



SOLIA METRE

Control device for photovoltaic installations and modules

Usage and maintenance manual

IMPORTANT: Before using this appliance, it is essential to carefully read this manual and keep it for subsequent use.

WELCOME

Congratulations on your purchase of this SOLIAMETRE appliance. It will let you check that your photovoltaic generators are functioning correctly, detect any faults and produce personalised reports. Thanks to its ergonomic design, intuitive use and simple handling, you will very quickly become proficient in its use.

The SOLIAMETRE is an appliance for measuring and analysing photovoltaic characteristics. It is composed of two units, a "sensor" box, which measures the solar radiation and the temperature, and a "main" box, which measures the voltage and current. The measured data is processed by the main box, which calculates and displays the characteristics and curves of the tested generator on an LCD screen. The SOLIAMETRE can:

- . Measure the I-V characteristic.
- . Measure the radiation and temperature of the cell.
- . Display the VOC, ICC, Pmpp, Vmpp, Impp, fill factor and series resistance.
- . Display the I-V and P-V curves.
- . Instantly correct measurements for STC (Radiation 1000W/m², Temperature 25°C and Spectrum 1.5AM).
- . Determine and calculate the form factor and the series resistance.
- . Calculate maximum values according to the temperature and minimum section of the cable.
- . Save and reload measurements that were taken on SD cards.
- . Save and display measurements on a PC.
- . Produce personalised reports via a PC interface.

Main box



Sensor box



Misuse of the appliances can cause damage and injury. Users must make sure that the appliances are installed and used appropriately. It is essential to carefully follow the instructions in this manual. SOLIA CONCEPT declines all responsibility concerning material damage or injury, whether direct or indirect, and the consequences, resulting from failing to observe the instructions given in the present document.



This appliance satisfies the requirements of all applicable European safety directives. This appliance bears the CE mark.

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A GENERAL INFORMATION

Before using the appliance, it is essential to carefully read this manual in full and keep it for subsequent use.

A.1 Package contents



1. 1 carrying case with foam padding.
2. 1 main box.
3. 1 sensor box.
4. 1 universal support for the sensor box.
5. 1 set of 4 MC4 banana cables.
6. 1 set of MC3-MC4 adapters.
7. 1 set of rechargeable batteries fitted in the units.
8. 1 battery charger and cigarette plug adapters.
9. 1 x 2 GB SD card with USB drive/adaptor.
10. 1 printed manual (electronic version on the SD card).
11. 1 quick start guide.

A.2 Storage

Always keep and transport your SOLIAMETRE and its accessories in the carrying case.

Always keep your SOLIAMETRE in a dry place protected from impact, heat, cold and abrasive products.

A.3 Cleaning

Before any maintenance on the appliance, all measurement cables must be disconnected and the appliance must be switched off.

For cleaning, use a soft, dry cloth and do not use any abrasive products.

A.4 Replacing the batteries

Before any maintenance on the appliance, all measurement cables must be disconnected and the appliance must be switched off.

To replace the batteries on the main box or the sensor box, unscrew the cover at the rear of the box. You can either replace the batteries, or recharge the rechargeable batteries supplied with the appliance, then put them back in place in the box. Then screw the cover back on.

The rechargeable batteries of type AA NIMH are supplied with an appropriate charger. At the end of a certain number of charge/discharge cycles, the battery life will diminish. Think about replacing them with AA (LR06) 1.5V batteries or rechargeable batteries of type AA (RC06) 1.2V.

Repairs: You should never perform repairs yourself. The warranty becomes void if a box is opened. In case of breakdown or malfunction, contact your reseller.

A.5 Disposal



Consider the environment when disposing of your appliance and return it to your reseller.

Otherwise, make sure that you comply with the European directive in force 2002/96/EC on waste electrical and electronic equipment (WEEE) for the various types of product present in your SOLIAMETRE.

B WARNINGS AND SECURITY



We remind you that if the appliance is not used under the conditions specified in the present document, the protection provided by the appliance may be compromised.

In all measurements, the safety instructions below must be necessarily respected.

B.1 Usage limits

The SOLIAMETRE must be used exclusively for photovoltaic generators with direct current of maximum 1000 Vcc, 24 A and 6 kW instantaneous.

The production of photovoltaic energy begins as soon as the photovoltaic panels are exposed. It is therefore essential to respect all of the safety rules that apply during work on electrical and photovoltaic generators.

As the units have a radio communication distance of 400 m, interference is possible if two users work within this area.

B.2 Environment

Never carry out work near to a source of gas or any other flammable substances: risk of explosion.

Neither box must be used in environments of extreme humidity (less than 85% of relative humidity).

The main box must never come into contact with any liquid whatsoever.

Neither box must be subject to temperatures above 65°C or below -15°C.

B.3 Usage conditions

Only qualified, authorised, ability personnel are authorised to take measurements.

All inappropriate interventions involve significant risk of accidents and serious injuries.

Before, during and after measurement, it is essential to ensure compliance with all rules relating to electrical safety.

For measurements on roofs, make sure that you comply with all safety directives relative to this type of work, particularly concerning work at height.

Never use a hard object to press the buttons on the units.

For the measurement, the photovoltaic generator must be connected exclusively to the SOLIAMETRE. All consumers, such as an inverter, a regulator or a battery, must be disconnected.

During connection, pay attention to the polarity! Always check that the cables are properly connected and that the connectors are properly engaged.

Any damaged cable or connector must be immediately replaced and disposed of.

The cables must never be disconnected during measurement: risk of electrical arc.

The banana plugs used must be safety insulated.

C TECHNICAL CHARACTERISTICS

Temperature sensors.....	-15 at +65 °C $\pm 0.5^{\circ}\text{C}$
Irradiance sensor.....	0 to 1300 W/m ² $\pm 4\%$ (monocrystalline reference cell)
Adaptive voltage measurement.....	0 to 1,000 Vcc $\pm 0.1\%$
Adaptive current measurement.....	0 to 24 A $\pm 0.1\%$
Maximum measurable power.....	6 kW instantaneous
Functioning temperature.....	-15 to +65°C
Usage humidity.....	< 85% relative humidity
Usage altitude.....	< 2,000 m
Insulation.....	6,000 V (standard EN505201)
Protection indices.....	Main box IP20 Sensor box IP54
Connectors.....	MC4 banana safety insulated Adapter SUNCLIX-MC4 Adapter MC3-MC4
Screen/processor.....	LCD QVGA (320 x 240) 3.5" colour, ARM Cortex M3
Memory.....	SD card 2 gigabytes maximum (about 20,000 curves per GB)
Communication between boxes.....	Radio link 433Mhz (range: 400 m free line-of-sight)
Power supply to main box.....	4 x AA (NiMH or Alkaline)
Power supply to sensor box.....	3 x AA (NiMH or Alkaline)
Autonomy.....	Main box 13h in use and 35h on standby Sensor box 25h (NIMH 2500mAh rechargeable batteries under full use)
Dimensions.....	Main box 210 x 105 x 41 mm Sensor box 160 x 82 x 41 mm
Weight.....	Main box 510 g Sensor box 310 g

Prerequisites for producing a report on a computer:

- ✓ LibreOffice or OpenOffice with a supporting operating system and hardware configuration.
- ✓ SD card reader.

PS: A portable version of LibreOffice is supplied on the SD card. This will let you produce a measurement report or export measurements to a Microsoft Office or other format without installing the LibreOffice suite. Nevertheless, it is preferable to install this suite on your computer.

D USE

SOLIA Concept shall not be liable if the appliance is incorrectly used or the results are erroneously interpreted.

D.1 Introduction

The STC (Standard Test Conditions) are the normal conditions under which the characteristics of the panels are tested. These are the values that are given in the manufacturers' documents. They correspond to radiation of 1000W/m^2 , a cell temperature of 25°C and a light spectrum of 1.5 AM (Air Mass).

These STC conditions are used to standardise the values for power, I_{sc} and V_{oc} for the panels as stated by the manufacturers, allowing them to be compared.

As the on-site measurement conditions are different to these conditions, it is difficult to compare the measured power with the stated power. This is why the SOLIAMETRE measures the radiation from a crystalline cell, together with its temperature. This is used to recalculate the measured characteristics and to correct them as STC values. Thus, the difference between the test conditions in the laboratory and the test conditions on-site are compensated. The measurements are then comparable with the manufacturers' data.

For proper correction to STC, the temperature coefficients of the modules (Alpha, beta and k) must be known and entered into the appliance. The coefficients are generally given in the technical data sheets for the modules. If these conditions are not fulfilled, the calculation of the STC values and the analysis of your photovoltaic generator will be less accurate or erroneous. The stronger the radiation and the closer the cell temperature to 25°C , the more accurate the correction to STC will be.

Reference for STC corrections: Standard IEC 60891 Version 2.0 2009-12.

Reference for the calculation of series resistance for the photovoltaic generator: "19th European photovoltaic Solar Energy Conference, Paris, France, 7-11 June 2004, Paper No 5BV.2.70".

The average values of the temperature coefficients (by default in the appliance) are approximate data for crystalline generators.

D.2 Conditions required

To correctly analyse your photovoltaic installation, the following conditions are necessary:

→ A minimum amount of sunshine: 400 W/m^2 is a good approximation.

