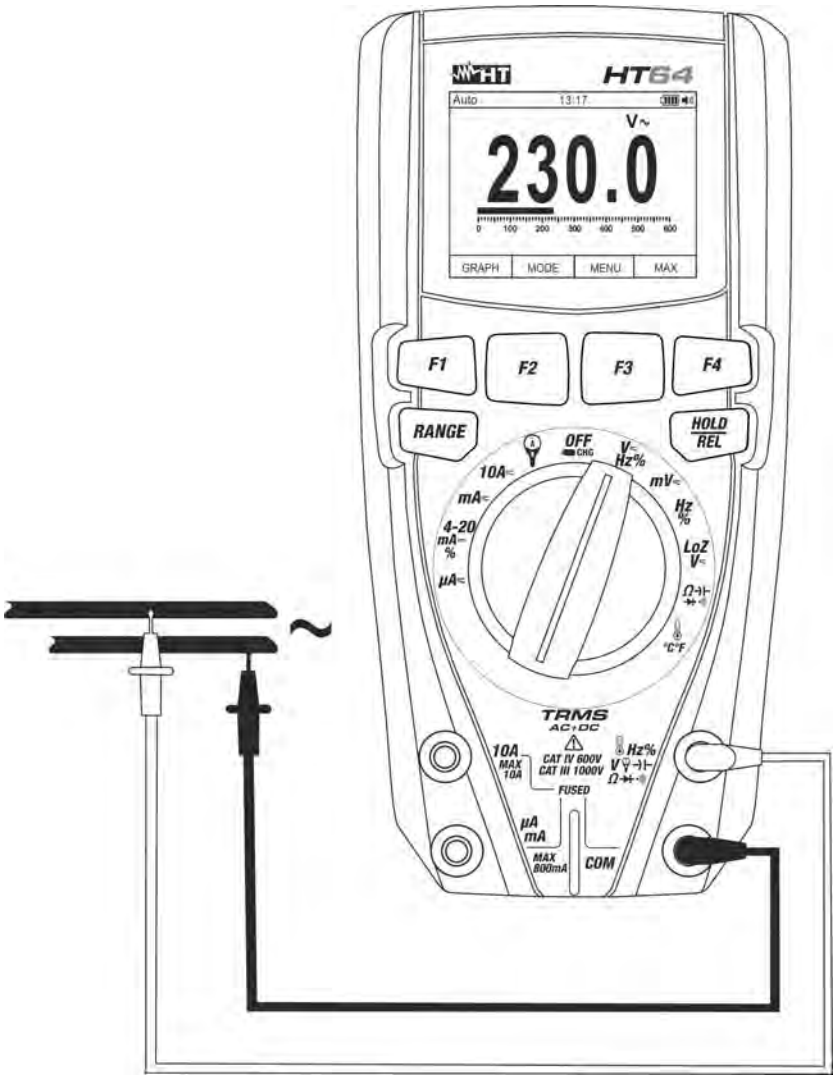


Fig. 23: Use of the instrument for AC voltage measurement

1. Select positions **V~Hz%** or **mV~**
2. In position **mV~**, press the **F2 (MODE)** key to view symbol "~" on the display.
3. Insert the red cable into input terminal **Hz%** **V** and the black cable into input terminal **COM**.
4. Position the red lead and the black lead respectively in the spots of the circuit to be measured (see Fig. 23). The display shows the value of voltage.
5. If the display shows the message "**O.L**", select a higher range.
6. Press the **F2 (MODE)** key to select measurements "**Hz**" or "**%**" in order to display the values of frequency and duty cycle of input voltage. Press the **F1(TRIG)** key to select the positive or negative half-wave of the function "%"The bargraph is not active in these functions.
7. To use the HOLD, RANGE and REL function, see § 4.2.
8. To use the internal functions, see § 4.3

5.3. AC/DC VOLTAGE MEASUREMENT WITH LOW IMPEDANCE (LOZ)

CAUTION

The maximum input AC/DC voltage is 600V. 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. 24: Use of the instrument for AC/DC voltage measurement with low impedance (LoZ)

1. Select position **LoZV≂**. The “LoZ” and “DC” symbols are shown
2. Press the **MODE (F2)** key to select possibly the “AC” measurement
3. Insert the red cable into input terminal **Hz% V Ω** and the black cable into input terminal **COM**
4. Position the red lead and the black lead respectively in the desired spots of the circuit to be measured (see Fig. 24) or in the spots with positive and negative potential of the circuit to be measured (see Fig. 22). The display shows the value of voltage.
5. The message “**O.L.**” indicates that the value of DC voltage exceeds the maximum measurable value.
6. When symbol “**-**” appears on the instrument’s display, it means that voltage has the opposite direction with respect to the connection in Fig. 22
7. To use the HOLD, RANGE and REL function, see § 4.2
8. To use the internal functions, see § 4.3

5.4. FREQUENCY AND DUTY CYCLE MEASUREMENT

CAUTION

The maximum input AC voltage is 1000V. 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.

