SOLAR300 – SOLAR300N

Quick reference guide

CE

© Copyright HT ITALIA 2010

Release EN 2.02 - xx/xx/2010

Contents

1. PRECAUTIONS AND SAFETY MEASURES

This meter has been designed in compliance with IEC/EN61010-1 directive. For your own safety and to avoid damaging the instrument we suggest you follow the procedures hereby described and to read carefully all the notes preceded by the symbol ⚠:

CAUTION

- The instrument consists in a main unit (**SOLAR300** or **SOLAR300N** generically called "instrument") and a remote unit for acquisition (**SOLAR-01** or **SOLAR-02** generically called "SOLAR-0x"). If not otherwise indicated, all safety instructions are intended as always referred to the main unit
- Do not measure voltage or current in wet or dusty places
- Do not measure in presence of gas, explosive materials or combustibles
- Do not touch the circuit under test if no measurement is being taken
- Do not touch exposed metal parts, unused terminals, circuits and so on
- Do not use the meter if it seems to be malfunctioning (i.e. if you notice deformations, breaks, leakage of substances, absence of messages on the display and so on)
- The meter has been designed for use in places with pollution class 2
- Do not take measurements on circuits exceeding the specified current and voltage limits
- Before connecting cables, crocodiles and clamps to the circuit under test, make sure that the right function has been selected
- The meter is designed for **Voltage and Current** measurements on installations of excess voltage category CAT IV 600V to earth and a 1000V maximum voltage between inputs. Category **CAT 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)

The herewith symbols are used on meter:

CAUTION: keep to what described by the manual. An incorrect use could damage the instrument or its components

High voltage: risk of electric shock

Double insulation

Ground reference

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

1.1. BEFORE AND DURING USE

Before and during measurements please take care of herewith points:

- **Perform a complete charging of internal battery for at least 5 hours before using meter for the first time**
- **Please press and hold the ON/OFF key for about 5s during the first turn on of meter**
- Do not touch any unused terminal when the meter is connected to the circuit under test
- When measuring current, other currents located near the leads may affect the measuring accuracy
- When measuring current, always position the wire in the very middle of the jaws in order to obtain the highest accuracy
- A measured value remains constant if the "**HOLD**" function is active. Should you notice that the measured value remains unchanged, disable the "**HOLD**" function

1.2. AFTER USE

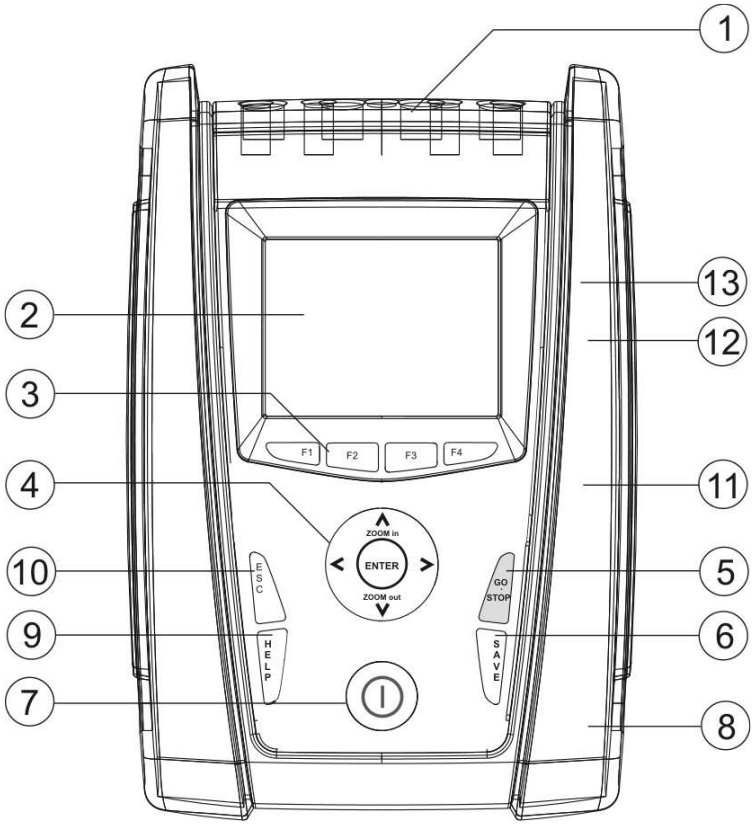
- After use, turn off the instrument by pressing **ON/OFF** key for a few seconds
- If you expect not to use the instrument for a long time please keep to the storage instructions described at paragraph 3.4 of instruction manual

CAUTION

Please read the instruction manual of the instrument which is included on CD-ROM support, before use

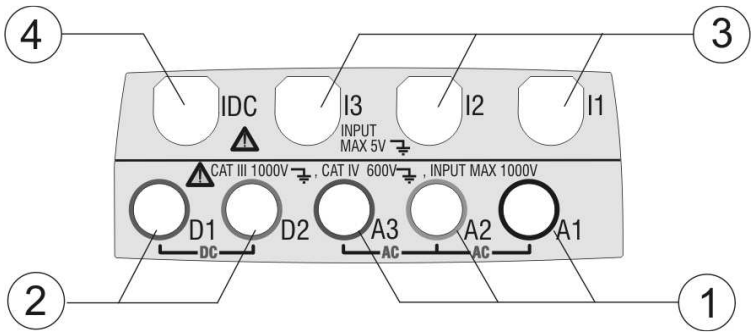
2. HOW TO OPERATE

2.1. INSTRUMENT DESCRIPTION



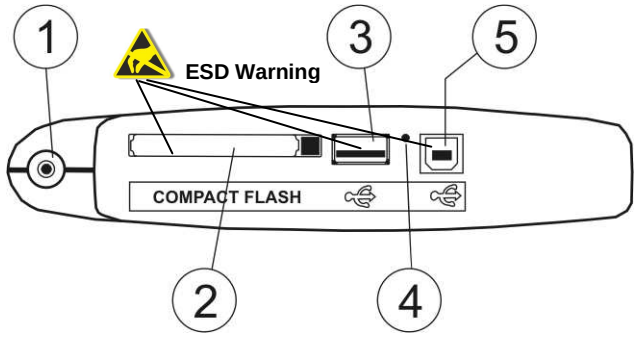
Legend:
1. Voltage and Current inputs
2. TFT display with “touchscreen”
3. **F1** – **F4** keys
4. Arrows keys and **ENTER** key
5. **GO/STOP** key
6. **SAVE** key
7. **ON/OFF** key
8. Input for external AC/DC adapter
9. **HELP** key
10. **ESC** key
11. Output for external compact flash connection
12. Output for external USB pen driver connection / SOLAR-0x
13. USB output for PC connection

Fig. 1: Description front panel of meter



Legend:
1. **A1**-**A2**-**A3** inputs for AC voltage connections on L1, L2, L3 phases
2. **D1**-**D2** inputs for DC voltage connections and N, PE for AC voltage
3. Inputs for AC currents connections on L1, L2, L3
4. Input for DC current transducer connection

Fig. 2: Description of input terminals of meter



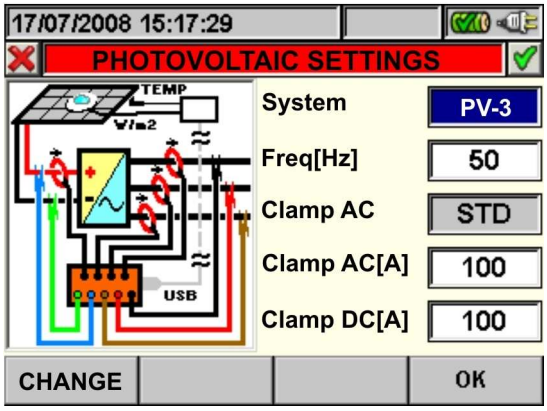
Legend:
1. Input for external adapter
2. Output for external compact flash (*)
3. Output for external pen driver USB / SOLAR-0x (*)
4. RESET command
5. USB output for PC connection (*)

Fig. 3: Description of output connectors of meter

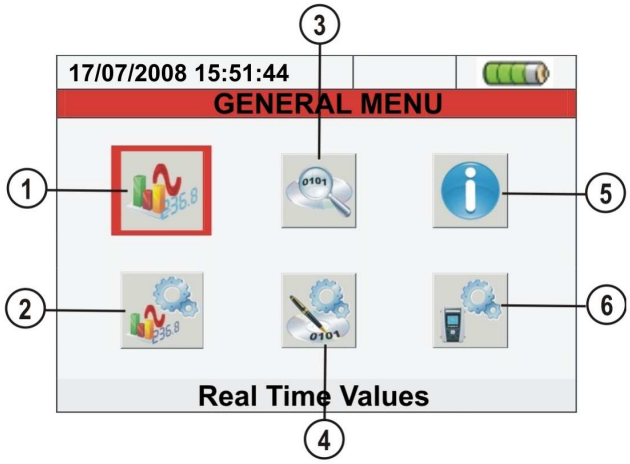
(*) Use the output connectors included into the lateral side only with meter OFF. These outputs should be interested by electrostatic discharges (ESD).