In order to minimise the effects of angles, avoid periods during which the sun is low (beginning and end of the day) and prefer the sun at the zenith. Also be careful of azimuths greater than 45° in relation to the sun because the radiation measurement may be erroneous.

→ Stable weather conditions during the measurement (duration of measurement: 10 ms).

Low wind (less than about 1 m/s or 4 km/h) is preferable, because photovoltaic modules may be subject to rapid temperature variations in case of high wind.

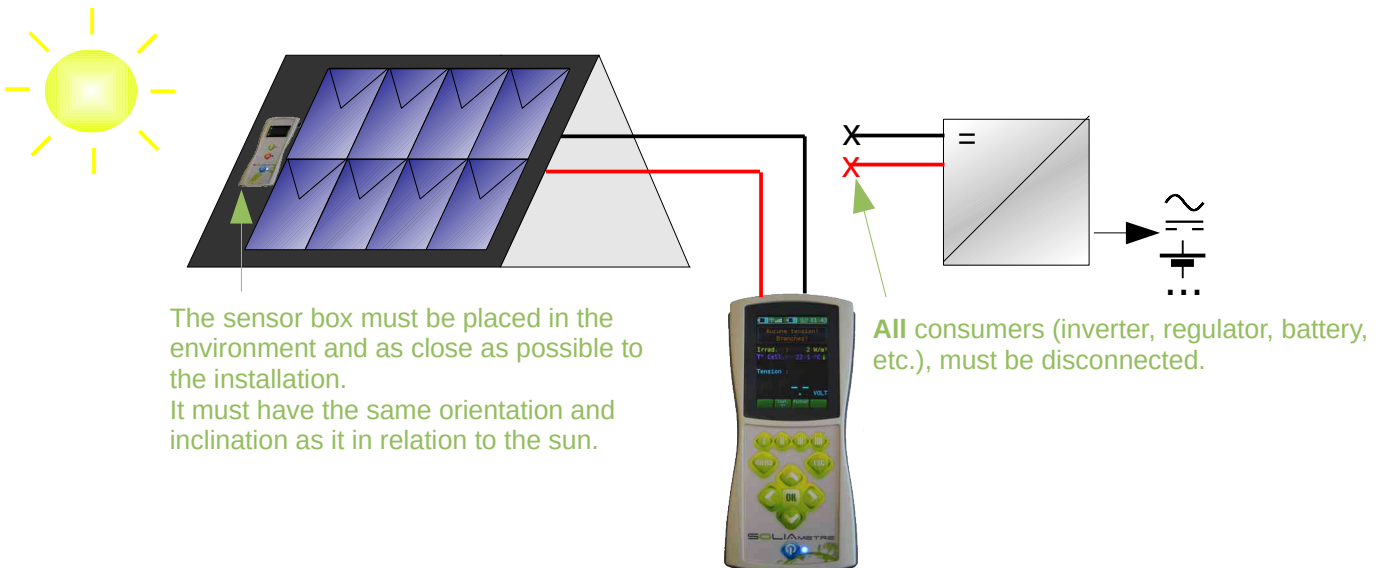
D.3 Preparing to take the measurement

1. Check the level of the batteries (status bar at the top of the screen) and recharge or replace them if necessary.
2. Insert the SD card (supplied with the delivery) in the main box. This lets you export measurements from your SOLIAMETRE to a computer. The slot is located in the lower part of the box.
3. Check the state of the measurement cables and always use cables in good condition
4. If you do not wish to take measurements with an STC correction, it is not necessary to use the sensor box. Go directly to point 8.



5. Place the sensor box as close as possible to the panels, at a representative point of the installation, paying attention to zones of shadow and to the albedo (ratio of the solar energy reflected by a surface) of the environment, which influence the radiation measurement. The sensor box must have the same orientation and the same inclination as the panels in relation to the sun without creating cast shadows. The environment of the modules may also affect the temperature of the cell. On an installation of several rows of modules, a difference in temperature may exist between the top and bottom of the installation. In this case, place the box in the middle of the installation. To attach the box, remember to use the universal clamp supplied.

6. Switch on the box by holding down the ON/OFF button for several seconds.
7. Let the sensor box rest for about 15 min. This is because to obtain a reliable measurement, the sensor box must be exposed to the installation environment for a while to stabilise the temperature and the radiation.
8. Disconnect all consumers connected to the photovoltaic generator, such as inverters.
9. Switch on the main box, by holding down the On/Off button. The radiation and the temperature of the cell should be displayed. If they do not display, move the main box closer to the sensor box until the data is displayed. If no communication occurs, switch off both boxes. Check the status of the boxes and the batteries, then switch both boxes back on.
10. To make the STC corrections, you must enter the temperature coefficients of the measured modules via the menu / T° Coefficient, enter the new values in accordance with section D.7.4.2 "Entering numbers" on page 15. These coefficients are given in the technical documentation for the modules. Average values for crystalline modules are given by default (default values). **To use the functions of comparisons, curves and defects on the theoretical data, the theoretical characteristics of the PV generator must be informed via "theoretical data".**
11. Connect the main box to the photovoltaic generator in place of the consumer. Pay attention to the polarity when connecting the box!



You can now take your measurements.

D.4 Taking the measurement

Once the main box has been connected, the voltage appears on the screen, together with the radiation and the temperature.

When the message banner tells you to, check on the screen that the radiation and temperature are stable and start the measurement by pressing the OK button.

A page is displayed on the screen showing the state of the measurement. If communication with the sensor box is established, all of the data is available directly after the measurement (measured values and STC). If communication is broken during the measurement, only the characteristic measured is available and a link activates on the main page to recover the missing data when communication is re-established.

On the main page, a section displays the appliance status. Always read what is specified in the status banner and, in case of a fault, see paragraph D.7 Main box, on page 13, for more details.

To be certain that the measurement taken is correct (no disruptive external elements), repeat each measurement two or three times.

To assist you in your analysis, see paragraph E Diagnostic support, on page 28. If a fault appears (curve deformed, STC power low, etc.), contact the installer and, as required, the module manufacturer for more information.

D.5 Processing the measurement

D.5.1 Processing the measurements and analysing the results

You can now display the results and use the various menus available in your SOLIAMETRE.

To access the various functions, press the "menu" button and use the navigation arrows, the OK button to validate and the ESC button to exit.

Remember to save your measurements using the "Saving measurement" menu. You are prompted to enter a name and a description to identify them.

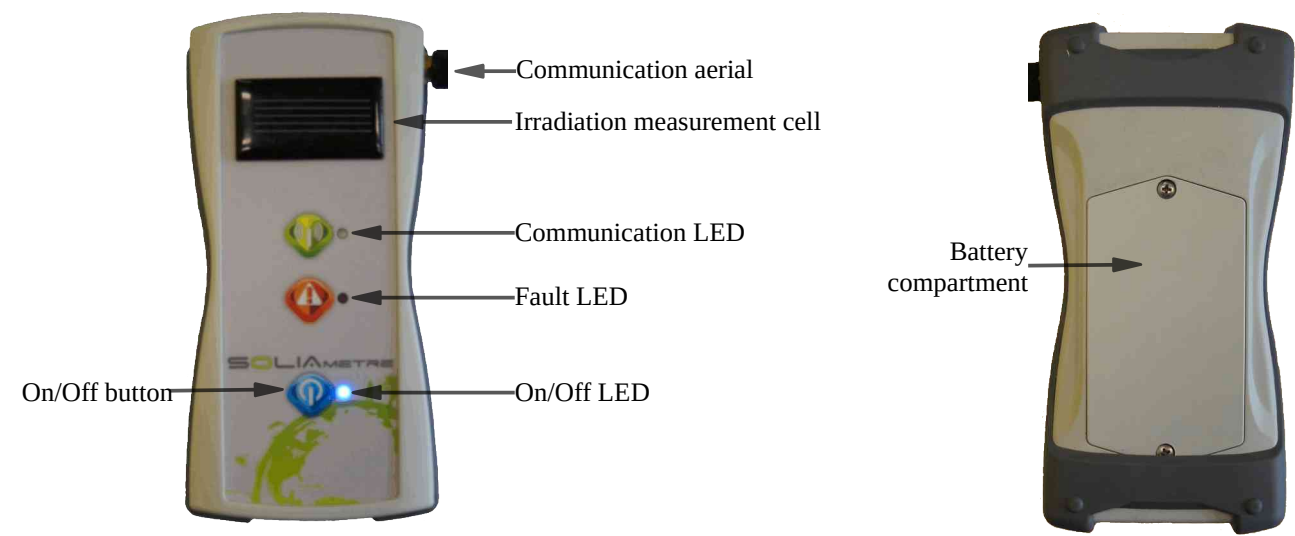
D.5.2 Use on a computer

The files saved on the SD card can be recovered via an application.

5. Open the "PVSoliametre" file and import the TESTFILE.txt file (present in the root of the SD card) to access and sort all your measurements, then automatically produce a report.

D.6 Sensor box

D.6.1 Presentation



D.6.2 Function

The sensor box measures the irradiance and the temperature of the photovoltaic cells in the plane of the panels or the installation. A radio link with the main box returns this data, which is used to correct the measured data to STC.

A monocrystalline cell is used to measure the irradiance. It can measure within the light spectrum of crystalline silicon (mono or poly). For any other type of module to be characterised (amorphous, CIGS, etc.), a measuring cell of similar technology to the module must be used. In this case, contact your reseller.

