

# TIER-1 POWER SYSTEM (T-1PS)

## User Manual V1.0

### 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



**Important Safety Instructions**  
**Save these Instructions**

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*Leading AC Backup Technology*

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1.0	04/08/2017	-	First release of the Manual.



*Leading AC Backup Technology*

**CE+T at a glance**

## 1. CE+T at a glance

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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 performance, 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 days per year.

## 2. Abbreviations

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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
TUS	TSI Universal Synchronization
TCP/IP	Transmission Control Protocol/Internet Protocol
USB	Universal Serial Bus
PE	Protective Earth (also called Ground Conductor)
N	Neutral
PCB	Printed Circuit Board
TRS	True Redundant Structure
MCB	Miniature Circuit Breaker
MCCB	Molded Case Circuit Breaker
CB	Circuit Breaker



### 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, 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, 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 manual.

#### 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 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 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.
- Never wear metallic objects such as rings, watches, or bracelets during installation, service and maintenance of the product.
- Maximum operating ambient temperature is 40°C (104°F).
- Insulated tools must be used at all times when working with live systems.
- When handling the system/units pay attention to sharp edges.
- This product is suitable for use in a computer room.

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

## Warranty and Safety Conditions

### 3.3 Installation

- This product is intended to be installed only in restricted access areas as defined by UL60950 and in accordance with the National Electric Code, ANSI/NFPA 70, or equivalent 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.
- 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 power free.
- REG systems and EPC systems that have no AC input wired and connected can be seen as independent power sources. To comply with local and international safety standards N (input) and PE shall be bonded. The bonded connection between N (input) and PE must be removed once the AC input is connected, Refer 8.5.4, page 28.
- 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 maximum. The parameter can be adjusted on T2S ETH; 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.
- The system is designed for installation within an IP20 environment. When installed in a dusty or humid environment, appropriate measures (air filtering ...) must be taken.
- Environment Conditions:
  - Storage Conditions: -40 to 70°C
  - Relative Humidity: 95%, non-condensing
  - Altitude above sea without de-rating: Less than 1500 m  
Greater than 1500 m – de-rating at 0.8% per 100 m

#### 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 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. The modular inverter system/rack can reach hazardous leakage currents. Grounding must be carried out prior to energizing the system. Grounding shall be made according to local regulations.





## Warranty and Safety Conditions

### 3.3.3 Other

- Insulation 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. Grounding must be carried out prior to energizing the system. Grounding shall be made according to local regulations (NEC - NFPA 70).
- Prior to any work conducted on a system/unit make sure that AC input voltage and DC input voltage are disconnected.
- Inverter modules and shelves contain capacitors for filtering and energy storage. Prior to accessing the system/modules after power down, wait at least 5 minutes to allow capacitors to discharge.
- Some components and terminals carry high voltage during operation. Contact may result in fatal injury.

### 3.5 Replacement and Dismantling

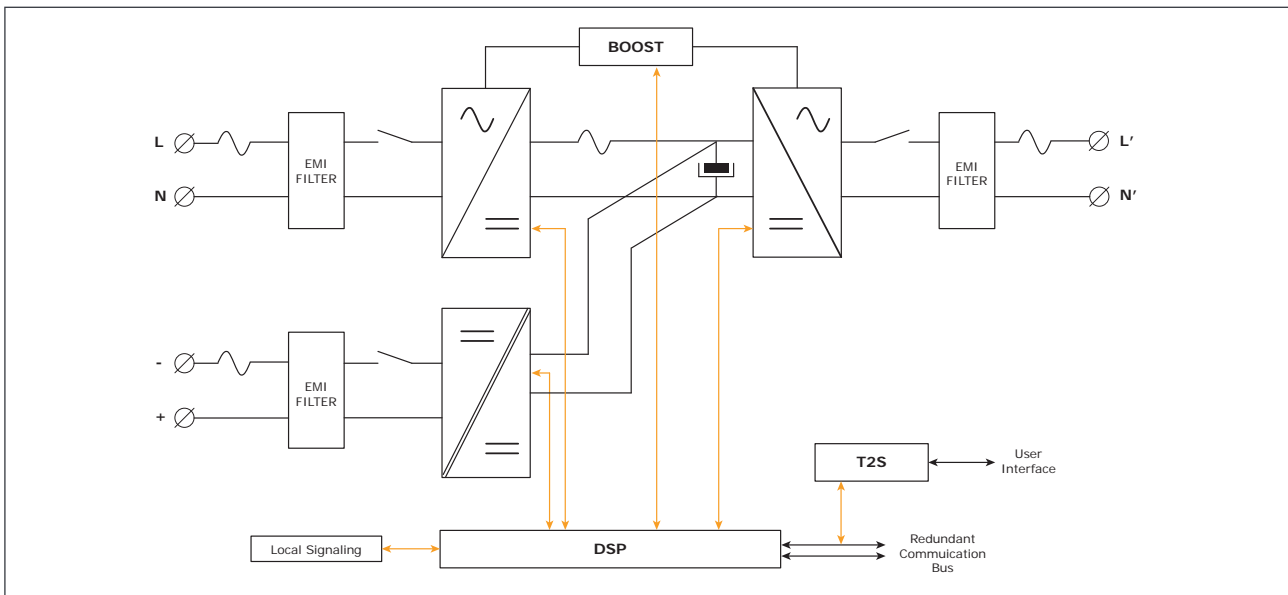
- ESD Strap must be worn when handling PCB's and open units.
- CE+T cannot be held responsible for disposal of the Inverter system and therefore the customer must segregate and dispose of the materials which are potentially harmful to the environment, in accordance with the local regulations in force 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](http://www.cet-power.com)

## 4. TSI TECHNOLOGY <sup>1</sup>

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

The block diagram 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. The output sine wave is constant and disturbance free regardless of the active source due to internal energy buffering,

The BOOST functionality multiplies the nominal current by 10 for a period of 20 ms (max) in the event of downstream current surge or fault. 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 TRS functionality is included in every inverter module. Running them in parallel provides a modular system with no single point of failure, 100% pure sinusoidal output, high system efficiency, and 0 ms source transfer time.

<sup>1</sup> 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.

### 4.1 EPC Mode

- In EPC mode, the AC Main source is the primary source while the DC source is secondary.
- The TSI is designed to operate on the AC main source on a permanent basis and to deliver output AC voltage with low THD.
- There is no physical difference on the output sine wave whether the source is AC (or) DC. If the AC main source is out of tolerance or drops below acceptable level, the converter seamlessly switches to DC and the converter operates in “Back-up mode” (Transfer time is 0 ms).
- As soon as the AC main source returns to its normal operating 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 sine wave output.

### 4.2 On-line Mode

- In On-line Mode, the DC source is the primary source of supply while the AC main source 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 AC power to the load.
- In case of short circuit at the load side, the boost is automatically energized for a specific duration to trip downstream protective devices.

### 4.3 Safe Mode

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

### 4.4 Mix Mode & Walk-in Mode

- Under certain circumstances the DC and AC source can be combined. The sequence is defined by a user selectable set of parameters. Start, control and exit functions 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.
- Setting for Walk-in mode and Mix-mode can be made through the T2S supervisor configuration file. See Section 8, page 24 for more information on T2S supervisor.

#### Note: 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.

## 5. Inverter Components

### 5.1 Inverter module

BRAVO: -48 VDC / 120 VAC, 60 Hz (50 Hz).

- 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.
- Inverter modules can be combined to build a single or multi-phase structure.
- The inverter modules are equipped with soft start.
- The fan is equipped with 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].



**Note:** BRAVO modules for use in NEBS environment are of different design. Use only BRAVO modules with specific NEBS label and Part Number.

### 5.2 Sub-rack (Shelf)

- The BRAVO shelf shall be integrated in min 600 mm deep cabinets, 19 Inch / ETSI mounting.
- The BRAVO shelf houses max four (4) inverter modules and one (1) T2S interface. Max 10 kVA per shelf.
- Additional shelves can be stacked and interconnected to build more powerful structures.
- The BRAVO 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.
- 18.9" (D) x 19" (W) x 2U (H). [480 mm (D) x 19" (W) x 2U (H)].
- 13 Lbs [6 Kg] empty.

**Note:** Sub-Rack (shelf) for use in NEBS environment are of different design. Use only shelves with specific NEBS label and Part Number



**Shelf is not field replaceable and is not sold separately**

## 6. Accessories

### 6.1 T2S ETH Interface

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

The T2S ETH doesn't perform any control or management of the TSI system. It can be removed, replaced or moved to another live system without affecting the original TSI system operation nor the target system.

#### 6.1.1 Parameters setting

The T2S ETH interface is featured with a ETH port 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 ETH is described in separate manual available on request)

#### 6.1.2 System diagnostic and troubleshooting

The T2S ETH 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 ETH is described in separate manual available on request)

#### 6.1.3 Monitoring

The T2S ETH monitors max of 32 system modules.

The T2S ETH is featured with

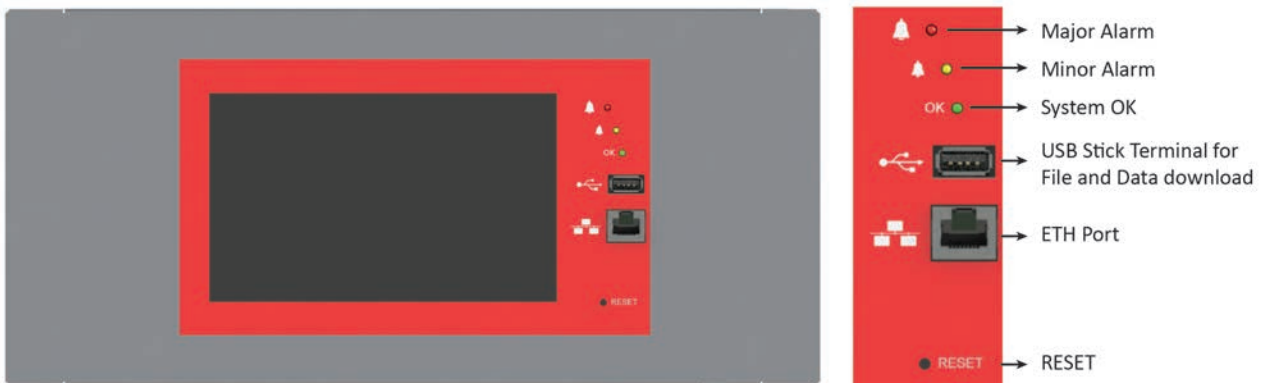
- 3 digital output alarm contacts.
- 2 digital input contacts.
- MOD bus.
- CAN bus (optional).
- Alarm monitoring.
- Log file of the latest 500 events as FIFO.
- SNMP V1 status monitoring.



