Inverter for photovoltaic applications

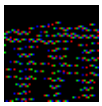
INSTRUCTION MANUAL
SOLEIL DSPX TLH 1500

STORE THIS DOCUMENT IN A SAFE PLACE FOR FUTURE REFERENCE
for the entire life of the appliance

INDICE

1 SYMBOLS USED IN THE MANUAL

The following symbols are used in this manual to both warn and advise users of particular situations that warrant attention. The symbols and their meanings are as follows.

Symbol	Description
	**INFORMATION** Additional information to be borne in mind. To be used for making notices and/or recommendations.
	**ATTENTION** This symbol is used to draw the attention of the user on situations that could cause serious injuries to people and/or serious damage to the system.
	**ELECTRICAL DANGER** This symbol is used to draw the attention of the user on the risk of electrical shocks. These warnings signal compulsory behaviour.
	**UNPACKING INSTRUCTIONS** These instructions explain how to remove the system from the packaging.
	**INSTALLATION INSTRUCTIONS** These step-by-step instructions describe how to install the inverter.
	**MANDATORY INSTRUCTIONS** Before carrying out any work on the appliance, read the operation and installation manual carefully.
	**DISPOSAL** Provides useful information on the disposal of the system.
 	**THE WARNING TRIANGLES ARE USED TO INDICATE WARNINGS ABOUT PERSONAL SAFETY. FOLLOW THESE INSTRUCTIONS VERY CAREFULLY TO PREVENT PERSONAL INJURY OR DAMAGE TO THE APPLIANCE.**

2 SAFETY INSTRUCTIONS

Failure to observe the following instructions can lead to serious consequences, like, among others, the destruction of the system, injuries to people and death due to electrical shocks.

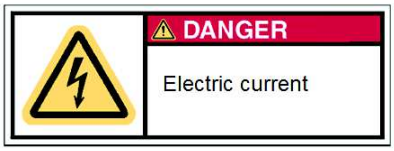
If the appliance is not used according to the manufacturer's instructions, the protection provided by the device may no longer apply.

It is therefore very important to read and understand all the safety instructions contained in this manual before using the inverter. In case of doubts or for additional information, please contact SIEL SPA customer service.

2.1 General precautions

Dangerous voltages

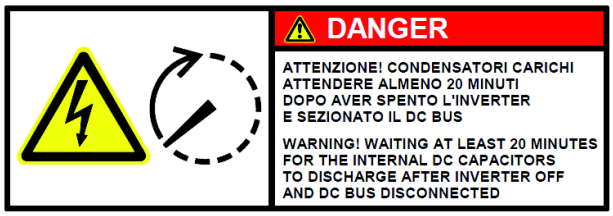
- The system uses very high internal voltages that could potentially cause injury.



- The inverter has multiple sources of power, pay attention to the marking on the machine and follow the instructions of this manual and the installation manual to ensure the correct procedures for connection and use.

- When the solar panels are exposed to sunlight, a dangerous DC voltage is present at the input terminals of the inverter.
- All components with potentially dangerous voltages are grouped in special areas that can be accessed only with tools that are not supplied with the inverter.
- All maintenance or repair work which requires access to those areas of the inverter may only be carried out by technical personnel specially trained by SIEL SPA.
- Before opening the inverter, it is essential to disconnect the AC and DC power sources. Please follow the sequence described by the "Installation manual IV7408".
- Once the inverter has been turned-off, some components inside the inverter and all the DC terminals can still be under voltage voltages for at least 20 minutes, with potential dangerous electrical discharges, due to the presence of electrolytic capacitors. Before carrying out any work on the

equipment, make sure that the voltage at the DC bars (metween positive and negative) has dropped to a safe level (< 60Vdc), my measuring it with a digital multi-meter.



Introduction of objects

- Do not introduce objects into the ventilation inlets and avoid using liquids to clean the system. Cleaning operations should only be performed using a dry cloth. These warnings should be observed even when the machine is off.

Trampling

- Roofs of inverters are not designed to withstand heavy weights. Never climb on the top of the device or place service platforms or other similar objects on it and do not use it as a support for further structures (cable raceways, brackets, etc...).

Section of the cables

- Always verify that the section of power and/or output cables is adequate. This requirement also applies to the other cables used for the system.
- The connections, cable cross sections and inverter installation must all meet the standards regulating the use of low voltage electrical currents.

Ground connection

- The first cable to be connected should always be the ground cable. When disconnecting the appliance, always leave the earth cable to last.
- Due to the presence of high leakage currents, pleae follow the steps specified in the installation manual to properly connect the inverter to ground.

Initial start-up

- Always power the system after it has been thoroughly inspected by qualified personnel.

Subsequent start-ups

- Verify that all the disconnecting switches of the system and installation are open before performing the start-up procedure.

Handling

- Inverters are heavy and should only be handled by qualified personnel.
- Before positioning the inverter, it is also important to make sure that the floor and overhead platforms can bear the weight of the appliance.
- Do not store or transport the system in tilted position or placed on one side.

Installation site

- Apparatus not suited to bathrooms or similar wet areas (see paragraph “Environmental considerations”) and exclusively suited for indoor operation.
- The inverter is not designed to be installed in areas where it could be exposed to impacts or vibrations; for example: means of transport for road, rail, rope, air, ship transportation or similar equipment (for example cranes, hoists, parts of the machine tools that are exposed to movements or vibrations, etc.).
- Do not install the inverter in explosive, corrosive, abrasive or saline environments.

Positioning

- Never position the invert near sources of heat.
- Never install the unit in an area with poor ventilation.
- Never position the inverter in an area that is not well protected. Inverters have not been designed for outdoor installation.
- Position the inverter in a dust free environment, as dust may enter the equipment and prevent it from cooling properly.
- The inverter must be installed on a stable, level surface that is longer and wider than the base of the appliance.
- See the appliance dimensions and warnings shown in the table in this manual in the “Installation” section.

Cleanliness of the site of installation

- The inverter installation site must be kept clean and dry at all times so as to prevent foreign material or liquids from entering the appliance. Besides affecting the operation of the appliance, dirt and dampness could greatly increase the risk of fire.

Reparations

- Do not attempt to repair the system directly, but have it serviced by the manufacturer or by an authorised support centre.
- Any repair work made to the equipment not explicitly authorized in written form or not carried out by SIEL SPA, beside involving actual danger, immediately voids the warranty. SIEL SPA shall not be liable for any consequent malfunction and for any arising loss or damages.

Technical support

- The Technical Support team must always be contacted if the system has been damaged, for example if liquid has penetrated the system, if objects have fallen on top of or inside the appliance, if it has been exposed to rain or humidity (outside the specifications range), if it is not working correctly, if it is performing poorly or if it has been dropped.

Accessories

- Only use accessories recommended by the manufacturer. The use of unauthorised accessories may seriously affect how the appliance operates. The use of non-original accessories will result in the warranty being invalidated and will exempt the manufacturer from any responsibility whatsoever for malfunctions and any consequences that might stem from them.

MTBF (Mean Time Between Failures)

- SIEL SPA inverters are designed and manufactured with a view to assuring remarkably high MTBF for the appliance. It is useful to remember that the MTBF is a statistical parameter and therefore has both conceptual and practical limitations.
- The MTBF specification applies only if the equipment has been correctly installed and serviced and therefore specifically excludes all conceptual or practical errors installation errors, negligence or improper use.
- According to their specific function, SOLEIL DSPX inverters are designed only for professional users and must not be used by untrained personnel

Maintenance

- To ensure that an appliance completes its expected life cycle, it is essential to strictly adhere to the maintenance schedule shown in this manual.
- Maintenance must always be carried out by SIEL, to ensure that only new and genuine spare parts are used and that the inverter (depending upon the service contract that is stipulated) is updated to

incorporate any technical improvements that may have been introduced in the meantime (according to the status of the art).

- In addition, any appliance that has been fitted with non-original, used or not up-to-date spare parts, will be deemed “modified” with the consequences as outlined in “modifications to the appliance”

Product nameplate

- The product ID plate which bears the appliance code number, serial number and technical data is situated on the rear of the inverter.
- The serial number shown on this ID plate must be quoted in all communications regarding the appliance.

Inverter in the electrical installation

- Always use an electrical supply that complies with the technical specifications and data shown on the ID plate.

Protection and disconnection devices

- Always check that the mains supply is fitted with suitable protective devices and switches and that they are in good working order.

Ventilation

- The temperature of the power stage heat sinks may increase to a maximum of 80°C. Never block or obstruct the inverter air vents in any way.
- The type and the implementation of any air distribution line must be approved by SIEL SPA.

Changes made to the system

- Any change made to the equipment not explicitly and formally authorized by SIEL SPA implies the immediate cancellation of warranty. SIEL shall not be liable for any consequent malfunction and for any arising loss.

User warning systems

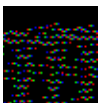
- All warning signals to users made by means of relay contacts are thoroughly insulated from dangerous voltages.
- The insulation between these contacts is only suitable for voltages of less than 48V AC (60 VDC). These contacts should never be used as switches.

User warning systems

- Always keep the original packaging.
- Inverters should always be returned, if required, in their original packaging.
- Appliances returned for repair work in unsuitable packaging or that have not been transported horizontally will not be accepted or repaired under warranty.

Limitation of responsibility

- SIEL SPA shall not be liable for any direct or indirect damages (including loss of profits or revenues) deriving from the malfunction of the device, even if SIEL SPA was warned in advance of the possibility of such damages.



Disposal

This product should not be disposed of as domestic waste and must instead be handed over to the nearest collection point specialised in the recycling of used electric or electronic equipment.

2.2 Lightening and overvoltage

In areas where storms are frequent, electrical discharges can occur through the mains.

It may therefore be advisable to install lighting conductors to protect the appliance control circuits from any damage that might occur due to high voltages in the surrounding atmosphere.

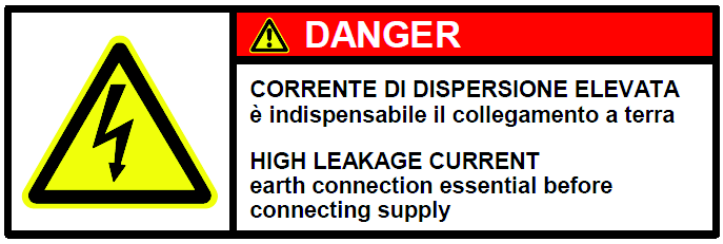
To protect the inverter from voltage peaks caused by atmospheric discharges, it is advisable to install varistors on the input connection lines (modules) and on the output lines (alternate current) of the system.

To protect the appliance from direct lighting strikes, both lightning rods and special protective devices should be installed.

2.3 Ground connection

The inverter must be grounded for compliance and as required by current regulations concerning low voltage. All the components of the installation must be grounded to the same system.

The first cable to be connected should always be the ground cable. When disconnecting the appliance, always leave the earth cable to last.



2.4 Battery maintenance

The SOLEIL DSPX TLH 1500 inverter family is equipped by batteries. For a correct use and maintenance, follow the indications below described:

- Battery maintenance must be performed only by qualified personnel who take the necessary precautions.
- Keep batteries out of reach of non-authorised personnel
- Replace the batteries with the same number and the same type of batteries as the original ones.

Batteries may cause electric shocks or burns due high short circuit currents.

The following precautions must be taken before handling them:

1. **Do not wear metal objects such as watches and rings**
2. **Use tools with insulated handles**
3. **Equipment and other metal objects must not come into contact with the battery and must be kept at a distance from it.**

RISK OF ELECTRIC SHOCK. Do not try to rewire. Alter or tamper with the wiring or the battery connectors. Such alterations may cause serious personal injury

PERICOLO DI SCOSSA ELETTRICA. Non cercare di ricablare, alterare o manipolare il cablaggio o i connettori della batteria. Tali alterazioni possono provocare gravi lesioni

The batteries must be disposed of according to the regulations.

3 DESCRIPTION OF THE EQUIPMENT

3.1 Introduction

The SOLEIL DSPX TLH 1500 range of inverters provides the ideal solution for connecting photovoltaic power production systems to three-phase power grids.

The series is composed of transformerless inverters.

The inverters of the SOLEIL DSPX TLH 1500 series are in compliance with the resolution AEEG 84/2012/R/ENEL (attachment A70 of TERNA, and CEI-016)

All inverters use a system which tracks the maximum power point of the photovoltaic generator (MPPT) thus achieving the maximum power efficiency in any operating status.

SOLEIL DSPX TLH 1500 inverters permit both automatic and manual operation. In automatic mode, maximum power point tracking is enabled, while in manual mode it is the user who sets system operation (mode used for specific test requirements) at a specific point.

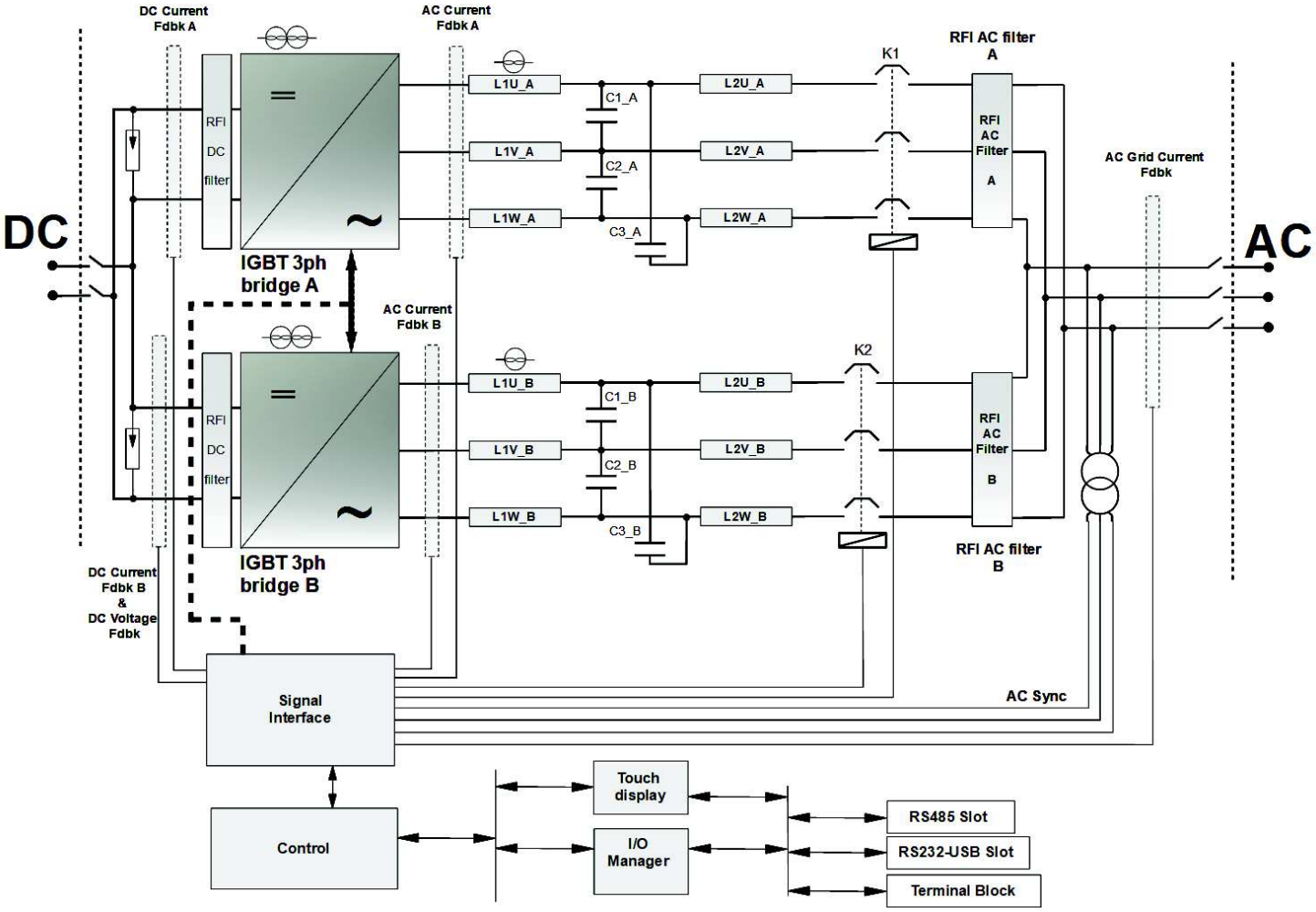
The waveform of the current injected in the electricity distribution grid is identical to that of the voltage with a power factor that can be regulated in accordance with standard CEI-016.

The inverter has a “touch screen” control panel allowing to view all system operating parameters (electrical values, status and alarms) and to input all basic commands.

The device is also equipped with two communication ports, which can be configured according to different serial transmission standards, and with a “volt free” contact terminal board for the remote signalling of the status and most important machine alarms as well as for receiving remote commands.

Pulse width modulation (PWM) control technology and IGBT power devices are used on SOLEIL DSPX TLH 1500 inverters, which permit the switching of significant levels of power with a high degree of sturdiness and reliability.

3.2 Equipment block diagram



Inverter series SOLEIL DSPX TLH 1500 block diagram

3.3 Operating principles

When the inverter is energized, the control system checks the power grid, voltage and frequency parameters. If these parameters are within the correct range, the inverter checks the voltage of the photovoltaic generator and when this reading is sufficiently high, the conversion process begins.

When the photovoltaic field voltage reaches the right level, the grid contactor closes and the inverter begins delivering power to the three-phase power grid.

At this point, the control system starts varying the photovoltaic generator's operating point to track the maximum power point. This tracking takes place at intervals of about 2 seconds.

If the grid voltage and frequency values are within the range of acceptance established by legislation, in conditions of low irradiation (DC voltage below the minimum threshold, see chapters 7 and 8, or the power injected into the grid is below a certain threshold), the inverter enters into standby mode for 6 minutes. After this pause, if the photovoltaic generator and grid parameters are correct, the inverter starts up automatically recovering the conversion process.

If the test detects abnormal operating conditions which can jeopardize machine reliability, adequate protections are activated. After the activation of a protection, the control system waits 10 seconds and, according to the "severity" level of the protection, it may decide to restart the inverter or to stop it until a

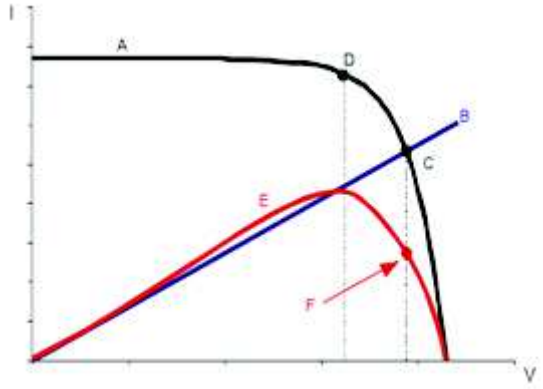
repair is carried out by the SIEL technical service. For more details about alarms and protections, see paragraph 4.5.2.