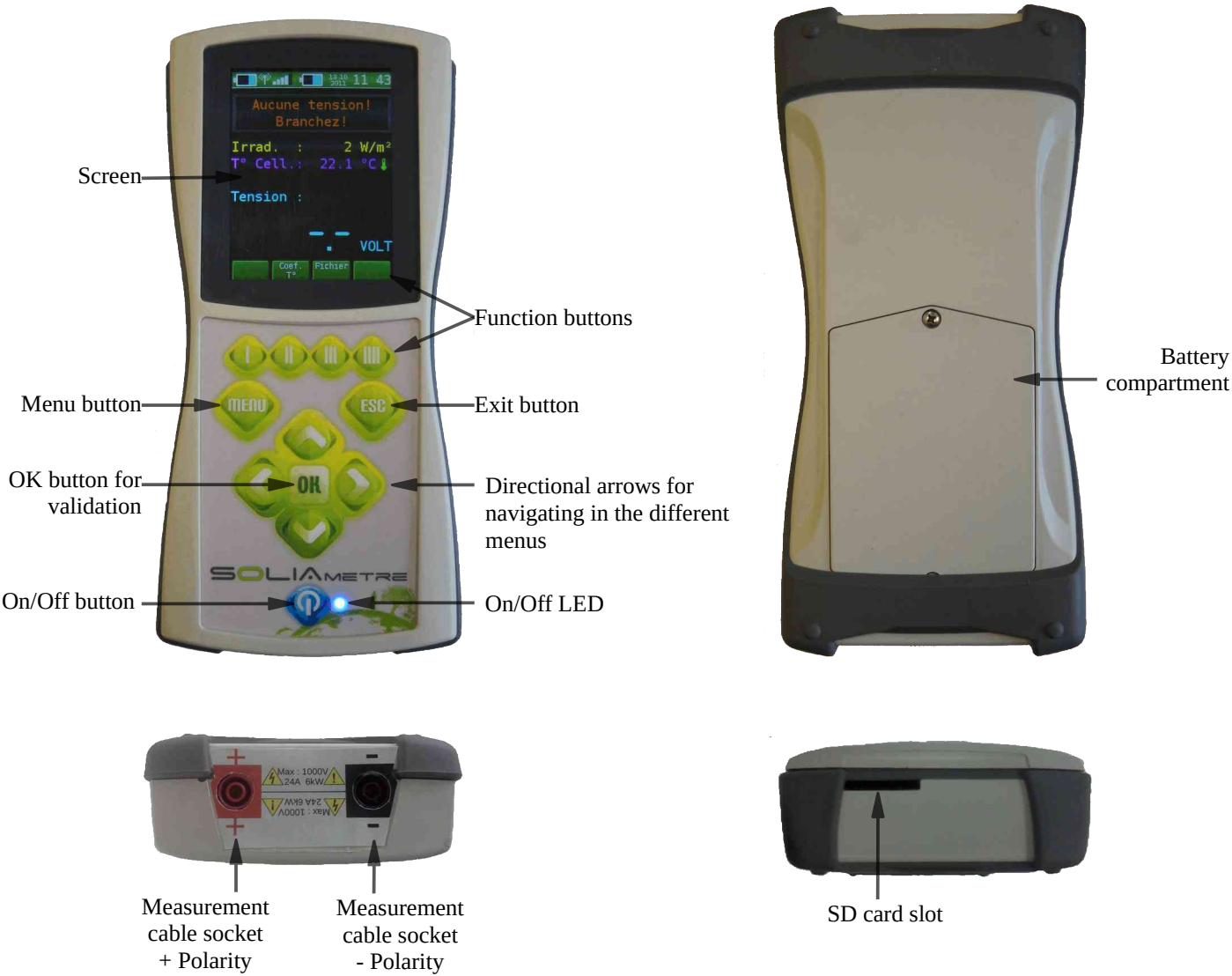
D.6.3 Status



LED	Status	Comment
Blue	Off	The box is off.
	On	The box is on.
Green	Off	Communication with the main box is interrupted.
	Flashing	Communication with the main box is in progress.
Red	Off	No fault detected. The box is working correctly.
	On	A fault is detected. Check the battery and the temperature of the box via the "SB informations" menu on the main box.

Note: This box has an automatic switch-off system. If no communication with the main box is performed for 30 min and the radiation measured is less than 50 W/m² (enclosed environment), the box will automatically switch off.

D.7 Main box

D.7.1 Presentation



-  Read all instructions!
-  Caution – risk of electric shock!

D.7.2 Function

The main box performs the measurement of the photovoltaic generator's I-V characteristic and calculates its correction to STC values. It has a 3.5 inch LCD screen and a user interface. It can analyse and process data and save it on the SD card.

D.7.3 Personalising the main box

When starting the box for the first time, you will be asked to choose the language, to set the date and time and to choose the temperature units.

However, these parameters can be adjusted at any time.

Language configuration: Menu / Parameters / Language, select the desired language and press OK to validate.

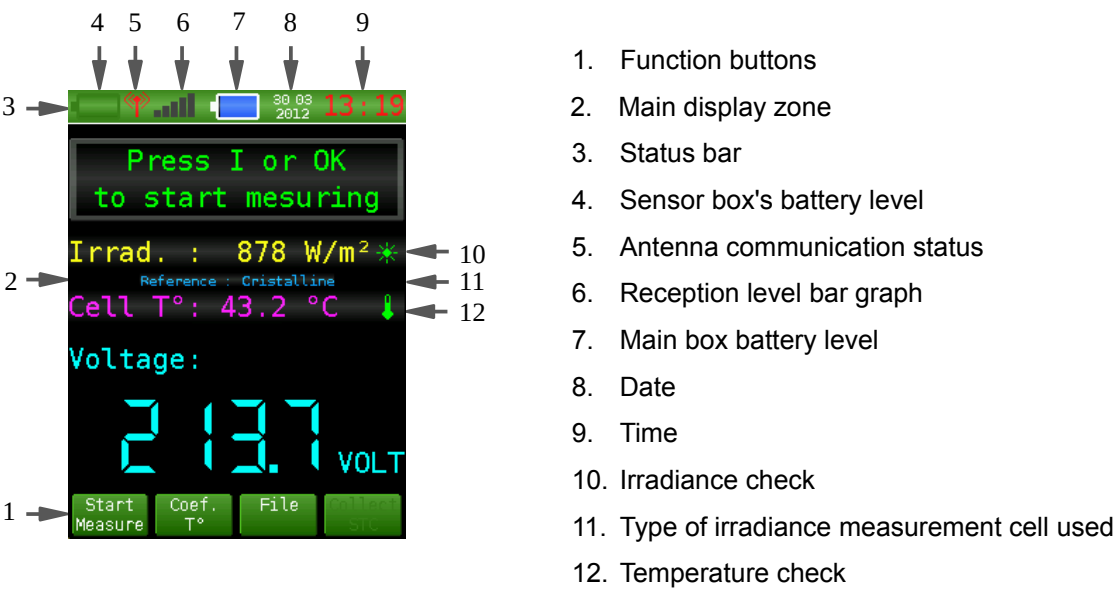
Adjusting the date and time: Menu / Parameters / Time setting, enter the new values in accordance with section D.7.4.2 Entering numbers on page 15.

Adjusting the temperature box: Menu / Parameters / Temperature unit, select the desired temperature units and enter OK to validate.

You can also choose the background colour: Menu / Parameters / Color theme, select the desired colour and enter OK to validate.

D.7.4 User interface

D.7.4.1 General information



Function buttons: They are specific to each menu and may act as shortcuts or activate functionalities that are related to the current menu. They are directly actioned by the buttons marked I, II, III and IIII located below the display.

Status bar: It is fixed and is found in all of the SOLIAMETRE's menus. It can tell you the date, the time, the battery levels of both units and the communication status.

Communication status: If the aerial remains red, the connection is cut, if it flashes green, the communication is established. The bar graph on the right gives the level of reception. If a counter replaces it, it gives the time remaining before the loss of temperature and irradiation information recorded in case of a measurement taken during loss of communication.

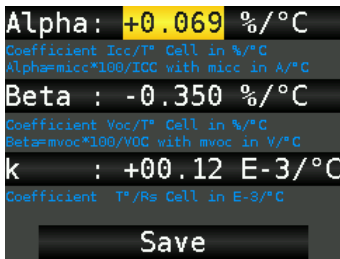
Irradiance check: This pictogram goes green when the irradiance is stable and is above the minimum level to make STC corrections (modifiable via the "STC Parameters" menu). Otherwise, it is red.

Temperature check: This pictogram goes green when the temperature is stable. Caution: this pictogram is an approximate guide. You should check that the temperature displayed is consistent with the ambient environment (this is because the temperature rise can be very quick upon installation and subsequently relatively slow).

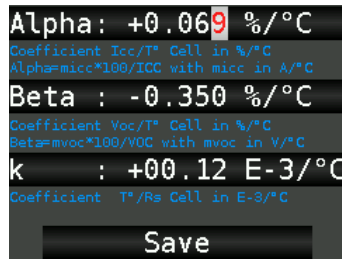
Tip! Pressing function buttons I and IIII simultaneously at any time will take a screenshot, which is saved on the SD card in the "Screen" directory. While saving, the time is displayed in red to warn you that the screenshot is in progress.