### 6.2 Catena GUI Shelf

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.



- Measures
  - AC IN (Voltage / Current / Power)
  - DC IN (Voltage / Current / Power)
  - AC OUT (Voltage / Current / Power)
  - Module Temperature
- Alarms
  - Major/Minor
  - System Level
  - Phase Information
  - Module Information
- 7" touchscreen
- Web browser with laptop (ETH)
- Height: 3U

**Note:** Catena is not intended to be connected to metallic Outside Plant (OSP) cable conductors.

(Operation of Catena is described in separate manual available on request)

### 6.3 Surge Arresters

The mains (AC) supply of the modular inverter system shall have suitable Lightning surge suppression and Transient voltage surge suppression installed. Manufacturer's recommendations of installation shall be followed. It is recommended to select a device with an alarm relay for function failure.

Surge arrester (optional) is installed in the rack. (NOTE: 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 surges 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 susceptible to lightning than other areas, whereas the intensity dramatically increases with the altitude.

The selection of the surge arresters as well as their installation shall adhere to strict rules. Not adhering to 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 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 not covered by CE+T product warranty.

**Caution:**

**For continued protection against risk of fire, replace only with same type and rating of fuse.**

### 6.4 TUS

TUS (TSI Universal Synchronization) allows synchronization of more than 32 TSI inverter modules to create a “large system” in order to share power, voltage, current, frequency between their AC output.

TUS is able to create A+B system where both system are synchronized with or without AC output connected in parallel.



The TUS shelf shall always be located at the bottom (below the power module) to prevent too high operating temperature of TUS module and impact their MTBF. Installer shall prevent any hot air from the back side of the power module to flow through the TUS shelf from the rear or the front.

*(Operation of TUS is described in separate manual available on request)*



## 7. T-1PS Design and Description

### 7.1 T-1PS 75 System

#### 7.1.1 T-1PS 75 System Design

T-1PS 75 is a cabinetized modular inverter specifically designed for clean, temperature controlled, environments.

- Telecom grade design.
- The system cannot be installed back to a wall. A minimum clearance distance of 36 inch is required.
- The system is intended for Central Offices only.
- Based on BRAVO 48 VDC-120 VAC TSI module.
- Fully modular.
- Support redundant configurations.
- Support EPC mode.
- Cabinet NEMA 1 (IP 20).
- 84.252" (H) X 23.622" (W) X 27.559" (D). [2140 mm (H) X 600 mm (W) X 700 mm (D)].
- Weight 1120 lbs (562 Kg)



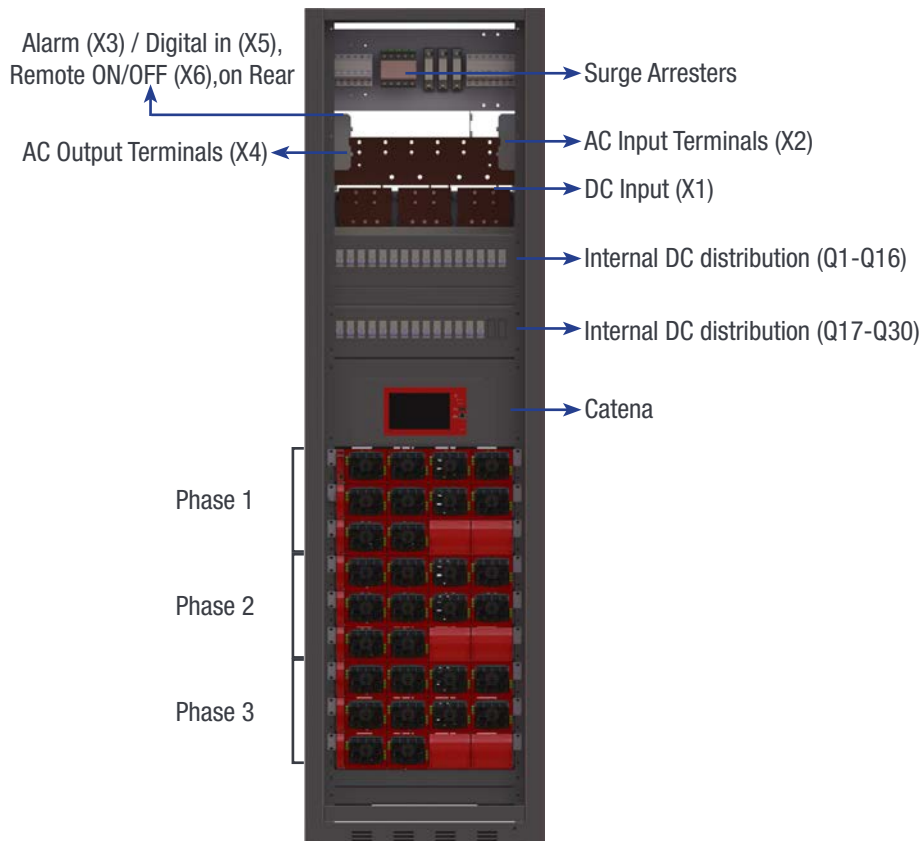
## T-1PS Design and Description

### 7.1.2 T-1PS 75 System Description

**T-1PS 75** comes fully equipped with

- DC individual protection for modules.
- CATENA GUI and remote monitoring capabilities.
- T2S ETH interface.
- TUS (Installed in 150 KVA and 225 KVA Systems).

**PLEASE ! Refer to the technical drawings received with your cabinet for exact positioning!**



## T-1PS Design and Description

### 7.2 T-1PS 150 and 225 System

#### 7.2.1 T-1PS 150 and 225 System Design

**T-1PS 150 and 225** is a cabinetized modular inverter specifically designed for clean and temperature controlled environments.

- Telecom grade design.
- The system cannot be installed back to a wall. A minimum clearance distance of 36 inch is required.
- The system is intended for Central Offices only.
- Based on BRAVO 48 VDC-120 VAC TSI module.
- Fully modular.
- Support redundant configurations.
- Support EPC mode.
- Cabinet NEMA 1 (IP 20).



