USER
MANUAL

HT

SOLAR-02

ENVIRONMENTAL PARAMETER DATA LOGGER

READY   Tc 45.3 °c   Te 32.1 °c   630 W/m²   RECORDING...

⏻ ESC   FUNC   SET   ▼

HT   SOLAR-02   PYRA/CELL   TEMP

USER
MANUAL   UK CA   C€

Rel. 4.00 - 21/11/22

EN

The remote unit SOLAR-02 has been designed to measure irradiation [W/m2] and temperature [°C] by means of appropriate probes connected to it. It can also be used in combination with a MASTER instrument to carry out the above-mentioned measurements for testing/recording the efficiency of single-phase and three-phase photovoltaic installations. The unit SOLAR-02 can be connected to the following accessories and MASTER instruments:

**TABLE 1:
LIST OF MASTER INSTRUMENTS
AND ACCESSORIES**

DESCRIPTION	ACRONYM	HT MODEL
Pyranometer	Irr-P	HT303, HT 303N
Irradiation sensor with 2 silicon cells	Irr-S2	HT304, HT304N
Temperature sensor	Tmp	PT300N
Master instrument - USB connection	M-USB	SOLAR300, SOLAR300N
Master instrument - RF connection	M-RF	SOLAR I-V, SOLAR I-Vw, SOLAR I-Ve,I-V400,I-V400w,I-V500w, PVCHECK, PVCHECKs

For the sake of brevity, in this manual, the master instruments and the accessories are indicated with the acronym given in column "Acronym" of the previous Table 1

The unit SOLAR-02 has the following functions:
- Real-time display of irradiation and temperature values of PV module cells and environment
- Connection with a irradiation sensor type Irr-P or reference cell type Irr-S2
- Connection to master unit via USB connection (M-USB) or radio frequency connection (M-RF)
- Synchronization with master unit M-USB or M-RF when starting testing/recording.
- Measurement of the tilting angle of PV panels

<table>
<tr><td>

CAUTION

- The remote unit SOLAR-02 is a measuring instrument capable of using radio frequency for data transfer. For internal reasons it was been adopted a 2.4GHz harmonized frequency band. The above said radio based device is built under Class 1 according to the Agreement stipulated among EEC and EFTA countries, as defined by ERC/REC 70-03 protocols
- About a WiFi portable devices the European standards dictate maximum radiated transmit power of 100mW EIRP and frequency range 2.400÷2.4835GHz. In France these types of equipment must be restricted to the 2.4465÷2.4835GHz frequency range and must be restricted to indoor use

</td></tr>
</table>

The instrument was designed in compliance with the requirements of R&TTE Directive as well as of harmonized directives for electronic measuring instruments. Before and during measurements, carefully observe the following instructions:

- Do not perform any measurement in humid environments, in the presence of gas or explosive or inflammable material or in dusty areas.
- Avoid any contact with the circuit to be tested if no measurements are being carried out.
- Avoid any contact with exposed metal parts, with unused measuring leads, circuits, etc.
- Do not perform any measurement when anomalies are found in the instrument, such as deformations, breaks, substance leaks, no display view, etc.
- Only use HT original accessories.
- Only use HT original accessories.

> **CAUTION**
>
> In accordance with the recommendations of the European Council 1995/519/EC and the standard EN62311, the instrument can be used safely while you are holding it in your hands. Under this circumstance power levels with 2.4GHz transmission are thoroughly covered as per the basic restrictions for human exposure to RF according to the above mentioned European rules

> **CAUTION**
>
> Warning: observe the instructions reported in the manual. An improper use could damage the instrument or its components

2.1 **PRELIMINARY INSTRUCTIONS**

- This instrument has been designed for use in the environmental conditions specified in § 7.3
- We recommend following the usual safety rules to protect yourself from dangerous voltages and currents and to protect the instrument against improper use
- Do not apply any voltage to the instrument's inputs
- Only the accessories supplied with the instrument guarantee safety standards. They must be in good conditions and replaced, if necessary, with identical models
- Do not subject the input connectors of the instrument to strong mechanical stress
- Check that the batteries are correctly inserted