D.7.4.2 Entering numbers

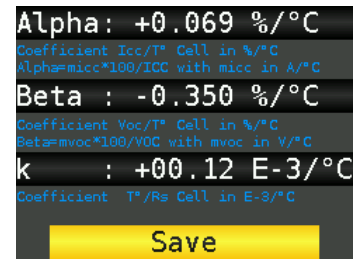
Numbers are entered figure by figure:



Screenshot 1



Screenshot 2



Screenshot 3

1. Select the desired number using the up and down arrows and press the OK button (Screenshot 1).
2. Select the figure that you wish to change using the left and right arrows (Screenshot 2).
3. Select the value of the figure that you want using the up arrow (to increase) or the down arrow (to reduce) and press the OK button to validate the number, or select another figure using the left and right arrows.
4. When the desired values are entered, select "Save" and press the OK button to validate (Screenshot 3).

D.7.4.3 Entering text

Text is entered using a virtual keyboard:




Screenshot 4



Screenshot 5



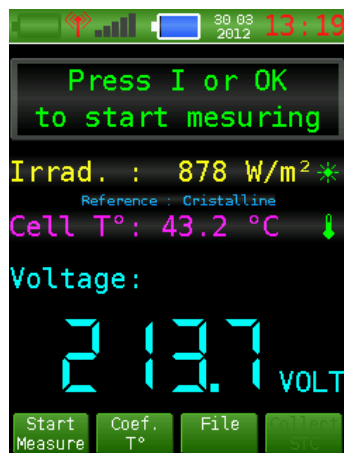
Screenshot 6

1. The number of characters is limited. The number remaining is indicated above the entry zone (on the top left).
2. Characters are selected using the directional arrows. Press OK to enter the desired character or select  then press OK to delete the previous character.
3. Press the | button to go into uppercase. Press again on | to return to the lowercase keyboard (Screenshot 4).
4. Press the button || to display a list of keywords. Press again on || to return to the normal keyboard. (Screenshot 5).
5. Press the button ||| to be able to move the cursor. Press again on the button ||| to return to the keyboard and make corrections (Screenshot 6).
6. Press the button |||| to validate your entry.

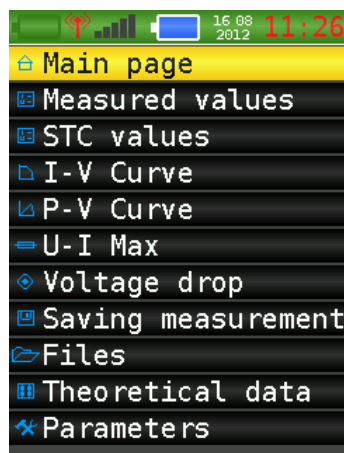
D.7.5 Functionalities

Different functions are offered and are accessible via the menu or the function buttons according to the page present on the screen. They let you analyse the measurements made directly on the installation site. The main functionalities are listed below.

D.7.5.1 Main page and menu



Screenshot 7



Screenshot 8

The main page (Screenshot 7) is SOLIAMETRE's initial page. It displays the main data for taking a measurement. The instantaneous radiation, temperature and voltage are displayed. **Measurements can be started from this page only.** If a measurement is waiting for communication, the function button |||| lets you recover the data. A message banner displays the status of your SOLIAMETRE. For more details, the table below is a summary of the messages that appear on the screen.

The menu page (Screenshot 8) is accessible directly via the Menu button. It lets you navigate within the different menus and functions.

Message	Meaning	Comment
No voltage!	No voltage detected.	No photovoltaic generator connected.
Low voltage!	Low voltage, less than 10V.	The voltage of the generator must be greater than 10V to take a measurement.
Voltage too high!	The measured voltage is too high.	The maximum acceptable voltage is 1,000V.
Leakage current!	A current is detected in SOLIAMETRE's measurement circuit that is not related to a measurement.	Immediately disconnect the photovoltaic generator and contact your reseller!
SB Temp. too high!	The temperature of the sensor box is above 65°C.	Switch off the box and shelter it from heat and the rays of the sun.
MB Temp. too high!	The temperature of the main box is above 65°C.	Switch off the box and shelter it from heat and the rays of the sun.
SB cell low!	The sensor box's batteries are very low.	Recharge or replace the batteries.
MB cell low!	The main box's batteries are very low.	Recharge or replace the batteries.
Internal error!	An error internal to the appliance has occurred.	Contact your reseller.
In thermal equilibrium!	The measuring system is dissipating the energy accumulated during the measurement.	Wait for a few seconds.

These alerts or faults prevent a measurement from being started. This lets you prevent possible damage and breakdowns.

D.7.5.2 Measurement page



Screenshot 9



Screenshot 10

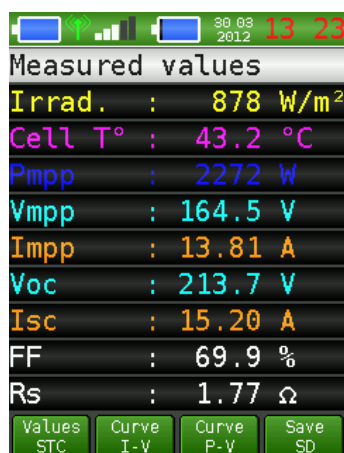
This is the page that is displayed when you start a measurement.

The "Measure in progress" page (Screenshot 9) is displayed on the screen during the measurement. **From its appearance and until it disappears, the measurement cables must under no circumstances be disconnected and/or the appliance switched off.**

The summary page (Screenshot 10) is the page that is displayed at the end of the measurement or recovery of STC data. It indicates the status of the measurement (see the table below for the details of these messages) and the power measured and its correction to STC values (if sensor data available). The function buttons then give direct access to the pages for the main characteristics or the page for the I-V curve as well as the backup page.

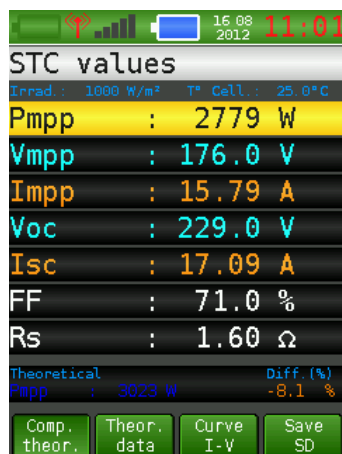
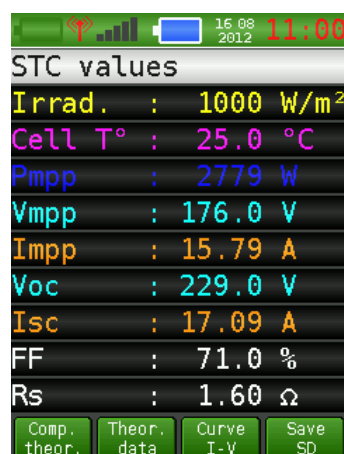
Message	Description
Successful measure!	The measurement was successful and the measured data and its correction to STC values are available.
Cell T° Variation or Irrad. too high	The temperature or the radiation have varied during the measurement. Start the measurement again. The threshold can be set or deactivated via the menu: STC parameters (see following menu).
Irrad. too low for STC correction	The irradiation is too low to perform an STC correction. The threshold can be set or deactivated via the menu: STC parameters (see the following menu).
STC pending...	In case of a communication break while a measurement is being taken, the SOLIAMETRE puts the STC corrections on standby. In this case, remember to insert the SD card. If the SD card is inserted, the measurements will be temporarily and automatically stored. In this way, several measurements can be taken in a row before recovering their data on irradiance and cell temperature. If the SD card is not present, only the last measurement taken remains on standby . As the sensor box records the last 20 min of radiation and temperature, move it near to the main box and recover the values using the function button in the main page before the end of the counter. If the time is exceeded, the data will be lost. Do not switch off the sensor box or the main box as long as the data is not recovered, otherwise it will be lost. Also, do not remove the SD card while waiting for data.
Data not saved	If communication is lost, the data on temperature and irradiation for the last 20 min is recorded. If this time is exceeded, the data is lost. This message is also displayed if the sensor box was not functioning during the measurement.
Measure error! Equipment default!	A fault has been detected in SOLIAMETRE's measurement circuit. Contact your reseller for repairs.
Current variation too high!	The current measured varied abnormally during the measurement cycle (including 2 measurements). Start the measurement again. This message may also appear if a module malfunctions. If the message is repeated several times, check the short-circuit current and the no-load voltage of the module using a multimeter. It is possible that the module has a no-load voltage but only discharges a low current at random.
Fault detected!	A fault was detected on the characteristic measured. See curve!
OFF SCALE	The values measured are outside the measurement or display range.
Power too high!	The measured power is too high and the measurement has been stopped before the end of the measurement cycle. The accuracy of the values displayed is more reliable.

D.7.5.3 Measured values.



This is the page that summarise the main characteristics of the measured photovoltaic generator. They easily let you see the radiation and the temperature of the cell during the measurement, as well as the Pmpp, Vmpp, Impp (power, voltage and current at the maximum point of power), Voc (open-circuit voltage), Isc (short-circuit current), Rs (series resistance) and FF (form factor).

