Leading AC Backup Technology

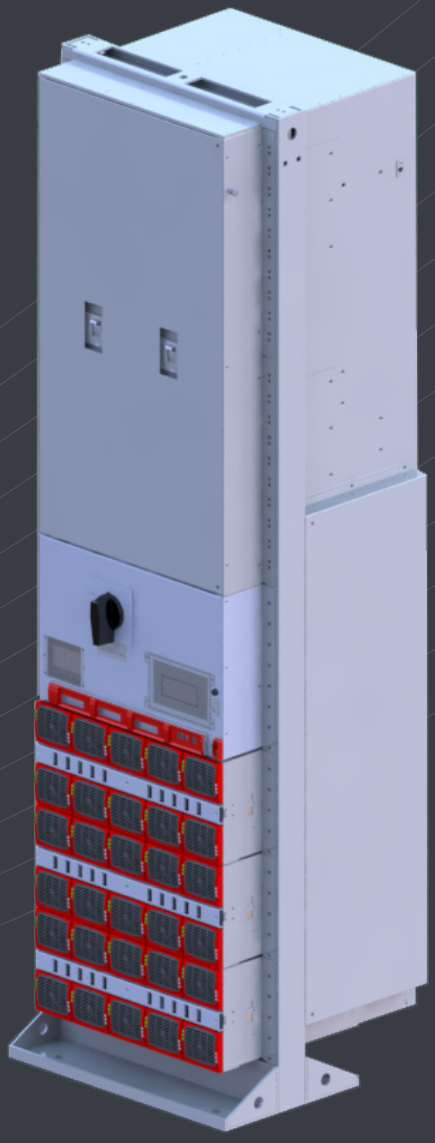
TSI BRAVO POWER CENTER (BPC)- 120 VAC

User Manual V7.0

BEYOND THE INVERTER

THE NEW GENERATION OF POWER CONVERTERS

- **DUAL INPUT INVERTER**
  The 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



Important Safety Instructions and Save these Instructions

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Table of content

Release Note:

Version	Release date (DD/MM/YYYY)	Modified page number	Modifications
7.0	03/12/2014	-	First release of the Manual.

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 disturbances;
- optimizes footprint.

Our systems are:

- modular
- truly redundant
- highly efficient
- maintenance free
- battery friendly

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

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

3. Safety Instructions

Important Safety Instruction. Save these Instruction.

3.1 Disclaimer

- The manufacturer declines all responsibilities if equipment is not installed, used or operated according to instructions herein by skilled technician 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 “qualified employee” with adequate training. Even the personnel who are in charge of simple repair or maintenance are required to have the knowledge or experience in relation 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 should have the knowledge to know how 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 hurt the employees that are working on them.
- Qualified employees also should know 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.
- 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.
- Maximum operating ambient temperature is 40°C (104°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, 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.
- 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

- Inverter System contains 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 modular 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 powerless.
- 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 8.6.3, page 28).
- Remove output neutral-to-ground jumper when input AC MAINS is connected (see section 8.6.4, page 29).
- 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 case of output short circuit, the inverter must disconnect in maximum 5 seconds. Parameter can be adjusted on T2S; however, if the parameter is set at a value >5 seconds, an external protection must be provided in order that the short circuit protection operates within 5 seconds. Default setting is 60s.
- The rack shall be secured to the building structure before operation.

3.3.1 Handling

- The cabinet shall not be lifted using lifting eyes.
- Remove weight from the rack 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 cover.

3.3.2 Surge and transients

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

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.

3.3.3 Other

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

3.4 Maintenance

- The modular inverter system/rack can reach hazardous leakage currents. Earthing must be carried out prior energizing the system. Earthing shall be made according to local regulations.
- Prior any work conducted to a system/unit make sure that AC input voltage and DC input voltage are disconnected.
- Prior to accessing to the system or modules,
  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

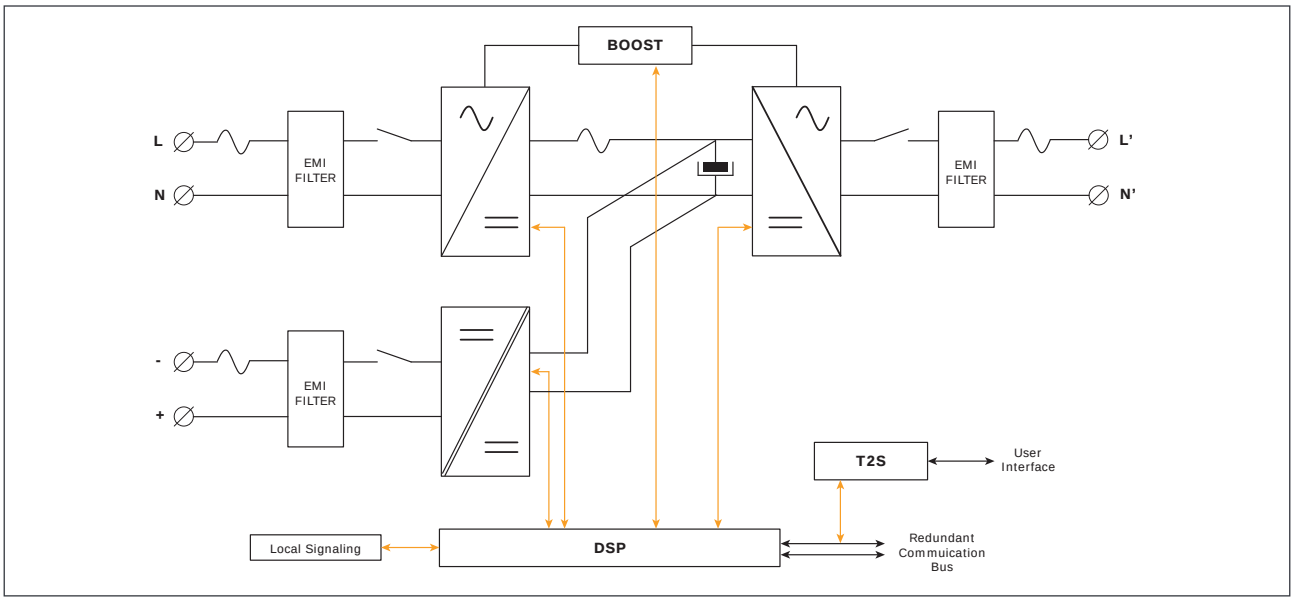
- ESD Strap must be worn when handling PCB's and open units.
- CE+T cannot be held responsible for disposal of the Inverter system and therefore the customer must segregate and dispose the materials which are potentially harmful to the environment, in accordance with the local regulations in force in the country of installation.
- If the equipment is dismantled, to dispose of the products it consists of, you must stick to 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 block diagram here below 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 20ms(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.

The 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.

4.1 On-line Mode

DC is the primary source of supply whilst Mains (AC) works as the secondary source of supply. Switching time between DC input and AC input is 0ms (source transfer).The power delivered by the DC source (usually a battery , but it could be any other type of DC generator) is converted to provide regulated and transient free power to the load. In case of short circuit at the load side, the boost is automatically and timely energized to trip downstream protective devices.

1 | Information and data given in this chapter intend to for an overview on the technology. Detailed features and parameters for each individual module type of the range may differ and should be referred in the dedicated data sheet.

4.2 Safe mode

Safe mode uses DC as primary source of supply while Mains (AC) is in standby.

Mains (AC) is normally disconnected through internal inlet relay and is only connected when down stream clearance is required (boost) or if DC is unavailable.

The transfer between DC and AC results in typical transfer time of 10ms.

Typically the safe mode is used in extremely harshed environments such as railways. Under such conditions it provides extra isolation against disturbances carried by the Mains.

4.3 EPC-mode

Mains input (AC) is the primary source whilst DC works as backup.

The TSI is designed to operate on Mains on permanent basis and to deliver output voltage conditioned with low THD.

There is no physical difference on the output sine wave 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” (Switching time back and forth is 0ms).

As soon as the Mains returns in to 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.

Remarks: REG modules:

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

4.4 Mix Mode & Walk-in-mode

Under some circumstances DC and AC source 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 fix and adjustable period of time.

5. Inverter Components

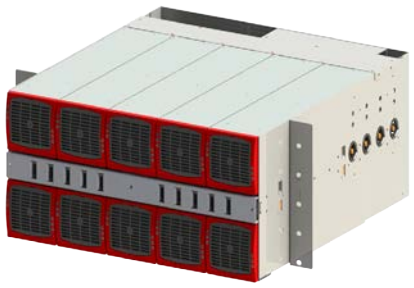
5.1 Inverter module

Bravo: -48 VDC / 120 VAC, 60Hz.

- The TSI Bravo is a 2500VA/2000W triple port inverter.
- All versions available in EPC or REG.
- The TSI inverter modules are hot swappable and hot pluggable.
- The module operator interface is LEDs showing converter status and output power
- Inverter modules run in single phase or three phase (2 wire or 3 wire) configurations.
- Fan is equipped with alarm and run time meter. The fan is field replaceable.
- 17.13" (D) x 4.02" (W) x 3.46" (H)
- 11 lbs (5 Kg).

5.2 Sub-rack

- The open relay rack is built from supporting shelves (sub-rack) of 23inch.
- Each shelf houses up to 10 modules in 2 rows with individual DC protection breaker.
- The 23 inch Bravo shelf is designed with Common DC input for 5 modules, Common AC input bus bar and Common AC output bus bar.
- Max 25kVA per double shelf.
- 22" (D) x 23" (W) x 5U (H)
- 77 lbs (35 kg) empty.



6. Accessories

6.1 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.

6.1.1 Parameters setting

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

6.1.2 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.
(Operation of T2S is described in separate manual available on request).

6.1.3 On-the-fly monitoring

The T2S monitors max 32 inverter modules.

The T2S is featured with

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

6.2 CANDIS

6.2.1 CANDIS shelf

The CANDIS shelf has slots for up to 3 display units and 1 TCP/IP agent.

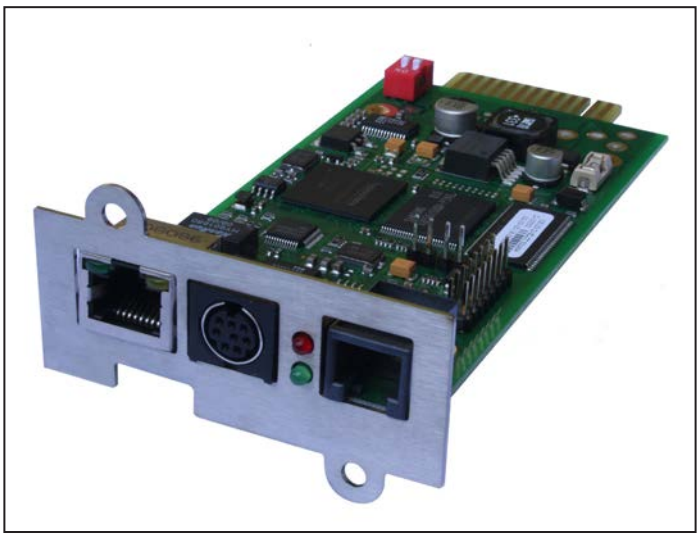
6.2.2 Display

Backlit 2 line dot matrix.

