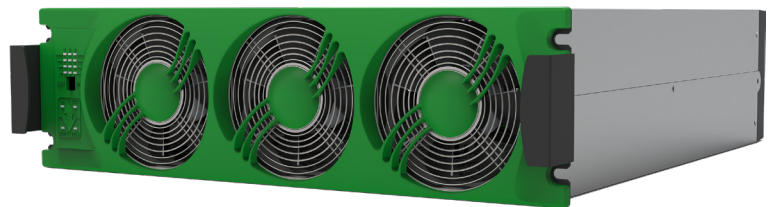# HERCULES - MODULAR PCS
User Manual V1.1

RE-INVENTING THE MODULAR PCS
THE NEW GENERATION OF POWER CONVERTERS

- SELECTIVITY
  Adapted response to short circuit and overload

- VERSATILE CHARGING
  Short or long backup recovery time at no extra cost

- BATTERY SUSTAINABILITY
  Qualitative charging for longer battery life expectancy

- HARSHEST AC INPUT CONDITIONS
  Without compromising the quality of the AC output

Table of Contents

Release Note:

Version	Release date (DD/MM/YYYY)	Modified page number	Modifications
1.0	11/05/2020	-	First release of the Manual
1.1	27/10/2021	-	Removed boost information

1. Introduction to CE+T Energrid

CE+T Energrid is a company in CE+T group. Their objectives are to design and provide energy management solutions for residential, commercial or industrial customers. Some examples of solutions are energy storage systems and microgrids. These solutions can be used by our customers to successfully reach energy transition optimizing their own energy consumption and maximising local renewable sources self-consumption. This can be done by merging energy production, storage, consumption and electrical vehicle charging. CE+T Energrid can offer complete solutions or elements that can be included in third-party solutions.

2. Abbreviations

TSI	Twin Sine Innovation		MIB	Management Information Base
EPC	Enhanced Power Conversion		OVP	Over-Voltage Protection
REG	Regular		PPP	Point to Point Protocol
DSP	Digital Signal Processor		RAS	Remote Access Server
AC	Alternating current		SCI	Serial Communication Interface
DC	Direct current		SNMP	Simple Network Management Protocol
DI	Digital Input		SOC	State Of Charge
ESD	Electro Static Discharge		Trap	Event Notification
MET	Main Earth Terminal		DER	Distributed Energy Resources
MBP	Manual By-pass		ESS	Energy Storage System
TCP/IP	Transmission Control Protocol/Internet Protocol			
USB	Universal Serial Bus			
PE	Protective Earth (also called Main Protective Conductor)			
N	Neutral			
PCB	Printed Circuit Board			
TRS	True Redundant Structure			
MCB	Miniature Circuit Breaker			
MCCB	Molded Case Circuit Breaker			
CB	Circuit Breaker			
PCS	Power Converter System			
ALCO	Alarm CutOff			
BCT	Battery Current Termination			
BDT	Battery Discharge Test			
BOD	Battery On Discharge			
BT	Battery Test (mode)			
CAN	Controller Area Network			
DOD	Depth Of Discharge			
EQ	EQualize (mode or voltage)			
FL	FLoat (mode or voltage)			
GUI	Graphical User Interface			
LCD	Liquid Crystal Display			
LED	Light Emitting Diode			
LVA	Low Voltage Alarm			
LVC	Low Voltage Connect			
LVD	Low Voltage Disconnect			
MAC	Media Access Control			

3. Introduction

3.1 Scope of the manual

This document describes the software features, on-site setup and operation of the Hercules Modular PCS with Pegasus controller and monitoring hub. Please refer to Hercules Installation manual for hardware installation and wiring information.

3.2 Hercules module description

The Hercules module is a modular PCS of 20 kVA / 20 kW.

The design of the module allows battery power controlling, dynamic load transfer, high efficiency, unsurpassed flexibility and scalability. The module is hot pluggable and hot swappable.

Hercules PCS modules are triple port converters (AC Input, DC, AC Output). Sinusoidal output is converted from AC Input or/and DC.

The block diagram here below gives an explicit description of the topology and operation.
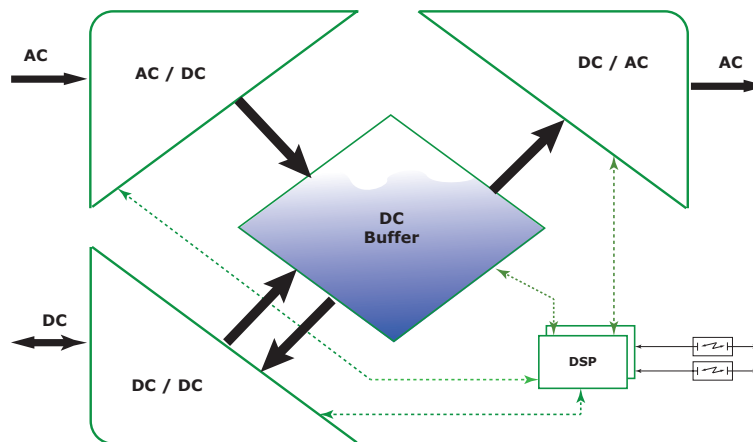
The module is built around the following sub-converters:

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

The energy can flow either from/to the AC source or from/to 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 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 PCS 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.

The TSI is designed to firstly operate on AC Input on permanent basis to deliver output voltage conditioned with low THD. A battery power setpoint is also available to fix the power charging/discharging the battery. Maximum power will always still 20 kVA / kW on each port with the highest priority always on AC Output supply.

There is no physical difference on the output sine wave whether the source is AC and/or DC. If the Ac Input 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 0 ms).