**T-1PS 150 KVA System**



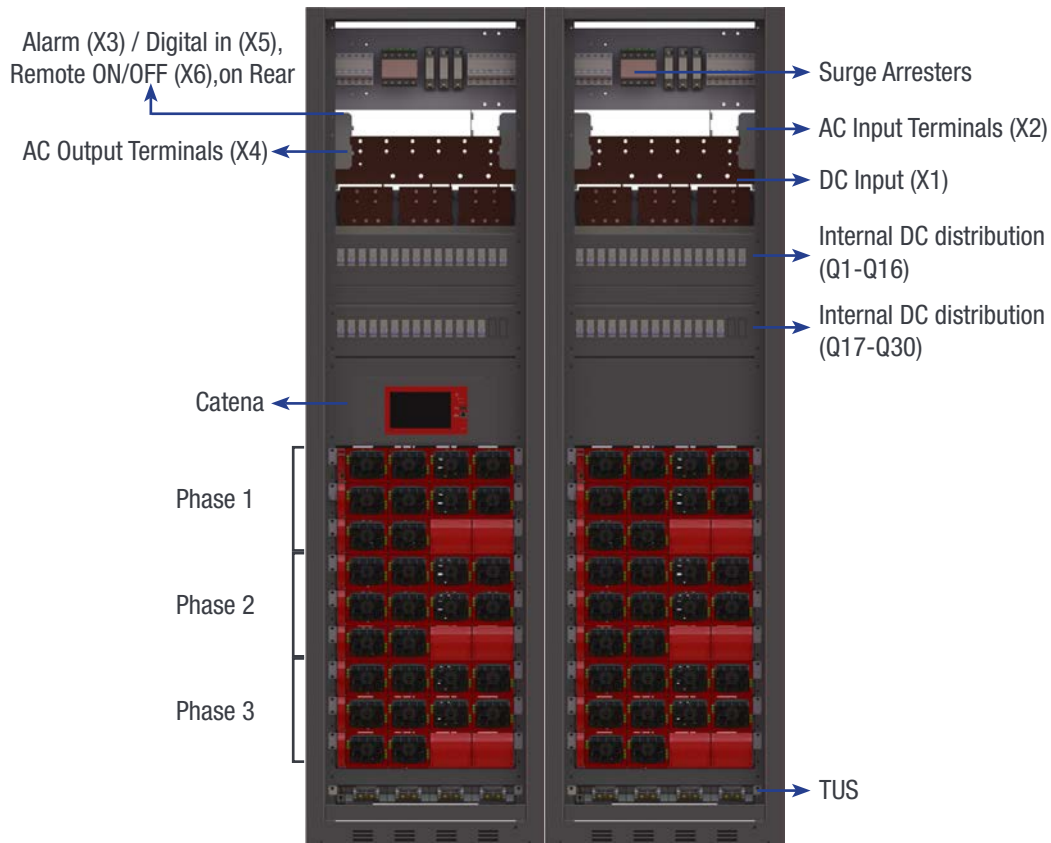
**T-1PS 255 KVA System**

## T-1PS Design and Description

### 7.2.2 T-1PS 150 and 225 System Description

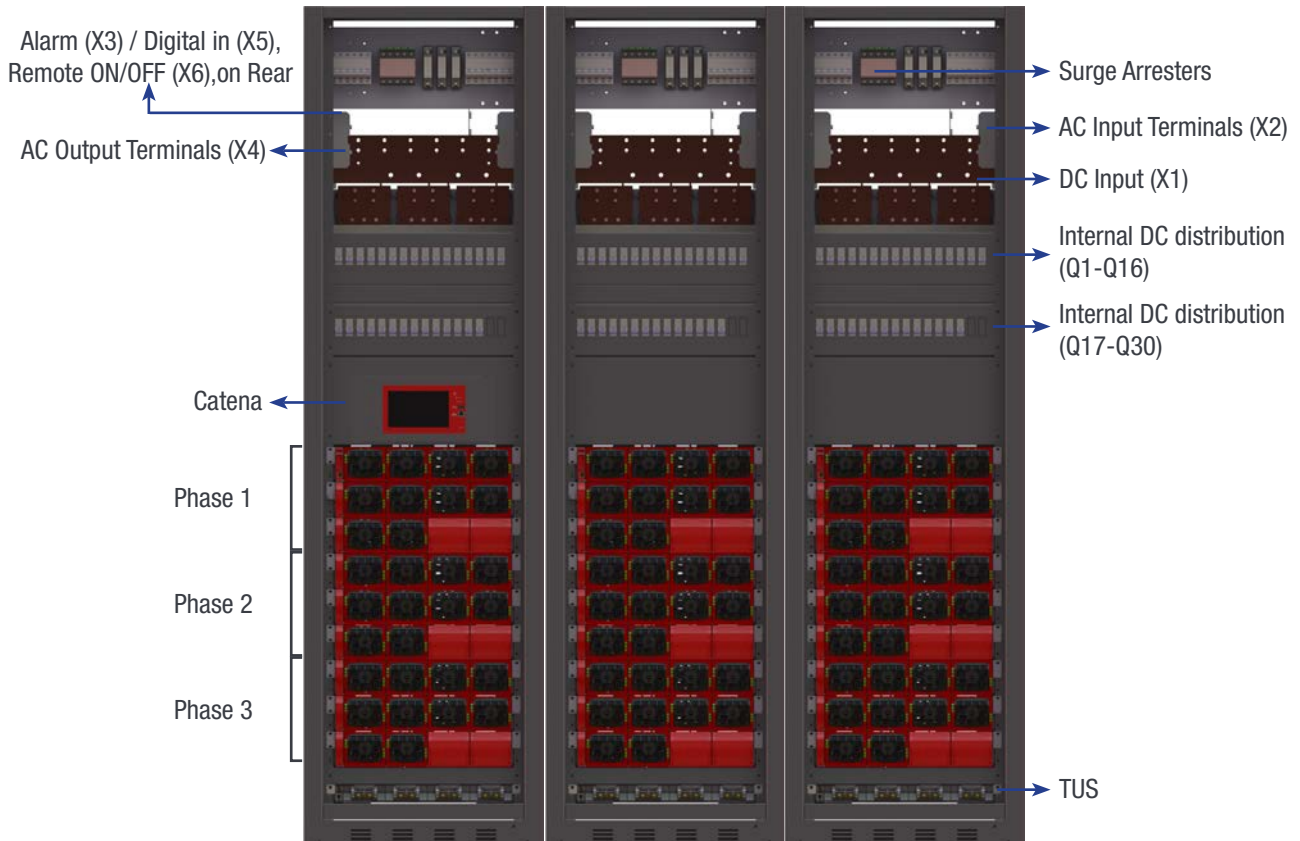
T-1PS 150 and 225 comes fully equipped with:

- DC individual protection for modules.
- External MBP included by default [wraparound bypass] (can be removed on request).
- CATENA GUI with aggregation capabilities (integrate parameters of all 3 cabinets) and remote monitoring capabilities.
- T2S ETH interface.
- TUS (Installed in 150 KVA and 225 KVA Systems).



T-1PS 150 KVA System - Details

## T-1PS Design and Description



**T-1PS 255 KVA System - Details**

### 7.3 Installation considerations

- All models of T-1 PS are Listed according to UL 1778 - 5th edition (File E323449).
- All models of T-1 PS are FCC compliant according to report L1R90028 issued by SGS Germany on June 19th 2017.

#### 7.3.1 T-1PS-75 to T-1PS-225 Single phase configuration

T-1PS-75 to T-1PS-225 are not intended to be deployed as single phase – 2 wires (L-N).

#### 7.3.2 T-1PS-75 to T-1PS-225 Split phase configuration

T-1PS-75 to T-1PS-225 are not intended to be deployed as split phase system, frequently named single phase 120/240 Vac or 120/208 Vac [Used 3 wires (L1 - L2 -N) + Ground].

Nevertheless it could be deployed this way keeping one complete phase idle (modules slots being neutralized).

#### 7.3.3 T-1PS-75 to T-1PS-225 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.  
[Used 4 wires (L1 - L2 - L3 - N) + Ground]

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

System Designation	Max Power (kVA)	Max power (KW)	Number of Shelves	Max number of Modules
T-1PS-3-75-xx-30	75	60	9	30*
T-1PS-3-150-xx-60	150	120	2 x 9	60*
T-1PS-3-225-xx-90	225	180	3 x 9	90*

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

System Designation	3 DC** input		
	Fuse or Breaker	Cable Min (per feed)	Cable Max (per feed)
T-1PS-3-75-xx-30	3 x 600 A	2 x 500 kcmil	2 x 500 kcmil
T-1PS-3-150-xx-60	2 x 3 x 600 A	2 x 500 kcmil	2 x 500 kcmil
T-1PS-3-225-xx-90	3 x 3 x 600 A	2 x 500 kcmil	2 x 500 kcmil

\*\* : Refer Section 8.5.5, page 30



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## T-1PS Design and Description

System Designation	AC Input & AC Output		
	Branch Protection		Cable Max Based on Terminal Size
	Breaker	Cable Min	
T-1PS-3-75-xx-30	250 A	300 kcmil	300 kcmil
T-1PS-3-150-xx-60	2 x 250 A	2 x 300 kcmil	300 kcmil
T-1PS-3-225-xx-90	3 x 250 A	3 x 300 kcmil	300 kcmil

## 8. System Installation

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### 8.1 Site Preparation

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

when installing T-1PS inverter systems, UL489 listed AC upstream (input) and downstream (output) circuit breakers are required.

#### **At Input**

Branch circuit protection breaker should be provided in upstream switchgear regardless of any protective device already installed at the input of the T-1PS.

#### **At Output**

Whenever the T-1PS is supplied with supplementary output breaker or without any protective device at all (see option listed in 7.1.2, page 18), an appropriate branch protection should be provided between T-1 PS and the loads.

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

- Refer to Section 7 for sizing protections and connecting cables. All cables must be copper rated for min 75°C (167°F).
- All cables must be C-UL-US or CSA Listed cables.
- All cables lugs must be C-UL-US or CSA listed. They must be sized according to the rated current of the inverter system and to the customer terminal connection.
- 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.
- T-1PS is designed for temperature controlled (max 40°C / 104°F) and clean environments. Presence of airborne particles such as urban dust, sand and metallic dusts are forbidden. Appropriate filters shall be installed.

#### **Warning:**

Filters mounted to the air inlets reduce the air pressure and may cause inverters cut off by thermal runaway. Deratings 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

CE+T cabinets are always fixed on a pallet, and then packed in a wooden crate.

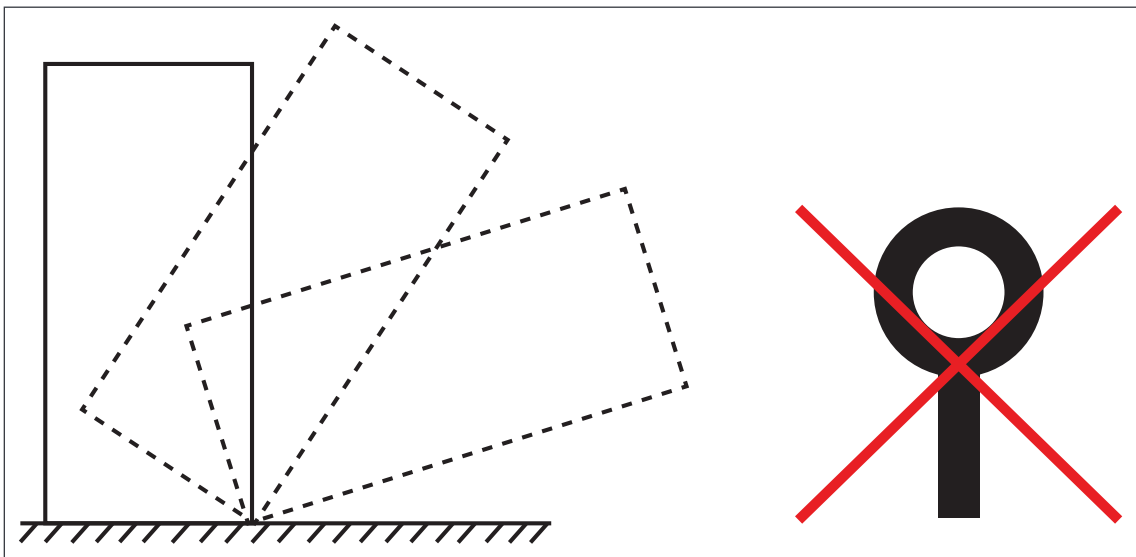
These crates are usually delivered laying flat, horizontally.

To unpack your cabinet, we recommend the following method:

1. Make sure that the crate is laying flat, with the correct side up. This side is identified by a double red arrow.
2. Remove the top cover in order to be able to identify the top and bottom sides of the cabinet.
3. Raise the crate vertically with the top side of the cabinet up. Make sure that the cabinet does not fall forward out of the crate while you do so.
4. Remove the cabinet and its attached pallet from the crate.

