FIMER

Inverter for Life

FIMER
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Istruzioni Originali

Original instructions

Übersetzung der Originalbetriebsanleitung

Notice originale

Manual original

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SOCIO

Company certified according to the
regulations:
UNI EN ISO 9001:2015
UNI EN ISO 14001:2015
OHSAS 18001:2007

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INDEX

1. GENERAL INFORMATION

Document Title: **USER MANUAL for BESS INVERTER:** S9900TL
Converter Unit model used for Battery energy Storage

Document Classification: User and Installation Manual
ORIGINAL INSTRUCTIONS

1.1 Manufacturer's address

FIMER S.p.A
Via J.F. Kennedy - 20871 Vimercate – (MB) - Italy
Tel. +39 039 98981 r.a. - Fax +39 039 6079334 - www.FIMER.com - BESS@FIMER.com

1.2 Information on electromagnetic compatibility.

Attention:
This product can only be sold to qualified installers. To prevent disturbances, installation restrictions or additional measures may be necessary.

1.3 Information on the manual

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This publication is the exclusive property of FIMER. This manual is given to purchasers of our equipment and to instruct and inform end users. The technical contents, illustrations and anything else contained in this manual are to be treated as confidential and no part may be reproduced without specific authorisation by FIMER. Technicians and end users may not divulge the information contained herein or use this manual for purposes other than those strictly connected to the correct use of the equipment.
FIMER shall not assume any liability for any damages caused by its improper use, the same applies to people or companies involved in the preparation or production of this manual. The product specifications are subject to change without notice. The images are only indicative.

1.4 Environmental impact declaration

The grid-connected BESS inverters manufactured by FIMER offer lower consumption of raw materials and lower amounts of waste throughout their working life. In typical applications, these positive effects on the environment far outweigh the negative impacts of the manufacturing of the products and final disposal.
The packaging of the products is of a good quality and can be reused. All the products are placed inside sturdy cardboard and wooden boxes, which are themselves made with a high percentage of fibre and recycled materials. If not reused, the packaging can be recycled. Polyethylene used to make the protective film and bags for wrapping the products can be recycled for the same purpose. The packaging strategy adopted by FIMER is based on easily recyclable products with low environmental impact and, thanks to regular controls and analysis, aims at identifying new improvement opportunities in this area.

At the end of their life and operation, the inverters can be dismantled very easily by separating the main components which can then be recycled. Some parts of these devices are snap-locked to each other and therefore can be separated without the use of tools, while many other components are secured with normal screws and therefore can be easily disassembled with the use of common screwdrivers. In any case, virtually every part of the product is recyclable. Do not dispose of the device or its parts with household waste. In accordance with European Directive 2012/19/UE on electric and electronic waste and its application in national law (i.e. Italian Dls 14 March 2014 n° 49), used electronic devices must be collected separately and recovered ecologically. The device must be disposed of in compliance with the collection and disposal system adopted and authorised in your area. Failure to comply with this EU Directive may adversely affect the environment and human health!

2. INTRODUCTION

Dear Customer,

Congratulations on choosing our Storage inverter, whose characteristics of high technology and reliability coming from the design and quality control system make it a highly innovative and durable product.

This manual contains all the information necessary to install and use the product safely. It is recommended to carefully read its contents before connecting and operating the machine. Proper use of the product guarantees the reliability and quality of the system over time, which is indispensable to obtain excellent performances and outputs.

The contents of the manual will help you resolve most doubts and problems. Do not hesitate to contact your usual installer, distributor or sales representative if you experience problems during the use and installation which are not clearly described or documented in the manual. To obtain the latest information on the product or the latest version of the manual, please visit our website.

Keep this manual in a safe place near the machine for quick reference.
This manual is an integral part of the machine; in case of resale of the inverter, this manual should also be given to the purchaser.
The manual must always accompany the inverter each time it is moved.

Thanks again for choosing our Storage inverter.

3. GENERAL INFORMATION

3.1 Symbols used in the manual

	INFORMATION: It is recommended that the user carefully considers what is described and pays attention to the instructions contained in the manual.
	CAUTION or DANGER: The user is asked to pay the utmost attention to what is described in order to prevent the occurrence of situations that may cause serious damage or malfunctions to the equipment, as well as accidents, injuries or death to people.
	RISK OF ELECTRIC SHOCK: It is compulsory to follow the instructions to avert the danger of electric shock and electric discharges.
	PACKAGING INSTRUCTIONS
	INSTALLATION INSTRUCTIONS: Describes the installation procedure of the inverter.
	OPERATING INSTRUCTIONS: Describes the use of the inverter and its graphic display.
	DISPOSAL: Contains useful information for disposing of the inverter.
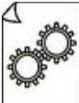
4. SAFETY INSTRUCTIONS AND OTHER WARNINGS

The failure to follow these instructions may have serious consequences, such as the destruction of the device, personal injury or death due to electrocution. Therefore, the following safety instructions must be read and understood before installation and use of the inverter. For any clarifications or additional information, contact the FIMER technical service.

Upon receipt of the inverter:

- Once the inverter has been removed from its original packaging, visually inspect for damage that may have occurred during shipment. If damage is found, contact the dealer or manufacturer.

Dangerous voltages:

- The storage inverter uses high voltages that may cause damage, even serious, to people.
- The conductors and components with dangerous voltages are segregated into special areas that can only be accessed by using tools not supplied with the inverter.
- The inverter must always be used with all the panels properly secured and with the front door closed.
- All maintenance and repairs that require access to the inside of the device can only be performed by FIMER technicians or by properly trained personnel.
- Before removing any panels of the machine (which can only be performed by FIMER personnel), it is absolutely necessary to open the switches on the direct current side (Battery side) and on the alternating current side (grid side) and wait at least 10 minutes to allow all the capacities inside the inverter to be completely discharged.
- Always make sure there are no dangerous voltages by measuring with a multimeter.

Grounding:

- The inverter is a Class I device
- Due to EMC filters, <u>the machine has a high dispersion current towards the ground (around 500mA in normal operating conditions and in the presence of undistorted and undisturbed mains power)</u>; therefore, it can only be operated with a fixed protection connected.
- Always connect the ground wire to the appropriate copper bar provided for this purpose and identified by the symbol .
- In case of disconnection of the inverter, disconnect the ground wire last.

Plant:

- Always connect the inverter to the power grid and do not connect it to any other type of voltage or current generator other than the suitable battery racks in order to prevent damage and breakage.
- Follow the directions and requirements given by the manufacturer of the battery racks that make up the storage generator, and by the electric grid company.
- Power up the inverter with the values specified in the technical specifications of the product and indicated in the device's rating values.
- Provide a circuit for the emergency shutdown of the machine (EPO circuit).

Safety standards:

- In addition to the installation and operating operations, it is important to comply with the local security and safety regulations on accident prevention and environmental protection.
- Personnel who access the premises where the inverters are installed must always wear ear protection. These ear protections must be available in this area in an easily accessible and clearly visible position; the need for their use must be clearly highlighted by a special sign on the wall.

Safety and danger signs:

All the safety and danger signs applied on the device:
- must be kept legible
- must not be damaged
- must not be removed
- must not be covered with stickers or writing

Introduction of objects:

- Do not introduce objects into the ventilation holes and avoid contact with any type of liquid; only clean with a dry cloth. These precautions must also be observed when the machine is turned off.

Walk-on capability:

- the upper panels of the inverters are not designed to support heavy loads. Never climb on the equipment, do not rest against it and do not use it as a support for additional devices (walkways, pipes, ventilation ducts etc…).

Cable section:

- Make sure the cables entering and exiting the inverter are of the appropriate size. Also check the cables of the system.
- The connections, section of the cables used and the installation must comply with the regulations in force.

Initial start-up:

- Never supply power to the apparatus before a site inspection is carried out by competent personnel expressly authorised by FIMER.

Subsequent start-ups:

- Initiate the start-up procedure with all the switches open.

⚠ Handling:

- The inverters are very heavy devices and should only be handled and moved by qualified personnel.
- Check the load-carrying capacity of the floor slabs and any "raised" floors on which the inverter will be placed.
- Do not store or carry the system on an angle and do not rest it on its side.

⚠ ⚡ Installation area:

- The device must be installed in a dedicated room.
- The heavy duty inverters, by their nature, are noisy and suitable for installing in industrial environments.
  Therefore, the installer must be responsible for positioning the equipment in an adequately insulated room and/or in a room away from places where people spend extended periods of time.
- The inverters cannot be installed in areas where unqualified personnel can freely circulate.
- The protection degree of the device is IP20: therefore, it is not suitable for outdoor use.
- The location where the inverter is installed must be equipped with appropriate extractor fans to ensure the necessary cooling of the machine and that the temperature of the room where the inverter is installed falls within the allowable temperature range (see the section relating to the technical specifications). If the required change of air is not observed, the temperature of the room where the inverter is installed will increase. This in turn will shorten the life of the inverter, reduce the output and, if the maximum temperature declared is exceeded, cause damage to the machine.
- Keep the distances reported in section 11.3 around the machine in order to guarantee sufficient cooling of the apparatus.
- Always check that, in addition to the air extractor fan, there is also an opening (equipped with mesh) to allow air to enter.
- Do not connect air cooling ducts directly to the machine. The fans inside the apparatus are not able to push air into the ducts (the prevalence is not sufficient). If ventilation ducts are required, contact the FIMER technical centre.
- The room must be closed on all sides and on the roof (it is absolutely forbidden to install the inverter in a simple shelter or in a room with no walls and/or with no doors that can be closed).
- The floor of the room must be made of concrete or similar materials.
- The floor must not be made of dirt or however, dusty.
- The room must be dry and not subject to flooding, even if only small.
- To ensure correct functioning of the apparatus, make sure the cooling air inlets and outlets are not blocked; if obstructed, the inverter will not be able to supply its nominal power and will have a shorter operating life.
- The apparatus is not suitable for bathrooms or other types of humid areas.

- The apparatus is not suitable for installing in common areas such as hallways, stairwells, etc.
- The inverter is not designed to be installed in environments subject to knocks or vibrations, for example, transportation by road, on tracks, on cables, air, sea and similar means (such as cranes, overhead travelling cranes, parts of machine tools subject to movement or vibration…).
- The inverter is designed to take into account a **pollution degree whose value is 2**.
- Do not install the inverter in environments where there is a dusty or explosive or corrosive or abrasive or saline atmosphere.
- Any installation not complying with these recommendations will lead to the immediate termination of the warranty and the cessation of any liability for any malfunctions and any resulting consequences.

Positioning:

- Position the inverter away from heat sources.
- Avoid direct exposure to sunlight.
- Position the inverter on a base consisting of a stable flat surface that extends beyond the base of the product in all directions.
- Install the inverter in areas large enough to allow maintenance, opening of the doors, removal of the external and internal panels for allowing routine maintenance and repair in case of faults.
- Follow the values shown in the figures contained in this manual and the warnings reported in the "Installation" chapter.
- Any installation not complying with these recommendations will lead to the immediate termination of the warranty and the cessation of any liability for any malfunctions and any resulting consequences.

Repairs:

- Never repair the inverter alone, but always contact the manufacturer or their authorised service centre.
- Any repair not authorised in writing and not directly managed by FIMER, besides being objectively dangerous, determines the immediate termination of the warranty and cessation of any liability for any malfunctions and resulting consequences.
- In case of repair, only use original spare parts, as there is no guarantee that any unoriginal parts will be able to withstand the stresses to which they are subjected during normal operation.
- Never make any changes and never install unauthorised devices inside the inverter.
- Never bypass the safety devices and have them reset by personnel specialised to perform the necessary repairs before restarting the apparatus.

Support and service:

- Service must be requested when the apparatus has been damaged in any way such as in cases where liquid has penetrated, objects have fallen on top or inside the apparatus, when it has been exposed to rain or humidity (outside the specified values), when it does not operate properly, when there are evident changes in performance or when it has been dropped.
- Faults that may affect the safety of the machine and the entire system must be repaired before restarting the system.

Duration of the inverter:

- The FIMER inverters are designed and built to guarantee a high MTBF. However, it should be noted that the MTBF is a statistical parameter with all the conceptual and practical limitations that this entails.
- Remember that the MTBF relates to a device that is properly ventilated, installed and maintained; in other words, it cannot account for conceptual or practical errors in the construction of the plant, for neglect or wilful misconduct.
- It should be pointed out that continuous operation of the machine at high temperatures will lead to the shortening of its expected life.
- The inverters discussed in this manual, due to their function, are devices only suitable for professional users and should not be used by inexperienced personnel.

Maintenance:

- To ensure the effective and expected life expectancy of the apparatus, it is necessary to perform the maintenance described in this manual.
- Routine maintenance of the apparatus must be periodically performed by qualified service personnel (such as the installer of the BESS), visually checking the status of the machine and its components internal to it and checking the tightening of the screws disconnectors, Bus DC and component output on the grid side, for more details refer to as set out in Appendix 3 of this manual.
- The extraordinary maintenance of equipment must always be carried out by authorized personnel by FIMER or its service center, and this is the only way to ensure original and new spare parts are always used and it is the only way to ensure that (according to maintenance contract) the inverter is constantly updated with any improvements made in the meantime (in accordance with state of the art).In particular, if unoriginal spare parts are used, which are not new or not in line with the state-of-the-art, the apparatus will be considered "modified" with the resulting legal and practical consequences.

Rating plate of the product:

- The identification plate of the product reporting the code, serial number and technical data of the apparatus, can be accessed by opening the front door of the inverter (next to the sectioning organs).
- For any communications relating to the apparatus, report the serial number affixed on this identification plate.

Modifications to the apparatus:

- Any modifications to the apparatus not explicitly and formally authorised by FIMER immediately leads to the termination of the warranty and the cessation of any liability for any malfunction and resulting consequences.

Signals available to the user:

- All the signals given to the user via the relay contacts are completely isolated from dangerous voltages.
- The insulation between the various contacts is only suitable for voltages below 48Vac (60Vdc), these contacts must not be used to change mains voltages.

Packaging:

- Any transport must be made with the inverters contained in the original packaging.
- In particular, machines returned for repair with inadequate packaging or transported in a horizontal position shall not be accepted or will not be recognised by the warranty.

Limitation of liability:

- Under no circumstance shall FIMER be liable for any direct or indirect damages arising from the malfunctioning of the equipment (including damages for loss of earnings or profits), even assuming that FIMER had been informed of the possibility of these damages.
- The manufacturer assumes no liability for improper use or any use other than that for which the inverter was intended, including the failure to follow and perform the periodic maintenance operations, and which could cause damage or malfunction.
- The failure to respect the environmental operating conditions of the inverter and the installation requirements described in this manual may cause damage to the

equipment or to the system and is considered equal to the improper use of the inverter for which FIMER shall be exempt of any liability.

 Disposal:

- WEEE stands for Waste of Electrical and Electronic Equipment (EEE), including all components, subassemblies, and any consumables that form an integral part of the product when a decision is made to discard it. The legislation provides for two main categories called Professional WEEE and Household WEEE.
- Professional WEEE refers to all waste of electric and electronic equipment destined for industrial use.
- The inverters described in this manual are professional products and therefore, should be considered as professional WEEE at the time of their disposal.
- At the time of writing of this instruction manual the application of the legislation was not yet final, therefore please contact the distributor and/or manufacturer for information on the disposal or, alternatively, bring the equipment to a collection point for recycling the electric and electronic equipment.

 Electric shock and surges:

- The inverter is equipped with a standard Type II arrester on the DC input line and one type I+II SPD on the AC output line.
- This arrester has been installed to protects the inverter from external originated overvoltages, it is not designe to protect the batteries or grid.
- We strongly advise the installation of Battery Rackes equipped with their own surge protection device, specifically designed for battery coupling.

5. TECHNICAL SPECIFICATIONS OF THE INVERTER

Model:	S9900TL 1000Vdc – 935 kVA
DC INPUT – PV GENERATOR	
Nr. Power stack	10
Battery voltage Range (V_{DC}) (*Note 1*)	625 – 950
DC voltage range at the max. power (V_{DC})	645 – 950
Battery type	Li-ion, Lead, Ni-Cd, NaNiCl$_2$
Absolute Maximum Voltage (V_{DC})	1000
Maximum input current @25°C (A_{DC})	1600
Voltage Ripple	<2%
Number of input max in parallel	4
Overvoltage Protection	SPD varistor device Class II
DC input connection	DC Switch
AC OUTPUT – AC GRID	
Max Power (kW) (*Note1*)	990 @ 25°C / 935 @ 50°C
Max Apparent Power (kVA)	990 @ 25°C / 935 @ 50°C
Max Current (A_{AC})	1545 @ 25°C / 1460 @ 50°C
Max unbalance Current	< 2%
Nominal Voltage (V_{AC})	370
Frequency (Hz)	50 / 60
Nr. Phases	3 (L1 – L2 – L3 – PE)
Aux Supply (Normal Line)	230 Vac – 16 A – 50/60 Hz (L-N)
Aux Supply (Preferential Line)	230 Vac – 10 A – 50/60 Hz (L-N)
Total Aux. Consumption (W)	2800
Distortion factor (THD) (*Note 2*)	<3%
Power Factor (cos ϕ) (*Note 3*)	from -1 to +1 inductive or capacitive
Galvanic insulation	No (Transformer less)
AC input connection	Magneto-Thermic Circuit Breaker
GENERAL DATA	
Max Efficiency	98,9%
European Efficiency	98,6%
Night consumption (W)	<60
Weight (kg)	1400
Protection degree	IP20
Cooling	Air forced cooling fan speed controlled
Air Flow	4800 m$_3$/h
Maximum power dissipated in overload condition	24,9 kW 21410 Kcal/h
Noise level	85 dBa
Dimensions (H x L x P)	2400 x 2240 x 760
Operating temperature (°C)	- 10 ÷ +50
Storage temperature (°C)	- 20 ÷ +60
Humidity (Not condensing) (%)	0 ÷ 95
Height above the sea without derating (*Note 4*)	1000 m
Overvoltage Category	II
Color	RAL 9006

Note 1: Valid at Power Factor=1 and Vac nominal
Note 2: THD is lower than 3% for inverter power greater than 25%.
Note 3: P-Q capability is circular.
Note 4: For applications above 1000 m a. s. l. please contact FIMER for details.

Note: Each inverter must be connected separately to its own LV/MV transformer or it has to be connected to a separate LV secondary input of the LV/
.

6. DECLARATION OF CONFORMITY

FIMER
INVERTER FOR LIFE

Uffici : Via J.F. Kennedy
20871 Vimercate (MB) Italy
Phone: +39 039 98981
Fax: +39 039 6079334

web site: www.fimer.com
e-mail: info@fimer.com

INFOLINE
tel. +39 039 6079326

SOLAR TECHNICAL SERVICE
service.solar@fimer.com

CE

DICHIARAZIONE DI CONFORMITÀ CE	DECLARAÇÃO DE CONFORMIDADE CE
CE DECLARATION OF CONFORMITY	FÖRSAKRAN OM OVERENSSTAMMELSE CE
KONFORMITÄTSERKLÄRUNG CE	VERKLARING VAN CONFORMITEIT CE
DÉCLARATION DE CONFORMITÉ CE	BEKREFTELSE OM OVERENSSTEMMELSE CE
DECLARACIÓN DE CONFORMIDAD CE	

OVERENSSTEMMELSESERKUERING CE
YHDENMUKAISUUSVAKUUTUS CE
UYGUNLUK BİLDİRİMİ CE
إعلان مطابقة للمواصفات الأوروبية CE

Si dichiara che l'apparecchio tipo
We hereby state that the machine type
Wir erklären, dass das Gerät Typ
On déclare que la machine type
Declara que el aparato tipo
Declara-se que a máquina tipo
Vi försakrar att maskinen av typ
Verklaard wordt dat het apparaat type
Vi bekreftelser, at maskinen type
Vi erklrerer, at maskinen type
Todistamme etta laite mallia
Yandaki makine modellerinin
نصرح بان الجهاز نوع

STORAGE INVERTER MODEL — **S9900TL**

è conforme alle direttive
is in compliance with the directives
den Richtlinien entspricht
est conforme aux directives
es conforme a las directivas
é conforme as directivas
ar i överensstammelse med direktiven
overeenkomstig de richtlijnen
er i overensstemmelse med direktivene
er i overensstemmelse med direktivene
on yhdenmukainen direktiivissa
yandaki direktiflere ve
مطابق للتوجيهات

2014/35/EU (LVD)
2014/30/EU (EMC)
2011/65/EU (RoHS)

è conforme alle norme
is in compliance with the rules
den Normen entspricht
est conforme aux normes
es conforme a las normas
é conforme as normas
ar i överensstammelse med direktiven
overeenkomstig de richtlijnen
er i overensstemmelse med direktivene
er i overensstemmelse med direktivene
on yhdenmukainen direktiivissa
yandaki normlara uygun olduğunu
bildiririz
ومطابق للمقاييس

EN62109-1:2010
EN62109-2:2011
EN61000-3-11:2001
EN61000-3-12:2011
EN61000-6-2:2005
EN61000-6-3:2007
EN61000-6-4:2007
CEI016 - 2014-09
CEI016-V1 2014-12
CEI016-V2 2016-07

VIMERCATE (MB)
13-11-2018

AMBROGIO F. CARZANIGA
CHAIRMAN

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اي عمل أو تعديل غير مرخص من قبل شركة FIMER يبطل فوراً مفعول هذه الوثيقة.