3.4 Maximum power point tracking (MPPT)

When a photovoltaic cell receives solar radiation, it generates an electrical voltage which depends on the incident radiation and on the temperature of the cell itself.

When a load is connected to the photovoltaic cell, a current will start to circulate through the load and the voltage of the cell will decrease according to the voltage-current characteristics (V-I).

The figure below shows the typical V-I characteristic curve of a cell (A), which by analogy is identical to that of a photovoltaic module, or to that of a photovoltaic generator (or field) made up of several suitably connected modules. The same figure shows the load characteristic curve (B) which will be resistive. The intersection of the curve of the photovoltaic generator with the characteristic curve of the charge is called the operating point (C).



A: Characteristic of the photovoltaic generator

B: Load characteristic

C: Operating point

D: Maximum power point

E: Photovoltaic generator power curve

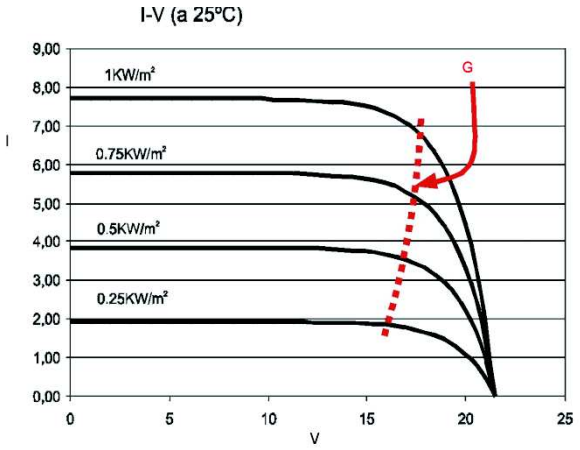
F: Operating point power

Response V-I of the photovoltaic generator implies a much more precise output power characteristic (F), which will vary when the operating point changes (as shown in the graph below).

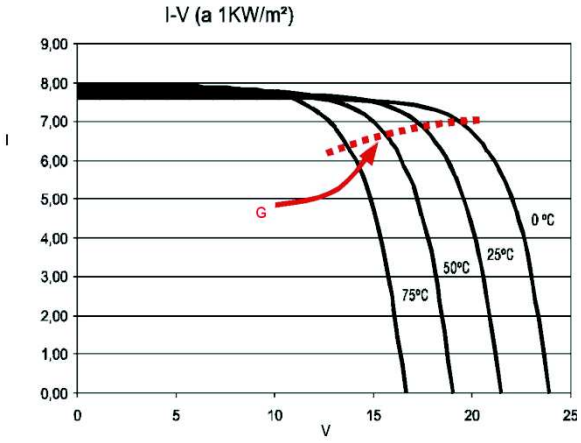
The operating point corresponding to the highest possible power is called the Maximum Power Point (D).

Additionally, the photovoltaic generator curve is not fixed, but changes according to the temperature and incident solar radiation. The following figure shows:

- the typical curve of a photovoltaic module as a function of the radiation (picture A);
- the typical curve of a photovoltaic module as a function of the temperature (picture B);



Pic. A



Pic. B

The evolution of the maximum power point (G) is also shown on the curves.

Therefore, the purpose of the maximum power tracking algorithm (Maximum Point Power Tracker) is to vary the device's load resistance to ensure the constant functioning of the photovoltaic system (panel + inverter) in the highest possible point of power; in this way the maximum level of power will be delivered to the power distribution grid.

In automatic mode, the inverter constantly tracks the maximum power point

The device can also be operated in Manual mode, during which the user determines a fixed operating point. Obviously, **the maximum level of power efficiency for the installation is not achieved in this mode**; for this reason, manual operation must only be used as a method of checking the device by trained technical personnel.

3.5 'Master-Slave' mode of operation

Up to 4 inverters can be connected in parallel (on both DC and AC sides), obtaining an inverter 'virtually' composed by 8 power modules; each power modules features half the power of the single inverter. For the operation of inverters in parallel configuration, it is necessary to connect the inverters as described in Annex 10 of this document.

Master & Slave is a control logic performed by a DSP controller. This last, as a function of the apparent power generated by all the inverter in parallel configuration, enables the operation of one or more 'Slave' modules.

The module selected as 'Master', is always the one among the modules composing the parallel system, which has been operated for the minimum amount of hours. Every time the whole system (all the inverters in parallel) is in the state of 'Low Radiation', a new Master selection is executed, taking into account the hours of operation of all the inverters in the system.

Master & Slave logic of operation, allows achieving higher values of efficiency at low level of generated power.

When the power generated is very low, only the 'Master' module is active, whereas all the other moduls are disabled (not operating).

Every time the power generated by Master module overcomes a certain power threshold ('Pthr'), one 'Slave' module is enabled and start generating power, contributing to the total power generation along with the 'Master'. 'Pthr' power threshold can be set by the user through a parameter: by default this parameter is set to 90% of rated power of the single module.

When a 'Slave' module is enable and starts generation, power generated by the Master module decreases and becomes equal to following expression:

PThr*(NModON-1)/ NModON

(NModOn is the number of modules enabled and operating in that moment)

If the available power is such to allow the Master to increase the generated power beyond the level of power established by parameter Pthr, another Slave is enabled and start generation.

On the other side, as soon as the available power decreases and the value of power generated by the 'Master' becomes lower than

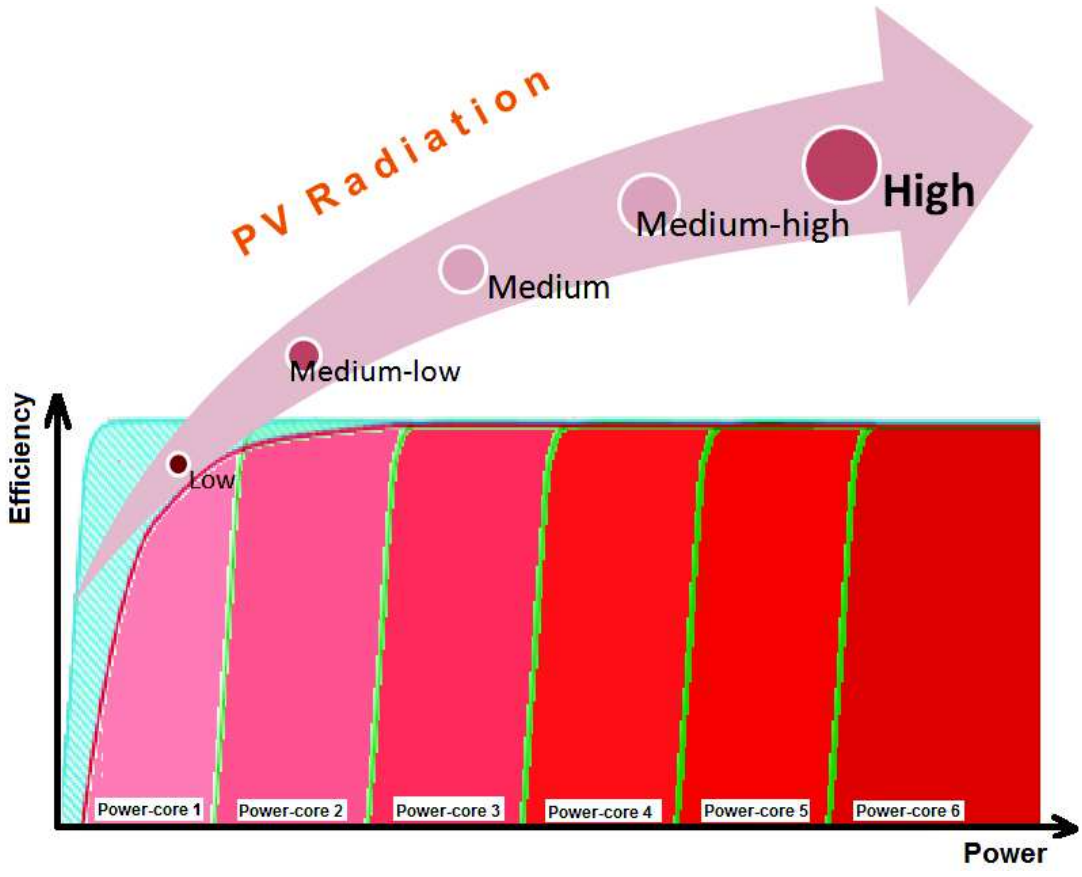
PThr*NModON/(NModON-1) – Phys,

(Phys is an hysteresis threshold, selectable by a dedicated parameter)

one Slave module gets disabled and stop generating.

For parameters set-up, please refer to 'Annex 11: Master & Slave Configuration settings'.

In the following, a representation of the efficiency trend as function of number of modules present in the parallel system, is provided (for a parallel system composed by 3 inverters 1330M, totally 6 power modules).

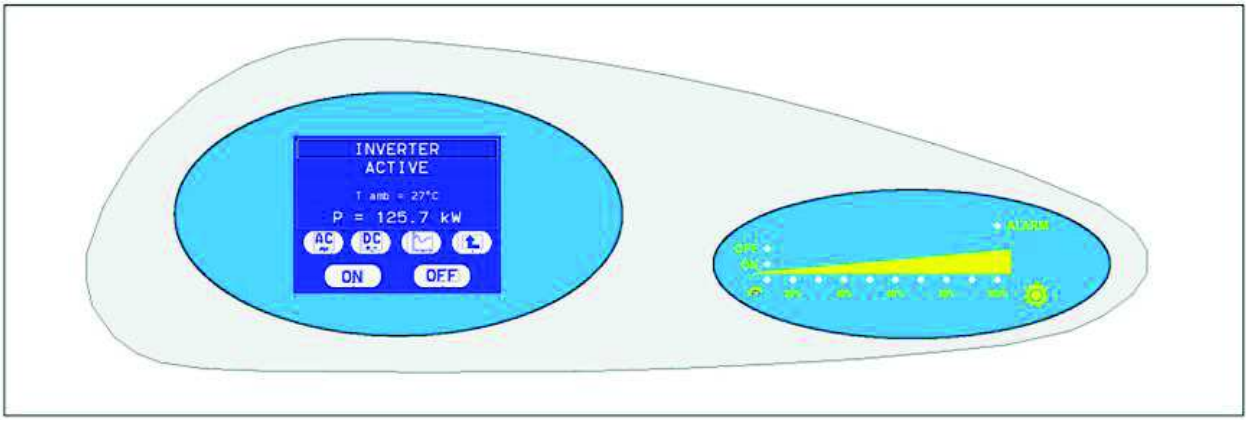


4 INVERTER OPERATION

4.1 Inverter control panel

The control panel is made up of a monochromatic “touch screen” display and a LED signalling panel showing the generated power.

The “touch screen” display acts both as viewer and as an interface to input or change the machine parameters.



The LED lights mean as follows:

- ALARM it lights up when the machine has stopped because an alarm/a protection has activated
- OFF: it lights up when the machine is in the “disabled inverter status”
- ON: It lights up when the inverter switches to the operating status energising the power grid (“inverter generating power” status)
- ON and OFF flashing alternatively: it happens during the first start up and in the “enabled inverter” status as well as after an error has been detected, immediately before closing the contactor and starting the generation process
- LED power bar the amount of lit up LEDs is proportional to the instant power percentage delivered to the grid

4.2 Quick Start

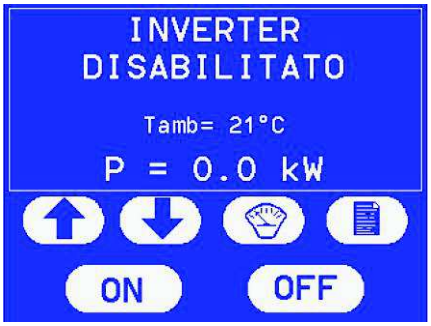
To start the inverter:

- the input DC and output AC cables must be properly connected.
- the EPO contacts (terminal contacts 13-14 – see section **Errore. L'origine riferimento non è stata rovata.**) and EXTERNAL START INVERTER must be closed (terminal contacts 11-12 – see section **Errore. L'origine riferimento non è stata trovata.**). As a default setting, both these contacts are short-circuited by the manufacturer.

  Closing the alternate current switch, voltage is fed to the control logic, the touch screen lights up showing a welcome screen and an acoustic “beep” is emitted.

.

Immediately after the welcome message, the main screen appears:



The top two lines show status messages and any alarm conditions in rotation. Immediately after the controller has been powered on under suitable grid and voltage conditions, the sequence of messages to appear is as follows:

- Inverter disabled
- Remote switch open
- Mains voltage OK
- Mains frequency OK

If you press the ON key on the “touch screen” and confirm by pressing the ENTER key as displayed in the following screenshot, the inverter will switch to “Enabled inverter” mode while the ON and OFF LEDs will flash alternately.

Under this condition, the following messages can appear on the display:

- Inverter enabled
- Remote switch open
- Mains voltage OK
- Mains frequency OK

The inverter waits for the grid parameters (voltage and frequency) to come into the pre-established range for at least 5 minutes (modifiable, see the appendix “Features Regarding Grid Services”, section 8.2.1), after which the generation of grid power can begin.

At this point the ON LED stays lit. The messages shown on the display are as follows:

- 'Inverter generating'
- "Remote switch closed"
- "Mains voltage OK"
- "Mains frequency" OK

The default inverter operating mode is AUTOMATIC, i.e. with maximum power point tracking enabled.

During standard operation, if the photovoltaic field voltage drops below the minimum level (see "Technical information") or the available power from the power grid is below a given threshold (1,5% of the rated input power), the inverter switches to "Inverter enabled" mode and starts a 6-minute countdown.

The sequence of the messages displayed is as follows:

- "Inverter enabled"
- "Remote switch open"
- "Mains voltage OK"
- "Mains frequency" OK
- "Insufficient radiation"

When the countdown is over, if the mains and cell voltage conditions are correct, the inverter starts up again, closes the contactor and resumes the power generation to grid.

If the electrical grid is not suitable (voltage or frequency outside specification), the inverter remains in "inverter enabled" status, the ON and OFF LEDs flash alternatively and the sequence of messages displayed is as follows:

- "Inverter enabled"
- "Remote switch open"
- "Mains frequency outside specification" or "Mains voltage outside specification"

When correct conditions of the power grid are restored, the inverter starts up again, closes the contactor and resumes the power generation to grid.

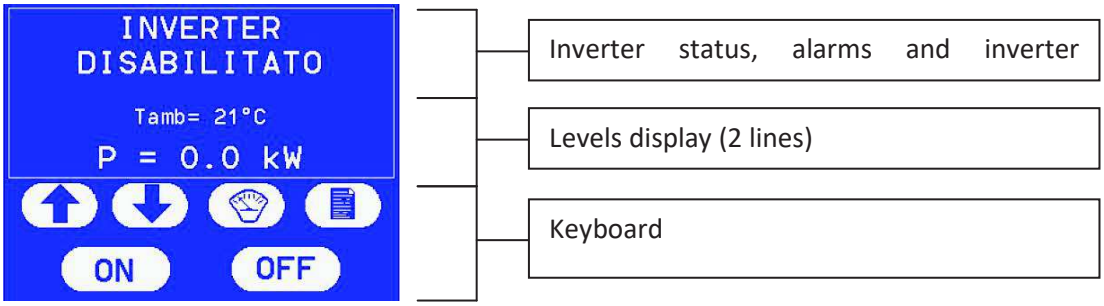
To disable the inverter, all that is needed is to press OFF without having to confirm the command with other buttons. Confirmation of switching off the inverter is given by the yellow OFF LED that stays lit.

Users should take note of the fact that under such conditions, the inverter does NOT generate electricity and this condition should only be employed for maintenance work.

4.3 Touch screen display

4.3.1 Introduction

The following picture shows the touch screen main window, displayed immediately after the control system is energized.



Every screen display is subdivided into three sections as shown in the diagram:

- Section for status messages, alarms, inverter protection
- Section for measurement values
- Section for keyboard

The messages are shown in rotation in all the screens at about one message a second. The status of the inverter (see section 4.5) is shown in this section along with any alarm or active protection messages.

The levels, subdivided into AC and DC, are always shown in the format:

Secondary display (lower case, first line)

MAIN DISPLAY (upper case, second line)

The section relating to buttons varies in line with the selection made by the user.

The combination of buttons present depends on the screen being shown. For safety purposes, the only key present on all the screens is the OFF button.

The touch screen fades after not being used for 3 minutes. If you touch the panel again, the display lighting is restored.

4.3.2 Navigation display

To navigate around the display, just touch the screen in the designated areas.

The touch functions on the main screen are as follows:

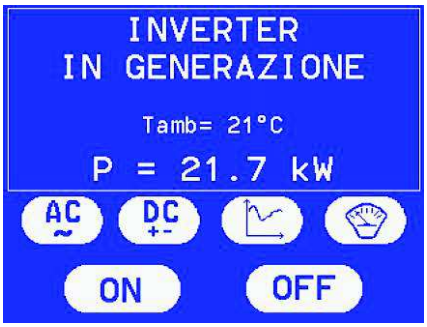
Arrow buttons: to scroll through all active status/alarm messages

Level access button: give you access to the measurements screen.

Menu set-up access button: give you access to the set-up menu.

4.3.3 Measurements menu

Pressing the AC and DC keys, it is possible to access the machine measurement value screens on the alternate current side (output to mains) and the direct current side (photovoltaic field input).



To move from the AC measurement screen to another, just press “AC”.

To move from the DC measurement screen to another, just press “DC”.

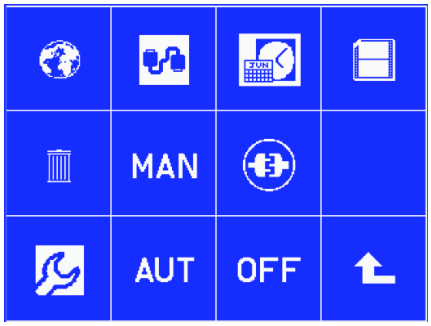
From the AC measurement screen, you can move to the DC screen by pressing the DC button.