If you prefer to take the wooden crate apart before raising the cabinet, make sure you do not damage or dent the cabinet while doing so.

**Warning :** The top cover fixing bolts may NEVER be replaced with lifting eye bolts.



### 8.3 Module packing

Modules ordered with system are packed separately in a carton or a pallet. They come labeled. Please insert modules in the preassigned slots.

If the modules have been ordered separately they are packed in carton on pallet and identified to be placed in the right slot (Important for dual or 3 phase system).

Module packing material shall be taken apart and stored in case of return under warranty. Improper packing of a returned module may void the warranty.

### 8.4 Anchoring the cabinet to the floor

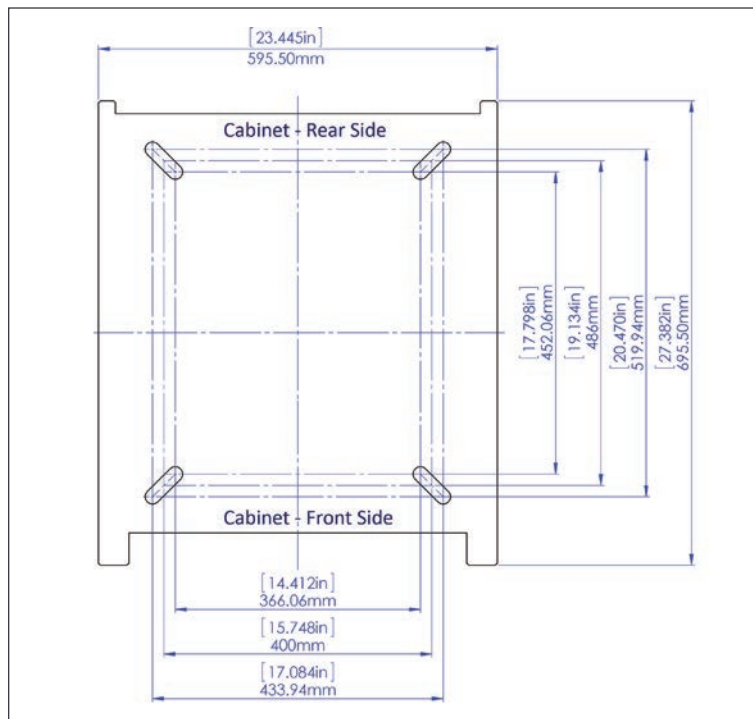
The cabinet is fixed through the base of the cabinet.

Remove lowest front cover to get access to the fixing holes.

Max screw diameter is 0.8" (22 mm). See Hole pattern, foot print. For foot print measurements.

Must have 36" (900 mm) clearance at front and back.

The installer has to level and plumb the frames in order to compensate the variations in floor flatness.



### 8.5 Cabling

Check section 7, page 17 to identify system configuration and refer to section 7.3, page 22 for cable sizes. Refer also to 8, page 24 for important safety notices.

#### 8.5.1 Tightening Torque

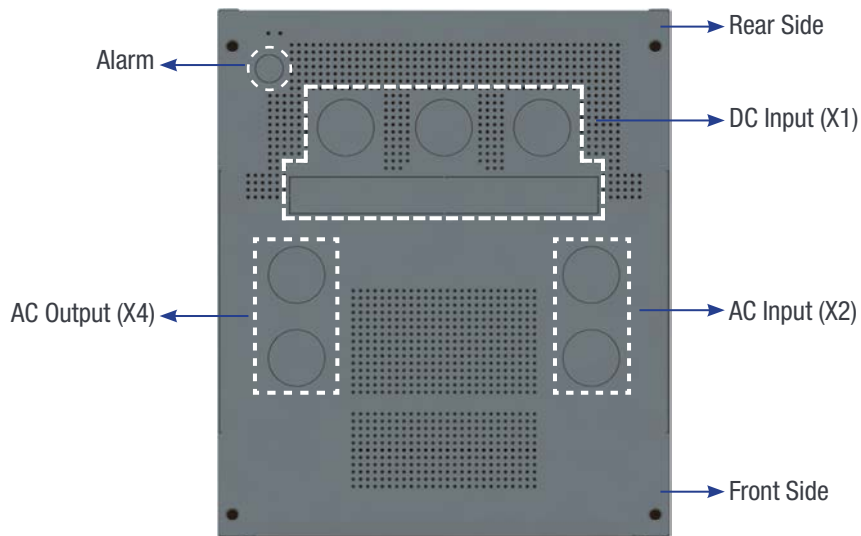
Torque recommendation for cable termination are

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)

### 8.5.2 Cable inlets

Use appropriate collar to fix the conduits to the cabinet ceiling. Use existing punch out in order to not block the airflow through the top of the cabinet. The ceiling can be split to facilitate the cabling.

Cables entrances should be protected by bushings, UL category NZMT2, rated for minimum 50°C



**Top View**

### 8.5.3 Grounding

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



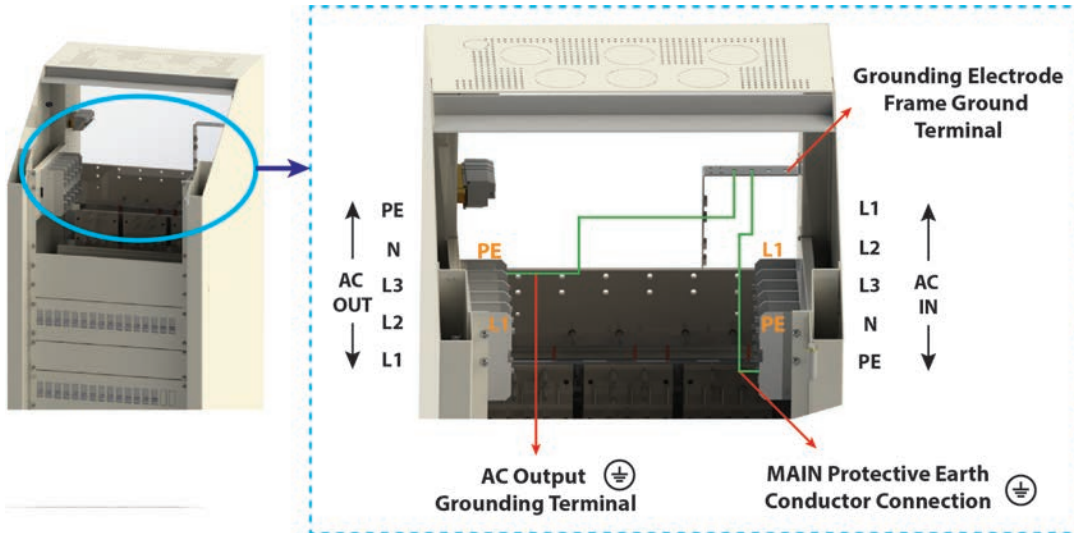
Ground must be terminated even if commercial Mains are not available. Recommended Cable cross section is the size equal (min) to Neutral cable cross section. Adhere to local regulations. (See 8.5.4, page 28)

Ground has to be connected in accordance with local code and NEC - NFPA 70.

T-1 PS is only intended for Common Bonding Network (CBN).

## System Installation

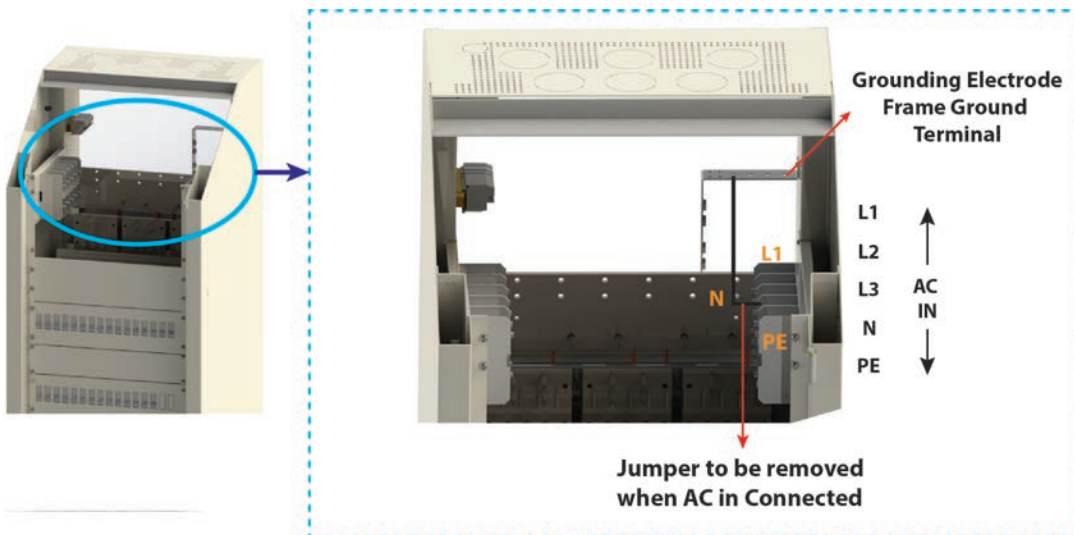
Connection in yellow-green are factory wired and shall not be removed. (In the following image the connection is shown in green color).



### 8.5.4 AC Input and Output

The pictorial representation of terminal blocks arrangement is as follows.

If AC IN is connected, remove the bonding neutral jumper, remove cable between X2 (AC IN) and frame Ground.



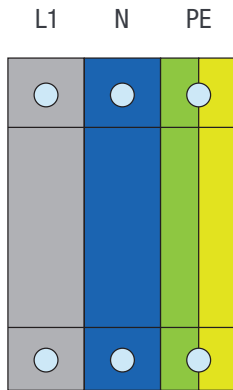
**Note:**

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 PE output terminal bonding that circuit to the enclosure and ground the enclosure to a suitable grounding electrode in accordance with local code requirements.