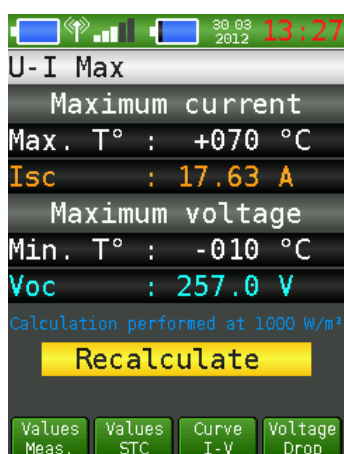
D.7.5.4 STC values



This page provides the same characteristics (Pmpp, Vmpp, Impp, Voc, Isc, FF, Rs) that previous page but corrected in STC conditions. These values are calculated from radiation and temperature data and the temperature coefficients alpha, beta and k according to the standard IEC60891. They let you compare the values measured with the values provided by the manufacturer. If the data on radiation and temperature is not collected following a communication problem, the STC values are not available.

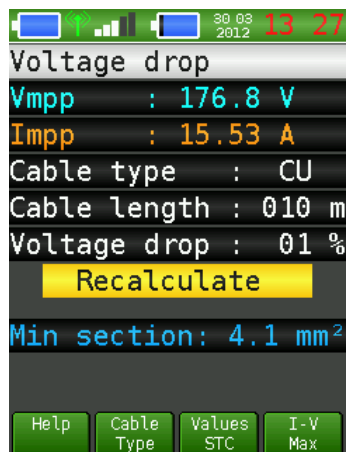
The function button I allows to compare the corrected STC values and the theoretical values of the generator. The theoretical data must be informed via the menu "Data theoretical". You can compare the actual data measured with the theoretical data for valid the conformity.

D.7.5.5 U-I max



This page lets you calculate the maximum values for open-circuit voltage and short-circuit current for extreme temperatures. These values are used to dimension an inverter, a regulator or any type of consumer and let you check compliance with the conversion system installed. The temperatures are configurable, with defaults of -10°C minimum and +70°C maximum. In case of modification, enter the desired values, then select "Recalculate" and press the OK button. The new values are calculated and are immediately displayed. The values used for the calculation are the corrections to STC (1000 W/m², spectrum 1.5 AM).

D.7.5.6 Voltage drop



This page lets you calculate the minimum cable section for the measured solar installation. It follows the standard NFC 15-712-1 (revised July 2010), which provides the following calculation conditions:

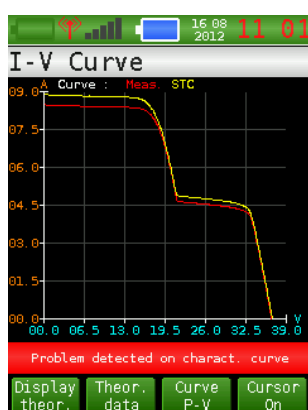
- Maximum voltage drop of 3%.
- Resistivity of cable: resistivity x 1.25.
- Reference voltage: Umpp STC.
- Reference current: Impp STC.

The type and length of cable between the appliance and the modules, and the desired voltage drop, are configurable. In case of modification, enter the desired values, then select "Recalculate" and press the OK button. The new section is calculated and is displayed immediately.

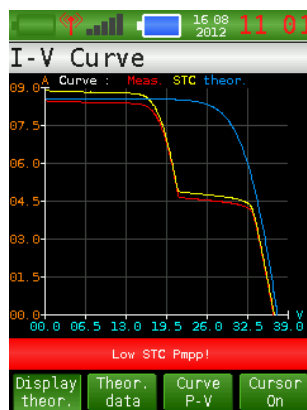
Note: The values corrected to STC are necessary for the U-I max and Voltage Drop function.

D.7.5.7 I-V curve and P-V curve

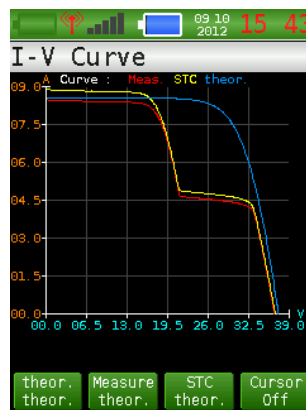
These are two pages for displaying the measured, STC and theoretical curves. The I-V curve shows the current according to the voltage, while the P-V curve shows the power according to the voltage.



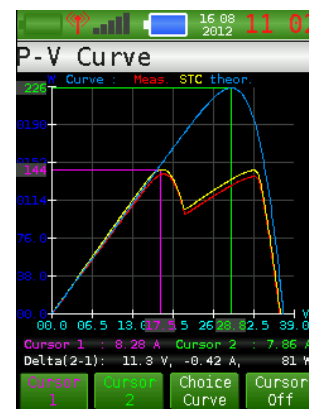
Screenshot 15



Screenshot 16



Screenshot 17



Screenshot 18

The SOLIAMETRE help you in the diagnostic study in analysing your measurement and showing the next messages :

Message	Meaning	Comment
Problem detected on charact. curve	"Intelligent" algorithm search a "break" in the I-V curve.	To detect for example a cell or cell shaded string or cell failure that causes a current to flow through a bypass diode.
Fill factor too low! <0.6	Comparison the fill factor with a low value of 60% for crystalline modules.	Indicates poor quality of the PV generator generally related to high series resistance.
Delta Mpp STC/Theoretical >10%	The corrected values mpp STC are lower or higher over 10% to the theoretical values.	Indicates a large difference between the theoretical power and the power corrected at STC.
Delta Isc STC/Theoretical >10%	The value of short-circuit current is lower or higher by more than 10% of the theoretical value.	Indicates a large difference between the theoretical short-circuit current and the corrected short circuit corrected at STC.
Delta Voc STC/Theoretical >10%	The value of the open-circuit voltage is less than or more than 10% of the theoretical value.	Indicates a large difference between the theoretical open circuit voltage and the open circuit voltage corrected at STC.
Rs STC > Theoretical + 20%	The value of the series resistor is higher by more than 10% of the theoretical value.	Indicates a series resistance corrected at STC greater than the theoretical value.

To fully use the functions related to the theoretical curves, the theoretical characteristics of PV generator must be informed via the menu "Theoretical data".

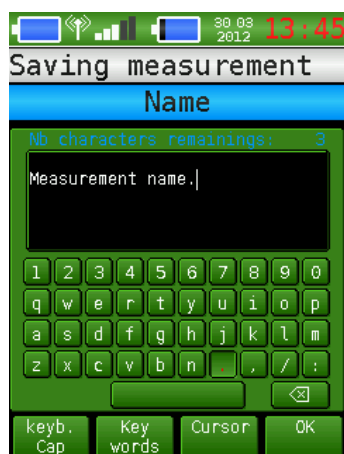
To better understand the reasons for these messages and diagnose your installation please refer to "A Practical Guide to photovoltaic analysis " available on our website.

The theoretical curve of the system can be displayed with the function button |.

Cursors may be actioned using the function button |||. They let you navigate between the curves, let you see the values of particular points and the delta between two points. Use of cursors:

1. Press the button ||| to activate the cursors.
2. If theoretical curve is display or not, three types of cursors may be selected (Screenshot 16). For example, if the theoretical curve is displayed, the button function ||| gives you a cursor on the STC curvea and the other on the theoretical curve (Screenshot 17).
3. Select the cursor with the function buttons | and || and browse on the curve with the right and left arrows (Screenshot 18).
4. Press the function button ||| to change the type of cursor or |||| to deactivate the cursors.

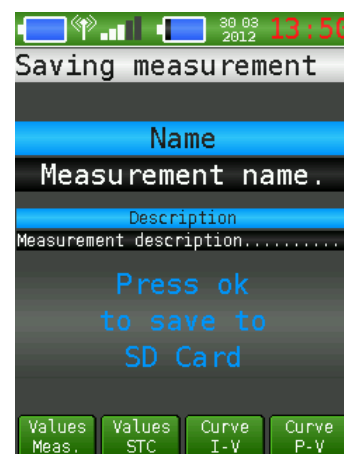
D.7.5.8 Saving



Screenshot 19



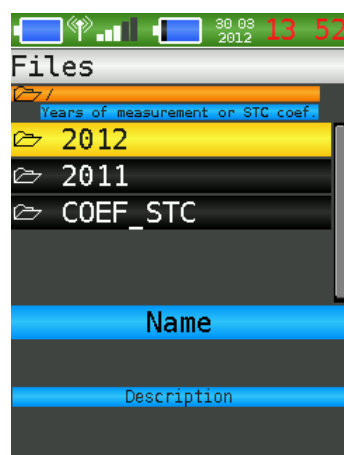
Screenshot 20



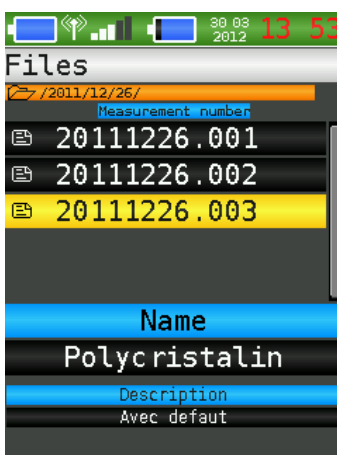
Screenshot 21

This page lets you save the measurements taken or the STC coefficients. You are prompted to enter a name (Screenshot 19) followed by a description (Screenshot 20). This enables you to easily find your files on your computer or from your SOLIAMETRE (see following menu).