3. SWITCHING ON THE METER

Keep the **ON/OFF** key pressed some seconds to turn on the meter. The following screen, relative to the last used settings, is shown:



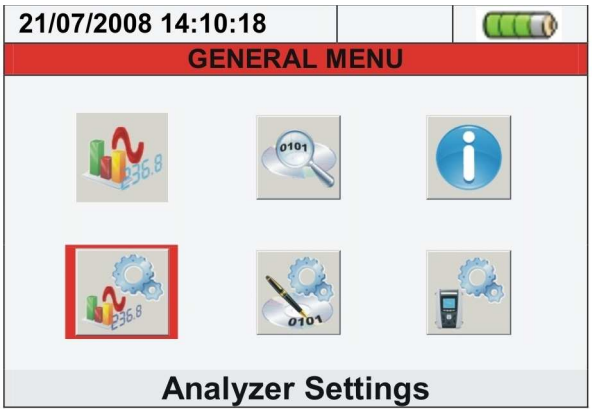
The meter shows the “Analyzer Configuration” screen with the last used settings. Press **OK** to confirm it or press **CHANGE** to modify the parameters. Then the GENERAL MENU is displayed:



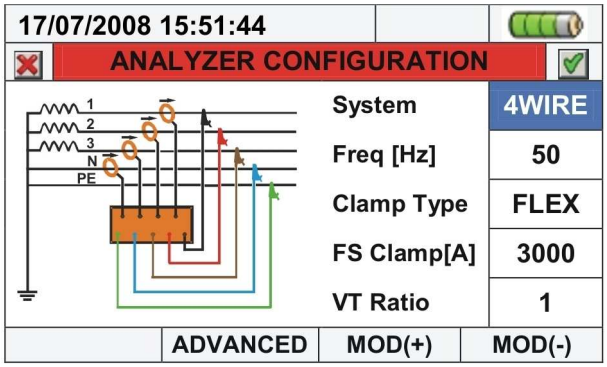
1. **Real Time Values**: the meter shows the input TRMS values
2. **Analyzer Settings**: the meter displays the active configuration which can be modified
3. **Recording Results**: the meter lists the saved recordings which have been performed
4. **Recording Settings**: the meter shows the active parameters which can be set and unset, the user could choose a predefined setting
5. **Meter Information**: the meter displays its general information
6. **General Settings**: the meter displays general settings which can be modified

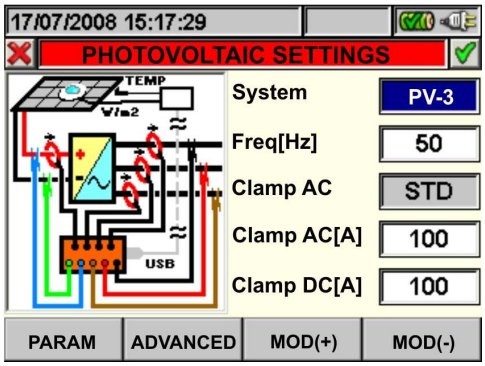
4. ANALYZER SETTINGS

Click the “Analyzer Settings” icon of the GENERAL MENU



The meter displays the last saved active configuration (Analyzer of Photovoltaic) as herewith shown:





- **System**: system type (4-wire, 3-wire, ARON, Single or PV-1, PV-3) by using MOD(+) / MOD(-) keys
- **Freq [Hz]**: system frequency (50Hz or 60Hz) by using MOD(+) / MOD(-) keys
- **Clamp Type**: used clamp type (Flexible – FLEX or Standard – STD) in "Analyzer" section by using MOD(+) / MOD(-) keys
- **Clamp AC**: STD clamp type selection cannot be modified in "Photovoltaic" section
- **FS Clamp[A]**: full scale of the clamp (300/3000 – Flex clamp, Ampere by Ampere setting - STD clamp) in "Analyzer" section by using MOD(+) / MOD(-) keys
- **Clamp AC[A]**: set full scale clamp (from 1 to 3000A) of AC clamp used in "Photovoltaic" section

CAUTION

If the **PV** systems are set on meter the "**STD**" clamp type is the only possibility (not modified) both for DC and AC clamps. **The FLEX type clamp NOT BE ok for PV systems**

- **Clamp DC[A]**: set full scale clamp (from 1 to 1000A) of DC clamp used in "Photovoltaic" section
- **VT Ratio**: voltage transformer ratio, set 1 while performing a measurement without any VT (direct connection to the mains) in "Analyzer" section by using MOD(+) / MOD(-) keys

Save the settings by pressing the **SAVE** or **ENTER** key or the smart icon ☑. To quit this menu without saving press the **ESC** key or the smart icon ☒.

4.1. CONNECTION OF METER IN A SINGLE PHASE SYSTEM

CAUTION

- The maximum voltage among D1, D2, A1, A2, A3 inputs is 1000V / CAT IV 600V to ground. Do not measure voltages exceeding the limits described by this manual. Should you exceed the voltage limits you could damage the instrument and/or its components or endanger your safety
- If possible, before connecting the meter to the electrical equipment under test take the power supply off

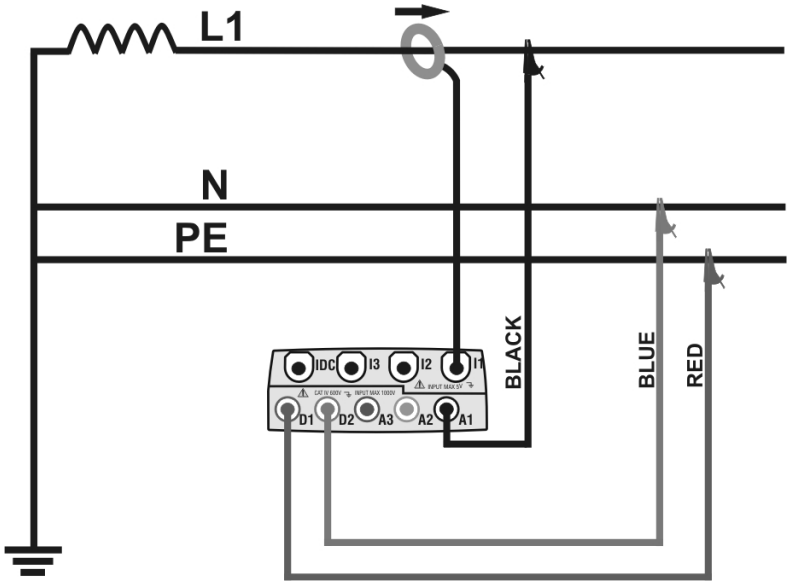


Fig. 4: Meter connection in a Single phase system

4.2. CONNECTION OF METER IN A THREE PHASE 4 WIRE SYSTEM

CAUTION

- The maximum voltage among D1, D2, A1, A2, A3 inputs is 1000V / CAT IV 600V to ground. Do not measure voltages exceeding the limits described by this manual. Should you exceed the voltage limits you could damage the instrument and/or its components or endanger your safety
- If possible, before connecting the meter to the electrical equipment under test take the power supply off

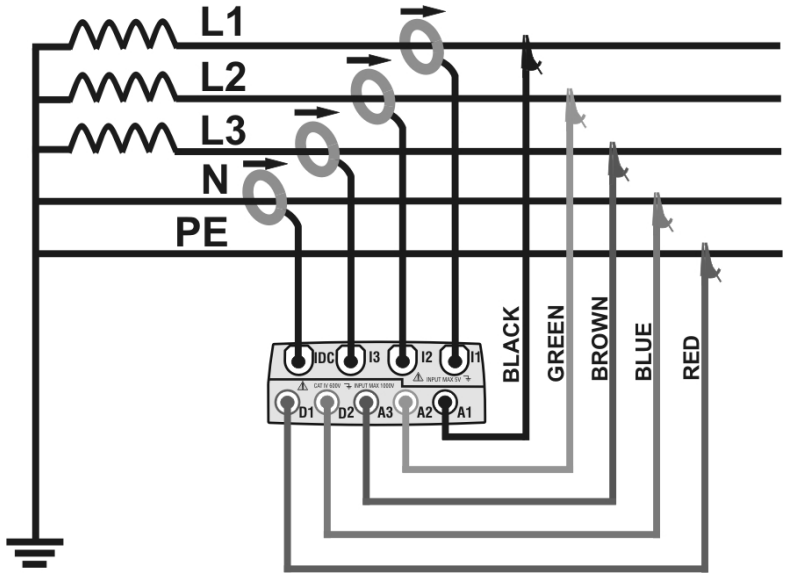


Fig. 5: Meter connection in a three phase 4-wire system

4.3. CONNECTION OF METER IN A THREE PHASE 3 WIRE SYSTEM

CAUTION

- The maximum voltage among D1, D2, A1, A2, A3 inputs is 1000V / CAT IV 600V to ground. Do not measure voltages exceeding the limits described by this manual. Should you exceed the voltage limits you could damage the instrument and/or its components or endanger your safety
- If possible, before connecting the meter to the electrical equipment under test take the power supply off