The display shows two values simultaneously.

6.2.3 TCP/IP Agent

The TCP/IP interface board is mounted on the CanDis shelf and is powered within the system.



Remark:

TCP/IP interface also exists as stand alone unit with protective enclosure. Features are identical. It can be mounted independently from the CANDIS shelf, fixed on a support or snapped-on to DIN rail.

6.3 Manual by-pass

The manual by pass operates via manually operated switches to create a short cut from Mains input directly to the output AC distribution. Standard manual by-pass are “Make before Break”. When engaged or disengaged no glitch is transmitted to the load.

When MBP is engaged, inverter modules are switched off and can be removed without impacting the load. DC source is not physically disconnected. After DC disconnection, the rack is safe for any maintenance intervention. There is a signal available for system status “MBP engaged” / “MBP disengaged”. It can be used for remote alarm or to enable operation of external bypass.

NOTE! When the system is in by-pass the load is subjected to mains disturbances.

6.4 Surge Arresters

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

Surge arrestor(optional) is installed in the rack. (Remark: option not yet available)

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.

Lightning currents conducted in inverter circuits can cause immediate and catastrophic equipment failure. Surges from induced lightning and power switching operations are smaller but are more numerous and can result in equipment misoperation, lockup or damage.

Some areas are more subjected to lightning than other whereas the intensity dramatically increases with the altitude.

The selection of the surge arresters as well as their installation obeys to strict rules. Not matching these rules could simply void their action. The selection of the surge arrester and its physical implementation cannot be covered in this document. The installer must analyze the local conditions and do the needful; eventually he should require the site to be inspected to cover his liability.

In any case inverter damages that could be related to improper protection are covered by CE+T product warranty

7. BPC Design and Description

7.1 System Design

BPC is a OPEN RELAY RACK modular inverter specifically designed for clean and temperature controlled environments.

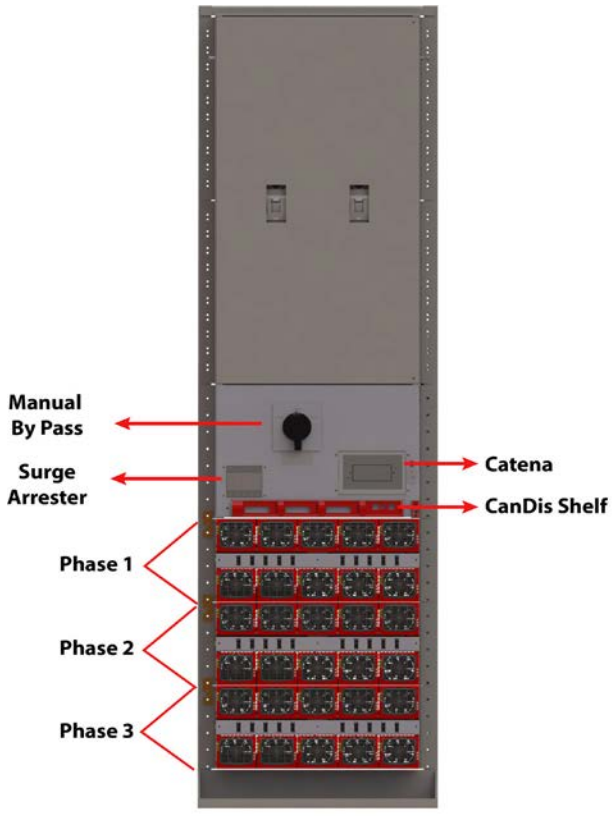
- Telecom grade design.
- For airflow, provisions are provided at **Rear**.
- Based on Bravo 48VDC-120VAC TSI module.
- Fully modular.
- Support redundant configurations.
- Support EPC mode.
- Open Relay Rack NEMA 1 (IP 20)
- BPC is available in several selectable options:

1. "Piggyback" option, to be used together with DC infrastructure. System comes without AC protection and must be connected to DC source with pigtail power cord (considered as internal connection for NEC).
2. "Bulk protected IN & OUT" option, can be used away from DC infrastructure. System comes with input and output built-in AC protections and DC landing area. This option fully supports NEC cabling recommendations.
3. "Bulk protected out" option, can be used away from DC infrastructure. System comes with output AC protections and DC landing area (no AC input built-in protections). This option fully supports NEC cabling recommendations.
4. "Built-in distribution" option, can be used away from DC infrastructure for sites with space constraints. System comes with integrated AC output distribution and DC landing area (no AC input built-in protections). This option fully supports NEC cabling recommendations.

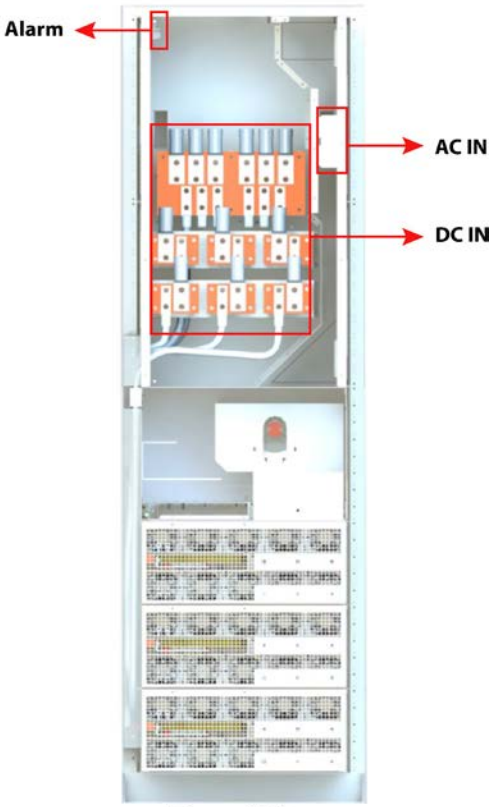
7.2 System Description

BPC comes fully equipped with

- DC individual protection for one shelve (Four Modules).
- MBP included by default.
- T2S interface.
- AC input breaker (bulk)-branch circuit protection.
- AC output breaker (bulk)-branch circuit protection.



Front View



Rear View

Options

- MBP is present by default. It can be removed on request.

7.3 BPC Single Phase Configuration

A single phase system is 120VAC from L to N. Input and output are the same, made upon 2 wires + Ground.

System Designation	Max Power (KVA)	Max power (KW)	Max number of Modules
CETBPC-1-25-00-10	25	20	10

System Designation	Individual DC*** input		
	Fuse or Breaker	Cable Min (per feed)	Cable Max (per feed)
CETBPC-1-25-00-10	2x300 A	1x500 kcmil	1x500 kcmil

*** : Refer Section 8.6.5, page 32

System Designation	AC Input & AC Output		
	Branch Protection		Cable Max Based on Terminal Size
	Breaker	Cable Min	
CETBPC-1-25-00-10	250 A	1x300 kcmil	300 kcmil

7.4 BPC Split Phase Configuration

A split phase system* is 120VAC from L to N and 240VAC from L1 to L2 are phase shifted by 180 degree(upon request,it can also be 208VAC. L1, L2 are phase shifted by 120 degree). Input and output are made upon 3 wires + Ground, cabling and phase shift must match.

System Designation	Max Power (kVA)	Max power (KW)	Max number of Modules
CETBPC-2-25-00-10	25	20	10**
CETBPC-2-50-00-20	50	40	20

* :Also named sometimes (including by UL). “Single phase 240VAC”. Number of wires is always meaningful to distinguish from other single phase.

** : Number of modules must be even, with same number in each phase in order to comply with UL recommendations.

System Designation	Individual DC*** Input		
	Fuse or Breaker	Cable Min (per feed)	Cable Max (per feed)
CETBPC-2-25-00-10	2x300 A	1x500 kcmil	1x500 kcmil
CETBPC-2-50-00-20	4x300 A	1x500 kcmil	1x500 kcmil

*** : Refer Section 8.6.5, page 32

System Designation	AC input & AC output Per Pole		
	Branch Protection		Cable Max Based on Terminal Size
	Breaker	Cable Min	
CETBPC-2-25-00-10	125 A	1x1/0 AWG	1x1/0 AWG
CETBPC-2-50-00-20	250 A	1x300 kcmil	1x300 kcmil

7.5 BPC Three phase configuration

A Three phase system is 120VAC from L to N and 208 VAC from L1 to L2, L1 to L3, L2 to L3.

All phases are phase shifted by 120 degree one to the other.

System Designation	Max Power (kVA)	Max power (KW)	Max number of Modules
CETBPC-3-37-00-15	37.5	30	15 *
CETBPC-3-75-00-30	75	60	30

* :Number of modules must be multiple of 3, with same number in each phase in order to comply with UL recommendations.

System Designation	Individual DC** Input		
	Fuse or Breaker	Cable Min (per feed)	Cable Max (per feed)
CETBPC-3-37-00-15	3x300 A	1x500 kcmil	1x500 kcmil
CETBPC-3-75-00-30	6x300 A	1x500 kcmil	1x500 kcmil

** : Refer Section 8.6.5, page 32

System Designation	AC Input & AC Output Per Pole		
	Branch Protection		Cable Max Based on Terminal Size
	Breaker	Cable Min	
CETBPC-3-37-00-15	125 A	1x1/0 AWG	1x1/0 AWG
CETBPC-3-75-00-30	250 A	1x300 kcmil	1x300 kcmil

Remark:

Sometimes three phase systems with 2 legs instead of three can be requested. They can be called split phase or dual phase. Effectively they are based upon same hardware than split phase (see 7.4, page 20) with 3 wires (L1-L2-N) . Since phases are shifted by 120 degree the L1 - L2 output voltage is 208VAC.

Three phase configuration can be connected to 240VAC L-L(138VAC L-N) sources. Refer to supplier fro specific recommendations and approval.

7.6 BPC Module Based Current Ratings

# Modules	Rated AC Input/Output Current per Phase (Amps)	Rated DC Intput Current per Polarity (Amps)
120 Vac - Single Phase - 2 Wires + PE		
1	20,83	48,00
2	41,66	96,00
3	62,49	144,00
4	83,32	192,00
5	104,15	240,00
6	124,98	288,00
7	145,81	336,00
8	166,64	384,00
9	187,47	432,00
10	208,30	480,00
120/240 Vac - Single Phase - 3 Wires + PE		
2	20,83	96,00
4	41,66	192,00
6	62,49	288,00
8	83,32	384,00
10	104,15	480,00
12	124,98	576,00
14	145,81	672,00
16	166,64	768,00
18	187,47	864,00
20	208,30	960,00
120/208 Vac - Single Phase - 4 Wires + PE		
3	20,83	144,00
6	41,66	288,00
9	62,49	432,00
12	83,32	576,00
15	104,15	720,00
18	124,98	864,00
21	145,81	1.008,00
24	166,64	1.152,00
27	187,47	1.296,00
30	208,30	1.440,00
Upstream / downstream protections and field wiring should be based on the maximum number of modules		

8. System Installation

8.1 Site Preparation

- Refer to section 7 to identify type of system and configurations.
- Input and output protections

When installing BPC inverter systems, UL489 listed AC upstream (input) and downstream (output) circuit breakers are required.