7. INVERTER BLOCK DIAGRAM
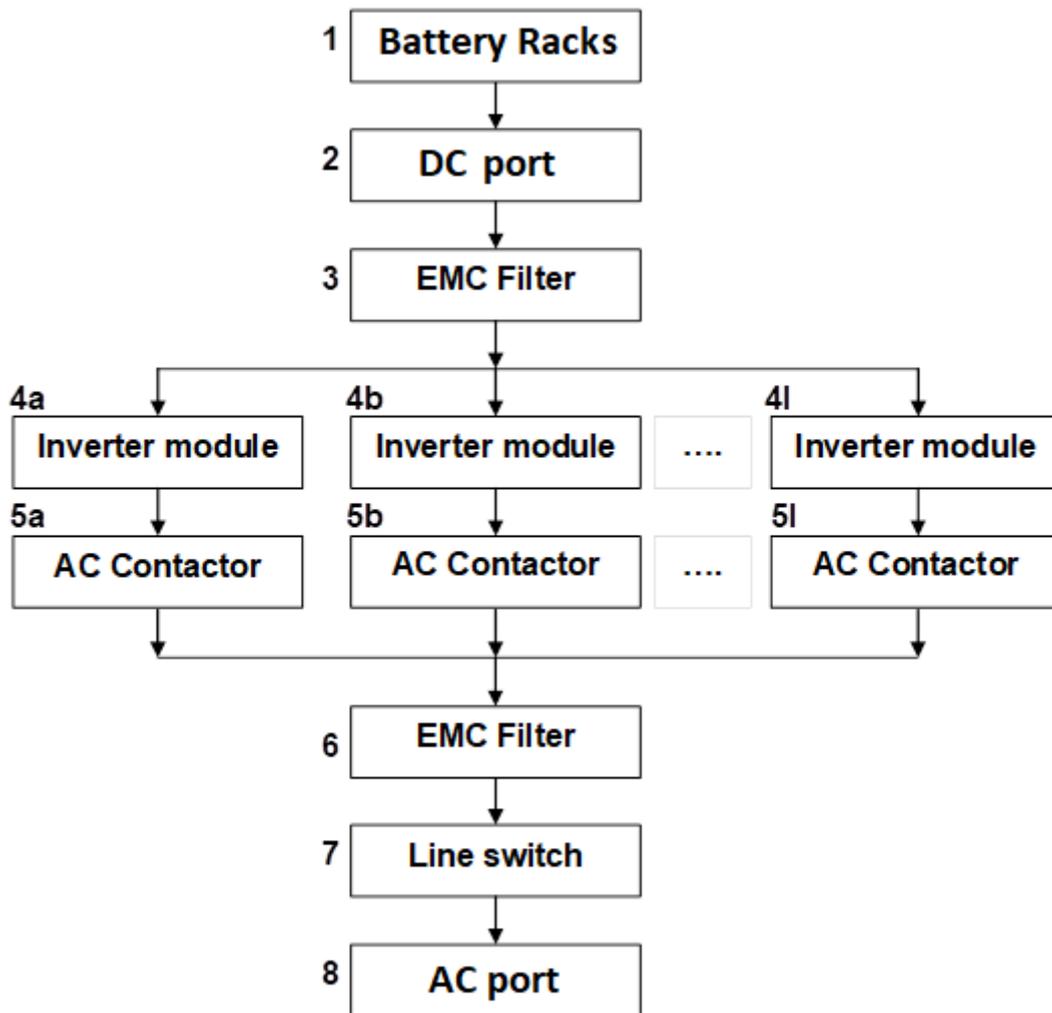
Fig. 1

1	BESS Battery Rack	5a, b …l	module contactors
2	input switch	6	low-pass power filter
3	filter for electromagnetic compatibility	7	line switch
4a, b …l	10 inverter modules	8	Low voltage local mains (LV winding of the LV-MV transformer)

N.B.: The block diagram is related to the S9900TL inverter; it requires 10 power stack modules; and relative contactors;

ELECTRIC BLOCK DIAGRAM
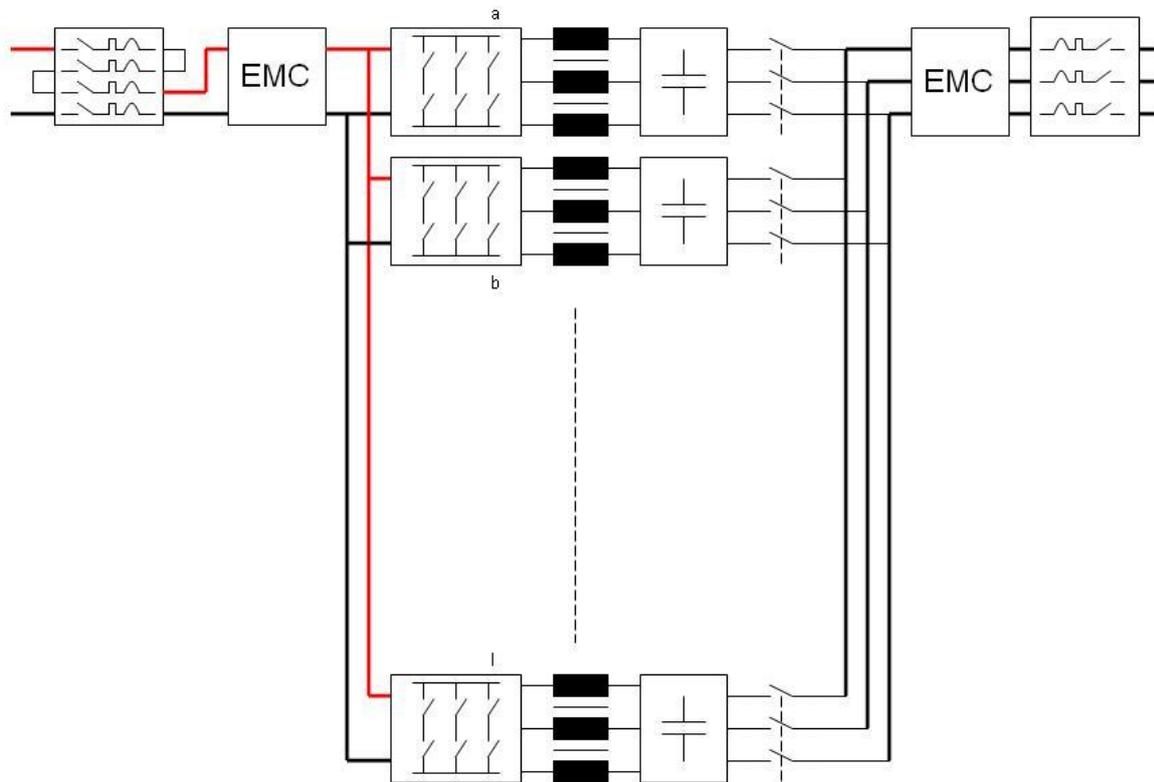
N.B.: The block diagram of the upper figure is related to the S9900TL inverter; it requires 10 power stack modules; and relative contactors, inductors and capacitors.

8. DESCRIPTION OF OPERATING PRINCIPLE

8.1 Introduction

The S9900TL inverter, as all the other ones of the transformerless central family, are suitable for connecting Battery Energy Storage System to public medium-voltage grids for the excange of electricity. They are not equipped with isolation transformers between the solar field and grid because this function is performed by a dedicated LV-MV transformer housed in an appropriate facility.

The modular design of the inverter allows obtaining an high reliability (MTBF), very short repair times (MTTR) and a need for very few spare parts.

The adoption of an innovative modulation system (IPCCM - Improved Predictive Current Control Modulation) not only guarantees a perfectly sinusoidal current waveform, but above all allows obtaining very high conversion efficiency.

The inverter is controlled by a multi-microprocessor in which a supervisor processor coordinates the stack behaviour in order to maximise, in every operating condition, the efficiency of the system. Other processors rely on the operation of each module by following the instructions coming from the supervisor (slave modules). Another two microprocessors are responsible for displaying the state of the machine on a colour touch-screen display located on the front of the apparatus, and for managing the commands and remote diagnostics.

As for the components used, in order to maximise reliability and duration of the life of the apparatus, the electrolytic capacitors were completely removed from the control circuits and, above all, from the power circuits.

In particular, the electrolytic capacitors positioned in parallel to the battery modules have been replaced by components in metallised polypropylene. The fans were also selected from components with variable speed to maximum the expected life.

In order to ensure minimum repair times, all the components of the inverter, including the magnetic components, can be replaced from the front; this means there is no need to access the machine from the rear.

S9900 storage inverter has been conceived as part of a more complex system defined as Batterry Energy Storage Sytem (BESS) where the inverter is defined as Power Converter System (PCS). The PCS can be considered the power hardware interface between the application level of the Storage Management System (SMS) and the battery racks.

8.2 Start-up

FIMER Storage inverts has been designed to fully customized on the specific application and according to BESS constrains and therefore the start-up phase shall be managed by the application level (i.e. SMS) according to the services that the storage system has been design to satisfy.

Having the capability to automatically manage its behaviour, during the start-up phase the storage inverter will keep under control:

- Power interfaces insulation level → AC and DC sides insulation levels can be monitored with the purpose to avoid power exchange is insulation level are too low;
- Battery voltage alignment → in the event of a misalignment between battery and DC bus voltages the inverter is able to automatically align the voltage levels (pre-charge phase) in order to avoid overcurrent during the DC parallel transition
- Battery interface monitoring → in order quickly manage hazardous situation the invert can be configure to exchange hardwire signals directly connected to the batteries
- Grid alignment → before to close the grid parallel phase and start energy exchange the inverts will align its AC voltage levels (amplitude and phase) with the grid.

Once all the safety condition has been satisfy, all alarms has been cleared and alignment phases successfully completed the storage invert can start to satisfy application requests.

8.3 Power exchange

The inverter starts its power exchange phase once it has been connected to the grid.

During power exchange, the supervisor adjusts the voltage and current on the BESS Battery Rack according to set-points received by its application level (i.e. SMS).

Depending on the specific application, stacks activation strategy can be configured. Where a fast response is required (i.e. primary frequency regulation) all of the stack can be constantly kept running giving the priority to the response time against auxiliary power consumption. Where system efficiency is the priority (power shifting) a sequential turn-on strategy based on the power request can be applied .

In order to maximise efficiency, the fans of the apparatus do not run at a constant speed, but at a variable speed depending on the current that circulates in the circuits and the ambient temperature.

This will also optimise the life of the fans that basically are the only moving parts of the inverter.

9. STORAGE

If the inverter is not installed immediately or in case of long inactivity period, it must be stored in an adequate ambient, better by using its original packaging and protected against humidity and weather conditions.

The storage room must meet the following requirements:
Ambient temperature: -25°C ÷ +60°C
Relative humidity: 95% max (not condensating)

The recommended storage temperature is between +5°C and +40°C

10. INSTALLATION AREA

Before proceeding with installation, carefully read the section "SAFETY INSTRUCTIONS AND OTHER INFORMATION." In particular, the points relating to "Installation Area", "Positioning", and "Ventilation".

Check that the ambient temperature with the inverter running conforms to:

- Operating Temperature: -10°C ÷ 50°C
- Maximum temperature for 8 hours per day: 45°C
- Average temperature for 24 hours: 35°C

Please note: the average temperature recommended for the life of the inverter is between 10°C and 35°C.

11. PRELIMINARY OPERATIONS

11.1 Packaging Inspection

On receiving the inverter, check that the packaging has not been damaged during transport.

Check that none of the anti-tip devices positioned on the packaging have turned red, otherwise, follow the instructions reported on the packaging.
Take care when removing the packaging to avoid scratching the cabinet of the inverter.
The equipment must be handled with care, any bumps and falls can damage it.
Check that the apparatus is intact without any dents; also check that all the ventilation slots are not deformed, so as to guarantee the declared degree of protection.
If the equipment is damaged <u>DO NOT CONNECT IT</u> and contact the supplier immediately.

11.2 Handling

The inverter is normally supplied on a special platform. For handling and moving, use a pallet or forklift.

When using a forklift, widen the forks until they line up with the appropriate lifting points located on the bottom of the machine.
Alternatively, **paying the utmost attention,** a pallet can be used by inserting the forks in the centre of the machine o at the proper side as shown in below attached picture.
Caution: this means the cabinet is lifted from the centre which can make it unstable, therefore only move it for short distances, on a smooth floor with the aid of a person on each side to keep the machine stable.

Fig. 2.a   Fig. 2.b
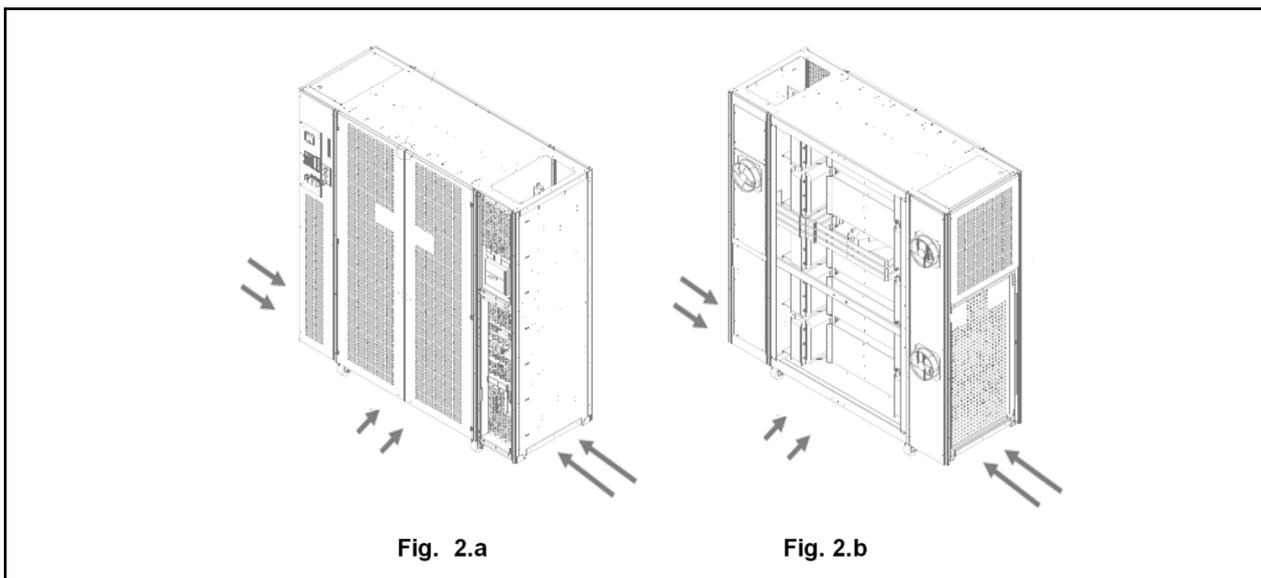
Picture related to inverter S9900TL

11.3 Positioning

The cooling air enters the inverter from the top and through the grills located on the front of the door, and exits from the back of the machine.
Follow these recommendations when positioning the apparatus:

- There must be at least one meter of free space in front of the equipment to allow for any maintenance.
- Make sure there is a distance of at least 50cm between the roof of the machine and the ceiling and 30cm between the back and the wall in order to allow a correct flow of air coming from the fans (see Figure 3).
- DC cables enter the machine from the top of the cabinet. The power and signal cables must be connected from the front.
- AC cables enter the machine from the bottom of the cabinet. The power and signal cables must be connected from the top.
- Multiple cabinets can be joined together side by side.

Fig 3
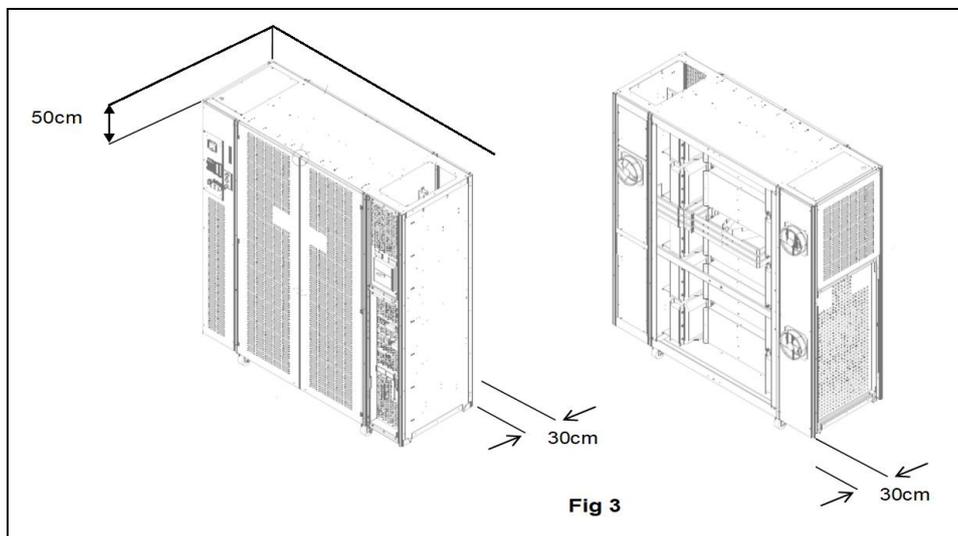
Picture related to inverter model: S9900TL

12 PREPARATION OF THE ELECTRICAL SYSTEM

12.1 System protections

The cables of the system must be properly sized to carry the maximum currents reported in the technical specifications.

In particular, the connection to the AC system is of a 3-pole type (no neutral).

A single-phase 230Vac (10A max) connection is also required for supplying power to the control logics board and display of the converter (we suggest to use a preferential supply line by UPS); a single-phase 230Vac (16A max) connection is also required for supplying power cooling fans.

AC output

The AC output line of the inverter has an automatic circuit breaker (whose current size is equal to 1600A for --S9900TL) with a breaking capacity equal to 30kA.

This breaker cannot protect the line connected to the inverter from any faults. Therefore, an appropriate protection must be installed upstream, which must be sized according to the currents in play and to the characteristics of the cable installed.

Contribution to the short circuit current of the system: This theoretically equals the maximum current indicated in the rating data. In the short interim before shutdown (max. 200msec), the inverter provides a contribution to the short circuit current equal to the inverter's maximum rated current (see the technical specifications). This value is absolutely negligible compared to the system's normal short circuit currents.

DC input

The DC input line of the inverter has one disconnecting switches whose max. current size is 1600A for --S9900TL.

12.2 Connections of the Storage battery rack and the electricity grid

The operations described in this chapter can only be performed by qualified personnel.

The first connection to be made is the one of the ground conductor to the bar indicated by the symbol:

The size of section of cables for wiring the GND must be equal to half of size section of a single phase of the inverter unless adequate short circuit calculation has been provided

Connect only one cable terminal to each single point of connection of the GND copper bar.

For the connection use the M8 cable terminal by using that has to be fixed with a screw and nut using split spring washer to ensure a seal and secure the appropriate hole provided on the earth bar.

DO NOT OPERATE THE INVERTER WITHOUT THE GROUND CONNECTION!

Before making the connection, open all the switches of the machine and check that the inverter and the lines to be connected are completely disconnected from the power sources: Storage battery rack and AC mains network.

In particular, ensure that:
- the line coming from the Storage battery rack is disconnected;
- the switches of the converter of the IDC and IAC inverters are in the open position;
- there are no dangerous voltages (DC and AC) by measuring with a multimeter.

