



Leading Conversion Technology for Power Resilience

BRAVO ST - 120 VAC - UL

User Manual V7.2

BEYOND THE INVERTER

THE NEW GENERATION OF POWER CONVERTERS

- **DUAL INPUT INVERTER**
Commercial Power as default source
- **AC BACKUP IN A DC ENVIRONMENT**
Leverage your existing DC infrastructure
- **ONE STOP SHOP**
Wide output power range
- **HARSHEST AC INPUT CONDITIONS**
Without compromising the quality of the AC output



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Belgium, China, India, Luxembourg, Malaysia, Russia, United Kingdom, United States, Australia & Germany

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Release Note:

Version	Release date (DD/MM/YYYY)	Modified page number	Modifications
7.0	16/12/2015	-	First release of the Manual.
7.1	11/11/2016	-	Amendment and correction.
7.2	05/06/2020	-	New layout

1. CE+T at a glance

CE+T Power designs, manufactures and markets a range of products for industrial operators with mission critical applications, who are not satisfied with existing AC backup systems performances, and related maintenance costs.

Our product is an innovative AC backup solution that unlike most used UPS's

- Maximizes the operator's applications uptime;
- Operates with lowest OPEX;
- Provides best protection to power disturbances;
- Optimizes footprint.

Our systems are:

- Modular
- Truly redundant
- Highly efficient
- Maintenance free
- Battery friendly

CE+T power puts 60+ years expertise in power conversion together with worldwide presence to provide customized solutions and extended service 24/7 - 365 days per year.

2. Abbreviations

TSI	Twin Sine Innovation
EPC	Enhanced Power Conversion
REG	Regular
DSP	Digital Signal Processor
AC	Alternating current
DC	Direct current
ESD	Electro Static Discharge
MET	Main Earth Terminal
MBP	Manual By-pass
TCP/IP	Transmission Control Protocol/Internet Protocol
USB	Universal Serial Bus
PE	Protective Earth (also called Main Protective Conductor)
N	Neutral
PCB	Printed Circuit Board
TRS	True Redundant Structure
MCB	Miniature Circuit Breaker
MCCB	Molded Case Circuit Breaker
CB	Circuit Breaker
G	Ground / Grounding
UA	Urgent Alarm
NUA	Non-Urgent Alarm

3. Warranty and Safety Conditions*

WARNING:

The electronics in the power supply system are designed for an indoor, clean environment.

When installed in a dusty and/or corrosive environment, outdoor or indoor, it is important to:

- Install an appropriate filter on the enclosure door, or on the room's air conditioning system.
- Keep the enclosure door closed during operation.
- Replace the filters on a regular basis.

Important Safety Instructions and Save These Instructions.

3.1 Disclaimer

- The manufacturer declines all responsibilities if equipment is not installed, used or operated according to the instructions herein by skilled technicians according to local regulations.
- Warranty does not apply if the product is not installed, used and handled according to the instructions in the manuals.

3.2 Technical care

- This electric equipment can only be repaired or maintained by a “qualified employee” with adequate training. Even personnel who are in charge of simple repairs or maintenance are required to have knowledge or experience related to electrical maintenance.
- Please follow the procedures contained in this Manual, and note all the “DANGER”, “WARNING” AND “NOTICE” marks contained in this manual. Warning labels must not be removed.
- Qualified employees are trained to recognize and avoid any dangers that might be present when working on or near exposed electrical parts.
- Qualified employees should know how to lock out and tag out machines, so the machines will not accidentally be turned on and injure employees working on them.
- Qualified employees also understand safety related work practices, including those by OSHA and NFPA, as well as knowing what personal protective equipment should be worn.
- All operators are to be trained to perform the emergency shut-down procedure.
- Maximum operating ambient temperature for 48 VDC is 40°C (104° F) and for 110 VDC is 50° C (122° F).
- This unit is intended for installation in a temperature-regulated, indoor area that is relatively free of conductive contaminants.
- Never wear metallic objects such as rings, watches, or bracelets during installation, service or maintenance of the product.
- This product is suitable for use in a computer room.
- **CAUTION** – Risk of electric shock. Capacitors store hazardous energy. Do not remove cover until 5 minutes after disconnecting all sources of supply.

* These instructions are valid for most CE+T Products/Systems. Some points might however not be valid for the product described in this manual

- **CAUTION** – Risk of electric shock. This Inverter / UPS receives power from more than one source. Disconnection of the AC source and DC source is required to de-energize this unit before servicing.
- **CAUTION** - For continued protection against risk of fire, replace only with same type and rating of fuse.
- Insulated tools must be used at all times when working with live systems.
- When handling the system/units pay attention to sharp edges.

3.3 Installation

- This product is intended to be installed only in a restricted access area as defined by UL 60950 and in accordance with the National Electrical Code ANSI/NFPA 70, or equivalent local agencies.
- The Inverter System may contain output over-current protection in the form of circuit breakers. In addition to these circuit breakers, the user must observe the recommended UL listed upstream and downstream circuit breaker requirements as defined in this manual.
- UL listed (DIVQ) branch overcurrent protections have to be provided by others / by customer.
- Please use extreme caution when accessing circuits that may be at hazardous voltages or energy levels.
- The inverter rack is a dual input power supply. The complete system shall be wired in a way that both input and output leads can be made power free in a single action.
- REG systems can be seen as independent power sources. To comply with local and international safety standards N (output) and PE shall be bonded.
- EPC system that have no AC input wired and connected to comply with local and international safety standards N (output) and PE shall be bonded. The bonded between N output and L must be removed once the AC input is being connected.
- When AC Mains is not connected, the output AC circuit is considered as a separately-derived source. If local codes require grounding of this circuit, use the identified terminal for bonding this circuit to the enclosure. Ground the enclosure to a suitable grounding electrode in accordance with local code requirements. Ground the enclosure to the electrode terminal (see section 8.3.4, page 21).
- Remove output neutral-to-ground jumper when input AC MAINS is connected (see section 8.3.5, page 22).
- Use 90°C copper wires / conductors only.
- AC and DC circuits shall be terminated with no voltage / power applied.
- The safety standard IEC/EN62040-1-1 requires that, in the event of an output short circuit, the inverter must disconnect in 5 seconds. The parameter can be adjusted on T2S; however, if the parameter is set at a value > 5 seconds, an external protection must be provided so that the short circuit protection operates within 5 seconds. Default setting is 60 seconds.
- All illustrations in the manual are for general reference, refer to the technical drawing which is received along with the system for exact information.

3.3.1 Handling

- The cabinet shall not be lifted using lifting eyes.
- Remove weight from the cabinet by unplugging the inverters. Mark inverters clearly with shelf and position for correct rebuild. This is especially important in dual or three phase configurations.
- Empty inverter positions must not be left open. Replace with module or dummy cover.

3.3.2 Surge and transients

The mains (AC) supply of the modular inverter system shall be fitted with Lightning surge suppression and Transient voltage surge suppression suitable for the application at hand. Manufacturer's recommendations of installation shall be adhered to. Selecting a device with an alarm relay for function failure is advised.

Indoor sites are considered to have a working lightning surge suppression device in service.

- Indoor sites Min Class II.
- Outdoor sites Min Class I + Class II or combined Class I+II.

Note:

Choosing and installing surge arrestors must obey to precise technical rules. Distance to equipment to protect, cable gage and cable routing have significant influence on proper device service.

Some areas are more susceptible to be hit by electrical strikes, especially when altitude increases.

Good earthing is also crucial for surge arrestors to work properly.

CE+T declines any liability in regard to damaged caused to equipment not correctly or not sufficiently protected.

3.3.3 Other

- Isolation test (Hi-Pot) must not be performed without instructions from the manufacturer.

3.4 Maintenance

- The inverter system/rack can reach hazardous leakage currents. Earthing must be carried out prior to energizing the system. Earthing shall be made according to local regulations.
- Prior to any work conducted to a system/unit, make sure that AC input voltage and DC input voltage are disconnected.
- Prior to accessing the system or modules, make sure all source of supply is disconnected.
CAUTION – Risk of electric shock. Capacitors store hazardous energy. Do not remove cover until 5 minutes after disconnecting all sources of supply.
- Some components and terminals carry high voltage during operation. Contact may result in fatal injury.

3.5 Replacement and Dismantling

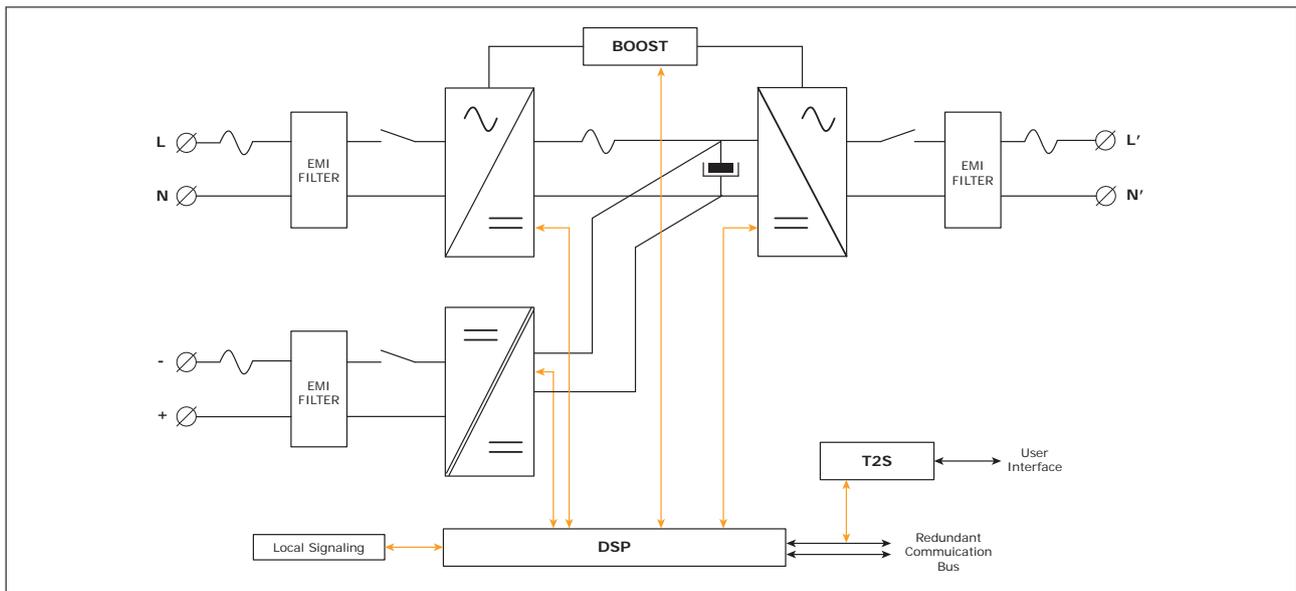
- ESD Strap must be worn when handling PCB's and open units.
- The inverter system/rack is not supplied with internal disconnect devices on input nor output
- CE+T cannot be held responsible for disposal of the Inverter system and therefore the customer must segregate and dispose of the materials which are potentially harmful to the environment, in accordance with the local regulations in force in the country of installation.
- If the equipment is dismantled to dispose of its component products, you must comply with the local regulations in force in the country of destination and in any case avoid causing any kind of pollution.