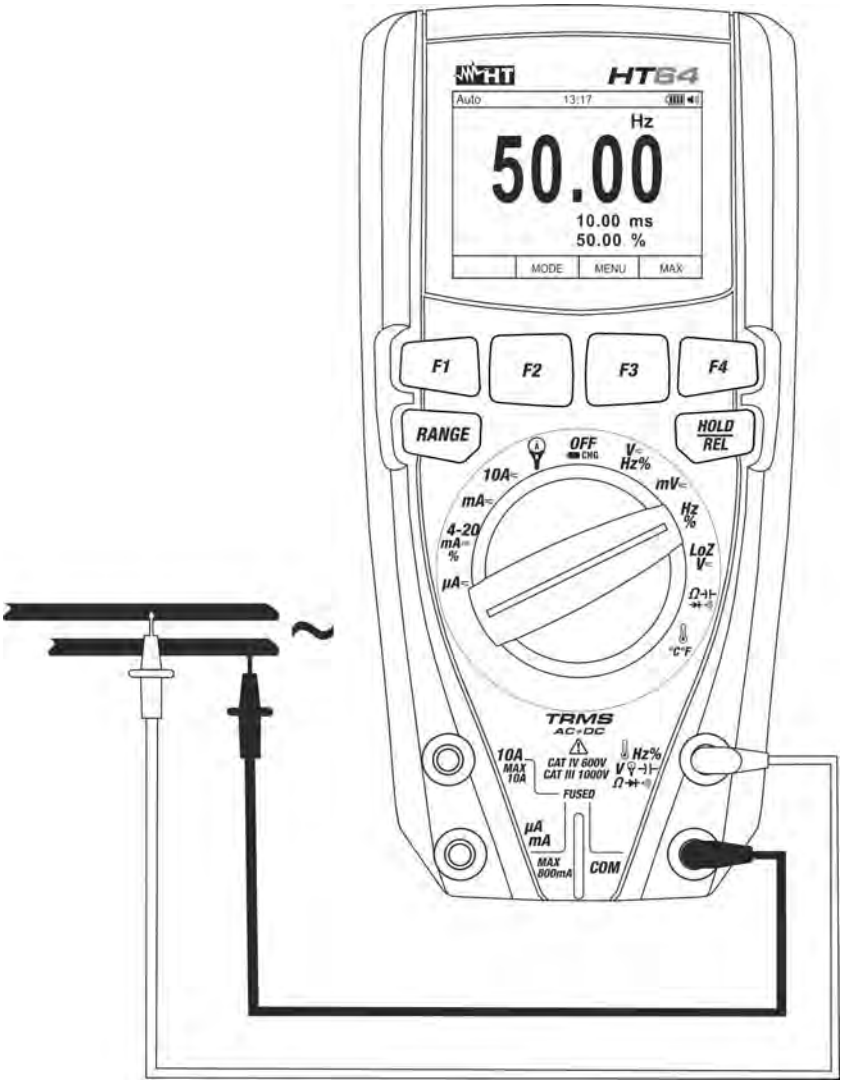


Fig. 25: Use of the instrument for frequency measurement and duty cycle test.

1. Select position **Hz%**.
2. Press the **F2 (MODE)** key to select measurements "**Hz**" or "**%**" in order to display the values of frequency and duty cycle of input voltage.
3. Insert the red cable into input terminal **Hz%** and the black cable into input terminal **COM**.
4. Position the red lead and the black lead respectively in the spots of the circuit to be measured (see Fig. 25). The value of frequency (Hz) or of duty cycle (%) is shown on the display. The bargraph is not active in these functions.
5. To use the HOLD and REL function, see § 4.2.
6. To use the internal functions, see § 4.3

5.5. 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.

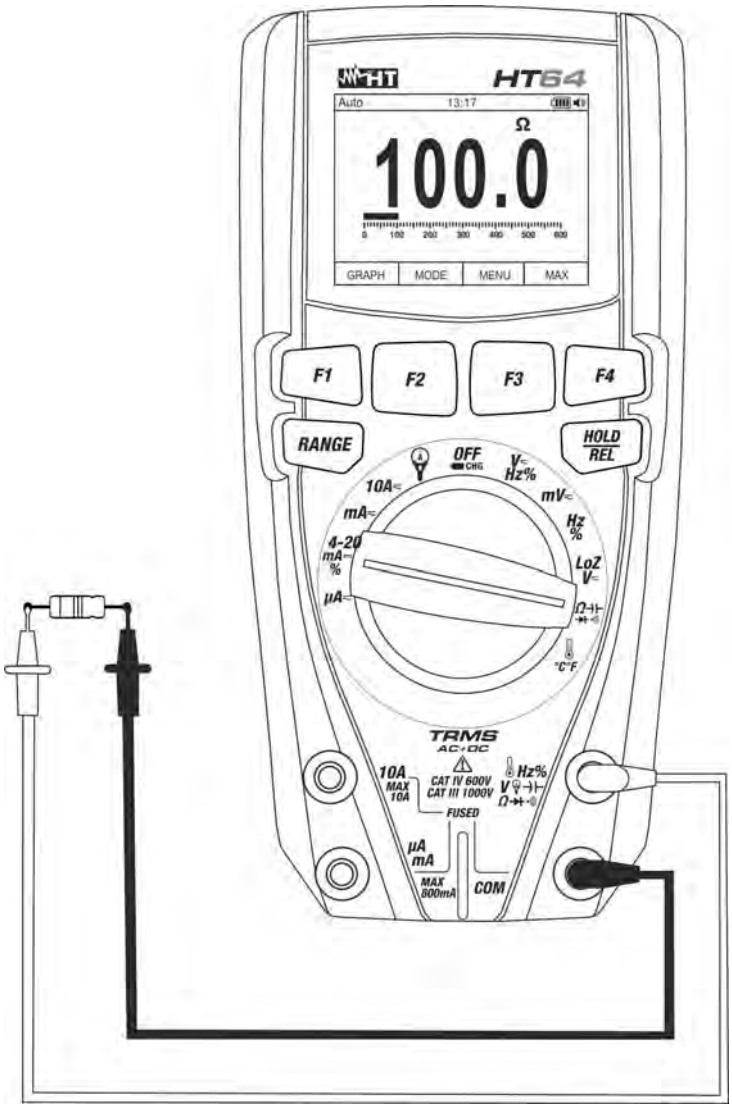


Fig. 26: Use of the instrument for resistance measurement and continuity test

1. Select position Ω⊣⊢▶•))
2. Insert the red cable into input terminal Hz% V⊣⊢Ω▶•)) and the black cable into input terminal **COM**.
3. Position the test leads in the desired spots of the circuit to be measured (see Fig. 26). The display shows the value of resistance.
4. If the display shows the message "**O.L**", select a higher range.
5. Press the **F2 (MODO)** key to select measurement "•))" relevant to the continuity test, and position the test leads in the desired spots of the circuit to be measured.
6. The value of resistance (which is only indicative) is displayed in Ω and the instrument sounds if the value of resistance is <50Ω
7. To use the HOLD, RANGE and REL function, see § 4.2.
8. To use the internal functions, see § 4.3.