At AC and DC Input

Branch circuit protection breaker shall be provided in upstream switchgear regardless of any protective device already installed at the input of the BPC.

At output

Whenever the BPC is supplied with supplementary output breaker or without any protective device at all (see option listed in Section 7.2, page 18), appropriate Branch Protection Breaker shall be provided on site according to following table:

Output distribution shall be structured to guarantee tripping segregation. Contact manufacturer for recommendations and calculation methodology.

- Refer to Section 7.3, page 19 for sizing protections and connecting cables.
  All cables must be copper and rated for min 90°C (194°F).
- Cables shall be halogen free.
- Wire all positions for future expansion.
- Input AC / Output AC / Input DC / Signal cables shall be separated.
- Cable crossings shall be done in 90 deg angles.
- Empty inverter positions shall be covered with blanks.
- System cooling - BPC should not be installed at back of the wall. Air inlets at the front of the system must be in cold side. Air outlets are at the rear of the rack.
- Maximum operating ambient temperature is 40°C (104°F).
- This unit is intended for installation in a temperature-regulated, indoor area that is relatively free of conductive contaminants.
- For units not provided with Listed (DIVQ) over current protection – Input and Output over current protection is required by others.

Warning:

Presence of airborne particles such as urban dust, sand and metallic dusts are forbidden. Appropriate filters shall be installed.

Filters mounted to the air inlets reduce the air pressure and may cause inverters cut off by thermal runaway. De-ratings should apply. Refer to supplier for specific recommendations and approvals.

Corrosive chemicals and contaminants in the air or in the vicinity of the system are forbidden. Refer to supplier for specific treatments in industrial and maritime areas.

8.2 Unpacking the system

Modules are packed separately. They are normally marked to be replaced in the right slot (important for multi phase systems).

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

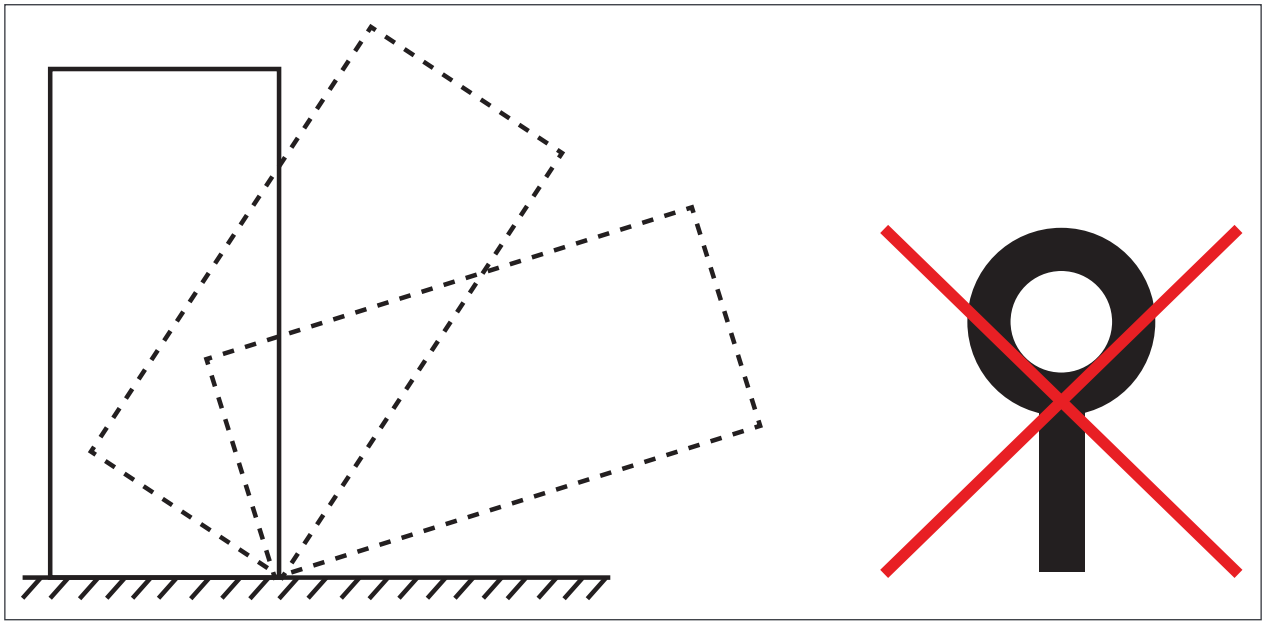
The rack is packed in a wooden box.

The packing material of the TSI system is recyclable.

Transport the rack in the box on the pallet.

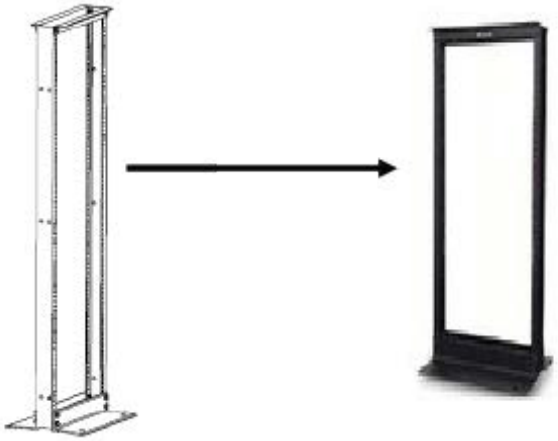
8.3 Raising the Rack

The top cover fixing bolts must NOT be replaced with lifting eye bolts. If modules are present then they must be removed before raising the rack .Mark and remove modules from the shelves, (because the modules must be replaced in the same slot) and raise the rack on actual location.



8.4 23 Inch Rack (Network Bay Frame/23 inch rack)

The TSI BRAVO High Density Frame-Mounted Inverter System is designed to mount in a standard 23 inch frame. Depending on the application, the system may arrive for installation in either a seven-foot frame, a half-height frame, or in lightweight rails. When planning the installation, consideration must be given to the placement of the frame. Allow for a footprint of 26 inched wide by 36 inches deep to ensure sufficient clearances from other vertical surfaces (walls or adjacent bays). The rear and right-hand side of the system must be accessible for terminating the input and output power cables. Since the system is fan-cooled, allow for adequate airflow front and rear (keep 1 feed free at rear).



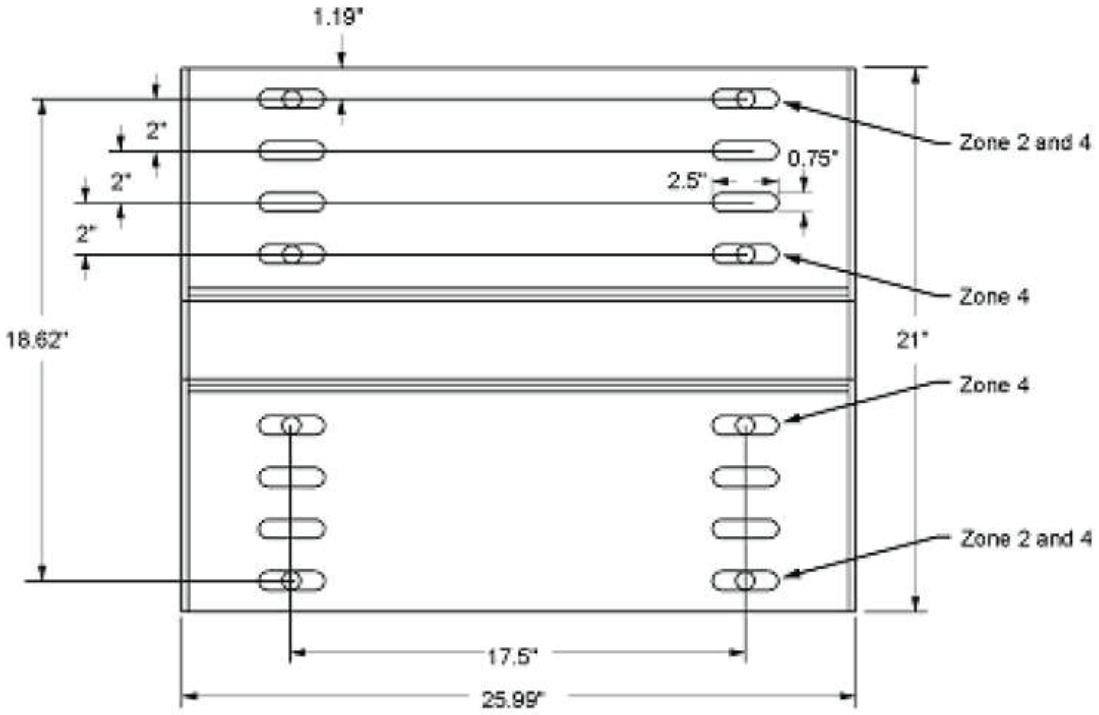
8.5 Fixing the relay rack to the floor

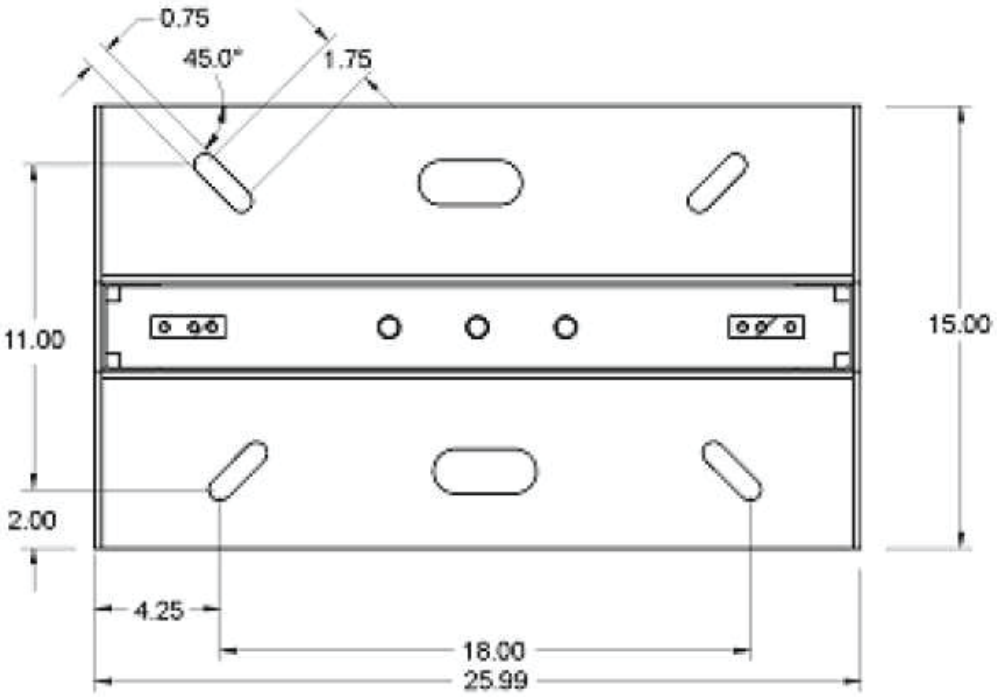
The TSI BRAVO System is suitable for mounting in standard 23 inch frames as well as heavy duty frames for seismic applications. The diagrams below show examples of commercially available frames that may support the BRAVO system in either case.