To download the latest documentation and software, please visit our website at www.cet-power.com.

4. TSI TECHNOLOGY ¹

Inverter modules carrying the TSI logo and the EPC mark are triple port converters (AC in, DC in, AC out). Sinusoidal output is converted from Mains or/and DC.

The following block diagram gives an explicit description of the topology and operation.



The module is built around the following sub-converters

- AC to DC at input
- DC to DC at input
- DC to AC at output

The energy can flow either from the AC source or the DC source under the control of the local DSP controller. Thanks to internal energy buffering, the output sine wave is constant and disturbance free regardless of the active source.

The BOOST functionality multiplies the nominal current for a period of 20 ms (max) in the event of down stream current surge. The upstream breakers do not have to be oversized to prevent tripping. After the boost has been activated or if the AC input is not present the overload capacity is 150% for 15 seconds regardless of the source currently used.

The TSI works according to True Redundant Structure (TRS) that features decentralized and independent logic, redundant communication bus and three internal levels of disconnection to isolate a module after internal failure.

This functionality is included in every inverter module. Running them in parallel provides a modular system with, no single point of failure, always conditioned output, high system efficiency and 0ms source transfer time.

¹ Information and data given in this chapter is intended to serve as an overview of the TSI Technology. Detailed features and parameters for each individual module type in the range may differ and should be referred to in the dedicated data sheet.

4.1 EPC Mode

- Mains input (AC) is the primary source whilst DC works as backup.
- The TSI is designed to operate on Mains on a permanent basis and to deliver output voltage conditioned with low THD.
- The output sine wave is physically independent of whether the source is AC (or) DC. If the Mains is out of tolerance or goes down, the converter seamlessly switches to DC and the converter operates in “Back-up mode” (Changeover switching time is 0 ms).
- As soon as the Mains returns to its valid range, the EPC mode is automatically resumed.
- The EPC mode offers higher efficiency (up to 96% depending on the model) without compromising the purity of the output sine wave.

4.2 On-line Mode

- DC is the primary source of supply whilst Mains (AC) works as the secondary source. Switching time between DC input and AC input is 0ms (source transfer).
- The power delivered by the DC source (usually a battery, but possibly any other type of DC generator) is converted to provide regulated and transient-free power to the load.
- In the event of a short circuit on the load side, the boost is automatic, timely and energized for a specific duration to trip downstream protective devices.

4.3 Safe Mode

- Safe mode uses DC as the primary source of supply while Mains (AC) is on standby.
- Mains (AC) is normally disconnected through an internal inlet relay and is only connected when downstream clearance is required (boost) or if DC is unavailable.
- The transfer between DC and AC results in a typical transfer time of 10 ms.
- Typically the safe mode is used in extremely harsh environments such as railways. Under such conditions, it provides extra isolation against mains-borne disturbances.

4.4 Mix Mode & Walk-in-Mode

- Under some circumstances the DC and AC sources can be combined. The sequence is defined by a user selectable set of parameters. Start, control and exit are fully automatic.
- A specific example of Mix-mode is the Walk-in mode where the transfer from DC source to AC source is ramped up within a fixed and adjustable period of time.
- Setting for Walk-in Mode and Mix-Mode can be made through the T2S supervisor configuration file. See Section 10, page 28 for more information on T2S supervisor.

Note: REG modules:

Inverter modules carrying the TSI logo together with the REG mark work only with DC input. Sinusoidal output is converted from DC with the module operating as a traditional inverter. EPC mode and the boost are not available with REG modules.

5. Description

Bravo ST has been designed to give quality power, ease of use, and reliability. It provides up to 4000 watts (Bravo ST 5 KVA) or up to 2000 watts (Bravo ST 2.5 KVA).

In normal operation:

- AC input present the TSI module will operate in EPC mode.
- AC input fail the TSI module will switch to DC (battery) and continue to feed the load.
- DC input fail the system operate on AC input.

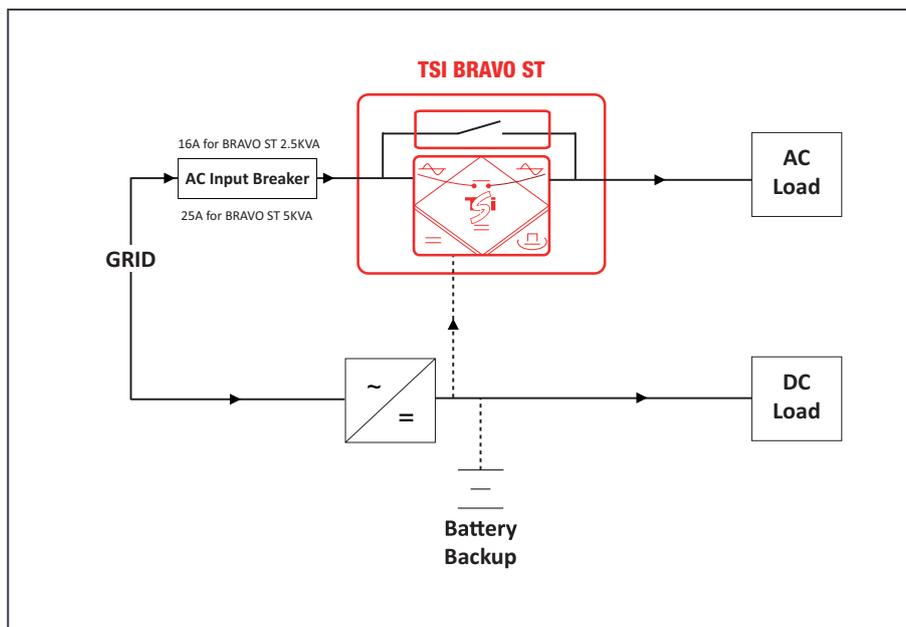
TSI module fail (N+1):

- If N+1 configuration selected the second module will continue to feed the load.
- If the second module fail the system will switch to AC through the automatic by pass to allow module replacement.

TSI module fail (N no redundancy):

- If one module fail the BRAVO ST will switch to AC through the automatic by pass to allow module replacement.

All part of the BRAVO ST (Inverter modules and by pass module) are hot swappable without shut down of the AC output.



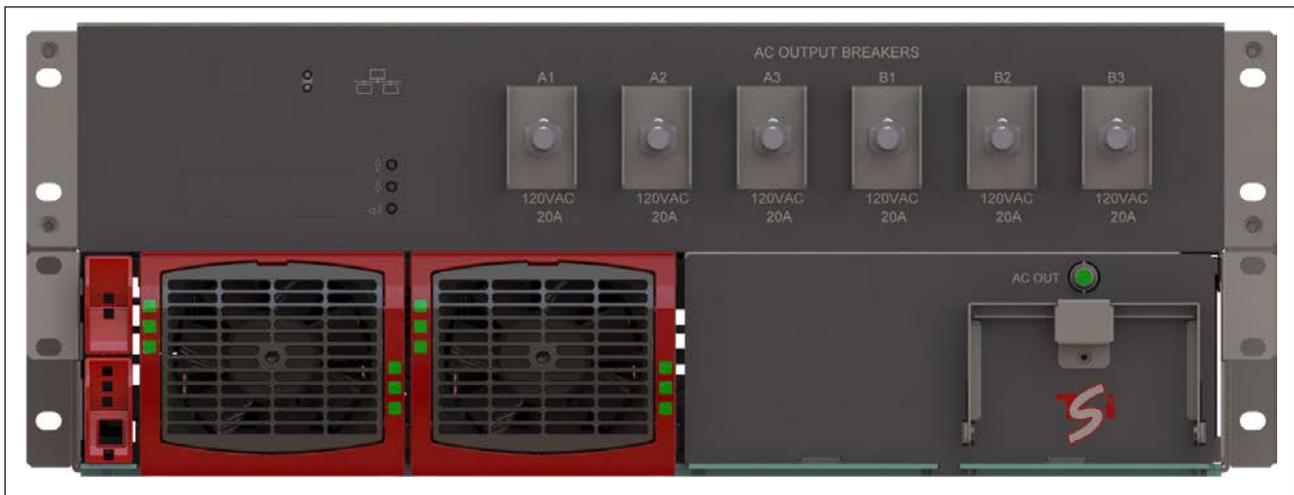
Warning:

If all modules fails and AC input not present, the system will stop to prevent “backfeed” protection upstream.

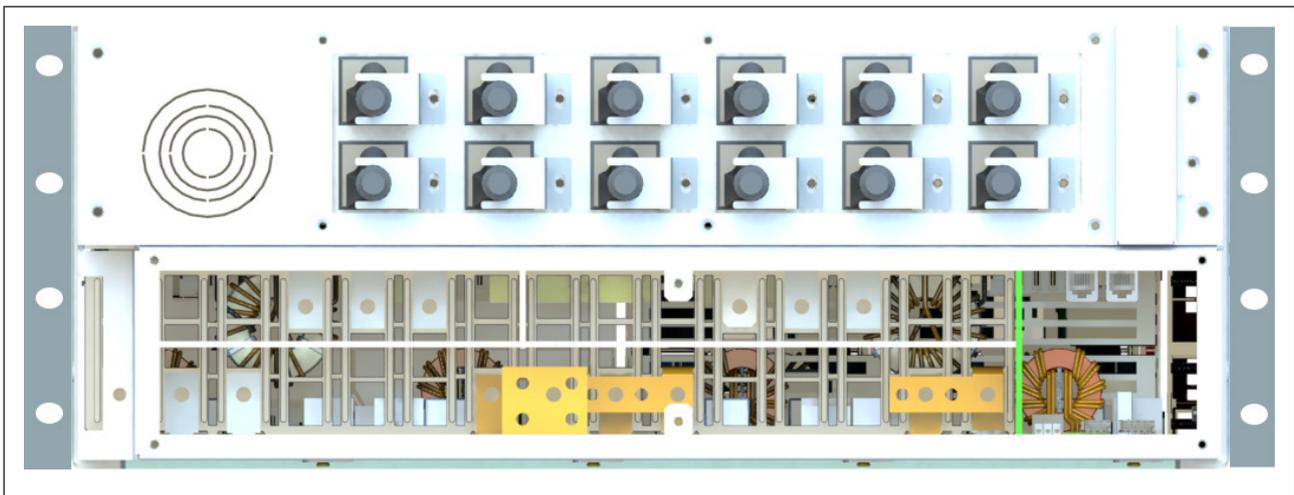
Bravo ST 120 VAC is a standalone Inverter with following capacities.