5.6. DIODE 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.

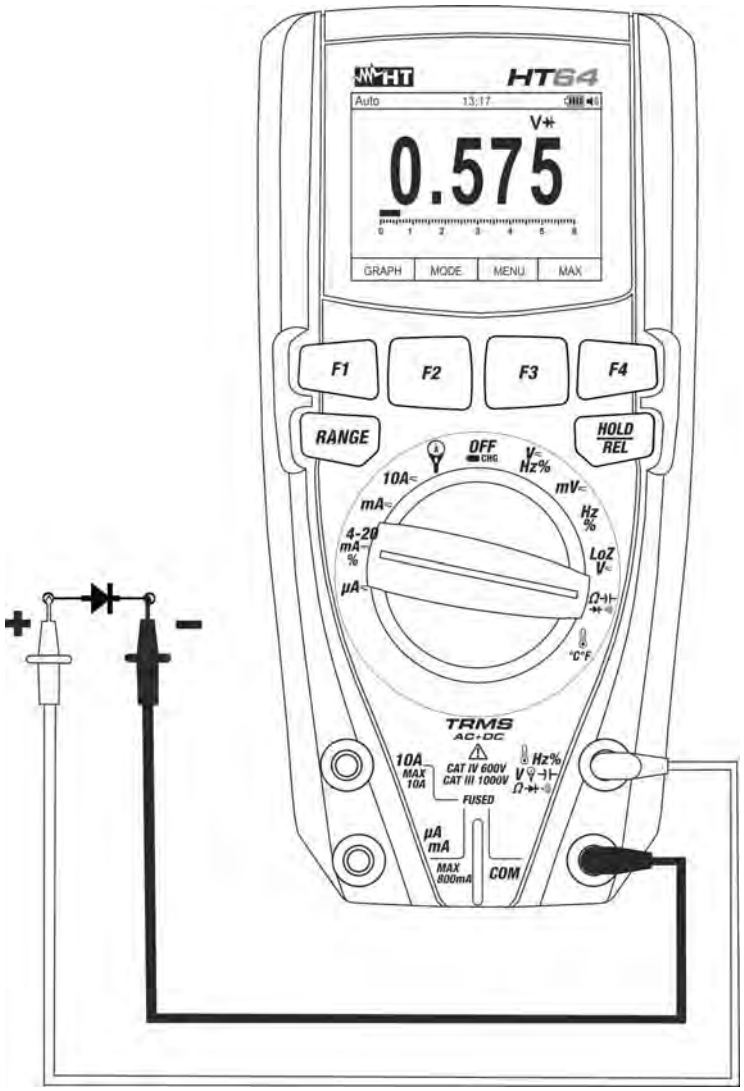


Fig. 27: Use of the instrument for diode test

1. Select position Ω⊣▶•))
2. Press the **F2 (MODE)** key to select "⊣▶" measurement.
3. Insert the red cable into input terminal **Hz% V** ⊣ **Ω** ⊣▶•)) and the black cable into input terminal **COM**.
4. Position the leads at the ends of the diode to be tested (see Fig. 27), respecting the indicated polarity. The value of directly polarized threshold voltage is shown on the display.
5. If threshold value is equal to 0mV, the P-N junction of the diode is short-circuited.
6. If the display shows the message "**O.L**", the terminals of the diode are reversed with respect to the indication given in Fig. 27 or the P-N junction of the diode is damaged.
7. To use the HOLD and REL function, see § 4.2.
8. To use the internal functions, see § 4.3.

5.7. 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. When connecting the multimeter and the capacitance to be measured, respect the correct polarity (when required).

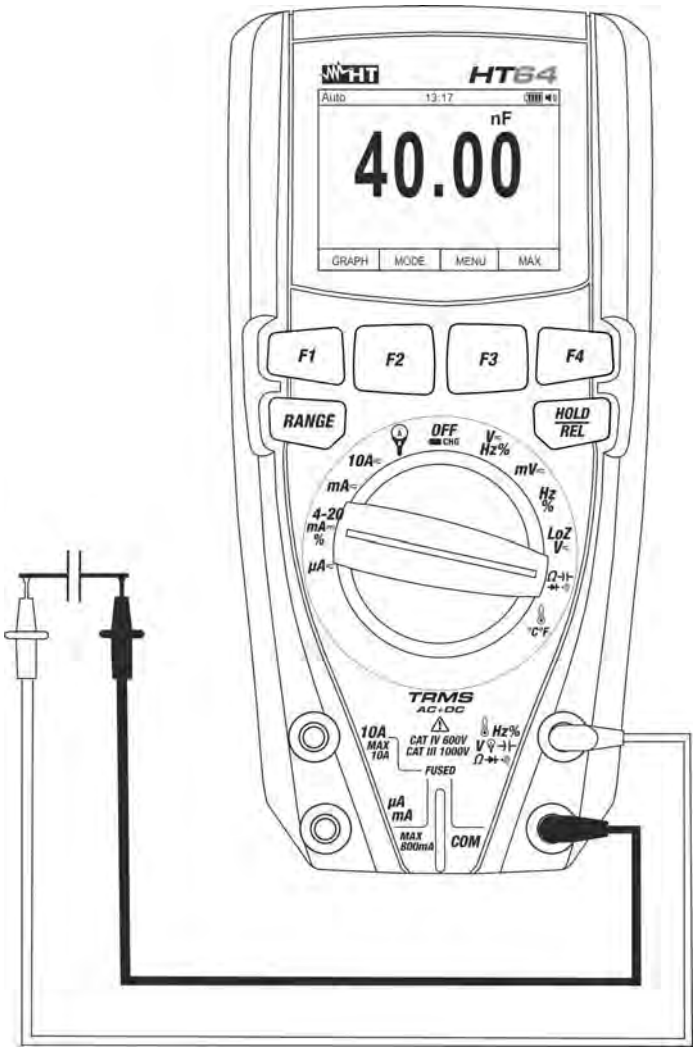


Fig. 28: Use of the instrument for Capacitance measurement

1. Select position Ω⊣⊢▶⊢•))
2. Press the **F2 (MODE)** key until the symbol "nF" is displayed.
3. Insert the red cable into input terminal **Hz%** **V**⊣⊢**Ω**⊢▶⊢•)) and the black cable into input terminal **COM**.
4. Press the **REL/Δ** key before carrying out measurements.
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 (see Fig. 28). The display shows the value. **Depending on the capacitance, the instrument can take about 20s before displaying the correct final value**. The bargraph is not active in this function.
6. The message "**O.L.**" indicates that the value of capacitance exceeds the maximum measurable value.
7. To use the HOLD and REL function, see § 4.2.
8. To use the internal functions, see § 4.3.