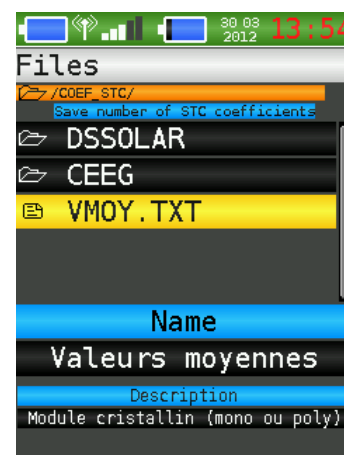
D.7.5.9 Files



Screenshot 22



Screenshot 23



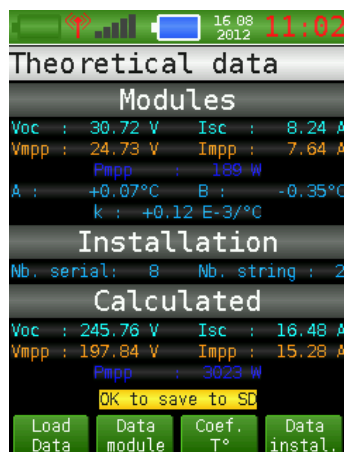
Screenshot 24

This menu lets you reload old measurements that have been taken or STC coefficients that have been saved. The name and description appear when you browse in valid files.

The measurements are sorted by date as follows: year, month, day and number.

The SD card must under no circumstances be withdrawn or the SOLIAMETRE switched off when reading or writing files: risk of damage to card.

D.7.5.10 Theoretical data

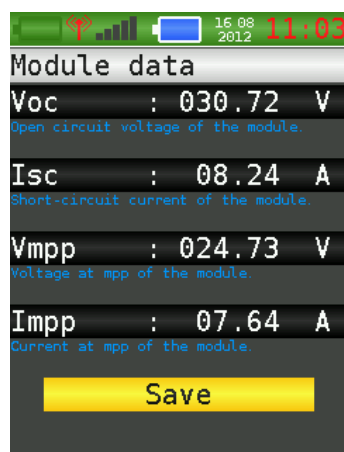


This page summarise the theoretical data of the PV generator. It allows access to different pages for enter, save and reload the theoretical data on SD card.

- > The function button I allows reload data on the SD card.
- > The function button II allows access to the module data.
- > The function button III allows access to the module coefficients temperature.
- > The function button IIII allows access to the composition of the installation.
- > The OK button saves all the data on the SD card. You are prompted to enter a name followed by a description. This files can be viewed and modified with a computer and a standard text editor.

To fully use the functions related to the theoretical curves, the theoretical characteristics of PV generator must be informed via the menu "Theoretical data".

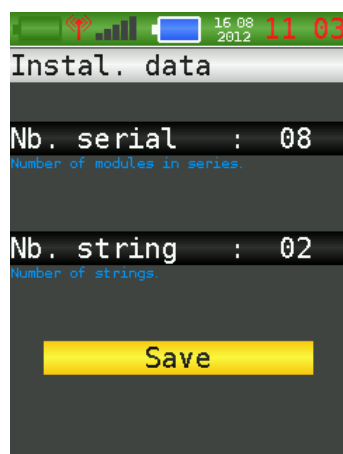
D.7.5.11 Module data



This page allows entry the theoretical data of module. These data are given in the manufacturer datasheet. Enter the value of Voc (voltage open circuit), Isc (short circuit), and Vmpp Impp (voltage and current the maximum power point).

Caution: Do not forget to save by selecting "Save" before exiting.

D.7.5.12 Installation data

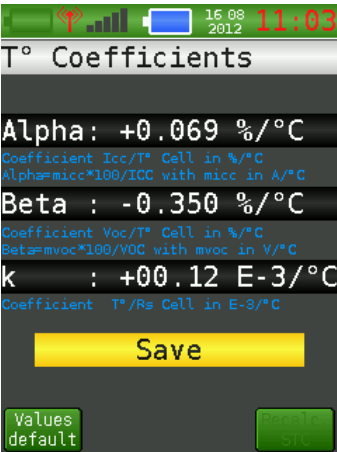


This page allows entry the composition of the PV system. Enter the number of modules in series and the number of strings.

For a single module measured, the number of modules and string is 1.

Caution: Do not forget to save by selecting "Save" before exiting.

D.7.5.13 *Temperature coefficient*



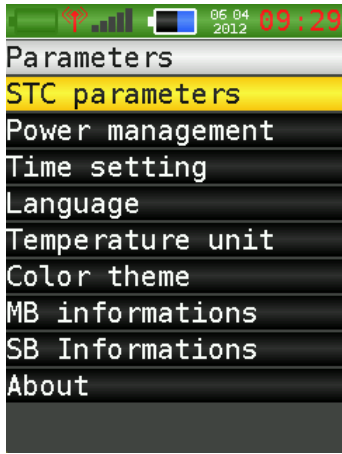
This page lets you enter the temperature coefficients for the photovoltaic generator that you are measuring. They are used during the correction to STC. These values are available in the documentation from the manufacturer of the module. If you do not know them, the default average values are given for crystalline modules (mono or poly).

- The function button I lets you return to the default values.
- The function button II returns to the file menu to reload the coefficients saved on the SD card.
- The function button III appears after saving. It lets you save the current coefficients on the SD card.
- The function button IIll also appears after saving if the irradiance and temperature data are available. It lets you correct, to STC values, the last measurement taken with the new coefficients.

Caution: Do not forget to save by selecting "Save" before exiting.

Coefficient	Description	Comment	Average value
Alpha	Temperature coefficient of short-circuit current	The value must be recorded as a percentage. If a manufacturer's value is given in A/°C (mIsc) Alpha = mIsc*100/Isc(stc).	Between 0.04 and 0.098 %/°C
Beta	Temperature coefficient of open-circuit voltage	The value must be recorded as a percentage. If a manufacturer's value is given in V/°C (mVoc) Beta = mVoc*100/Voc(stc).	Between -0.24 and -0.45 %/°C
k	Temperature coefficient of the series resistance	The value must be recorded on the power 1E-3.	Between 4.0 and 10.00 E-3/°C.

D.7.5.14 *Parameters*

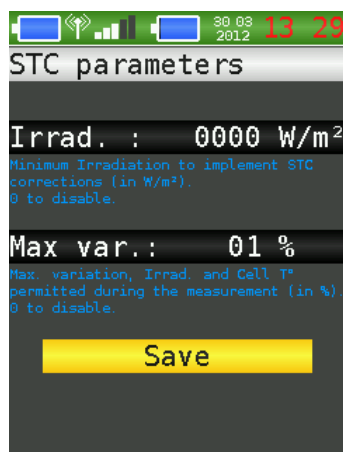


This sub-menu lets you access the parameters for your SOLIAMETRE:

- STC parameters
- Power management
- Time setting
- Language choice
- Choice of temperature units
- Choice of colour theme.

The information pages give certain data that is internal to the SOLIAMETRE (main box MB and sensor box SB), such as their serial number, calibration date, temperature, and their different battery voltages. The "STC parameters" and "Energy management" menus are detailed below.

D.7.5.15 STC parameters

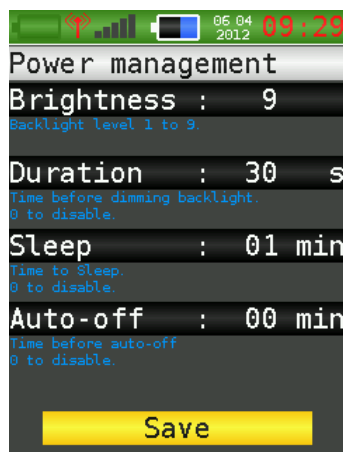


Two parameters that prevent errors during correction to STC may be modified from this menu:

- The minimum irradiation required below which the correction to STC is no longer performed (see above paragraph "[Usage conditions](#)").
- The maximum variation in irradiation and temperature during the measurement (the standard IEC60891 gives a maximum variation of 2%).

Note: These parameters can be deactivated by entering the value 0 for their respective values.

D.7.5.16 Power management



The power management parameters let you set the power saving system that is present in your SOLIAMETRE. This system lets you extend the life of your batteries, so you can use your SOLIAMETRE for longer without recharging them. The system comprises three stages that occur one after the other if you do not use your SOLIAMETRE (no press on any button):

- The backlighting dims after the specified period.
- Sleep mode is activated once the backlighting has dimmed (if active) after the specified period.
- Automatic switch-off occurs once sleep mode has been activated (if active) after the specified period.

Note: The different stages can be deactivated by entering the value 00 as their respective values.

Note: When on sleep mode, the screen switches off and the blue LED flashes. Press and release the On/Off button quickly to wake up your SOLIAMETRE.

Parameter	Comment
Brightness	The level of screen brightness, adjustable from 1 to 9.
Duration	Time before backlighting automatically dims.
Sleep	Time before automatically going into sleep mode.
Auto-off	Time before automatic switch-off.

D.7.5.17 Automatic measure

This menu is accessible with the function button III on the main page. It allows to programme and launch automatically a series of measures. All measurements are recorded on the SD card.



For program your series of steps, you must enter the desired number of measurements ("Nb. Measure"), the time interval between two measurements ("Interval") and the start delay ("Delay. "). After you can enter a name.

Measuring and recording are automatically. The time and the number of measurements remaining are displayed between measurements. The values of the measured power and the corrected power at STC are also displayed. If the values are replaced by dashes, an error is occurred during the last measurement. The serie continue, except error on SD card. The recording on the SD card is automatic with the name informed. A description is create automatically with the number, date and the time of measurement.