Before operation, always secure the framework to the floor with anchors approved for the specific application and location.

It is recommended that ½" anchors or larger be used in all cases. If there is question regarding the appropriate anchors and framework to use, please refer to the frame work supplier, local building codes and building drawings as necessary for additional information.

Always lift the frame mounted versions of the system by the frame. The BRAVO system is not designed for direct lifting.





When installing the Rail Mounted BPC system, it is recommended that the frame be secured to the floor before mounting the BPC system in the frame. Take care when lifting the Rail Mount System. Improper lifting of the unit may cause permanent damage to the system.

8.6 Cabling

Check section 7 to identify system configuration and refer to section 7.3, page 19, 7.4, page 20, and 7.5, page 21 for cable sizes. Refer also to 8.1, page 23 for important safety notices.

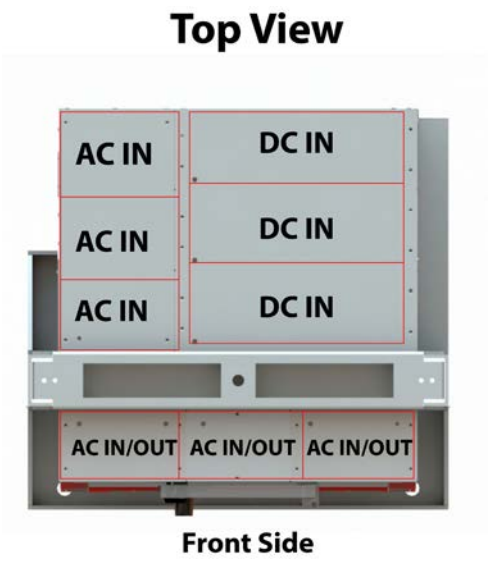
8.6.1 Tightening Torque

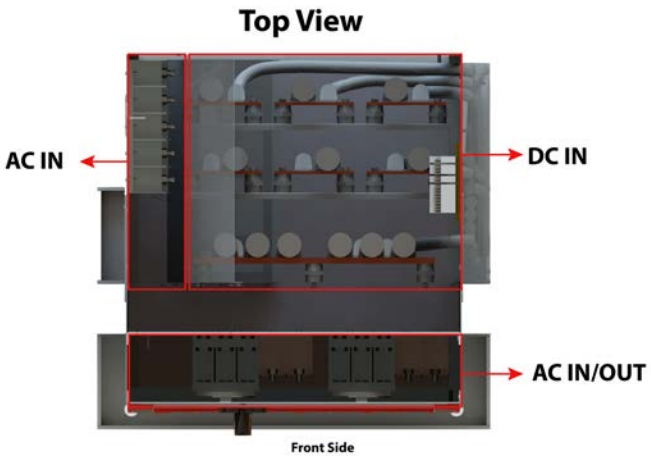
Torque recommendation for cable termination are

Size of wire for connection [AWG/kcmil]	Tightening Torque [pound-inches (N-m)]
2 -1	150 (16.9)
1/0 - 2/0	180 (20.3)
3/0 - 4/0	250 (28.2)
250 - 350	325 (36.7)
500	375 (42.4)

8.6.2 Cable Inlets

Use appropriate collar to fix the conduits to the rack ceiling. At top of the rack, use the existing sheet and make desired holes based on the cable size. The ceiling can be split to facilitate the cabling.
Install proper bushing to protect DC cables.





8.6.3 Grounding

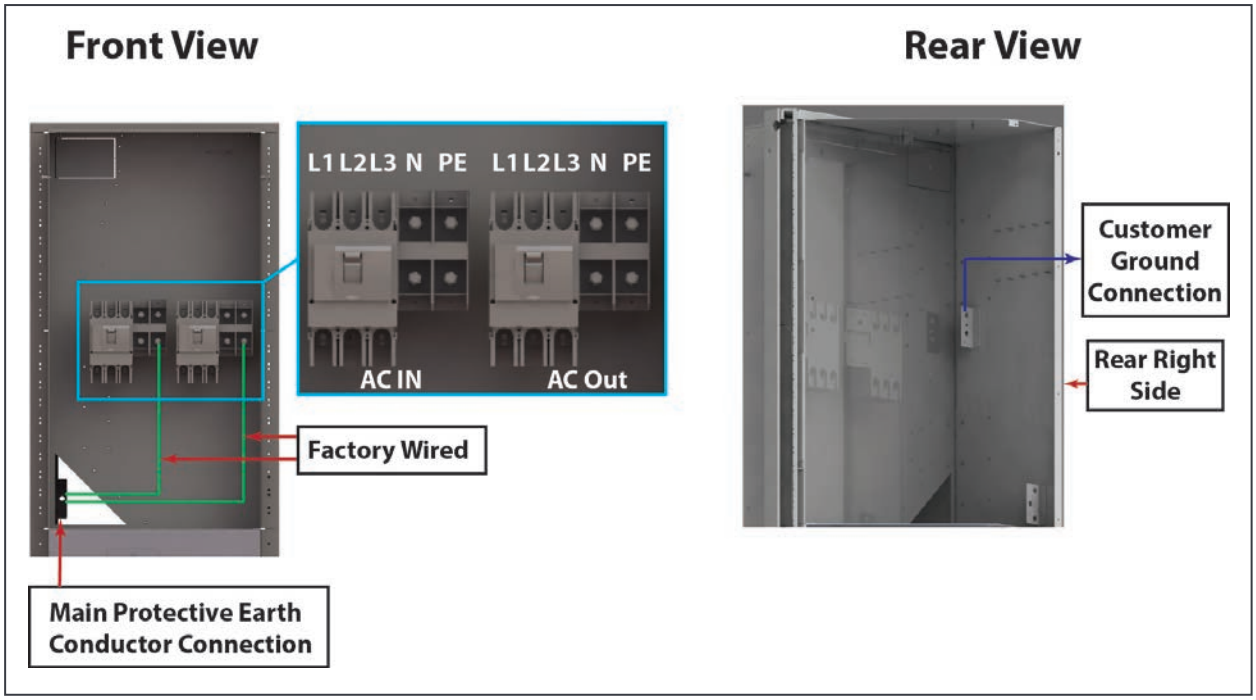
Main protective conductor(PE) connection is made to the X2(AC IN) terminal block marked with symbol for identification.

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. (see 8.6.4, page 29)

Ground has to be connected in accordance with local code.

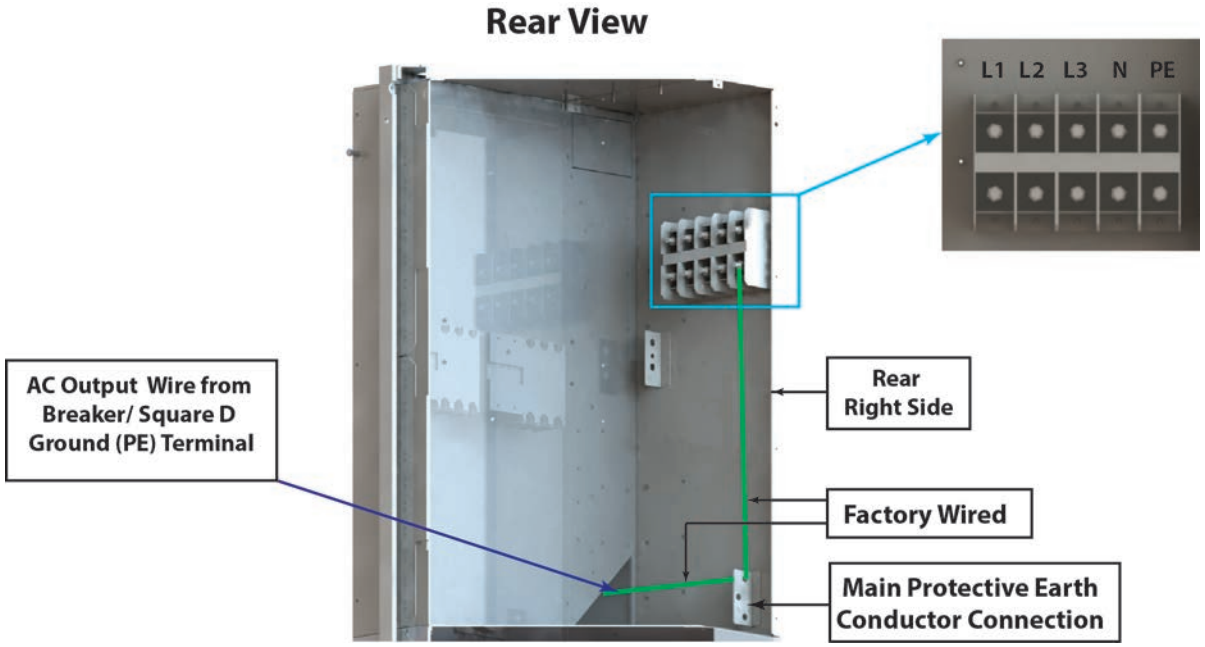
8.6.3.1 Grounding- 250 A Breaker

PE (Protective Earth) is connected to Earth Plate. It is factory wired and should not be removed.



8.6.3.2 Grounding- 125 A Breaker / Square-D

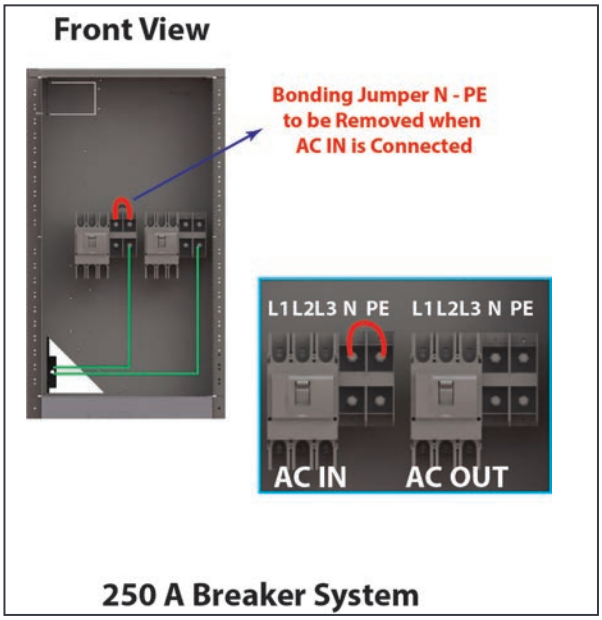
PE (Protective Earth) is connected to Earth Plate. It is factory wired and should not be removed.