5.8. TEMPERATURE MEASUREMENT WITH K-TYPE PROBE

CAUTION

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

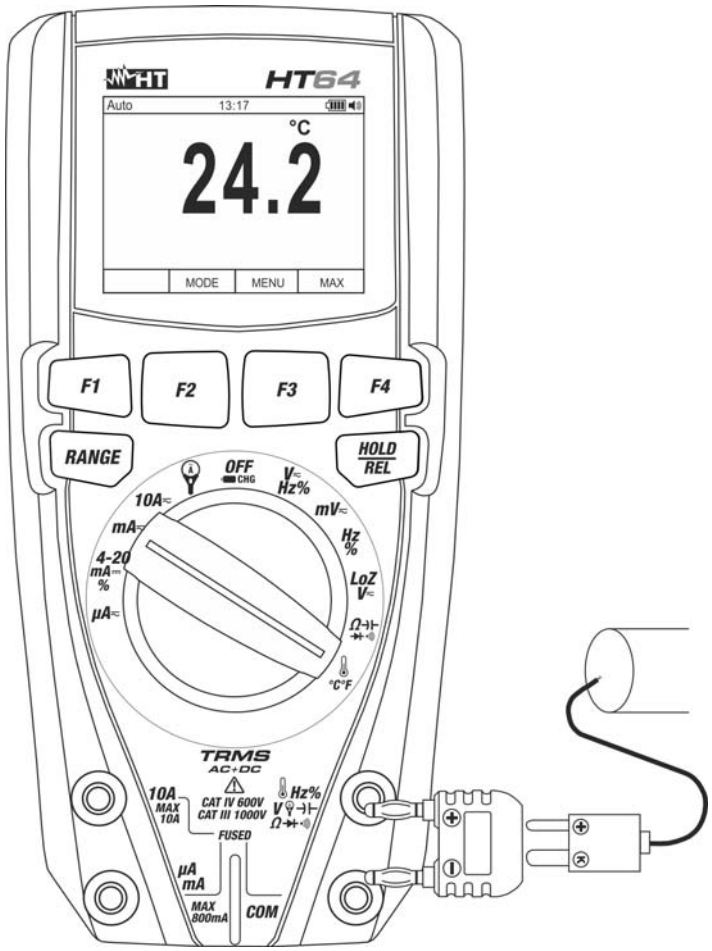


Fig. 29: Use of the instrument for Temperature measurement

1. Select position **°C°F**
2. Press the **F2 (MODE)** key until the symbol "°C" or "°F" is displayed.
3. Insert the provided adapter into input terminals **Hz%** **V** (polarity +) and **COM** (polarity -) (see Fig. 29)
4. Connect the provided K-type wire probe or the optional K-type thermocouple (see § 7.2.2) to the instrument by means of the adapter, respecting the positive and negative polarity on it. The display shows the value of temperature. The bargraph is not active in this function.
5. The message "**O.L.**" indicates that the value of temperature exceeds the maximum measurable value.
6. To use the HOLD and REL function, see § 4.2.
7. To use the internal functions, see § 4.3.

5.9. DC, AC+DC CURRENT MEASUREMENT AND E 4-20MA% READING

CAUTION

Maximum input DC current is 10A (input **10A**) or 600mA (input **mAμA**). Do not measure currents exceeding the limits given in this manual. Exceeding voltage limits could result in electrical shocks to the user and damage to the instrument.

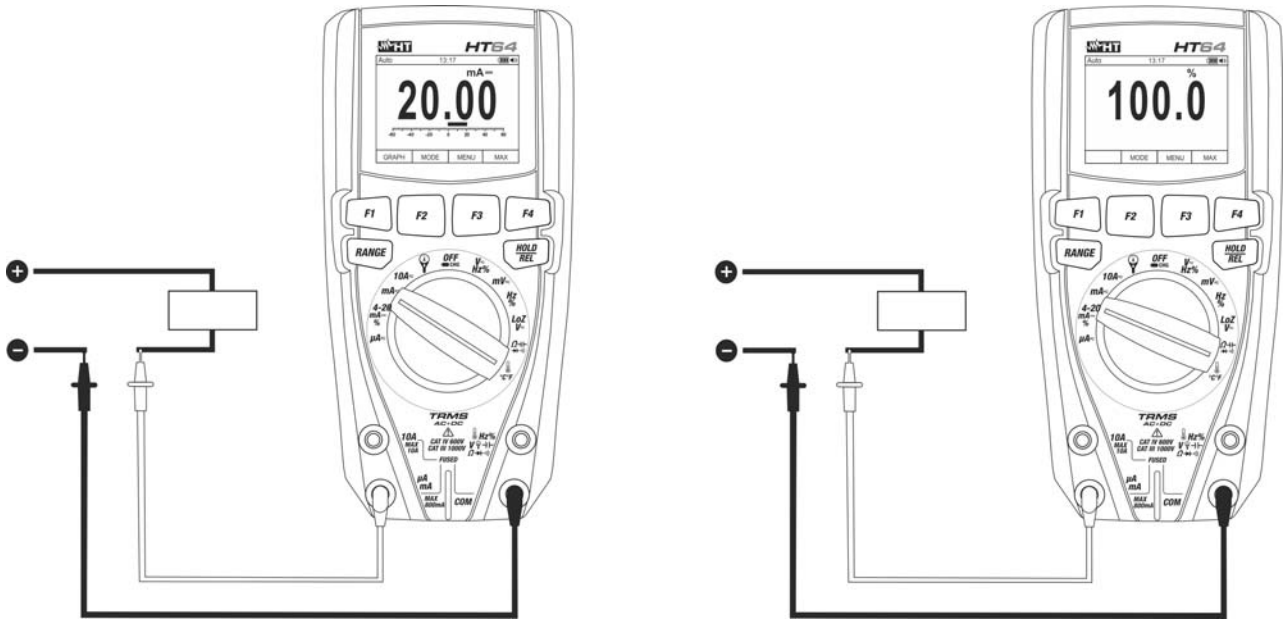


Fig. 30: Use of the instrument for DC current measurement and 4-20mA% reading.

1. Cut off power supply from the circuit to be measured.
2. Select position **μA⎓**, **mA⎓** or **10A⎓** to measure DC current or the same position **4-20mA⎓%** for 4-20mA% reading.
3. Insert the red cable into input terminal **10A** or into input terminal **mAμA** and the black cable into input terminal **COM**.
4. 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. 30).
5. Supply the circuit to be measured.
6. The value of DC current (see Fig. 30 – left side) appears on the display.
7. The value of reading 4-20mA% (0mA = -25%, 4mA = 0%, 20mA = 100% and 24mA = 125%) (see Fig. 30 – right side) appears on the display. The bargraph is not active in this function.
8. If the display shows the message "**O.L**", 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 in Fig. 30.
10. To use the HOLD, RANGE and REL functions, see § 4.2.
11. For AC+DC measurement, see § 4.3.2 and to use the internal functions, see § 4.3

5.10. AC CURRENT MEASUREMENT

CAUTION

Maximum input AC current is 10A (input **10A**) or 600mA (input **mAμA**). Do not measure currents exceeding the limits given in this manual. Exceeding voltage limits could result in electrical shocks to the user and damage to the instrument.