- Standalone model 5000 VA.
- Standalone model 2500 VA, with Redundancy.
- Standalone model 2500 VA, without Redundancy.

120 Vac and 48/110 Vdc as Input and 120 Vac as Output fitted with Enhanced Power Conversion (EPC) mode.



Front View



Rear View

5.1 Typical load

- Resistive.
- Inductive and resistive.
- Capacitive and resistive.

6. Bravo ST Components

6.1 Inverter Module

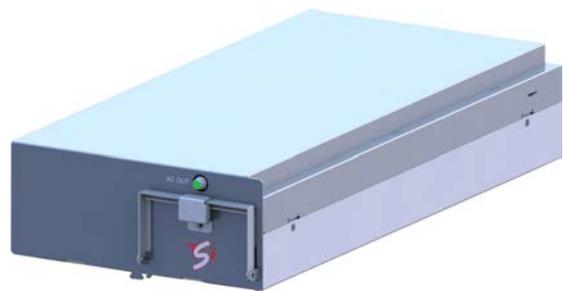
Bravo: 48 VDC 2500 VA -120 VAC.
 110 VDC 2500 VA -120 VAC.



- The BRAVO module shall have software version V203 or higher to operate with BRAVO ST.
- The TSI Bravo is a 2500 VA / 2000 W converter based on the TSI technology (see section 4, page 10).
- The TSI inverter modules are hot swappable and hot pluggable. They are featured with self setting capabilities for easy plug-and-play operation.
- LED's on module front plate display the status of converter and output power.
- The inverter modules are equipped with soft start.
- The fan is equipped with an alarm and run time meter. It is field replaceable.
- 17.13" (D) x 4.02" (W) x 3.46" (H). [435 mm (D) x 102 mm (W) x 88 mm (H)].
- 11 lbs [5 kg].

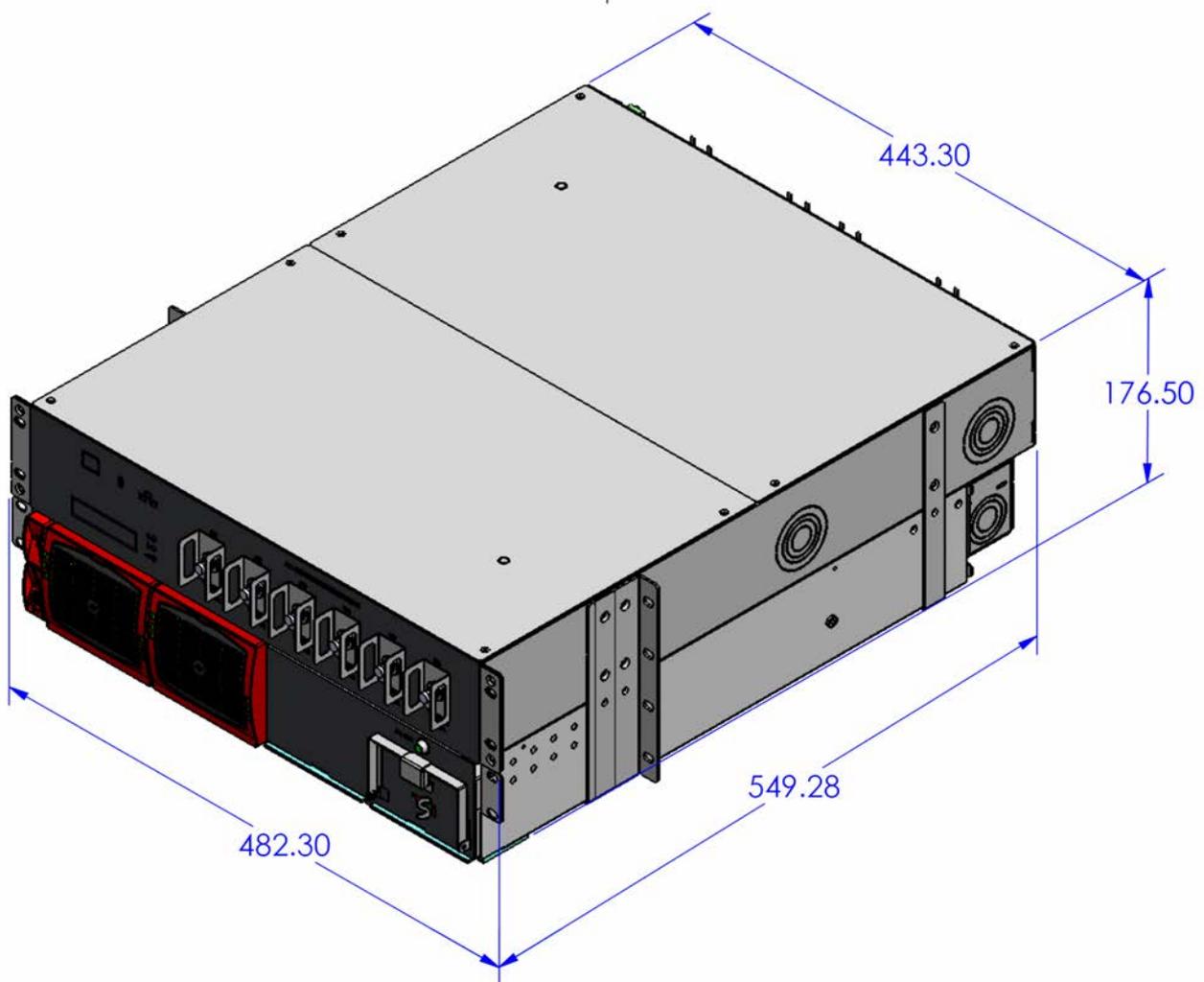
6.2 Automatic By-Pass Module

- 5000 VA By-Pass.
- It will automatically connect the load to the commercial grid (if available) when one or both inverter modules are not available.
- Transfer time < 10 ms.
- Hot pluggable: can be removed without shutting down the system provided that sufficient inverter modules are present and running.



6.3 Sub-rack

- The BRAVO ST 120 VAC shelf shall be integrated in min 600 mm deep cabinets, 19 inch / ETSI mounting.
- The BRAVO ST 120 VAC shelf houses maximum two (2) inverter modules and one (1) T2S interface. Maximum 5 KVA per shelf.
- The Bravo ST 120 VAC shelf is designed with individual DC input, common AC input and common AC output.
- Optional rear cover can be provided for enhanced safety in cabinet.
- 549.31 mm (D) x 443.31 mm (W) x 176.50 mm (H).



7. Accessories

7.1 T2S Interface

The T2S is an interface giving access to the TSI modules that are connected together in any TSI systems.

The T2S doesn't perform any control or management of the TSI system. It can be removed, replaced or moved to another live system without affecting neither the original TSI system operation nor the target system.

7.1.1 Parameters setting

The T2S interface is featured with a USB connector at the front. Connected to a laptop, it enables TSI system settings, modules and phase assignments, and other various adjustments to allow TSI best fit with actual site conditions. (Operation of T2S is described in separate manual available on request).

7.1.2 System diagnostic and troubleshooting

The T2S is featured with built-in user interface to allow on-line diagnostic through laptop.

Installers and maintenance technicians should always carry proper laptop to access/reconfigure the system on site.

7.1.3 On-the-fly monitoring

The T2S is featured with

- 3 outgoing alarms contacts.
- 2 digital inputs.
- MOD bus.
- CAN bus (optional).
- Alarm monitoring.
- Recording of the latest 200 events. FIFO.



7.2 Surge Arresters

The mains (AC) supply of the modular inverter system shall be fitted with Lightning surge suppression and Transient voltage surge suppression suitable for the application at hand. Manufacturer's recommendations of installation shall be adhered to. Selecting a device with an alarm relay for function failure is advised.

Surge arrestor(optional) is installed in the cabinet.

Indoor sites are considered to have a working lightning surge suppression device in service.

- Indoor sites Min Class II.
- Outdoor sites Min Class I + Class II or combined Class I+II.

8. Bravo ST System Installation

8.1 Unpacking the system

BRAVO ST is packed in a wooden box.

Modules are packed separately. They are normally marked to be replaced in the right slot.

Module packing material shall be taken apart and stored in case of return under warranty. Unproper packing may void the warranty.

The packing material of the TSI system is recyclable.

8.2 Mechanical Installation

- Sub-rack is preferable mechanically fixated without modules.
- T2S-2U can be left in the system.
- Min two (2) fixing screws per side of the system.
- Fixing holes for inch and ETSI mounting frames.

8.2.1 Fixing

A full range of accessory is ready made to allow easy integration of the TSI in almost any kind of standard cabinets. Among other we provide fixing set for:

- 19" – 600 mm depth cabinets.
- 19" – 800 mm depth cabinets.
- ETSI – 600 mm depth cabinets.
- 19" and 23" mid mounting brackets is supplied by default.

8.2.2 Fixing the System to Cabinet

CE+T offers adapter plates to mount the Bravo ST System into the 23-inch open relay racks. These can be ordered by contacting CE+T.

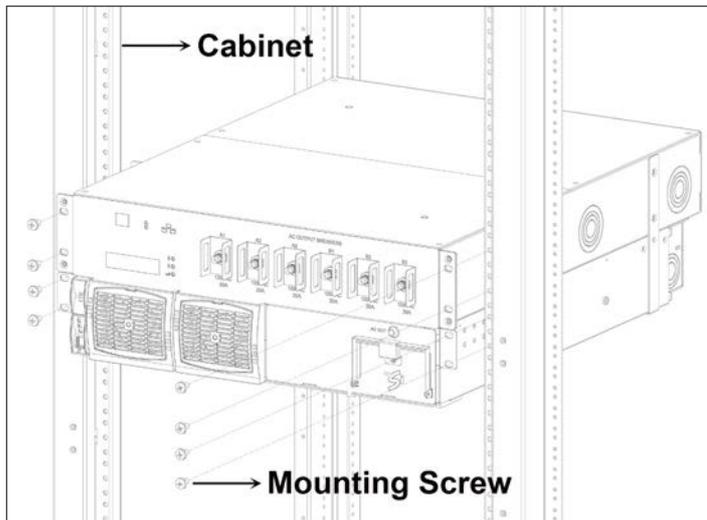
All Bravo ST Systems are designed for 19-inch mounting applications, but it can be mounted in 23-inch, two post, open relay rack/ network frame assemblies if required in application.

