

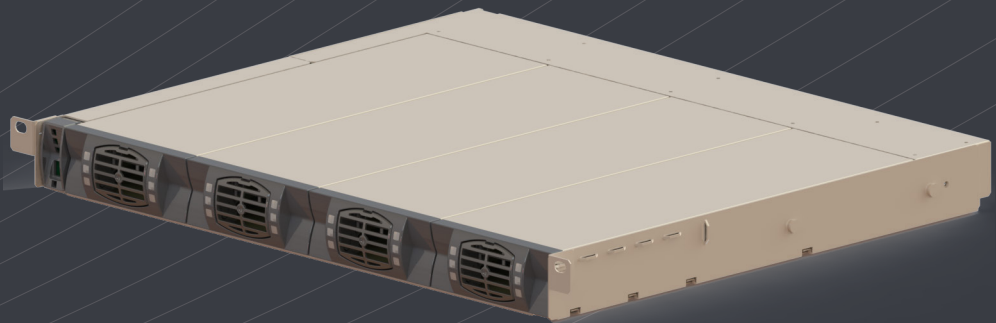
TUS - ALS

TUS - Active Load Sharing

Product Description & User Manual V1.0

BEYOND THE INVERTER

THE NEW GENERATION OF POWER CONVERTERS



Important Safety Instructions and Save these Instructions

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Release Note:

Version	Release date (DD/MM/YYYY)	Modified page number	Modifications
7.0	28/06/2017	-	First release of the manual.



Leading AC Backup Technology

CE+T Power at a glance

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

2. Abbreviations

ECI	Enhanced Conversion 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
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 Conditions¹

WARNING:

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

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

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

Important Safety Instructions and Save These Instructions.

3.1 Disclaimer

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

3.2 Technical care

- This electric equipment can only be repaired or maintained by a “qualified employee” with adequate training. Even personnel who are in charge of simple repairs or maintenance are required to have knowledge or experience related to electrical maintenance.
- Please follow the procedures contained in this Manual, and note all the “DANGER”, “WARNING” AND “NOTICE” marks contained in this Manual. Warning labels must not be removed.
- Qualified employees are trained to recognize and avoid any dangers that might be present when working on or near exposed electrical parts.
- Qualified employees 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.
- Insulated tools must be used at all times when working with live systems.
- When handling the system/units pay attention to sharp edges.
- Product shall be installed and used by duly trained personnel.

¹ 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.
- Please use extreme caution when accessing circuits that may be at hazardous voltages or energy levels.
- The system is designed for installation within an IP20 or IP21 environment. When installed in a dusty or humid environment, appropriate measures (air filtering ...) must be taken.

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. Earthing must be carried out prior to energizing the system. Earthing shall be made according to local regulations.

3.3.3 Other

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

Warranty and Safety Conditions

3.4 Maintenance

- The modular inverter system/rack can reach hazardous leakage currents. Earthing must be carried out prior to energizing the system. Earthing shall be made according to local regulations.
- Prior to any work conducted on a system/unit make sure that AC input voltage and DC input voltage are disconnected.
- 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 TUS modules and accessories, and therefore the customer must segregate and dispose of the materials which are potentially harmful to the environment, in accordance with the local regulations in force in the country of installation.
- If the equipment is dismantled, to dispose of its component products, you must comply with the local regulations in force in the country of destination and in any case avoid causing any kind of pollution.

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

4. TUS ALS Introduction

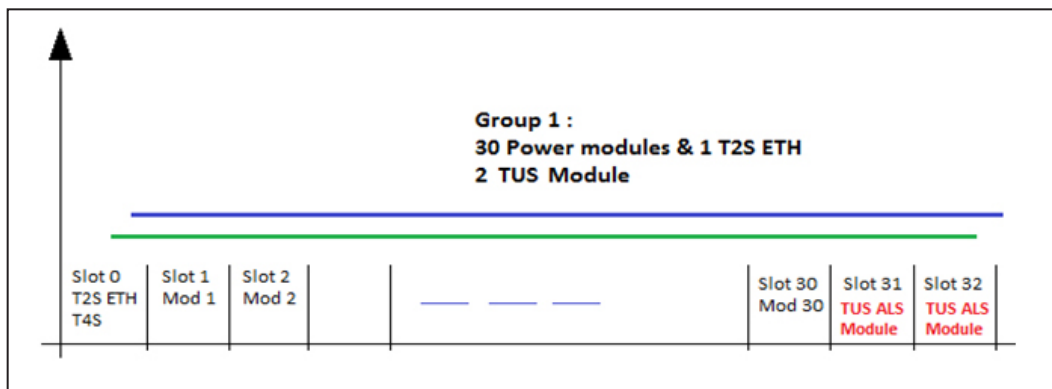
TUS ALS (TSI Universal Synchronization Active Load Sharing) allow to synchronize more than 32 ECI inverter modules to create a “large system” with an active load sharing of power, voltage, current, frequency between their AC output.