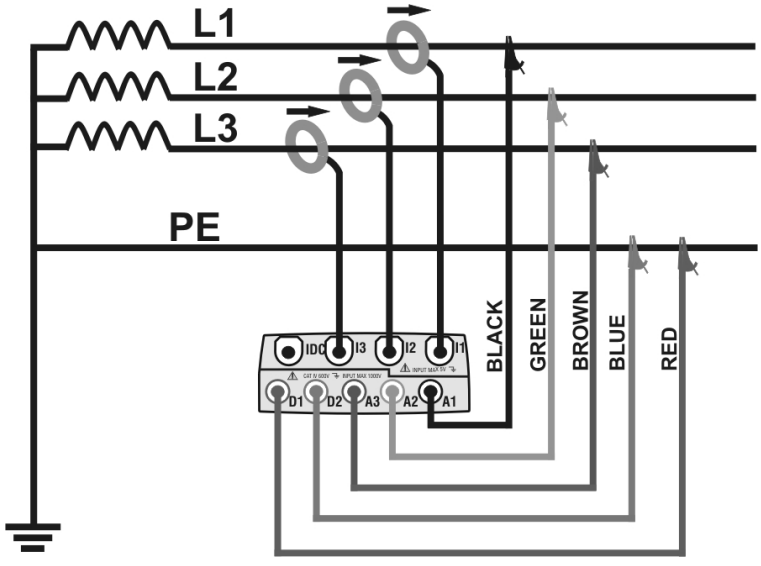


Fig. 6:Meter connection in a three phase 3-wire system

4.4. TESTING A SINGLE PHASE PHOTOVOLTAIC SYSTEM PV-1 WITH REMOTE UNIT SOLAR-01

CAUTION

- The maximum voltage between inputs D1, D2, A1, A2 and A3 is 1000V / CAT IV 600V to earth. Do not measure voltages exceeding the limits indicated in this manual. If these voltage limit values are exceeded, the user may be exposed to electrical shocks and the instrument could get damaged
- Where possible, disconnect the connecting points of the instrument, before connecting it, by means of disconnecting switches S1 and S2

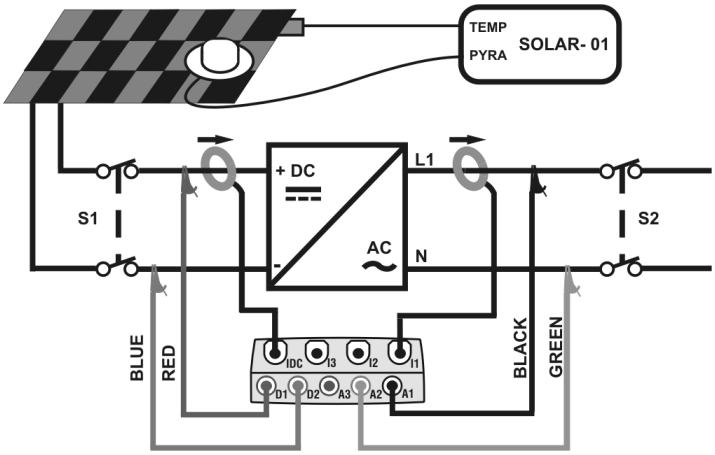
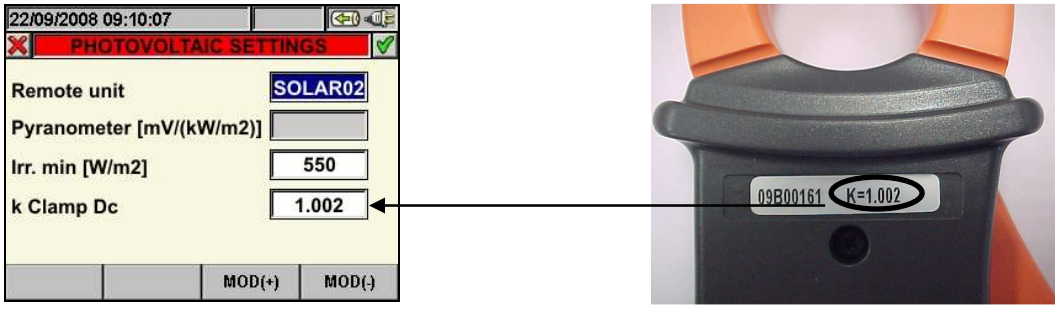


Fig. 7: Meter connection in a single-phase photovoltaic system with SOLAR-01

1. Set the **PV-1** configuration and check that the parameters of the photovoltaic system considered correspond to the set values (see § 5.3.2 and § 5.3.3.of user's manual). In particular:
   - Set the desired full scale value of DC and AC clamps
   - Set the correct Pnom value of the installation on test
   - Select the remote unit "SOLAR01", the correct sensitivity of the pyranometer (this value is indicated on the label sticked on it) (§ 5.3.3)
   - Set the K corrective factor of DC clamp HT4004 supplied with the instrument which is indicated in a label on the back side of clamp (see below picture and § 5.3.3.3)



2. Select the "REAL TIME VALUES" section of meter
3. Connect inputs **D1** and **D2** to the positive and negative string output poles respectively. Connect inputs **A1** and **A2** to the Phase and Neutral conductors, respecting the colors as shown in Fig. 7
4. Supply the electric system considered in case it was temporarily put out of service to connect the instrument and check the correct values of Vac and Vdc parameters
5. Connect the output of the DC clamp to the **IDC** input

CAUTION

BEFORE CONNECT DC CLAMP ON CONDUCTOR

Turn on the clamp, select the correct range and press the ZERO key to the DC clamp in order to eliminate possible residual magnetizations in the clamp (values of current up to 0.02A are acceptable). Connect the output of the clamp to the IDC input of the instrument

6. Connect the DC clamp to the positive side of output string **by respecting the direction of the arrow on the clamp** itself and **check the status of internal batteries before the connection**

7. Connect the AC current clamp to the Phase L1 conductor **by respecting the direction of the arrow** on the clamp itself. Connect the output of the clamp to the **I1** input of the instrument
8. Check that the Pac Active Power is positive and that the power factor Pf corresponds to the load (typically equal to 1.00). In case of negative values of the active power open the clamp, rotate it by 180° and connect it again to the conductor
9. Turn on the **SOLAR-01** unit by means of the relevant key on the unit itself. SOLAR-01 will switch to stand/by mode (**STATUS LED** flashing).
10. Connect the SOLAR-01 unit to the main unit by means of the USB cable. The main unit must display the message "SOLAR-01 connected". Should this message not appear, disconnect and connect again the USB connector
11. **Press the F1 key to start testing a photovoltaic system** (see § 5.5 of user manual) by checking that (after pressing the F1 key) the following icon  is displayed on instrument and the **LED REC** flashing on unit SOLAR-01. Please also consider the possible situation of LED of SOLAR-01 unit (see § 8.3 of user manual)
12. Waiting for the icon  appear on the display of main unit, disconnect the unit SOLAR-01 from the main unit, and bring it close to the photovoltaic cells
13. Position the pyranometer on the plane of the photovoltaic panels and the temperature sensor as near as possible to the cells which the panel consists of (typically, on the back of the panel)
14. Waiting some instants in order to permits to the probes to reach a stable measurement and then connect the irradiation and temperature probes respectively to the inputs **PYRA** and **TEMP** of the SOLAR-01 unit
15. Wait for the **READY LED** to start flashing. This event indicated that the instrument has detected some data with solar irradiation > minimum limit threshold (§ 5.3.3.3)
16. When the **READY LED** of unit SOLAR-01 flashes disconnect the irradiation and temperature probes from the SOLAR-01 unit, bring the SOLAR-01 next to the main unit and connect them by means of the USB cable. The main unit must display the message "SOLAR-01 connected". Should this message not appear, disconnect and connect again the USB connector
17. Press the **F1** key (Finish) on the main unit to stop the test
18. After the automatic data transfer phase, the instrument will automatically display the maximum performance values
19. Press **SAVE** to save the results obtained. Pressing the key will display the virtual keyboard to type possible comments. A further pressing of the **SAVE** key will store the measure and the typed comments and will go back to the initial screen, ready for a new measurement
20. Press **ESC** to delete the detected data and go back to the initial screen, ready for a new measurement