D.8 Use on a computer and the measurement report

Caution: The files are saved in specific directories that are created automatically. They should not be moved and neither should the names of these directories or their files be changed. Changing them may cause errors during navigation and make it impossible to reload the files with your SOLIAMETRE or from your computer via the report file.

D.8.1 Measurement report

The values measured may be recorded on the SD card (see the "Save" menu in the previous paragraph). The data thus saved can be reused on a PC via an interface created directly on a spreadsheet. In this way, you can create your own curves or highlight the most interesting values. A customisable measurement report is also supplied to substantiate a written record of a measurement. **To use this function, you can use LibreOffice Portable supplied on the SD card or install the "LibreOffice" suite (<http://www.libreoffice.org>). Think to enable macros to run.**

How to install LibreOffice: <http://www.libreoffice.org/get-help/installation/windows/>

If you do not have administrative rights on your Windows computer, you can use the portable version LibreOffice: <http://www.libreoffice.org/download/portable/>



1. With LibreOffice portable : Double-click on the "SLMPV.bat" files.
With LibreOffice on your PC : open the "SLMPVxx.ods" file with LibreOffice Calc.
The last version of "SLMPVxx.ods" is downloadable from our website at: www.solia-concept.fr.
2. Once open, click on "Import the list of tests" and select LISTMEAS.TXT in the source directory on the SD card.
3. You can sort the saved measurements by date, name or description.
4. When you have chosen your saved measurement, click on "Import the selected test".
5. The completed measurement report is created in the "Report" sheet.
6. The characteristic curves are available in the "Curves" sheet.
7. All the results of the measurements are available in the "ResultsData" sheet and you can use this spreadsheet to make use of this data.

D.8.2 STC coefficients

The saved theoretical data may be created or modified from your computer. To create or modify such a file, follow these instructions:

1. In the source directory of your SD card, go into the "TH_DATA" directory (or create it – caution: the case must be exactly the same), then copy a file that is already present and rename it or create a text file and name it "xxxxxxx.txt" (8 characters maximum). For improved storage, you can create new directories in the "TH_DATA" directory (8 characters maximum, 2 sub-directories maximum).
2. **Respecting the location of the semicolons and line breaks, and in accordance with the following syntax, edit your file:**

Syntax	Comment
Soliametre;	Allows the file to be recognised by the SOLIAMETRE, followed by a semicolon.
Name: <i>Name of the record</i> ;	Name of the record (20 characters maximum), followed by a semicolon.
Description: <i>Description of the record</i> ;	Description of the record (34 characters maximum), followed by a semicolon.
A: <i>+0.169</i> ;	Parameter Alpha in %/°C. Caution: respect the following format A:+x.xxx; or A:-x.xxx;
B: <i>-0.350</i> ;	Parameter Beta in %/°C. Caution: respect the following format B:+x.xxx; or B:-x.xxx;
K: <i>+10.00</i> ;	Parameter k in E-3/°C. Caution: respect the following format K:+xx.xx; or K:-xx.xx;
Voc: <i>+30.72</i> ;	Voltage Voc in V. Caution: respect the following format Voc:+xxx.xx;
Isc: <i>+08.24</i> ;	Current Isc in A. Caution: respect the following format Isc:+xxx.xx;
Vmpp: <i>+24.73</i> ;	Voltage Vmpp in V. Caution: respect the following format Vmpp:+xxx.xx;
Impp: <i>+07.64</i> ;	Current Impp in A. Caution: respect the following format Impp:+xxx.xx;
Serie: <i>08</i> ;	Nb. of module of serie. Caution: respect the following format Serie:xx;
String: <i>02</i> ;	N. of string. Caution: respect the following format String:xx;

The easiest method is to copy an existing file:

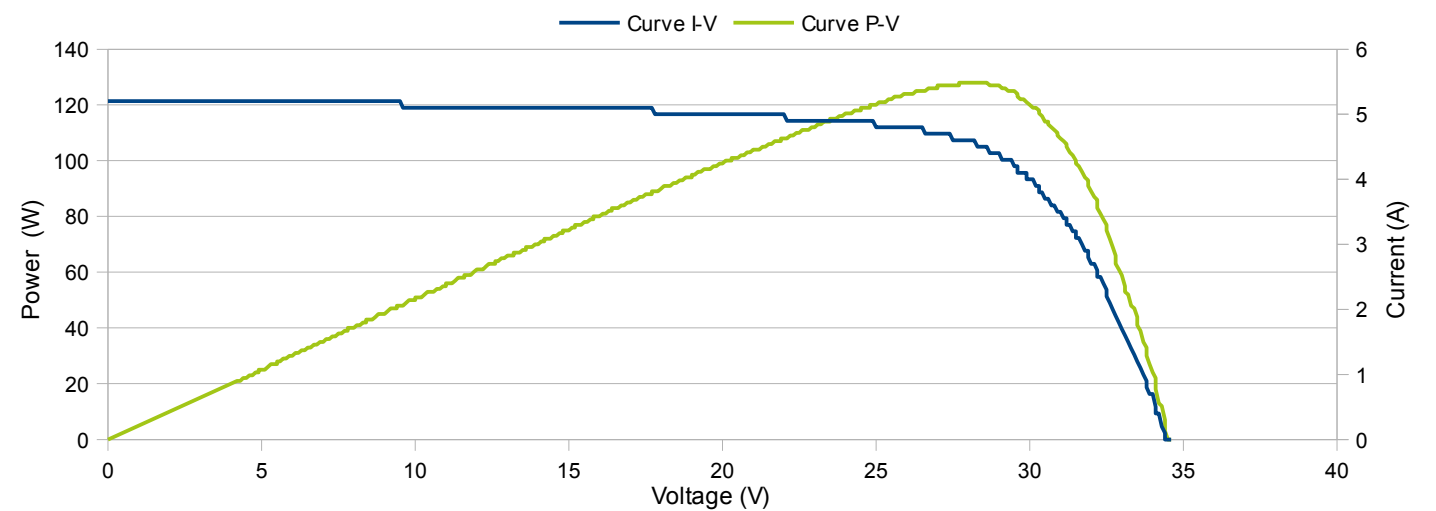
- > Copy an existing file of theoretical data on the directory "TH_DATA" on the SD card.
- > Paste it to SD card in the same directory.
- > Rename it. "xxxxxxx.txt" (8 characters max).
- > Open it with "notepad" in windows or any other text editor.
- > Change only the parameters required (in *orange italics* above).
- > Save (be careful to keep the format. Txt).

E DIAGNOSTIC SUPPORT

This paragraph provides support for the diagnostic study of your photovoltaic generator. Curves and characteristic values are given as examples showing correct functioning and frequent cases of faults on this type of installation.

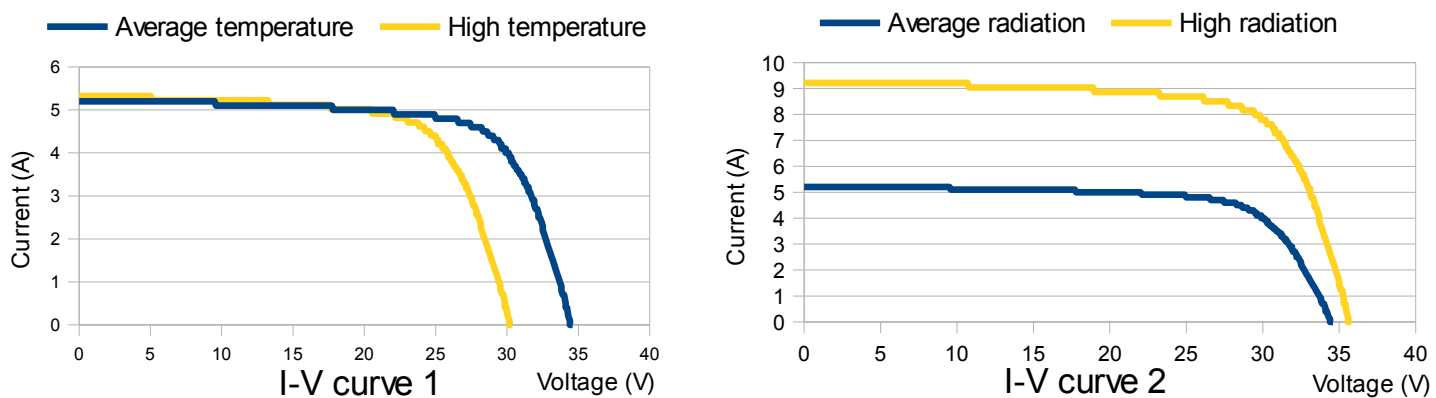
E.1 Typical characteristics of a photovoltaic module

E.1.1 Characteristic curves



The I-V and P-V curves are typical and essential characteristics of a photovoltaic generator. The P-V passes a peak known as the Maximum Point of Power. It is this point that defines the power of a photovoltaic generator when the curve is drawn under STC conditions. All photovoltaic generators without faults have these forms of characteristics.