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

One **large system** with TUS ALS consist of several « groups » of maximum each 30 ECI inverter modules.

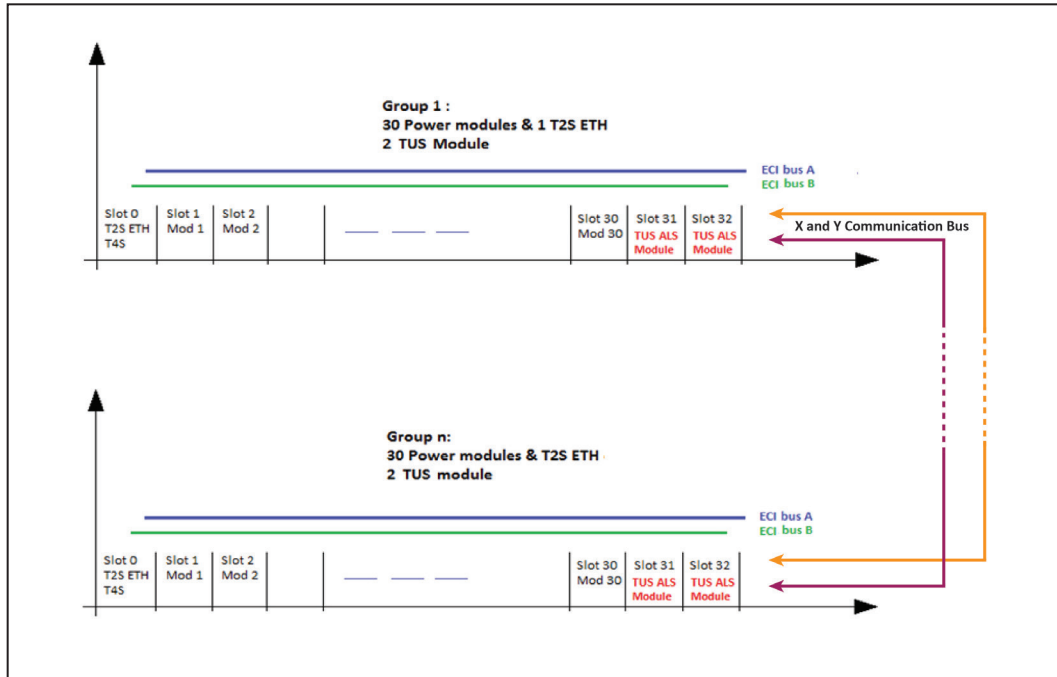
Each **group** of max 30 ECI inverter will require :

- One TUS ALS shelf that can receive up to 2 TUS ALS modules.
- 2 x TUS ALS module or Synchronizator. The TUS ALS module takes 2 addresses on the BUS limiting the maximum ECI power module to 30