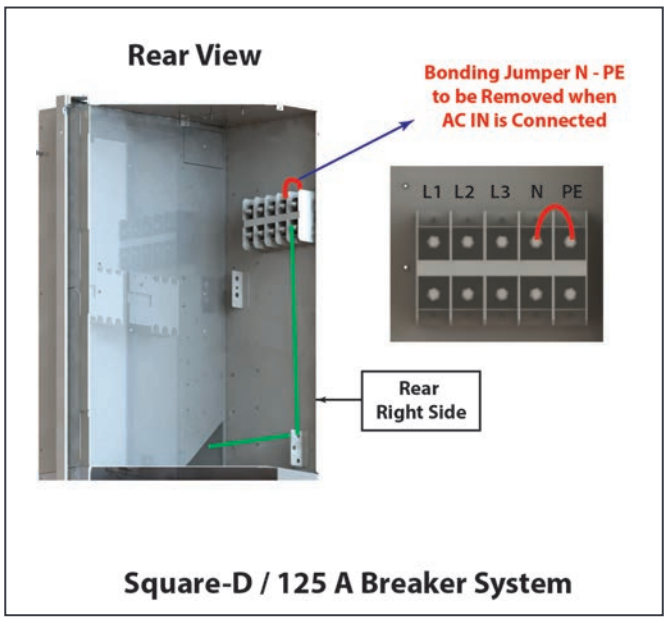


8.6.4 AC Input

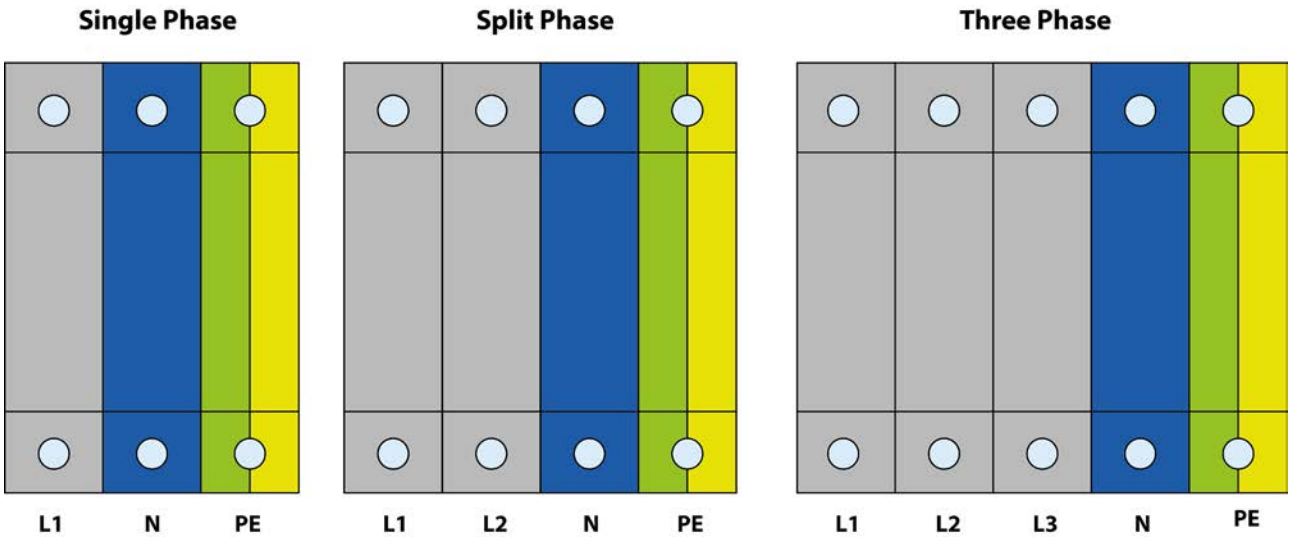
The pictorial representation of terminal blocks arrangement is as follows.

If AC IN is connected, remove the bonding jumper between N and PE.



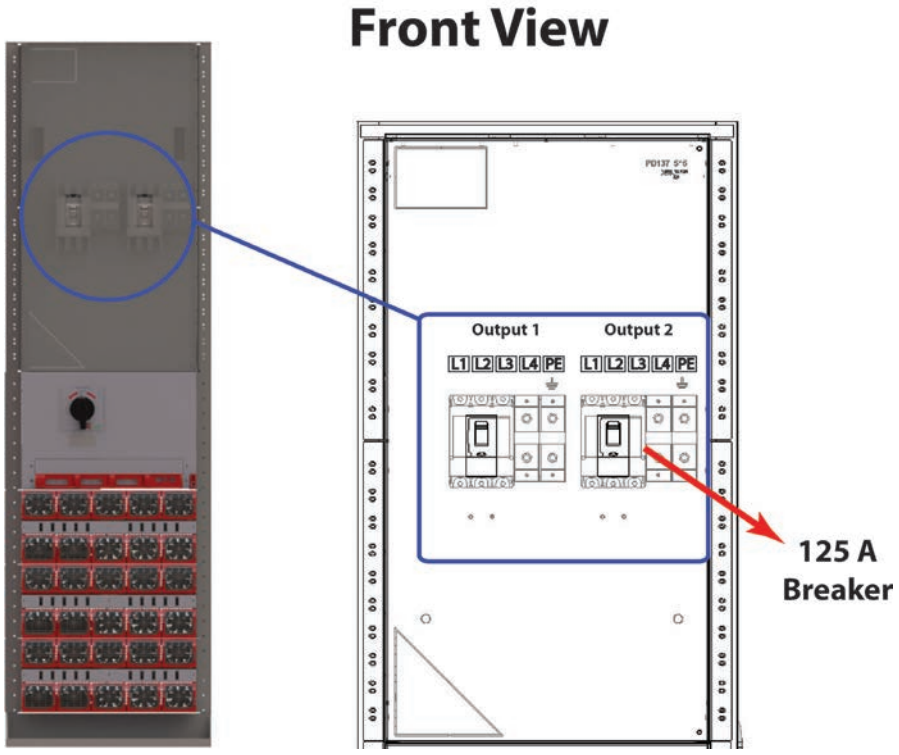


AC input should be wired to connecting terminal blocks as per following indications:

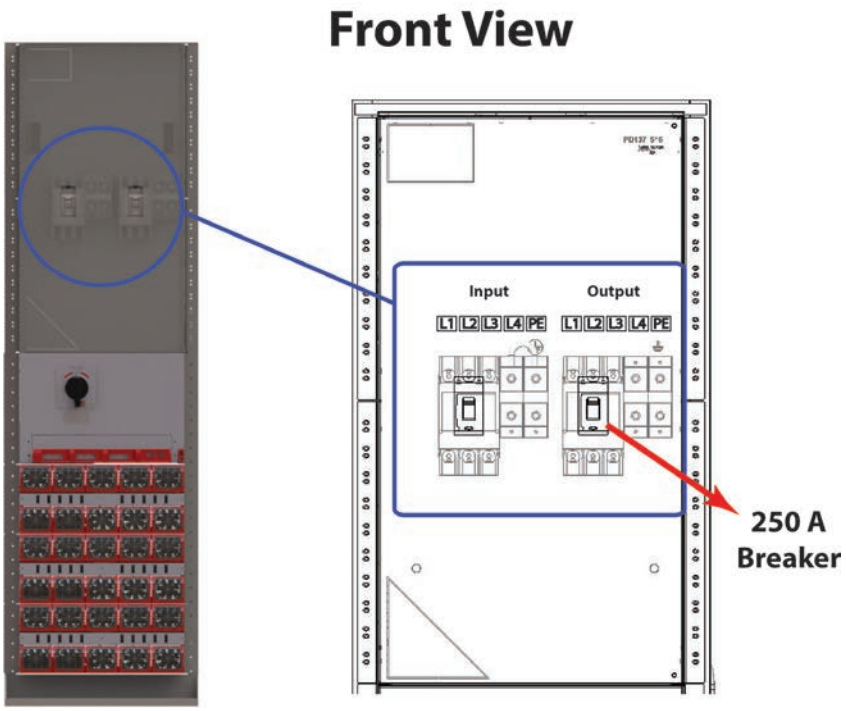


AC output should be wired to connecting terminal blocks as per anyone of the following possibilities.

8.6.4.1 Connecting AC Output to 2x125 A Breaker (STUDS M6)

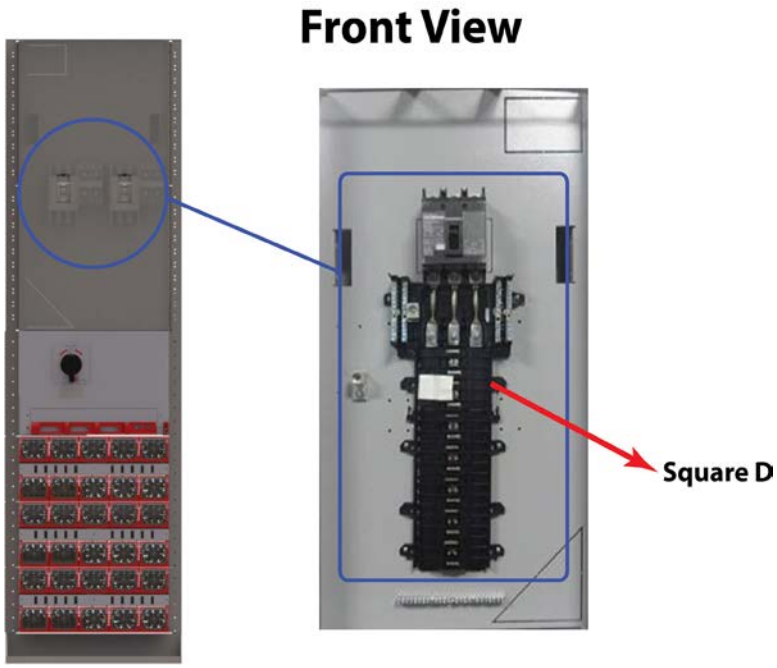


8.6.4.2 Connecting AC Output to 2x250 A Breaker (STUDS M10)



8.6.4.3 Connecting AC Output to Square-D Distribution Panel

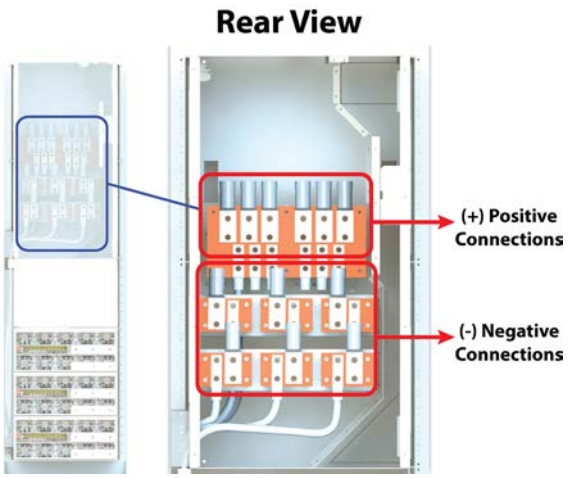
Note: Install only UL-Listed branch circuit breakers by Schneider Square-D, Type QO, QOA or Q1.

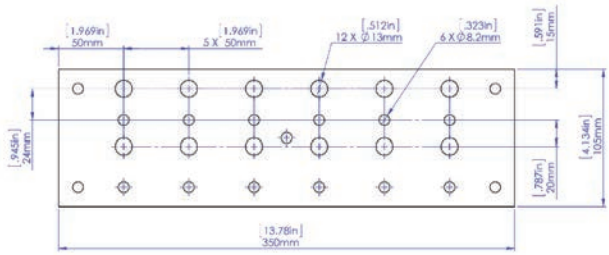


8.6.5 DC Input

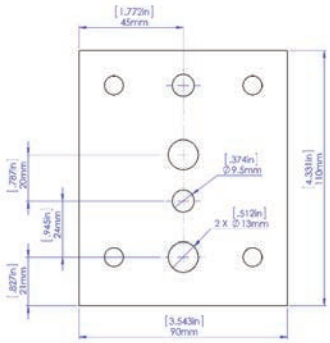
8.6.5.1 Individual Feed DC Input

- Use only C-UL-US or CSA Listed cable lugs.
- Individual DC connection.
- Note: Cable shoes are not included in the delivery.
- 2 hole xx" (M10) holes with 1"(25.4mm) between centre .
- Internal DC distribution with circuit breakers to each shelf.
- Max 1x500 kmcil
- Can be single or double lug (refer to site requirement for right type).