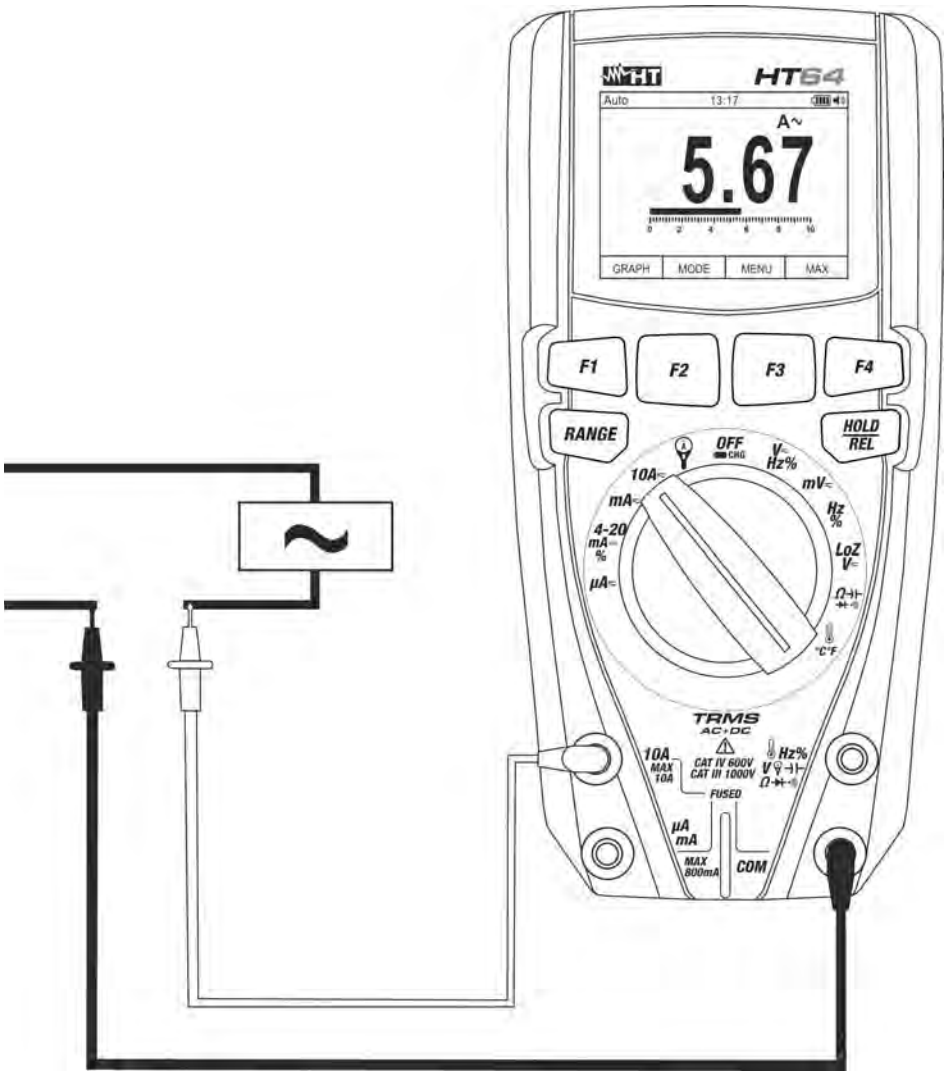


Fig. 31: Use of the instrument for AC current measurement

1. Cut off power supply from the circuit to be measured.
2. Select positions **μA≂**, **mA≂** or **10A≂**
3. Press the **F2 (MODE)** key to select "AC" measurement.
4. Insert the red cable into input terminal **10A** or into input terminal **mAμA** and the black cable into input terminal **COM**.
5. Connect the red lead and the black lead in series to the circuit whose current you want to measure (see Fig. 31).
6. Supply the circuit to be measured. The display shows the value of current.
7. If the display shows the message "**O.L**", the maximum measurable value has been reached.
8. To use the HOLD, RANGE and REL functions, see § 4.2.
9. To use the internal functions, see § 4.3

5.11. DC, AC, AC+DC CURRENT MEASUREMENT WITH TRANSDUCER CLAMPS

CAUTION

- Maximum current measurement in this function is 3000A AC or 1000A DC. Do not measure currents exceeding the limits given in this manual
- The instrument performs the measurement by using both flexible transducer clamp (optional accessory F3000U) and other **standard** clamp transducers of HT family. For transducer clamps with Hypertac output connector is necessary the NOCANBA optional adapter in order to perform the connection

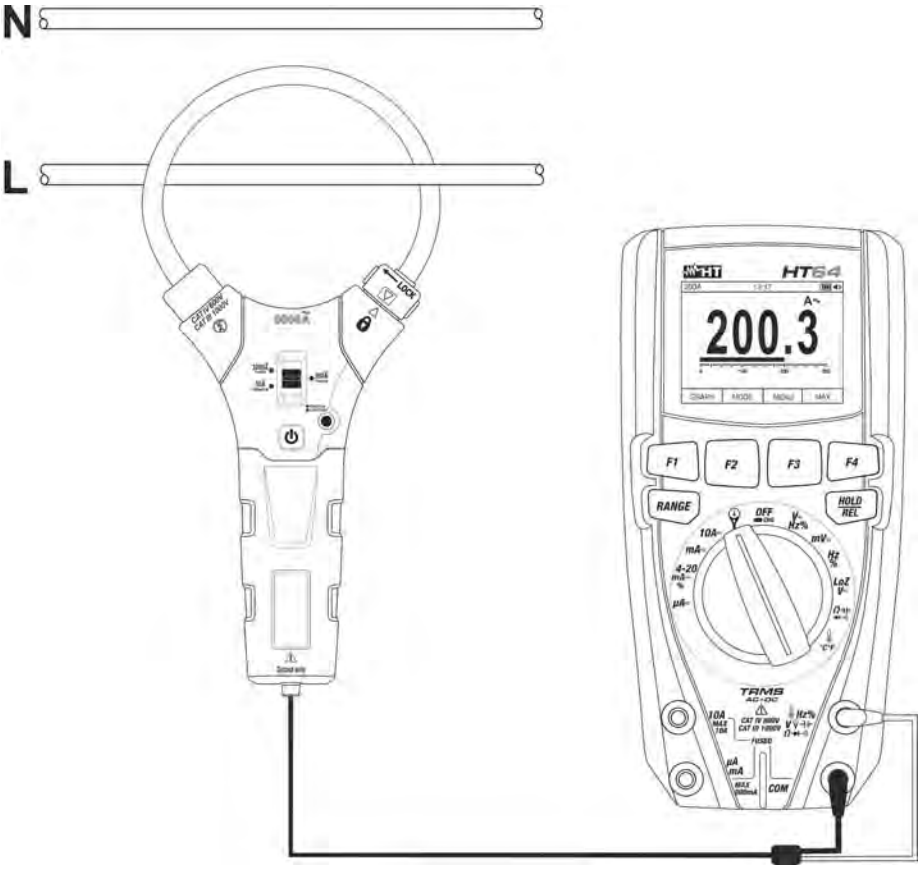


Fig. 32: Use of the instrument for DC/AC current measure with use of transducer clamp