4.5. TESTING A SINGLE PHASE PHOTOVOLTAIC SYSTEM PV-1 WITH REMOTE UNIT SOLAR-02

CAUTION

- The maximum voltage between inputs D1, D2, A1, A2 and A3 is 1000V / CAT IV 600V to earth. Do not measure voltages exceeding the limits indicated in this manual. If these voltage limit values are exceeded, the user may be exposed to electrical shocks and the instrument could get damaged
- Where possible, disconnect the connecting points of the instrument, before connecting it, by means of disconnecting switches S1 and S2

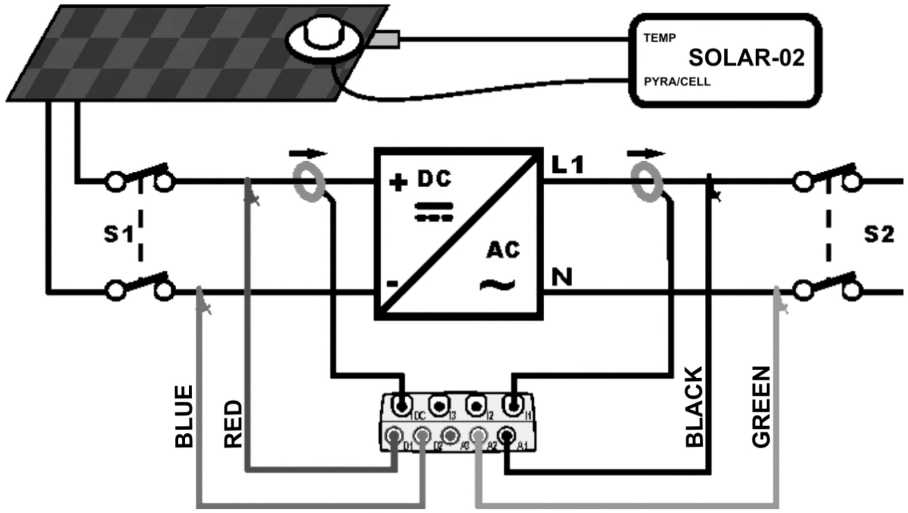
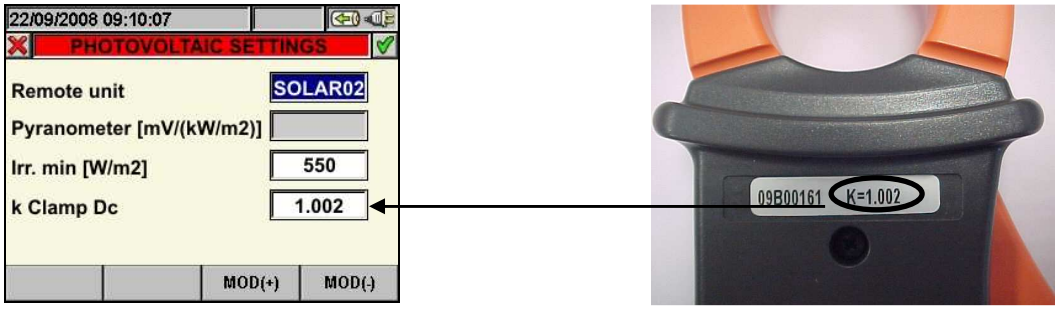


Fig. 8: Meter connection in a single-phase photovoltaic system with SOLAR-02

1. Set the **PV-1** configuration and check that the parameters of the photovoltaic system considered correspond to the set values (see § 5.3.2 and § 5.3.3.of user's manual). In particular:
   - Set the desired full scale value of DC and AC clamps
   - Set the correct Pnom value of the installation on test
   - Select the remote unit "SOLAR02". For setting of pyranometer or reference cell HT304 sensitivity please refer to the user manual of SOLAR-02
   - Set the K corrective factor of DC clamp HT4004 supplied with the instrument which is indicated in a label on the back side of clamp (see below picture and § 5.3.3.3)



2. Use the remote unit SOLAR-02 in independent mode to perform a possible preliminary measurement of irradiance
3. Select the "REAL TIME VALUES" section of meter
4. Connect inputs **D1** and **D2** to the positive and negative string output poles respectively. Connect inputs **A1** and **A2** to the Phase and Neutral conductors, respecting the colors as shown in Fig. 7
5. Supply the electric system considered in case it was temporarily put out of service to connect the instrument and check the correct values of Vac and Vdc parameters
6. Connect the output of the DC clamp to the **IDC** input

CAUTION

BEFORE CONNECT DC CLAMP ON CONDUCTOR

Turn on the clamp, select the correct range and press the ZERO key to the DC clamp in order to eliminate possible residual magnetizations in the clamp (values of current up to 0.02A are acceptable). Connect the output of the clamp to the IDC input of the instrument

7. Connect the DC clamp to the positive side of output string **by respecting the direction of the arrow on the clamp** itself and **check the status of internal batteries before the connection**
8. Connect the AC current clamp to the Phase L1 conductor **by respecting the direction of the arrow** on the clamp itself. Connect the output of the clamp to the **I1** input of the instrument
9. Check that the Pac Active Power is positive and that the power factor Pf corresponds to the load (typically equal to 1.00). In case of negative values of the active power open the clamp, rotate it by 180° and connect it again to the conductor
10. Turn on the **SOLAR-02** unit by means of the relevant key on the unit itself. The unit will remain on hold. Select the type of irradiance sensor on the unit (see § 4.5 of SOLAR-02 user manual
11. Connect the SOLAR-02 unit to the main unit by means of the USB cable. The main unit must display the message "SOLAR-02 connected". Should this message not appear, disconnect and connect again the USB connector
12. **Press the F1 key to start the test on a PV system** (see § 5.6). The icon  is shown on the display of instrument and the "**HOLD**" message along with the waiting time to reach the "00" instant condition are displayed on SOLAR-02 unit
13. Waiting for the icon  appear on the display of main unit, disconnect the unit SOLAR-02 from the main unit, and bring it close to the photovoltaic cells. The "**Recording…**" message is displayed on SOLAR-02
14. Position the pyranometer on the plane of the photovoltaic panels. In case of use of reference cell HT304 please refer to § 4.2 of it's user manual for a correct fixing
15. Position the temperature sensor as near as possible to the cells which the panel consists of (typically, on the back of the panel)
16. Waiting some instants in order to permits to the probes to reach a stable measurement and then connect the irradiation and temperature probes respectively to the inputs **PYRA/CELL** and **TEMP** of the SOLAR-02 unit
17. Wait for "**READY**" message displayed on SOLAR-02. This event indicated that the instrument has detected some data with solar irradiation > minimum limit threshold (§ 5.3.3.3)
18. **Wait at least 1 minute in order to recording more valid samples** than disconnect the irradiation and temperature probes from the SOLAR-02 unit, bring the SOLAR-02 unit next to the to the main unit and connect them by means of the USB cable. The main unit must display the message "SOLAR-02 connected" (should this message not appear, disconnect and connect again the USB connector
19. Press the **F1** key (Finish) on the main unit to stop the test
20. After the automatic data transfer phase, the instrument will automatically display the maximum performance values
21. Press **SAVE** to save the results obtained. Pressing the key will display the virtual keyboard to type possible comments. A further pressing of the **SAVE** key will store the measure and the typed comments and will go back to the initial screen, ready for a new measurement
22. Press **ESC** to delete the detected data and go back to the initial screen, ready for a new measurement

4.6. TESTING A THREE PHASE PHOTOVOLTAIC SYSTEM PV-3 WITH REMOTE UNIT SOLAR-01

CAUTION

- The maximum voltage between inputs D1, D2, A1, A2 and A3 is 1000V / CAT IV 600V to earth. Do not measure voltages exceeding the limits indicated in this manual. If these voltage limit values are exceeded, the user may be exposed to electrical shocks and the instrument could get damaged
- Where possible, disconnect the connecting points of the instrument, before connecting it, by means of disconnecting switches S1 and S2