Similarly, from any DC measurement screen, you can move to the AC screen by pressing the AC button.

To go back to the main screen, just press the ‘return’ button  .

For more information about the electrical values of the machine to be displayed, see paragraph 4.4.

4.3.4 Set-up menu



This menu lets you access the following appliance functions:

Language selection (section 4.3.4.4)

Setting serial ports (section 4.3.4.3)

Setting the date and time (section 4.3.4.5)

Events log display (par. 4.3.4.2)

Reset history

Advanced appliance settings (section 4.3.4.6)

Selecting Automatic/Manual modes (section 4.3.4.1)

Selection of grid connection protocol (section **Errore. L'origine riferimento non è stata rovata.**)

Return to main screen

4.3.4.1 Selecting AUTOMATIC/MANUAL modes

To select MANUAL or AUTOMATIC mode, use the AUT/MAN buttons.

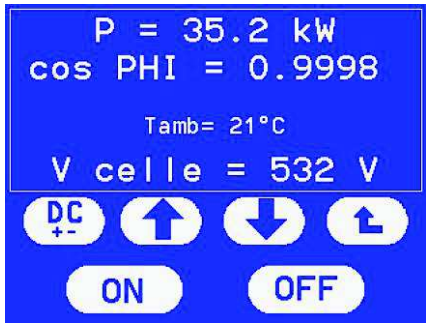
The following screen will appear to let you confirm your choice of **AUT** or **MAN**:

Press the white button to confirm.

After selecting **AUTOMATIC** mode, the main screen will appear. In this operating mode, using the maximum power point tracker (MPPT) system, the inverter will maximises the quantity of power taken from the photovoltaic field.

If you select the **MANUAL** mode, the maximum power point tracker algorithm is disabled and you may set the desired power level (according to actual radiation condition). For this reason, MAN mode should only be used by qualified personnel for diagnostic purposes.

In this case, the following screen appears:



Using the arrow keys  , you can change the delivered power (the arrow direction shows the increase or decrease of power).

To disable MANUAL mode and to return to AUTOMATIC, just press the “return” button  .

The set-up menu will then appear. Selecting **AUT** restores **AUTOMATIC** mode.

To return to the main screen from the set-up menu, press the ‘return’ button  .

The inverter default setting is in **AUTOMATIC**.

If you try to select an already active mode, nothing happens

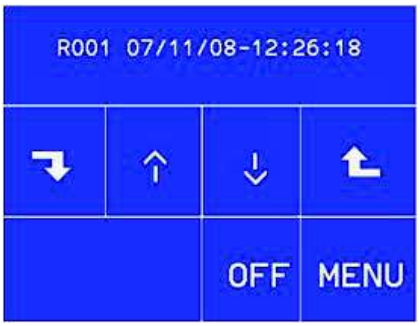
4.3.4.2 Display and navigation of history

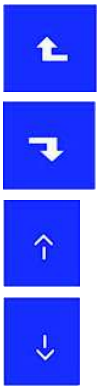
The inverter is fitted with a system that saves events (alarms, malfunctions, protection) to its memory bank. As soon as it occurs, an “event” is saved to a progressive list along with details of time and date it occurred. Every record also contains details of the appliance status (AC and DC measurements).

To access the appliance history section, once you are in the set-up menu (section 4.3.2) :

- Press the key with icon 

  The records list will appear:





Back key

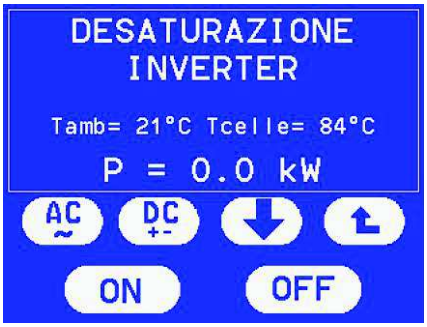
Record details access key

Previous record display key

Next record display key

  Each history record has a progressive number (R001 in the diagram) from the date and time that the event took place.

- Press the  ,  keys to display the different log records (R002, R003, etc).
- If you press the  key, you access the record details, i.e. all the information regarding device operations stored when the event occurred.



  The diagram shows one of the conditions applicable to alarm R001 dated 7 November 2008 (‘Inverter desaturation’).

  The other indications scroll automatically in the first two lines of the display.

  If you press the  keys, you enter the machine measurement values which were stored when the event occurred.

  For a more detailed description of the electrical measurements that the appliance can display, see section 4.4.

  If you press  , the status message of the inverter is displayed, including the message regarding the originating alarm/error of the record (“Inverter desaturation” in this example).

- Press  to go back to the record list display, from which you can return to the main window by pressing  twice.

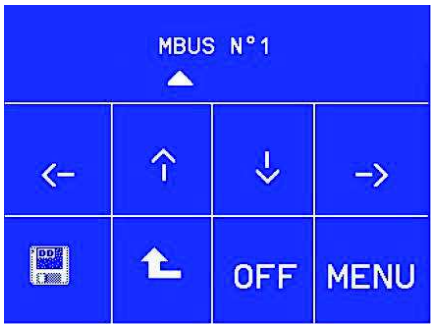
4.3.4.3 Serial settings

The inverter uses serial settings (RS-232, RS-485) to export two communication protocols (Modbus, OCS3). Before connecting the serial port, select the protocol and inverter node address.

From the set-up menu:

- Press the key with icon 

  The following screen will appear:



- Using  and  move to the field you wish to change (protocol or address) indicated by the cursor  .
- Press the key and the  keys to change the field value.
- Press “Save”  to confirm settings.
- Press  to go back to the set-up menu screen.

4.3.4.4 Language selection

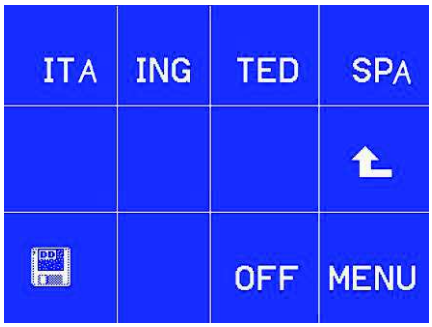
Messages can be displayed in the following languages:

- Italian (default)
- English
- German
- Spanish
- French

To set the language from the set-up menu:

- Press the key with icon 

  The following screen appears:



- Press the icon of the language you want to select.
- Press “Save”  to confirm settings.
- Press  to go back to the set-up menu screen.

4.3.4.5 Date and time settings

To set the date and time from the set-up menu:

- Press the key with icon 

  The following screen will appear:

- Using  and  move to the field you wish to change (date or time) indicated by the cursor  .
- Press the key and the  keys to change the field value.
- Press “Save”  to confirm settings.
- Press  to go back to the set-up menu screen.

4.3.4.6 Advanced machine settings

Some inverter operating parameters are password protected but can be edited to enable/set up particular features, by entering the value of an accessible parameter through the relevant address.

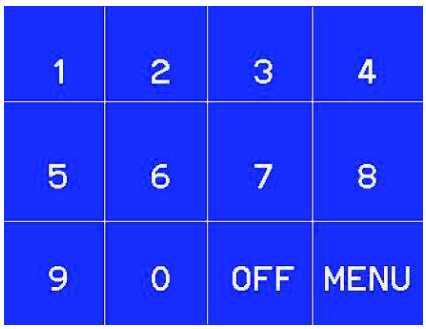
Parameters can be edited with the machine in a DISABLED status, following the procedure described as follows.

THIS MANUAL CONTAINS ALL AND ONLY THE PARAMETERS ACCESSIBLE TO THE USER, WITH THE RELATIVE ADMITTED VALUES; A VALUE THAT IS NOT PROVIDED FOR CAN COMPROMISE CONVERTER OPERATIONS.

From the set-up menu:

- Press the key with icon 

The following screen will appear:



- Enter the password **14914** to access the User parameters. If the password is recognised as valid the screen below will be shown; otherwise the set-up menu will be shown again

Reading parameters

Press the **READ** key to open the menu to read parameters.

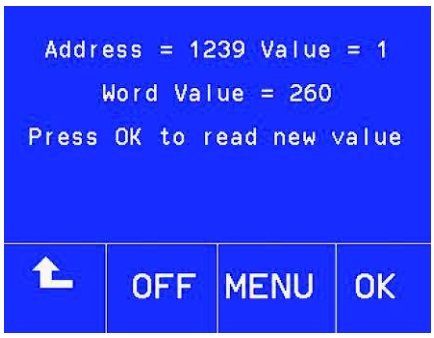
Proceed as follows:

- Press **OK** to enter the address of the parameter of the value you wish to read.

  Press  to return to the previous menu (by pressing the **MENU** key you return to the set-up menu, or press **OFF** to immediately turn off the inverter and immediately return to the main screen).

- A numerical keyboard will appear; set up the address always using four digits. If the value of the address is less than 1000, enter a sufficient number of zeroes before it to have four digits (Example: address 99 is entered as 0099).

- On pressing the fourth digit a confirmation screen will appear with the address just entered. If its value is correct press **OK** to confirm.
  The display shows the value of the selected parameter.



The **Value** field represents the value of the parameter in the “a byte” format (in the example illustration the byte with the address 1239 has the value 1), while the field **Word Value** is the value in the “a word” format (in the example the word formed from byte 1239 and 1240 has the total value of 260).

If the entered address is not valid, the error message “Reading error with DSP board” will be shown.

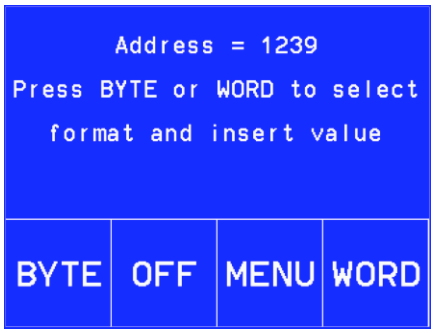
Verify the value of the address and possibly retry by pressing OK.

Entering parameters

Press the **WRITE** key to open the parameter entry menu.

Proceed as follows:

- Press **OK** to enter the address of the parameter of the value you wish to read.
- The screen will appear to enter the address. Proceed exactly as in the case of reading parameters.
- Once the address of the parameter that you wish to change has been confirmed, the following screen will appear:



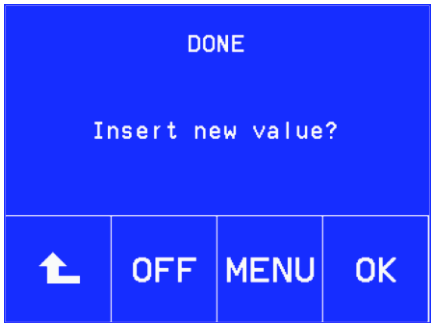
- Press **BYTE** if you intend to enter the new value in the “a byte” format; press **WORD** if you intend to enter the new value in the “a word” format.
- A numerical keyboard will appear. Enter the new value considering that: the “a byte” format is three digits long (from 0 a 255), while the “a word” format is five (from 0 to 65535). If the value to be entered is composed of a number of digits that is less that that required, place a sufficient number of zeroes before it to complete the format (Example: the value 99 will be entered in the “a byte” format as 099, while in the “a word” format as 00099).

- Once the last number has been entered, a confirmation window will appear. Press **OK** to confirm the value to be changed.

- If the written value is accepted by the inverter, a screen will appear with the word “Wait…” at the end of which the message “DONE” will be shown for confirmation.

If the value-address is not available to the user, the message “ACCESS DENIED. Address Not Available” will be shown, and you will return to the initial WRITE menu screen.

- Once the writing operation is completed it is possible to choose whether to set a new parameter, or end the edit phase and save the new machine set-up.



Press **OK** to enter a new value.

By pressing **OFF** to exit the mode you change parameters WITHOUT saving the changes. **To completely cancel the changes it is necessary to reboot the machine.**

Press **MENU** and then YES to confirm changes and save them in the non-volatile memory.

4.4 Machine values

The appliance measurements displayed are summarised in the following table:

Acronym	Measurement	Unit of measurement	AC/DC	Main or secondary display
Vrs	RS Linked voltage	V (rms)	AC	S
Vst	ST Linked voltage	V (rms)	AC	S
Vtr	TR Linked voltage	V (rms)	AC	S
Ir	R Phase current	A (rms)	AC	S
Is	S Phase current	A (rms)	AC	S
It	T Phase current	A (rms)	AC	S
P	Active power	KW	AC	P
Q	Reactive power	KVA	AC	P
Cos phi	Power factor		AC	S
Tamb	Ambient temperature	°C		S
Energy	Energy produced	kWh/MWh	AC	P
Hours	Running hours	h	AC	S
Vcel	Cell voltage	V	DC	S
Icel	Cell current	A	DC	S
Pcel	Cell power	KW	DC	P
Irry	Vertical radiation	W/sq mt	DC	S
Tcel	Cell temperature	°C	DC	S
Riso	Isolation resistance	kΩ	DC	S

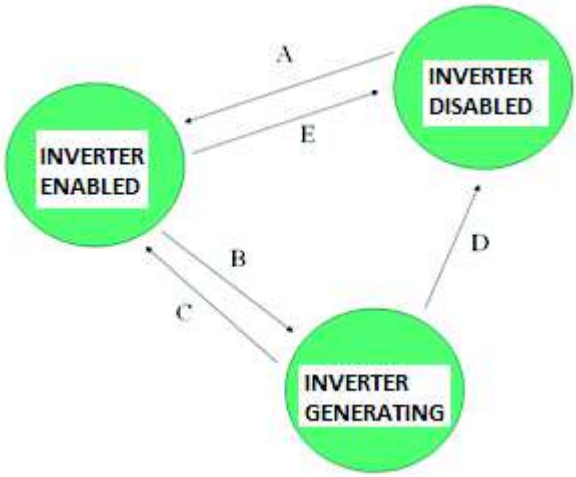
As previously explained in section 4.3.3, press AC to view the alternate current value display (AC); to view the direct current value display press DC.

The measurements are always shown in the 'main display" format (upper case letters, second line) – secondary display (lower case letters, first line).

4.5 Status, alarms and inverter protection

4.5.1 Details about status and operating conditions

The inverter features three operating conditions:



The status of the inverter is shown in the two rows at the top of each window.

Inverter disabled

The inverter is still ("OFF" Led lit up). PWM impulses are off and the inverter is offline. The inverter is in this status:

- As soon as logic control is turned on for the first time.
- After pressing the OFF key.
- After the EPO triggers.
- After appliance protections repeatedly trigger.
- To enable the inverter, press the ON key and confirm on the display.

Inverter enabled

In these conditions the inverter is always offline (contact open) and does not generate power although PWM impulses to the bridge can be on. Once in this condition, the controller checks:

- For the presence of network synchronism in the voltage and frequency acceptance interval.
- For cell voltage (and, eventually, solar radiation) in the acceptance interval.
- For protections off (the countdown triggered by a protection has elapsed).
- The contact "EXTERNAL START INVERTER"(terminals 11-12, see par. **Errore. L'origine riferimento non è tata trovata.**) is closed.

If all these conditions are met, the inverter releases PWM impulses and accelerates the voltage ramp output to the bridge.

In these conditions, the ON and OFF leds blink alternatively.

When output voltage reaches a set value, the control closes the contact and switches to *'inverter in generation*' conditions.

Inverter generating

In these conditions, the inverter is online (contact closed) and generates power ('ON' led on). If one of the following events occurs during operations:

- Radiation conditions are not enough to keep the inverter operating (cell voltage or input power below the respective threshold, see par. 4.5.2), or the voltage and mains synchronism values are not in the allowable range (see par. 4.5.2), or
- If a machine protection triggers (other than EPO),

  the contact is opened, PWM impulses are immediately turned off, a countdown starts (depending on the type of protection triggered) and the inverter returns to *'inverter on'* conditions.

  If the EPO triggers, the inverter switches to *'inverter disabled*'.

  If a protection triggers, the 'ALARM' led turns on and beeps.

If you press the OFF button, no matter what the condition is, the inverter immediately switches to the "disabled inverter" status.

If a protection triggers, the 'ALARM' led turns on and beep sounds. Touching any button on the touch screen silences the beep.

The triggering of a protection causes the inverter to disconnect from the mains and the immediate cancellation of impulses. The inverter is programmed to start again after the activation of a protection (with the exception of EPO), after a specific countdown is over (the amount of the countdown depends on the protection type). The continuous triggering of a protection is however a sign of a "serious" appliance malfunction. For this reason, if the protection activity occurs fairly frequently and lasts a long time, the controller can decide not to restart the inverter. In this event, the controller will change the status from 'inverter generating' to 'inverter disabled' until specialised technical assistance from SIEL is provided.

EPO: if the EPO activates the inverter switches to the "disabled inverter" status. The protection system is restored by reclosing the EPO switch. To re-enable the inverter, press the ON button on the keyboard then confirm.

Below is a table with detailed descriptions of appliance statuses and of events that activate various changes of status.

The input "External start inverter" functions as a go-ahead signal to start the inverter. If the inverter has already been started and stopped by a contact opening, on the re-closure of the contact "External start inverter", the inverter will immediate restart.

Current status	Previous status	Event	Subsequent status	Graphic change	Actions
Inverter disabled	Any	Press button ON+confirm	Inverter enabled	A	• PWM pulses off • Switch open
	Inverter generating	EPO closes, press button ON+confirm	Inverter enabled		
Inverter enabled	Any	OFF button pressed	Inverter disabled	E	• PWM pulses off • Switch open
		10 sec countdown expired with closed “EXTERNAL START INVERTER” contact	Inverter generating	B	• PWM pulses on • Switch open • Voltage ramp
	Inverter generating	Minimum radiation 6-minute countdown expired	Inverter generating	B	• PWM pulses on • Switch open • Voltage ramp
		Grid parameters verified in the range of acceptance			
		10-second countdown for desaturation protection has expired			
		10 sec countdown time passed for maximum current			
		Inverter module temperature reset below 90°C			

Current status	Previous status	Event	Subsequent status	Graphic change	Actions
Inverter generating	Inverter enabled	-	-	-	• PWM pulses on • Closed contactor • Generation of power in the grid
	Any	OFF button pressed	Inverter disabled	C	-
	Inverter generating	Insufficient irradiation	Inverter enabled	C	6-minute countdown start
		Grid parameters (voltage and frequency) outside of the limits			Awaiting re-entry into the range of acceptance (see par. 8.2.1)
		Desaturation protection triggered			• 10-second countdown starts. • ALARM LED lights up on control panel • Beep sounds
		Protection is activated against maximum current			
		Protection is activated against inverter overtemperature			• ALARM LED lights up on control panel • Beep sounds
	Any	IMPULSE ENABLING contact opens	Inverter enabled	C	10-second countdown starts.
		EPO contact opens	Inverter disabled	D	• ALARM LED lights up on control panel • Beep sounds

4.5.2 Faults, alarms and protections

Inverters belonging to Soleil DSPX TLH 1500 family, are composed by two distinct power modules. Depending on how the inverter is configured, the modules can be both in generation (inverter configured as 'monolithic') or turn-on one at a time, depending on the generated power (inverter configured as 'Master & Slave').