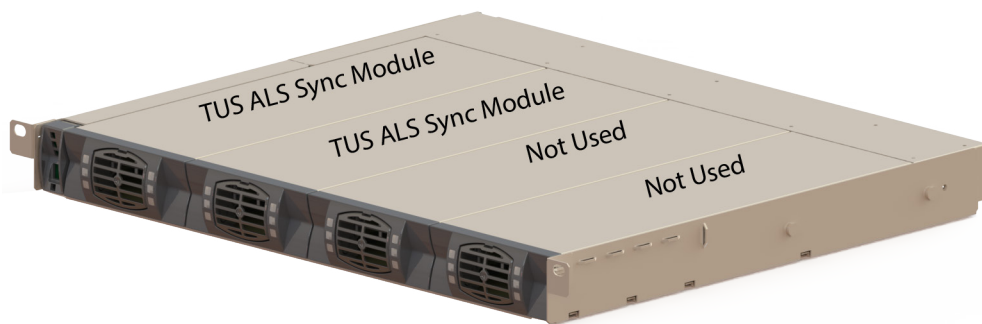
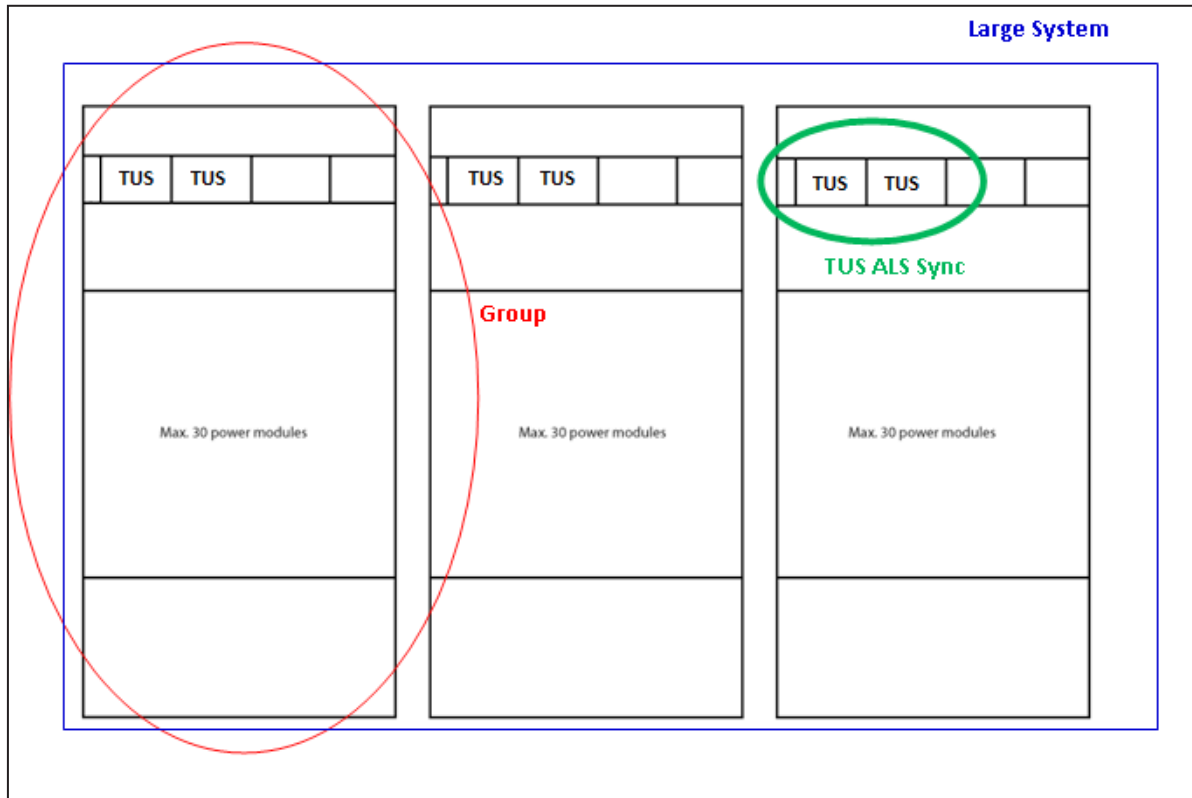
TUS ALS Introduction

To complete the solution the different group of module will need to be connected together through a double bus (X and Y communication)



TUS ALS Introduction

Example below: Large System with 3 groups ECI inverter system (30 modules) with TUS ALS shelves on the TOP