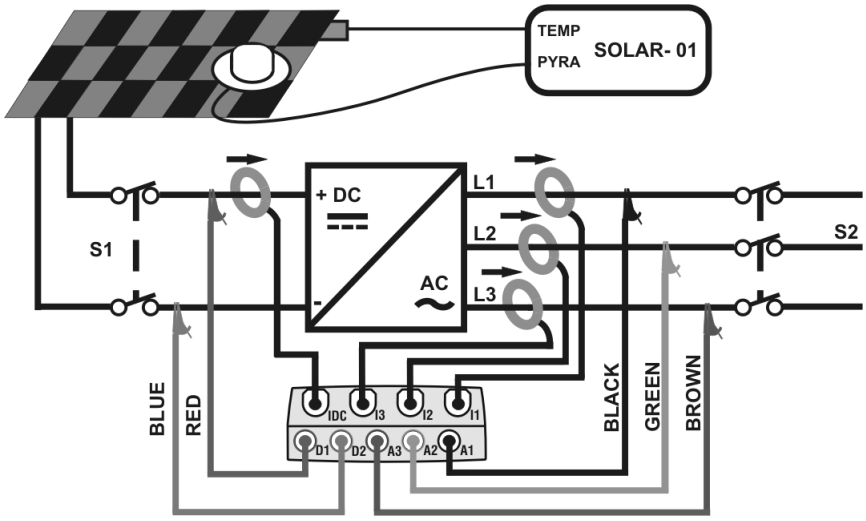
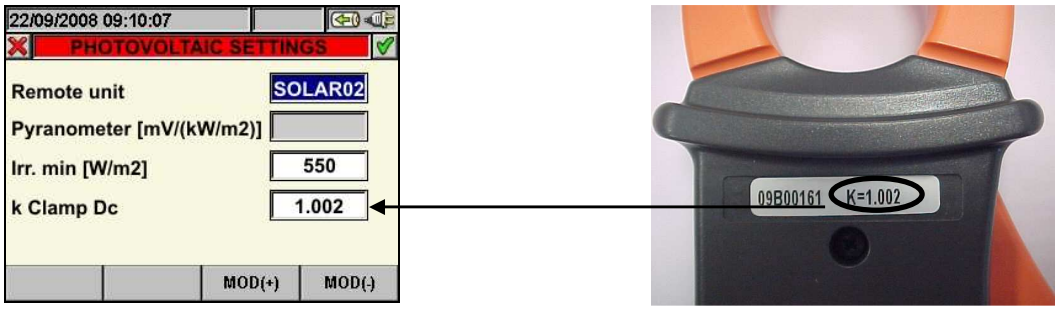


Fig. 9: Meter connection in a three-phase photovoltaic system with SOLAR-01

1. Set the **PV-3** configuration and check that the parameters of the photovoltaic system considered correspond to the set values (see § 5.3.2 and § 5.3.3.of user's manual). In particular:
   - Set the desired full scale value of DC and AC clamps
   - Set the correct Pnom value of the installation on test
   - Select the remote unit "SOLAR01", the correct sensitivity of the pyranometer (this value is indicated on the label sticked on it) (§ 5.3.3)
   - Set the K corrective factor of DC clamp HT4004 supplied with the instrument which is indicated in a label on the back side of clamp (see below picture and § 5.3.3.3)



2. Select the "REAL TIME VALUES" section of meter
3. Connect inputs **D1** and **D2** to the positive and negative string output poles respectively. Connect inputs **A1**, **A2** and **A3** to the Phase conductors, respecting the colors as shown in Fig. 10
4. Supply the electric system considered in case it was temporarily put out of service to connect the instrument and check the correct values of Vac1, Vac2, Vac3 and Vdc parameters
5. Connect the output of the DC clamp to the **IDC** input

CAUTION

BEFORE CONNECT DC CLAMP ON CONDUCTOR

Turn on the clamp, select the correct range and press the ZERO key to the DC clamp in order to eliminate possible residual magnetizations in the clamp (values of current up to 0.02A are acceptable). Connect the output of the clamp to the IDC input of the instrument

6. Connect the DC clamp to the positive side of output string **by respecting the direction of the arrow on the clamp** itself and **check the status of internal batteries before the connection**

7. Connect the AC current clamps to the Phase L1, L2, L3 conductors **by respecting the direction of the arrow** on the clamp itself. Connect the output of the clamps to the **I1, I2, I3** inputs of the instrument
8. Select the Measure Display mode and check that the Pac Active Power is positive and that the power factor Pf corresponds to the load (typically equal to 1.00 for measures made downstream the inverter in photovoltaic systems). In case of negative values of the active power open the clamp, rotate it by 180°and connect it again to the conductor. In case of doubt, to check the connections made, it can be useful to **temporarily modify the settings and the connections** of the instrument in order to perform a measurement in three-phase 3-wire mode downstream the inverter (see § 5.3.1 and 7.7 of user's manual)
9. Turn on the **SOLAR-01** unit by means of the relevant key on the unit itself. SOLAR-01 will switch to stand/by mode (**STATUS LED** flashing).
10. Connect the SOLAR-01 unit to the main unit by means of the USB cable. The main unit must display the message "SOLAR-01 connected". Should this message not appear, disconnect and connect again the USB connector
11. **Press the F1 key to start testing a photovoltaic system** (see § 5.5 of user's manual) by checking that (after pressing the F1 key) the following icon  is displayed on instrument and the **LED REC** flashing on unit SOLAR-01. Please also consider the possible situation of LED of SOLAR-01 unit (see § 8.3 of user manual)
12. Waiting for the icon  appear on the display of main unit, disconnect the unit SOLAR-01 from the main unit, and bring it close to the photovoltaic cells
13. Position the pyranometer on the plane of the photovoltaic panels and the temperature sensor as near as possible to the cells which the panel consists of (typically, on the back of the panel)
14. Waiting some instants in order to permits to the probes to reach a stable measurement and then connect the irradiation and temperature probes respectively to the inputs **PYRA** and **TEMP** of the SOLAR-01 unit
15. Wait for the **READY LED** to start flashing. This event indicated that the instrument has detected some data with solar irradiation > minimum limit threshold (§ 5.3.3.3)
16. When the **READY LED** of unit SOLAR-01 flashes disconnect the irradiation and temperature probes from the SOLAR-01 unit, bring the SOLAR-01 next to the main unit and connect them by means of the USB cable. The main unit must display the message "SOLAR-01 connected". Should this message not appear, disconnect and connect again the USB connector
17. Press the **F1** key (Finish) on the main unit to stop the test
18. After the automatic data transfer phase, the instrument will automatically display the maximum performance values
19. Press **SAVE** to save the results obtained. Pressing the key will display the virtual keyboard to type possible comments. A further pressing of the **SAVE** key will store the measure and the typed comments and will go back to the initial screen, ready for a new measurement
20. Press **ESC** to delete the detected data and go back to the initial screen, ready for a new measurement

4.7. TESTING A THREE PHASE PHOTOVOLTAIC SYSTEM PV-3 WITH REMOTE UNIT SOLAR-02

CAUTION

- The maximum voltage between inputs D1, D2, A1, A2 and A3 is 1000V / CAT IV 600V to earth. Do not measure voltages exceeding the limits indicated in this manual. If these voltage limit values are exceeded, the user may be exposed to electrical shocks and the instrument could get damaged
- Where possible, disconnect the connecting points of the instrument, before connecting it, by means of disconnecting switches S1 and S2

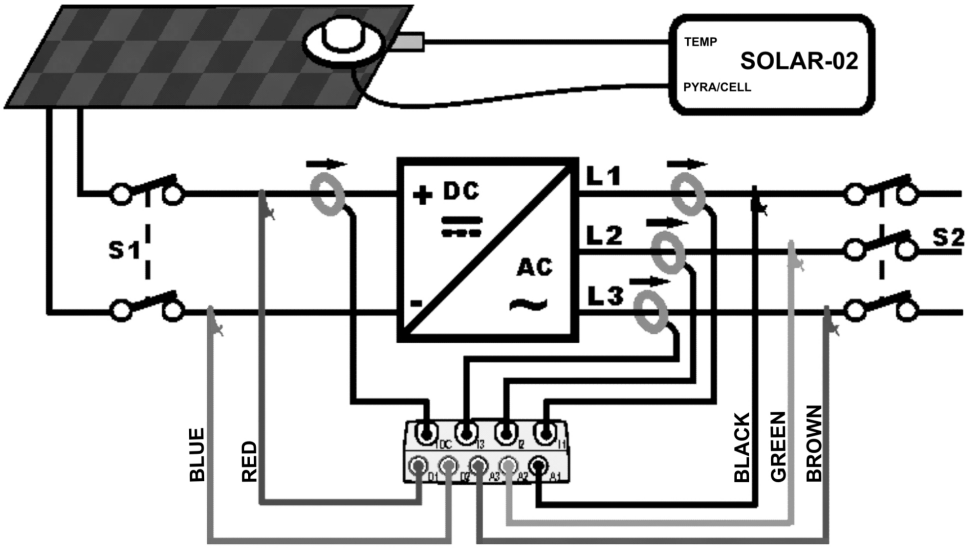
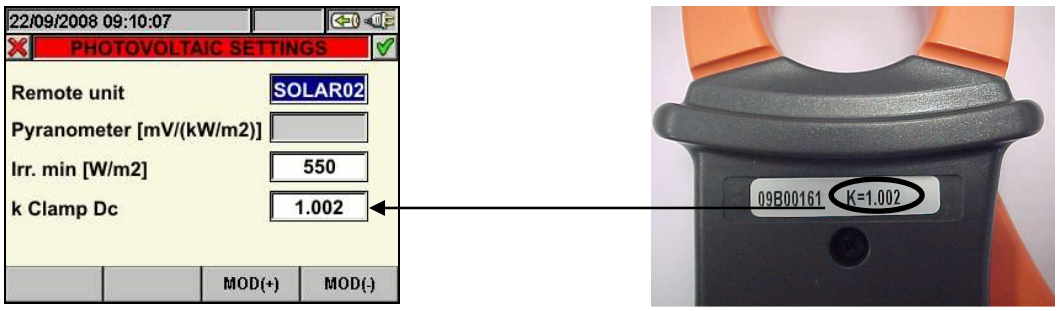