> **CAUTION**
>
> The RF connection of remote unit SOLAR-02 is normally disabled for default. **For use of this unit with the Master meter "M-RF" (see Table 1) is necessary to activate the RF connection** (see § 5.6.1)

2.2 DURING USE

We recommend carefully reading the following recommendations and instructions:

CAUTION
• Failure to observe the warnings and/or instructions may damage the instrument and/or its components or generate a danger for the operator. • The symbol «▭» indicates that the batteries are flat. Stop testing and replace the batteries according to the procedure described in § 6.2 • When the instrument is connected to the circuit being tested, never touch any lead, even if unused.

2.3 AFTER USE

When measurements are completed, turn off the instrument by pressing and holding the ON/OFF key for some seconds. If the instrument is not to be used for a long time, remove the batteries and follow the instructions given in § 7.3

3 PREPARATION FOR USE

3.1 INITIAL INSPECTIONS

Before shipment, the instrument's electronics and mechanics have been inspected. All possible precautions have been taken in order for the instrument to be delivered without damage. However, we recommend generally inspecting the instrument in order to detect any damage suffered during transport. Should you detect any anomalies, immediately contact the forwarding agent. Moreover, we recommend checking that the package contains all parts listed in § 0. Should you find any discrepancy, please contact the dealer. Should it become necessary to return the instrument, please follow the instructions reported in § 8
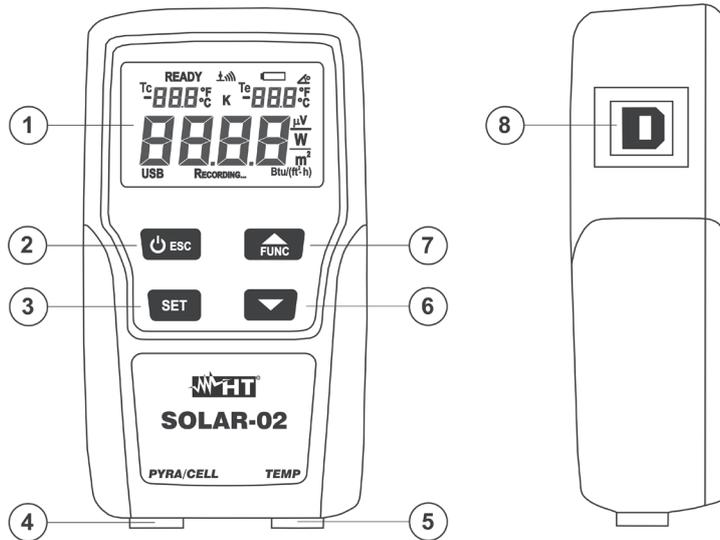
3.2 POWER SUPPLY

The instrument is supplied by 4 x 1,5V batteries type IEC LR03 AAA. When batteries are almost flat, the symbol " ▭ " appears on the display. To replace the batteries, see § 6.2

3.3 STORAGE

In order to guarantee precise measurements, after a long storage period, in extreme environmental conditions, wait for the instrument to return to normal conditions (see § 7.3)

CAPTION:
1. LCD display
2. ⏻/**ESC** key
3. **SET** key
4. **PYRA/CELL** input
5. **TEMP** input
6. ▼ arrow key
7. **FUNC/▲** key
8. USB port for connection to master instrument M-USB

4.2 **DESCRIPTION OF FUNCTION KEYS**

⏻ ESC This key has a double function of turning ON/OFF the unit and of returning to the previous screen (**ESC**)

SET The **SET** key allows a rapid selection of the sensitivity of the solarimeter/ reference solar cell in use

FUNC This key has a double function of increasing (▲), which can be used when programming, and of passing from the display of the environmental temperature Te to the display of the tilting angle (**FUNC**).
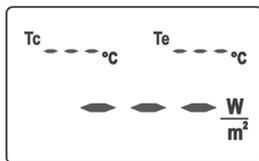
▼ The ▼ key is used when programming the unit to set the parameter values,