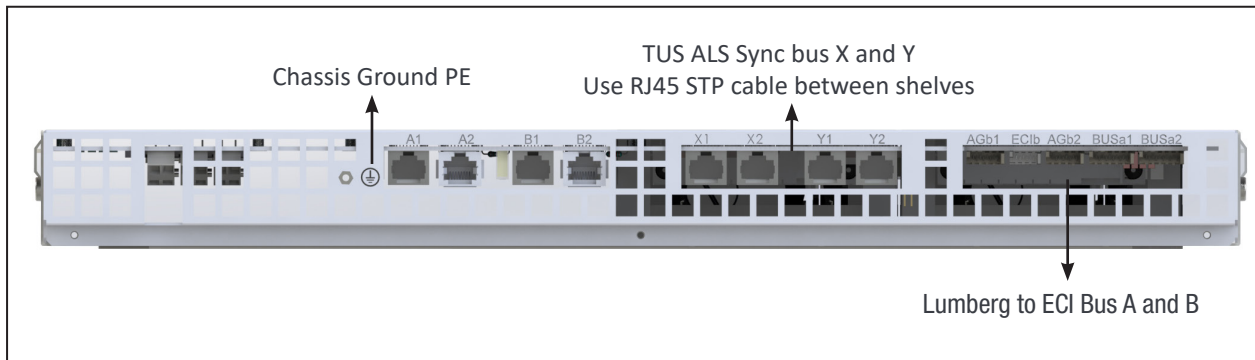
5. Installation and Connection

5.1 TUS ALS modules in TUS ALS shelf

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

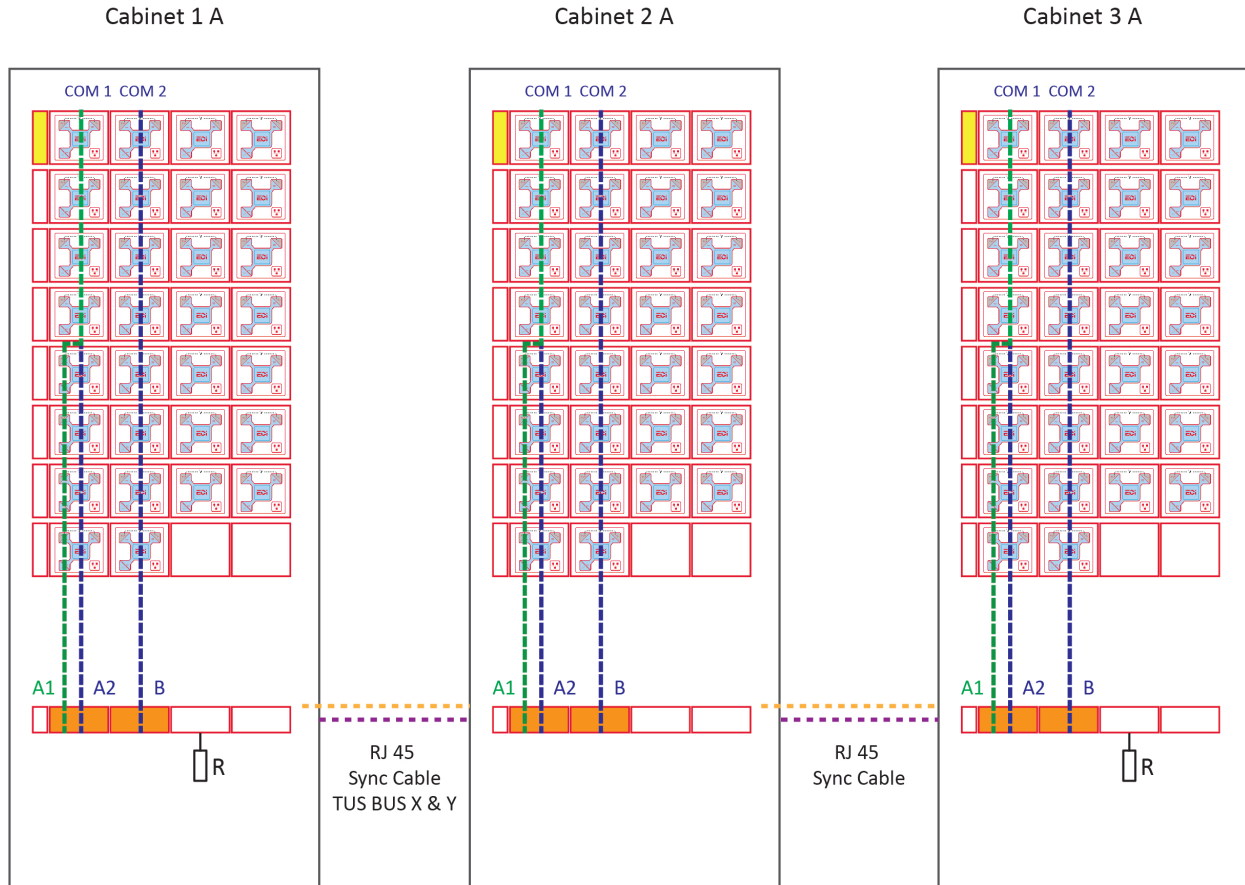
5.2 TUS ALS shelf connection

The TUS ALS shelf and accessories installed in ECI inverter cabinet (preinstalled in factory)



TUS ALS Rear View

Installation and Connection



COM 1 / COM 2 = Lumberg Cables



TUS ALS 3 Phase system layout presentation

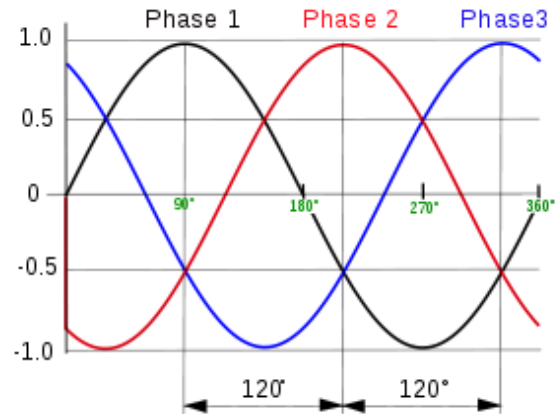
5.3 System Configuration and parameter

5.3.1 Three phase load configuration

In a 3 phase system it is of the highest importance to insure that all 3 output phases L1-L2-L3 are all shifted by 120° from each other. This is to insure the right working of the given three phase load(s).

In such case it is very important to keep permanently the 120° phase shift between each phase.

If in any situation ECI system and TUS ALS system cannot keep the phase shift the entire inverter system will shut down in order to protect the load.



While single phase loads are distributed on the three output phases above requirements are less critical and the ECI Bravo Inverter Systems may drift from each other without harming the load in any way. In this case, the only point to check is the correct sizing of the neutral wire that needs to be at least twice the size of the line wires. In those conditions the parameter 103 Ext Clock can be set to 0

Start up procedure recommended:

1. Always start first on DC input
2. Wait all TUS ALS module LED becomes green
3. Connect the AC input power to the ECI inverter system.