Fig. 10: Meter connection in a three-phase photovoltaic system with SOLAR-02

1. Set the **PV-3** configuration and check that the parameters of the photovoltaic system considered correspond to the set values (see § 5.3.2 and § 5.3.3.of user's manual). In particular:
   - Set the desired full scale value of DC and AC clamps
   - Set the correct Pnom value of the installation on test
   - Select the remote unit "SOLAR02". For setting of pyranometer or reference cell HT304 sensitivity please refer to the user manual of SOLAR-02
   - Set the K corrective factor of DC clamp HT4004 supplied with the instrument which is indicated in a label on the back side of clamp (see below picture and § 5.3.3.3)



2. Use the remote unit SOLAR-02 in independent mode to perform a possible preliminary measurement of irradiance
3. Select the "REAL TIME VALUES" section of meter
4. Connect inputs **D1** and **D2** to the positive and negative string output poles respectively. Connect inputs **A1**, **A2** and **A3** to the Phase conductors, respecting the colors as shown in Fig. 9
5. Supply the electric system considered in case it was temporarily put out of service to connect the instrument and check the correct values of Vac1, Vac2, Vac3 and Vdc parameters
6. Connect the output of the DC clamp to the **IDC** input

CAUTION

BEFORE CONNECT DC CLAMP ON CONDUCTOR

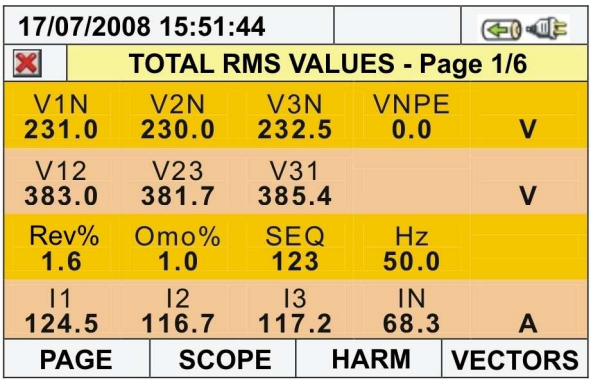
Turn on the clamp, select the correct range and press the ZERO key to the DC clamp in order to eliminate possible residual magnetizations in the clamp (values of current up to 0.02A are acceptable). Connect the output of the clamp to the IDC input of the instrument

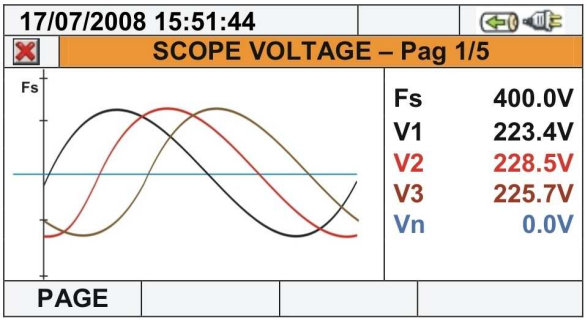
7. Connect the DC clamp to the positive side of output string **by respecting the direction of the arrow on the clamp** itself and **check the status of internal batteries before the connection**
8. Connect the AC current clamps to the Phase L1, L2, L3 conductors **by respecting the direction of the arrow** on the clamp itself. Connect the output of the clamps to the **I1, I2, I3** inputs of the instrument
9. Select the Measure Display mode and check that the Pac Active Power is positive and that the power factor Pf corresponds to the load (typically equal to 1.00 for measures made downstream the inverter in photovoltaic systems). In case of negative values of the active power open the clamp, rotate it by 180°and connect it again to the conductor. In case of doubt, to check the connections made, it can be useful to **temporarily modify the settings and the connections** of the instrument in order to perform a measurement in three-phase 3-wire mode downstream the inverter (see § 5.3.1 and 7.7 of user's manual)
10. Turn on the **SOLAR-02** unit by means of the relevant key on the unit itself. The unit will remain on hold. Select the type of irradiance sensor on the unit (see § 4.5 of SOLAR-02 user manual)
11. Connect the SOLAR-02 unit to the main unit by means of the USB cable. The main unit must display the message "SOLAR-02 connected". Should this message not appear, disconnect and connect again the USB connector
12. **Press the F1 key to start the test on a PV system** (see § 5.6). The icon  is shown on the display of instrument and the "**HOLD**" message more than the waiting time to reach the "00" instant condition are shown at display of SOLAR-02 unit
13. Waiting for the icon  appear on the display of main unit, disconnect the unit SOLAR-02 from the main unit, and bring it close to the photovoltaic cells. The "**Recording…**" message is shown at display of SOLAR-02
14. Position the pyranometer on the plane of the photovoltaic panels. In case of use of reference cell HT304 please refer to § 4.2 of it's user manual for a correct fixing
15. Position the temperature sensor as near as possible to the cells which the panel consists of (typically, on the back of the panel)
16. Waiting some instants in order to permits to the probes to reach a stable measurement and then connect the irradiation and temperature probes respectively to the inputs **PYRA/CELL** and **TEMP** of the SOLAR-02 unit
17. Wait for "**READY**" message at display of SOLAR-02. This event indicated that the instrument has detected some data with solar irradiation > minimum limit threshold (§ 5.3.3.3)
18. **Wait at least 1 minute in order to recording more valid samples** than disconnect the irradiation and temperature probes from the SOLAR-02 unit, bring the SOLAR-02 unit next to the to the main unit and connect them by means of the USB cable. The main unit must display the message "SOLAR-02 connected" (should this message not appear, disconnect and connect again the USB connector
19. Press the **F1** key (Finish) on the main unit to stop the test
20. After the automatic data transfer phase, the instrument will automatically display the maximum performance values
21. Press **SAVE** to save the results obtained. Pressing the key will display the virtual keyboard to type possible comments. A further pressing of the **SAVE** key will store the measure and the typed comments and will go back to the initial screen, ready for a new measurement
22. Press **ESC** to delete the detected data and go back to the initial screen, ready for a new measurement

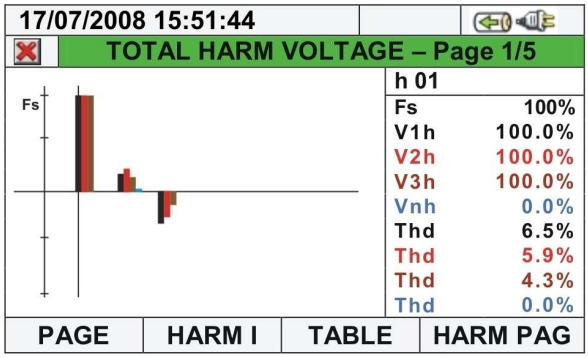
5. MEASURED VALUES DISPLAYING

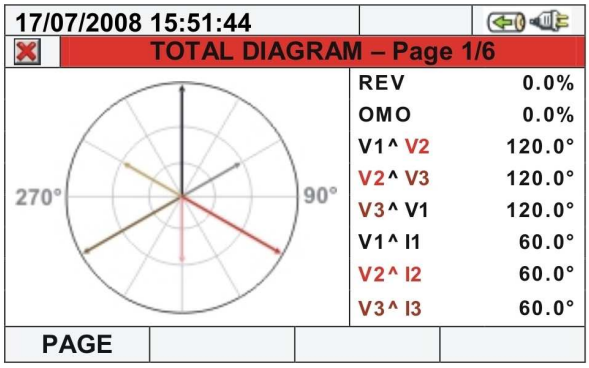
5.1. ANALYZER SECTION

Inside “Real time values” section the herewith screens, selectable with **PAG**, **SCOPE**, **HARM** and **VECTORS** keys, referring to the TRMS real time values, the input signals waveforms, the voltages and currents harmonic analysis and the voltage/current vector diagrams respectively, are shown:



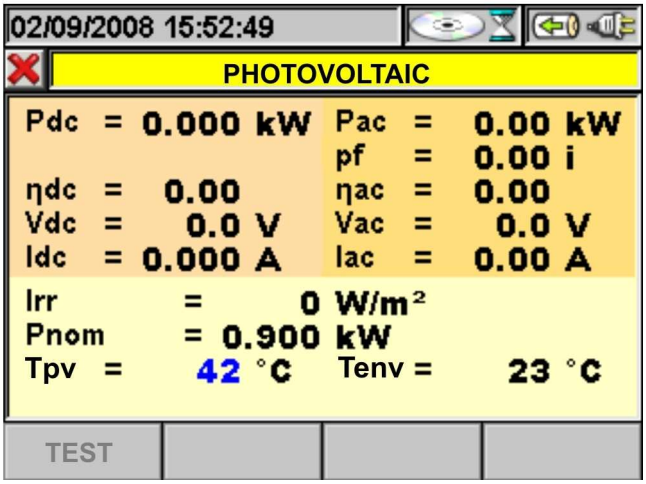






5.2. PHOTOVOLTAIC SECTION

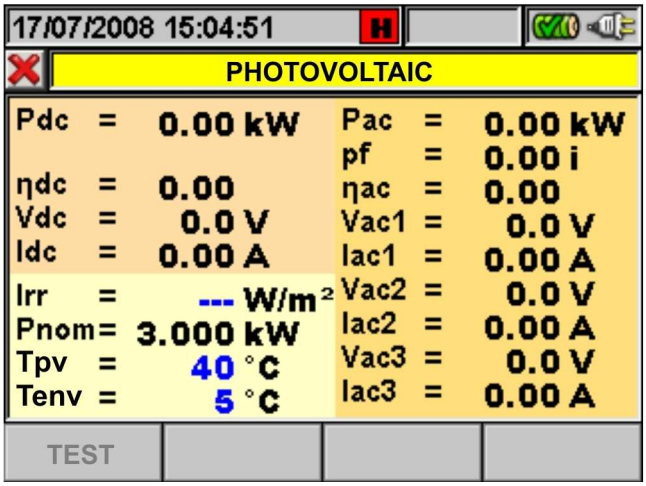
Inside “Real Time Values” section the herewith screens relative to single phase and three phase installations are shown by meter:



Legend of parameters:

Pdc	→	DC power at inverter input
ηdc	→	Photovoltaic panel performance
Vdc	→	DC voltage at inverter input
Idc	→	DC current at inverter input
Pac	→	AC power at inverter output
Pf	→	Power factor at inverter output
ηac	→	Inverter performance
Vac	→	AC voltage at inverter output
Iac	→	AC current at inverter output
Irr	→	Solar radiation value
Pnom	→	Nominal power of the photovoltaic cells
Tpv	→	Temperature of the photovoltaic cells
Tenv	→	Environmental temperature

Fig. 11: Parameters screen of a single phase photovoltaic system



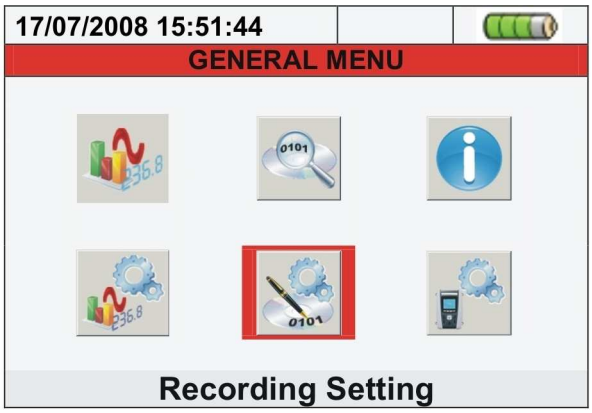
Legend of parameters:

Pdc	→	DC power at inverter input
ηdc	→	Photovoltaic panel performance
Vdc	→	DC voltage at inverter input
Idc	→	DC current at inverter input
Pac	→	AC power at inverter output
Pf	→	Power factor at inverter output
ηac	→	Inverter performance
Vac1,2,3	→	AC voltages at inverter output
Iac1,2,3	→	AC currents at inverter output
Irr	→	Solar radiation value
Pnom	→	Nominal power of the photovoltaic cells
Tpv	→	Temperature of the photovoltaic cells
Tenv	→	Environmental temperature

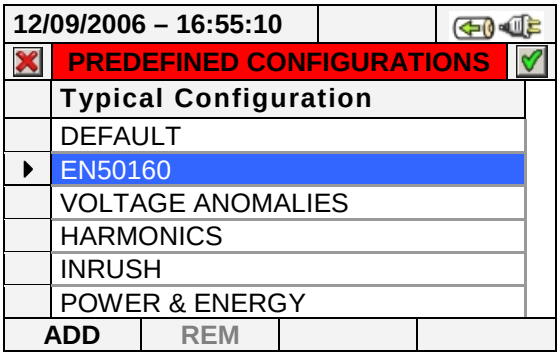
Fig. 12: Parameters screen of a three phase photovoltaic system

6. RECORDING SETTINGS

Click the “Recording Settings” icon of the GENERAL MENU



Press the **PREDEF.** key to open the predefined configurations:



Select the desired typical configuration. The instrument automatically sets the parameters and the recording autonomy which is shown at display. The possible predefined configurations are:

1. **DEFAULT**: Setting parameters of default configuration from the exit of meter by factory.
2. **EN50160**: Setting parameters for networks quality recording (voltage anomalies, harmonics, flicker (only SOLAR300N), unbalance and spikes (only SOLAR300N) in compliance to EN 50160 standard
3. **VOLTAGE ANOMALIES**: Setting parameters for voltage anomalies recording only (sags, swells)
4. **HARMONICS**: Setting parameters for voltages and currents harmonic analysis
5. **INRUSH**: Setting parameters inrush current events detection (only SOLAR300N)
6. **POWER & ENERGY**: Setting parameters for power and energy measures

Save the performed settings by press the **SAVE** or **ENTER** key or the smart icon ☑.

7. START / STOP A RECORDING

To start and/or stop a recording press **GO/STOP** key while the meter is displaying:

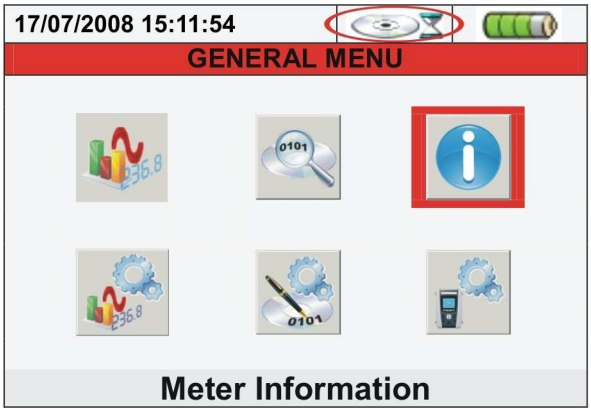
- The “GENERAL MENU” window
- Any screen of the “Real time values” section

Two different recording modes are available:

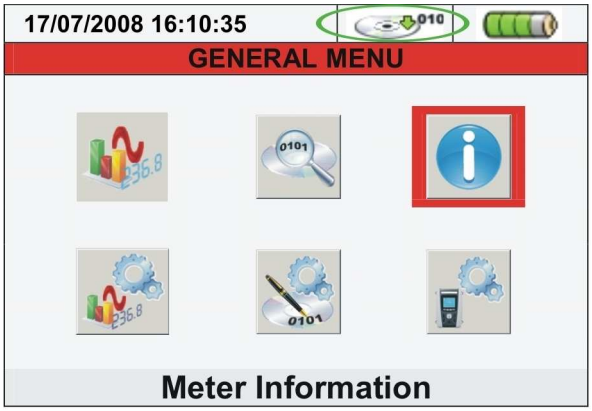
- **MANUAL**: the recording starts the next minute
- **AUTO**: the recording starts at the date and time set by user but it’s necessary pressing **GO/STOP** key in order to put the meter under waiting mode

To start the recording, no matter which mode is selected, the user has to press the **GO/STOP** key

The **red** circled symbol in the herewith picture is displayed while the meter is under waiting mode:



The **green** circled symbol in the herewith picture is displayed while the meter is under recording mode:



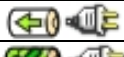
At the end of the recording the meter AUTOMATICALLY saves the recorded data

8. MAINTENANCE

8.1. GENERAL

Never use the meter in environments with a high humidity or temperature. Do not expose the meter to direct sunlight. Always turn off the meter after use

8.2. SITUATIONS RELATIVE TO INTERNAL BATTERY

Icon at display	Description
	Too low battery level. Perform a battery charging
	Residual battery charging at 25%
	Residual battery charging at 50%
	Residual battery charging at 75%
	Battery fully charged
	Only adapter connected. Battery disconnected
	Battery and adapter connected. Recharging battery
	Battery fully charged with adapter connected
	Battery charge unknown. Connect adapter
	Problem with battery. Contact HT ITALIA Technical Service
	

8.2.1. Replacement instrument internal battery

1. Disconnect voltage test leads and transducer clamps from any circuit under test
2. Turn off the meter and disconnect all test cables from it
3. Unscrew the screw of battery cover and remove it
4. Disconnect the old battery from internal connector and insert the new in the same side
5. Reposition the cover and fasten it with the proper screw

8.2.2. Replacement SOLAR-01 and SOLAR-01 internal batteries

The SOLAR-01 is supplied by two type AA 1.5 V alkaline batteries. The simultaneous flashing of the three LEDs READY STATUS and REC indicates that the battery is low. In this case, stop the measurements in progress, turn off the instrument by means of the appropriate ON/OFF key and disconnect the external probes. Remove the cover of the battery compartment and replace both batteries with two new batteries of the same type. For battery replacement on remote unit SOLAR-02 make reference to the user manual

8.3. CLEANING

Use a soft dry cloth to clean the meter. Never use wet clothes, solvents, water etc.. and take particular care at TFT display.