4.3 **CONDITIONS WHEN TURNING ON**

1. Press the ⏻/**ESC** key to turn on the instrument
2. After the initial screen, where all display symbols appear, the screen beside, relevant to the loaded firmware version (FW, e.g. 4.01), is displayed by the unit for a few seconds

3. The screen beside is displayed in order to show that no probe is connected. From this moment on it is possible to use the unit
4. Press and hold the ⏻/**ESC** key for a few seconds to turn off the unit

5.1 GENERAL

The remote unit SOLAR-02 can be used in the following modes:

1. Independent operation without connection to any master instrument for measuring in real time the values of irradiation, cell temperature and environmental temperature on PV installations. To this purpose, the unit accepts, as inputs:

For irradiation measurement (expressed in W/m2 - **PYRA/CELL** input):
• Solarimeter probe with thermobattery type Irr-P (see Table 1)
• Double reference silicon cell type **Irr-S2** (see Table 1)

For module and environmental temperature measurement (expressed in °C – TEMP input)
• Temperature probe type Tmp (see Table 1)

2. Operation for testing/recording synchronized with a master instrument for measuring and saving irradiation and temperature values of cells:
• Connection via USB cable C2007 → Master instrument type M-USB (see Table 1)
• Connection with radio frequency (RF) → Master instrument type M-RF (see Table 1)

According with settings receveid by MASTER instrument, SOLAR-02 display a Tc value:
• Measured by the temperature probe "Tmp" (see Table 1)
• Calcuted using NOCT (set in MASTER instrument), Irradiance and Environment Temperature measured by SOLAR-02 according to relationship

where: $\quad Tcel = Tenv + (NOCT - 20) \times \dfrac{G_p}{800}$

Tamb= Environment Temperature
Gp= Irradiance measured
NOCT= Normal Operating Cell Temperature

CAUTION

The presence of "**K**" symbol on the left of "Tc" temperature value, indicates that the Cell temperature (Tc) value displayed is not a measured value buti s a calculated value according with previous relationship. When the SOLAR-02 is switched on (before connection to MASTER instrument) the Tc value is the measured value.

5.2 PROGRAMMING THE REMOTE UNIT SOLAR-02

In order to obtain correct irradiation measurement results, it is necessary to carry out a correct preliminary setting of the sensitivity values of the probes connected to the **PYRA/CELL** input of the unit. The set values will be read and considered by the master instruments upon testing/recording and will be kept by the SOLAR-02 even when the unit is turned off, until they are modified.

The unit SOLAR-02 allows setting the parameters of max 3 irradiation sensors. In detail:
• The use of a sensor type **Irr-S2** requires setting the sensitivity (K) expressed in **mV/kW*m⁻²** or in **µV/W*m⁻²** and the parameter Alpha expressed in **%/°C** for the various types of silicon (monocrystalline, polycristalline, etc.)
• The use of a sensor type **Irr-P** → requires setting the sensitivity (K) expressed in **mV/kW*m⁻²** or in **µV/W*m⁻²**. The parameter Alpha expressed in **%/°C** is ignored.V/W*m-2. The parameter Alpha expressed in %/°C is ignored.

5.2.1 SETTING THE VALUES OF SENSOR 1 (PYRA OR MONO)

```
SEt  k 1
7.00 μV/W/m²
```

```
SEt  k Te 1
0.06
```

1. Press and hold the **SET** key while turning on the instrument by means of the ⏻/**ESC** key. The unit shows the screen beside.
2. Use the arrow keys ▲ and ▼ to set the correct K sensitivity value reported on the (front or rear) label, located on the sensor itself.
3. Press the **SET** key to confirm the value.
4. With sensor type Irr-P, press the **ESC** key to exit the programming mode, saving the changes made. In case a sensor type Irr-S2 is used, it is necessary to set the parameter "Alpha" instead.
5. Use the arrow keys ▲ and ▼ to set the value of Te (Alpha) corresponding to the value of sensitivity K previously set.
6. Press the **SET** key to confirm the value and go on setting sensor 2.