The AC network to which the inverter is connected must be a three-phase network (no neutral).

The connection system is an IT-type system. The BESS inverter contains a device for monitoring the insulation resistance of the DC poles with respect to ground. If there is a loss of insulation on the Storage side, the inverter generates an alarm.

The cables must be connected as shown in the figure below where are explained all the details of the wiring connection (Note: following pictures are referred to an inverter with 6 IGBT stack module; anyway the left connecting column related to the wiring of the DC and AC cable in input to the inverter are the same for all the models):
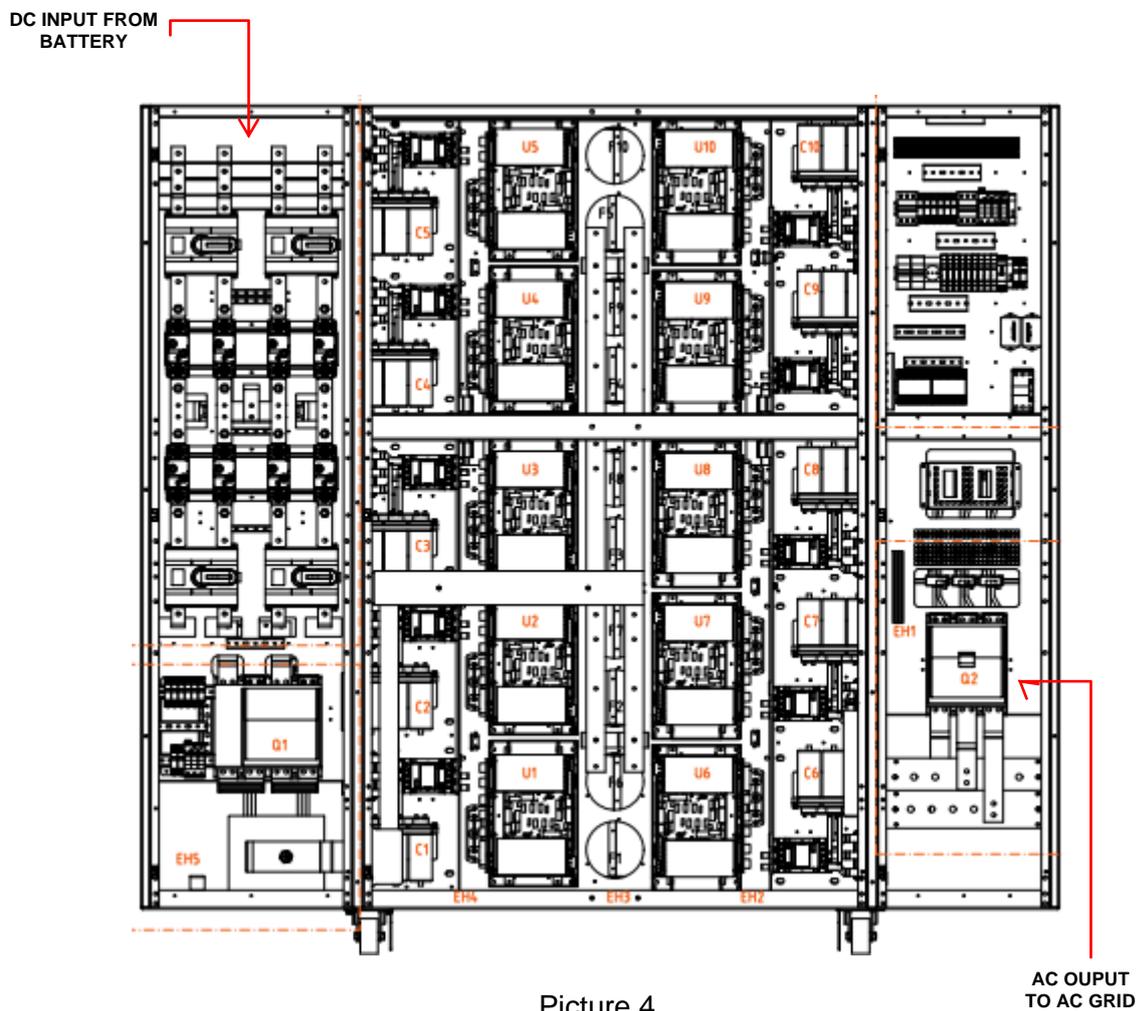
Picture 4
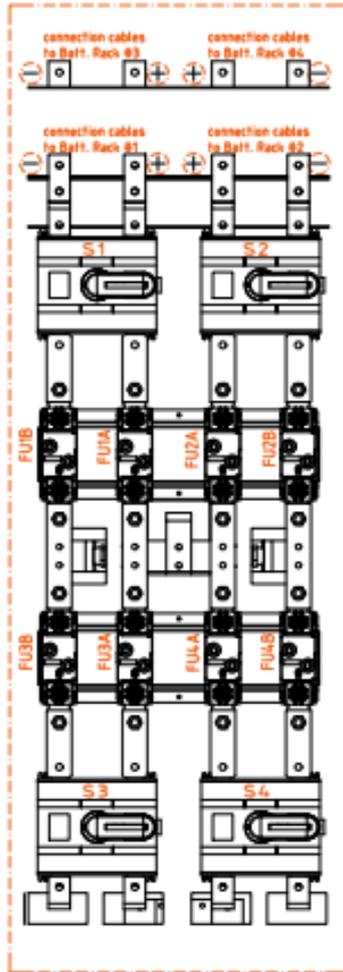
DC Input

Figura 5a
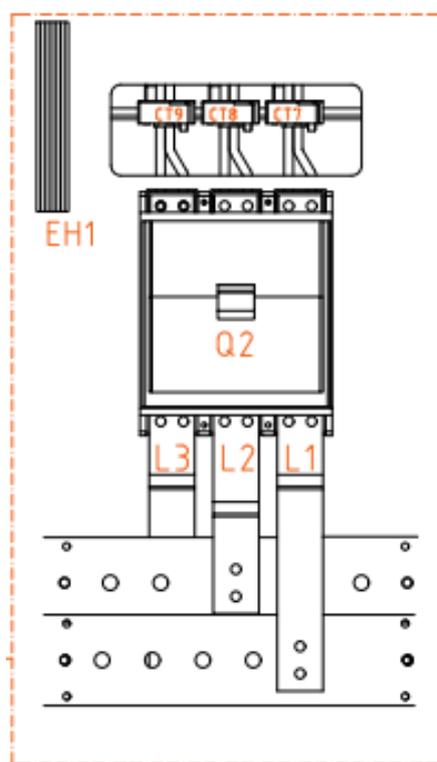
Figura 5b

BESS INVERTER SIDE
Connect the cables coming from the BESS Battery Rack to the I_{DC} switchs as shown in Picture 4 and 5.
ALWAYS CHECK FOR PROPER POLARITY OF THE BESS BATTERY RACK (the inverter is protected against reverse polarity of the Storage battery rack, but cannot run with the polarities inverted).

AC MAINS NETWORK SIDE
The AC network to which the inverter is connected must be a three-phase network (no neutral).

CONNECTION OF GRID AND BESS CABLES
The Storage cables or grid cables must comply with the indications reported in the Picture 4 and 5.
Pay attention when connecting the phases of the grid cables and make sure to follow the correct cyclic direction.
The inverter is protected against reverse phase sequence and cannot function if connected incorrectly. This will result in the "Phase Sequence" alarm being generated and the machine will not be able to start.

GRID SIDE SWITCH

The inverter contains an ABB automatic 3-pole circuit breaker:
T7S1600 3P PR231/PLS/I for S9900TL
The characteristics are reported below:

Interruttori automatici per distribuzione di potenza
Caratteristiche elettriche

		Tmax T1 1P	Tmax T1			Tmax T2						Tmax T3		Tmax T4				Tmax T5				Tmax T6				Tmax T7			
Corrente ininterrotta nominale	[A]	160	160			160						250		250/320				400/630				630/800/1000				800/1000/1250/1600			
Poli	[Nr.]	1	3/4			3/4						3/4		3/4				3/4				3/4				3/4			
Tensione nominale d'impiego, Ue (AC) 50-60 Hz	[V]	240	690			690						690		690				690				690				690			
(DC)	[V]	125	500			500						500		750				750				750				–			
Tensione nominale di tenuta ad impulso, Uimp	[kV]	8	8			8						8		8				8				8				8			
Tensione nominale d'isolamento, Ui	[V]	500	800			800						800		1000				1000				1000				1000			
Tensione di prova a frequenza industriale per 1 min.	[V]	3000	3000			3000						3000		3500				3500				3500				3500			
Potere di interruzione nominale limite in cortocircuito, Icu		B	B	C	N	B	C	N	S	H	L	N	S	N	S	H	L	V	N	S	H	L	V	N	S	H	L	S	H	L	V(700)

(table abbreviated due to high density)

STORAGE SIDE SWITCH

The inverter contains two ABB switches:
T7D/BESS-E 1600 4p 1000VDC disconnecting switch for S9900TL.

Molded case switch-disconnectors up to 1500V DC in compliance with IEC 60947-3

Electrical charachteristics

Tmax PV switch-disconnectors in compliance with the IEC60947-3		T4D/PV-E	T5D/PV-E	T7D/PV-E [1]
Rated service current in category DC22 A, Ie	(A)	250	500	1250-1600
Number of poles	(No.)	4	4	4
Rated service voltage, Ue		1500V DC	1500V DC	1500V DC
Rated impulse withstand voltage, Uimp	(kV)	8	8	8
Rated insulation voltage, Ui	(V)	1500V DC	1500V DC	1500V DC
Test voltage at industrial frequency for 1 minute	(V)	3500	3500	3500
Rated short-circuit making capacity, switch-disconnector only, Icm	(kA)	3	6	19.2
Rated short-time withstand current for 1s, Icw	(kA)	3	6	19.2
Versions		F	F	F
Standard terminals		F	F	F
Mechanical life	(No. Operations)	7500	7500	20000
Electrical life (operations @ 1500 V DC)	(No. Operations)	1000*	1000*	500*
Basic dimensions	W (mm/in)	140/5.52	186/7.33	280/11.02
	D (mm/in)	103.5/4.07	103.5/4.07	178/7.01
	H (mm/in)	205/8,07	205/8.07	268/10.55
Weight (with standard terminals only)	(kg/lbs)	3.05/6.72	3,15/9.15	14/30.86

1) installation in vertical position only
* openings with SOR or UVR

OVERALL DIMENSIONS AND CONNECTIONS WITH GRID AND BESS SWITCHES

According to IEC 60947-3

T7D/PV-E

Configurations without jumpers (cables)
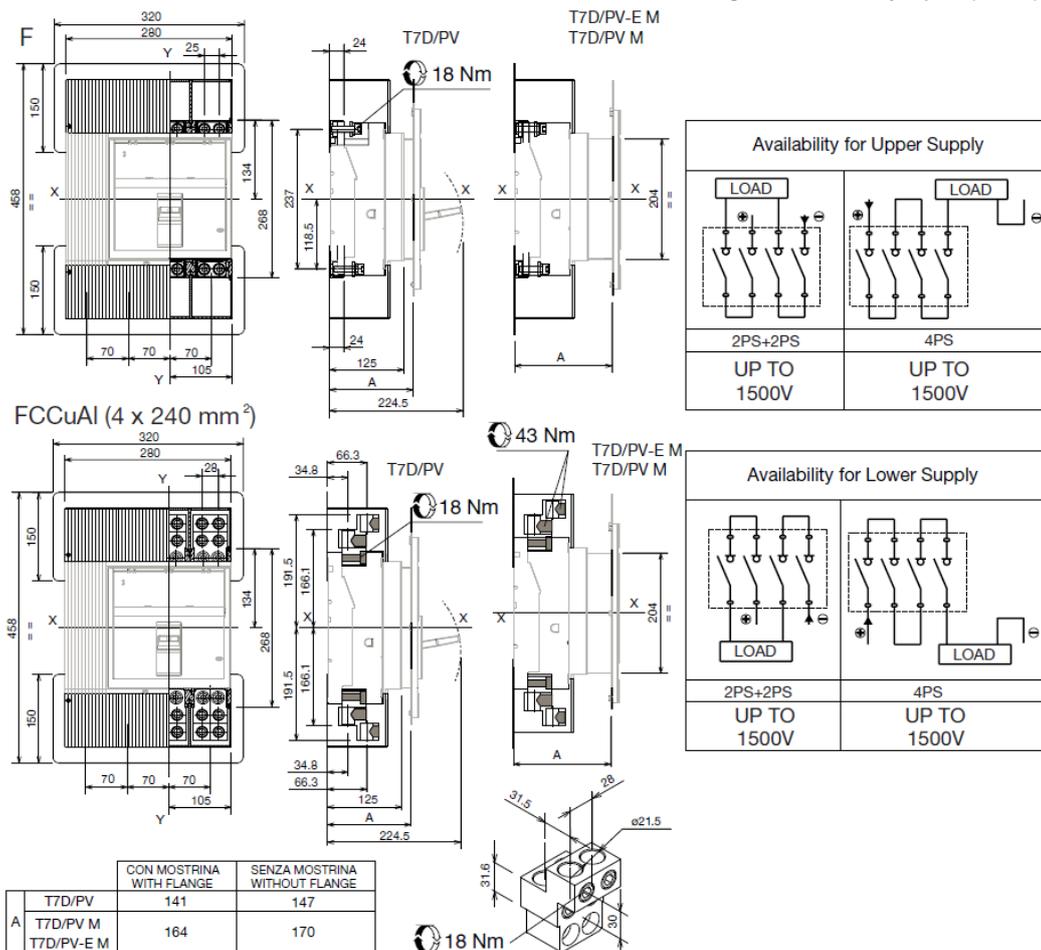
INSTRUCTION FOR CONNECTING AUXILIARY SUPPLY (UPS and NORMAL)

The connection of the auxiliary power supply for power the control board and the fans of the inverter are realized by connecting cables to these terminals: :

- **XA19 e XA20**: *Normal line* for power cooling fans of the inverter (the switch Q3 in Figure 6 is the one related to fans)

- **XA17 e XA18**: *Prefered Supply by UPS* for power the electronic board and the control circuit of the inverter (the switch Q4 in Figure 6 is the one related to this function)
  -

DETAIL C
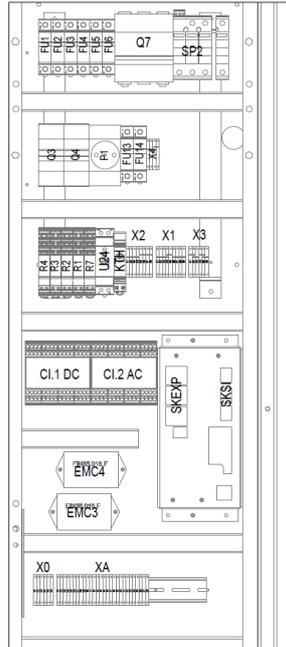
TERMINAL FOR EXTERNAL CONNECTION
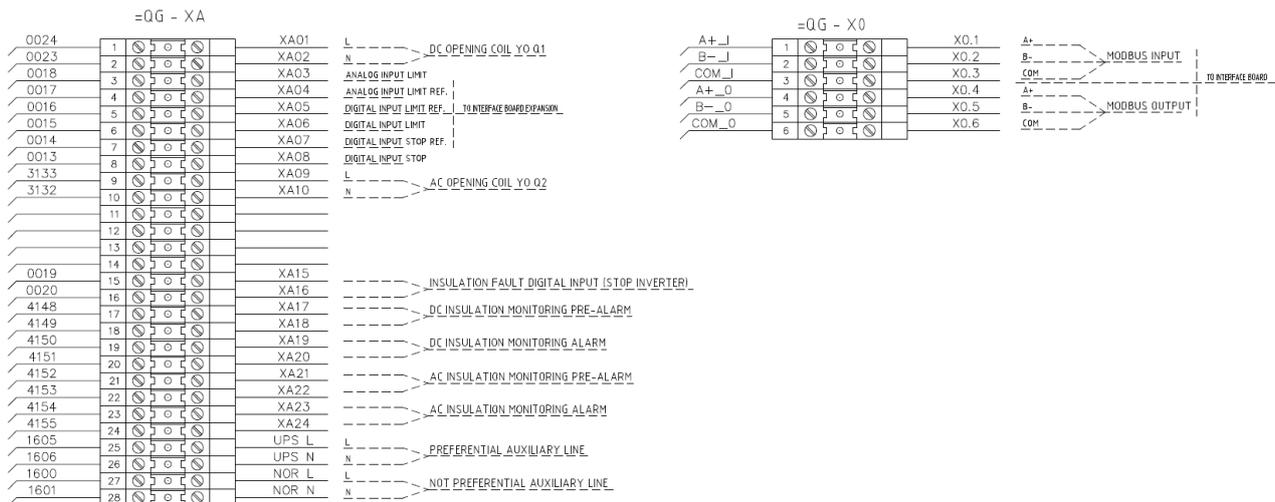
Figure 6

TERMINALS FOR REMOTE CONTROL CONNECTION

For connecting the digital output and signal line of the inverter to a remote control system (SCADA/PPC) please refer to the following terminals (please refer to Picture 6):

- **From XA01 to XA16**: the terminals in object are related to the analogical/digital input/output of the inverter monitored by the SCADA/PPC System and available for a remote control and set of the functioning of the complete BESS plant and for the connection to the Smart Grounding Kit System .
- **X0.1 and X0.4 (A+); X0.2 and X0.5 (B-); X0.3 and X0.6 (COM** to these terminals must be connected the serial communication line (RS485 port with MODBus RTU protocol) of the SCADA Remote control system

The following table describes in detail the meaning of the terminals from XA11 to XA20:

XA01– XA02 (*RELEASE COIL*)	Terminals for activating the release coil powered in current (230V$_{AC}$) that opens the maim input DC switch of the inverter, by a remote command, according to the following logical of intervention: • OPEN INVERTER if the command is ON
XA03– XA04 (*RESERVED for PPC*)	Digital input terminals for activating/deactivating, by a remote PPC command, the operative mode of the BESS converter, according to the following logical of intervention: • STOP INVERTER if the command is OFF (logic value 0) • START INVERTER if the command is ON (logic value 1)
XA05– XA06 (*RESERVED for PPC*)	Digital input terminals for enable/disable, by a remote PPC command the maximum limit of power that the inverter can feed into the grid; the value of max power is set by remote using an analogic signal that is described in following with the description of terminals XA17-XA18; the logical of intervention is hereby described: • ENABLE OF POWER LIMIT if the command is OFF (logic value 0) • THE INVERTER CAN RUN WITHOUT ANY LIMIT AT THE MAX POWER AVAILABLE FROM THE BESS INVERTER if the command is ON (logic value 1)
XA07– XA08 (*RESERVED for PPC*)	Analogic input terminals that are correspondent to the maximum value of power that can feed into the grid by the inverter; the value of the analogic signal can be set within a variable range: • Minimum value: correspond to 0V • Maximum value: can be set in a range within 5V and 10V The value of the analogic input correspond to the limit of maximum power that the BESS converter can feed into the grid only if it is enable the digital input described by the terminals XA17 and XA18. For example: 0V=0% ; 5V=100% if the max analogic value of the signal is 5V otherwise 5V=50% if the max analogic value of the signal is 10V)
XA09– XA10 (*RELEASE COIL*)	Terminals for activating the release coil powered in current (230V$_{AC}$) that opens the maim output AC switch of the inverter, by a remote command, according to the following logical of intervention: • OPEN INVERTER if the command is ON
XA11– XA12 (*RESERVED for SGS*)	Terminals for identifying the status of the DC circuit breaker and necessary for the correct management of the control logic of the Smart Grounding Kit System
XA13– XA14 (*RESERVED for SGS*)	Terminals for identification that the inverter is converting energy into the network and necessary for the correct management of the control logic of the Smart Grounding Kit System
XA15– XA16 (*RESERVED for SGS*)	Terminals to keep the inverter in stop condition on insulation leak fault and necessary for the correct management of the control logic of the Smart Grounding Kit System

12.3 Connections for signals, remote contacts and EPO (Emergency Power Off) circuit

To access the interface board, open the front door and identify the connectors shown in Figure 7.