Important note & product limitations

During start up of power system all phases are starting up on their own (not all at the same time). Therefore with real 3 phases load connected, an external device shall be installed to connect the load as soon as all 3 phase are on and phase sequence respected.

Installation and Connection

5.3.2 Parameter related to TUS ALS with T2S ETH

Please note this section only refer to TUS ALS configuration. The power module shall be properly configured please refer to the T2S ETH user manual

Each “group” or “sub system” of power module shall have his own T2S ETH that needs to be configured to operate with the TUS ALS.



CET+ POWER Leading AC Backup Technology

T2S Mode: Master ECI380V Logged as: Expert
21/11/2013 15:33

Monitoring Inputs/Relays SNMP Modbus **Power** Info

General AC In DC Group AC Out **Synchronization** Other

Synchronization

Multiple sub-systems sync	Enable
In case of sync failure	Never stop
Number of sync modules	2
System ID	1
Output phase ID	1
Group ID	1
Number of lines in system	1
Aux X power supply alarm	Don't care
Aux Y power supply alarm	Don't care
DC sync ID	DC 1

Cancel Save

Events Connections Files Parameters Home Logout

- In the following section a “sub system” refers to an association of 1 T2S ETH, maximum 30 power modules and 2 TUS ALS modules.
- System or large system is an aggregation of the above sub-system or group to build a complete system single or three phases.

Installation and Connection

5.3.3 Settings

- **Multiple Sub-system sync**

Define if TUS is present
 Enable when system is equipped with TUS
 Disable when system is not equipped with TUS
- **In case of sync failure**

Stop or not system when synch is lost
Never stop in case of synchronization failure
Stop after 1 minute in case of synchronization failure
Stop immediately in case of synchronization failure. To be use when systems are in parallel
- **Number of sync module**

Define the number of TUS module present
 Number of TUS module present on the corresponding T2S ETH
- **System ID**

Define the address for each sub system
 Sub-system address (one sub system per T2S ETH)
 Must different for all sub-system on the same complete system.
- **Output phase ID**

Define on which phase the sub system is operating
 Phase number
- **Group ID**

Define the group of sub system for active load sharing
 For the active load sharing, all sous system in parallel must has the same ID group
- **Number of line in system**

Define the number of sub system
 Number of T2S ETH present on the system. This must configure accordingly to monitor properly the alarm.
- **Aux X power supply alarm**

Define where comes from the power supply for TUS
 Internal with TUS ALS. Or external with external 12V power supplies
- **Aux Y power supply alarm**

Define where comes from the power supply for TUS
 Internal with TUS ALS. Or external with external 12V power supplies
- **DC Sync ID**

Define from which battery group is the source system fed
 Set DC1 to have all module on the same DC group. If you have several DC group each sub system shall be affected to the correct DC group.

Installation and Connection

5.3.3.1 Example 1

Three phases system with maximum **90 power modules** (30 modules per phase) and only **1 DC group** and internal power supply for TUS modules.

Each phase is fed by one cabinet of **30 power modules** and **2 sync modules**.

T2S ETH 1	T2S ETH 2	T2S ETH 3
Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE
Number of Sync modules 2	Number of Sync modules 2	Number of Sync modules 2
System ID 1	System ID 11	System ID 21
Output phase ID 1	Output phase ID 2	Output phase ID 3
Group ID 1	Group ID 1	Group ID 1
Number of line 3	Number of line 3	Number of line 3
AUX X Power supply alarm Internal	AUX X Power supply alarm Internal	AUX X Power supply alarm Internal
AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal
DC sync ID DC 1	DC sync ID DC 1	DC sync ID DC 1
Output Phase 0°	Output Phase 120°	Output Phase 240°

Installation and Connection

5.3.3.2 Example 2

Three phase system, each phase has two cabinets of **29 power modules** each and **3 sync modules**.

Each sub-system has its **own DC**.

T2S ETH 1	T2S ETH 2	T2S ETH 3
Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE
Number of Sync modules 3	Number of Sync modules 3	Number of Sync modules 3
System ID 1	System ID 11	System ID 21
Output phase ID 1	Output phase ID 2	Output phase ID 3
Group ID 1	Group ID 1	Group ID 1
Number of line 6	Number of line 6	Number of line 6
AUX X Power supply alarm Internal	AUX X Power supply alarm Internal	AUX X Power supply alarm Internal
AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal
DC sync ID Disable	DC sync ID Disable	DC sync ID Disable
Output Phase 0°	Output Phase 120°	Output Phase 240°

T2S ETH 4	T2S ETH 5	T2S ETH 6
Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE
Number of Sync modules 3	Number of Sync modules 3	Number of Sync modules 3
System ID 2	System ID 12	System ID 22
Output phase ID 1	Output phase ID 2	Output phase ID 3
Group ID 1	Group ID 1	Group ID 1
Number of line 6	Number of line 6	Number of line 6
AUX X Power supply alarm Internal	AUX X Power supply alarm Internal	AUX X Power supply alarm Internal
AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal
DC sync ID Disable	DC sync ID Disable	DC sync ID Disable
Output Phase 0°	Output Phase 120°	Output Phase 240°

Installation and Connection

5.3.3.3 Example 3

A+B Three phase system.