### 5.2.2 SETTING THE VALUES OF SENSOR 2 (MULTI)

```
SEt  k 2
30.6 μV/W/m²
```

1. Use the arrow keys ▲ and ▼ to set the correct K sensitivity value reported on the (front or rear) label, located on the sensor itself.
2. Press the **SET** key to confirm the value.

```
SEt  k Te 2
0.02
```

3. Use the arrow keys ▲ and ▼ to set the value of Te (Alpha) corresponding to the value of sensitivity K previously set.
4. Press the **SET** key to confirm the value.

5.2.3 SETTING THE VALUES OF SENSOR 3

```
SEt  k 3
20.8 μV/W/m²
```

1. With sensor type Irr-S2, press the **ESC** key to exit the programming mode, saving the changes made.
2. Use the arrow keys ▲ and ▼ to set the correct K sensitivity value reported on the (front or rear) label, located on the sensor itself.
3. Press the **SET** key to confirm the value.

```
SEt  k Te 3
0.05
```

4. Use the arrow keys ▲ and ▼ to set the value of Te (Alpha) corresponding to the value of sensitivity K previously set.
5. Press the **SET** key to confirm the value.

5.3 USING THE SOLAR-02 IN INDEPENDENT MODE
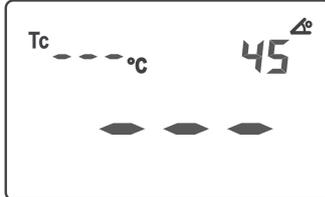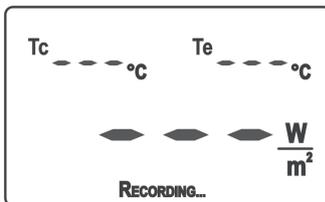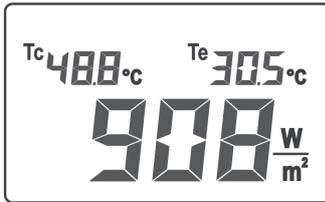
1. Turn on the instrument by pressing the ⏻/ESC key.
2. Press the **SET** key. The unit shows the screen beside in which the K value of the currently set sensor is selected.
3. Use the arrow keys ▲ and ▼ to select the desired type of sensor considering the unit programming (see § 0)
4. Confirm selection with the **SET** key to go back to the measuring mode
5. Position the irradiation measuring probe type "Irr-P" or "Irr-S2" (see Table 1) on the modules' surface and connect the relevant output lead to the **PYRA/CELL** input of the unit SOLAR-02
6. Fasten the temperature probe type Tmp with adhesive tape (see Table 1) on the rear side of the modules and connect the relevant output lead to the **TEMP** input of the unit SOLAR-02
7. Read on the display, in real time, as shown in the figure beside, the values of:
- Irradiation on the main display, expressed in **W/m²**
- Tc = temperature of cells expressed in **°C**
- Te = temperature of environment expressed in **°C**

5.4 USING THE INCLINOMETER FUNCTION

1. Turn on the unit by pressing the ⏻/ESC key. The display shows the following screen

2. Press the **FUNC/▲** key to activate the inclinometer mode of the unit SOLAR-02 instead of the measurement of temperature Te as shown on the screen beside
3. Fasten the unit on the module's surface, if necessary by means of the two magnets available on the rear side
4. Wait for a few seconds
5. Read, in real time, the value (expressed in °) of the tilting angle against the horizontal plane of the object to be tested

### 5.5 USING THE SOLAR-02 WITH MASTER INSTRUMENT TYPE "M-USB"

For the definitions of the instrument types, see Table 1. For the use, functions and activation of a testing/recording on the master instrument, please see the user manual of the master instrument itself.