It is mandatory to use bottom support or slider when installing the system in 19-inch ETSI cabinet.

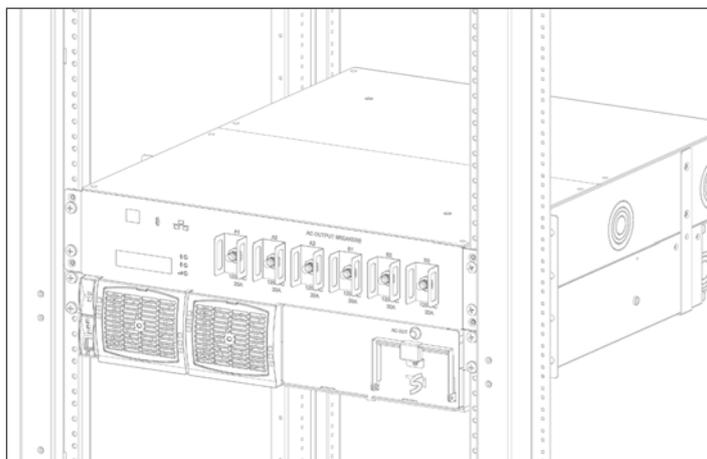
Note: Mounting adapters defined herein are not intended for use in 4 post relay rack.

Fix the Brackets, Bottom Support / Slider to the rack using the screws which is supplied along with the kit and then fix the system in the rack.

8.2.2.1 Fixing the System into 19 inch Cabinet

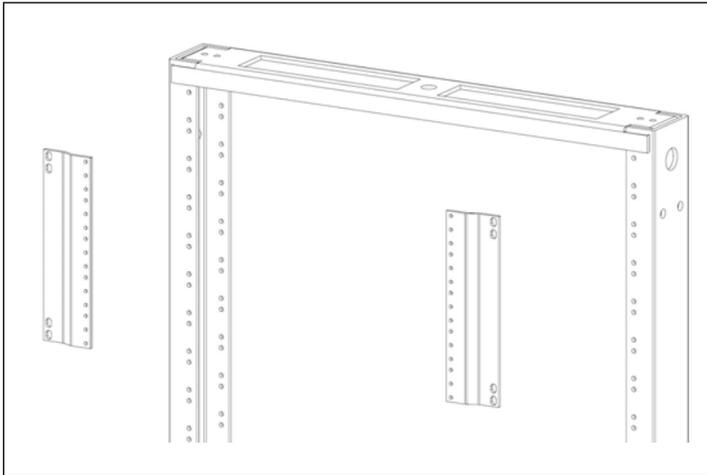


Place the System in the cabinet.



Fix the System in the cabinet with supplied mounting screws.

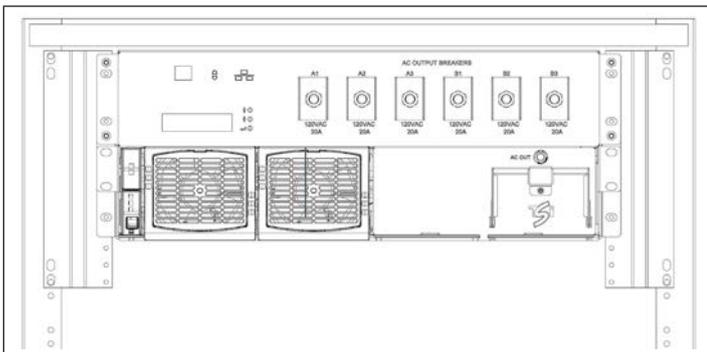
8.2.2.2 Fixing the System into 23 inch Cabinet



Place the bracket in the cabinet.



Fix the bracket with supplied mounting screws.



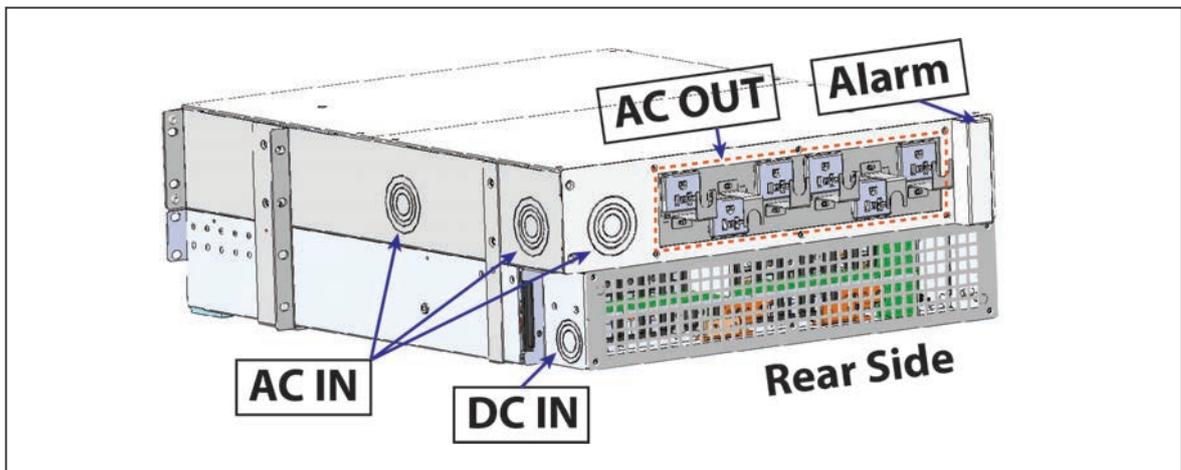
Fix the System with supplied mounting screws.

8.3 Electrical Installation

8.3.1 Pre-requisites

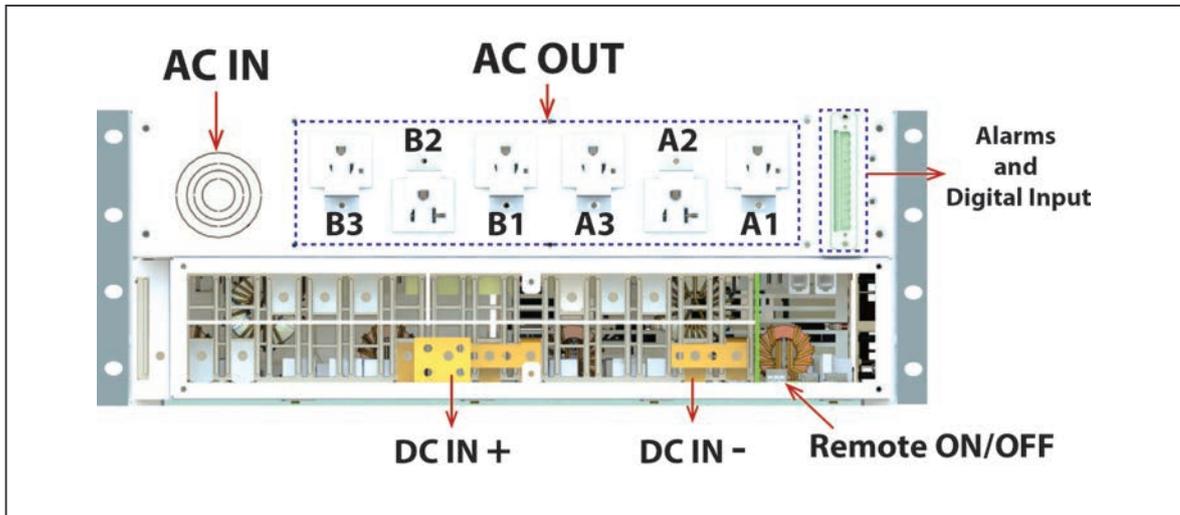
- The system have markings for all terminations.
- All cables shall be rated at min 90° C.
- Electrical terminations shall be tightened with 5 Nm.
- DC connection screws are M6 x 12 mm and AC connection with terminal block.
- DC Input-Individual (per module); observe polarity.
- AC Input / AC output – Bulk, respect phases.
- Wire all positions in the system as per markings.
- Input AC / Output AC / Input DC / Signal cables shall be separated.
- Cable crossings shall be done at 90° angles.
- It is recommended to install appropriate breaker at AC input and place a warning label near the breaker stating message as **“ISOLATE UNINTERRUPTIBLE POWER SUPPLY (UPS) BEFORE WORKING ON THIS CIRCUIT”**.

8.3.2 Cable Inlets



8.3.3 Terminations

Rear Side of Bravo ST 120 VAC terminations are clearly marked in the following figure.



8.3.4 Grounding

“PE CHASSIS GROUND”

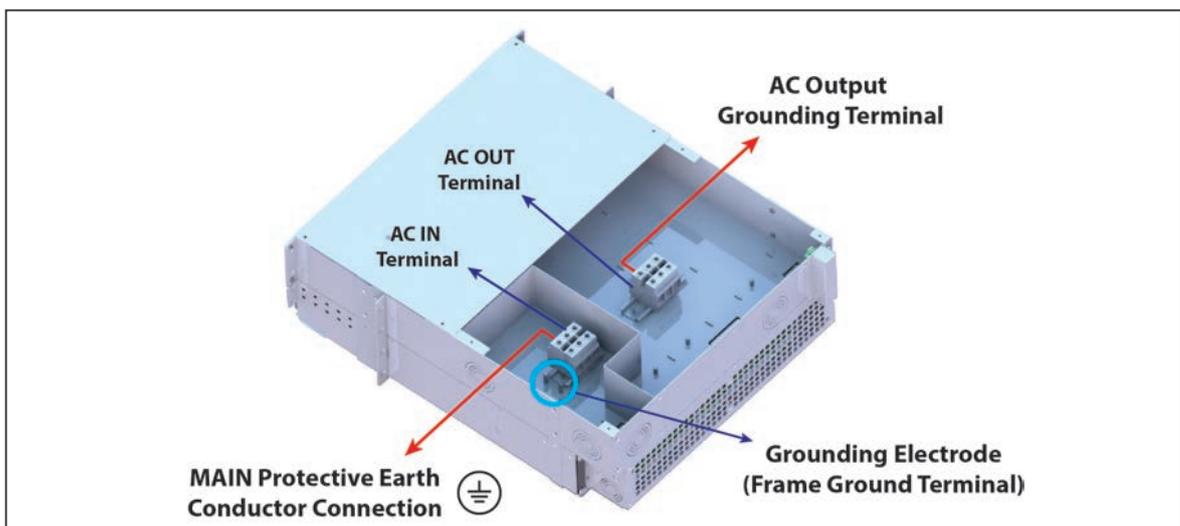


PE Chassis ground shall be wired to MET or distributed earth bar connected to MET, according to local regulations.