A system has **30 modules** per phase + **2 TUS modules** (total 90 modules and 6 TUS modules for 3 phase)

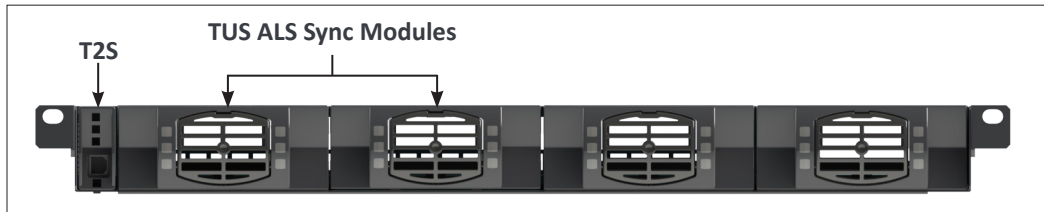
B system has **30 modules** per phase + **2 TUS modules** (total 90 modules and 6 TUS modules for 3 phase)

There is **one DC for A** and **one DC for B**.

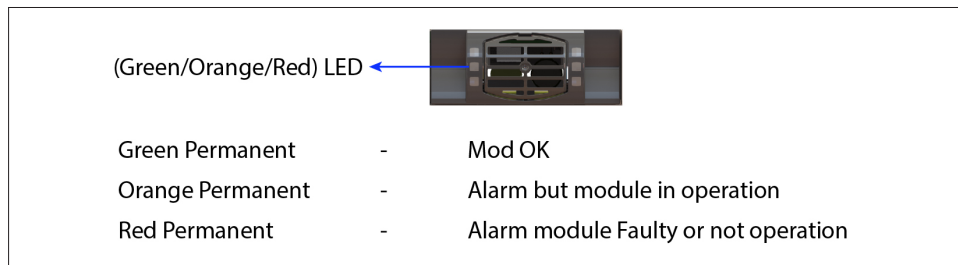
T2S ETH 1	T2S ETH 2	T2S ETH 3
Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE
Number of Sync modules 2	Number of Sync modules 2	Number of Sync modules 2
System ID 1	System ID 11	System ID 21
Output phase ID 1	Output phase ID 2	Output phase ID 3
Group ID 1	Group ID 1	Group ID 1
Number of line 6	Number of line 6	Number of line 6
AUX X Power supply alarm Internal	AUX X Power supply alarm Internal	AUX X Power supply alarm Internal
AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal
DC sync ID DC 1	DC sync ID DC 1	DC sync ID DC 1
Output Phase 0°	Output Phase 120°	Output Phase 240°

T2S ETH 4	T2S ETH 5	T2S ETH 6
Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE	Multiple sub systems sync ENABLE
Number of Sync modules 2	Number of Sync modules 2	Number of Sync modules 2
System ID 2	System ID 12	System ID 22
Output phase ID 1	Output phase ID 2	Output phase ID 3
Group ID 2	Group ID 2	Group ID 2
Number of line 6	Number of line 6	Number of line 6
AUX X Power supply alarm Internal	AUX X Power supply alarm Internal	AUX X Power supply alarm Internal
AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal	AUX Y Power supply alarm Internal
DC sync ID DC 2	DC sync ID DC 2	DC sync ID DC 2
Output Phase 0°	Output Phase 120°	Output Phase 240°

5.4 TUS ALS module User interface LEDs



TUS ALS shelf - Front View



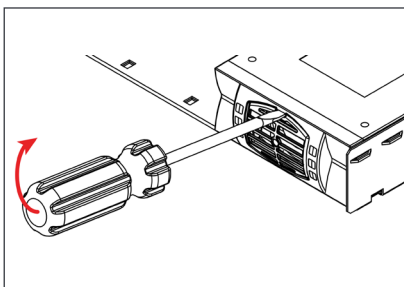
TUS ALS - LED Indications

5.5 Replacement of TUS ALS module or TUS ALS shelf

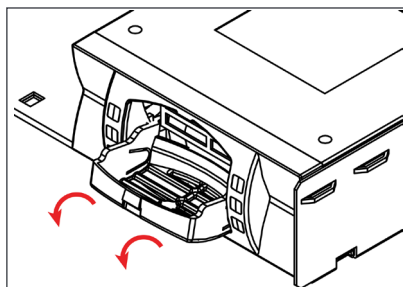
5.5.1 TUS ALS module

Before replacing a TUS ALS It is mandatory to make sure there is minimum 1 TUS ALS module in operation per system