5.5.1 PRELIMINARY CHECK
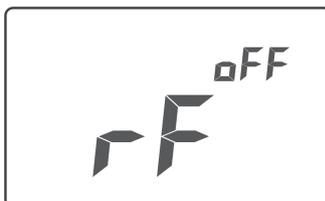
For the "M-USB" master instruments the enable of internal RF module is NOT necessary. Check that the parameter which enable/disable the RF module should be corrected set at the first usage of the unit in the herewith way:
By press and hold the **FUNC/▲** key while switching on the meter by ⏻/ESC key. The message "**rF**^OFF" is displayed for a few seconds. If the message "**rF**^ON" is displayed switch off the unit and repeat the operation. Afterwards the initial screen is displayed by the meter. The setting of "RF" parameter is maintained also during the replace of batteries

5.5.2 USE OF THE UNIT
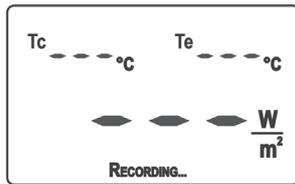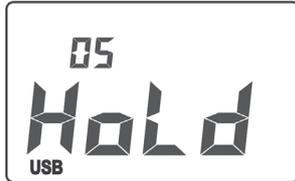
1. Switch on the unit and press the **SET** key. The unit shows the screen beside in which sensor 1 is selected
2. Use the arrow keys ▲ and ▼ to select the desired type of sensor considering the unit programming (see § 5.2)
3. Confirm selection with the **SET** key to go back to the measuring mode
4. Connect the unit SOLAR-02 to the master instrument by means of the USB cable. The symbol "USB" is shown on the display while the unit is detected by the master instrument
5. By activating a testing/recording on the master instrument, the unit SOLAR-02 waits for the synchronization, showing the message "**HoLd**" on the display and the indication of the waiting time necessary before being able to activate the testing procedures (see example in the screen beside)
6. Once the waiting phase (HOLD) has ended, the message "**Recording...**" will be displayed. It is now possible to disconnect the USB cable from the unit SOLAR-02 and take the unit near the PV modules. Possible hyphens "- - -" indicate that no irradiation and temperature probes are connected to the unit SOLAR-02 yet
7. Place the Irradiance probe (Irr-P or Irr-S2 – see Table 1) parallel to PV modules surface and connect the output connector to SOLAR-02 PYRA/ CELL input
8. Using a tape fix the temperature probe (Tmp – see Table 1) on the backside of the module and connect the output connector to SOLAR-02 TEMP input

9. Upon reaching an irradiation value higher that the threshold set by the MASTER instrument, the unit SOLAR-02 shows the message "**READY**" on the display
10. Disconnect the irradiation and temperature probes, connect the unit to the master instrument again by means of the USB cable

11. Upon detecting the control to stop testing/recording from the master instrument, the unit stops working, shows on the display the message "**SEnd**" and sends the data to the master instrument to determine the final result of the testing

### 5.6 USING THE SOLAR-02 WITH MASTER INSTRUMENT TYPE "M-RF"

For the definitions of the instrument types, see Table 1. For the use, functions and activation of a testing/recording on the master instrument, please see the user manual of the master instrument itself.

5.6.1 PRELIMINARY CHECK
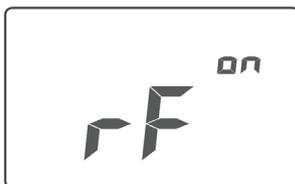
For the "M-RF" master instruments the enable of internal RF module IS NECESSARY. Check that the parameter which enable/disable the RF module should be corrected set at the first usage of the unit in the herewith way: By press and hold the **FUNC/▲** key while switching on the meter by ⏻**/ESC** key. The message "rF^{ON}" is displayed for a few seconds. If the message "rF^{OFF}" is displayed switch off the unit and repeat the operation. Afterwards the initial screen is displayed by the meter. The setting of "RF" parameter is maintained also during the replace of batteries