Main protective conductor (PE) connection is made to the X2 (AC IN) terminal block marked with symbol for identification.

PE must be terminated even if commercial Mains is not available and shall be connected to building or main panel ground. Recommended Cable cross section is the size equal (min) to Neutral cable cross section. Adhere to local regulations.

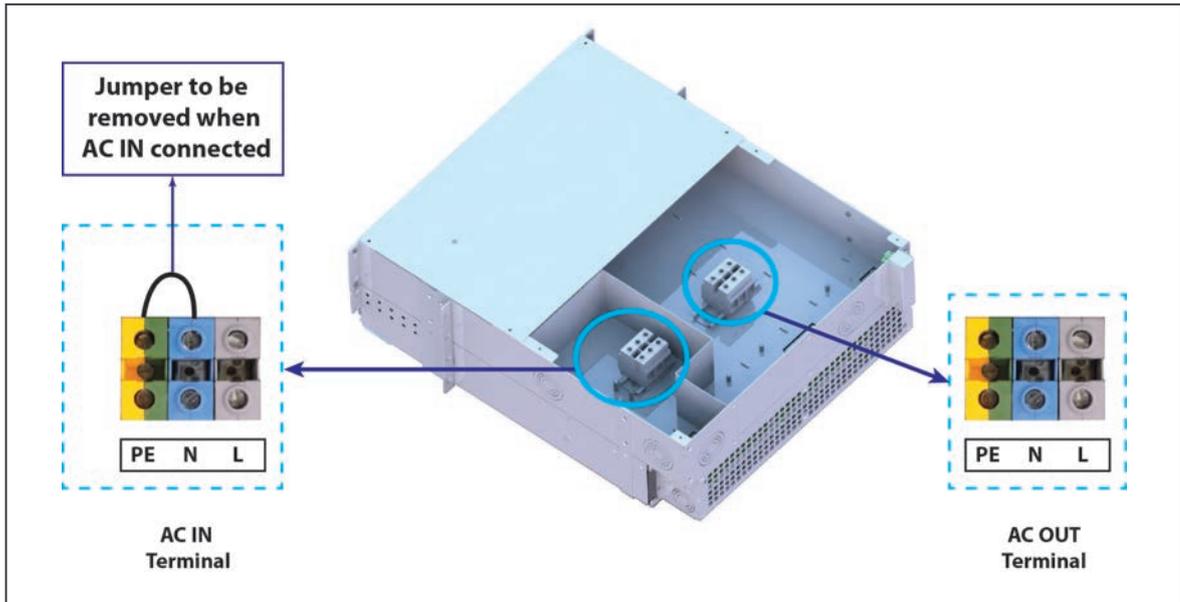
Ground has to be connected in accordance with local code.



8.3.5 AC Input and Output

The pictorial representation of terminal blocks arrangement is as follows.

If AC IN is connected, remove the bonding neutral jumper cable between AC IN Neutral and PE terminal.



8.3.6 DC Input

Model	Individual Feed		Common Feed		Torque lb.in
	Breaker	Cable Min	Breaker	Cable Min	
48 VDC	2 X 60 A / 1P	1 X 4 AWG	1 X 125 A / 1P	2 X 4 AWG	26.1 - 52.0
110 VDC	2 x 30 A / 2P	1 X 8 AWG	1 x 60 / 2P	2 X 8 AWG	

Recommended Lugs for DC Input cable:

Company	Part Number	Cable	Lug	Sleeve
Panduit	LCCF4-14B-L	4 AWG		Min 1 inch Length 600 V / 105°C
	LCCF8-14B-L	8 AWG		
Cembre	CL4-D141	4 AWG		
	CL8-D141	8 AWG		

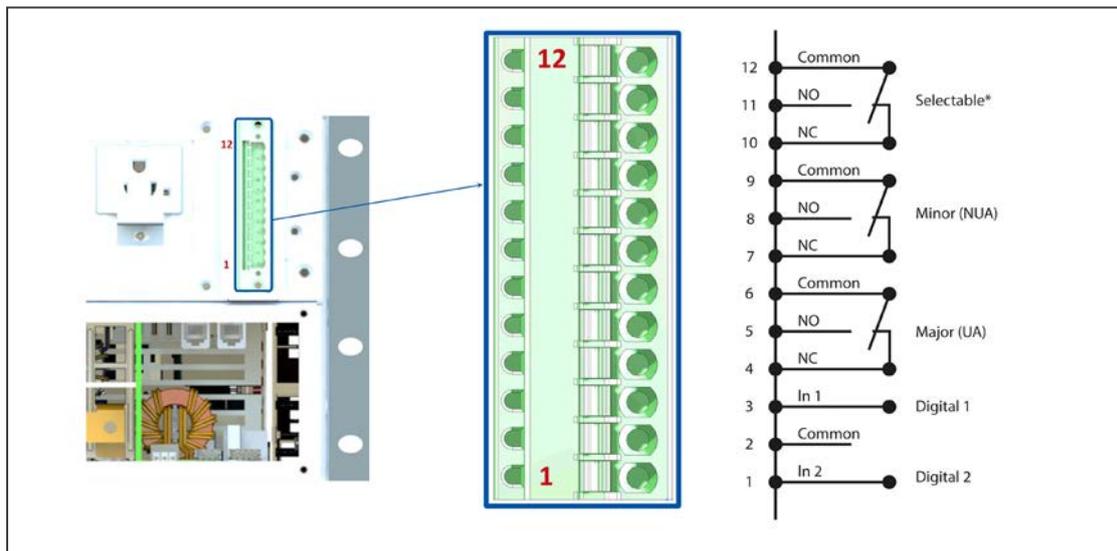
8.3.7 AC Input (AC Input protection mandatory)

Model	Breaker	Cable Min	Cable Max	Torque lb.in
48 VDC	60 A / 1P	1 X 4 AWG	1 X 2 AWG	24.9 - 26.7
110 VDC				

8.3.8 AC Output

Model	Cable Min	Cable Max	Torque lb.in
NEMA Receptacles 5 - 15R	14 AWG	NA	NA
NEMA Receptacles 5 - 20R	12 AWG		
Bulk Output	1 X 4 AWG	1 X 2 AWG	24.9 - 26.7

8.3.9 Signalling



Relay characteristics (Selectable, Major, Minor)

- Switching power 60 W
- Rating 2 A at 30 VDC / 1 A at 60 VDC
- Max wire size 1 mm²

Digital input characteristics (Digital IN 1/2)

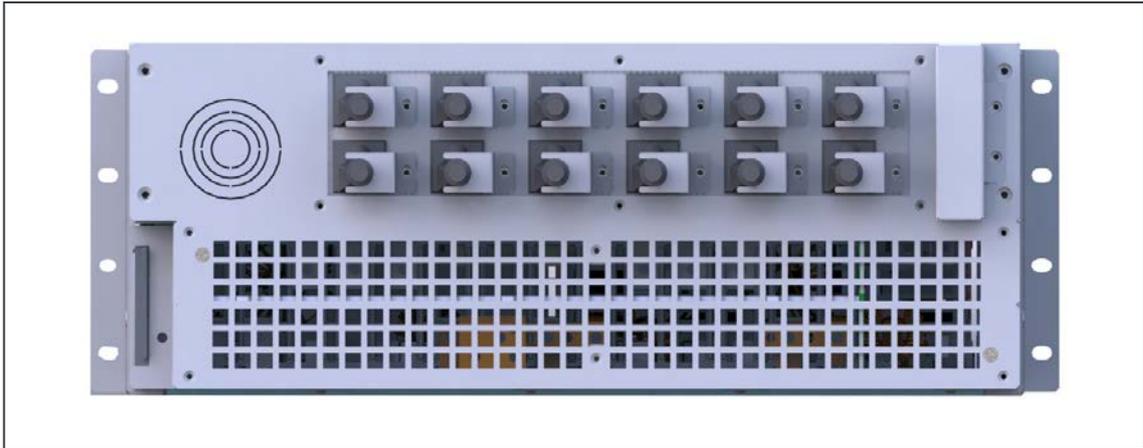
- Signal voltage +5 VDC (galvanically insulated)
- Max wire size 1 mm²

Note: In this system Remote ON/OFF function is not accessible to the customer connection.

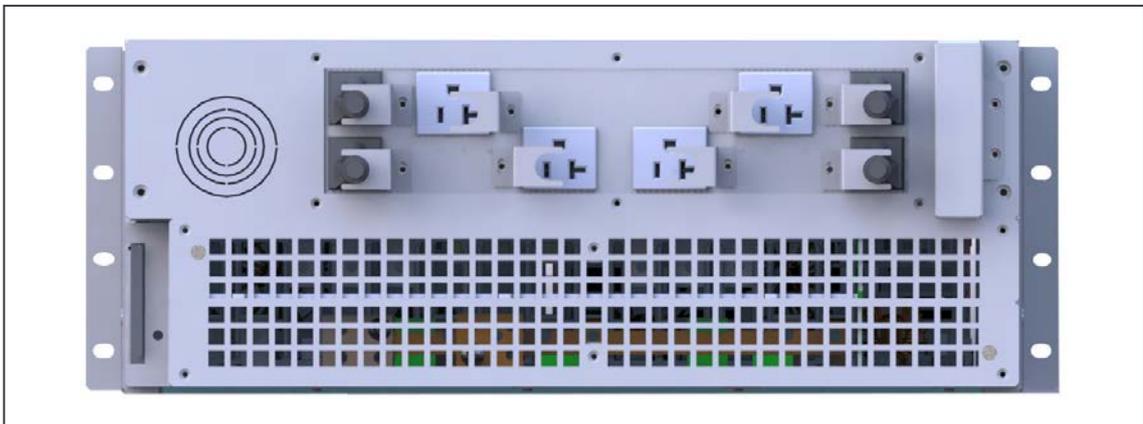
8.4 Wiring - Receptacle

TSI Bravo ST 120 VAC can be configured with NEMA or with hardwired AC Output connection.