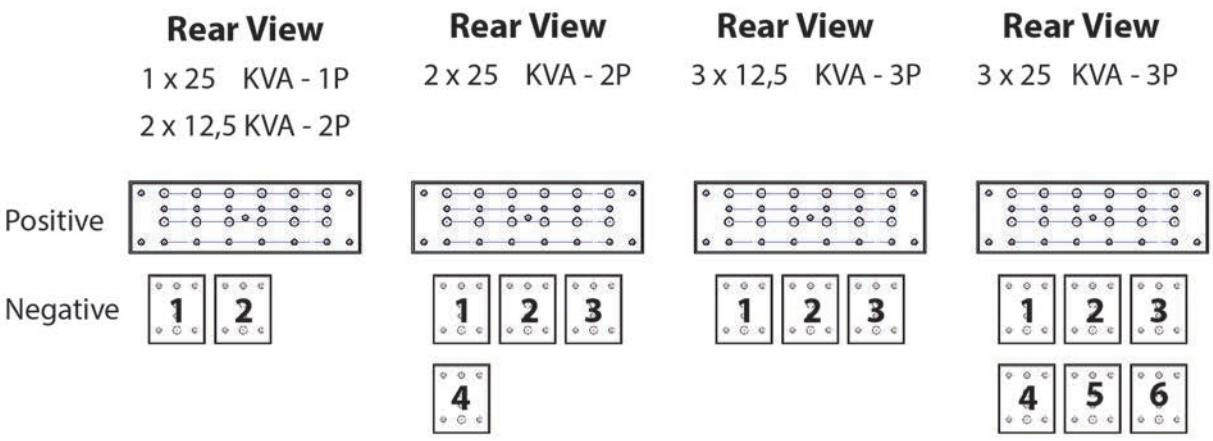




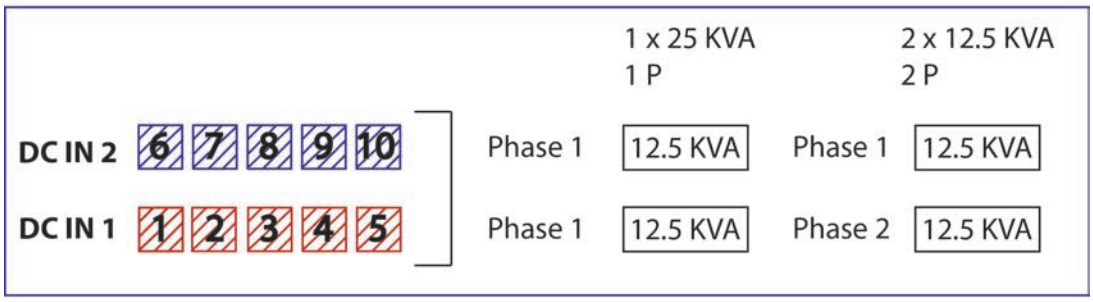
Postive Terminal Hole Details

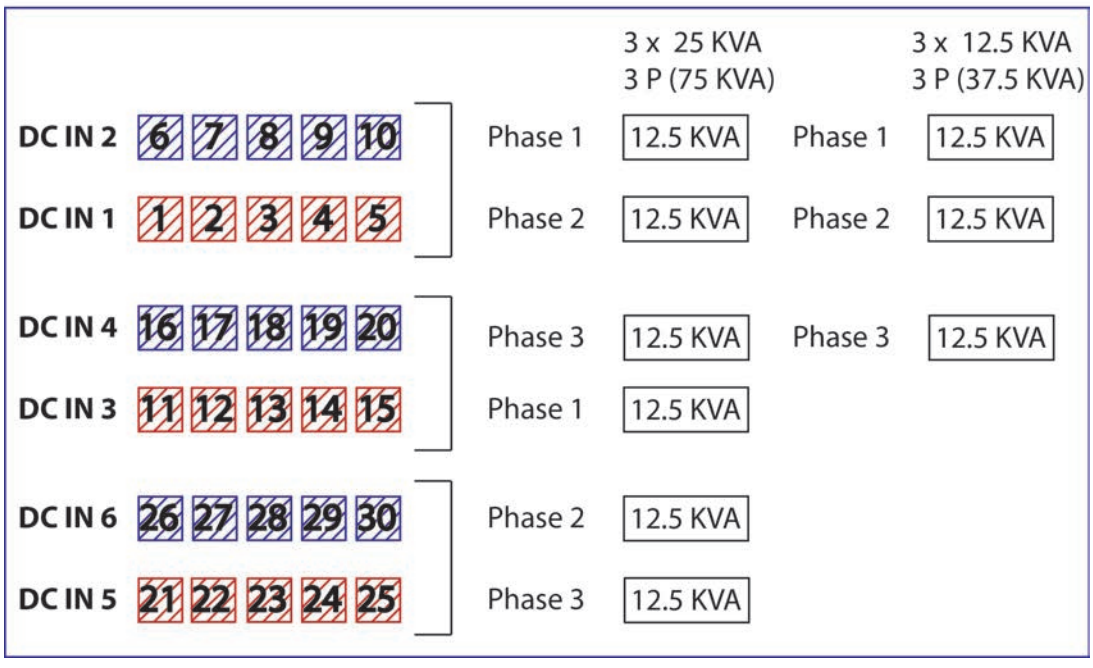


Negative Terminal Hole Details



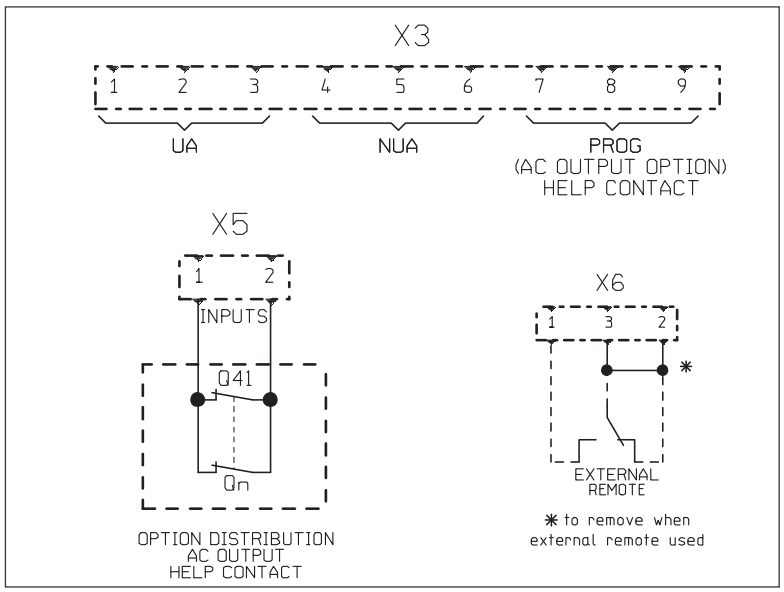
Individual Phase Details





8.6.6 Signalling

All relays are shown in non energized state.



8.6.6.1 Alarm (X3)

- Relay characteristics X3 (Major (UA), Minor(NUA), Prog)

  - Switching power 60W
  - Rating 2A at 30VDC / 1A at 60VDC
  - Max wire size 17 AWG (1mm2)

Relays are energized when idle and contacts are released when event occurs.

8.6.6.2 Digital In (X5)

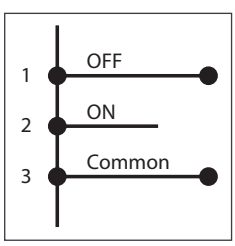
- Input characteristics X5 (Digital In 1, Digital In 2)

  - Signal voltage +5VDC (galvanically insulated)
  - Max wire size 17 AWG (1mm2)

8.6.6.3 Remote ON/OFF (X6)

Note: The system is by default equipped with a connection between pin 3 and 2. If remote ON/OFF is not used the strap shall remain. Should the remote ON/OFF be used the strap must be replaced with a changeover contact or emergency button.

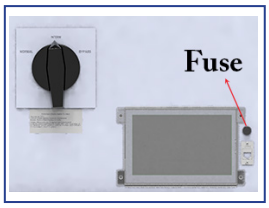
- The remote ON/OFF switch the output AC OFF.
- Input AC and input DC is not affected by the remote ON/OFF.
- The remote ON/OFF requires changeover contacts, one input opens as the other close. If both transitions are not picked up the status is not changed.
- Digital input characteristics (Remote On/Off)
  - Signal voltage +5VDC (galvanically insulated)
  - Max wire size 17 AWG (1mm2)



Functional table for remote ON/OFF function

#	Pin 1-3	Pin 2-3	Status	Indication
1	Open	Open	Normal operation	All (Green)
2	Closed	Open	OFF	AC output (OFF) AC Input (Green) DC Input (Green)
3	Open	Closed	Normal operation	All (Green)
4	Closed	Closed	Normal operation	All (Green)

8.7 Catena GUI Interface



Catena GUI Interface is a powerful web based touch screen graphical display, it allows user to easily access and monitor the system.

In addition to the touch screen display, user can also access to same GUI by using an Ethernet port which is present on the catena.

The Catena GUI Interface is protected with Fast Acting Fuse, which is present at front right side of the Catena. Incase of fuse failure, replace with same type and rating of fuse.

Warning: Risk of electric shock. For continued protection against risk of fire, replace only with same type and rating of Fuse.

Fuse Specification: Size - 5x20mm, Rated current - 2A, Rated Voltage - 250Vac 300Vdc, Fuse characteristics - Time-lag

Note:

Catena takes power from the shelve one. In order to access the Catena, the DC should feed on shelve one.