9. POWER SUPPLY

Internal power supply:	Li-ION, 3.7V rechargeable battery, autonomy >3 hours
External power supply:	AC/DC adapter, 100÷240VAC / 50-60Hz – 5VDC
Power supply SOLAR-01:	2x1.5V alkaline batteries type AA LR06
Power supply SOLAR-02:	4x1.5V alkaline batteries type AAA LR03
Auto power OFF:	after 5min of no use (without external adapter)

10. REFERENCE STANDARDS

Safety of meter:	IEC/EN61010-1
Technical literature:	IEC/EN61187
Safety standard accessories:	IEC/EN61010-031, IEC/EN61010-2-032
Insulation:	Double insulation
Pollution degree:	2
Max altitude:	2000m (*)

CAUTION

(*) Information about the use of meter at altitude from 2000 to 5000m

As for voltage inputs B1...B4 the instrument is to be considered downgraded to overvoltage category CAT III 600V to ground, max 1000V between inputs or CAT IV 300V to ground, max 600V between inputs. Markings and symbols indicated on the instrument are to be considered valid when using it at an altitude lower than 2000m

Overvoltage category (@ altitude <2000m):	CAT IV 600V to Ground, max 1000V between inputs
Quality network:	IEC/EN50160
Quality of electrical power	IEC/EN61000-4-30 Class B
Flicker (only SOLAR300N):	IEC/EN61000-4-15, IEC/EN50160
Harmonics:	IEC/EN61000-4-30 Class B, IEC/EN50160
Unbalance:	IEC/EN61000-4-30 Class B, IEC/EN50160

11. ENVIRONMENT

Reference calibration temperature:	23°± 5℃
Working temperature:	0 ÷ 40℃
Relative humidity:	<80%HR
Storage temperature:	-10 ÷ 60℃
Storage relative humidity to:	<80%HR

This instrument complies with the 2006/95/CE (LVD) and EMC 2004/108/CE Directives

12. TECHNICAL SPECIFICATION

DC Voltage – PV sytems

Range	Accuracy	Resolution	Input impedance
0.0 ÷ 1000.0V	±(0.5%rdg+2dgt)	0.1V	10MΩ

Voltage values < 20.0V are zeroed

AC TRMS Voltage Phase-Neutral/ Phase -Ground/ Phase - Phase – Single / Three phase PV systems

Range	Accuracy	Resolution	Input impedance
0.0 ÷ 600.0V	±(0.5%rdg+2dgt)	0.1V	10MΩ
0.0 ÷ 1000.0V (F-F)			

Max crest factor = 2 ; Voltage values < 20.0V are zeroed ; Meter can be connected to TV with factor selectable between 1÷3000

AC TRMS Voltage Phase-Neutral/ Phase -Ground/ Phase - Phase – Single / Three phase NPV systems

Range	Accuracy	Resolution	Input impedance
0.0 ÷ 600.0V	±(0.5%rdg+2dgt)	0.1V	10MΩ
0.0 ÷ 1000.0V (F-F)			

Max crest factor = 2 ; Voltage values < 2.0V are zeroed ; Meter can be connected to TV with factor selectable between 1÷3000

Voltage anomalies Phase-Neutral – Single phase NPV plants / Three phase with neutral / Three phase without neutral

Range	Voltage accuracy	Time accuracy (50Hz)	Voltage resolution	Voltage resolution (50Hz)
0.0 ÷ 600.0V	±(1.0%rdg+2dgt)	±10ms	0.2V	10ms
0.0 ÷ 1000.0V (F-F)				

Max crest factor = 2 ; Voltage values < 2.0V are zeroed; Meter can be connected to TV with factor selectable between 1÷3000 ; Selectable threshold ±1% to ±30%

Voltage Spikes – Phase-Ground - Single phase and Three phase systems (only PQA824)

Range	Voltage Accuracy	Voltage Resolution	Time resolution (50Hz)	Detection time (50Hz)
-1000V ÷ 100V	±(2.0%rdg+60V)	1V	±10ms	78µs – 2.5ms (SLOW)
100V ÷ 1000V				
-6000V ÷ -100V	±(10%rdg+100V)	15V		5µs – 160µs (FAST)
100V ÷ 6000V				

Voltage detection threshold set from 100V ÷ 5000V ; Maximum number of recorded events: 20000

DC / AC current with standard STD transducer

Range	Accuracy	Resolution	Input impedance	Overload protection
0.0÷1000.0mV	±(0.5%rdg+0.06%FS)	0.1mV	510kΩ	5V

Measure with clamp and output = 1VDC/AC with I = Inom ; Current values < 0.1% FS are zeroed ; Max crest factor = 3

AC current with flexible FLEX transducers – NPV systems – Range 300A

Range	Accuracy	Resolution	Input impedance	Overload protection
0.0 ÷ 49.9A	±(0.5%rdg+0.24%FS)	0.1A	510kΩ	5V
50.0 ÷ 300.0A	±(0.5%rdg+0.06%FS)			

Measure with HTFLEX33D clamp ; Max crest factor = 3; Current values < 1A are zeroed

AC current with flexible FLEX transducers – NPV systems – Range 3000A

Range	Accuracy	Resolution	Input impedance	Overload protection
0.0 ÷ 3000.0A	±(0.5%rdg+0.06%FS)	0.1A	510kΩ	5V

Measure with HTFLEX33D clamp ; Max crest factor = 3; Current values < 5A are zeroed

Inrush Current (only SOLAR300N)

Range	Accuracy	Resolution	Time resolution (50Hz)	Time accuracy (50Hz)
Depending on clamp type	±(1.0%rdg+0.4%FS)	Depending on clamp type	10ms	±10ms

Max crest factor = 3 ; Maximum number of recorded events: 1000

DC power (Vmis > 150V, Imis > 10%FS)

Parameter	Full scale clamp	Range [W]	Accuracy	Resolution [W]
POWER	10A, 100A, 1000A	0–9.999k, 0-99.99k, 0-999.9k	±(0.7%rdg+3dgt)	0.001k – 0.1k

Vmis = voltage at which power is measured ; FS = full scale clamp

AC Power / Energy – Single and Three phase systems (@ PF = 1, Vmis >200V, Imis >10%FS)

Parameter [W, VAr, VA] [Wh, VArh, VAh]	Full scale clamp FS	Range [W, VAr, VA] [Wh, VArh, VAh]	Accuracy	Resolution [W, VAr, VA] [Wh, VArh, VAh]
Active power, Reactive power Apparent power, Active Energy Reactive Energy, Apparent Energy	FS ≤ 1A	0.0 – 999.9	±(0.7%rdg+3dgt)	0.1 - 0.001k
	1A< FS ≤ 10A	0.000 – 99.99k		0.001k - 0.01k
	10A< FS ≤ 100A	0.00 – 999.9k		0.01k – 0.1k
	100A< FS ≤ 3000A	0.0 – 9.999M		0.1k – 0.001M

For STD clamp ; Vmis = voltage at which power is measured

Power factor (Cosφ) – Single and Three phase systems

Range	Accuracy (°)	Resolution (°)
0.20÷0.50	1.0	0.01
0.50÷0.80	0.7	
0.80÷1.00	0.6	

Voltage / Current harmonics

Range	Accuracy (*)	Resolution
DC ÷ 49[a]	±(5.0%rdg+5dgt)	0.1V / 0.1A

(*) add to the error of correspondent RMS parameters

Frequency

Range	Accuracy	Resolution
42.5÷69.0Hz	±(0.2%rdg+1dgt)	0.1Hz

Flicker – Single phase / Three phase systems (only SOLAR300N)

Parameter	Range	Accuracy	Resolution
Pst1', Pst	0.0÷10.0	compliance to EN50160	0.1
Plt			

Irradiation measurement (by SOLAR-01 unit - Input PYRA)

Range	Accuracy	Resolution	Overload protection
0.00 ÷ 12.0.0mV	±(1.0%rdg+5dgt)	0.01mV	5V
0.0 ÷ 120.0mV		0.1mV	

Temperature measurement (by SOLAR-01 unit - Input TEMP)

Range	Accuracy	Resolution	Overload protection
0 ÷ 100°C	±(1.0%rdg+2dgt)	1°C	5V

Via della Boaria 40
48018 – Faenza (RA)- Italy
Tel:+39-0546-621002 (4 linee r.a.)
Fax: +39-0546-621144
Email: ht@htitalia.it
Web:www.htitalia.com