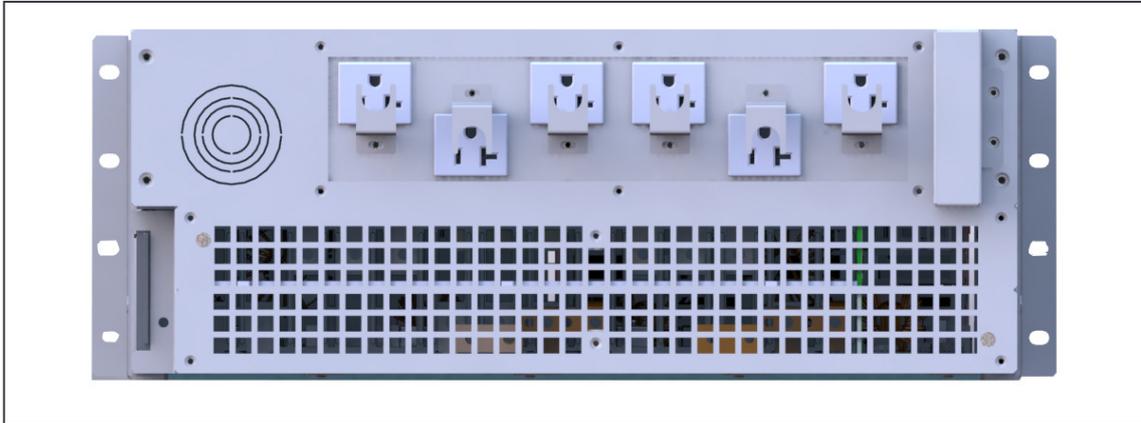
8.4.1 6 X (2 x NEMA 15R Receptacles)



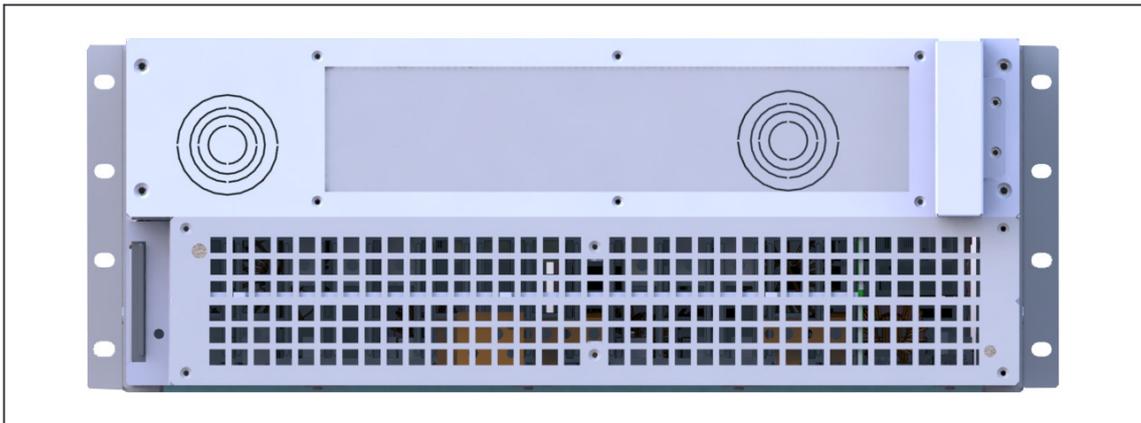
8.4.2 2 X (2 X NEMA 15R Receptacles), 4 X (1 X NEMA 20R Receptacles)



8.4.3 6 X (1 x NEMA 20R Receptacles)

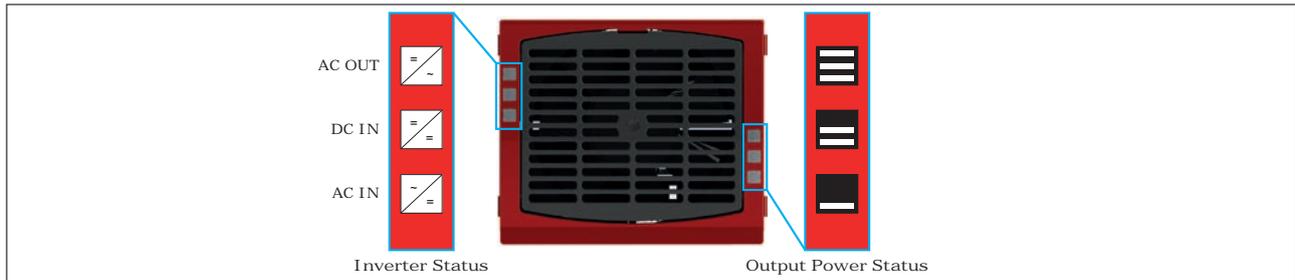


8.4.4 Bulk Output



9. Human-Machine Interface

9.1 Inverter module (Requires firmware V203 or higher)



Inverter Status LED	Description	Remedial action
OFF	No input power or forced stop	Check environment
Permanent green	Operation	
Blinking green	Converter OK but working conditions are not fulfilled to operate properly	
Blinking green/orange alternatively	Recovery mode after boost (10 In short circuit condition)	
Permanent orange	Starting mode	
Blinking orange	Modules cannot start	Check T2S configuration or Module with wrong firmware. Need firmware V203 or higher.
Blinking red	Recoverable fault	
Permanent red	Non recoverable fault	Send module back for repair

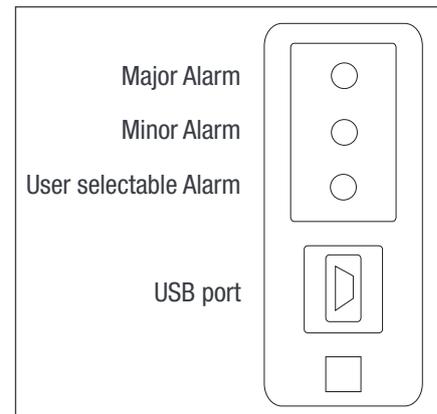
Output Power (redundancy not counted)						
<5%	5% to 40%	40 to 70%	80 to 95%	100%	100% = overload	Output Power (redundancy not counted)
×	×	×	≡	≡	≡	Status output power LED
×	×	=	=	=	=	
—	—	—	×	—	—	
1B	1P	2P	2P	3P	3B	Behaviour (B = Blinking – P = Permanent)

9.2 T2S

- T2S has two new parameters.
 - 420 ST module number 0,1,2 define the number of BRAVO in the configuration.
 - 421 ST module redundancy 0 or 1.

Note: The BRAVO module V203 or higher those parameters appear automatically and T2S is pre configured in factory.

- If you change T2S you must be sure to configure the parameter correctly prior to insert in the BRAVO ST.
- Alarm indication on T2S (Urgent / Non Urgent / Configurable)
 - Green: No alarm
 - Red: Alarm
 - Flashing: Exchanging information with inverters (only Configurable alarm)
- Outgoing alarm relay delay
 - Urgent 60 seconds delay
 - Non urgent 30 second delay
- Parameter setting via Laptop.
- Factory default according to list of set values.



The following BRAVO ST configuration parameters are:

1. BRAVO ST - 5KVA –No redundancy

```
;420;      ;ST Module Number      ;      ;2;      ;;
;421;      ;ST Module Redundancy  ;      ;0;      ;;
```

2. BRAVO ST - 2.5 KVA –No redundancy

```
;420;      ;ST Module Number      ;      ;1;      ;;
;421;      ;ST Module Redundancy  ;      ;0;      ;;
```

3. BRAVO ST - 2.5 KVA –1+1 redundancy

```
;420;      ;ST Module Number      ;      ;1;      ;;
;421;      ;ST Module Redundancy  ;      ;1;      ;;
```

10. System set up

Bravo ST 120 VAC System is delivered with default set of parameters referred as factory settings.

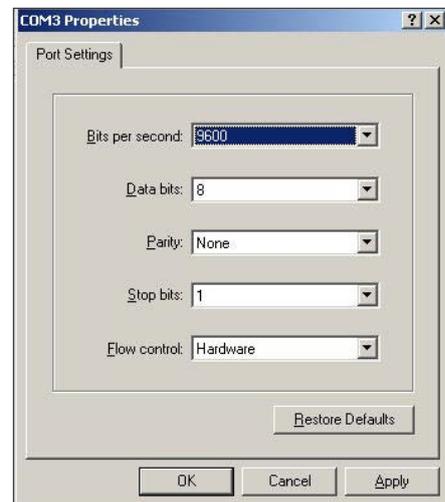
Upon various site operating conditions or Site Manager requirements some parameters might have to be adjusted.

Refer to “TSI T2S 120VAC User Manual Vx_x” for detailed description of system status reading and changing as well as parameter adjustment.

- Parameter set up requires HyperTerminal installed on laptop.
- USB cable type A to B (not included).
- T2S driver “CET_T2S.inf” installed on laptop.
- Available for download:
 - On my.CET for direct customers, in the “Document” section.
 - At the following URL for everyone else:
http://www.cet-power.com/uploads/Driver_T2S/Driver_T2S_for_Windows_and_hypercentinal.zip.
- Read T2S manual for detailed setup.

10.1 Communication settings

- Bits per second 9600
- Data bits 8
- Parity None
- Stop bits 1
- Flow control None



10.2 Menu access

Root Menu

- 1 > System configuration
 - 0 > Return to previous menu
 - 1 > Send config file to T2S
 - 2 > Read config file from T2S
 - 3 > Restore default settings (not available since version 2.5)
 - 4 > Restore factory settings (not available since version 2.5)
- 2 > System information's selection
 - 0 > Return to previous menu
 - 1 > Module information's
 - 0 > Return to previous menu
 - 1 > Variables set 1
 - 2 > Variables set 2
 - 3 > Variables set 3
 - 4 > Variables set 4
 - + > Next page
 - > Previous page
 - 2 > Phase information
 - 0 > Return to previous menu
 - 1 > Variables set 1
 - 2 > Variables set 2
 - 3 > Variables set 3
 - 3 > Groups information
 - 0 > Return to previous menu
 - 1 > Display AC group information
 - 2 > Display DC group information
 - 4 > Alarms information
 - 0 > Return to previous menu
 - 1-1 > Page selection
 - 5 > History of the log display
 - 0 > Return to previous menu
 - 1-14 > Page number selection
 - 16 > Clear log
 - 17 > Save log to a file
 - 6 > Module errors information
 - 0 > Return to preceding menu
 - 1-32 > Detailed Modules errors
- 3 > System actions selection
 - 0 > Return to previous menu
 - 1 > System actions
 - 0 > Return to index
 - 1 > Turn ON system
 - 2 > Turn OFF system
 - 3 > Change Date and time setting
 - 2 > Inverter Module action
 - 0 > Return to previous menu
 - 1-4 > Page number selection
 - 5 > Identify selected Module
 - 6 > Turn ON selected Module
 - 7 > Turn OFF selected Module
 - 8 > Change address of sel. Module
 - 9 > Change phase of selected Module
 - 10 > Automatic address assignment
 - 11 > Change DC group of selected Module
 - 12 > Change AC group of sel. Module
 - 13 > Notify changed fan of sel. Module
 - + > Increment selector
 - > Decrement selector
 - 3 > T2S actions
 - 0 > Return to index
 - 1 > Force refresh of configuration texts and constants
 - 2 > Force refresh of events description texts
- 4 > Security Access
 - 0 > Return to index
 - 1 > Enable Password protection

11. Inserting/removing/replacing modules

11.1 TSI Inverter

- The TSI inverter module is hot swappable. BRAVO ST operate with module having firmware V203 or higher.
- When a new module is inserted in a live system it automatically takes the working set of parameters.
- When a new module is inserted in a live system it is automatically assigned to the next available address.
- While swapping the modules, power to load will be vary depending upon the models and are listed below.