CN1
1 Open = global alarm
2 Open = global alarm
3 Open = overtemperature
4 Open = overtemperature

CN2
1 Closed = system fault
2 Closed = system fault
3 Open = no generation
4 Open = no generation

CN3
1 EPO contact
2 aux EPO contact
3 aux EPO contact
4 EPO contact

CAN inverter

MODBUS Master (SBC, 1ph inverter)

MODBUS Slave (external datalogger)

Terminals for communication bus

LAN

ACCESSORIES

Figure 7

CN1 Connector
- The opening of the contact positioned between terminals 1 and 2 of CN1 signals a fault in the operation of the inverter. This contact also opens in case of complete power failure of the inverter.
- The closing of the contact between terminals 3 and 4 of CN1 signals an excessive rise in the ambient temperature

CN2 Connector
- The closing of the contact positioned between terminals 1 and 2 of CN2 signals a fault in the inverter.
- The opening of the contact positioned between terminals 3 and 4 of CN2 signals a situation of no production. This contact also opens in case of complete power failure of the inverter.

Caution: all the contacts have a maximum output of 0.5A and 24V

To make the connection to the terminals, extract the female connectors and join the ends to the signal cables. On completion of the operation, reposition the connectors.

Repeat the operation for the other signal cables.

CN3 Connector (Connector for EPO circuit)

The opening of the jumper present on the connector positioned between terminals 1 and 4 of connector CN3 turns off the inverter.

The inverter is supplied by the manufacturer with the EPO (Emergency Power Off) terminals short circuited.

In the presence of a dangerous situation, this input can be used to turn off the inverter by simply pressing one button (normally closed).

The EPO command turns off and disconnects the inverter modules from the network, but does not open the connection to the Storage battery rack.

<u>Therefore, dangerous voltages remain inside the machine due to the presence of the Storage battery rack voltage and the mains voltage on the contacts of the remote disconnection switches of the modules (contactors 7a, 7b….. 7l in the block diagram).</u>

To restore the functioning of the machine, use the touch-screen display as described in section 13.

The system can be equipped with a second EPO button, or two buttons can be connected in series, or the following circuit can be created:
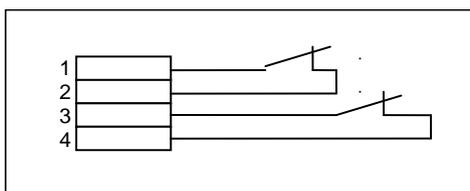
The emergency button is not supplied with the machine: the installer is responsible for ensuring that a suitable device is used (a self-hold device is recommended) which can also be used to release the switch of the BESS Battery Rack and line.

CAN ports and MODBus

The CAN ports and MODBus are double socket and connected in parallel (pin to pin) between them to facilitate the creation of the bus. The termination jumper must be disconnected on all drives that are inside the bus data line, except that the first and / or last line of the data to which it belongs. Obviously, in the case of single inverter should be left closed its jumper.

By connecting multiple inverters on a single bus MODBus rights LAN cables can be used to create bridges between them.

The pin ports MODBus is as follows (where in the following figure are shown the layout of a standard RJ45 connector male):
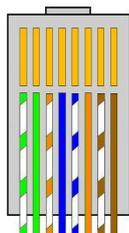
The signals of the communication bus are as described below:
<u>Inverter Side</u>
    Pin 4   A+ (BLUE)
    Pin 5   B- (WHITE-BLUE)
    Pin 7   COM (BROWN-WHITE)

Expansion card of the interface card

The expansion card interface card is also present in the machine and the complete details of the possible connection of the radiation sensor (Sensor Box FIMER) is as described below:
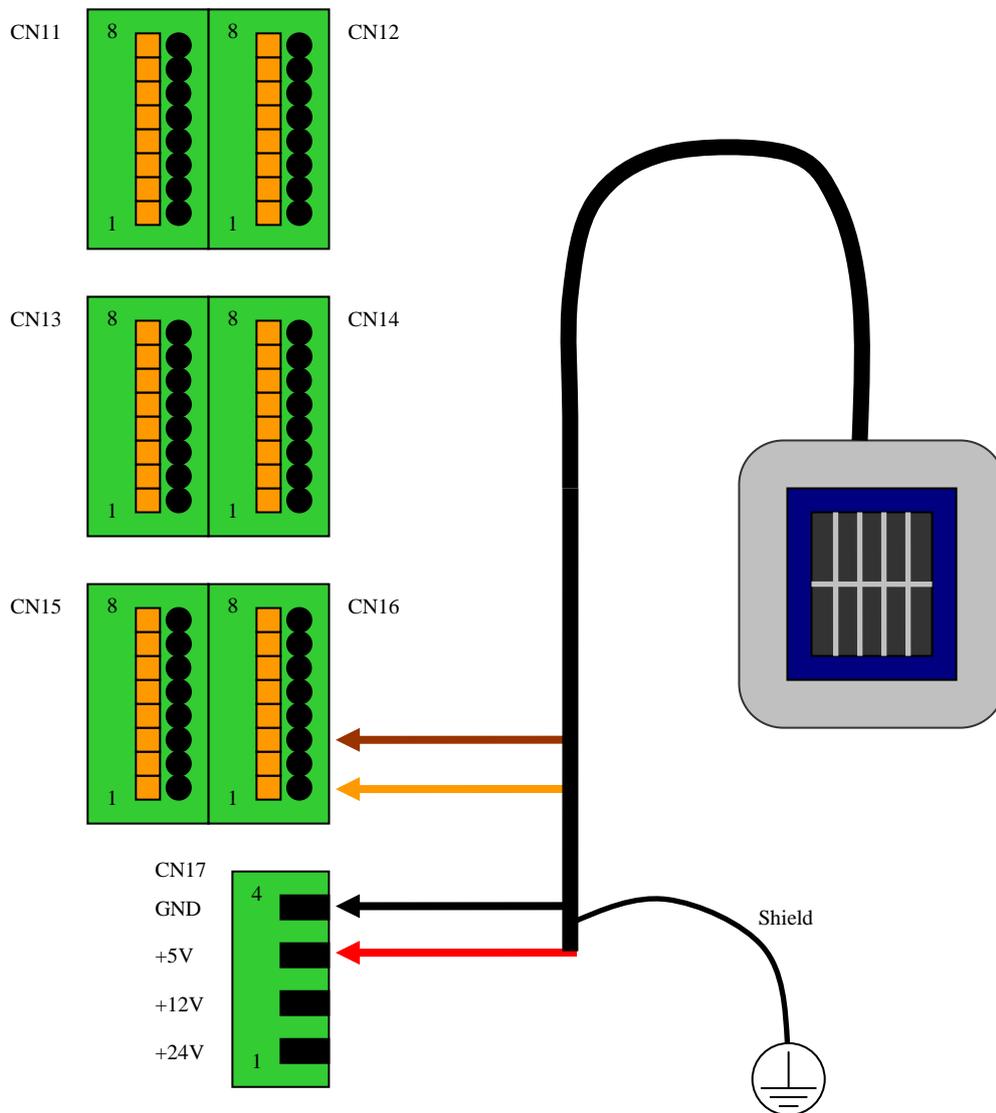
TABELLA DI CONNESSIONE

CARD	SENSOR	FUNCTION
CN 17 PIN 4	BLACK	GND
CN 17 PIN 3	RED	5V
CN 16 PIN 1	ORANGE	IRRADIATION
CN 16 PIN 3	BROWN	TEMPERATURE

.

13. INITIAL START-UP

Once the above electrical connections have been made and the switch cover panel has been repositioned, the inverter can be started.
Follow these steps:

1. Open the door of the inverter to access the input and output switches;
2. Close all switches of the system;
3. Check that the DC voltage coming from the Storage battery rack falls within the range allowed by the inverter;
4. Close the IDC switch of Figure 4;
5. Close the IAC switch of Figure 4;
6. Wait for the following screen to appear on the front display of the apparatus (if the screen does not appear, stop the start-up procedure and request assistance);
7.

8. At this point, the apparatus can be started;
9. Touch any point of the touch screen and the following screen appears:
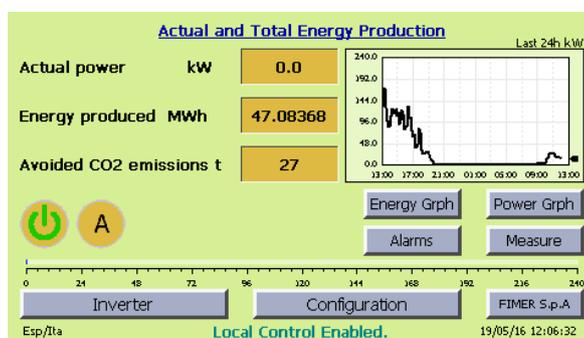
10. Check that no alarm is show
11. Check that main electrical measures are within the working range

12. Touch the ON
13. At this stage the storage inverter is ready to exchange power with the grid

14. INVERTER OPERATIVITY

The most commonly used configuration is the automatic operation. When configured in automatic operation the inverter can be considered as a slave power conversion system that behave as request by the upper hierarchy level (i.e. SMS). Main PCS functionalities are:

- Active power regulation → the PCS is able to exchange power with batteries and grid according to set points received by the SMS;
- Reactive power regulation → the PCS is able to exchange reactive power with the grid according to set point received by the SMS
- SoC equalization → the PCS is able to balance the State of Charge of the battery rack according to the strategy defined by the SMS
- Battery Stand-by → in case of long inoperative period the PCS is able to manage a minimum SoC of the battery rack

Same functionalities can be managed manually by and operator, please note that manual operation shall be reserved for service or maintenance activities.

15. OPERATION

During automatic operation, the user can check the PCS behaviour by accessing the touch-screen display.
The touch-screen display shows all the information relating to the operation of the machine.

15.1 Home page
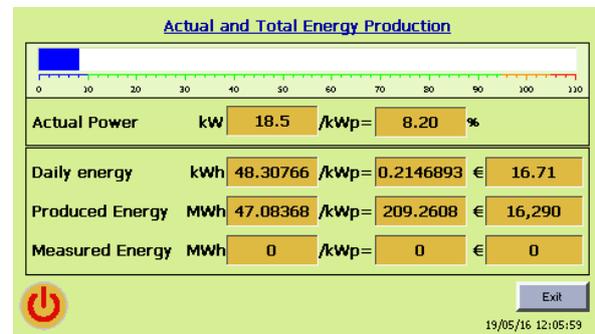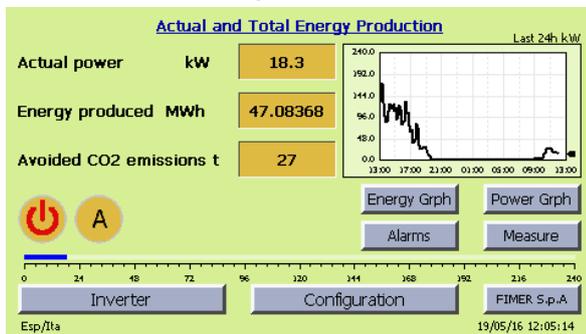
Description of the meaning of the elements displayed:

Actual power	Instantaneous active power delivered to the network (expressed in kW)
Energy produced	Total energy produced with activation of the inverter (expressed in MW/h) Pressing this area of the display opens a screen with more complete data, see below.
Last 24 hours kW	Trend of the instantaneous power in the last 24 hours
ON/OFF button	Switches the machine on and off
A	Automatic operating mode (Note 1)
Energy Grph	Displays pages about Energy production
Power Grph	Displays pages about Power curves
Alarms	Displays the state of the machine (see following sections)
Measure	Displays details of the machine measurements (see following sections)
Inverter	Allows passing to the inverter's management and verification mode (see following sections)
Configuration	Allows passing to the inverter's configuration mode (see following sections)

FIMER S.p.A.	Displays the address and telephone number of the FIMER service centre (see following sections)
Esp/Ita	Cyclically switches between Italian, English and Spanish language.

Note 1: the inverter must always be in automatic operating mode (the manual operating mode is only for service technicians).

15.2 Fault signals

If a fault occurs during operation, an acoustic signal is activated and the alarm icon appears on the current screen:

Click on the alarm icon to access the alarm summary page.
(See section 15.4)

15.3 Measurements

Press the "Measure" button to open the screen summarising all the machine measurements.
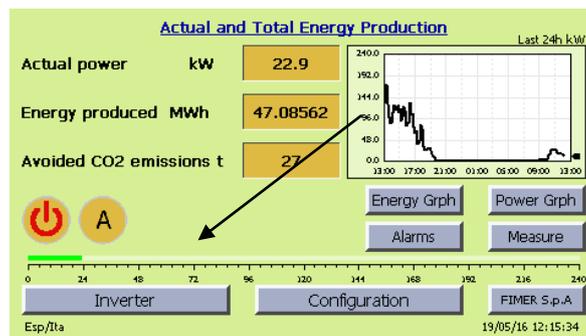
The following screen appears which contains the main electrical quantities of the apparatus.
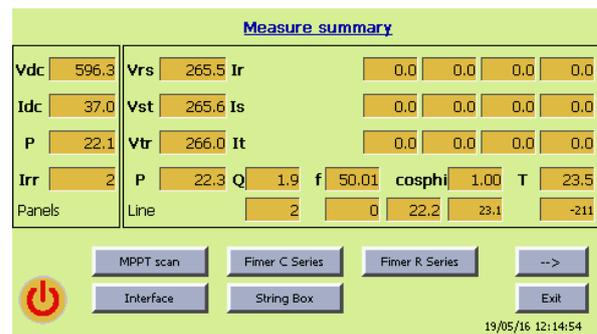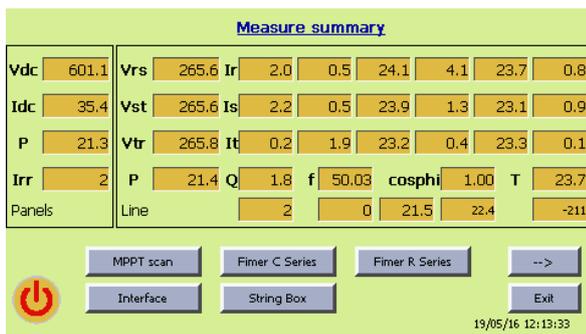
The right arrow allows alternating between the display showing the first 6 modules and the display showing the last 4 modules.

In particular:

Panels	
Vdc	Overall voltage of the internal DC bus
Idc	Total current of the Battery Rack
P	Power extracted from the Battery Rack
Irr or VBESS	Radiation (optional) or BESS Battery Rack voltage.
Grid	

Vrs, Vst, Vtr	Grid connected voltages
Ir, Is, It	Grid current fed by each module
P	Total active power.
Q	Reactive power fed into the grid
f	Grid frequency
cosphi	Cosphi measure
T	Temperature inside the inverter

The ON and OFF button is available on every screen (confirmation is requested to turn off the apparatus).

The "FIMER series R" and "FIMER series C" buttons allow accessing the following screens:

By using the arrows, all the inverters connected can be selected in order to view the actual measurements (which are sent to the "FIMERGuard" monitoring system).

Touch the "Exit" button to return to the home page.

15.4 Alarms

Touch the "Alarms" button (indicated by the arrow) to access the screen summarising all the signals and/or active alarms.
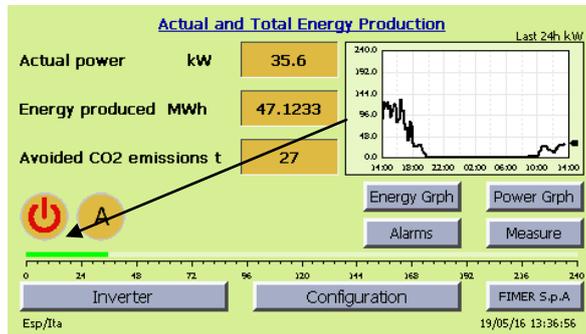
This screen can be accessed from any page by pressing the alarm icon

.

In both cases, the page reporting the active alarms appears:
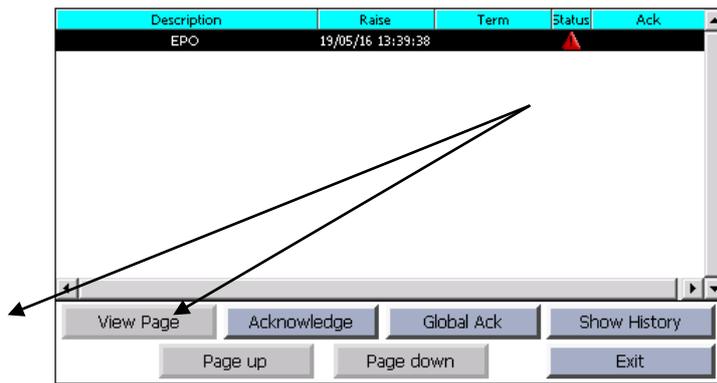
In this case, we have an active alarm that has not been silenced.
Press one of the recognition functions (indicated by the arrows) to move to the following page:
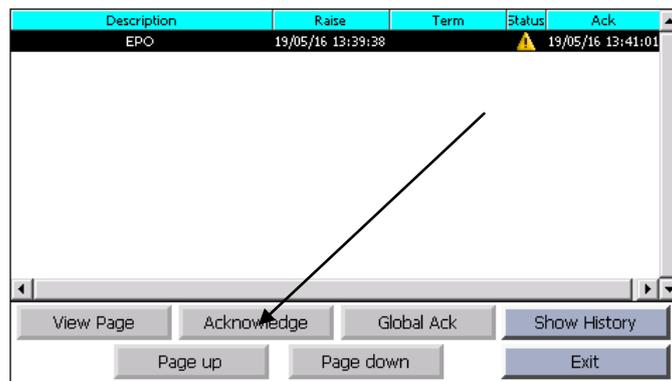
where the alarm icon has gone from red to yellow to indicate that the alarm has been silenced, but is still active.
Vice versa, if the condition that generated the alarm has disappeared in the meantime, the request for recognition will remove the alarm from the list.

To see all past and present alarms, press the "show history" button (indicated by the arrow), which will display the following screen:

Press the "Save Alarm History" button from this page to save the list displayed on a USB memory stick (operation reserved only to service technicians).

15.5 Inverter
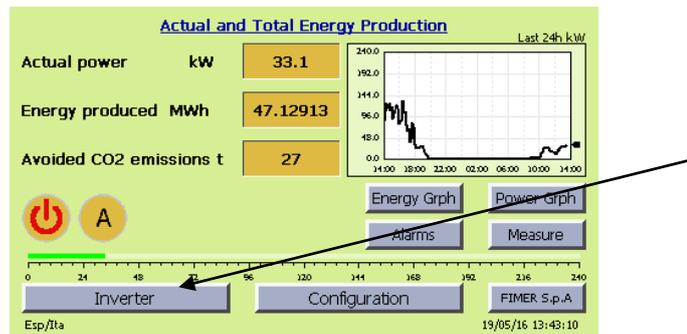
Press the "inverter" button (indicated by the arrow) to access the screen containing the calibration parameters of the inverter.
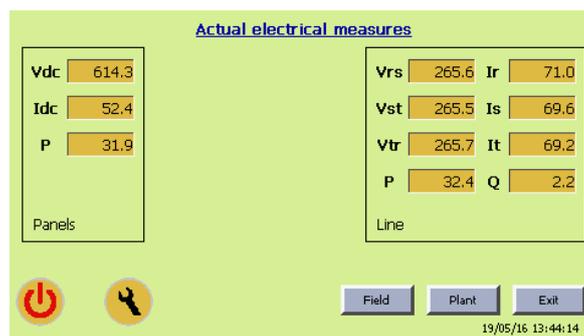
The measurements highlighted are the same as those described in the "Measurements" section. Authorised operators can access the calibration and configuration functions of the inverter via this screen: access to the relative menus is password protected.

15.6 Configuration
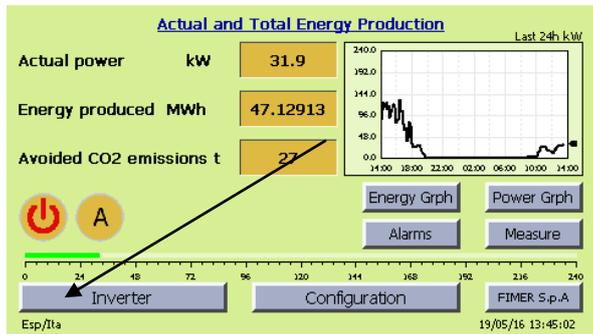
Press the "Configuration" button (indicated by the arrow) to access the screen for personalising the inverter.
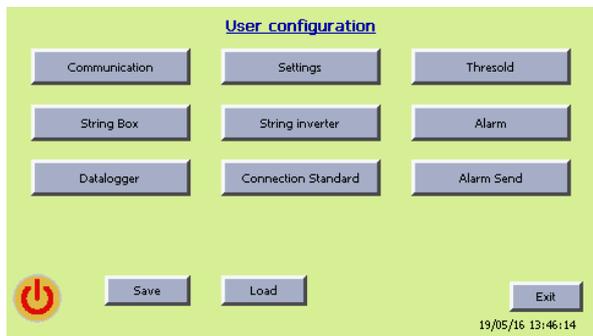
The following sections describe the screens corresponding to the buttons.