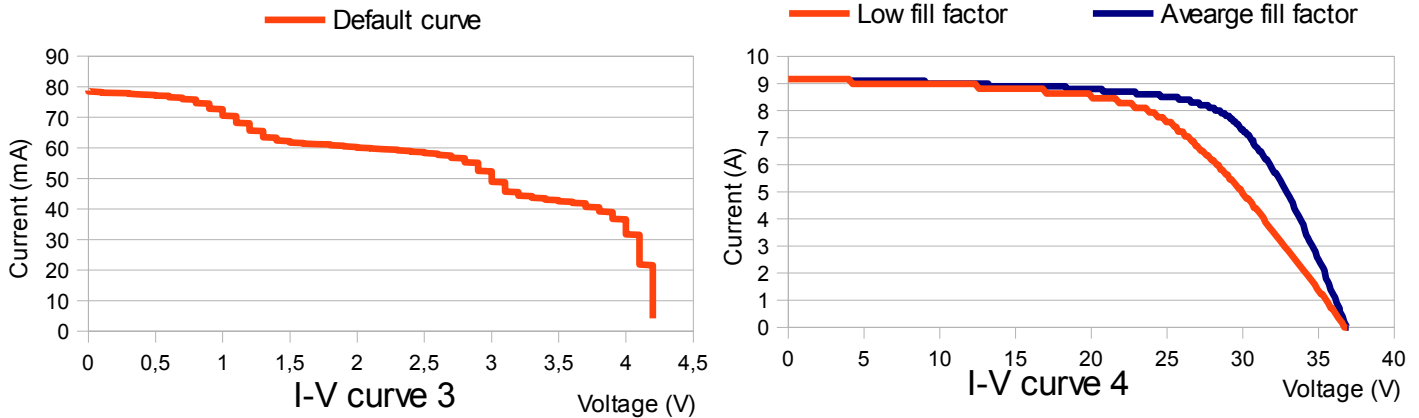
E.1.2 Effect of radiation and temperature



The temperature influences the voltage, with it dropping around 0.35% of V_{oc} per degree Celsius (I-V curve 1). On the other hand, the current increases with the temperature, around 0.07% of I_{cc} per degree Celsius.

The radiation has an enormous influence on the current with an increase in the short-circuit current that is linear with it (I-V curve 2). The voltage varies little with a slight increase in radiation. The correction to STC allows deviation to be detected and corrected, to determine the real power of the photovoltaic generator that is measured.

E.2 Frequent faults



Most faults can be detected via characteristic curves. **The shape of the current/voltage curve is an essential characteristic of a photovoltaic generator.** To detect a fault, the display of the notable characteristics (V_{oc} , I_{sc} , P_{mpp}) can only be used to detect a fault but not to explain it. However, the problem can be identified by analysing the I-V curve. Knowledge of the physics of semiconductors is preferable but, with experience, frequent faults are easily identifiable.

I-V curve 3: The curve drawn is a common I-V characteristic of a module with a fault. The "staircase" shape of the curve is typical of a module where one or more sequences of cells are bypassed by bypass diodes. **This type of fault on the module can lead to a great loss of power from the whole installation.**

- ✓ If you see this kind of "staircase" on the characteristic, first check that no shadow is cast on the module or the installation. Then check that it is clean. Shade created by dirt on a module can lead to this type of curve.
- ✓ If the installation is clean and the sequences of panels are assembled in parallel, check the installation sequence by sequence. Modules that are mounted in parallel with different orientations can cause this type of fault. In this case, pay attention to losses of power from the whole of the installation.
- ✓ If only a single module has this type of curve as a characteristic, it is very likely to be faulty. Contact the module manufacturer for more details.

I-V curve 4: The two curves are drawn for panels with the same V_{oc} and I_{sc} but with different form factors. The fill factor is the power at the MPP point divided by the V_{oc} multiplied by the I_{sc} . It allows the steepness of the curve to be assessed and thus the quality of the photovoltaic generator. **It is important to note that a simple correspondence of the V_{oc} and the I_{sc} measured with a multimeter on these two panels is absolutely no guarantee of any correspondence concerning their powers or the power displayed on the backs of the panels.** The SOLIAMETRE, by drawing the curve in its entirety, can characterise the module and check it.

The fill factor is usually influenced by the technology and/or the series resistance. The technology is the main factor that influences this fill factor. On average, the crystalline technology has a fill factor greater than 70%, while the amorphous technology has an average fill factor less than 60%. The series resistance of a photovoltaic module is the sum of the intrinsic resistances of the photovoltaic cells placed in series (so pay attention to the technology), the connection systems between cells and the connection cables.

If you find a low fill factor and a high series resistance, first check the cabling of your photovoltaic installation. If the cabling is correct, check the fill factor module by module. If the fill factor of the module is low in relation to its documentation, contact the manufacturer of the module for more details.

F MALFUNCTIONS

Problem	Probable cause	Solution
A box does not switch on.	The batteries are exhausted.	Change the batteries or recharge them if they are rechargeable.
The measured voltage is correct but the measured current is nil.	The protection fuse is inoperable.	Contact your reseller.
The two boxes no longer communicate.	The distance between the two boxes is too great or the signal is obscured.	Ensure that the aerial on the sensor box is properly tightened and bring both boxes closer together to test communication.
The appliance does not recognise a new SD card.	Note that the SD card must have a capacity of less than or equal to 2 GB. The SDHC or SDXC formats are not supported.	Replace the card with a compatible module.
The appliance cannot read the SD card.	Files or directories have perhaps been moved or are damaged.	Save any important data on the card and format it in the FAT16 format.
The time becomes incorrect at each shutdown.	The RTC battery is exhausted.	Check the voltage of the RTC battery via the menu "Parameters/MB informations". If it is less than 3V, contact your reseller.

If your problem is not mentioned and/or it persists, contact your reseller.

G TERMS AND CONDITIONS OF WARRANTY

New appliances have a 12 month manufacturer's warranty from the date of delivery. This warranty covers defects in parts and manufacture of the appliance. Each appliance is delivered with an invoice that acts as a certificate of warranty. Presentation of this document will be required when the warranty is invoked. This warranty will not be applicable if the name of the model or the serial number shown on the product has been changed, erased, deleted or made unreadable.

The benefit of this warranty is subject to correct usage and correct storage of the appliance in accordance with this manual, in which you will find all of the usage precautions. Before using your appliance, we recommend that you read it carefully.

If a product proves defective during the period of warranty, please contact your reseller. To benefit from the warranty, any product must first be subject to the examination of SOLIA CONCEPT's technical service, whose agreement is essential for it to be invoked.

Under this warranty, the only obligation that SOLIA CONCEPT will have will be the free replacement or repair of the product or the component recognised as defective by its technical services, unless this mode of compensation proves impossible or disproportionate.

This warranty covers neither transport costs nor the risks associated with journeys to deposit and recover your product at the reseller.

This warranty does not cover the following points:

- Periodic maintenance and repair or replacement of parts subsequent to normal wear and tear.
- Consumable elements and parts subject to wear that should be replaced periodically during the lifetime of the appliance.
- Damage or faults resulting from use, functioning or handling of the product that is not compliant with normal use.
- Damage caused by wilful misconduct.
- Damage or modifications caused by:
 - x Incorrect use that is not compliant with the instructions given with the appliance.
 - x Infections by viruses or the use of the product with non-supplied or incorrectly-installed software.
 - x The use of the product with accessories, peripherals and other products for which the type, the state and the standards do not comply with the instructions of SOLIA CONCEPT.
 - x Repairs carried out or attempted by persons other than SOLIA CONCEPT repairers.
 - x Modifications or adaptations carried out without the prior written agreement of SOLIA CONCEPT.
 - x Negligence.
 - x Accidents, fires, liquids, chemical products, other substances, floods, vibration, excessive heat, inadequate ventilation, voltage surges, excessive or inadequate electrical power, radiation, electrostatic discharges including lightning, and other external effects and forces.

The warranty becomes void if parts that are counterfeit or of competitor brands are fitted on the appliances or if the buyer makes modifications to the appliances or uses them irrationally.

H DECLARATION OF COMPLIANCE

DECLARATION OF COMPLIANCE



We,

SOLIA Concept
ZA de Troyalac'h Sud
1 rue Louis Blériot
29170 SAINT-EVARZEC
FRANCE

Declare, under our sole responsibility, that the product:

CONTROL DEVICE FOR PHOTOVOLTAIC INSTALLATIONS AND MODULES

Product reference: **SOLIAMETRE**

Serial number: *See appliance's identification plate*

through its design and construction, meets the requirements of European directives and applicable standards:

- ✓ **Low voltage directive 2006/95/EC**, standard applied EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements.
- ✓ **EMC directive 2004/108/EC**, standard applied EN 301489-3: Telecommunications – EMC and radio-electrical spectrum (ERM) – EMC standard for radio equipment and services – Part 3: Specific conditions for short-range devices (SRD) operating on frequencies between 9 kHz and 40 GHz.
- ✓ **R&TTE directive 1999/5/EC**, standard applied EN 300220-2: Electromagnetic compatibility and Radio spectrum Matters (ERM) – Short Range Devices (SRD) – Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW – Part 2: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive (V2.3.1).


Subject to installation, use and maintenance in accordance with their intended use, with the regulations and applicable standards, with the manufacturer's instructions and with best practice.



Saint-Evarzec, date 14/03/2012

Olivier BELLEC
Co-manager

I NOTE:

 Appliance designed and manufactured in France by SOLIA Concept.

Patented measurement system.

The French text shall prevail.
French legislation shall be authoritative.
Subject to technical modifications.



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