1. Select position
2. Press **F2(MODE)** key to select “AC”, “DC” or “AC+DC” measurement
3. Press **RANGE** key to select on the instrument the **same range** set on the transducer clamp among the options: **1000mA, 10A, 30A, 40A (only for HT4006) 100A, 300A, 400A (only for HT4006), 1000A, 3000A**.The selected range appear in the top left part of the display
4. Insert the red cable into input terminal **Hz%VΩ** and the black cable into input terminal **COM**. For other standard transducers (see §) with Hypertac connector use the NOCANBA optional accessory. For information about the use of transducer clamps refer to relative user manual
5. Insert the cable inside the jaw (see Fig. 32). The value of current appears on the display
6. If the display shows the message “**O.L**”, the maximum measurable value has been reached
7. To use the HOLD, RANGE and REL functions, see § 4.2
8. To use the internal functions, see § 4.3

6. MAINTENANCE

CAUTION

- Only expert and trained technicians should perform maintenance operations. Before carrying out maintenance operations, disconnect 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.

6.1. RECHARGING THE INTERNAL BATTERY

When the LCD displays symbol "▭", it is necessary to recharge the internal battery.

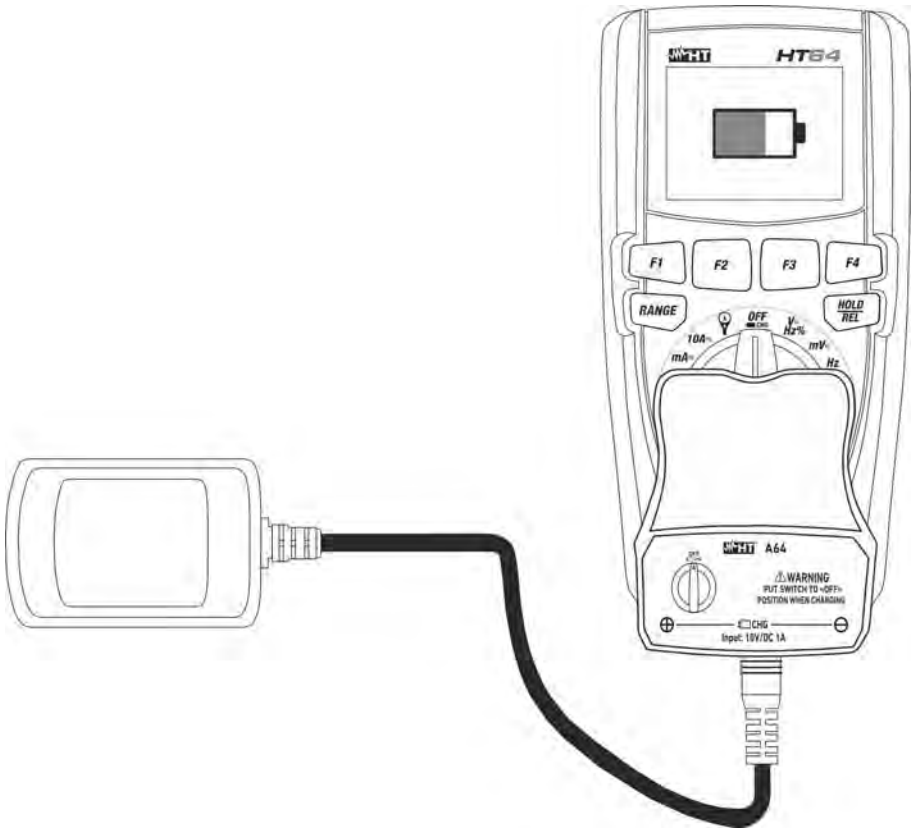


Fig. 33: Recharging the internal battery

1. Position the rotary switch to **OFF** and remove the cables from the input terminals.
2. Insert the adaptor of the battery charger power supply into the instrument, into the four input terminals (see Fig. 33).
3. Insert the connector of the power supply into the adapter and connect the power supply to the electric mains.
4. A blinking symbol of a green battery appears on the display. The recharging process is complete when the symbol is steady.
5. Disconnect the battery charger from the instrument when the operation is complete.

CAUTION

If the charging process does not run, check the integrity of the **F800mA/1000V** protection fuse (see § 7.1.2) and replace it if necessary (see § 6.2)