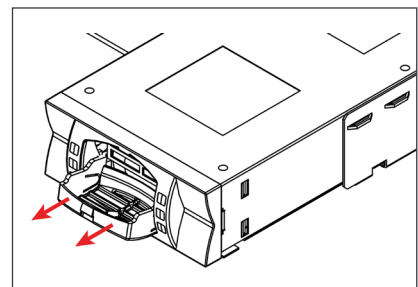
1. Identify the module to replace
2. Make sure there is minimum 1 TUS ALS module in operation in the system
3. Open the module front grid
4. Unplug the module
5. Insert new module in the same slot
6. Make sure the module is properly insert and locked (front grid closed)
7. The new module will start and connect automatically on the bus



A) Use screwdriver to release the latch



B) open the cover completely



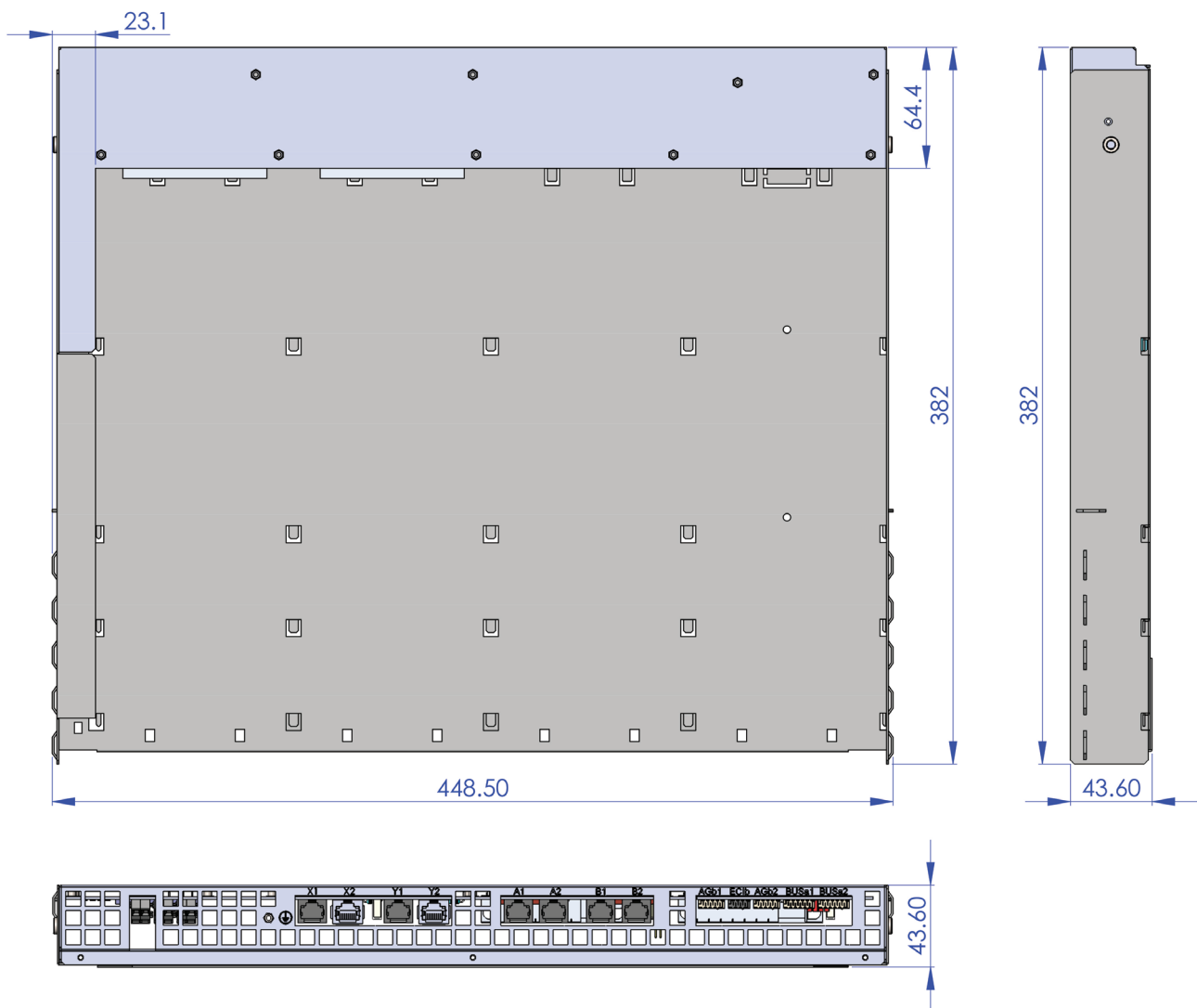
C) Use the cover as a handle to remove the module