15.6.1 Communication

The screen allows configuring the MODBUS parameters for connecting to a third-party datalogger or to a display panel."ModBus TCP Enable" flag enables a ModBus TCP server to allow data acquisition.
The protocol document for interrogating the inverter is available on request.
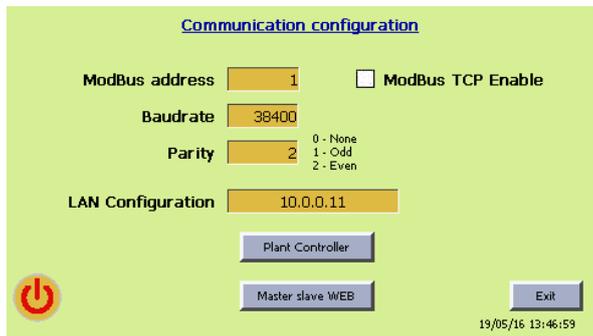
The LAN configuration can be changed. Press the box next to the words "LAN Setup" to close the application that manages the display for accessing the control panel of Windows CE. The "Network" function allows entering the network data necessary for making the functions of the inverter available through LAN/Internet.
At the end, close the control panel with the X located in the upper right hand corner of the screen and then press "Start Application" to go back to the inverter display page.
 "Plant Controller" and "Master slave WEB" keys allows to enable and to configure respectively inverter remote control and a simple web server.

15.6.2 Datalogger

The screen allows entering the communication settings (email) for monitoring the inverter.

Datalog Configuration

From	datalog@fimer-solar.com	Fimer Guard
To	datalog@fimer-solar.com	
Smtp	smtp.fimer-solar.com	Auth
Format	CSV	Utc
System id		
User id		

☑ Enable
Test   Send   Exit
05/06/12 09:24:24
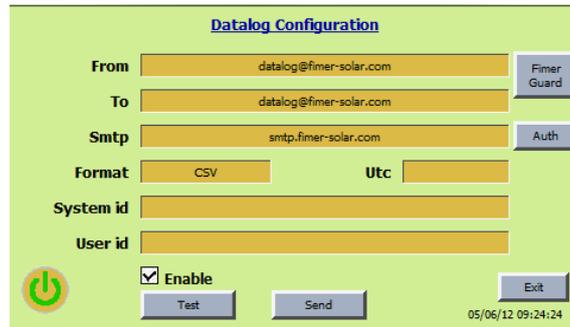
The "FIMERGuard" button allows automatically filling in the parameters to access FIMERGuard.
The "Test" button runs a test on the reachability of the server and the functioning of the USB flash driver that stores the monitoring data, two separate windows show the results of the test.
The "Send" button instantly sends the monitoring data.

15.6.3 Settings

Settings Configuration

pls/kWh	0	MPPT scan	30
time zone (Italy=+1)	2	auto update ☑ Update	
Alarm Temp	45	Forced Ventilation	75

Alarm disable

Inverter Reset   Exit
19/05/16 13:57:08
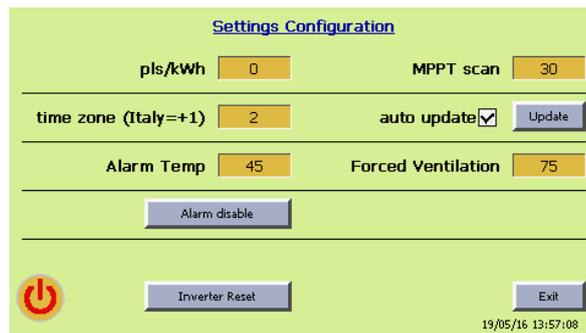
Impulses/kWh allows setting the parameter of an energy meter outside the inverter to be used both as an additional measurement available in the inverter, and as data supplied to the FIMERGuard monitoring system.

Alarm Temp temperature threshold above which a "High Temperature" warning is triggered.

Forced Ventilation sets the percentage rotation fan speed when an overheating stop occurs.

Time zone allows defining and setting the time zone. Press the box next to the words "Time zone" to close the application that manages the display for accessing the control panel of Windows CE. The time zone can be changed using the "Date/Time" function.
At the end, close the control panel with the X located in the upper right hand corner of the screen and then press "Start Application" to go back to the inverter display page.

Auto Update, if checked, the clock is updated automatically by the FIMERGuard server.

The "**Update**" button forces an immediate update of the clock.

15.6.4 Alarms

This page allows setting the alarm functions.

Alarm Configuration

Stop when Insulation Loss ☐		
User alarm 1	0	0 - None 1 - Alarm if closed 2 - Alarm if open 5 - Alarm if closed + stop 6 - Alarm if open + stop
User alarm 2	0	
Rele 1 logic	0	0 - Normal 1 - Inverted
Rele 2 logic	0	
Rele 3 logic	0	
Rele 4 logic	0	Exit

19/05/16 14:16:34

"Stop when Insulation Loss" flag allows to stop the inverter if a BESS Battery Rack insulation loss condition is detected.

Alarms 1/2 allow setting the logics associated with the user alarm contacts present on the interface expansion board.
If the alarm is enabled and present, it will also be forwarded to FIMERGuard.
If the function selected also includes the Stop action, the inverter will be stopped for as long as the alarm persists.

Relay logics 1/2/3/4 allow changing the normal open and closed condition of the relays that signal the operating states of the inverter (contacts present on CN1 and CN2 of the interface).

15.6.5 Alarm Send

Alarm Send Configuration

From	datalog@fimer-solar.com	Fimer Guard
To	datalog@fimer-solar.com	
Smtp	smtp.fimer-solar.com	Auth
Subject	Inverter name	

Test		Exit

05/06/12 09:29:06

The screen allows setting the parameters (email) for sending the alarm messages.
The "FIMERGuard" button allows automatically setting the values required to report the alarms to FIMERGuard.

This function can be used independently from the monitoring software by entering the parameters provided by your internet provider. If necessary, the "Subject" Battery Rack allows the immediate identification of the inverter if more than one is present.

Two emails will be sent for each alarm, one for the activation of the alarm (ON) and one at the end (OFF). The text message will contain the description of the alarm.
The subject of the email will be: Alarm <serial number> <Subject>

16. TURNING OFF

To turn off the inverter, press this button from any screen:
You will be prompted to confirm your intention to shutdown the machine.
To secure the apparatus, open both the IDC and IAC switches (Figure 4) and wait 10 minutes to allow all the capacities contained in the apparatus to be discharged.

17. DESCRIPTION OF THE MEASUREMENT SYSTEM

The DC side of the inverter is equipped with a measurement system and monitoring of the currents and voltage of parallel racks collected before inverter. Those physical quantities and full controls are available through ModBus[1].

The system is made by …
- **Mother Board** (451.191.187) – This is the main board: it contains a micro controller that manage the overall function of the measurement system, it acquires the racks current values and sent such data to the Inverter.

- …

Mother Board

This section contains a detailed description of the connectors, switches and LEDs of the Mother Board and can be used as reference for the other sections of this manual, please refer to figure 7.
It has to be specify that inverter schematics shall always considered as the main reference.

LEDs

The card has three LEDs which purpose is explained in the following:
- **RX (D1/Green)** –This LED mainly shows running state (slow blinking) and reception frames on ModBus communication port.
- **TX (D2/Green)** – This LED mainly shows transmission frames on ModBus communication port.
- **FAULT (D3/Red)** – The main purpose of this LED is to signal error conditions or bootloader activity with fast pulse (100 ms period).

Summary of LEDs behaviour and meanings:

	BOOTLOADER			
	No-app waiting	*Programming*	*Programming Error*	*Programming OK*
LED_RX	x	ON	Fast Blink	ON
LED_TX	x	x	x	ON
LED_ERR	Fast Blink	Fast Blink	Fast Blink	Fast Blink

	APPLICATION		
	Idle (OK)	*Idle (ERROR)*	*Idle (ALARM)*
LED_RX	Blink + Pulse on Rx	Blink + Pulse on Rx	Blink + Pulse on Rx
LED_TX	Pulse on Tx	Pulse on Tx	Pulse on Tx
LED_ERR	x	ON	Blink

3sec

---

[1] In current manual data communication with Modbus correspond to network serial line RS-485 whose transmission mode is RTU.

	APPLICATION		
	After restart key	*Success of ZERO or command/param. Set*	*Failure of ZERO or command/param. set*
LED_RX	x	ON	ON
LED_TX	x	ON	ON
LED_ERR	Fast Blink 2s	OFF	ON

3sec

When RED led is fast blinking the bootloader is active and meaning of two

Keys

There are three keys to perform the following operations:

- **RESTART (S3)** – Keep pressed for at least 3 sec. to perform a soft reset of board.
- **ZERO (S2)** – Keep pressed for at least 3 sec. to perform a zero calibration of current readings.
- **CFG (S1)** – Keep pressed for at least 3 sec. to execute the operation selected by MODE rotary switch.

Rotary switches

These switches are used to enter parameters or command; based on MODE the other rotary switches changes their meanings to allow setup of many parameters in a simple way.
There are four rotary switches:

- MODE (U22) – Selection of parameters or commends.
- SEL1 (U21) – Selection of data 1 of specified MODE.
- SEL2 (U20) – Selection of data 2 of specified MODE.
- SEL3 (U19) – Selection of data 3 of specified MODE.

Summary of rotary switches configurations, acquired after 3seconds of continuous press of CFG key. The response of settings will be confirmed by LEDs as described in before.

PARAMETERS			
	Set channel strings	*Set ModBus Address*	*Set ModBus Modes*
SEL_MODE	1	2	3
SEL_P1	Channel [1…8 : Set specific channel, 9 : Set all channels at same time]	ModBusID*100	ModBus Speed BAUD Rate [0 : 1200, 1 : 2400, 2 : 4800, 3 : 9600, 4 : 19200, 5 : 38400(default), 6 : 57600, 7 : 115200]
SEL_P2	N*10	ModBusID*10	ModBus Parity [0 : NONE, 1 : ODD, 2 : EVEN (default)]
SEL_P3	N	ModBusID	ModBus StopBits [0 : 1StopBit (default), 1 : 2StopBits]
	It is possible to setup current channels by specifying the numbers of stings connected. Maximum N is 32. If N=0 channel is disabled.	*It is possible to select a ModBus ID from 1 to 247, the default value is 1.*	

COMMANDS			
	Backup configuration on SD card	*Restore configuration from SD*	*Restore configuration and S/N from SD*
SEL_MODE	9	9	9
SEL_P1	0	0	0
SEL_P2	0	0	0
SEL_P3	0	1	2

	Save diagnostic log on SD	*Factory reset*
SEL_MODE	9	9
SEL_P1	1	1
SEL_P2	1	0
SEL_P3	0	0

SD-Card

The SD card slot allow the user to upgrade firmware, save&restore configuration and save diagnostic logs on a standard SD/SDHC card formatted with FAT16/32 filesystem.

Power Supply Connector J1

The connector J1 provides power supply to the Mother Board. The board provide two power inputs on this connector to allow supply redundancy. The pin 1 and the pin 3 are two inversion-protected inputs while the pin 2 and pin 4 are connected together to the negative terminal.
The input voltage should be 24V / 1A ?

Table 1 - Power connector J1

PIN	Description
1	Vin1 (+24V)
2	GND
3	Vin2 (+24V)
4	GND

Digital outputs connector J9

The pins 1/2 and 3/4 are isolated normally open (NO) contacts of two auxiliary relays.
These outputs actually has no logic but can be controlled via ModBus.

Table 2 – Digital outputs connector J9

PIN	Description
1	Output1 – N.O.
2	Output1 – COM
3	Output2 – N.O.
4	Output2 – COM

Digital inputs connector J8

The pins 1/2 and 3/4 are two dry contact inputs. To avoid hardware damage only an open collector output or dry contact to GND can be connected!!
ATTENTION: Inputs are NOT isolated from power supply, the GND signal is the same.
These inputs actually has no logic but their status can be read via ModBus.

Table 3 – Digital inputs connector J8

PIN	Description
1	Input1 – Dry contact
2	GND
3	Input2 – Dry contact
4	GND

Modbus Interface Connector J23/CN1

The connector J23 can be used to connect the motherboard to a Modbus bus. The pins 1 and 3 are associated respectively to the pins A+ and B- (inverting pin) of the RS-485 interface. The pin 4 is ground connection and can be used as common reference (COM). The pin 2 is connected to the pin

1 by mean of a 120 ohm resistor, this can be used to activate a bus termination. To do this the user must connect the pins 2 and 3 together, anyway be aware that the best solution is to place an external resistor as described in the section *"Creation of a MODBUS RTU network"* below.

The connectors CN1 can be used do chain multiple boards using a standard RJ45 ethernet cable.

Table 4 – ModBus connector J23

PIN	Description
1	A+
2	A+/120OHM
3	B-
4	COM_MC (ModBus+CAN common ground)

Table 5 - RJ45-8P8C ModBus connectors CN1 A&B

	Straight wire:	ModBus signals:
	1 - White/Orange	1 – n.c.
	2 - Orange	2 – n.c.
	3 - White/Green	3 – n.c.
	4 - Blue	4 – A+
	5 - White/Blue	5 – B-
	6 - Green	6 – n.c.
	7 - White/Brown	7 – COM_MC
	8 - Brown	8 – n.c.

CAN Interface Connector J24/CN2

The connector J24 can be used to connect the motherboard to a CAN bus. The pins 1 and 3 are associated respectively to the pins CAN-H and CAN-L. The pin 4 is ground connection and can be used as common reference (COM). The pin 2 is connected to the pin 1 by mean of a 120 ohm resistor, this can be used to activate a bus termination: to do this the user must connect the pins 2 and 3 together.
The connectors CN1 can be used do chain multiple boards using a standard RJ45 ethernet cable.

Table 6 – CAN connector J24

PIN	Description
1	CAN_H
2	CAN_H + 120OHM
3	CAN_L
4	COM_MC (ModBus+CAN common ground)

Table 7 - RJ45-8P8C ModBus connectors CN2 A&B

	Straight wire:	ModBus signals:
	1 - White/Orange	1 – CAN_H
	2 - Orange	2 – CAN_L
	3 - White/Green	3 – COM_MC
	4 - Blue	4 – n.c.
	5 - White/Blue	5 – n.c.
	6 - Green	6 – n.c.
	7 - White/Brown	7 – n.c.
	8 - Brown	8 – n.c.

Connector for PT100 probe J22

PT100 temperature sensor can be connected to the card by mean of connector J22, both two and four wires connection are supported. The pins 1 and 4 are respectively the positive terminal and negative terminals of the current source, pins 2 and 3 are the terminals of the voltage measurement circuit.

Table 8 – PT100 probe connector J22

PIN	Description
1	RED – Current I+
2	RED – Voltage V+
3	WHITE – Voltage V-
4	WHITE – Current I-

Voltage/Current Analog Inputs Connectors J19, J20 and J21

The pins 3 and 4 of these connectors are analog inputs, they are configurable either as voltage input (ranging from 0 up to 5 volt) or current (ranging from 4 up to 20mA). To select between the two kinds of input the U60 switches must be configured following this table:

Table 9 - U60 Dip Switch

U60 Dip Switch	1	2	3	4
ON	J19 to 4-20mA	J20 to 4-20mA	J21 to 4-20mA	Not used
OFF	J19 to 0-5V	J20 to 0-5V	J21 to 0-5V	Not used

Table 10 – 5V/4-20mA analog inputs J19, J20 and J21

PIN	Description
1	+24Vaux
2	+12Vaux
3	Analog input (0-5V or 4-20mA)
4	GND_AUX

Auxiliary power supply J18

External devices can be powered by QPPI (external condition cabinet) mainboard trough this connector. These outputs are protected and current limited.
ATTENTION: Shorting outputs together (for example +24Vaux with +5Vaux) can cause hardware damage!

Table 11 – Auxiliary power output connector J18

PIN	Description
1	+24Vaux (±10%, Imax=40mA)
2	+12Vaux (±10%, Imax=40mA)
3	+5Vaux (±10%, Imax=40mA)
4	GND_AUX

BESS-VDC bus voltage sense J25-J26

The DC voltage of parallel node is read by two faston connectors. The sensor is galvanically isolated and up to 1700V can be read.

Table 12 – BESS-VDC voltage sensing J25,J26

PIN	Description
J25	+V DC-Bus (Max.1700V)
J26	-V DC-Bus

BESS-I parallel current sensors J10, J11, J12, J13, J14, J15, J16, J17

In multichannel DC current acquisition, the measurement are acquired by using LEM current sensors powered by board. Standard sensors are 400A of nominal current but reading covers ±300A(±3V) range to optimize sensivity.

Table 13 – BESS-I parallel current sensors J10 …to… J17

PIN	Description
1	+15V
2	-15V
3	Current reading analog input (±3V)
4	GND (same as power supply GND)

18. Maintenance

Replacement of machine parts is not expected for at least 10 years.

During this time, annual routine maintenance should be performed by checking the proper functioning and cleaning the apparatus, particularly the air inlets.

This maintenance interval is sufficient for a machine installed in a clean environment with a pollution degree not exceeding 2.

Operation in dusty or dirty environments may require more frequent maintenance.

The apparatus must not operate in humid environments with a saline, abrasive or explosive atmosphere.

After 10 years, extraordinary maintenance may be necessary with relative shutdown of the system for replacing some parts.

19. MECHANICAL DIMENSIONS

For the S9900TL inverter the max mechanical dimensions are as follow described:

S9900TL
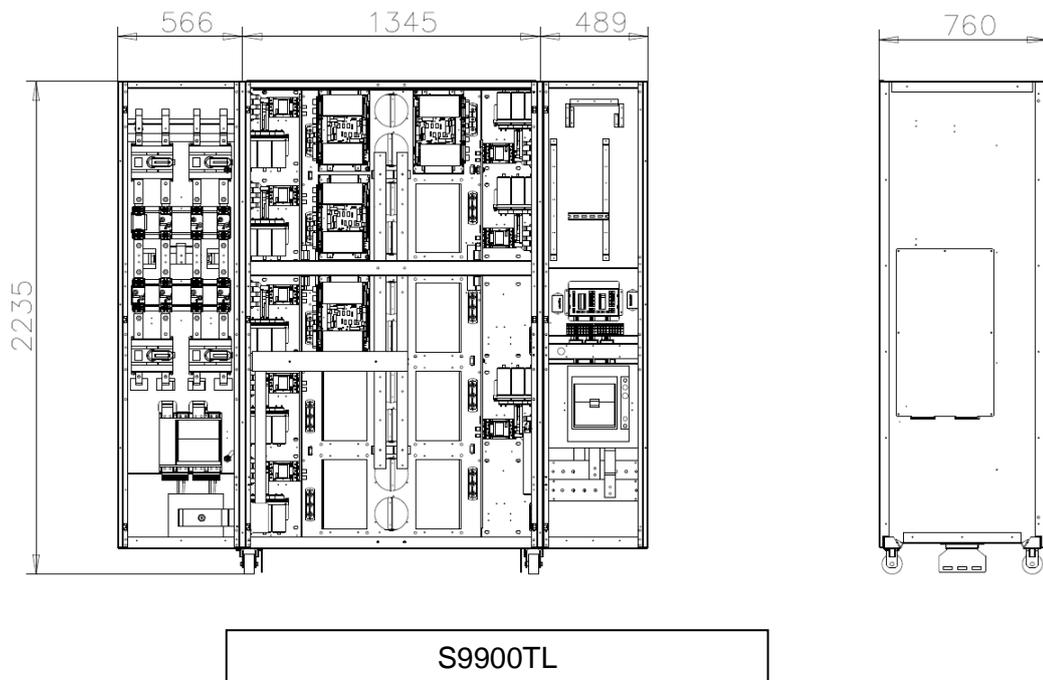
If the inverter is installed in a prefabricated cabinet (shelter-type), it is recommended to mechanically secure the inverters to the supporting structure. This can be done with the fastening screws of the eyebolts and the metal brackets.