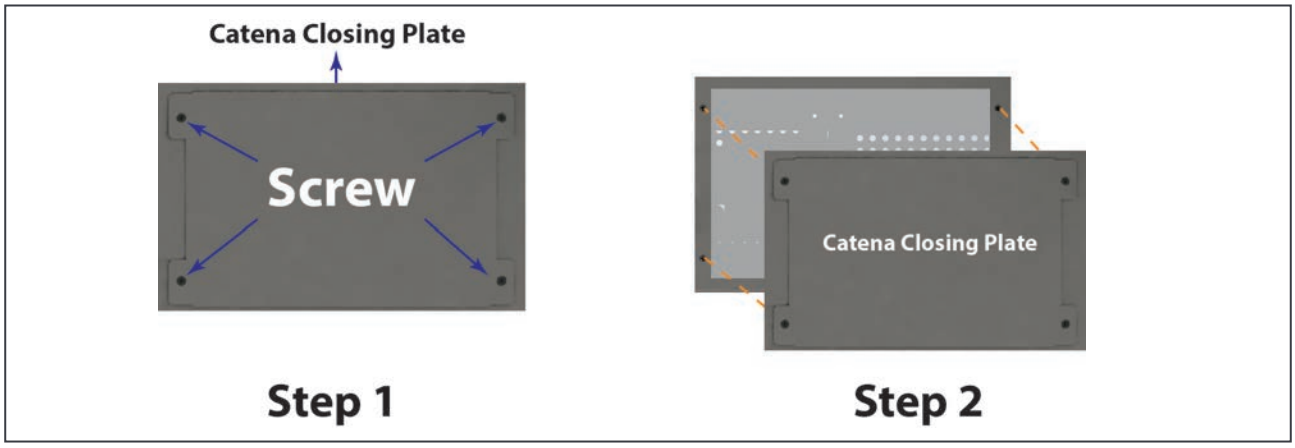
If Catena GUI Interface is not present in the system, Catena GUI Interface slot have to be covered using Catena Closing Plate.

8.7.1 Installing Catena GUI Interface

Catena GUI Interface can be installed into the system as per the following steps, if Catena GUI interface did not came along with system.

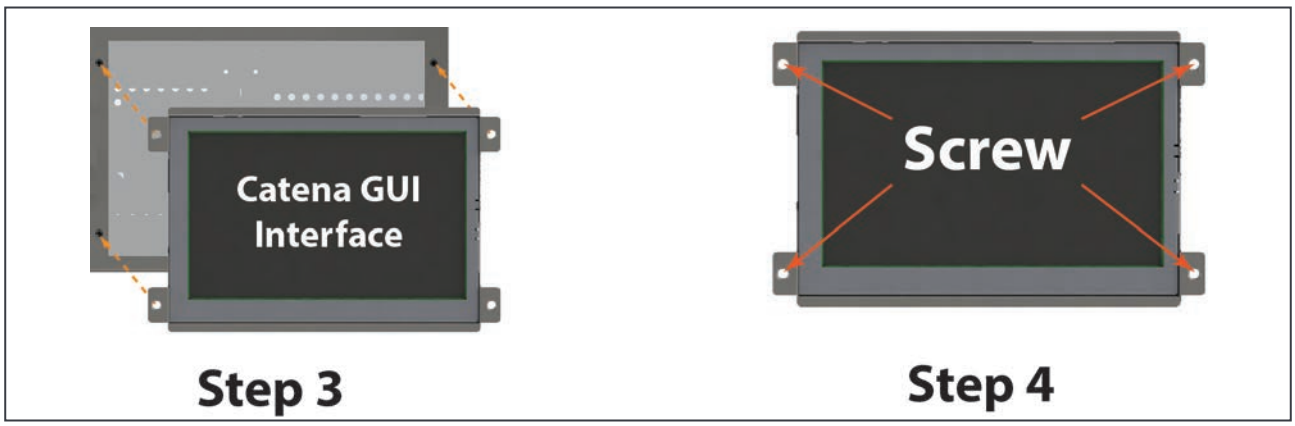
Step 1: Unscrew all the four screws of the catena closing plate.

Step 2: Remove the Catena closing plate.



Step 3: Connect appropriate cable to the Catena GUI Interface from the system and place it into the slot.

Step 4: Screw all the four screws on the Catena GUI Interface.

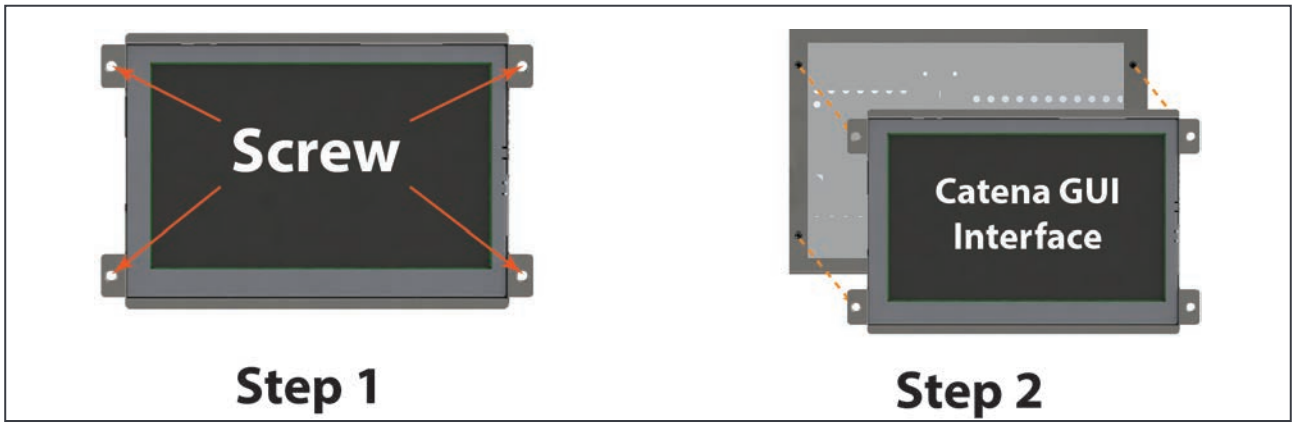


8.7.2 Replacing Catena GUI Interface

Catena GUI Interface can be replaced into the system as per the following steps.

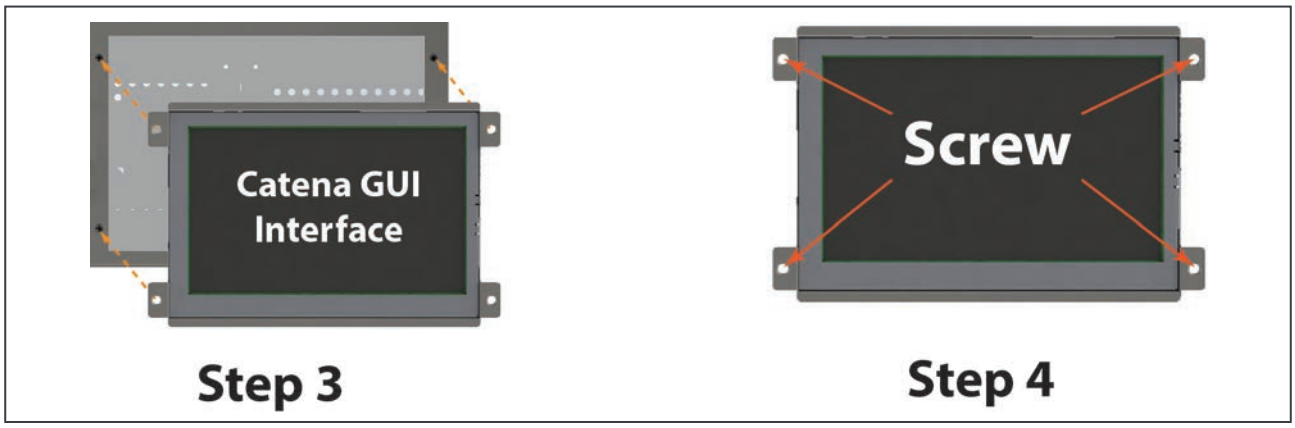
Step 1: Unscrew all the four screws on the Catena GUI interface.

Step 2: Disconnect appropriate cables in the Catena GUI Interface and remove it from the system.



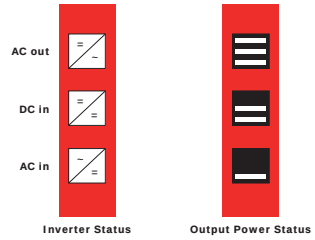
Step 3: Connect appropriate cable to the Catena GUI Interface from the system and place it into the slot.

Step 4: Screw all the four screws on the Catena GUI Interface.



9. Human-Machine Interface

9.1 Inverter module

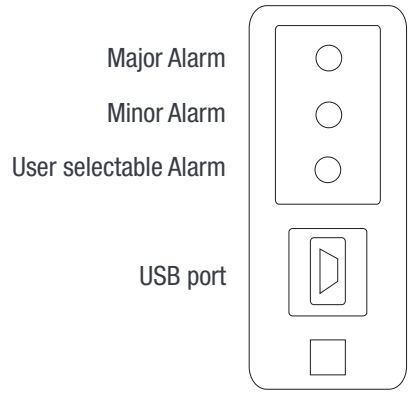


Inverter Status LED	Description	Remedial action
OFF	No input power or forced stop	Check environment
Permanent green	Operation	
Blinking green	Converter OK but working conditions are not fulfilled to operate properly	
Blinking green/orange alternatively	Recovery mode after boost (10 In short circuit condition)	
Permanent orange	Starting mode	
Blinking orange	Modules cannot start	Check T2S
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

- 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 or Copy/Paste.
- Factory default according to list of set values, see Table of set values



9.3 CANDIS

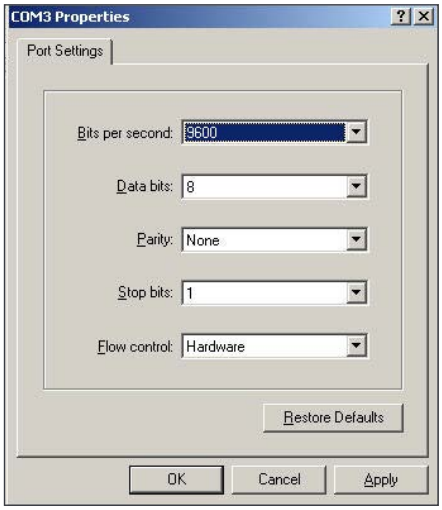
Refer to “Operating manual CanDis_Vx.xx” for detailed local monitoring with CANDIS.

10.System Set up

BPC 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 Hyper terminal installed on laptop
- USB cable type A to B (not included)
- T2S driver “CET_T2S.inf“installed on laptop.
- Available for download at http://www.acbackuptsi.com
  - Username: T322010000
  - Password: No password required (enter).

10.1 Communication setting

- Bits per second 115200
- Data bits 8
- Parity None
- Stop bits 1
- Flow control None

Remark: Refer to document XXXX for detailed system setting and operation.

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 (no more available since version 2.5)
  - 4 > Restore factory settings (no more 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

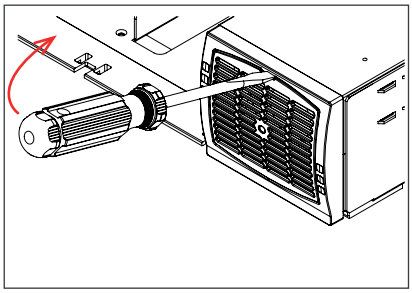
11.1 TSI Inverter

- The TSI inverter module is hot swappable.
- 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.

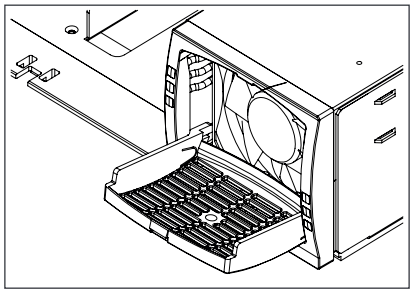
11.1.1 Removal

Notice: When one or several inverter modules is/are removed, live parts become accessible. Replace module with blinds without delay.