Note:

Before swapping Inverter module, make sure the commercial grid is available to prevent any shut down of the AC output voltage.

The commercial grid shall be within the limit in voltage (105 Vac to 140 Vac) and frequency between 47.5 Hz to 52.5 Hz for 50 Hz nominal and 57.5 Hz to 62.5 Hz for 60 Hz nominal.

If the load is supplied by “relay box” and the AC commercial input is not within the range (voltage and frequency) please DO NOT INSTALL NEW module. Risk of shutdown of the LOAD is present !!!

Module inserted in BRAVO ST with firmware below V203 cannot be used. They will not operate properly and will heat up abnormally.

BRAVO ST 5000VA - 2 Inverter Modules present + By Pass Module

- Any one or both Inverter Modules can be removed or added.
- When, either one or both Inverter Modules are replaced the AC output will be transferred to the AC commercial grid through the By-Pass Module.

Bravo ST 2500 VA with Redundancy (2 Inverter Modules present + By Pass Module)

- Any one or both Inverter Modules can be removed or added.
- If one Inverter Module is removed, the load is supplied from the redundant Inverter Module.
- If both Modules are removed, the load will automatically connect to grid through the By Pass Module.

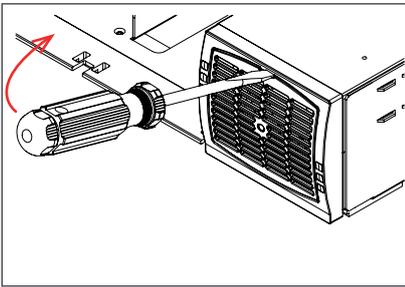
Bravo ST 2500 VA without Redundancy (One Module present + By Pass Module)

- The Inverter Module can be removed or added.
- When the Module is removed, the load will automatically connect to grid through the By Pass Module.

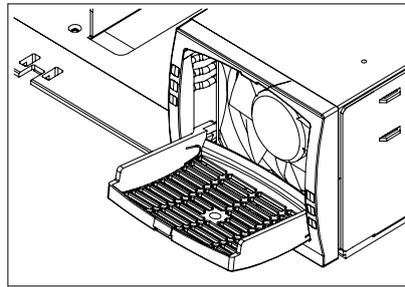
11.1.1 Module Removal

Notice: When one or several inverter modules is/are removed, live parts become accessible. Replace module(s) with dummy cover without delay.

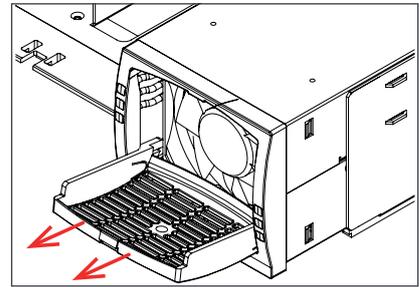
1. The inverter module is not switched off when opening the handle. The handle only hooks the module to the shelf.
2. Use a screw driver to release the handle latch.
3. Open the handle and Pull the module out.
4. Replace with a new module or dummy cover.



A) Use screwdriver to release the latch



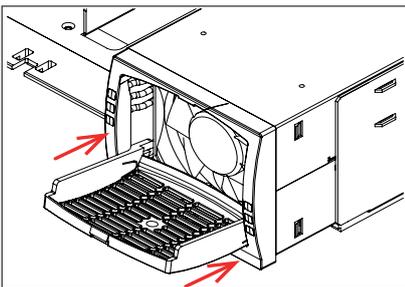
B) open the cover completely



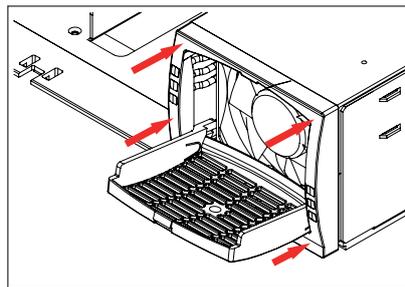
C) Use the cover as a handle to remove the module

11.1.2 Inserting

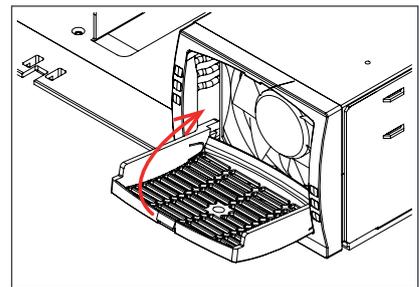
1. Check module compatibility (DC Voltage!)
2. Use a screw driver to release the handle latch.
3. Open the handle and Push firmly until the unit is properly connected.
4. Close the cover and latch in position.



A) Slide the module in



B) Push firmly till the connection is properly engaged



C) Close the cover and latch the module in place: if too hard redo step B

Once the module is properly insert and locked it will restart automatically and the load will be transferred from the by-pass module to the inverter. The sequence might take 10 to 40 seconds.

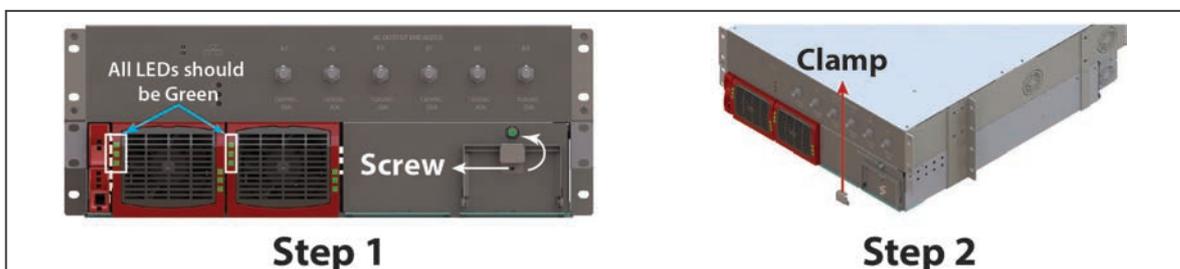
11.2 TSI By-Pass Module Replacement

11.2.1 Removal

Note : Before replacing the By-Pass Module please make sure the inverter module are in operation and both AC input and DC input source are available.

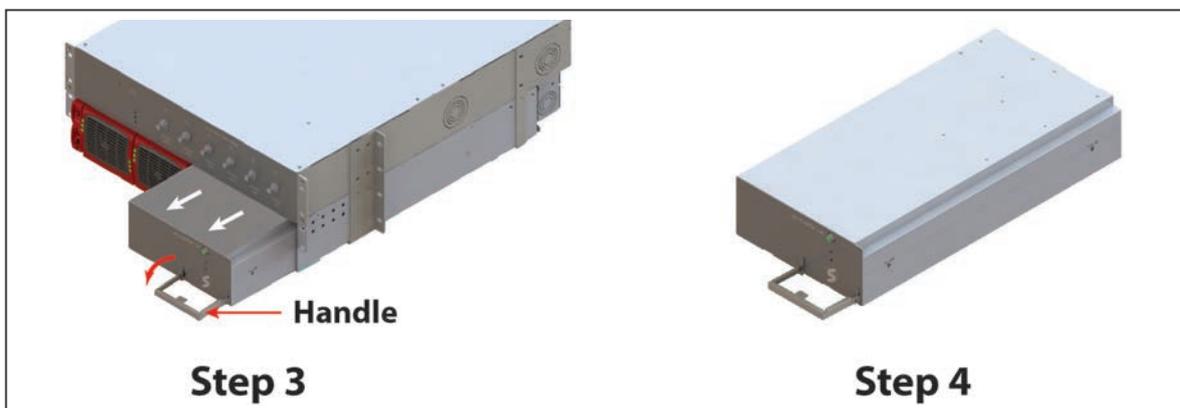
Step 1: Unscrew the screw in anti clockwise direction.

Step 2: Remove the front clamp.



Step 3: Place the handle in horizontal position and using the handle, gently remove the By-Pass Module from the shelf.

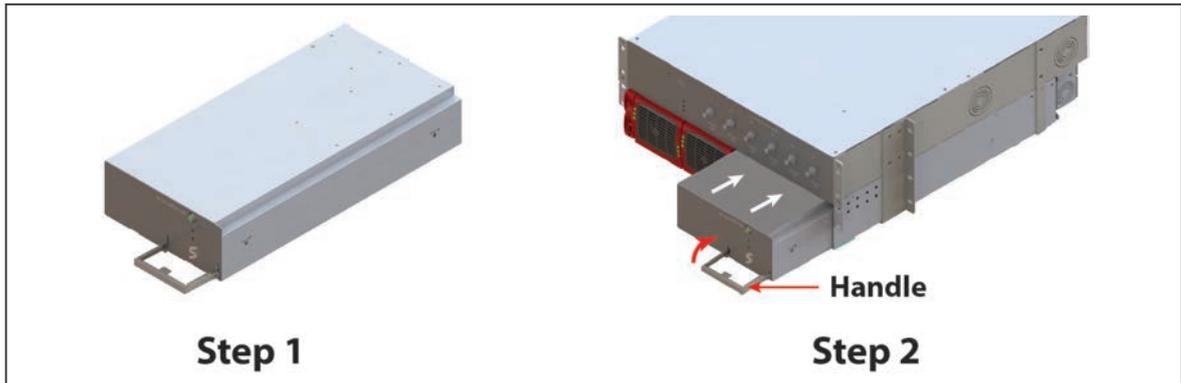
Step 4: Place the By-Pass Module in flattened surface.



11.2.2 Inserting

Step 1: Take a new By-Pass Module.

Step 2: Using the handle, gently push the By-Pass Module into the shelf and close the handle in vertical position.



Step 3: Place the front clamp.

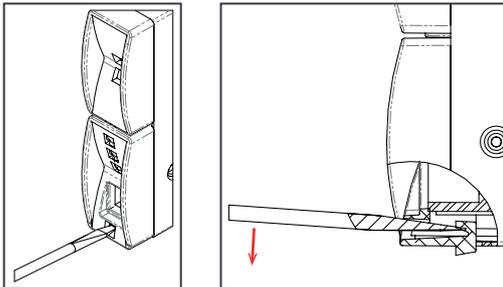
Step 4: Tight the screw in clockwise direction.