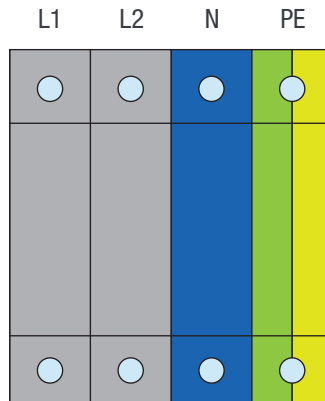
## System Installation

AC Input and AC Output shall be wired to connecting terminal blocks as per following indications:

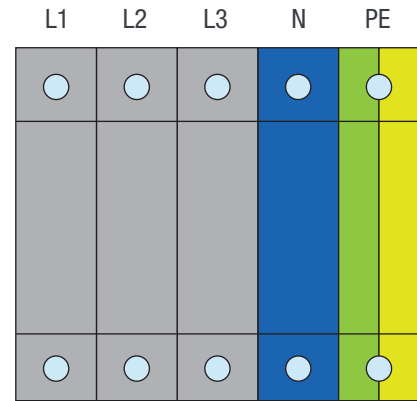
Single Phase 2 wires + PE



Single Phase 3 wires + PE



Three Phase 4 wires + PE



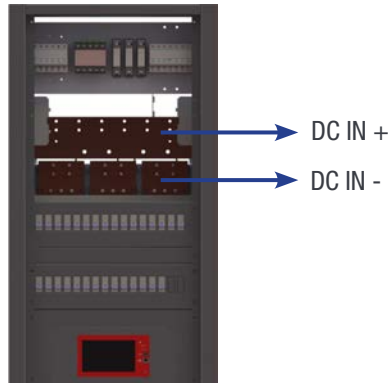
**WARNING !!!**

Recommendation of IEC 60364 4. 43

**431.3 Disconnection and reconnection of the neutral conductor in multi-phase systems**

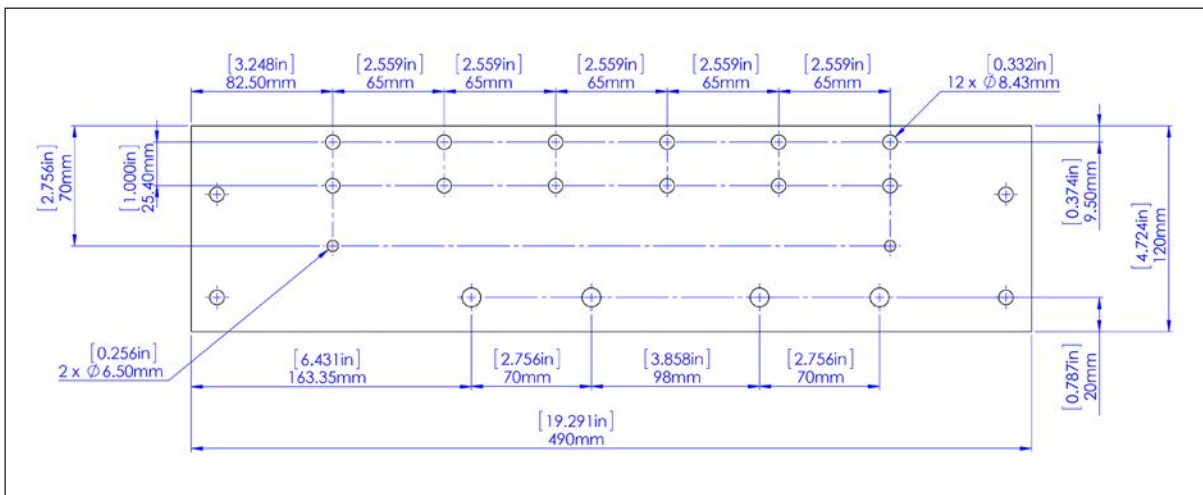
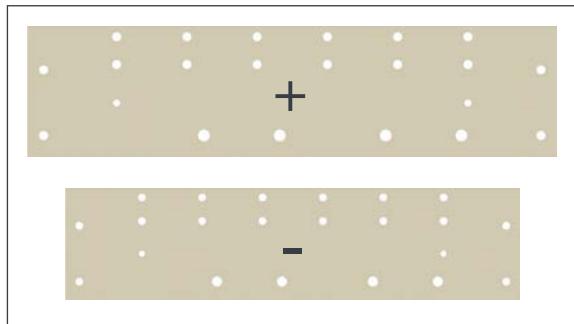
Where disconnection of the neutral conductor is required, disconnection and reconnection shall be such that the neutral conductor shall not be disconnected before the line conductors and shall be reconnected at the same time as or before the line conductors.

### 8.5.5 DC Input



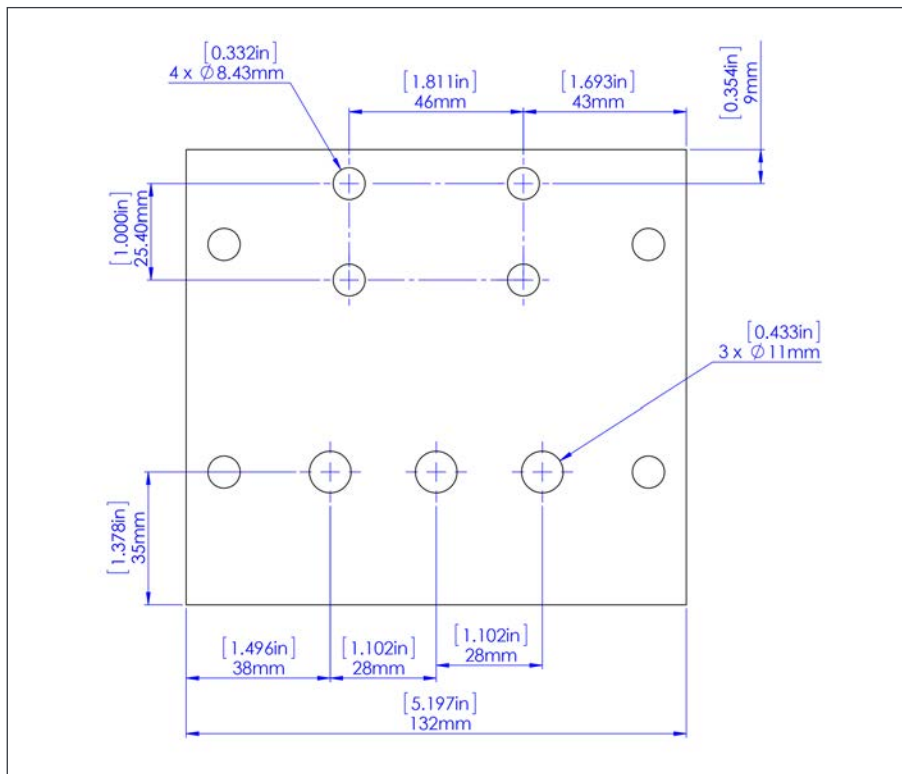
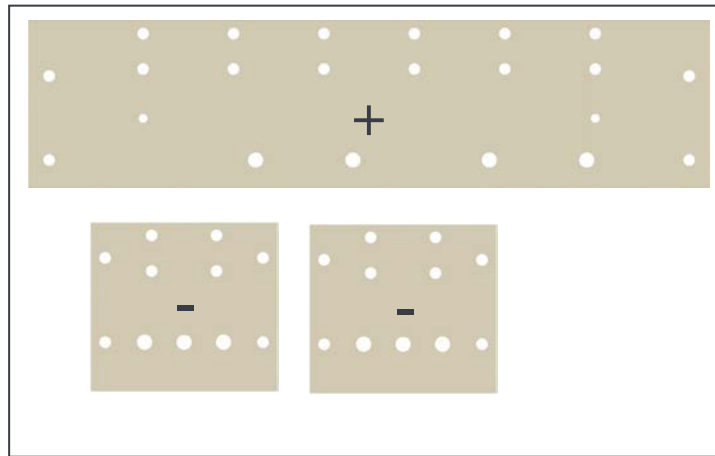
#### 8.5.5.1 Bulk Input

- Common DC input per system.
- Note: Screws and nuts are not included in the delivery.
- 2 hole 1/2" (M12) holes with 1-3/4" (44.45 mm) between center or 2 hole 3/8"(M8) holes with 1" (25.4 mm) between center.
- Internal DC distribution with circuit breakers (Q01-Q30) per inverter module.
- Max 9 x 500 kcmil (240 mm<sup>2</sup>)



### 8.5.5.2 DC input continued

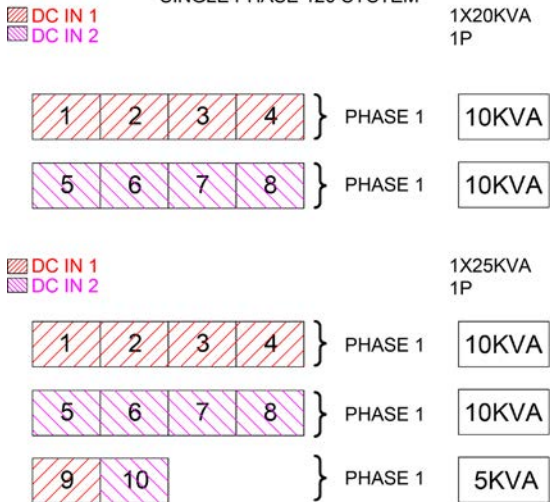
- 2 x DC input per system.
- Note: Screws and nuts are not included in the delivery.
- 2 hole 1/2" (M12) holes with 1-3/4" (44.45 mm) between center or 2 hole 3/8" (M8) holes with 1" (25.4 mm) between center.
- Internal DC distribution with circuit breakers (Q01-Q30) per inverter module.
- Max 3 x 500 kcmil (240 mm<sup>2</sup>) per pole (group)