Some of the anomalies and protections are named with the same acronyms, irrespective of the inverter configuration; this type of anomalies/protections stops the power generation of both power modules.

Some of the anomalies and protections are named tied to the relevant modules ('A' or 'B').

- In 'Master & Slave' configuration, this type of anomalies/protections stops the power generation of the module that the anomalies/protections refer to.
- In 'Monolithic' configuration, this type of anomalies/protections stops the power generation of both power modules.

The events that may occur during the operation of the inverter are classified as follows:

Anomaly: it is an event that may occur without failure of the inverter, but changing its regular operation, by causing a temporary interruption of the power generation (transition from status 'INVERTER GENERATING to 'INVERTER ENABLED' and start of a timer.

Alarm: it is an event representing an improper operating condition of the inverter, but not such to stop the power generation.

Protection Module A / Protection Module B: it is an event occurring when some 'severe' malfunctions are present in either (or both) the power modules of the inverter, causing a stop of the power generation. Some protections require the intervention of SIEL service personnel and manual reset of the protection.

As already mentioned, the intervention of 'Emergency Power Off' contact ('EPO') causes the complete stop of the power generation (transition from status 'INVERTER GENERATING' to 'INVERTER DISABLED').

Anyone of previously described events is signaled on the user operator interface (touch-screen display) as text message.

4.5.2.1 Anomalies, Alarms, Protections of inverter (stop of both modules)

Displayed message	AN - Fault AL - Alarm PR - Protection	Cause	Effect
LOW IRRADIATION	AN	Voltage from PV field is lower than relevant threshold (Note 1)	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'. • Start of a timer counting-up 6 minutes.
		Input power from PV field is lower than relevant threshold (Note 2)	
OUT OF RANGE VOLTAGE	AN	RMS value of AC voltage for synchronization to the grid is out of its	Note 3

		acceptance range (Note 3)	
OUT OF RANGE FREQUENCY	AN	Network synchronism frequency outside acceptance parameters (note 3)	
INVERTER STOPPED EXTERNALLY	AN	'EXTERNAL START INVERTER' contact opened	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'.
LOSS OF INSULATION	AL	One of the two DC poles is short-circuited to earth (note 4)	Depending on the set behaviour (Note 4), the inverter may remain in the status in which it is found or move to the status of "disabled inverter".
GROUND POLE FUSE TRIPPING	AL	The electrical connection between the DC pole and earth was interrupted (note 4)	
NO DSP-SIGNALLING COMMUNICATION	AL	Connections between the control board and touch-screen board are down	The inverter does not change its current status.
EEPROM COMMUNICATION ERROR	AL	Configuration loading error at start-up	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
IO BOARD CANBUS FAULT COM	PR	IO board CAN Communication failure	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'.
EPO TRIGGERED	AL	EPO switch opened	Inverter status switch to 'INVERTER DISABLED'
HIGH STRING VOLTAGE	PR	Cell voltage over maximum threshold (note 6)	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'. • Wait until bus voltage returns under the safety value.
UNBALANCE CURRENT	PR	Unbalance Current between module A and module B (note 8)	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
HALF POSITIVE DC BUS	PR	Abnormal operation of	The inverter is in the "Inverter

OVERVOLTAGE		the Power Module	disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
HALF NEGATIVE DC BUS OVERVOLTAGE			
HW HALF POSITIVE DC BUS OVERVOLTAGE			
HW HALF NEGATIVE DC BUS OVERVOLTAGE			
DC SWITCH FAULT	PR	DC Breaker fault	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
FAULT DC BUS CIRCUIT PRECHARGE	PR	DC bus precharge circuit fault (Q@Night function)	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
EXT CANBUS COM FAULT	PR	External CAN communication fault	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'.
DC SHORT CIRCUIT	PR	Short circuit on the DC PV plant	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
MULTIPLE MASTER	PR	MASTER/SLAVE ddresses fault	The inverter doesn't switch in "inverter generating' status, until the Master/Slave addresses are correct
FAULT AUX. SUPPLY	PR	48V Auxiliary Power supply fault	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
UPS BATTERY DISCHARGING	AN	UPS battery discharging	The inverter doesn't change its status
UPS BATTERY FAULT	AN	UPS battery fault	The inverter doesn't change its status
DC SURGE ARRESTER OPEN	AN	DC surge arrester opened	The inverter doesn't change its status
AC SURGE ARRESTER OPEN	AN	AC surge arrester opened	The inverter doesn't change its status
AMB. TEMPERATURE SENSOR FAULT	AN	Ambient temperature sensor fault	The inverter doesn't change its status

4.5.2.1 AnomalieS, Alarms and Protections for single module.

Displayed message	AN - Fault AL - Alarm PR - Protection	Cause	Effect
AC CONTACTOR A FAULT	PR	AC Contactor module A fault	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
AC CONTACTOR B FAULT	PR	AC Contactor module B fault	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
OVERCURRENT INV PHASE R MODULE A	PR	Rms or peak value of the current generated in the grid outside allowable range (note 5	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
OVERCURRENT INV PHASE S MODULE A			
OVERCURRENT INV PHASE T MODULE A			
OVERCURRENT INV PHASE R MODULE B			
OVERCURRENT INV PHASE S MODULE B			
OVERCURRENT INV PHASE T MODULE B			
HW OVERCURRENT MODULE A			
HW OVERCURRENT MODULE B			
IGBT FAULT HI PHASE R MODULE A	PR	Power semi-conductor fault	The inverter is in the "Inverter disabled" status; ***requires an intervention by a SIEL SPA qualified technician.***
IGBT FAULT LO PHASE R MODULE A			
IGBT FAULT HI PHASE S MODULE A			
IGBT FAULT LO PHASE S MODULE A			
IGBT FAULT HI PHASE T MODULE A			
IGBT FAULT LO PHASE T MODULE A			
IGBT FAULT HI PHASE R MODULE B			
IGBT FAULT LO PHASE R MODULE B			
IGBT FAULT HI PHASE S MODULE B			
IGBT FAULT LO PHASE S MODULE B			
IGBT FAULT HI PHASE T MODULE B			
IGBT FAULT LO PHASE T MODULE B			

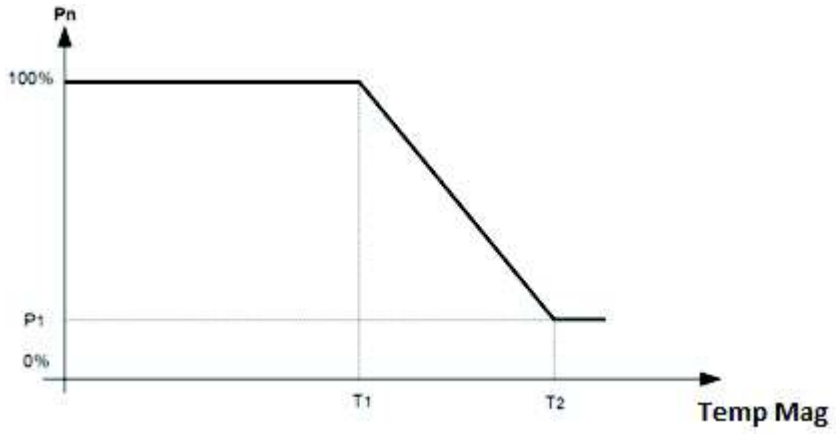
MODULE A DRIVER FAULT **MODULE B DRIVER FAULT**			
MODULE A CANBUS COM. FAULT	PR	Driver module A CAN Communication failure	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'.
MODULE B CANBUS COM. FAULT	PR	Driver module B CAN Communication failure	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'.
MODULE A OVERTEMPERATURE	PR	Inverter heat sink module A overtemperature	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'. • Wait until temperature value returns under the threshold value and wait 10 sec before starting
MODULE B OVERTEMPERATURE	PR	Inverter heat sink module B overtemperature	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'. • Wait until temperature value returns under the threshold value and wait 10 sec before starting
MAGNETICS MOD A OVERTEMPERATURE	PR	Inverter magnetic module A overtemperature	• If the inverter status in 'INVERTER ENABLED', it remains unchanged. • If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'. • Wait until temperature value returns under the threshold value and wait 10 sec before starting
MAGNETICS MOD B OVERTEMPERATURE	PR	Inverter magnetic module B overtemperature	• If the inverter status in 'INVERTER ENABLED', it remains unchanged.

			• If the inverter status in 'INVERTER GENERATING', status transition occurs to 'INVERTER ENABLED'. • Wait until temperature value returns under the threshold value and wait 10 sec before starting
MOD A TEMPERATURE SENSOR FAULT	AN	Module A temperature sensor disconnects	The inverter doesn't change its status
MOD B TEMPERATURE SENSOR FAULT	AN	Module B temperature sensor disconnects	The inverter doesn't change its status
MAGNETICS MOD A TEMP SENSOR FAULT	AN	Module A magnetics temperature sensor disconnects	The inverter doesn't change its status
MAGNETICS MOD B TEMP SENSOR FAULT	AN	Module B magnetics temperature sensor disconnects	The inverter doesn't change its status

1. Minimum cell voltage: see the tables shown in chapter 7 "Technical information".
2. Minimum power: 1,5% of nominal power (at DC side input).
3. Behaviour complies with the requirements of the CEI-016 andCEI-021 standards.
4. The inverter is equipped with the control of the isolation of the DC side. The same device also permits the detection of the opening of the fuse of the earthing pole, if panels that provide for it are inserted. The two features are complementary. As a default, the inverter measures the insulation resistance with the activation of an alarm if the measurement is less than a set value. Should the earthing pole control feature be implemented, contact the SIEL SPA customer support service. It is possible to choose whether the insulation defect or the operation of the fuse of the earthing pole must only give an alarm or stop the inverter (Protection), also in this case it will be necessary to contact the SIEL SPA customer support service. The implementations described in the above lines can also be carried out in the factory if requested in the ordering phase.
5. The intervention threshold of the maximum current protection is equal to 125% of the rms value of the rated inverter current (see the tables reported in chapter 7 "Technical Information").
6. The maximum voltage protection system cuts in when DC BUS voltage exceeds the value shown in the 'Technical data' tables in section 7. The protection is reset if the direct voltage drops below the safety value (90% of maximum voltage).

4.5.3 Power derating as a function of temperature of magnetic components

The inverter control DSP performs an automatic power limitation as a function of the temperature of magnetic components, according to following trend:



P1 –Power value (expressed as percentage of rated power of the inverter) that can be generated when temperature of magnetic components reaches 'T2' value.

T1 – Temperature of magnetic components at which power limitation starts.

T2 - Temperature of magnetic components at which power limitation rate is maximum (i.e. minimum generated power)..

As long as the temperature of magnetic components is lower than T1, generated power is 100% of rated power Pn

As soon as the temperature of magnetic components overcomes the temperature threshold T1, generated power gets linearly derated as the temperature increases, until reaching the power value 'P1' (corresponding to temperature of magnetic components 'T2').

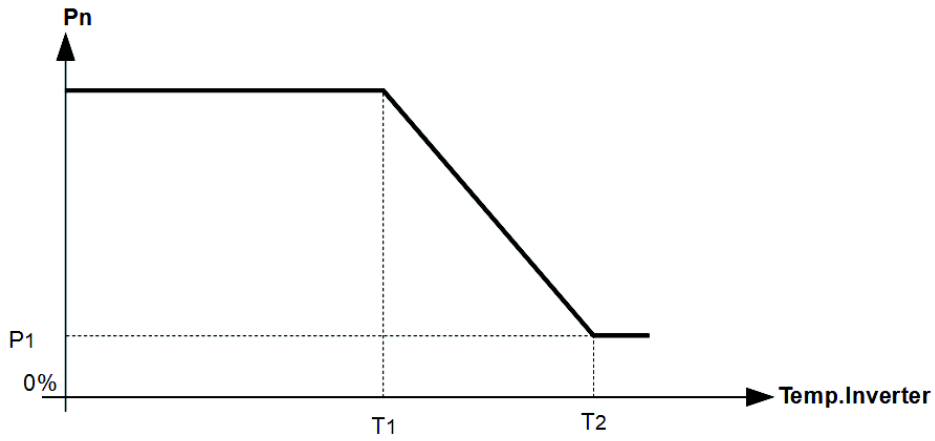
In any case, as soon as the' temperature overcomes 'T2' threshold, the inverter gets into protection trip for 'magnetic over-temperature'.

Power level P1 and T1 and T2 thresholds, can be set through following parameters:

PARAMETER		DESCRIPTION	DEFAULT VALUE	RANGE	UNITS
1638	B	P1 – percentage of rated power that can be generated when the temperature of magnetic components reaches temperature 'T2'	30	0 - 100	%
1466	B	T1 – Temperature threshold at which the power limitation starts	130	0-255	°C
1467	B	T2 - Temperature threshold beyond which Magnetic components Over-temperature protection trip occurs.	150	0-255	°C

4.5.4 Power derating as a function of power module temperature

Similarly to magnetic components, the inverter control DSP performs an automatic power limitation as a function of the temperature of the inverter power module, according to following trend:



Power level P1 and T1 and T2 thresholds, can be set through following parameters:

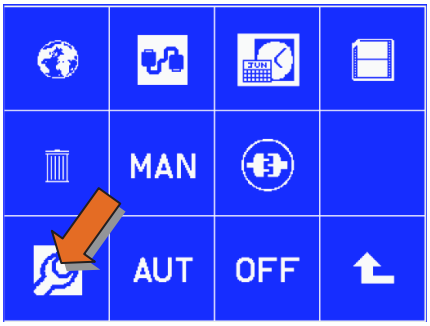
PARAMETER		DESCRIPTION	DEFAULT VALUE	RANGE	UNITS
1639	B	P1 – percentage of rated power that can be generated when the temperature of inverter module reaches temperature 'T2'	30	0 - 100	%
1438	B	T1 – Temperature threshold at which the power limitation starts	80	0-255	°C
1439	B	T2 - Temperature threshold beyond which inverter Over-temperature protection trip occurs	85	0-255	°C

In any case, should the power limitation not be enough to limit the temperature raise of the modules, as soon as the temperature sensor (mounted on the heat-sink of power modules) detects a temperature equal to 90°C on the heat-sink , the inverter over-temperature protection trips occurs.

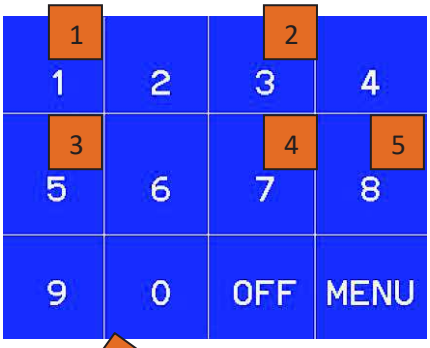
This protection in performed by an HW-implemented over-temperature trip circuitry.

4.6 Identification of code revision firmware installed on solar converters

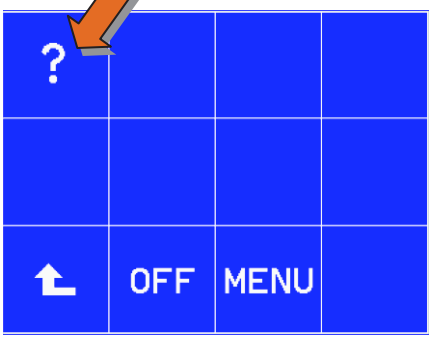
From the main screen of the display of the machine, press the **Menu** key to access the corresponding page.



Access the **Advanced setup** menu by pressing the key on.



Enter the code number **13578**.



Go to the screen **firmware** revision code of the machine using the appropriate button.

Using the arrow keys, scroll the display to the DSP BOARD to read the regulation firmware version installed in the inverter.

For the converter construction date, the firmware identification code can be viewed in one of the following formats:

MCxxxx . yy . zz for example MC0162.00.01

MCxxxx yy REV zz for example MC010900 REV 24

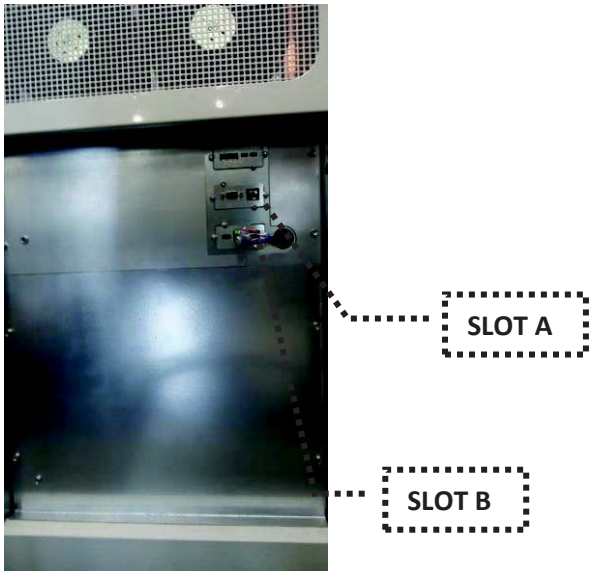
For all display formats, the field must be interpreted in accord to the following table:

Field	Meaning
MCxxxx	Identification code of the firmware. *MC0109 Identification code for SOLEIL DSP inverters* *MC0162 Identification code for new generation SOLEIL inverters*
yy	Major Revision Code, indicates changes with the addition of new features
zz	Minor Revision Code, indicates changes related to bugfix and anomalies *Firmware with different minor revision code, from the point of view of functionality for Network Services are equivalent*

5 COMMUNICATIONS AND I/O

5.1 Ports and protocols

The SOLEIL DSPX xxxx TLH 1500 inverters are equipped with a communication platform based on two ports, which can accommodate different interface devices for the remote transmission of values, status and alarms.