11.3 T2S

11.3.1 Removal

- Use a small screw driver to release the latch keeping the T2S in position.
- Pull the T2S out.



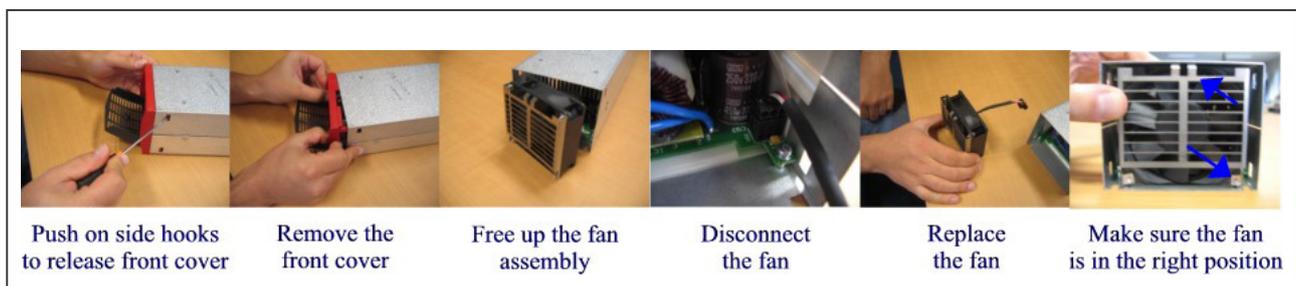
11.3.2 Inserting

- Push the T2S firmly in place until the latch snaps into position.

11.4 Fan replacement

The FAN life is approximately 60,000 (Sixty Thousand) hours. The inverter modules have fan runtime meters and fan failure alarm. Fan failure can result from a failing fan or driver circuit.

- Let the module rest at least 5 minutes before initiating work.
- The inverter front must be removed. Use a blunt tool to depress the latches on the module side fixing the front to the module.
- Remove the fan and unplug the supply cord.
- Replace with new fan and connect supply cord
- Replace front, make sure that the front latches properly.
- Plug in
- Check fan for operation
- Access T2S and reset the fan run time alarm from within the action menu.
- Once the FAN is replaced and module installed back in your system, You will need to clear the FAN alarm of the module. This can be done through the T2S menu 3 Action then 2 inverter action then 13 Notify change FAN.
- Refer to T2S manual for more details.



12. Final check

- Make sure that the system is properly mounted in the cabinet/floor.
- Make sure that the system is connected to Ground.
- Make sure that all DC and AC input breakers are switched OFF.
- Make sure that all cables comply with recommendations and local regulations.
- Make sure that all cables are strain relieved.
- Make sure that all breakers comply with recommendations and local regulations.
- Make sure that DC polarity complies with marking.
- Re-tighten all electrical terminations.
- Make sure that inverter/controller positions are left open.
- Cover empty inverter positions with dummy cover.
- Make sure that the Remote ON/OFF is wired appropriately for local regulations.
- Make sure that the point of AC supply meets local regulations.

13. Commissioning

The DC breaker is a protection device. Modules are plugged into a system and the DC breaker is then engaged. Please make sure that the corresponding DC breaker is engaged in the ON position. Failure to observe this rule will result in not all modules operating when running on DC, and module failure when the AC input recovers from the fault condition.

Installation and commissioning must be done and conducted by trained people fully authorized to do so. Performing any isolation test is prohibited without instructions from the manufacturer.

Equipment is not covered by warranty if procedures are not respected.

13.1 Check list

DATA	
Date	
Performed by	
Site	
System serial number	
Module serial numbers	
T1S/T2S serial number-Specify T1S/T2S	
ACTION	OK/ N.OK
Unplug all inverters except one inverter per phase (Just pull the inverter out from the shelf, to break electrical contact	
Check the commercial AC power before closing the AC input breaker.	
Switch the commercial AC ON and switch OFF AC output breaker.	
Check if inverters are working (Green LED)	
Check the DC power supply and switch the DC breakers ON	
Plug in all inverters (max two) one by one	
Check output voltage (on bulk output or on receptacle)	
Check if inverters are working properly	
Check if system has no alarm (Disable the alarm if any)	
Read configuration file and review all parameters. Some parameters must be adapted to site conditions (LVD, load on AC, AC threshold level)	
Switch OFF ACin and check if system is working on DC	
Switch ON ACin and check if system correctly transferred load on AC	
Switch OFF system and start on AC only	
Switch OFF system and start on DC only	
Remove one module and check if load transferred to the By Pass. If not remove the second module and check if the load transferred to the By Pass.	
Once all module in operation and no alarm. Switch on AC output breaker.	
Test on load (if available)	
ALARM	
Switch ON AC input and DC input and check that no alarms are present	
Pull out one inverter and check alarm according to redundancy	
Pull out two inverters and check alarm according to redundancy	
Switch OFF AC input (commercial power failure) and check the alarm according to the configuration	
Switch OFF DC input (DC power failure) and check that the alarm according to the configuration	
Check the different digital input according to the configuration (when used)	

14. Trouble Shooting and Defective Situations Resolution

14.1 Trouble Shooting

Inverter module does not power up:	<ul style="list-style-type: none"> Check AC input present and in range (AC breakers) Check DC input present and in range (DC breakers) Check that the inverter is properly inserted Remove inverter to verify that slot is not damaged, check connectors Check that module(s) is (are) in OFF state Check for loose terminations
Inverter system does not start:	<ul style="list-style-type: none"> Check that T2S is present and properly inserted Check remote ON/OFF terminal Check the configuration and setting Check threshold level
Inverter only run on AC or DC:	<ul style="list-style-type: none"> Check AC input present and in range (AC breakers) Check DC input present and in range (DC breakers) Check the configuration and setting Check threshold level(s)
No output power:	<ul style="list-style-type: none"> Check output breaker
All OK but one has alarm:	<ul style="list-style-type: none"> Check configuration file and correct number of modules Download/clear log file
No output alarm:	<ul style="list-style-type: none"> Check the default time delay (UA: 60 s, NUA: 30 s) Check configuration file
No information on CanDis:	<ul style="list-style-type: none"> Check that T2S is present and properly inserted Check that the RJ45 cable is connected between T2S shelf and CanDis shelf
No value on TCP/IP:	<ul style="list-style-type: none"> Check that the RJ45 cable is connected between T2S shelf and CanDis shelf Wait approximately 2 minutes to allow the system to collect serial data.

14.2 Defective modules

Unless input power is down all LEDs on each module should be green (see section 9, page 26). No light, orange light, red or flashing light are abnormal conditions. Refer to section 10.2, page 29 to collect and record module information. If no fix can be found, replace module.

14.2.1 Replacing modules

Refer to section 11, page 30 to remove and re-insert modules.

14.2.2 Return defective T2S interface

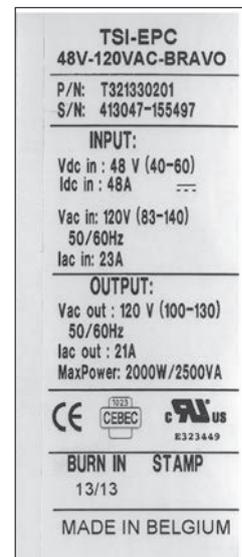
A T2S totally dark (indication area) or that cannot interface with your laptop are evidence of failure. Proceed as per section 14.2.4, page 39.

14.2.3 Return defective shelf

The shelf is passive. Failure is unlikely to happen. In turn defective situation are barely always visible. After depose proceed as per section 14.2.4, page 39.

14.2.4 Return defective modules

- A repair request should follow the regular logistics chain:
End-user => Distributor => CE+T Power.
- Before returning a defective product, a RMA number must be requested by email at tech.support@cetamerica.com.
- The RMA number should be mentioned on all shipping documents related to the repair.
- Be aware that products shipped back to CE+T Power without being registered first will not be treated with high priority!
- Information on failure occurrence as well as module status given through Menu 2-1 shall be attached to defective unit return package or recorded in RMA.



15. Service

For Service

- Check Service Level Agreement (SLA) of your vendor. Most of the time they provide assistance on call with integrated service. If such SLA is in place, you must call their assistance first.
- If your vendor doesn't provide such assistance (*) you may call CE+T directly.
Toll free Number **1(855) 669 - 4627**(**)

Service is available from 8:00 A.M. to 10:00 P.M. EST, Monday through Friday, except closing periods for holidays or inclement weather.

Major Incidents and Emergency conditions can be invoked for immediate handling of same number or by dropping a mail on tech.support@cetamerica.com(***)

(*) CE+T will redirect your call to your vendor if he has such SLA in place.

(**) Valid in USA and Canada only.

(***) Messages that are not Major Incident or Emergency will be served at the next scheduled working day.

16. Maintenance Task

As maintenance will be performed on live system, all task should be performed only by trained personnel with sufficient knowledge on TSI product.

Tasks:

- Identify the site, customer, rack number, product type.
- Download and save configuration file for back up.
- Check configuration file to be in accordance with operational site conditions.
- Read and save log file for back up.
- Check and analyze log file, and if alarm are present.
- Replace dust filter if present. Filter is mandatory in dusty environment.
- Check module temperature and log value. If internal temperature is higher then previous year, it should be interesting analyze if it is due an increasing load or dust effect. It is common to have a delta of 15°C by 30% of load between the ambient and the internal temperature. If temperature increase due internal dust, clean the module by air suction blower or vacuum cleaner.
- Clean cabinet (vacuum cleaner or dry cloth).
- Control the inverter mapping (AC Group, DC Group, Address).
- Check load level and record the rate value (print in word document the 4 screen modules information for the 32 modules, the 3 screen for the phases value and the 2 screens for the group AC and DC value).
- Change the configuration file for AC and DC mix mode to check that all TSI work on both power supply.
- Check alarm operation (e.g., redundancy lost, mains failure, DC failure) on dry contact and through SNMP system or web interface.
- Switch OFF AC IN and check alarms.
- Check temperature terminal and temperature wiring. If possible use an infrared camera.
- Read and record value as wave form, power factor, Crest factor, THD I from power analyzer.
- Take cabinet picture.
- Keep track of report and provide end user with a copy.
- Perform a MBP procedure. This task is not really recommended*, but could be demanded by site manager.

* It is not recommended because when you perform a By-pass procedure, generally there is no back up on AC input line, and the load shutdown if mains disappear.