20. MACHINE CONNECTIONS

The following figure shows the positions of the circuit breakers and / or switches both DC side and AC side. The customer does not occur to wire directly the cable on these switches, but on the copper bars which have up to four fixing holes. For the connection of both DC and AC cables use cable and the appropriate terminals (M12 terminal type) , for the ground wire cable use an appropriate terminals (M8 terminal type); these cables should be fixed with nut spring washer using split to ensure a seal and secure it to the appropriate hole provided on the earth bar

The following pictures describes the connection for all inverters because the connecting column is always the same:
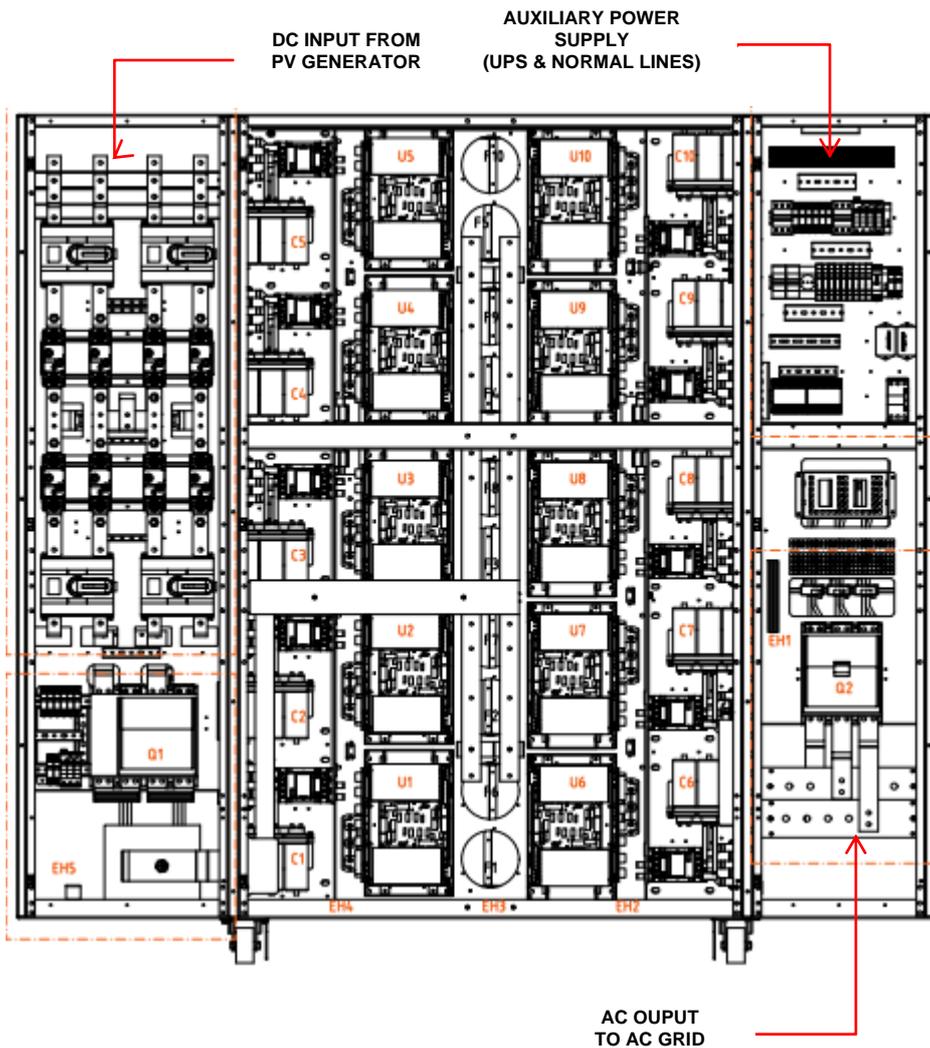
20. COOLING AIR FLOW AND CIRCULATION

In all FIMER central inverters without transformer for connection to MV grid, the fresh air enters the inverter through the slits on the front doors of the equipment, the hot air exits through the vents instead of the rear wall of the inverter.

The air flow rate required to ensure the proper functioning of the inverter is indicated in the technical data of the individual converters (see Chapter 5 of this manual) and on the basis of these values it is therefore necessary that the air get in and get out in the room where the inverter is housed through the appropriate air inlet grille in order to meet the specifications of the inverter and ensure the proper operation of the machines; the air flow into the inverter is ensured by the presence of internal fans that work regulated in temperature, therefore the control electronics of the inverter increases the speed the fan in a manner directly proportional to the temperature measured inside the converter and the funs push the air from the front toward the rear of the inverter itself.

Hot Air Output

Side air fresh air Input*

Front side fresh air Input
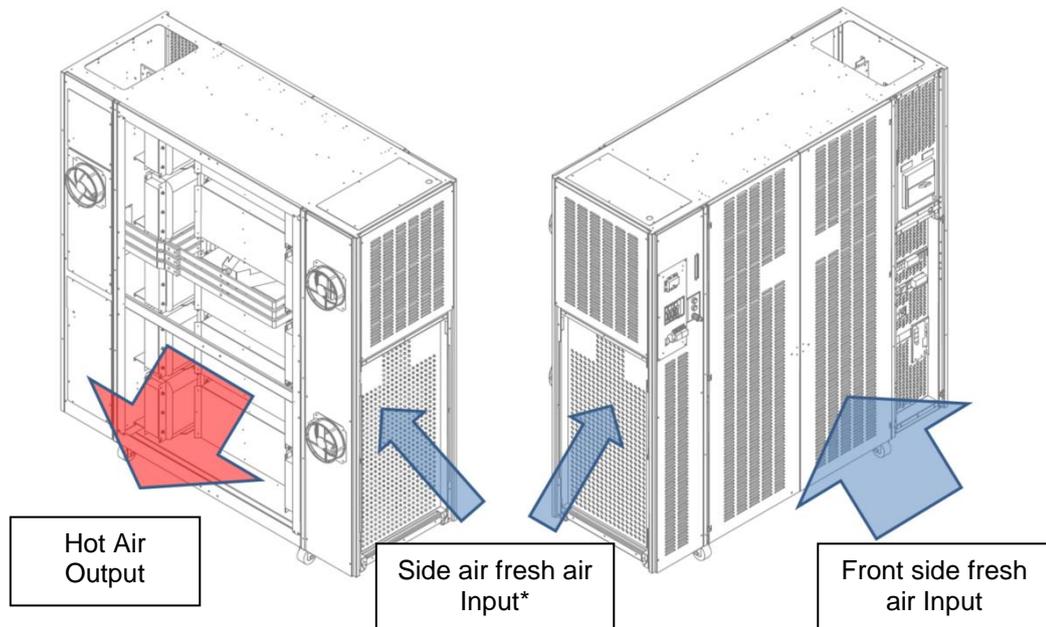
Front side air inlet and back air exhaust represent the standard configuration while side air inlet is available when more than 4 DC battery racks are connect.

Based on the cooling air tour and on the cooling air flow described above it reiterates the need to ensure the distance from the ceiling and the wall of the room where the inverter is positioned as shown in Section 11.3 of this manual.

You may, however, subject to authorization by the inverter manufacturer and appropriate study by BESS plant project engineer, provide for exceptions to the distances given in Section 11.3 through the implementation of appropriate passages or separation walls which prevent mixing the hot air and cold air and avoid the return of the hot air at the front of the inverter.

Only by operating in the manner just described and ensuring an air flow rate corresponding to the inverter in question it is able to ensure the perfect separation of the zone of fresh air from that for the hot air and the proper operation of the equipment.

ANNEX 1: Technical specifications of the AC and DC surge arresters

SPD on DC side

Type 2 surge arrester - VAL-MS 1000DC-PV/2+V-FM - 2800627

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Surge arrester for 2-pos. isolated 1000 V DC voltage systems, for DIN rail mounting, 3-pos. base element with remote indication contact, three plug-in temperature-monitored protective elements, status message on each plug.

Your advantages

- ☑ Increased safety, thanks to compliance with standard EN 50539-11
- ☑ Reliable contact, thanks to integrated rotating latch
- ☑ Easy replacement, thanks to plug-in arresters
- ☑ Optimum inverter protection, thanks to low protection level
- ☑ Efficient replacement of defective plugs, thanks to visual status indicator
- ☑ Optimized maintenance planning, thanks to remote signaling
- ☑ Protection against mismatching, thanks to keyed plugs and base elements
- ☑ Always the right arrester, thanks to universal type 1/type 2 protective components

Key Commercial Data

Packing unit	1 pc
GTIN	
GTIN	4046356615075
Weight per Piece (excluding packing)	360.000 g
Custom tariff number	85363030
Country of origin	Germany

Technical data

Dimensions

Height	98.7 mm
Width	53.4 mm

Type 2 surge arrester - VAL-MS 1000DC-PV/2+V-FM - 2800627

Technical data

Dimensions

Depth	65.7 mm (incl. DIN rail 7.5 mm)
Horizontal pitch	3 Div.

Ambient conditions

Degree of protection	IP20 (only when all terminal points are used)
Ambient temperature (operation)	-40 °C ... 80 °C
Ambient temperature (storage/transport)	-40 °C ... 80 °C
Altitude	≤ 2000 m (amsl (above mean sea level))
Permissible humidity (operation)	5 % ... 95 %
Shock (operation)	60g (Half-sine / 11 ms / 3x ±X, ±Y, ±Z)
Vibration (operation)	7.5g (5-500 Hz/2.5 h/XYZ)

General

IEC test classification	PV II
	PV T2
EN type	T2
SPD failure behavior	OCM (Open-circuit mode)
Connection configuration	Y configuration
Installation location	Interior
Accessibility	Accessible
Installation location of the disconnect device	Internal
Mode of protection	(L+) - (L-)
	(L+) - PE
	(L-) - PE
Mounting type	DIN rail: 35 mm
Color	jet black RAL 9005
Housing material	PA 6.6-FR
	PBT-FR
Degree of pollution	2
Distance between live and grounded parts	8 mm
Flammability rating according to UL 94	V-0
Type	DIN rail module, two-section, divisible
Surge protection fault message	Optical, remote indicator contact

Additional descriptions

Note	The device is intended for touch proof installation in a housing. Ensure that there is a gap of at least 8 mm between the active and grounded parts in the connection area.

Type 2 surge arrester - VAL-MS 1000DC-PV/2+V-FM - 2800627

Technical data

Connection data

	4.5 Nm (25 mm² ... 35 mm²)
Stripping length	16 mm
Conductor cross section flexible	1.5 mm² ... 25 mm²
Conductor cross section solid	1.5 mm² ... 35 mm²
Conductor cross section AWG	15 ... 2
Connection method	Fork-type cable lug
Conductor cross section flexible	1.5 mm² ... 16 mm²

UL specifications

SPD Type	1CA
Maximum continuous operating voltage MCOV	1170 V DC
Nominal voltage	1170 V DC
Mode of protection	(L+) - (L-)
	(L+) - G
	(L-) - G
Power distribution system	DC PV
Voltage protection rating VPR	3 kV
Nominal discharge current I_n	10 kA
Short-circuit current rating (SCCR)	50 kA

UL indicator/remote signaling

Operating voltage	125 V AC
Operating current	1 A AC
Tightening torque	4 lb$_f$-in.
Conductor cross section AWG	30 ... 14

UL connection data

Conductor cross section AWG	10 ... 2
Tightening torque	30 lb$_f$-in.

Standards and Regulations

Standards/regulations	EN 50539-11 2013

Environmental Product Compliance

REACh SVHC	Lead 7439-92-1
China RoHS	Environmentally friendly use period: unlimited = EFUP-e
	No hazardous substances above threshold values

Type 2 surge arrester - VAL-MS 1000DC-PV/2+V-FM - 2800627

Dimensional drawing
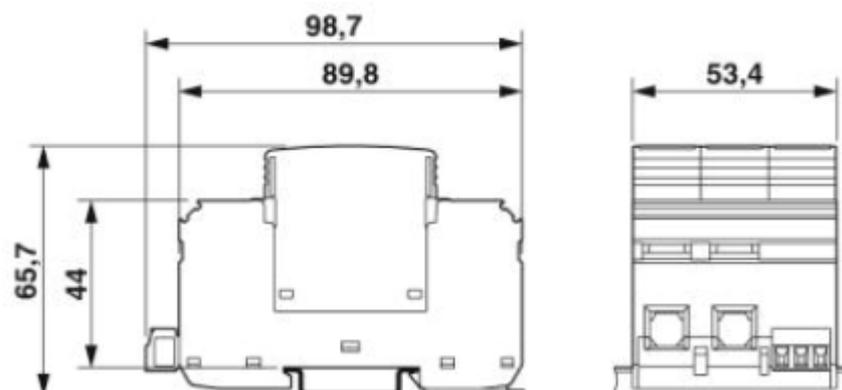
SPD on AC side

Lightning/surge arrester type 1/2 - VAL-MS-T1/T2 335/12.5/3+0-FM - 2800188

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Universal varistor-based plug-in lightning/surge arrester for 3-phase power supply networks with common N and PE (4-conductor system: L1, L2, L3, PEN), with remote indication contact.

Your advantages

- ☑ Plugs can be checked with CHECKMASTER
- ☑ With floating remote indication contact
- ☑ Secure hold of plugs in the event of high lightning current loads and strong vibrations thanks to new latching
- ☑ Mechanical coding of all slots
- ☑ Pluggable
- ☑ Thermal disconnect device for each individual plug

Key Commercial Data

Packing unit	1 pc
GTIN	
GTIN	4046356518598
Weight per Piece (excluding packing)	526.000 g
Custom tariff number	85363030

Technical data

Dimensions

Height	98.7 mm
Width	53.4 mm
Depth	77.5 mm (incl. DIN rail 7.5 mm)
Horizontal pitch	3 Div.

Ambient conditions

Degree of protection	IP20 (only when all terminal points are used)

Lightning/surge arrester type 1/2 - VAL-MS-T1/T2 335/12.5/3+0-FM - 2800188

Technical data

Ambient conditions

Ambient temperature (operation)	-40 °C ... 80 °C
Ambient temperature (storage/transport)	-40 °C ... 80 °C
Altitude	≤ 2000 m (amsl (above mean sea level))
Permissible humidity (operation)	5 % ... 95 %
Shock (operation)	30g (Half-sine / 11 ms / 3x ±X, ±Y, ±Z)
Vibration (operation)	7.5g (10 ... 500 Hz / 2.5 h / X, Y, Z)

General

IEC test classification	I / II
	I
	T1 / T2
	T1
EN type	T1 / T2
	T1
IEC power supply system	TN-C
Mode of protection	L-PEN
Mounting type	DIN rail: 35 mm
Color	jet black RAL 9005
Housing material	PA 6.6
	PBT
Degree of pollution	2
Flammability rating according to UL 94	V-0
Type	DIN rail module, two-section, divisible
Number of positions	3
Surge protection fault message	Optical, remote indicator contact

Protective circuit

Nominal voltage U_N	240/415 V AC (TN-C)
Nominal frequency f_N	50 Hz (60 Hz)
Maximum continuous voltage U_C	335 V AC
Rated load current I_L	80 A
Residual current I_{PE}	≤ 2400 µA
Standby power consumption P_C	≤ 810 mVA
Nominal discharge current I_n (8/20) µs	12.5 kA
Maximum discharge current I_{max} (8/20) µs	50 kA
Impulse discharge current (10/350) µs, charge	6.25 As
Impulse discharge current (10/350) µs, specific energy	39 kJ/Ω
Impulse discharge current (10/350) µs, peak value I_{imp}	12.5 kA
Total discharge current I_{total} (8/20) µs	150 kA
Total discharge current I_{total} (10/350) µs	37.5 kA

Lightning/surge arrester type 1/2 - VAL-MS-T1/T2 335/12.5/3+0-FM - 2800188

Technical data

Protective circuit

Short-circuit current rating I_{SCCR}	25 kA
Voltage protection level U_p	≤ 1.2 kV
	≤ 1.6 kV (30 kA - 8/20 µs)
Residual voltage U_{res}	≤ 1.2 kV (at I_n)
	≤ 1.1 kV (at 10 kA)
	≤ 1 kV (at 5 kA)
	≤ 0.9 kV (at 3 kA)
TOV behavior at U_T	415 V AC (5 s / withstand mode)
	457 V AC (120 min / safe failure mode)
Response time t_A	≤ 25 ns
Max. backup fuse with V-type through wiring	80 A (gG - 16 mm²)
Max. backup fuse with branch wiring	160 A (gG)

Indicator/remote signaling

Switching function	PDT contact
Operating voltage	5 V AC ... 250 V AC
	30 V DC
Operating current	5 mA AC ... 1.5 A AC
	1 A DC
Connection method	Plug-in/screw connection via COMBICON
Screw thread	M2
Tightening torque	0.25 Nm
Stripping length	7 mm
Conductor cross section flexible	0.14 mm² ... 1.5 mm²
Conductor cross section solid	0.14 mm² ... 1.5 mm²
Conductor cross section AWG	28 ... 16

Connection data

Connection method	Screw connection
Screw thread	M5
Tightening torque	3 Nm (1,5 mm² ... 16 mm²)
	4.5 Nm (25 mm² ... 35 mm²)
Stripping length	16 mm
Conductor cross section flexible	1.5 mm² ... 25 mm²
Conductor cross section solid	1.5 mm² ... 35 mm²
Conductor cross section AWG	15 ... 2
Connection method	Fork-type cable lug
Conductor cross section flexible	1.5 mm² ... 16 mm²

UL specifications

SPD Type	4CA

Lightning/surge arrester type 1/2 - VAL-MS-T1/T2 335/12.5/3+0-FM - 2800188

Technical data

UL specifications

Maximum continuous operating voltage MCOV (L-L)	335 V AC
Maximum continuous operating voltage MCOV (L-G)	335 V AC
Nom. voltage	240 V AC
Mode of protection	L-L
	L-G
Power distribution system	Delta
Nominal frequency	50/60 Hz
Measured limiting voltage MLV (L-L)	3570 V
Measured limiting voltage MLV (L-G)	2630 V
Nominal discharge current I_n (L-L)	20 kA
Nominal discharge current I_n (L-G)	20 kA

UL indicator/remote signaling

Operating voltage	125 V AC
Operating current	1 A AC
Tightening torque	4 lb-in.
Conductor cross section AWG	30 ... 14

UL connection data

Conductor cross section AWG	10 ... 2
Tightening torque	30 lb-in.

Standards and Regulations

Standards/regulations	IEC 61643-11 2011
	EN 61643-11 2012

Environmental Product Compliance

REACh SVHC	Lead 7439-92-1
China RoHS	Environmentally Friendly Use Period = 50
	For details about hazardous substances go to tab "Downloads", Category "Manufacturer's declaration"

Dimensional drawing
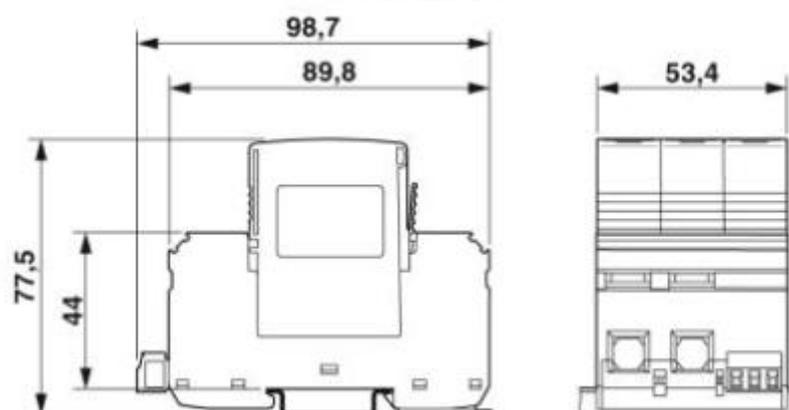
Approvals

cUL Recognized		http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm	FILE E 330181
IECEE CB Scheme		http://www.iecee.org/	AT 2584
ÖVE		https://www.ove.at/zertifizierung-pz/zertifizierungsregister/	18583-009-06
EAC			EAC-Zulassung
EAC			RU C-DE.A*30.B01561
cULus Recognized			

ANNES 2: Notes on the design and dimensioning of MV / LV transformers.