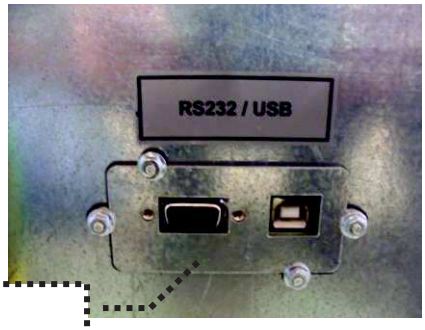
Each of the slots supports differing types of peripherals and communication protocols as can be seen in the following table:

BOARD	SLOT A	SLOT B
RS-232/USB	OCS3 protocol	OCS3 and Modbus protocols
RS-485	Not available	OCS3 and Modbus protocols

By default, the appliance is fitted with an RS-232/USB interface board (type B) for point-to-point type connections and with an RS-485 interface board for field bus connections.

To replace one type of board with another, you need to:

- Set the communication protocol parameters by touch as explained in section 4.3.4.3.
- Unscrew the nuts (1 to 4) as shown in the picture and remove the metal cover.
- Remove the card (an empty slot appears as shown in the right section of the picture) and insert the new card pushing it until you notice a resistance.
- Replace the metal cover (supplied with the board) then refit the four nuts.
- Plug the communications cable into the board connector.



Metal cover plate

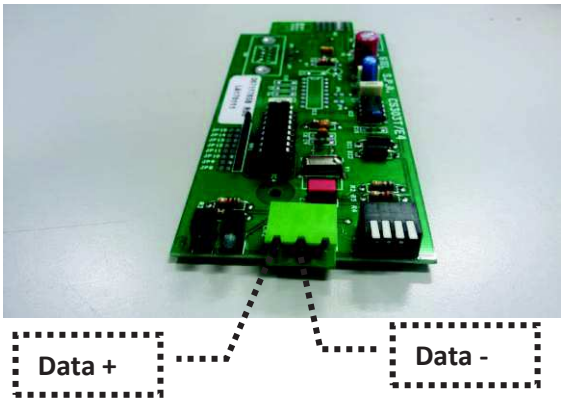
A board can be replaced even while the inverter is running.

For more information about other cards (not RS-232 and RS-485) and about communication protocol, contact SIEL SPA Commercial Office.

5.2 Communication boards

5.2.1 RS-232/USB serial interface card

5.2.2 Serial RS-485 interface board



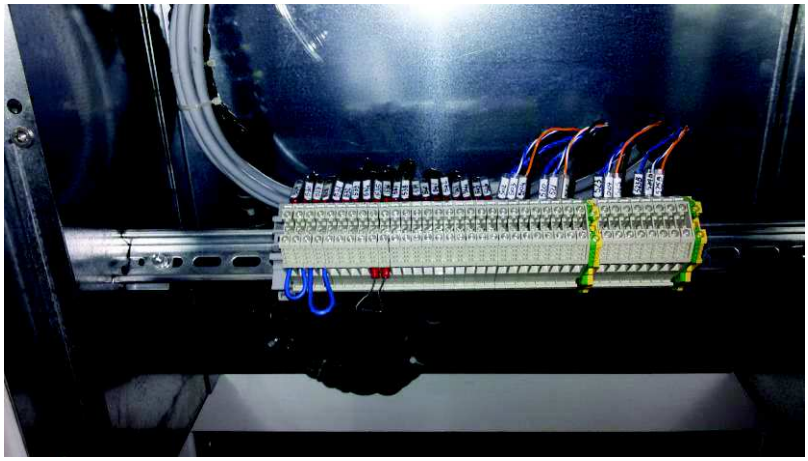
This board allows you to connect the inverter to a RS-485 field bus serial with the Modbus protocol. The connection of each inverter to the RS-485 bus must take place according to a “chain” type (avoiding “star” connections).

The connection diagrams are found in “Installation Manual” document IV408.

5.3 Terminal board I/O (terminal block)

The inverter has a terminal block for cables that lets the user:

- Acquire detailed digital information about inverter status (volt free).
- Send commands to the inverter (using relays).
- Send analogue signals (voltage 0-5V) to the inverter (measurements or references).



To get acccess to the terminal block, it is necessary to remove the metal panel located in the front side of the inverter below the air intake grid of power modules, by removing the screws securing the panel.

5.3.1 Analog and Digital inputs

Terminal	Signal name	I/O	Type	Meaning	
1-2	EXTERNAL START INVERTER	I	Input contact	Open	External inverter stop command
				Closed	External inverter start command
3-4	USER REMOTE EPO CONTACT	I	Input contact	Open	Inverter remote emergency stop
				Closed	
5(+)-6(-)	CELL TEMPERATURE	I	Analogue	Temperature module probe input	
7(+)-8(-)	CONF. AN. INPUT1	I	Analogue	Analog expansion input	*For information contact SIEL*
9(+)–10(-)	RADIATION	I	Analogue	Radiation sensor input	
11(+)-12(-)	CONF. AN. INPUT2	I	Analogue	Analog expansion input	*For information contact SIEL*

Notes

1. The volt-free contacts have the following characteristics:
    a. Maximum commutable voltage: 48Vac, 60Vdc.
    b. Maximum commutable current: 6A
    c. The analog input are signalled at 0-5V.

5.3.2 RS485 communication

Terminal	Signal name	I/O	Type	Meaning	
21(+)-22(-) 23(GND)-24(SHIELD)	RS-485 MODBUS PPC	I/O	Serial	RS 485 MODBUS input (POWER PLANT CONTROLLER)	21(+) - 22(-) 23(GND)-24(SHIELD)
25(+)-26(-) 27(GND)-28(SHIELD)	SAC TO CSP BUS	I/O	Serial	Bus communication for CSP	25(+) - 26(-) 27(GND)-28(SHIELD)
29(+)-30(-) 31(GND)-32(SHIELD)	RS-485 MODBUS IN	I/O	Serial	RS 485 MODBUS input (Inverter and datalogger for CSP)	29(+) - 30(-) 31(GND)-32(SHIELD)
33(+)-34(-) 35(GND)-36(SHIELD)	RS-485 MODBUS OUtPUT	I/O	Serial	RS 485 MODBUS output (Inverter and datalogger for CSP)	33(+) - 34(-) 35(GND)-36(SHIELD)

Notes

a. The serials are differential +5 / -5V.

5.3.3 DC disconnector switch: shunt trip coil

The inverter is equipped with a minimum-voltage shunt trip coil (optional), timer-controlled, to open the DC automatic disconnector switch.

When this coiled is powered on (+24V), after a programmable delays, an auxiliary contact opens, by forcing the DC disconnector switch of the inverter to open.

Terminals for connection and electrical characteristics, are reported in following table:

Terminals	Name	I/O	Electrical characteristics			
			Time scale	Voltage supply	Rated Frequency	Max absorbed power
+24 / -24	Time-delay relay	I	0,1sec...10h 0.1...10gg Only ON Only OFF	24...48VDC	50/60Hz	1,2VA/0,8W max

5.3.4 Output relays

Morsetti	Nome segnale	I/O	Tipo	Significato	
13-14	RELAY 1 (Enable/Disable)	O	Output contact	Open	Inverter disabled
				Closed	Enabled inverter not generating power
15-16	RELAY 2 (Protection)	O	Output contact	Open	No protection present
				Closed	Protection present
17-18	RELAY 3 (Perdita isolamento o Fusibile polo a terra aperto nota [1])	O	Output contact	Open	No protection present
				Closed	Isolation loss / Fuse open
19-20	RELAY 4 (Start/Stop)	O	Output contact	Open	Inverter not generating
				Closed	Inverter connected to the mains and generating

nota [1] The relay is associated to the configuration of the inverter (either with negative pole grounded or insulation control).

Each of the four relays can be configured through its own parameter (within brackets the 'default' configuration).

5.3.4.1 Configuration of relays

Following table shows the list of parameters used for configuration of relays with their own 'default' value.

PARAMETER		DESCRITPION	DEFAULT	RANGE
1658	b	Configuration of output relay 1	1	0-255
1659	b	Configuration of output relay 2	8	0-255
1660	b	Configuration of output relay 3	4	0-255
1661	b	Configuration of output relay 4	2	0-255

Values of parameters are associated to a different information carried by the relay according to:

VALUE	INFORMATION	DESCRIPTION OF RELAY OPERATION
1	Enable / Disable	Relay closed when the inverter status in 'ENABLED'
2	Start / Stop	Relay closed when the inverter starts generation
4	Loss of insulation / Grounding fuse-open	- If the inverter is configured to constantly perform the insulation monitoring, the relay closes-up as soon as an insulation loss occurs (from either negative or positive pole to ground). - If the inverter is configured to perform fuse check (negative pole grounded), the relay closes-up as soon as the fuse gets interrupted
8	Alarm presence	the relay closes-up as soon as some anomaly/alarm occurs Il relè si chiude in presenza di una qualsiasi avaria

6 ACCESSORIES (OPTIONAL)

Only use accessories recommended by the manufacturer. The use of unauthorised accessories may seriously affect how the appliance operates. The use of non-original accessories will result in the warranty being invalidated and will exempt the manufacturer from any responsibility whatsoever for malfunctions and any consequences that might stem from them.

6.1 Radiation sensor

An instantaneous radiation sensor is available on request.

The radiation value reading (in W/sq mt) can be viewed on the touch screen display and via Modbus.

The sensor is a 405x355x35mm photovoltaic module and it shall be installed as coplanar as possible to the actual photovoltaic field (same tilt and azimuth angles).

The following table lists the electrical data:

Pmax	Imp	Vmp	Isc	Voc
15W ±3%	0.85 A	17.7 V	0.92 A	21.6 V

The module shall be connected to terminals **9**(Irr+) and **10**(Irr-) of the inverter with two 0.5/1.5 sq mm wires (par. **Errore. L'origine riferimento non è stata trovata.**). The load resistance of the module is setup at actory on the external machine side of terminals 9 and 10 (connect the wires from the parallel module to the resistance).

7 TECHNICAL DATA

The following tables[1] contain the SOLEIL DSPX xxxx TLH 1500 inverter series technical data:.

"SOLEIL DSPX xxxx TLH 1500" inverters family are compliance with the following standards

- Inverter in compliance with Resolution **AEEG 84/2012/R/EEL art. 4.1b**, and for LV and MV connections, with crystalline modules

Please refer to **Notes** at the end of all the TECHNICAL SPECIFICATION Tables, for definitions and conditions in which the technical data are expressed.

[1] The data included in the tables refers to the issue date of this document. SIEL reserves the right to change the technical specification at any time.

7.1 Inverter SOLEIL DSPX xxxx TLH 1500

7.1.1 Inverter 530Vac output voltage

SOLEIL DSPX TLH 1500	550	1100 (*)	2200 (*)	3300 (*)	4400 (*)
DC input side - Recommended power of the modules					
Rated [kWp]	559	1116	2227	3336	4447
Maximum [kWp]	699	1395	2784	4170	5556
Number of power cores	1	2	4	6	8
DC input side - Electricel specifications					
Operating voltage range [V]	800 - 1450				
MPPT Voltage[V]	800 - 1400				
Max Voltage [V] (no peration) @-10°C	1500				
Rated DC voltage (max efficiency)	1100				
Min Voltage [V] @+70°C	800				
Max Input DC current [A]	699	1395	2784	4170	5559
Module Max Isc [A]	874	1744	3480	5213	6949
N. DC input	4	4	4	4	4
N.MPPT	1	1	1	1	1
AC output side					
Pmax rated power [kW] [1]	550	1100	2200	3300	4400
Maximum power Smax [kVA] [1]	594	1188	2376	3564	4752
Max Active Power Pmax [kVA] [1]	594	1188	2376	3564	4752
Connection	3ph				
Rated voltage [V] (line to line)	530				
Rated current [A] [2]	600	1199	2397	3595	4794
Maximum current [A] [3]	719	1438	2876	4314	5752
Min Smax operating voltage [V] [4]	90% Vn				
Minimum operating voltage [V] [4]	85% Vn				
Maximum operating voltage [V] [4]	115% Vn				
Nominal frequency [Hz]	50 o 60				
Frequency interval [Hz] [5]	Adjustable (47,5 - 51,5) o (55,5 to 62,5)				
Max efficiency [%] [6] (**)	99,45	99,45	99,45	99,45	99,45
Euro efficiency [%] [6] (**)	99,21	99,21	99,24	99,24	99,22
Static MPPT efficiency (**)	99,8				
Dynamic MPPT efficiency (**)	98,78				
THD% I @Pnom	<3				
Power factor [1]	0.0 … 1.0 leading-lagging				
Max current unbalacement	1%				
Short circuit current contribution [A]	1079	2157	4314	6471	8628

Other Data					
Ventilation system	Forced air				
Dissipated power without load [W]	80	80	80	80	80
Control	DSP				
Output wave form	Pure Sine Wave				
Operating temperature (full power)[°C]	-20°C / +51°C				
Max Operating temperature [C°]	+60°C				
Storage temperature range [°C]	-25°C / +70°C				
Operating humidity range	5% / 95%				
Maximum altitude with no power derating at max ambient temp (+51°C)	1000m (a.s.l.)				
Power derating with altitude	1% every 100mt above 1000 mt				
Environment category	INDOOR				
Pollution Degree	PD3				
Overvoltage class (input DC)	Classe II				
Overvoltage class (output AC)	Classe II				
Mechanical characteristics					
Dba	85	85	85	85	85
Class of protection	IP20				
Footprint size for basement (LxD) [mm]	2000/1000	2000/1000	2000/1000	2000/1000	2000/1000
Overall (LxDxH) [mm]	2000/1000/2000	2000/1000/2000	2000/1000/2000	2000/1000/2000	2000/1000/2000
Weight [kg]	1600	1800	3600	5400	7200

(*): Operating with **Master & Multi-Slave** logic

(**): Third Party lab measured values. Test report available upon request. Values measured according to IEC EN 50530.

7.1.1 Inverter 600Vac output voltage

SOLEIL DSPX TLH 1500	665	1330 (*)	2660 (*)	4000 (*)	5330 (*)
DC input side - Recommended power of the modules					
Rated [kWp]	676	1349	2693	4033	5377
Maximum [kWp]	845	1686	3366	5041	6721
Number of power cores	1	2	4	6	8
DC input side - Electricel specifications					
Operating voltage range [V]	900 - 1450				
MPPT Voltage[V]	900 - 1400				
Max Voltage [V] (no peration) @-10°C	1500				
Rated DC voltage (max efficiency)	1150				
Min Voltage [V] @+70°C	900				
Max Input DC current [A]	751	1498	2991	4480	5974
Module Max Isc [A]	939	1873	3740	5602	7469
N. DC input	4	4	4	4	4
N.MPPT	1	1	1	1	1
AC output side					
Pmax rated power [kW] [1]	665	1330	2660	3990	5320
Maximum power Smax [kVA] [1]	699	1397	2793	4190	5586
Max Active Power Pmax [kVA] [1]	699	1397	2793	4190	5586
Connection	Trifase				
Rated voltage [V] (line to line)	600				
Rated current [A] [2]	640	1280	2560	3840	5120
Maximum current [A] [3]	748	1496	2991	4487	5982
Min Smax operating voltage [V] [4]	90% Vn				
Minimum operating voltage [V] [4]	85% Vn				
Maximum operating voltage [V] [4]	115% Vn				
Nominal frequency [Hz]	50 o 60				
Frequency interval [Hz] [5]	Impostabile (47,5 - 51,5) o (55,5 to 62,5)				
Max efficiency [%] [6] (**)	99,52	99,52	99,52	99,52	99,52
Euro efficiency [%] [6] (**)	99,28	99,31	99,33	99,34	99,32
Static MPPT efficiency (**)	99,8				
Dynamic MPPT efficiency (**)	98,78				
THD% I @Pnom	<3				
Power factor [1]	0.0 … 1.0 leading-lagging				
Max current unbalacement	1%				
Short circuit current contribution [A]	1122	2241	4481	6720	8960

Other Data					
Ventilation system	Forced air				
Dissipated power without load [W]	80	80	80	80	80
Control	DSP				
Output wave form	Pure Sine Wave				
Operating temperature (full power)[°C]	-20°C / +51°C				
Max Operating temperature [C°]	+60°C				
Storage temperature range [°C]	-25°C / +70°C				
Operating humidity range	5% / 95%				
Maximum altitude with no power derating at max ambient temp (+51°C)	1000m (a.s.l.)				
Power derating with altitude	1% every 100mt above 1000 mt				
Environment category	INDOOR				
Pollution Degree	PD3				
Overvoltage class (input DC)	Classe II				
Overvoltage class (output AC)	Classe II				
Mechanical characteristics					
Dba	85	85	85	85	85
Class of protection	IP20				
Footprint size for basement (LxD) [mm]	2000/1000	2000/1000	2000/1000	2000/1000	2000/1000
Overall (LxDxH) [mm]	2000/1000/2000	2000/1000/2000	2000/1000/2000	2000/1000/2000	2000/1000/2000
Weight [kg]	1600	1800	3600	5400	7200

(*): Operating with **Master & Multi-Slave** logic

(**): Third Party lab measured values. Test report available upon request. Values measured according to IEC EN 50530.