5.6.2 USE OF THE UNIT
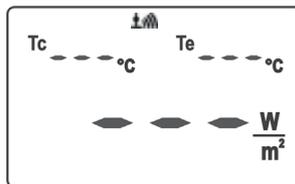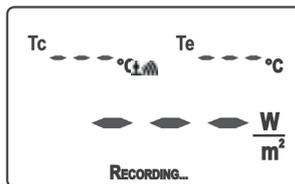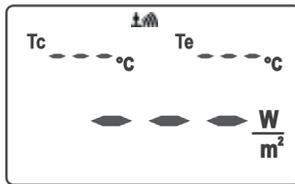
1. Switch on and approach the unit SOLAR-02 to the master instrument (max distance 1m). The symbol "⊥📶":
- Is blinking approx 30s at display while searching a M-RF master unit
- Is fixed at display when a M-RF master unit is found
- Disappears from display if no M-RF master unit is found within approx 30s. Press the ▼ key for re-start a new search of a "M-RF" master unit
2. Press the **SET** key. The unit shows the screen beside in which sensor 1 is selected.
3. Use the arrow keys ▲ and ▼ to select the desired type of sensor considering the unit programming (see § 5.2)
4. Confirm selection with the **SET** key to go back to the measuring mode
5. With operative RF connection, by activating a testing/recording on the master instrument, the unit SOLAR-02 waits for the synchronization, showing the message "**HoLd**" on the display and the indication of the time during which it is necessary to keep the unit SOLAR-02 near the master instrument before being able to activate the testing procedures
6. Once the waiting phase (HOLD) has ended, the message "**Recording…**" will be displayed. It is now possible to take the unit SOLAR-02 away from the master instrument and take it near the PV modules. Possible hyphens "**- - -**" indicate that no irradiation and temperature probes are connected to the unit SOLAR-02 yet
7. Place the Irradiance probe (Irr-P or Irr-S2 – see Table 1) parallel to PV modules surface and connect the output connector to SOLAR-02 **PYRA/CELL** input
8. Using a tape fix the temperature probe (Tmp – see Table 1) on the backside of the module and connect the output connector to SOLAR-02 **TEMP** input
9. Upon reaching an irradiation value higher that the threshold set by the MASTER instrument, the unit SOLAR-02 shows the message "**READY**" on the display
10. Disconnect the irradiation and temperature probes and take the unit again near the master instrument in order to activate the RF connection
11. Approach the unit SOLAR-02 to the master instrument (max distance 1m):
- If the "⊥📶" symbol is blinking at display wait for the reciprocal detection of both units and after this the symbol is fix at display
- If the "⊥📶" is missed at display press the ▼ key for restart a new search of a "M-RF" master unit

12. Upon detecting the control to stop testing/recording from the master instrument, the unit stops working, shows on the display the message "**SEnd**" and sends the data to the master instrument

6 MAINTENANCE

6.1 GENERAL INFORMATION

1. Whether in use or in storage, please do not exceed the specifications to avoid any possible damage or danger during use.
2. Do not keep this instrument at high temperatures and/or humidity or expose it to direct sunlight.
3. For long-term storage, remove the battery to avoid leakage of battery fluid that can damage the internal components.

6.2 BATTERY REPLACEMENT

When battery is low, the symbol " ▭ " is displayed to require replacement. Please proceed as follows:

1. Remove the battery cover (see Fig. 1 – part 8) by unscrewing the fastening screw;
2. Remove the battery;
3. Replace the battery with a new one of the same type respecting the polarity;
4. Restore the battery cover back into place;
5. Use the appropriate battery disposal methods for your area.

6.3 CLEANING

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

6.4 END OF LIFE

CAUTION: this symbol indicates that the equipment and its accessories shall be subject to a separate collection and correct disposal.

7.1 TECHNICAL SPECIFICATIONS

Accuracy is referred to reference conditions: 23°C, <80%RH

IRRADIATION – PYRA/CELL INPUT

RANGE [W/M²]	RESOLUTION [W/M²]	ACCURACY
0 ÷ 1400	1 + INT (100 * 0.1/K)	± [1.0%reading + INT(1000 * 0.1/K) dgt]

K = sensibilità della sonda per misura di irraggiamento utilizzata (espressa in mV/kW/m² o in uV/W/m²)