Please note that using central inverters FIMER TL - series without transformer is necessary to use MV / LV transformers with multiple secondary connections (LV) to link to connect separately each of these inverters TL - series without transformer.

Must always be present the screen between the MV winding of and that / those LV widdings

It requires that the secondary windings (LV connections) are not overlapping each other:

Construction suggested:
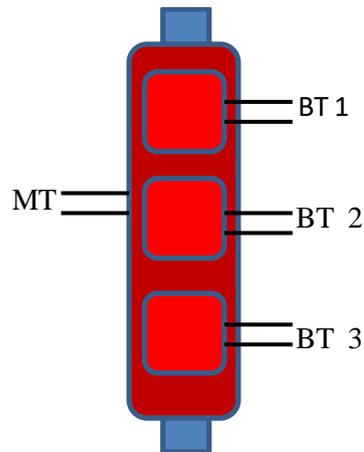
ANNEX 3: Preventive and periodic maintenance of central inverters

FIMER recommend to their customers to comply with a correct and constant preventive maintenance of storage inverters, so that we can maximize the reliability of service and minimize repair costs not included.

Through proper preventive maintenance, the availability of storage inverters has lengthened the life cycle.

Preventive maintenance

Preventive maintenance if has not been delegated to a separate and appropriate maintenance contract with the inverter manufacturer is usually borne by the client, to whom are entrusted all the operations of periodic verification. By qualified service personnel may be carried out of the routine operations that can assess the state of the drive, with a frequency of intervention that varies according to the environmental conditions in which the drive is installed. In Italy an average of two visits per year of preventive maintenance are recommended, including the controls of all the parts that make up the system including any replacement of consumables.

As regards the inverter Centralized FIMER, preventive maintenance includes the following procedures:

- Visual inspection of the inverter.
- Cleaning of the external structure with a focus on air path.
- Cleaning inside the inverter to remove dust, pollen and all kinds of dirt introduced in the equipment and that could damage the electronic cards or disrupt the operation of the fans.
- Verification of the working temperature of the converter in order to assess the proper ventilation of the room in which you installed the converter.
- Check suitability of the premises (excluding water infiltration, pollen or rodents).
- Check the safety devices of the converter.
- Check the connections are tightened to exclude loose wires that could cause overheating.
- Control any water infiltration or condensation.

At each periodic maintenance is recommended to simulate the separation of the mains supply: inverter / inverters must / will instantly shut down, up again after the return of the network signal.

It is recommended to perform the inspection and maintenance only by personnel trained or qualified.

We remind all operators authorized to carry out maintenance that before entering the converter be sure to be aware of the safety regulations specified in manual and control all of the personal protective equipment required by the manufacturer

	When installing or servicing the drive in a yard with suspended materials handling wear helmet.
	Wear appropriate protective gloves before working on the drive.
	Wear appropriate shoes that can prevent accident to guard against falling heavy objects.
	In the event of prolonged exposure to noise wear hearing protection devices.
	Be careful! Before performing any maintenance, disconnect the inverter from the grid line and from the BESS Battery Rack.
	Be careful! Wear protective eye when performing any type of maintenance.

OPERATION		DESCRIPTION	RESULT AND SIGNATURE	
			POSITIVE	NEGATIVE
		"Operations of periodic inspection of central inverter"		
1	Ambient condition	Verify that the general conditions of the environment are specified by the manufacturer to ensure the perfect and continuous operation of the drive.		
2	General condition of the inverter	Check the external condition of the inverter: cleaning, damage to the "case" and that the general conditions of maintenance are good.		
3	Air flow	Check the operation and efficiency of the ventilation device (test of the thermostat). Check that the inlet fresh air and hot air exhaust are not blocked.		
4	Condition of filter for ventilation	Check the status of any filters installed on the ventilation unit of the drive or the room where it is installed.		
5	Infiltration	Check for any signs of infiltration of liquid in the area around or on the converter and in the case restore the isolation of the local as soon as possible.		
6	Manumission	Verify that there are no signs of tampering or theft to the converter, so that they may have changed the specifications.		
7	**Display**	**Check the operation of Display: Status pixels, color and operation of the software of the inverter.**		
		WARNING! To continue to inspect the inverter you should be qualified and licensed by FIMER S.p.A. **Isolate the inverter from the grid and from the BESS battery rack by opening the VDC and VAC switch or breakers contained in the inverter cabinet.** **Wait 20min before entering any maintenance in the cabinet top. It is necessary to wait for the discharging of the capacitors before doing any other type of operation. In the form of precaution also open the switches on the DC side of the 2 ° Parallel Panel**		
8	DC Switch	Check the tightness of power connections and the isolation of individual connections.		
9	Sourge Protection Device	Check the integrity of the AC and DC side surge, visually checking the appropriate warning.		
10	Fuse	Check the integrity and the perfect condition of the fuses.		
11	AC Switch	Check the tightness of power connections and the isolation of individual connections of the AC main switch and of all the contactors inside the inverter.		
12	Electronic cards	Check the connection status of each board by disconnecting and reconnecting the Bus, Flat and connectors.		
13	Inverter	Visual inspection of the inverter and their ventilation if possible GENTLY blow with compressed air to clean dust from heat sinks, fans and inverter (before blowing ensure that there is no moisture in the air line of the compressor).		
		Reconnect the drive to the grid and to the Storage Battery Rack to continue the testing procedure. Tests to follow can only be made under the presence of sunlight and electric grid.		

14	**Functional test of modules and electronic cards**	Turning ON the power of the inverter in manual mode at minimum power allowed by the size of the inverter installed. Verify that all fans, modules and electronic boards work properly without working alarm display and LED on the board.		
15	**Restoration**	Turn off the inverter and close the front panels		
16	**Operating test of the inverter**	Start up the inverter in automatic mode.		

Sorage Inverter

BESS Inverter datasheet Year_____ SN MEGASTATION _____ datasheet consecutive no. _____ ** BESS inverter: (Routine maintenance requires to put the system out of service and will only concern the parts of the plant directly served by them)**					
N.B. Refer to the manufacturers' datasheets, if existing or available. Operations are performed after visual and / or instrumental inspection.		**Maximum frequency**	**Performed on**	**Signature**	**Measures taken or suggested**
1	**INVERTER** – Checks / interventions: Check the external part of the inverter: cleanliness, any damage to the case, and good conditions of maintenance	**Yearly**			
2	**INVERTER** – Checks / interventions: Check plate data	**Yearly**			
3	**INVERTER** – Checks / interventions: Check the operation and efficiency of the ventilation device by performing functional tests and reading temperature on the display. Check that the fresh air inlet and hot air exhaust are not blocked	**Yearly**			
4	**INVERTER** – Checks / interventions: Check for signs of infiltration of liquids or condensation in or around the inverter and restore room insulation as necessary as soon as possible; prevent pollen or rodent infiltration	**Yearly**			
5	**INVERTER** – Checks / interventions: Verify that there are no signs of tampering or damage on the inverter, which may have altered the technical specifications	**Yearly**			
6	**INVERTER** – Checks / interventions: Clean the inside of the inverter to remove traces of dust, pollen and all kinds of dirt introduced in the equipment and that may damage electronic boards or disrupt the operation of the fans	**Yearly**			
7	**INVERTER** – Checks / interventions: Check the inverter safety devices	**Yearly**			
8	**INVERTER** – Checks / interventions: Check the tightness of power connections and the isolation of individual connections	**Yearly**			
9	**INVERTER** – Checks / interventions: Check the integrity of the existing arresters by visually checking the appropriate indicator	**Yearly**			
10	**INVERTER** – Checks / interventions: Check the integrity and perfect condition of fuses	**Yearly**			
11	**INVERTER** – Checks / interventions: Check the operation of the display: state of pixels, colour and operation of inverter management software	**Yearly**			
12	**INVERTER** – Checks / interventions: Check the connections of circuit breakers and contactors of individual modules and the perfect isolation of each connection	**Yearly**			
13	**INVERTER** – Checks / interventions: Check the connection status of each board by checking the correct fastening of the cable connectors and Flat cables	**Yearly**			
14	**INVERTER** – Checks / interventions: Visual inspection of the inverters and their ventilation: if possible GENTLY blow with compressed air to remove dust from heat sinks, fans, and power modules (before blowing make sure that there is no condensation in the air line of the compressor)	**Yearly**			
15					
NOTES:					**Maintenance technician signature**

ANNEX 4: Troubleshooting

	ALARM CODE	DESCRIPTION	POSSIBLE SOLUTION
1	AD Trim Zero KO	Trouble in the reading of tension	Check all the wires connections on the electronic cards of the modules. It the problems persist contact the FIMER Service.
2	Alim KO 24V	No 24Vdc from the DC pack	Check the status of the auxiliary switches VAUX(they must to be closed) or the presence of the auxiliary line supplied from the auxiliary transformer ***
3	User alarm 1	Programmable input alarm: it informs about a fault coming from an external device	Check the status of the device connected at the input or the connection with the expansion electronic card.
4	User alarm 2	Programmable input alarm: it informs about a fault coming from an external device	Check the status of the device connected at the input or the connection with the expansion electronic card.
5	Reserved	-	-
6	Dangerous current	Dangerous current measured at DC side	One of the strings has reached a dangerous value of current. Check the string currents values for identify which is the one with the over current problem.
7	No calibration	Missing motherboard calibration	Contact the FIMER Service
8	No configuration	Missing motherboard configuration	Contact the FIMER Service
9	EPO - emergency	Alarm Emergency Power Off : contact CN3 open (emergency shoot down)	If connected with the inverter verify the Emergency Power Off otherwise check the bridge on the connection CN3 of the inverter
10	Ventilator module xxx (fan)	Alarm of the ventilator: the fan doesn't work or the motherboard's input is broken and it can be driven..	Control the status of the fan: with module in running the fan must be in activity

	ALARM CODE	DESCRIPTION	POSSIBLE SOLUTION
11	Tension close to the limit	The tension relieved is close to the limit set	Check the values the three phases: if they are close to the limit also when the inverter is off it must to control the transformer, if the phases values are close to the limit only when the inverter is running, please contact the FIMER service
12	Service degraded	A module has not activated after at least three tries. The module has been disengaged	If the problem persist contact the FIMER service
13	DC lost of insulation	Lost of insulation has been felt from the inverter. The "grounding kit" fuse is burned because a current over his limit.	Control the grounding kit fuse and replace it in case the it is burned. In case the new fuse burn just after the new replacement, contact the FIMER service.
14	Modxxx AD Auto Zero KO	The module motherboard has a problem in the zeroing of the parameters	Check all the wires connections on the electronic cards of the modules. It the problems persist contact the FIMER Service.
15	Modxxx Alim KO 24V	No 24Vdc from the module DC pack	Check the status of the auxiliary switches VAUX(they must to be closed) or the presence of the auxiliary line supplied from the auxiliary transformer ***
16	Modxxx Condensator KO	The module motherboard has received a wrong tension value	Check all the wires connections on the electronic cards of the modules. It the problems persist contact the FIMER Service.
17	Modxx no calibration	Trouble with the module motherboard calibration	Contact the FIMER Service
18	Modxxx Assenza configurazione	No configuration of the modules	Contact the FIMER Service
19	Modxxx Eeprom Fault	Troubles with the motherboard Eprom	Contact the FIMER Service
20	Modxxx Overcurrent R	Over current in the first phase	Check the connections of the automatic breaker of the module in error but only in order to inform the FIMER service on his general statement. If everything it's fine restart the inverter for a second try, it could be possible that the overcurrent has been felt from the inverter for a temporary peak. If the problem will repeat inform the FIMER service

ALARM CODE		DESCRIPTION	POSSIBLE SOLUTION
21	Modxxx Overcurrent S	Over current in the second phase	Check the connections of the automatic breaker of the module in error but only in order to inform the FIMER service on his general statement. If everything it's fine restart the inverter for a second try, it could be possible that the overcurrent has been felt from the inverter for a temporary peak. If the problem will repeat inform the FIMER service
22	Modxxx Overcurrent T	Over current in the third phase	Check the connections of the automatic breaker of the module in error but only in order to inform the FIMER service on his general statement. If everything it's fine restart the inverter for a second try, it could be possible that the overcurrent has been felt from the inverter for a temporary peak. If the problem will repeat inform the FIMER service
23	Modxxx Overtemperature Mag1	Over temperature of the magnetic (transformer - only if the inverter is equipped with it)	Check the connection named "J17" on the module motherboard (not present on the inverter S9900TL or however in to the inverters transformerless). If the cable coming from the temperature sensor (the red one) that is fitted in the magnetic is well connected, the problem could be of overtemperature. Contact the service FIMER
24	Modxxx Overtemperature Mag2	Over temperature of the magnetic (inductance)	Check the connection named "J16" on the module motherboard. If the cable coming from the temperature sensor (the grey one) that is fitted in the magnetic inductor is well connected, the problem could be of overtemperature. Contact the service FIMER
25	Modxxx Overtension RS	Over tension measured between phases RS	Verify the value of the three phases: it must be around 550Vac. In case the values of the phases are fine, check the connections of the automatic breaker of the module in error but only in order to inform the FIMER service on his general statement. If everything it's fine restart the inverter for a second try, it could be possible that the overtension has been felt from the inverter for a temporary peak. If the problem will repeat inform the FIMER service

ALARM CODE		DESCRIPTION	POSSIBLE SOLUTION
26	Modxxx Overtension ST	Over tension measured between phases ST	Verify the value of the three phases: it must be around 550Vac. In case the values of the phases are fine, check the connections of the automatic breaker of the module in error but only in order to inform the FIMER service on his general statement. If everything it's fine restart the inverter for a second try, it could be possible that the overtension has been felt from the inverter for a temporary peak. If the problem will repeat inform the FIMER service
27	Modxxx Overtension TR	Over tension measured between phases TR	Verify the value of the three phases: it must be around 550Vac. In case the values of the phases are fine, check the connections of the automatic breaker of the module in error but only in order to inform the FIMER service on his general statement. If everything it's fine restart the inverter for a second try, it could be possible that the overtension has been felt from the inverter for a temporary peak. If the problem will repeat inform the FIMER service
28	Modxxx Overtension UDC	Over tension in the continue tension DC	Check the value of the tension VDC and if this is in the normal range (around 850-1320 Vdc) try a restart of the inverter. In case the alarm will happen again contact the FIMER service.
29	Modxxx Power OFF KO	Troubles in the driving of DC pack of the module	Verify the presence of the auxiliary line and/or the working of the DC pack of the module: in case both are ok, contact the FIMER service
30	Modxxx Rampa KO	The module cannot finish the start procedure: problem in the reading of values	Check all the wires connections on the electronic cards of the modules. It the problems persist after a restart, contact the FIMER Service.
31	Modxxx IGBT KO	The module doesn't start because problem in the IGBT drivers: general alarm	Check all the wires connections on the electronic cards of the modules. It the problems persist after a restart, contact the FIMER Service.
32	Modxxx lost of synchronism	Problem of connection between the Supervisor and the module motherboard	Check the connection between the modules electric card and the supervisor, the cable of which verify the connection is the flat one multicolour. If after the verify the problem persist, contact the FIMER service.

ALARM CODE		DESCRIPTION	POSSIBLE SOLUTION
33	Modxxx Over temperature	Limit temperature of the module	The IGBT module has reach the limit of temperature. Try a restart but if the problem persist, contact the FIMER service.
34	Modxxx undertension RS	Under tension measured between phases RS	Verify the value of the three phases: it must be around 550Vac. In case the values of the phases are fine, check the connections of the automatic breaker of the module in error but only in order to inform the FIMER service on his general statement. If everything it's fine restart the inverter for a second try, it could be possible that the undertension has been felt from the inverter for a temporary peak. If the problem will repeat inform the FIMER service
35	Modxxx under tension ST	Under tension measured between phases ST	Verify the value of the three phases: it must be around 550Vac. In case the values of the phases are fine, check the connections of the automatic breaker of the module in error but only in order to inform the FIMER service on his general statement. If everything it's fine restart the inverter for a second try, it could be possible that the undertension has been felt from the inverter for a temporary peak. If the problem will repeat inform the FIMER service
36	Modxxx under tension TR	Under tension measured between phases TR	Verify the value of the three phases: it must be around 550Vac. In case the values of the phases are fine, check the connections of the automatic breaker of the module in error but only in order to inform the FIMER service on his general statement. If everything it's fine restart the inverter for a second try, it could be possible that the undertension has been felt from the inverter for a temporary peak. If the problem will repeat inform the FIMER service

Encodings reporting related to individual modules can be generated with different numbers to depending on the module on which the anomaly was detected. In case of warning with red symbol and acoustic alarm that is not possible to recognize (as described in the instructions for use), please contact the Service FIMER.

ANNEX 5: Norms and requirement for connecting the inverter to the national grid and parameter setting

This Appendix in object is intended to illustrate to a skilled person, in the possession of a request of the grid distributor, how to implement the requested services.

For a description of the meaning of the parameters and modes of operation, please refer to the official documentation valid for the market where the inverter has to be installed

(e.g. VDE-AR-N-4105:2011-08 for German market; CEI-021 and CEI016 for Italian Market, "Norma tehnică "Condiţii tehnice de racordare la reţelele electrice de interes public pentru centralele electrice fotovoltaice" din 17.05.2013" for the Romanian market).