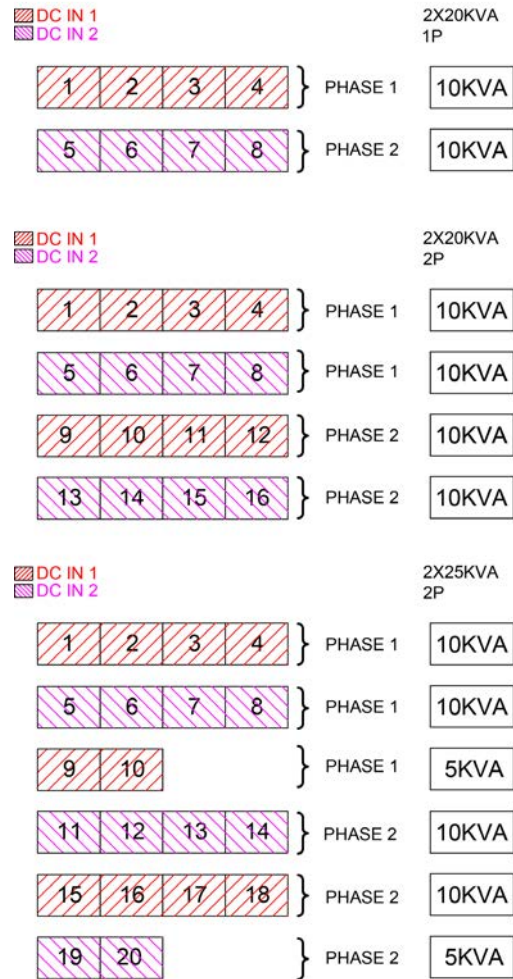


## System Installation

### 2 DC FEED INTERNAL WIRING PATTERNS SINGLE PHASE 120 SYSTEM



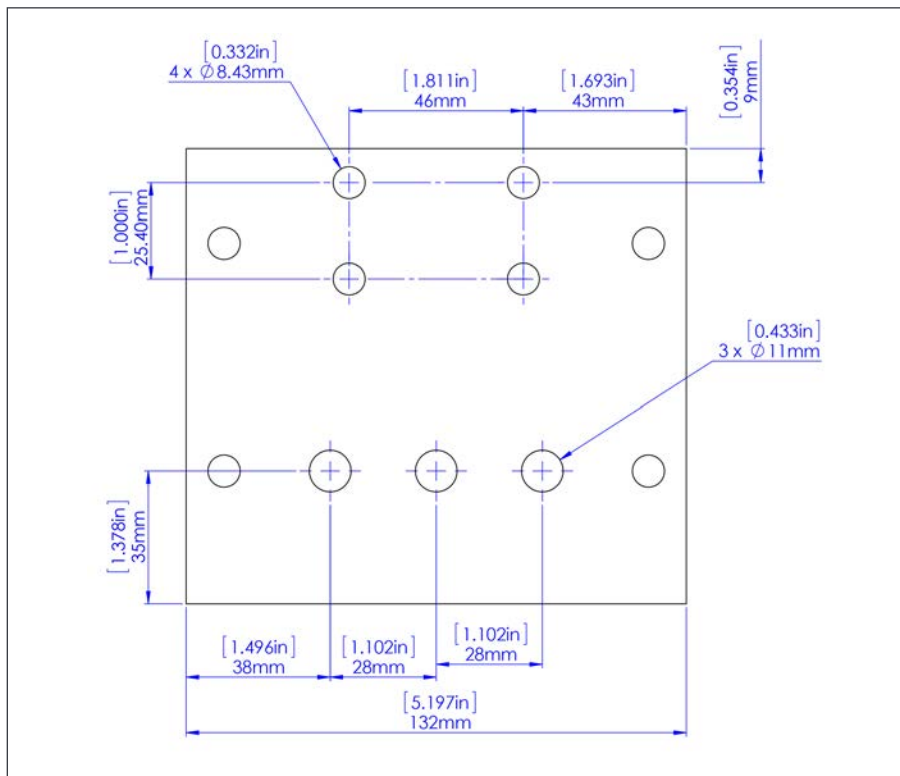
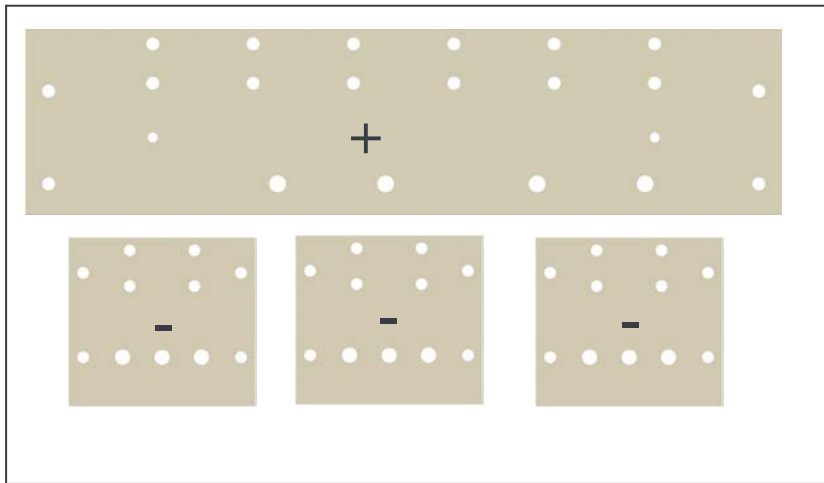
### SPLIT PHASE SYSTEM





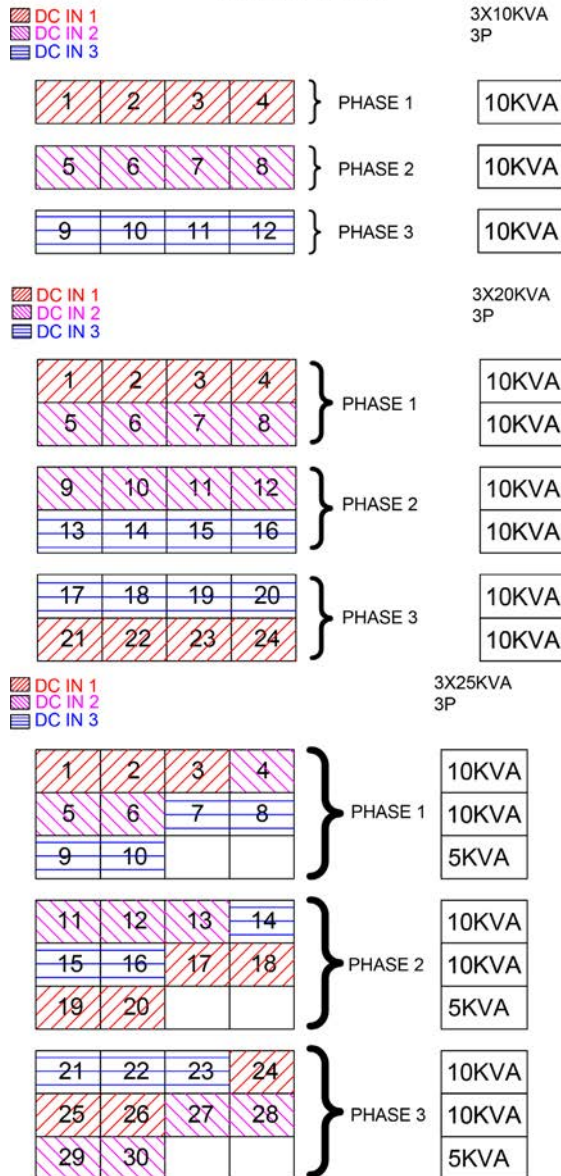
### 8.5.5.3 DC input continued

- 3 x DC input per system.
- Note: Screws and nuts are not included in the delivery.
- 2 hole 1/2" (M12) holes with 1-3/4" (44.45 mm) between center or 2 hole 3/8" (M8) holes with 1" (25.4 mm) between center.
- Internal DC distribution with circuit breakers (Q01-Q32) per inverter module.
- Max 2 x 500 kcmil (240 mm<sup>2</sup>) per pole (group).



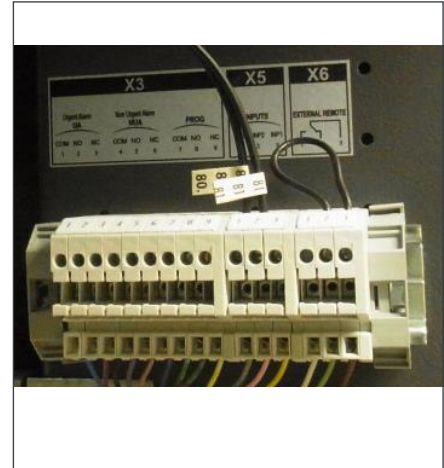
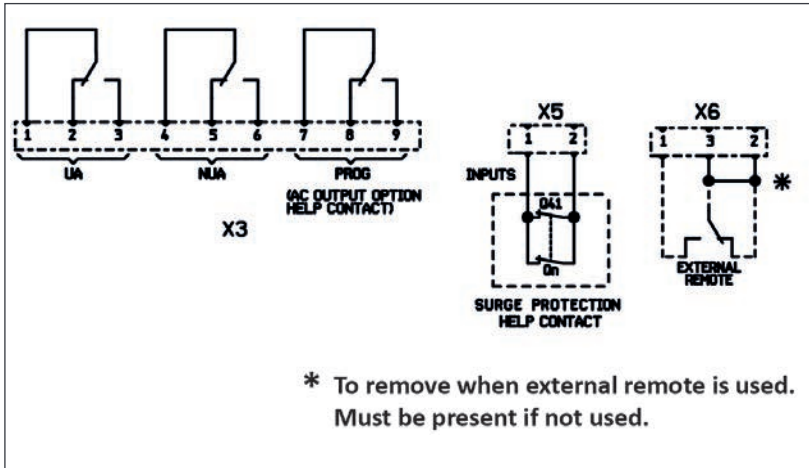
## System Installation

### 3 DC FEED INTERNAL WIRING PATTERNS



### 8.5.6 Signalling

All relays are shown in non energized state.