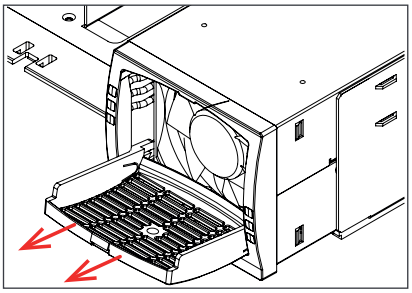
- Inverter module is not switched off when opening the handle. The handle only hooks the module to the shelf.
- Use a screw driver to release the latch of the handle.
- Open the handle and Pull the module out.
- Replace with new module or blind unit.



A) Use screwdriver to release the latch



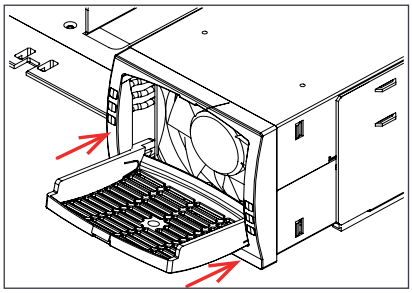
B) open the cover completely



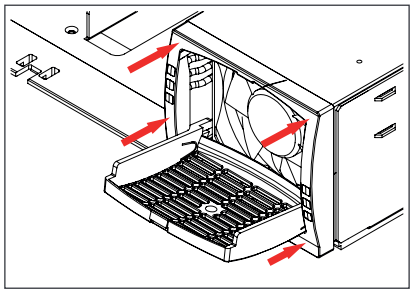
C) Use the cover as a handle to remove the module

11.1.2 Inserting

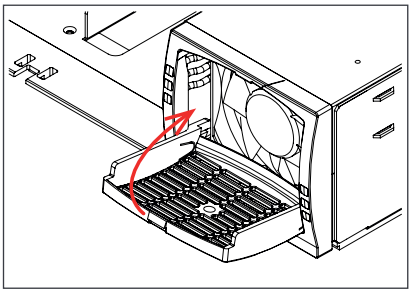
- Use a screw driver to release the latch of the handle.
- Open the handle and Push firmly until the unit is properly connected.
- Close the cover and latch in position.



A) Slide the module in



B) Push firmly till the connection is properly engaged

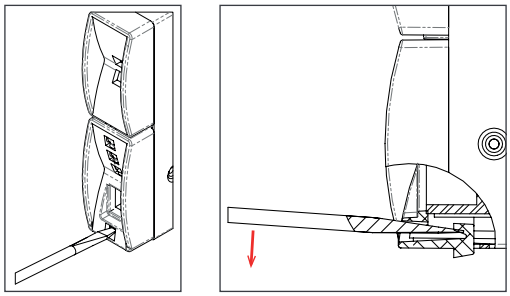


C) Close the cover and latch the module in place if too hard redo step B

11.2 T2S

11.2.1 Removal

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



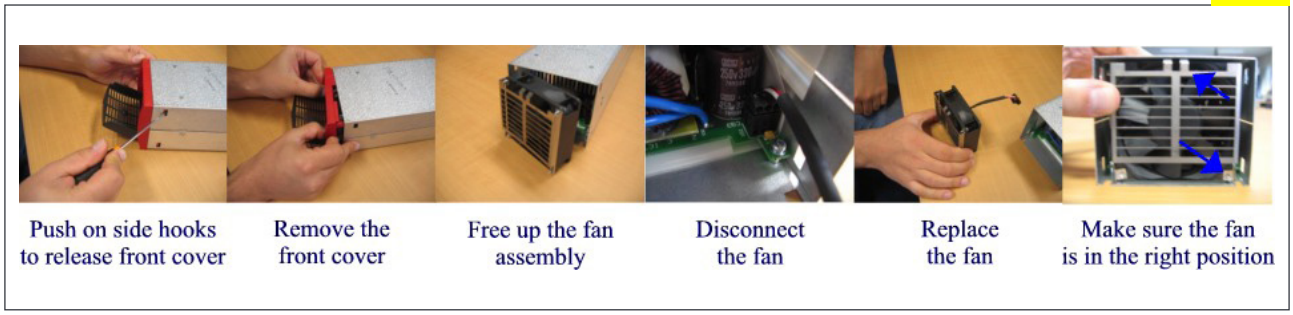
11.2.2 Inserting

- Push the module firmly in place until the latch snaps in position

11.3 Fan replacement

The FAN life is approx 45.000hours. The inverter modules have fan runtime meters and fan failure alarm. Fan failure can result from failing fan or driver circuit.

- Let the module rest at least 5 minutes prior to 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 latch properly.
- Plug in
- Check fan for operation
- Access T2S and reset the fan run time alarm from within the action menu



12.Manual By-Pass Operation

Manual By-Pass has to be operated by trained people only.

When system is in manual by-pass the load is subjected to mains AC voltage without active filtering.

Output alarm when system is in manual by-pass as “MBP Engaged” .

The manual by-pass is not possible to operate remotely.

MBP switch is optional

12.1 Pre requisites

Before engaging the MBP following conditions have to be fulfilled and actively checked.

- Commercial AC must be present.
- Inverter must be synchronized with commercial power.
  - Use Voltmeter to measure voltage between L1- commercial and L2 - inverter output.
  - Do same measurement with L2 – L3 and L3 – L1.
  - In all cases, voltage shall be less than 20V.
- The upstream AC & DC breaker must be correctly sized (Refer 7.3, page 19) to accept possible overload, The inverter might be overloaded during MBP procedure, depending on voltage network and output inverter voltage setting and if the AC is supplied by a Gen-set, the minimal required power will be twice nominal power of the inverter.

12.2 Manual by-pass Operation

The manual by pass operates via individual switch that creates a by-pass from mains input via output AC distribution. Inverter modules are by-passed and possible to disconnect without impacting the load.

Operation is “Make before Break”.

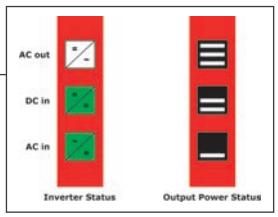
12.2.1 Normal to By-pass, Engage MBP

1. Turn the switch from **Normal** to **INTERIM**.
2. Turn the switch from **INTERIM** to **Bypass**.
3. Switch DC OFF.

Manual By-Pass put the module in OFF state but doesn’t disconnect the DC.
Make sure DC is disconnected before any intervention inside the system.

Warning: Risk of electric shock. Power will be available at AC Input terminal, AC Output terminal, DC Input terminal, and Surge Arrestors.

12.3 By-pass to Normal, Disengage MBP



1. Switch DC ON.
2. Turn switch to INTERIM (mid position).
3. PAUSE, wait until the inverter modules have come to full operation (30-60seconds).
4. Complete twist to NORMAL.

WARNING

IF ATS (automatic transfer switch) IS INSTALLED UPSTREAM TO SELECT AC SOURCE. MAKE SURE THAT THE ATS SWITCH DOES NOT ALLOW TRANSFER BETWEEN AC SOURCE OUT OF SYNC. THE MAXIMUM ALLOWED PHASE SHIFT IS 10°.

12.4 Switching OFF BPC System

Perform the following steps to Switch OFF the BPC System.

Caution: While switching OFF the BPC System, the power to load will be disconnected.

1. Switch OFF AC Output Breakers.
2. Switch OFF AC Input Breakers.
3. Switch OFF DC Input Breakers.
4. Switch OFF the Upstream and Downstream Breakers.

Caution – Risk of electric shock. Capacitors store hazardous energy. Do not remove the system from the cabinet atleast five minutes after disconnecting all sources of supply.

13. Final check

- Make sure that the sub-rack/rack is properly fixed to the frame/floor
- Make sure that the sub-rack/frame is connected to Ground.
- Make sure that all DC and AC input breakers are switched OFF.
- Make sure that all cables are according to recommendations and local regulations.
- Make sure that all cables are strained relived.
- Make sure that all breakers are according to recommendation and local regulations.
- Make sure that DC polarity is according to marking.
- Re tighten all electrical terminations.
- Make sure that no inverter/controller positions are left open.
- Cover empty inverter positions with blanks.
- Make sure that the Remote ON/OFF is appropriately wired according to local regulations.
- Make sure that the point of AC supply meets local regulations.

14.Commissioning

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

Installation and commissioning must be done and conducted by trained people fully authorized to act on installation.

It is prohibited to perform any isolation test without instruction from manufacturer.

Equipments are not cover by warranty if procedures are not respected.

14.1 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 off the inverter from the shelf, to interrupt electrical contacts)	
Check the commercial AC before closing the AC input breaker.	
Switch ON the commercial AC	
Check if inverters are working (Green led)	
Check the DC power supply and switch ON the DC breakers	
Plug in all inverters one by one	
Check output voltage (on bulk output or on breaker)	
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 according to the site (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	
Check if display working properly (if this CANDIS option is present)	
Check if TCPIP working properly (if this option is present)	
Test on load (if available)	
ALARM	
Switch ON AC input and DC input and check that no alarm 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)	

15.Trouble Shooting and Defective Situations Fixing

15.1 Trouble Shooting

Inverter module does not power up:	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:	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:	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:	Check output breaker
All OK but I have alarm:	Check configuration file and correct No of modules
	Download/clear log file
No output alarm:	Mind the default time delay (UA: 60s, NUA: 30s)
	Check configuration file
No information on CanDis:	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:	Check that the RJ45 cable is connected between T2S shelf and CanDis shelf
	Wait approx 2 minutes to allow the system to collect serial data.

15.2 Defective modules

Unless input power is down all module LEDS should lit green(see section 9, page 32). No light, orange light , red or flashing light are abnormal conditions. Refer to section 10.2, page 34 to collect and record module information. If no fix can be found, replace module.

15.2.1 Replacing modules

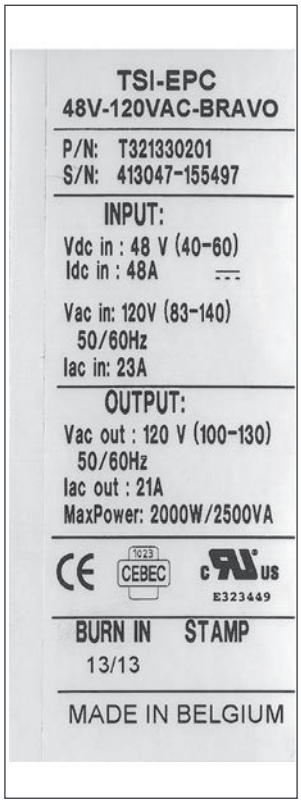
Refer to section 11, page 35 to remove and re-insert modules.

15.2.2 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 15.2.4, page 47.

15.2.3 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 15.2.4, page 47.



15.2.4 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 through the http://my.cet-power.com extranet. Repair registering guidelines may be requested by email at repair@cet-power.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.

16. 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 customer.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 a day.

17.Maintenance Task

As maintenance will perform on live system, all task should perform only by trained people with sufficient acknowledge on TSI product.

Tasks :

- Identify the site, customer, responsible, 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 built up clean the TSI with vacuum cleaner and/or soft compressed air.
- Clean system (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 system 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.