7.1.2 Inverter 640Vac output voltage

SOLEIL DSPX TLH 1500	708	1415 (*)	2830 (*)	4245 (*)	5660 (*)
DC input side - Recommended power of the modules					
Rated [kWp]	718	1435	2865	4291	5721
Maximum [kWp]	899	1794	3582	5364	7152
Number of power cores	1	2	4	6	8
DC input side - Electricel specifications					
Operating voltage range [V]	950 - 1450				
MPPT Voltage[V]	950 - 1400				
Max Voltage [V] (no peration) @-10°C	1500				
Rated DC voltage (max efficiency)	1170				
Min Voltage [V] @+70°C	950				
Max Input DC current [A]	757	1511	3016	4517	6023
Module Max Isc [A]	947	1889	3770	5647	7529
N. DC input	4	4	4	4	4
N.MPPT	1	1	1	1	1
AC output side					
Pmax rated power [kW] [1]	707,5	1415	2830	4245	5660
Maximum power Smax [kVA] [1]	722	1444	2887	4330	5774
Max Active Power Pmax [kVA] [1]	722	1444	2887	4330	5774
Connection	3ph				
Rated voltage [V] (line to line)	640				
Rated current [A] [2]	639	1277	2553	3830	5106
Maximum current [A] [3]	724	1448	2894	4341	5788
Min Smax operating voltage [V] [4]	90% Vn				
Minimum operating voltage [V] [4]	85% Vn				
Maximum operating voltage [V] [4]	115% Vn				
Nominal frequency [Hz]	50 or 60				
Frequency interval [Hz] [5]	Adjustable (47,5 - 51,5) o (55,5 to 62,5)				
Max efficiency [%] [6] (**)	99,55	99,55	99,55	99,55	99,55
Euro efficiency [%] [6] (**)	99,29	99,33	99,36	99,36	99,35
Static MPPT efficiency (**)	99,8				
Dynamic MPPT efficiency (**)	98,78				
THD% I @Pnom	<3				
Power factor [1]	0.0 … 1.0 leading-lagging				
Max current unbalacement	1%				
Short circuit current contribution [A]	1086	2172	4341	6512	8682

Other Data					
Ventilation system	Forced air				
Dissipated power without load [W]	80	80	80	80	80
Control	DSP				
Output wave form	Pure Sine Wave				
Operating temperature (full power)[°C]	-20°C / +51°C				
Max Operating temperature [C°]	+60°C				
Storage temperature range [°C]	-25°C / +70°C				
Operating humidity range	5% / 95%				
Maximum altitude with no power derating at max ambient temp (+51°C)	1000m (a.s.l.)				
Power derating with altitude	1% every 100mt above 1000 mt				
Environment category	INDOOR				
Pollution Degree	PD3				
Overvoltage class (input DC)	Classe II				
Overvoltage class (output AC)	Classe II				
Mechanical characteristics					
Dba	85	85	85	85	85
Class of protection	IP20				
Footprint size for basement (LxD) [mm]	2000/1000	2000/1000	2000/1000	2000/1000	2000/1000
Overall (LxDxH) [mm]	2000/1000/2000	2000/1000/2000	2000/1000/2000	2000/1000/2000	2000/1000/2000
Weight [kg]	1600	1800	3600	5400	7200

(*): Operating with **Master & Multi-Slave** logic

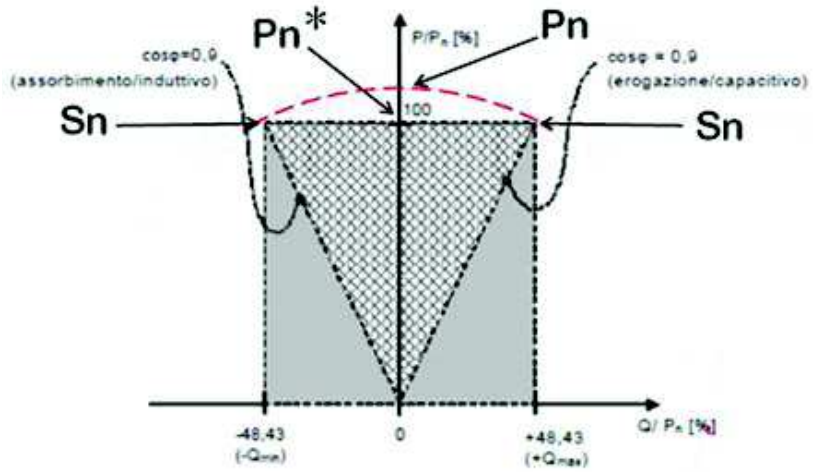
(**): Third Party lab measured values. Test report available upon request. Values measured according to IEC EN 50530.

Note

1. Power definitions (from table of technical characteristics):

   - **Sn:** rated value of the **apparent power**. This value is defined as the power value that can be continuously generated when the ambient temperature exceeds 40°C, up to 51°C and the voltage of operation is between 0.9Vn and the rated voltage Vn.
   - **Smax:** maximum value of the **apparent power** that can be generated throughout the whole operating temperature range and the voltage of operation is between 0.9Vn and the rated voltage Vn. This value is available from the minimum operating temperature up to 40°C, according to graphical trends "Apparent Power vs Temperature" reported in paragraph 1.1.
   - **Pmax:** maximum value of the **active power** (at power factor = 1) that can be generated throughout the whole operating temperature range and the voltage of operation is between 0.9Vn and the rated voltage Vn. This value is available from the minimum operating temperature up to 40°C, according to graphical trends "Apparent Power vs Temperature" reported in paragraph 1.1.

   Other power definitions (see figure below):
   - **Pn (Rated value of active power)**: This value is defined as the power value that can be continuously generated at power factor 1, when the ambient temperature exceeds 40°C, up to 51°C and the voltage of operation is between 0.9Vn and the rated voltage Vn.
   - **Pn* (Rated value of active power at p.f. = 0,9Pn)**: This value is defined as the power value that can be continuously generated at power factor 0.9 (lead/lag), when the ambient temperature exceeds 40°C, up to 51°C and the voltage of operation is between 0.9Vn and the rated voltage Vn.



2. **In:** rated value of current, corresponding to the rated value of apparent power Sn, when the voltage is at its rated value Vn.
3. **Imax**: maximum value of current, corresponding to the maximum value of apparent power, when the grid voltage is 0.9Vn (-10%).

4. Voltage definitions
   - **Min Smax operating voltage**: minimum voltage at which the Smax generation of the maximum power is possible.
   - **Min operating voltage**: from 90%Vn to 85%Vn the inverter operates within the limitation of the current; for voltages less than 85%Vn, the inverter can remain connected to the grid without generating power (LVFRT function enabled, see graphic) or disconnect itself.
   - **Max operating voltage**: for voltage values above 115%Vn, the inverter disconnects from the grid.

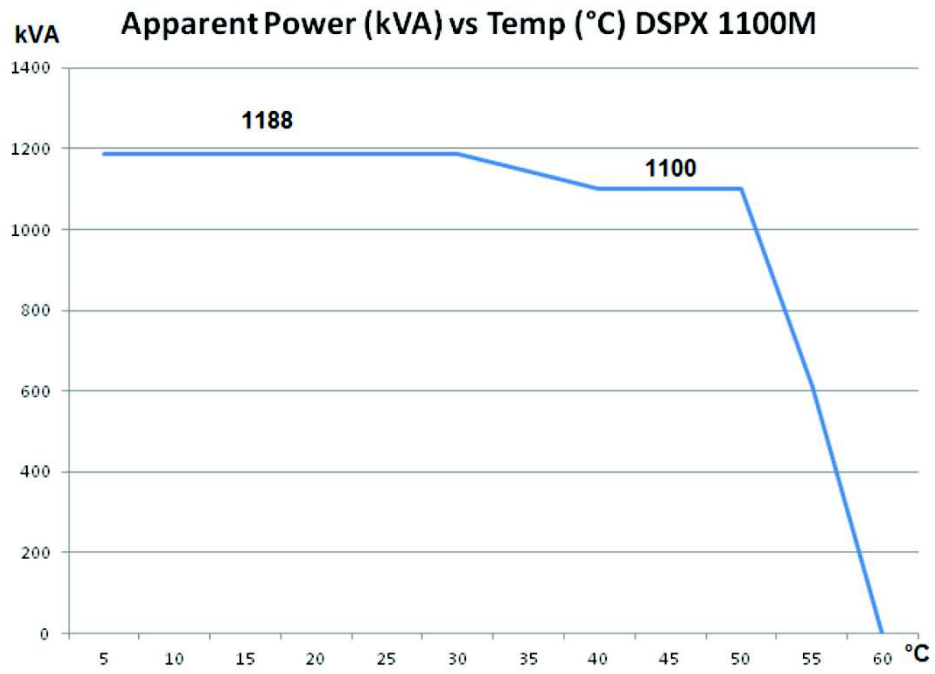
5. **Frequency range**: Configurable according to the type of connection

6. **Max/Euro Efficiency**: Efficiency measured at min DC voltage

7.2 Apparent power vs Ambient Temperature graphs

In order to maximize power generation, the SOLEIL DSPX TLH 1500 inverters implement a Power vs Temperature profiling function. For low values of the ambient temperature (between 5°C and 40°C), the generated apparent power is equal **Smax**, whereas for values of temperature between 40°C and 51°C, the generated apparent power is equal to **Sn**.

SOLEIL DSPX 1100M TLH 1500



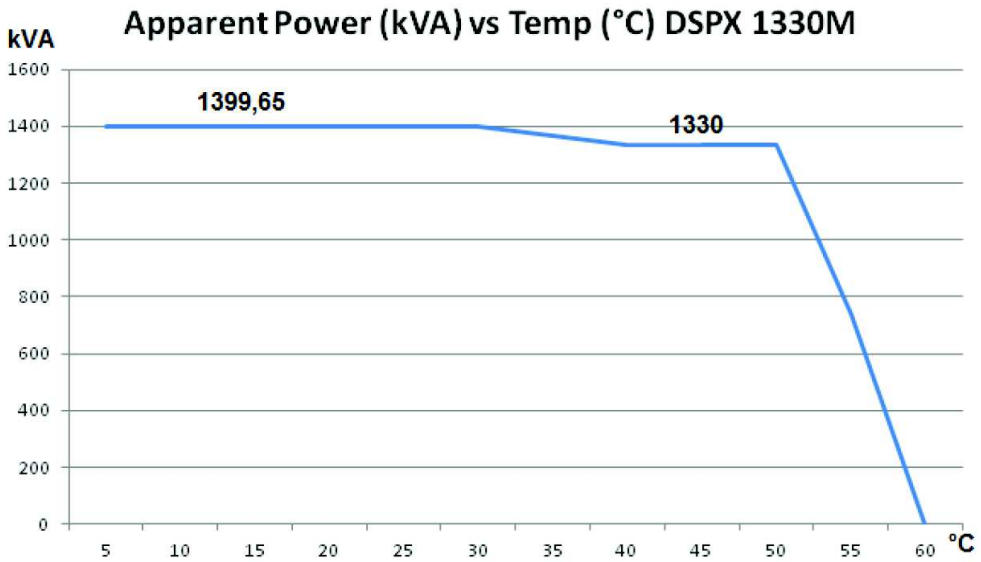
For the other models of this family, values of Smax and Sn are scaled-up or down, depending on the power of the inverter:

Sn = 550 kVA -- > Smax 594 kVA Sn = 1100 kVA -- > Smax 1188 kVA

Sn = 2200 kVA --> Smax 2376 kVA Sn = 3300 kVA --> Smax 3564 kVA

Sn = 4400 kVA --> Smax 4752 kVA

SOLEIL DSPX 1330M TLH 1500



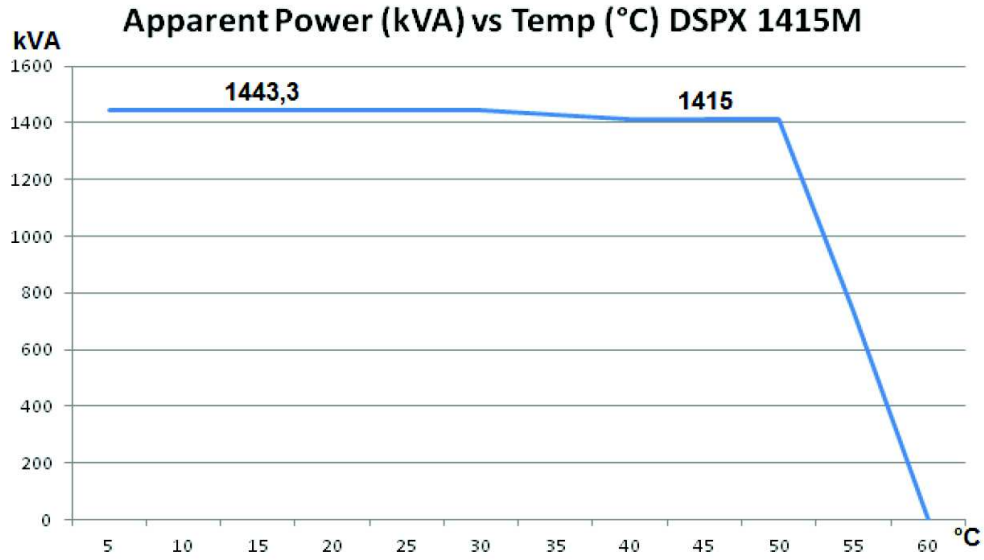
For the other models of this family, values of Smax and Sn are scaled-up or down, depending on the power of the inverter:

Sn = 665 kVA -- > Smax 699 kVA Sn = 1330 kVA -- > Smax 1399 kVA

Sn = 2660 kVA --> Smax 2793 kVA Sn = 4000 kVA --> Smax 4190 kVA

Sn = 5330 kVA --> Smax 5586 kVA

SOLEIL DSPX 1415M TLH 1500



For the other models of this family, values of Smax and Sn are scaled-up or down, depending on the power of the inverter:

Sn = 707,5 kVA -- > Smax 722 kVA Sn = 1415 kVA -- > Smax 1444 kVA

Sn = 2830 kVA --> Smax 2887 kVA Sn = 4245 kVA --> Smax 4330 kVA

Sn = 5660 kVA --> Smax 5774 kVA

8 APPENDIX: FEATURES REGARDING GRID SERVICES (CEI 0-21 CEI 0-16 AND ANNEX A70)

8.1 Introduction

SOLEIL DSPX inverters comply with CEI 0-21/CEI 0-16 regulations and with Terna attachment A70.

The features regarding “Grid services”, summarised below, can be configured by the installer through the use of the inverter touch screen control panel, according to the procedure described below.

The functions implemented, in accord with section 8.5 of the CEI 0-21 regulations, paragraph 8.8.5 and 8.8.6 of the CEI 016 regulations and chapter 7 of Attachment A70 are:

- Start and gradual increase of the power fed into the grid
- Immunity to brownouts (LVFRT Low Voltage Fault Ride Through)
- Limitation of the active power generated in the presence of transients on the transmission grid
- Active generated power limitation according to a set power limit
- Participation in the control of the grid voltage, in the following ways:
    - Reactive power distribution/absorption according to a set Q reference
    - Automatic supply of reactive power according to a pf = f(P) characteristic curve
    - Automatic supply/absorption of reactive power according to a Q = f(V) characteristic curve

SOLEIL DSPX inverters are configured as follows by default:

Start and gradual increase of the power supplied to the grid	f=49.9…50.1 Hz / 59,9...60,1 Hz, V=85…110% Vn (present for 5 continuous minutes) Power ramp lasting 5 minutes
LVFRT	Function disabled, enabled
Limitation of the Active Power in the presence of frequency transients	Enabled with the following parameters : • Frequency thresholds = 50.3 / 51.5 Hz – 60.3...61.5 Hz • droop = 2.4% • frequency thresholds for restoration of power = 49.9 and 50.1 Hz - 59,9 and 60.1 Hz • slope of transfer after over frequency = 5 minutes
Participation in the control of the voltage (reactive supply)	Function disabled, enabled

If it is necessary to modify the standard setting, follow the procedure described as follows which lists the parameters regarding the different features available in detail.

8.2 Configuration of parameters for grid-support functions

Depending on the installation, it might be necessary to modify some parameters in order to enable Grid support functions as established by the Country-specific grid code, upon request of the Distributor.

TO MODIFY CONFIGURATION PARAMETER OF THE INVERTER, PLEASE REFER TO THE PROCEDURE FOR PARAMETER READ/WRITE (PAR. 4.3.4.6).

8.2.1 Start and gradual increase of the power supplied to the grid

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1530	W	Upper limit of the grid frequency to define the range of acceptance for the start of the power generation phase.	5010 / 6010	4000 … 7000
1532	W	Lower limit of the grid frequency to define the range of acceptance for the start of the power generation phase.	4990 / 5990	4000 … 7000

The two thresholds together represent the range within which the grid frequency must terminate for a continuous defined time, before being able to start the power generation phase.
The two thresholds can be set in centi-Hz.

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1283	W	Lower limit of the grid (phase) voltage to define the range of acceptance for the start of the power generation phase (cei 016 → 90% Vn – cei 021 85% Vn)	-	90 … 500
1285	W	Upper limit of the grid (phase) voltage to define the range of acceptance for the start of the power generation phase.	-	90 … 800

The two thresholds together represent the range within which the grid (phase) voltage must terminate for a continuous defined time, before being able to start the power generation phase.
The two thresholds can be set in Volts.

In relation to the inverter nominal input voltage, the two default values are defined as follows:

Rated Voltage	W1283	W1285
530	276	337
600	312	381
640	333	406

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1266	w	Time of acceptance of the Grid parameters (Voltage and frequency) for the start of the phase of power generation.	300	1 … 900

Time of acceptance of the Grid parameters (voltage and frequency) for the start of the phase of power generation.
The data is expressed in seconds.

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1540	B	Enabling of power ramp start-up.	170	15, 170

Enabling-disabling power ramp.

Value = 15 Ramp disabled
Value = 170 Ramp enabled

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1541	B	Duration of the ramp to go from 0 to 100% of the nominal power.	5	1 … 10

Duration of the power ramp to go from 0% to 100% of the nominal power Pn.
The data is expressed in minutes.

8.2.2 Low Voltage Fault Ride Through (LVFRT)

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1563	B	Enabling of the management of Grid power failures.	170	15, 170

Enabling-disabling of the management of LVFRT grid power failures. By enabling the feature the inverter is able to not disconnect from the Grid when dealing with a voltage transient, as required by the regulations (Attachment A70 for the MV connection).