6.2. REPLACEMENT OF INTERNAL FUSES

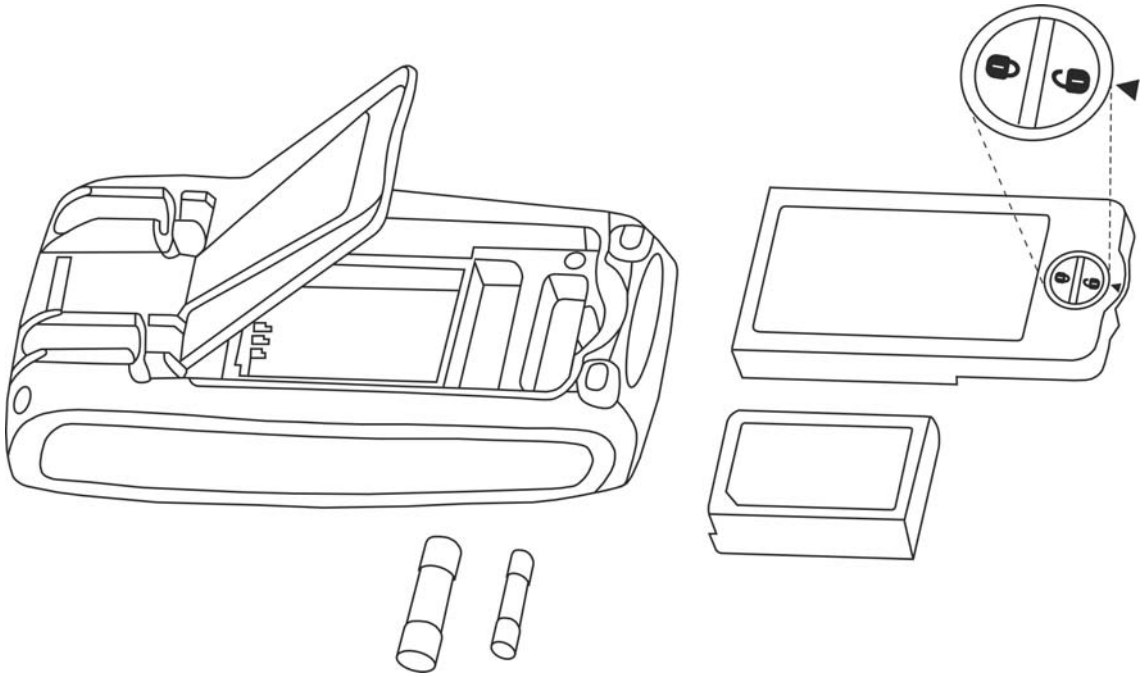


Fig. 34: Replacement of internal fuses

1. Position the rotary switch to **OFF** and remove the cables from the input terminals.
2. Turn the fastening screw of the battery compartment cover from position "🔒" to position "🔓" and remove it (see Fig. 34)
3. Remove the damaged fuse and insert a new fuse of the same type (see § 7.1.2).
4. Restore the battery compartment cover into place and turn the fastening screw from position "🔓" to position "🔒".

6.3. CLEANING THE INSTRUMENT

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

6.4. END OF LIFE

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

7. TECHNICAL SPECIFICATIONS

7.1. TECHNICAL CHARACTERISTICS

Accuracy calculated as [%reading + (num. digits*resolution)] at 18°C ÷ 28°C <75%HR

DC Voltage

Range	Resolution	Accuracy	Input impedance	Protection against overcharge
600.0mV	0.1mV	±(0.1%reading + 5digits)	>10MΩ	1000VDC/ACrms
6.000V	0.001V			
60.00V	0.01V			
600.0V	0.1V	±(0.2%reading + 5digits)		
1000V	1V			

AC TRMS Voltage

Range	Resolution	Accuracy (*)		Protection against overcharge
		(50Hz÷60Hz)	(61Hz÷1kHz)	
600.0mV	0.1mV	±(0.9%reading + 5digits)	±(3.0%reading + 5dgt)	1000VDC/ACrms
6.000V	0.001V			
60.00V	0.01V			
600.0V	0.1V			
1000V	1V			

(*) Accuracy specified from 10% to 100% of the measuring range, Input impedance: > 9MΩ ;
Accuracy PEAK function: ±(10%rdg + 30dgt), PEAK response time: 1ms
For not sinusoidal waveforms the accuracy is: ±(10.0%reading + 10dgt)

AC+ DC TRMS Voltage

Range	Resolution	Accuracy (*) (50Hz÷1kHz)	Input impedance	Protection against overcharge
6.000V	0.001V	±(3.0%reading + 20dgt)	>10MΩ	1000VDC/ACrms
60.00V	0.01V			
600.0V	0.1V			
1000V	1V			

(*) Accuracy specified from 10% to 100% of the measuring range
For not sinusoidal waveforms the accuracy is: ±(10.0%reading + 10dgt)

DC/AC TRMS Voltage with low impedance (LoZ)

Range	Resolution	Accuracy (*) (50Hz÷1kHz)	Input impedance	Protection against overcharge
6.000V	0.001V	±(3.0%reading+40dgt)	approx 3kΩ	600VDC/ACrms
60.00V	0.01V			
600.0V	0.1V			
600V	1V			

(*) Accuracy specified from 10% to 100% of the measuring range
For not sinusoidal waveforms the accuracy is: ±(10.0%reading + 10dgt)

DC Current

Range	Resolution	Accuracy	Protection against overcharge
600.0µA	0.1µA	±(0.9%reading + 5digits)	Quick fuse 800mA/1000V
6000µA	1µA		
60.00mA	0.01mA		
600.0mA	0.1mA	±(0.9%reading + 8digits)	
10.00A	0.01A	±(1.5%reading + 8digits)	Quick fuse 10A/1000V

AC TRMS Current

Range	Resolution	Accuracy (*) (50Hz÷1kHz)	Protection against overcharge
600.0µA	0.1µA	±(1.2%reading + 5digits)	Quick fuse 800mA/1000V
6000µA	1µA		
60.00mA	0.01mA		
600.0mA	0.1mA		
10.00A	0.01A	±(1.5%reading + 5digits)	Quick fuse 10A/1000V

(*) Accuracy specified from 5% to 100% of the measuring range; For not sinusoidal waveforms accuracy is: ±(10.0%reading + 10dgt)
Accuracy PEAK function: ±(10%rdg+30dgt) , AC+DC TRMS Current: accuracy (50Hz÷1kHz): ±(3.0%reading + 20dgt)

DC Current with transducer clamp

Range	Output ratio	Resolution	Accuracy (*)	Protection against overcharge
1000mA	1V/1A	1mA	±(1.5%rdg+ 6dgt)	1000VDC/ACrms
10A	100mV/1A	0.01A		
30A				
40A (**)	10mV/1A		±(1.5%rdg.+26dgt) (***)	
100A		0.1A	±(1.5%rdg+ 6dgt)	
300A				
400A (**)	1mV/1A		±(1.5%rdg.+26dgt) (***)	
1000A	1mV/1A	1A	±(1.5%rdg+6dgt)	
3000A				

(*) Accuracy referred to only instrument without transducer ; (**) With HT4006 transducer clamp ; (***) Accuracy instrument + clamp

AC TRMS Current with transducer clamp

Range	Output ratio	Resolution	Accuracy (*) (50Hz÷1kHz)	Protection against overcharge
1000mA	1V/1A	1mA	±(2.5%rdg + 10dgt)	1000VDC/ACrms
10A	100mV/1A	0.01A		
30A				
40A (**)	10mV/1A		±(3.5%rdg.+30dgt) (***)	
100A		0.1A	±(2.5%rdg + 10dgt)	
300A				
400A (**)	1mV/1A		±(3.5%rdg+30dgt) (***)	
1000A		1A	±(2.5%rdg + 10dgt)	
3000A				