5.6 TUS ALS Physical Dimensions

Width : 448.5 mm (without 19 " bracket)

Depth : 382 mm (excluding connectors)

Height : 43.6 mm



6. Commissioning

Before commissioning the ECI system equipped with TUS ALS make sure you followed all instruction for:

- Installing the TUS ALS equipment in the bay
 - Connect the TUS ALS communication cable X, Y mandatory as well as termination impedance
 - Connect external 12V power supplies (if any)
 - Configure each T2S ETH according the section settings
1. Disconnect AC output load all AC output breakers open
 2. If TUS ALS is used in A+B open the link to parallel AC output of both system
 3. Start each system using DC source AC source not connected
 4. Once system has started on DC make sure :
 - All Leds from TUS ALS sync module are orange
 5. Alarm “TUS ALS supply failure” is present on T2S of the inverter system. If external power supply (optional) is used and fed from AC input
 6. Check proper synchronisation between 2 system using oscilloscope
 7. Connect AC input to inverter system
 - All TUS ALS module should comes green permanent
 8. Check proper synchronization between both inverter system
 9. Basic Tests: AC input and DC input present and all TUS ALS module have green LED on
 - 9.1 Switch OFF AC input
 - 9.2 Switch ON AC input : All TUS ALS module have green LED
 - 9.3 Switch OFF DC input : All TUS ALS module shall have green LED on
 - 9.4 Switch ON DC input : All TUS ALS module shall have green LED on
 - 9.5 Turn OFF one Aux power supplies 12V (if any): Verify alarm Aux Power supply fail
 - 9.6 Turn ON the Aux power supply : No more alarm
 10. Connect both system AC ouput in parallel in case of A+B
 11. Connect AC load (close AC output breaker)

7. Trouble Shooting

TUS ALS alarms major (LEDs RED on module module out of service)

N°	Messages	Description	Origin
62	TUS ALS PARAM NOK	Wrong configuration file. Check the config file of the T2S	configuration
63	BUS XY FAIL	No communication neither on X Bus and Y Bus	T2S ETH module or cable X,Y bus problem
64	BUS XY CONFLICT	Conflict on BUS X and Y	Cable

TUS ALS alarms minor (LEDs ORANGE on module operational)

N°	Messages	Description	Origin
90	TUS ALS AC IN FAIL	Source AC IN (configured in file) missing or not conform	T2S clock
91	TUS ALS MISSING	1 module TUS ALS configured is not present or failed	Any T2S
92	1 TUS ALS SUPPL FAIL	1 Aux 12V power supply is faulty	T2S module
93	2 TUS ALS SUPPL FAIL	Both 12V power supplies faulty. The TUS ALS shelf supplied from another shelf	T2S module
94	TUS ALS PARAM NOK	Error in the config file	Configuration
95	BUS X FAIL	No communication on Bus X (Y is in operation)	T2S module
96	BUS Y FAIL	No communication on Bus Y (X is in operation)	T2S module

Warning !!! :

In case of failure, the TUS ALS system will not start. All TUS ALS module will be in error mode (Red LED on). But the ECI inverter module if AC input present will start and synchronize on AC input without the TUS ALS !!!!! =>

Therefore we recommend always to start first on DC input, and when all TUS ALS modules are green then connect the AC input power to the ECI inverter.

8. Defective modules

Unless input power is down all module LEDs should light green (see section 5.4, page 20). No light, orange light, red or flashing light are abnormal conditions. .

8.1 Replacing modules

Refer to section 5.5, page 20 to remove and re-insert modules.

8.2 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.

9. 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.
- Please contact CE+T support team at: customer.support@cet-power.com
- For USA & CANADA only, 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.

10. Maintenance Task

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

Tasks :

- Identify the site, customer, responsible, cabinet 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 ECI with vacuum cleaner and/or soft compressed air.
- Clean cabinet (vacuum cleaner or dry cloth)
- Control the inverter mapping (AC Group, DC Group, Address)
- Check load level and record the rate value (print in word document the 4 screen modules information for the 32 modules, the 3 screen for the phases value and the 2 screens for the group AC and DC value)
- Change the configuration file for AC and DC mix mode to check that all ECI work on both power supply
- Check alarm operation (e.g., redundancy lost, mains failure, DC failure) on dry contact and through SNMP system or web interface.
- Switch OFF AC IN and check alarms.
- Check temperature terminal and temperature wiring. If possible use an infrared camera.
- Read and record value as wave form, power factor, Crest factor, THD I from power analyzer.
- Take cabinet picture
- Keep track of report and provide end user with a copy.
- Perform a MBP procedure. This task is not really recommended*, but could be demanded by site manager.

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