Parameter Setting

From the main page of the display of the inverter select the menu (Button) "Configuration" and then "Connection standard"
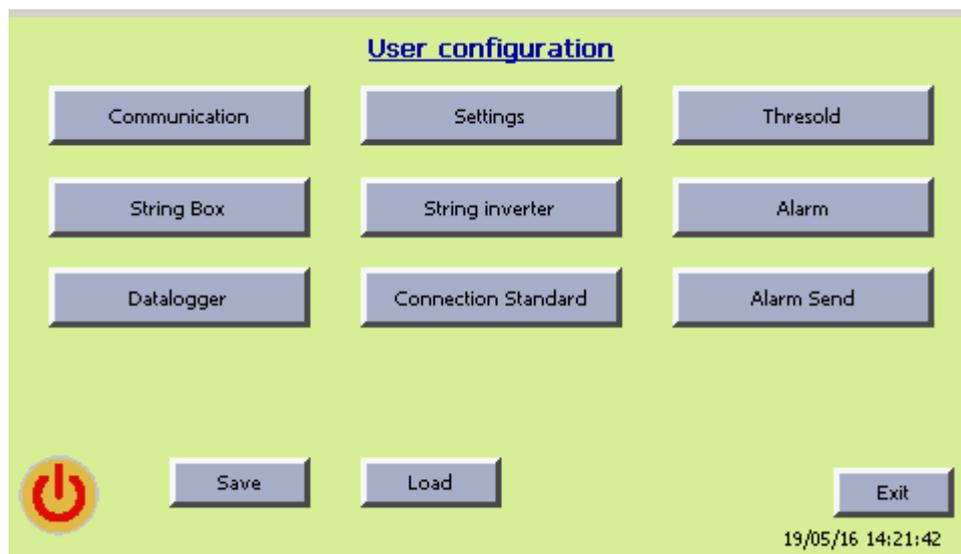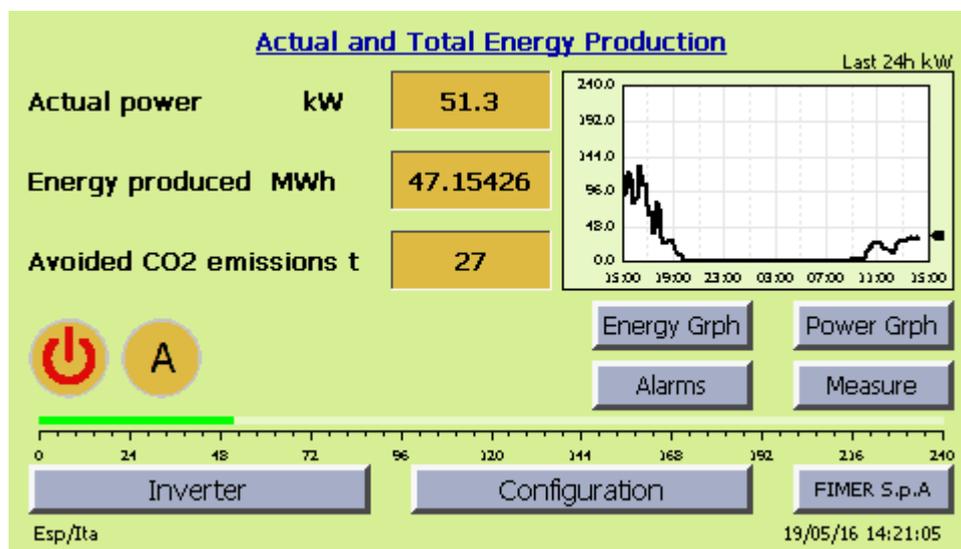
On the screen it will appear the page where are resumed all the different setting related to the grid services:
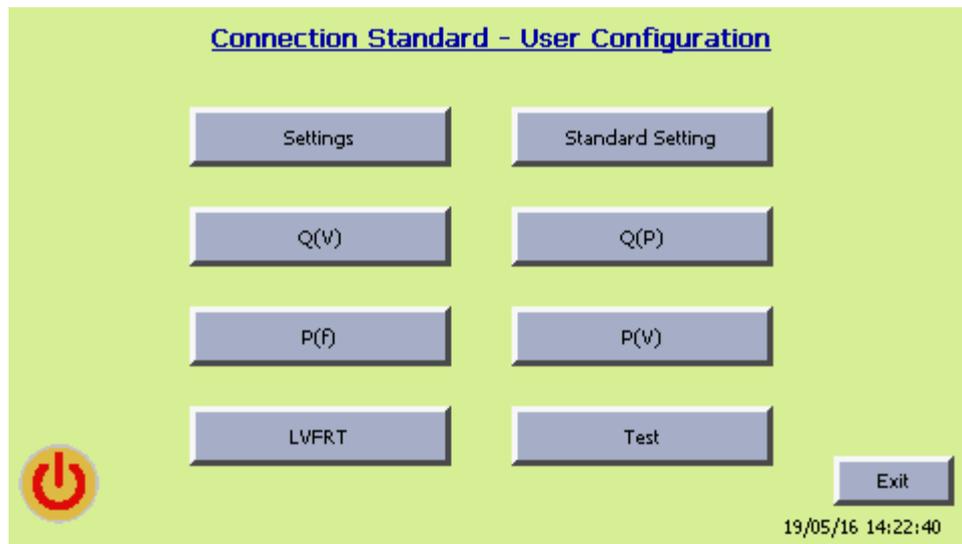
Into the page "Connection standard – Standard Setting" is possible to automatically set the default values valid for the different country where the inverter will be installed.
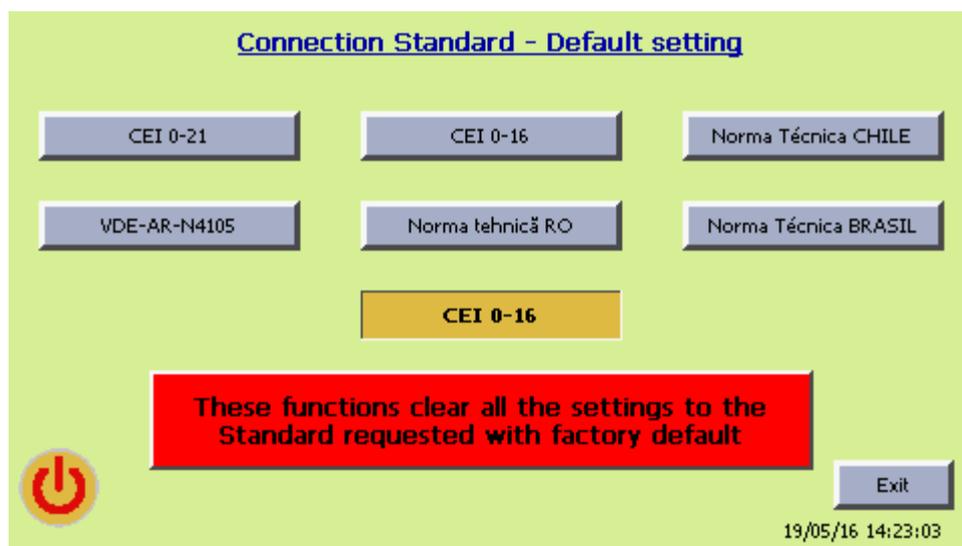
Centralized control of the operation of the inverter

The inverter provides some parameters inside the MODBus protocol available via an RS485 port on the user interface card of the inverter. If a different connection mode (e.g. IEC 61850) will be required by the local distributor then it is under the responsibility of the installer to provide a gateway appropriately configured to perform the functionality in object. Remote commands must be periodically refreshed, because no commands or requests will be rescue permanently in the internal memory of the BESS converter (after the shut down or reset of the inverter the default value are upload in the memory and logic of the converter).

Limit of the power in the centralized logic

The default value of the parameter, whose type is a 32-bit floating point, is -1(no limit) and is readable and writable.
The value equal to 100 corresponds to 100% of Pn.
Modbus address of the parameter is 35

Trigger for setting the curve Q(V) in centralized logic

The default value of the parameter, whose type is an unsigned integer, is 0 and is readable and writable.
A value set to "1" enables the programmed feature.
Modbus address of the parameter is 40

Reactive power requirement in centralized logic

The default value of the parameter, whose type is a 32-bit floating point, is 0 and is readable and writable.
The value is expressed in kVAR and follows the "usual" convention (positive values correspond to a capacitive current injected into the grid by the inverter; the grid consider the inverter like an inductor from its point of view).
Modbus address of the parameter is 33

Control in local logic

Setting of the connecting parameter

The inverter must monitor the quality of the grid for the time indicated in the proper setting label before connecting; just after the connection it needs to deliver power with the gradient shown

Configuration Settings

Nominal Voltage	260.00 Vn		☐ Y (star)
Frequency shift	0.00 Hz/s		
Nominal Power: Pn (kW)	216	216 Sn (kVA)	
Connection Pwr Gradient	20 %Pn/min		☐ Always Active
Maximum/minimum waiting	60	30 s	☐ Also Manual
Voltage limits	85	110 %Vn	
Frequency limits	49.9	50.1 Hz	
P over Q priority ☐	Q(x)	6 Minimum Modules	
Capacitive = +Q (gen.) ☐	Qinc	2592 kVAr/min	
PLim Ramp Up/Dw rate	0	0 kW/min	Exit

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Limit of the feed-in power according to the grid frequency P(f)

This service is related to the stability of the frequency of the grid.

P(f) Configuration

Pfm, delay	1 1.000 ms	Pfw1	49.900 Hz
Pfh1	50.300 Hz	Pfw2	50.100 Hz
Pfh2	51.500 Hz	Pft	300 s
Pfl	47.500 Hz	Pfp1	20 %Pimax/min
Pfstat	2.40 %	Pfp2	5 %Pn/min

Exit

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Function	Parametar		Default	Unit	min	Max	Step
P(f)	Pfm	Mode: 0 disabled 1 enabled 2 VDE: it doesn't record them minimum value	0				
	Delay	Delay at start	0	msec	0	1000	50
	Pfh1	First threshold	50.3	Hz			0.005
	Pfh2	Second threshold	51.5	Hz			0.005
	Pfl		47.5	Hz			0.005
	Pfstat	Statism	2.4		2	5	0.005
	Pfw1	Back window value	49.95	Hz			0.005
	Pfw2	Back window value	50.05	Hz			0.005
	Pft	Waiting time in window	300	s			1
	Pfp1	Ramp: % of P before	20	%/min			0.005
	Pfp2	Rampa min: % of max	5	%/min			0.005
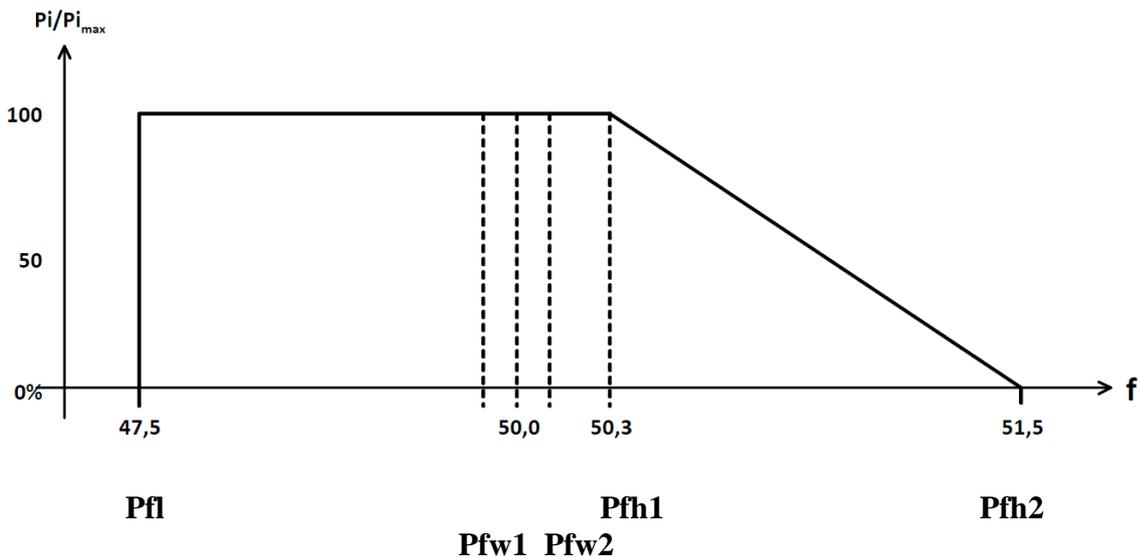
Warning: The parameters Pfh1, Pfh2 and Pfstat are related to each other. Changing Pfh1 or Pfh2 involves an automatic update of Pfstat. The value of Pfstat is not editable, but related to the slope of the curve between Pfh1 and Pfh2.

Generation of reactive power according to the grid voltage Q(V)

This service is related to the stability of the voltage of the grid.

Function	Parametar		Default	Unit	min	Max	Step
Q(V)	QVm	Mode: 0 disabled 1 lock-in - curve A 2 lock-in - curve B	0				
	Delay	Delay at start	3000	msec	0	30000	1000
	QVmin	Limit inferior then QV1i and QV2i	90	% V/Vn	0	100	0.005
	QVmax	Limit superior then QV1s and QV2s	110	% V/Vn	100	0	0.005
	QV1s			% V/Vn	100	QV2s	0.005
	QV2s			% V/Vn	QV1s	QVmax	0.005
	QV1i			% V/Vn	QV2i	100	0.005
	QV2i			% V/Vn	QVmin	QV1i	0.005
	QVlk-in		20	% P/Pn	10	100	0.005
	QVlk-out		5	% P/Pn		QVlk-in	0.005
	QVp1	Qmax		%Q/Pn		0.48	
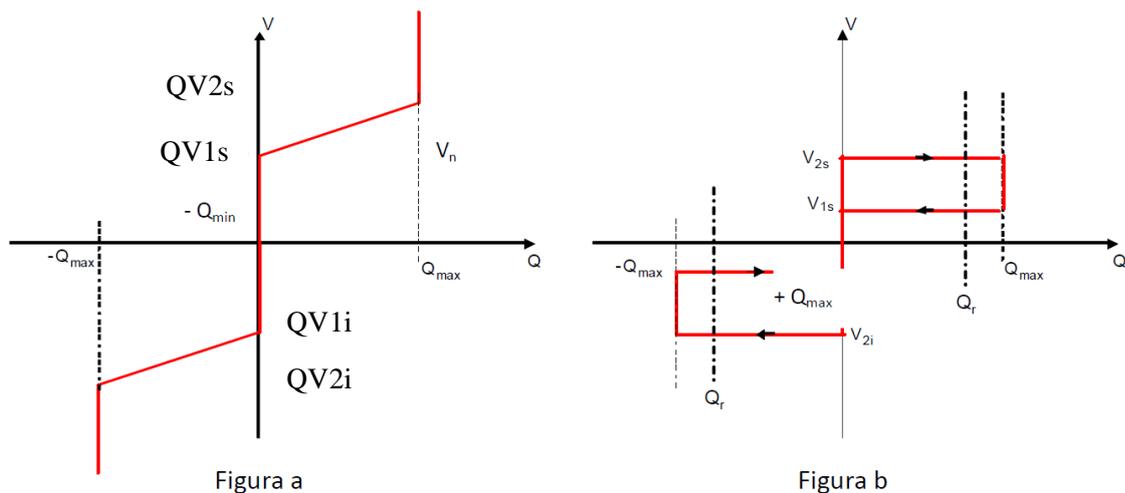
Figura a

Figura b

Generation of reactive power according to the grid power Q(P)

This service is related to the stability of the voltage of the grid.

Function	Parametar		Default	Unit	min	Max	Step
Q(P)	QPm	Mode: 0 disabled 1 fixed rectangular 2 fixed triangular 3 (command) rectangular 4 (command) triangular 5 lock-in - curve A 6 lock-in - curve B	0				
	QPp1	cosϕ reactive triangular	1		-0.86	0.86	0.005
	QPp2	Reactive fixed rectangular	0	% Q/Pn	0	48	0.005
	QPa		20	% P/Pn			0.005
	QPb		50	% P/Pn			0.005
	QPc		100	% P/Pn			0.005
	QPd		5	% P/Pn			0.005
	QPlk-in		110	% V/Vn	100	110	0.005
	QPlk-out		98	% V/Vn	90	100	0.005

The "command" is described in the Trigger activation curve Q (V) in centralized logic.
The parameter QPp1 refers to the mode 2, 4, 5 and 6, the parameter QPp2 refers to modes 1 and 3. The other parameters are related to modes 5 and 6.
The parameters QPlk QPlk-in and-out can be set equal to disable the function of lock-in/out as required by VDE norm.
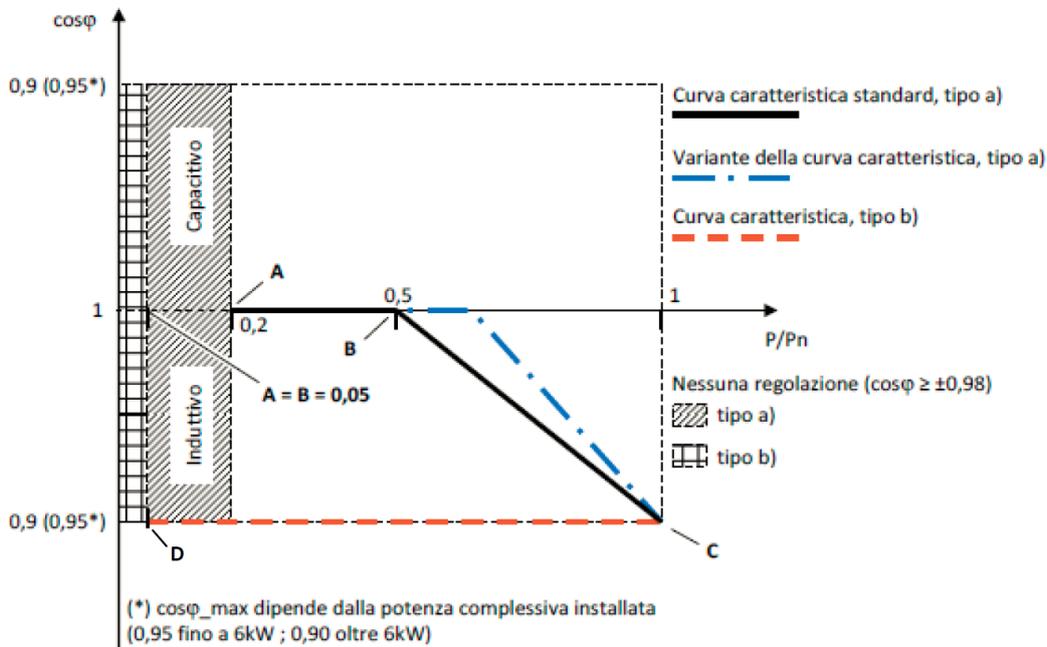
Reaction to the LVFRT fault of the grid

Un-affection to the grid power fault

Function	Parametar		Default	Unit	min	Max	Step
LVFRT	Lm	Mode: 0 disabled 1 active	0				
	Lv1	Too much lower threshold	40	%			0.005
	Lv2	Low threshold	85	%			0.005
	Lv3	High threshold	110	%			0.005
	Lt1	Max time under the too much lower threshold	200	ms			1
	Lt2	Max time under the low threshold	400	ms			1

Curve valid according to CEI 0-21
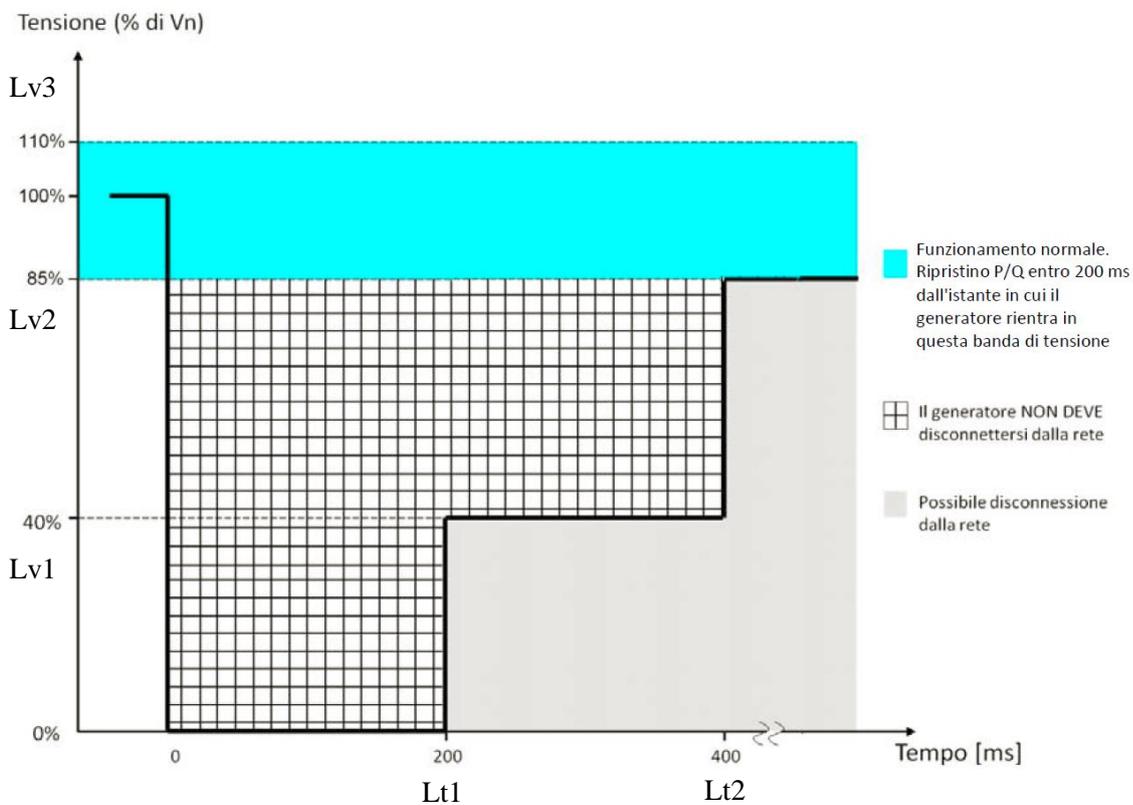
Curve valid according to CEI 0-16, VDE-AR-N-4105, Romanian Norm
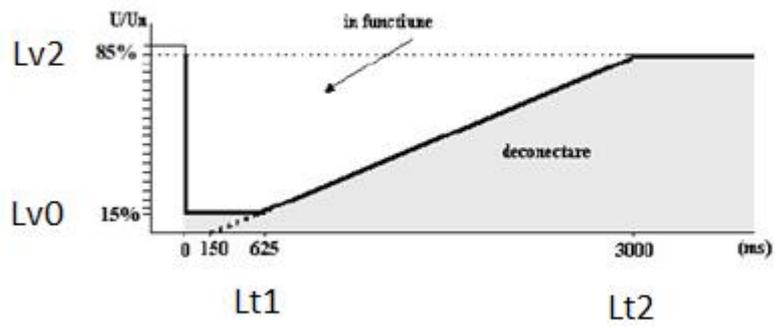
If the Romanian rule is set into inverter parameter, when you return to the area under the curve (gray area) the inverter will disconnect itself from the grid

FIMER

Inverter for Life

Via J.F. Kennedy
20871 Vimercate (MB) Italy
Phone: +39 039 98981
Fax +39 039 6079334

www.fimer.com
solar@fimer.com

INFOLINE
Tel. +39-039-6079326