(*) Accuracy referred to only instrument without transducer ; Accuracy specified from 5% to 100% of the measuring range;
(**) With HT4006 transducer clamp ; (***) Accuracy instrument + clamp
For not sinusoidal waveforms accuracy is: ±(10.0%reading + 10dgt)
Accuracy PEAK function: ±(10%rdg+30dgt) , AC+DC TRMS Current: accuracy (50Hz÷1kHz): ±(3.0%reading + 20dgt)

4-20mA% reading

Range	Resolution	Accuracy	Correspondence
-25%÷125%	0.1%	±50dgt	0mA=-25%, 4mA=0%, 20mA=100%, 24mA=125%

Diode test

Function	Test current	Max voltage with open circuit
→|–	<1.5mA	3.2VDC

Frequency (electronic circuits)

Range	Resolution	Accuracy	Protection against overcharge
40.00Hz ÷ 10kHz	0.01Hz ÷ 0.001kHz	±(0.5%reading)	1000VDC/ACrms

Sensitivity: 2Vrms

Frequency (electronic circuits)

Range	Resolution	Accuracy	Protection against overcharge
60.00Hz	0.01Hz	±(0.09%rdg+5digits)	1000VDC/ACrms
600.0Hz	0.1Hz		
6.000kHz	0.001kHz		
60.00kHz	0.01kHz		
600.0kHz	0.1kHz		
1.000MHz	0.001MHz		
10.00MHz	0.01MHz		

Sensitivity: >2Vrms (@ 20% ÷ 80% duty cycle) and f<100kHz; >5Vrms (@ 20% ÷ 80% duty cycle) and f>100kHz

Resistance and Continuity test

Range	Resolution	Accuracy	Buzzer	Protection against overcharge
600.0Ω	0.1Ω	±(0.8%reading + 10dgt)	<50Ω	1000VDC/ACrms
6.000kΩ	0.001kΩ	±(0.8%reading + 5digits)		
60.00kΩ	0.01kΩ			
600.0kΩ	0.1kΩ			
6.000MΩ	0.001MΩ			
60.00MΩ	0.01MΩ	±(2.5%reading + 10dgt)		

Duty Cycle

Range	Resolution	Accuracy
0.1% ÷ 99.9%	0.1%	±(1.2%reading + 2digits)

Pulse frequency range: 40Hz ÷ 10kHz, Pulse amplitude: ±5V (100μs ÷ 100ms)

Capacity

Range	Resolution	Accuracy	Protection against overcharge
60.00nF	0.01nF	±(1.5%reading + 20dgt)	1000VDC/ACrms
600.0nF	0.1nF	±(1.2%reading + 8digits)	
6.000μF	0.001μF	±(1.5%reading + 8digits)	
60.00μF	0.01μF	±(1.2%reading + 8digits)	
600.0μF	0.1μF	±(1.5%reading + 8digits)	
6000μF	1μF	±(2.5%reading + 20dgt)	

Temperature with K-type probe

Range	Resolution	Accuracy (*)	Protection against overcharge
-40.0°C ÷ 600.0°C	0.1°C	±(1.5%reading + 3°C)	1000VDC/ACrms
600°C ÷ 1350°C	1°C		
-40.0°F ÷ 600.0°F	0.1°F	±(1.5%rdg+ 5.4°F)	
600°F ÷ 2462°F	1°F		

(*) Instrument accuracy without probe ; Specified accuracy with stable environmental temperature at ±1°C
For long-lasting measurements, reading increases by 2°C

7.1.1. Reference standards

Safety:	IEC/EN61010-1
EMC:	IEC/EN 61326-1
Insulation:	double insulation
Pollution level:	2
Overvoltage category:	CAT IV 600V, CAT III 1000V
Max operating altitude:	2000m (6562ft)

7.1.2. General characteristics

Mechanical characteristics

Size (L x W x H):	175 x 85 x 55mm (7 x 3 x 2in)
Weight (batteries included):	400g (14 ounces)
Mechanical protection:	IP40

Power supply

Battery type:	1x7.4V rechargeable Li-ION battery, 1300mAh
Battery charger power supply:	100/240VAC, 50/60Hz, 10VDC, 1A
Low battery indication:	symbol "▮" on the display
Battery life:	approx. 15 hours
Auto Power OFF:	after 5 ÷60min minutes' idling (may be disabled)
Fuses:	F10A/1000V, 10 x 38mm (input **10A**) F800mA/1000V, 6 x 32mm (input **mAμA**)

Display

Conversion:	TRMS
Characteristics:	colour TFT, 6000 dots with bargraph
Sampling frequency:	3 times/s
Memory	MEASURES → max 2000, GRAPHS → max 50 RECORDINGS → 128 of max 20000 points

7.1.3. Environmental conditions for use

Reference temperature:	18°C ÷ 28°C (64°F ÷ 82°F)
Operating temperature:	5°C ÷ 40°C (41°F ÷ 104°F)
Allowable relative humidity:	<80%RH
Storage temperature:	-20°C ÷ 60°C (-4°F ÷ 140°F)
Storage humidity:	<80%RH

This instrument satisfies the requirements of Low Voltage Directive 2014/35/EU (LVD) and of EMC Directive 2014/30/EU
This instrument satisfies the requirements of European Directive 2011/65/EU (RoHS) and 2012/19/EU (WEEE)

7.2. ACCESSORIES

7.2.1. Accessories provided

- Pair of test leads with 2/4mm tips
- Adapter + K-type wire probe
- Li-ION rechargeable battery
- Battery charger power supply multiplug + interface — Code A64
- Carrying bag
- User manual

7.2.2. Optional accessories

- K-type probe for air and gas temperature — Code TK107
- K-type probe for semisolid substance temperature — Code TK108
- K-type probe for liquid substance temperature — Code TK109
- K-type probe for surface temperature — Code TK110
- K-type probe for surface temperature with 90° tip — Code TK111
- Flexible transducer clamp AC 30/300/3000A — Cod. F3000U
- Standard transducer clamp DC/AC 40-400A/1V — Cod. HT4006
- Standard transducer clamp AC 1-100-1000A/1V — Cod. HT96U
- Standard transducer clamp AC 10-100-1000A/1V — Cod. HT97U
- Standard transducer clamp DC 1000A/1V — Cod. HT98U
- Adapter for standard transducer clamp with Hypertac connector — Cod. NOCANBA

8. ASSISTANCE

8.1. 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.

8.2. ASSISTANCE

If the instrument does not operate properly, before contacting the After-sales Service, please check the conditions of battery 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.