Value = 15 function disabled
Value = 170 function enabled

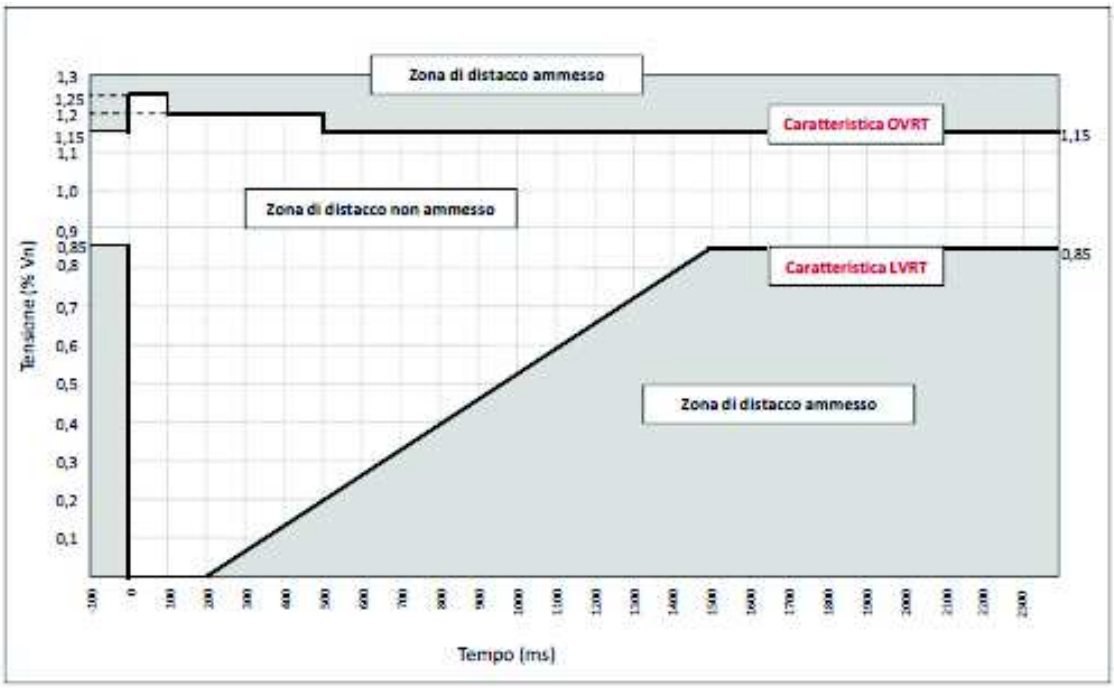
PARAMETER		DESCRIPTION	DEFAULT	RANGE
1561	w	Immunity time to LVRT grid power failures	1500	400/1500/2000

It is the immunity time to grid power failures, beyond which the inverter switches to "Grid voltage out of limits" protection status. The time can be set in msec and varies according to the selected connection type:

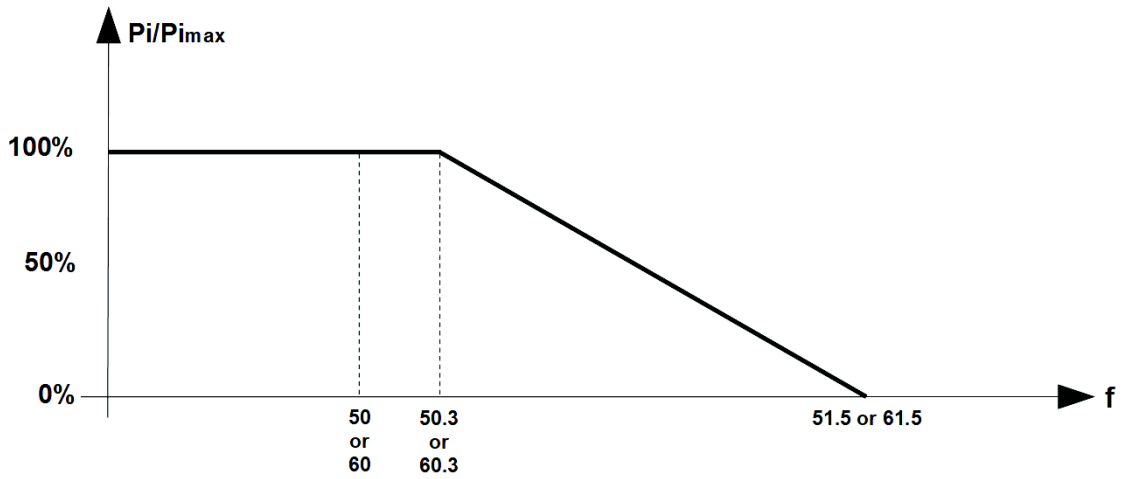
CEI 0-16 = 1500 → 1.5 sec

If the connection type is changed, this parameter must also be updated to a value consistent with the selected connection type as described above.
Where HV/HHV grid connection rules described in attachment A68 are required, CEI 0-16 connection type must be set and 2sec grid power failure immunity time (1561.w = 2000).

8.2.2.1 CEI016 LVFRT PROFILE (ITALY)



8.2.3 Limitation of the Active Power in the presence of frequency transients



PARAMETER		DESCRIPTION	DEFAULT	RANGE
1536	B	Enabling feature for the reduction of power due to over frequency.	170	15, 170

Enabling-disabling of the mode of reduction of active power supplied in accordance with the grid over frequency.

Value = 15 Mode disabled
Value = 170 Mode enabled

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1522	W	Initial frequency threshold for the reduction of the power emitted into the grid due to over frequency.	5030/6030	5000 … 7000
1524	W	Final frequency threshold (function of the droop chosen) for the reduction of the power emitted into the grid due to over frequency. **The value set must be larger than the parameter 1522.**	5150/6150	5000 … 7000

These threshold represent the range of frequency to be used for the calculation of the percentage of reduction of the power. The initial reference threshold is normally set at 50.3Hz; the final threshold must be calculated based on the required droop. The power is reduced in a linear manner starting from 0% at the initial frequency threshold, to arrive at 100% in conjunction with the final frequency threshold.
The two thresholds can be set in centi-Hz

Example
Initial threshold : 50.3 Hz → 50.3 * 100 = 5030 bit
Droop = 2.4 % → Final threshold = 50.3 + (50 * droop) = 51.5 Hz → 5150 bit

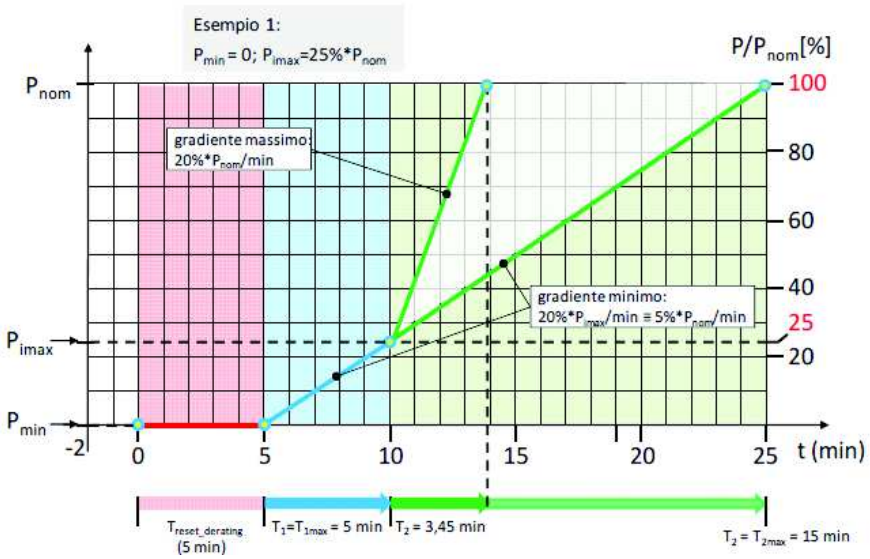
PARAMETER		DESCRIPTION	DEFAULT	RANGE
1526	W	Frequency threshold (HIGH) for the restoration of the power supplied before an episode of reduction due to over frequency.	5010/6010	5000 … 7000
1528	W	Frequency threshold (LOW) for the restoration of the power supplied before an episode of reduction due to over frequency.	4990/5990	4800 … 7000

The two thresholds represent the range within which the grid frequency must be terminated for a definite continuous period, before being able to carry out the restoration of the power previously reduced due to an episode of over frequency.

Both thresholds can be set in terms of hundredth of Hz.

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1538	B	Waiting time (in minutes) in the proper frequency range before restore the generated power to pre-fault value.	5	1 … 10

After an over-frequency event occurs, this parameter defines the waiting time within the proper range of frequency of the grid, before the inverter restores back the generated power value pre-existent to the fault. Value set in minutes.



PARAMETER		DESCRIPTION	DEFAULT	RANGE
1537	B	Time for determining the gradient of restoration of the power supplied before an episode of over frequency equal to Gradient = Pre-fault / Time	5	1 … 10

This parameter determines the time for returning to the value of power before an episode of over frequency which previously caused its reduction, assuming that it begins at a level of power equal to 0.
The data is expressed in minutes. Grid parameters (voltage and frequency) outside of the limits

8.2.4 Voltage and frequency thresholds

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1335	W	Upper limit of accepted grid (line) voltage. Beyond this limit, over voltage protection is set (1,2 Vn).	-	90 … 650
1337	W	Lower limit of accepted grid (line) voltage. Underneath this limit, under voltage protection is set (0,8 Vn).	-	90 … 650

The two thresholds together represent the range within which the grid (phase) voltage must terminate to avoid the grid outside limits voltage protection from triggering.
The two thresholds can be set in Volts.

In relation to the inverter rated input voltage, the two default values are defined as follows:

INVERTER RATED VOLTAGE	W1335	W1337
530	367	245
600	416	277
640	443	296

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1331	W	Upper grid voltage limit (phase) beyond which the grid outside limits frequency protection triggers	-	4000….7000
1333	W	Lower grid voltage limit (phase) under which the grid outside limits frequency protection triggers	-	4000….7000

The two thresholds together represent the range within which the grid (phase) frequency must terminate to avoid the grid outside limits frequency protection from triggering.
The two thresholds can be set in milli-hertz.

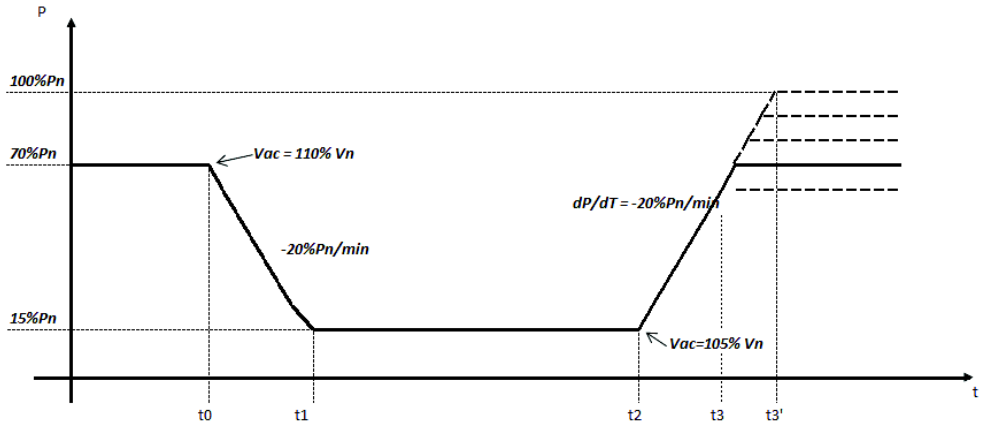
Default values are provided in the table below.

Parameter	Value	Frequency
W1331	5180/6180	51.8Hz/61.8Hz
W1333	4720/5720	47.2Hz/57.2Hz

8.2.5 Active Power limits for voltage values near 110%

When this function is enabled, the inverter, in local logic, limits power for voltage values near 110%.

When voltage exceeds 110% of the rated value “Vn” for more than two minutes, the inverter limits power with a negative gradient up to 15% of rated power Pn. When grid voltage returns to a value under 110%, generated power switches to the maximum generation power with a positive gradient equal to start up.



PARAMETER		DESCRIPTION	DEFAULT	RANGE
1254	B	Power limitation enabled P=f(Vac)	15	15.170

Enabling-disabling of the mode of reduction of active power supplied in accordance with the grid voltage Vac.

Value = 15 Mode disabled

Value = 170 Mode enabled

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1265	B	Vlock_in voltage threshold for power limitation function P=f(Vac)	110	100…110
1268	B	Vlock_out voltage threshold for power limitation function P=f(Vac)	105	100..110

Vlock_in and Vlock_out thresholds used to limit P power according to grid voltage Vac.
The lock-in and lock-out thresholds can vary from a minimum of 100% Vac up to a maximum of 110% Vac.

The data is expressed in percentage points with 1% resolution with respect to the supply VAC.

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1287	W	Time that determines the negative power gradient for power limit P=f(Vac)	300	10…900

It expresses the time it takes for P generated power to drop from 100% to 0% ratedP, determining the dP/dt gradient.

Data is expressed in seconds with 1 second resolution.

8.2.6 Q reactive power supply through Remote Setpoint

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1260	B	Q reactive power setpoint enabled	15	15 , 170

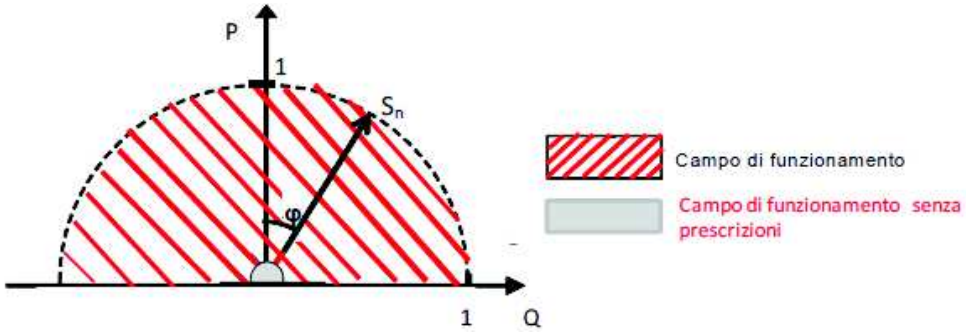
Value = 15 Mode disabled
Value = 170 Mode enabled

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1543	W	Q reactive power percentage setpoint	0	0 … 10000

The set value is the "Q" reactive power percentage of the inverter's apparent rated power "Sn".
If the selected standard is **CEI 021**, the maximum settable "Q" reactive power is +/-43.6% apparent "Sn" power (+/-4360.).

If the selected standard is **CEI 016**, the maximum settable "Q" reactive power is +/-100% apparent "Sn" power (+/-1000.). If the vector sum of "Q" reactive power and generated P active power exceeds the apparent "Sn" power, "Q" reactive power is automatically limited to a value where apparent "Sn" power is never exceeded.
This provides the semi-circular capability required by **CEI 016**.

The same reference



parameter (1543.w) can be used to generated a fixed "Q" reactive power percent of generated active power to thus obtain a fixed power factor.

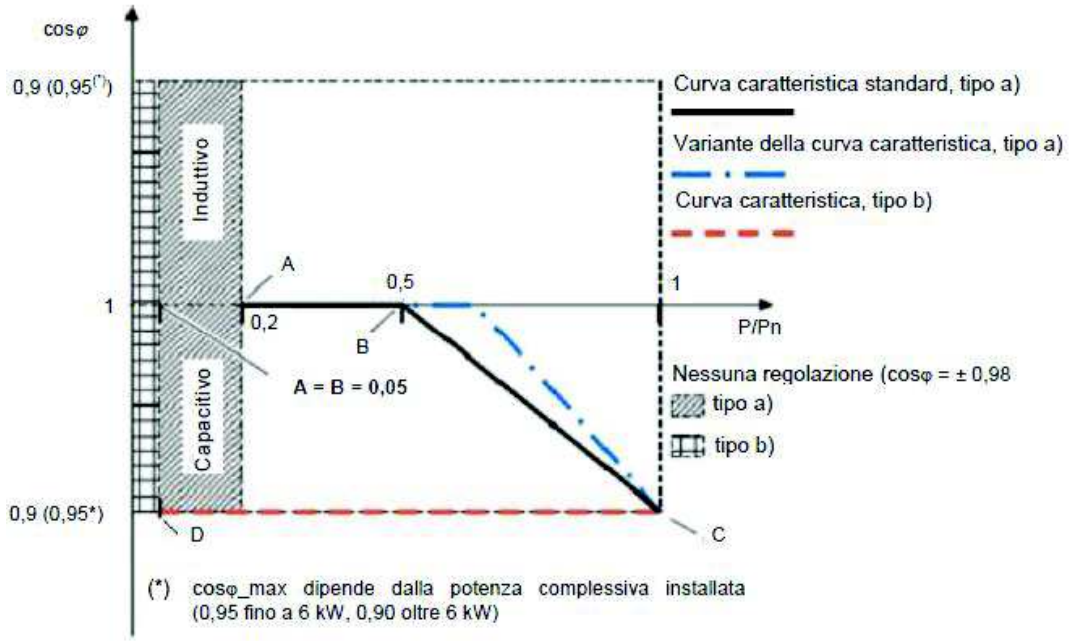
See paragraph ***"Participation in the control of the voltage - automatic supply of reactive power according to a pf = f(P) characteristic curve"***

8.2.6.1 Q reactive power reference sign

The sign used for reactive power generation from reference is the following:

- Positive reactive power: the generator supplies reactive power supplying current after voltage (over-excitation function).
- Negative reactive power: the generator absorbs reactive power supplying current before voltage (under-excitation function).

8.2.7 Participation in the control of the voltage - automatic supply of reactive power according to a pf = f(P) characteristic curve



PARAMETER		DESCRIPTION	DEFAULT	RANGE
1545	B	Enabling supply of reactive capacitive power according to the active power.	15	15, 160, 170

Enabling-disabling supply of the reactive (capacitive) power according to the active power supplied.

Value = 15 Supply disabled
Value = 160 Supply of reactive power in function of the active power according to the linear curve in parts (curve type A)
Value = 170 Q reactive power supply at rated fixed power factor (parameter 1546) when the lock-in power threshold (parameter 1549) is exceeded (curve type B)
Value = 180 Q reactive power supplied as a percent of P active power (variable power factor) in local
Value *=190* Q reactive power supplied as a percent of P active power (variable power factor) in remote control using a keep-alive signal

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1546	W	Minimum power factor set.	900	900 … 1000

It represents the minimum power factor set which by default is equal to 0.9.
The resolution of this parameter is equal to 0.001.

Example

0,9 → 0,9/0,001 = 900 bit

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1548	B	Lock-in Power threshold for the calculation of the reactive power f(P) by using the linear curve A described by the regulation CEI-021	50	20 … 100

Active power threshold where the supply of reactive power Q starts in linear mode (point B of the diagram shown above).
The data is expressed in percentage points (referring to the data of the active nominal power of the converter) with 1% resolution.

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1549	B	Lock-in power threshold for the calculation of the reactive power f(P) by using the curve B (maximum Q reactive) described by the regulation CEI-021.	5	5 … 10

Active power threshold where the supply of reactive power Q starts (point D of the diagram shown above).
The data is expressed in percentage points (referring to the data of the active nominal power of the converter) with 1% resolution.

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1550	B	Lock-in voltage threshold of power for the calculation of the reactive power f(P)	105	100 … 110
1551	B	Lock-out voltage threshold of power for the calculation of the reactive power f(P)	100	90 … 100

Lock-in and lock-out voltage threshold used to enable or not the reference calculation Q reactive f(P).
The lock-in threshold may vary from a minimum of 100% nominal Vac up to a maximum of 110% nominal Vac.
The lock-out threshold may vary from a minimum of 90% up to a maximum of 100%.