#### 8.5.6.1 Alarm (X3)

- Relay characteristics X3 (Major (UA), Minor(NUA), Prog)
  - Switching power 60 W
  - Rating 2 A at 30 VDC / 1 A at 60 VDC
  - Max wire size 16 AWG (1mm<sup>2</sup>)

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

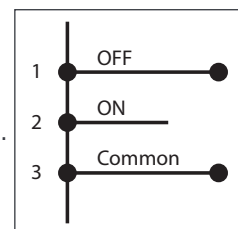
#### 8.5.6.2 Digital In (X5)

- Input characteristics X5 (Digital In 1, Digital In 2)
  - Signal voltage +5 VDC (galvanically insulated)
  - Max wire size 16 AWG (1mm<sup>2</sup>)

#### 8.5.6.3 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 switches the output AC OFF.
- 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 +5 VDC (galvanically insulated)
  - Max wire size 16 AWG (1mm<sup>2</sup>)



**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 (OFF) DC Input (Green)
3	Open	Closed	Normal operation	All (Green)
4	Closed	Closed	Normal operation	All (Green)

**Warning: If remote ON/OFF not used, pin 2 and 3 MUST be bridged together!**

## 8.6 Switching OFF T-1PS System

Perform the following steps to Switch OFF the T-1PS System.

**Caution: While switching OFF the T-1PS System, the power to load will be disconnected.**

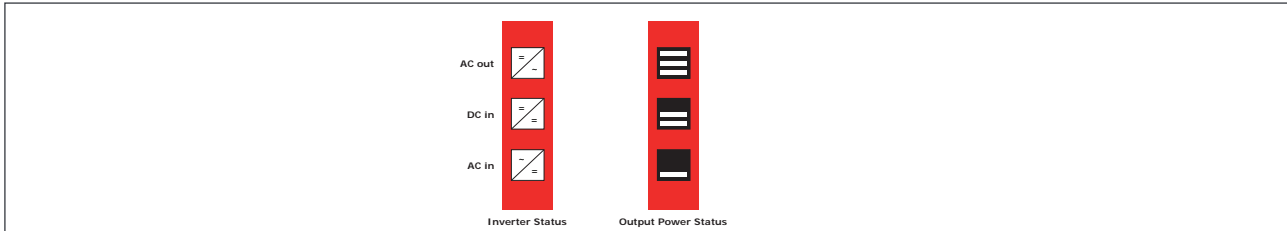
1. Switch OFF AC Output Breakers.
2. Switch OFF AC Input Breakers.
3. Switch OFF DC Input Breakers.
4. Switch OFF the Upstream and Downstream Breakers.

**Caution: Risk of electric shock. Capacitors store hazardous energy. Do not remove the system from the cabinet, wait at least five minutes after disconnecting all sources of power.**

**Caution: Risk of electric shock. This inverter receives power from more than one source. Disconnection of AC source and DC source is required to de-energize this unit before servicing.**

# 9. Human-Machine Interface

## 9.1 Inverter module

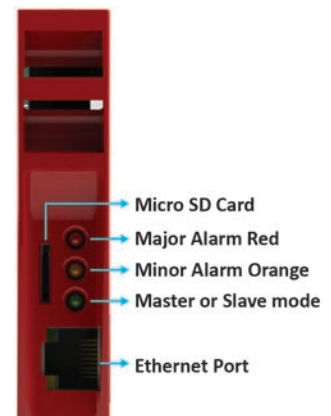


Inverter Status LED	Description	Remedial action
OFF	No input power or forced stop	Check environment
Permanent green	Operation	
Blinking green	Converter OK but working conditions are not fulfilled to operate properly	
Blinking green/orange alternatively	Recovery mode after boost (10 In short circuit condition)	
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 (Adjustable)
  - Non urgent 30 second delay (Adjustable)
- Parameter setting via Laptop.
- Factory default according to list of set values.





# 10. Inserting/removing/replacing modules

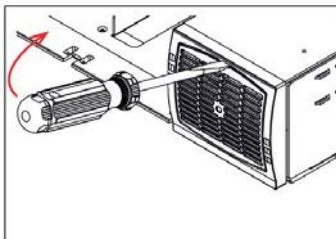
## 10.1 TSI Inverter

- The TSI inverter is hot swappable.
- When a new module is inserted in a live system it automatically adapts to a working set of parameters.
- When a new module is inserted in a live system it automatically assigns the next available address.
- If equipped with catena, will prompt user if module is a replacement for the missing module.

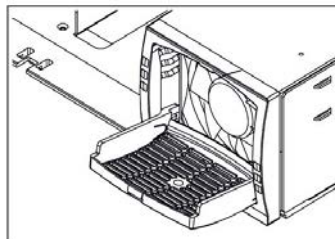
### 10.1.1 Removal

**Notice:** When one or several inverter modules is/are removed access to live parts becomes possible. Replace module(s) with blanks without delay.

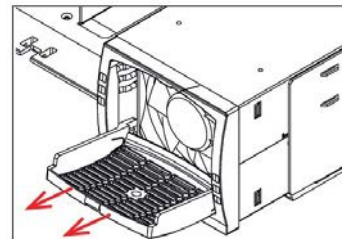
- The inverter module is not switched off when opening the handle. The handle only fixes the module to the shelf.
- Use a screw driver to release the handle latch.
- Open the handle and pull the module out.
- Replace with a new module or blank cover.



A) Use screwdriver to release the latch



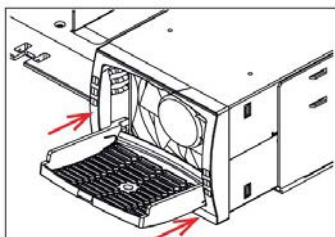
B) open the cover completely



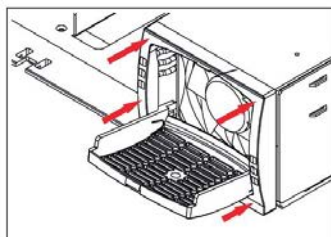
C) Use the cover as a handle to remove the module

### 10.1.2 Inserting

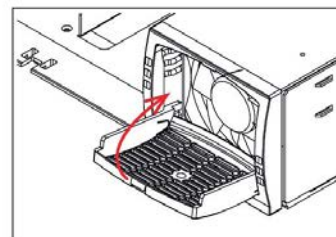
- Check module compatibility (DC Voltage matches).
- Use a screw driver to release the handle latch.
- Open the handle and push firmly until the unit is fully inserted.
- Wait until LEDs turn green.
- Close the cover and latch in position.



A) Slide the module in



B) Push firmly till the connection is properly engaged



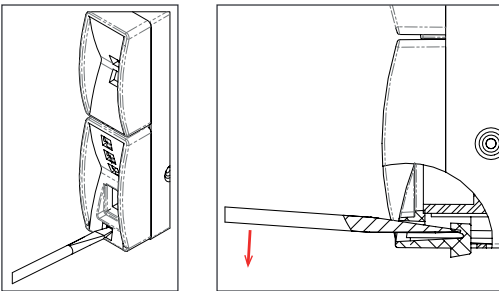
C) Close the cover and latch the module in place if too hard redo step B

## Inserting/removing/replacing modules

### 10.2 T2S

#### 10.2.1 Removal

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



#### 10.2.2 Inserting

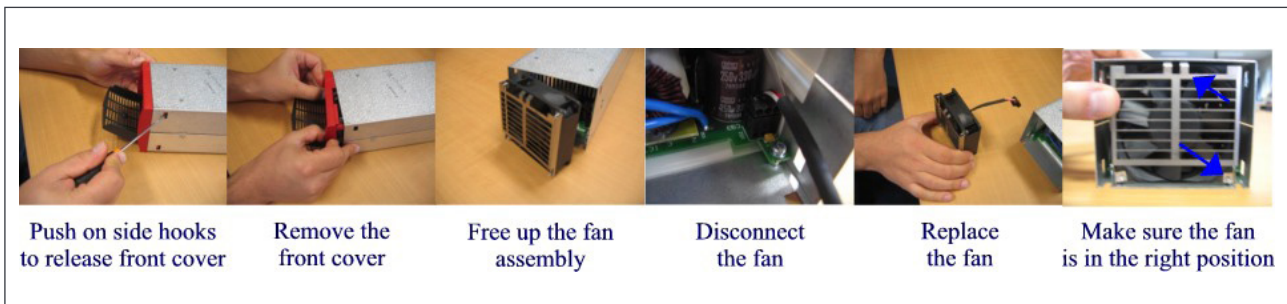
- Push the T2S firmly in place until the latch snaps into position.

### 10.3 Fan replacement

The FAN life is approximately 60,000 (Sixty Thousand) hours. The inverter modules have fan runtime meters and fan failure alarms. 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 module action menu.



# 11. External Wraparound MBS

MBS (Manual Bypass Switch) must be operated by trained personnel only. When system is in manual bypass the load is subjected to mains AC voltage without active filtering.

Output alarm when system is in manual bypass as “MBP Engaged”.  
The manual bypass is not possible to operate remotely.



Figure 1. Manual Bypass Switch Cabinet



Figure 2. Status indicators and operation switch



Figure 3. Distribution breaker compartment

<b>Rotary Switch</b>	<b>INVERTER AC FEED</b>	This switch controls AC power to the inverter mains input.
	<b>SOURCE</b>	This switch determines whether loads are fed from the inverter output or from the mains.
<b>LED Indicator Light</b>	<b>GREEN</b>	Indicates normal operation.
	<b>ORANGE</b>	Indicates bypass mode; inverter output is disconnected from loads.
	<b>WHITE</b>	Indicates OK to switch; confirmation that a signal is received from the inverter that mains and inverter output are in phase.
<b>Button</b>	<b>PUSH TO REQUEST</b>	To ensure the inverter source and bypass source are synchronized prior to switching, the MBS features a “handshaking” interlock scheme.