PROBE SENSITIVITY	RANGE [mV]	RESOLUTION [mV]	ACCURACY
K<10	15.00÷0.00	0.01	± (1.0%reading+0.1mV)
K≥10	65.00÷0.00	0.02	

TEMPERATURE – TEMP INPUT (MEASURED WITH "TMP" TEMPERATURE PROBE – SEE TABLE 1)

RANGE [°C]	RESOLUTION [°C]	ACCURACY
-20.0 ÷ 99.9	0.1	± (1.0%reading + 1°C)

TILTING ANGLE

RANGE [°C]	RESOLUTION [°C]	ACCURACY
0 ÷ 90	1	± (1.0%reading + 1°)

7.2 GENERAL CHARATERISTICS

Display: 4 LCD (2000 dots), decimal comma and point

Power supply
Batteries: 4x1,5V alkaline type AAA LR03
Duration of batteries: approx. 480 hours
Auto Power OFF: after 5 minutes of idleness (not in rec. oper.)

Radio module specifications
Frequency range**:** 2.400 ÷ 2.4835GHz
R&TTE category: Class 1
Max transmission power: 30 ÷ W

Input connectors
USB port: USB 2.0
PYRA/CELL and TEMP inputs: type Hypertac

Internal memory
Autonomy: approx. 1.5 hours (@ PI master = 5s)

Mechanical characteristics
Dimensions (L x W x H): 120x 65 x 35mm (5 x 3 x 1in)
Weight (batteries included): 215g (8ounces)

7.3 ENVIRONMETAL CONDITIONS

Reference temperature: 23°C ± 5°C ; (73°F ± 41°F)
Operating temperature: 0°C ÷ 40°C; (32°F ÷ 104°F)
Relative operating humidity: <80%RH
Storage temperature: -10°C ÷ 60°C; (14°F ÷ 140°F)
Storage humidity: <80%RH

> **This instrument complies with LVD 2014/35/EU and EMC 2014/30/EU Directive**
> **HT declares (see Declaration of Conformity) that the instrument is complying with prerequisites and other requirements of 1999/5/CE Directive**
> **This instrument satisfies the requirements of 2011/65/EU (RoHS) directive and 2012/19/EU (WEEE) directive**

7.4 ACCESSORIES

• ISO calibration report   • User manual

8 SERVICE

8.1 WARRANTY CONDITIONS

This instrument is guaranteed against material or production defects, in accordance with our general sales conditions. During the warranty period, the manufacturer reserves the right to decide either to repair or replace the product. Should you need, for any reason, to return the instrument for repair or replacement, please take prior agreements with the local distributor from whom the instrument was bought. Do not forget to enclose a report describing the reasons for returning (detected fault). Onlt use original packaging. Any damage occurred during transport due to non-original packaging will be charged to the customer. The manufacturer will not be held responsible for any harm to people or damage to property.

The warranty does not apply to:

- Accessories and batteries (not covered by warranty).
- Repairs made necessary by improper use (including adaptation to particular applications not foreseen in the instructions manual) or improper combination with incompatible accessories or equipment.
- Repairs made necessary by improper shipping material causing damages during transport.
- Repairs made necessary by previous attempts for repair carried out by non-skilled or unauthorized personnel.
- Instruments for whatever reason modified by the customer himself without explicit authorization of our Technical Department.

The contents of this manual may not be reproduced in any form whatsoever without the manufacturer's authorization.

> **Our products are patented and our logotypes registered. We reserve the right to modify specifications and prices in view of technological improvements or developments which might be necessary.**

8.2 AFTER-SALE SERVICE

Should the instrument not work properly, before contacting your distributor, please make sure that the battery is correctly installed and working, check the accessories and replace them if necessary. Make sure that your operating procedure corresponds to the one described in this manual. Should you need, for any reason, to return the instrument for repair or replacement, please take prior agreements with the local distributor from whom the instrument was bought. Do not forget to enclose a report describing the reasons for returning (detected fault). Only use original packaging. Any damage occurred during transport due to non-original packaging will be charged to the customer. The manufacturer will not be held responsible for any harm to people or damage to property.