The data is expressed in percentage points, referring to the nominal voltage (peak Vphase) of the inverter

8.2.7.1 Fixed power factor operations

Parameter 1545.b is set to 180 to select fixed power factor operating mode.

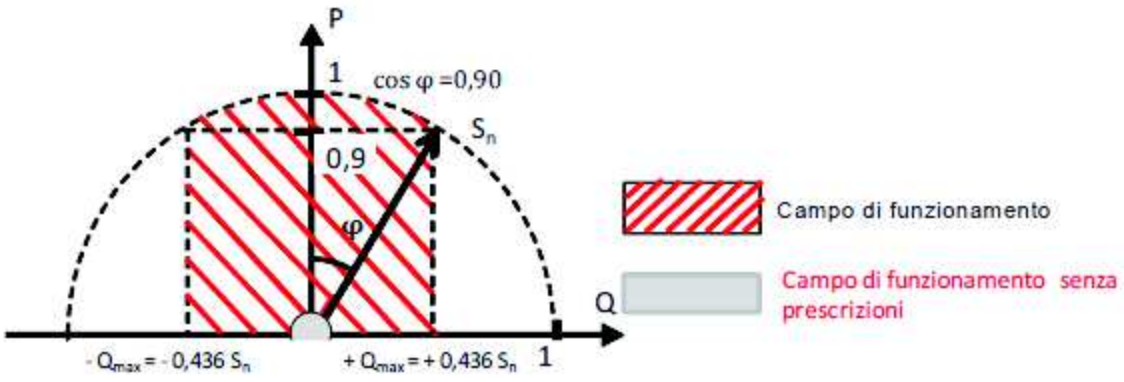
When this mode is selected, the Q reference (parameter 1543.w) is the fixed percent of Q compared to instantly generated P power.

This mode can achieve a fixed power factor between 1 and 0.7 both in over-excitation and under-excitation.

Q reference values for some desired “power factor” values are provided in the table.

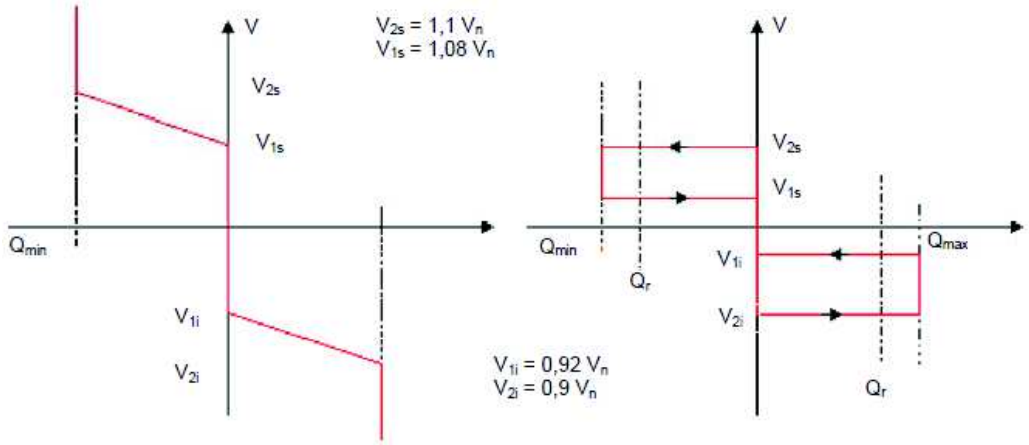
Desired power factor	Fixed power factor mode enabled (1545.b)	Q reference (1543.w) (over-excitation)	Q reference (1543.w) (under excitation)
1	170	0	0
0.95	170	3286	-3286
0.9	170	4843	-4843
0.85	170	6197	-6197
0.8	170	7500	-7500
0.75	170	8820	-8820
0.7	170	10000	-10000

The illustrated capability is obtained when the power factor is limited to 0.9.



For power values over 90% of Sn, reactive Q is limited to maintain the inverter’s maximum apparent Sn power.

8.2.8 Participation in the control of the voltage – Supply / automatic absorption of reactive powers according to a Q = f(V) characteristic curve



PARAMETER		DESCRIPTION	DEFAULT	RANGE
1552	B	Enabling supply of reactive power in function of the VAC supply voltage.	15	15, 160, 170

Enabling-disabling supply of the reactive power in function of the grid VAC voltage.

Value = 15 Supply disabled
Value = 160 Reactive power supply in VAC function with hysteresis
Value = 170 Reactive power supply in linear VAC function between V1s - V2s and V1i - V2i

Supply of reactive power in function of VAC with hysteresis

- If Q = 0
  Above V2s the maximum reactive capacitive power is supplied Q = MAX
- If Q = MAX
  Below V1s the supply of the reactive capacitive power is suspended Q = 0

- If Q = 0
  Above V2i the maximum reactive inductive power is supplied Q = MAX
- If Q = MAX
  Below V1i the supply of the reactive inductive power is suspended Q = 0

Supply of reactive power in function of linear VAC

- Between V1s and V2s the supply of the reactive capacitive power is carried out in linear mode respectively between 0% and 100% of the maximum reactive power deliverable (function of the pf).
- Between V1i and V2i the supply of the reactive inductive power is carried out in linear mode respectively between 0% and 100% of the maximum reactive power deliverable (function of the pf).

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1555	B	V1S voltage threshold for the calculation of the reactive power f(VAC).	108	100 … 110
1556	B	V2S voltage threshold for the calculation of the reactive power f(VAC) **The value set must be higher than the parameter 1555.**	110	100 … 110

V1S and V2S thresholds used for the supply the reactive capacitive power.
The lock-in and lock-out thresholds can vary from a minimum of 100% Vac up to a maximum of 110% Vac.
The data is expressed in percentage points with 1% resolution with respect to the supply VAC.

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1557	B	V1i voltage threshold for the calculation of the reactive power f(VAC).	92	90 … 100
1558	B	V2i voltage threshold for the calculation of the reactive power f(VAC) **The value set must be lower than the parameter 1557.**	90	90 … 100

V1i and V2i thresholds used for the supply of the reactive capacitive power.
The lock-in and lock-out thresholds can vary from a minimum of 90% Vac up to a maximum of 100% Vac.
The data is expressed in percentage points with 1% resolution with respect to the supply VAC.

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1553	B	Lock-in power threshold for the calculation of the reactive power f(VAC).	20	10 … 100
1554	B	Lock-out power threshold for the calculation of the reactive power f(VAC).	5	5 … 10

Lock-in and lock-out power thresholds which enable or not the supply of the reactive power.
The data is expressed in percentage points with 1% resolution.

9 ANNEX 1: CONFIGURATION OF INSULATION RESISTANCE MEASURE / GROUNDING FUSE INTERRUPTION

9.1 Introduction

SOLEIL DSPX TLH 1500 inverters are equipped with a device for measuring the Insulation Resistance towards the ground (DC side), which, if necessary, can be set for diagnosing the FV field pole earthed fuse if the plant has been configured for this operation mode.

The configuration parameters of the feature are the following:

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1302	B	Enabling measurement of insulation resistance / Pole earthed 15 = Disabled 160 = Enabled measurement R Isol 170 = Enabled detect fuse earthed on positive pole interrupted 180 = Enabled detect fuse earthed on negative pole interrupted 190= Enabled detect fuse earthed on positive pole interrupted with Riso measures, according to IEC 62109-2 200= Enabled detect fuse earthed on negative pole interrupted with Riso measures, according to IEC 62109-2	160	15, 160, 170, 180
1305	B	Select Alarm or Fault in the case of Interruption Pole earthed or low Riso 15 = only alarm 170 = stop inverter 160 = used only with 1302.b = 190 or 200: isolation loss only alarm - fuse fault stop inverter	15	15, 170
1306	W	Minimum threshold for alarm-fault isolation resistance [kOhm]	100	10 … 500
1309	W	Delay in activation alarm-fault for R iso function / Pole earthed [sec]	60	10 … 1000

AS A DEFAULT, THE MACHINES ARE CONFIGURED FOR THE "MEASUREMENT OF INSULATION RESISTANCE" MODE.

FOR ANY MACHINE SET-UP MODIFICATION PLEASE REFER TO THE PARAMETER READ-WRITE PROCEDURE DESCRIBED IN SECTION . 4.3.4.6, FOLLOWING THE INSTRUCTIONS IN THE FOLLOWING PARAGRAPHS

9.2 Set-up of grounded pole mode

1. Prepare the connection towards a FV field pole, as required by the design constraints. See the “Installation Manual” IV408.
2. Enable the feature by means of parameter b1302, by paying attention to the required system (170 or 180 according to which pole is earthed).
3. If necessary, change the protection triggering system (parameter b1305 for the choice of the mode: ALARM or STOP) and the time delay (parameter b1309).

9.3 Set-up of method of measuring Insulation Resistance

1. Ensure that there is no solidly earthed connection of a pole of the FV field on the plant
2. Verify the enabling of the feature (parameter b1302 = 160).
3. If necessary, change the protection triggering system (parameter b1305 for the choice of the mode: ALARM or STOP) and the time delay (parameter b1309).

9.4 Configuration of the inverter when connected to PV panels requiring pole-to-ground connection (either on negative or positive pole).

In case the PV panels require grounding (through fuse), the inverter logic performs following controls:
The inverter can perform both the measurements of the insulation resistance to earth and the integrity of the fuse pole to the ground in an automatic way. When the inverter is off, the RISO (Resistance from any DC pole and ground) measurement is continuously performed.
If the value of RISO is seen being within its acceptance limits, the inverter starts the generation, by shorting the fuse (connected to negative or positive pole) to ground (through an electronic switch), and starts monitoring the integrity of the connection between the grounding fuse and the ground.
To configure the inverter to operate in this mode of operation , please contact the "Technical Assistance"

1. 1. Prepare the ground connection of one pole of the PV array. Please refer to the 'Installation Manual' IV408
2. 2. Enable the function via parameter b1302, paying attention to the logic request (190 or 200 depending on which pole is earthed)
3. 3. If necessary, change the logic device trip b1305 parameter for selecting the mode:
4. 15 = only alarm for fuse fault and isolation loss
5. 170 = stop inverter for fuse fault and isolation loss
6. 160 = used only with 1302.b = 190 or 200: stop inverter for fuse fault or only alarm for isolation loss
7. Configure ALARM or STOP and the delay time (parameter b1309)

10 ANNEX 2: 'MASTER AND SLAVE' FUNCTION CONFIGURATION

10.1 Parameters for configuration

Soleil DSPX TLH 1500 inverters can be operated according to Master – Slave logic, as descrive in par. 3.5.

Parameters for configuration are:

Parameter		DESCRIPTION	DEFAULT	RANGE
1572	B	Threshold of power for start of 'Slave' module, expressed as percentage of the inverter rated power.	45	0 … 100
1573	B	Hysteresis threshold for 'Slave' module stop of operation, expressed as percentage of the inverter rated power.	5	1 … 20
1629	B	Address of the inverter within the 'Master-Slave' system Indirizzo dell'inverter nella funzione Master Slave	0	0 … 3
1641	B	Number of inverters present into the Master and Slave system	1	1 … 4

Configuration with only one inverter present:

Parameter	Value Inv1	Value Inv2	Value Inv3	Value Inv4
B1629	0			
B1641	1			

Configuration with two inverters present in the Master – Slave system:

Parameter	Value Inv1	Value Inv2	Value Inv3	Value Inv4
B1629	0	1		
B1641	2	2		

Configuration with three inverters present Master – Slave system:

Parameter	Value Inv1	Value Inv2	Value Inv3	Value Inv4
B1629	0	1	2	
B1641	3	3	3	

Configuration with four inverters present Master – Slave system:

Parameter	Value Inv1	Value Inv2	Value Inv3	Value Inv4
B1629	0	1	2	3
B1641	4	4	4	4

AS DEFAULT, EVERY INVERTER IS CONFIGURED TO BE OPERATED AS SINGLE (NOT IN A MASTER AND SLAVE SYSTEM).

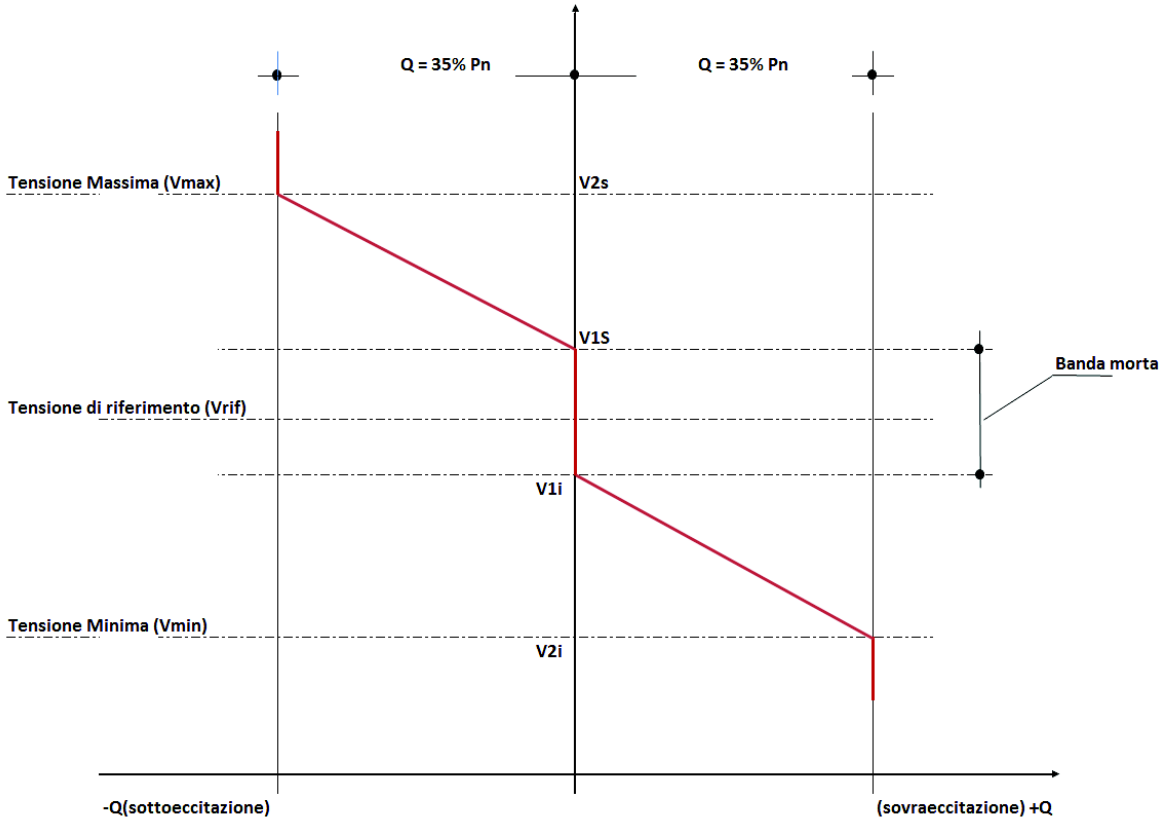
FOR MASTER – SLAVE OPERATINBG MODE WHEN MORE THAN ONE INVERTER ARE PRESENT, IT IS NECESSARY TO CONNECT IN ADVANCE THE INVERTERS AS REPRESENTED IN IV408 INSTALLATION MANUAL, PAR. 6.

11 ANNEX 3: SET UP OF THE REACTIVE POWER GENERATION METHOD ACCORDING TO THE VOLTAGE READ AT THE DELIVERY POINT (FOR HV GRID CONNECTIONS)

11.1 Introduction

SOLEIL DSPX inverters that meet CEI 016 connection standards can be connected to the HV/HHV grid. This type of connection is regulated by appendix A68 that describes the "MINIMUM REQUIREMENTS FOR CONNECTION AND OPERATIONS IN PARALLEL WITH THE HV GRID".

The A68 appendix requires reactive power supply or absorption according to the Q=f(V) characteristic curve illustrated below:



11.2 Configuration

The characteristic curve is set by the following parameters:

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1257	B	Reactive power supply enabled Q=f(V) at delivery point or inverter output	15/170	15 … 170

Enabled-disabled reactive power supply according to VAC voltage read at the HV grid pdc delivery point or inverter output

Value = 15 Q reactive power supply according to Vac voltage read at inverter output
Value = 170 Q reactive power supply according to Vac voltage read at HV grid delivery point

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1401	W	HV grid rated voltage	15000	0 ….. 32767

Indicates the HV grid rated voltage with a resolution of 10 volts per unit. **(1bit=10V)**

I.e.: HV grid rated value: 150000V (150kV)
Parameter value: 15000

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1269	W	Vref voltage (% HV grid rated voltage)	10200	0 ….. 32767

Percent of rated grid voltage to calculate Vref reference voltage.
The data is expressed in hundredths of percent (1bit = 0.01%)

I.e.: Grid Vrated = 150Kv Vref = 153Kv --> Vref = 102% Vrated
Percent value: 102%
Parameter value: 10200

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1365	B	Dead band	30	0 ….. 255

Percent of Vref to determine +/- deltaV of Vref to obtain the two V1s and V1i values
The data is expressed in hundredths of percent (1bit = 0.01%)

I.e.: Required dead band = 3% --> V1s = Vref + (3%Vrif) V1i = Vref – (3%Vref)
Parameter value: 30

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1303	W	Maximum voltage (Vmax) (% HV grid Vrated)	10500	0 ….. 32767

Percent of rated grid voltage to calculate Vmax maximum voltage.
The data is expressed in hundredths of percent (1bit = 0.01%)

I.e.: Grid Vrated = 150Kv Vmax = 157,5Kv --> Vmax = 105% Vrated
Percent value: 105%
Parameter value: 10500

PARAMETER		DESCRIPTION	DEFAULT	RANGE
1296	W	Minimum voltage (Vmin) (% HV grid Vrated)	9900	0 ….. 32767

Percent of rated grid voltage to calculate Vmax maximum voltage.
The data is expressed in hundredths of percent (1bit = 0.01%)

I.e.: Grid Vrated = 150Kv Vmin = 148,5Kv --> Vmin = 99% Vrated
Percent value: 99%
Parameter value: 9900

Reactive power generation Q = f (Vac), according to that required by appendix A68, requires voltage reference be those directly read at the delivery point on the HV/HHV grid.

To run this function for HV/HHV connections, efficient phase voltage values must be acquired through another system independent of the inverter and communicated to the latter via RS485 communication using MODBUS protocol.

For information on mapping and acquisition scales, see the following document:

"SP104 REVxx Technical Specifications for Modbus Area Mapping"