### 11.1 Pre-requisites

Before engaging the MBS, the following conditions must 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 L1 - inverter output.
  - Do same measurement with L2 IN – L2 OUT and L3 IN – L3 OUT.
  - In all cases, voltage shall be less than 20 V.

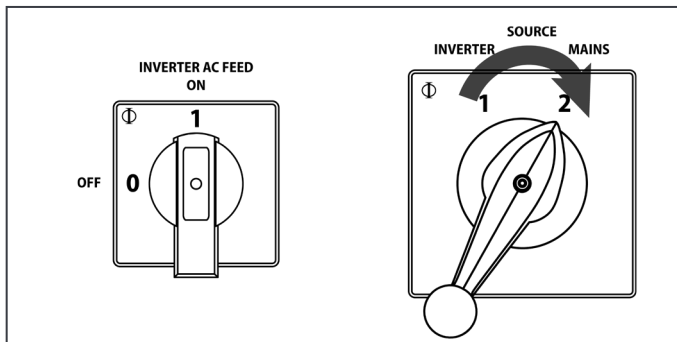
The upstream AC & DC breaker must be correctly sized (Refer 7.2.2, page 20) to accept possible overload, The inverter might be overloaded during MBS procedure, depending on voltage network and output inverter voltage setting and if the AC is supplied by a Gen-set, the minimal required power will be twice nominal power of the inverter.

### 11.2 Manual Bypass Switch Operation

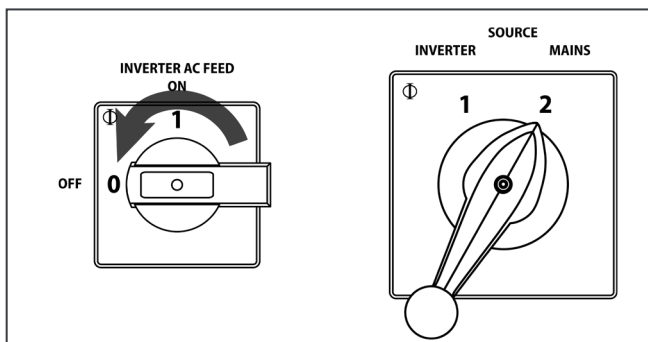
The manual bypass switch operates via individual cabinet that creates a by-pass from mains input via output AC distribution. Inverter modules are by-passed and possible to disconnect without impacting the load.

#### 11.2.1 Switching from NORMAL to BYPASS

1. Depress and release **REQUEST** button.
2. Wait for **OK TO SWITCH** indicator (*white*) to illuminate.
3. Within ten seconds turn **SOURCE** switch from position 1 (*INVERTER*) to position 2 (*MAINS*).



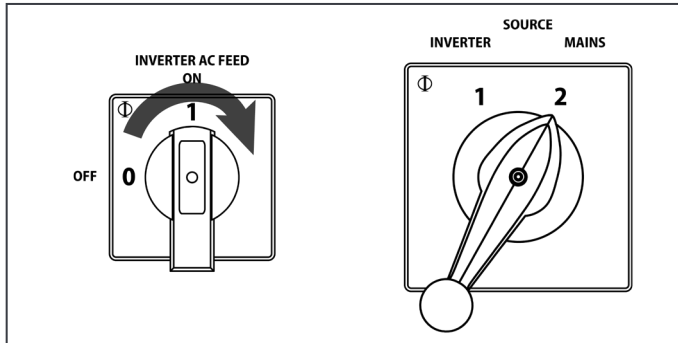
4. Verify that **BYPASS** indicator (*orange*) is illuminated.
5. Turn **INVERTER AC FEED** switch to position 0 (*OFF/OPEN*).



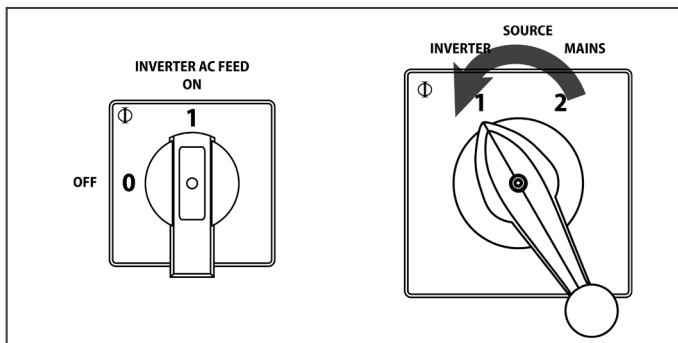
**Caution - Risk of electric shock.**  
 This inverter receives power from more than one source. Disconnection of AC source and DC source is required to de-energize this unit before servicing.

### 11.2.2 Switching from BYPASS to NORMAL

1. Turn **INVERTER AC FEED** switch to position 1 (*ON/CLOSED*).



2. Check that all inverter modules are operating (*module LEDs are green*).
3. Depress and release **REQUEST** button.
4. Wait for **OK TO SWITCH** indicator (*white*) to illuminate.
5. Within ten seconds turn **SOURCE** switch from position 2 (*MAINS*) to position1 (*INVERTER*).



6. Verify that **NORMAL** indicator (*green*) is illuminated

### 11.2.3 Emergency Interlock Release

**Be sure the two sources are synchronized prior to using this feature. Failure to do so may cause premature switch contact wear, switch damage, and/or loss of power to load equipment.**

In situations where the inverter cannot provide the ready signal (*inverter not yet installed, or inverter failure*), a means is provided to release the interlock at the MBS. Press and hold the **“OK TO SWITCH”** indicator while turning the **SOURCE** switch.

**More about EMBS, refer to External Wraparound Manual Bypass Switch Installation and Operation Manual**

## External Wraparound MBS

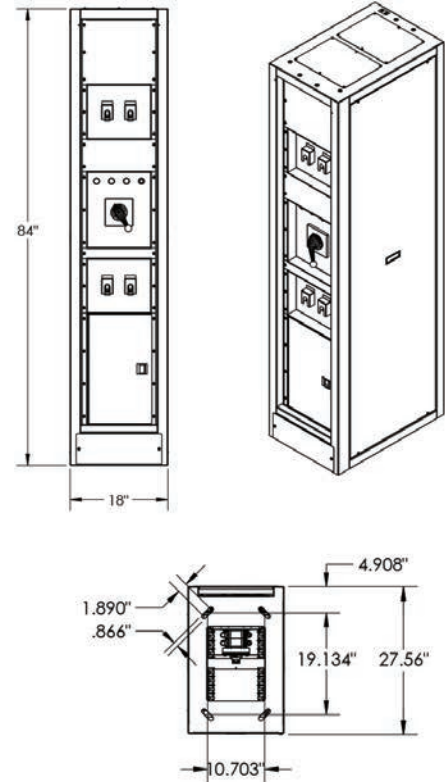
### 11.3 Specifications

#### Dimensions:

- 18" wide x 84" tall x 27.56" deep

#### Electrical:

- Voltage: 120/208 VAC 3 $\phi$ , 4 W
- Frequency: 60 Hz
- KVA Rating: 150
- Full Load Current: 444 A
- Switch Rating: 500 A
- Input Terminations: Single-Stud Terminals (M10)
- Output Terminations: Box Terminals
- Weight: 450 lbs



## 12. Final check

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- Make sure that the sub-rack/cabinet is properly fixed to the cabinet/floor
- Make sure that the sub-rack/cabinet is connected to Ground.
- Make sure that all DC and AC input breakers are switched OFF.
- Make sure that all cables are sized according to recommendations and local regulations.
- Make sure that all cables have strain reliefs installed.
- Make sure that all breakers are sized according to recommendation and local regulations.
- Make sure that DC polarity is according to marking.
- Torque all electrical terminations according to recommendation and local regulations.
- Make sure that no inverter/controller bays are left open.
- Cover empty inverter bays 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.

## 13. 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 in not all modules operating when running on DC and have module failure when AC input from fault.

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

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

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

### 13.1 Check list

Refer the document “Commissioning Procedure V.8.1”

## 14. Trouble shooting

---

### 14.1 Trouble shooting

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

### 14.2 Defective modules

Unless input power is down all LEDs on each module should be green (see section 9, page 37). No light, orange light, red or flashing light are abnormal conditions. Collect and record the module information. If no fix can be found, replace module.

#### 14.2.1 Replacing modules

Refer to section 10, page 38 to remove and re-insert modules.

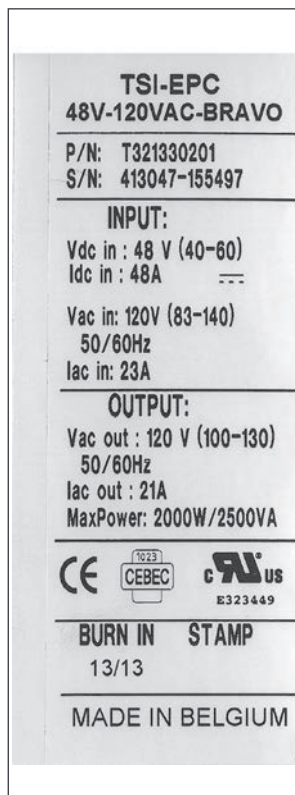
#### 14.2.2 Return defective T2S interface

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 47.

#### 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 47.

#### 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 through the <http://my.cet-power.com> extranet. Repair registering guidelines may be requested by email at [repair@cet-power.com](mailto: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





## 15. Service

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### 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](mailto: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 day.

## 16.Maintenance Task

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As maintenance will be performed on live system, all tasks should be performed only by trained personnel with sufficient acknowledge 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 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.