As soon as the AC Input returns into valid range, nominal operation is automatically resumed.

3.3 Reactive power capability of Hercules PCS module

Concerning the reactive power, the capability of Hercules modules is given in the following figure.

Reactive power capability at nominal voltage
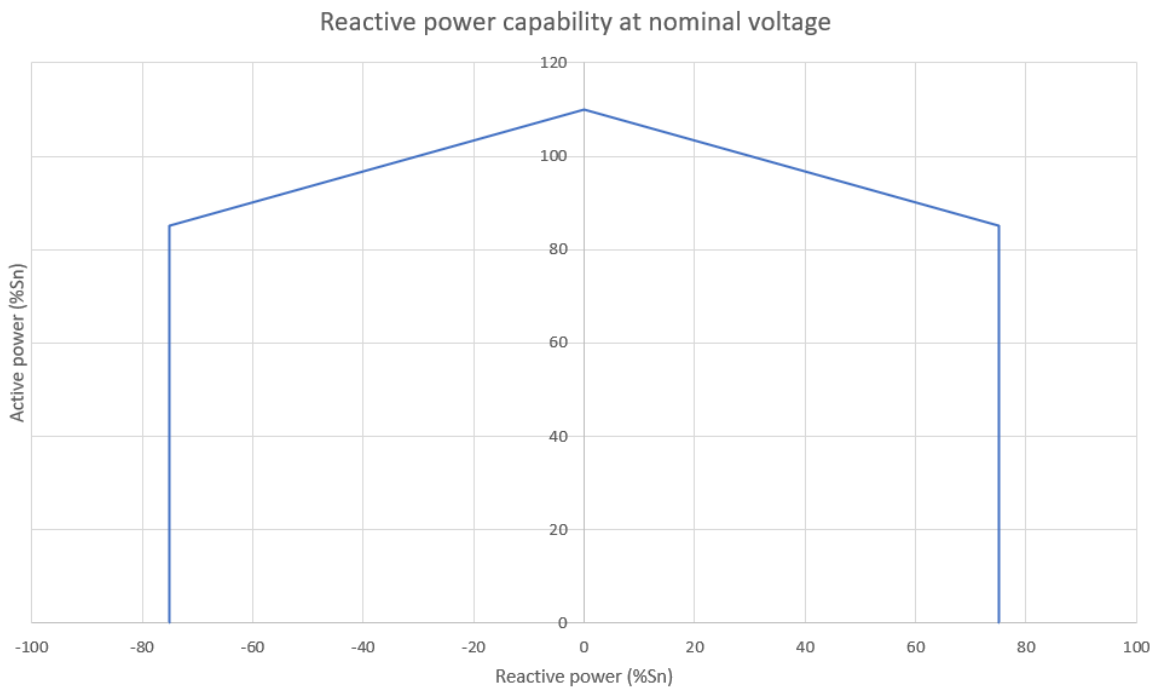
The ways to control this reactive power are multiple:

- Reactive power setpoint
- Power factor setpoint
- Voltage related control mode Q(u)
- Power related control mode

The configuration, activation and deactivation of the control modes of these functions are field adjustable and password protected.

3.4 Hercules PCS module User Interface
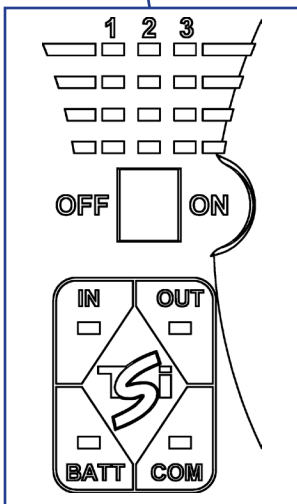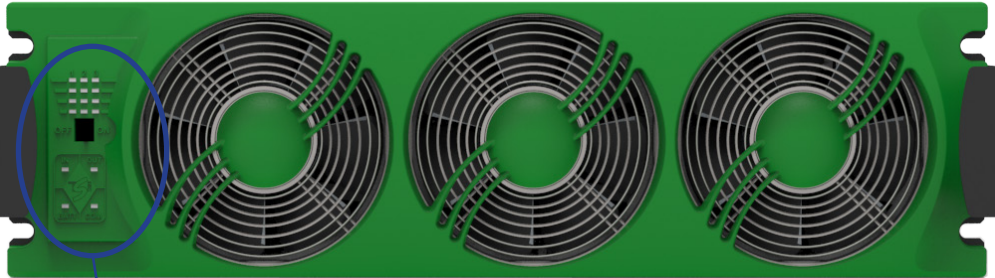
AC Output power bar graph 0-100% (25% increment)
Phase 1- phase 2 - phase 3

ON/OFF switch to switch ON/OFF the AC Output

AC Input and AC Output LED status

DC Input and Communication LED status

3.4.1 Output Power LED interface :

Each segment represent 25% load.

Load can differ between the 3 phases in one module.
Load can differ in one phase in several modules.

Overload (blinking)
100% - 110% segment 0-25 blinking
110,1% - 135% segment 0-50 blinking
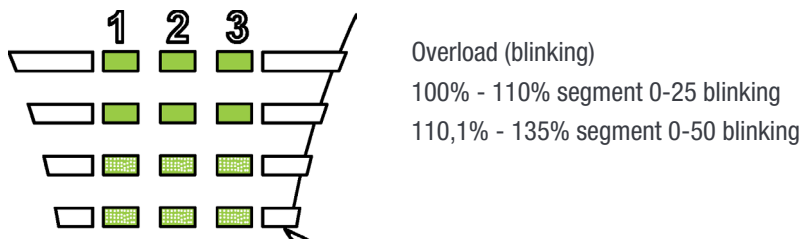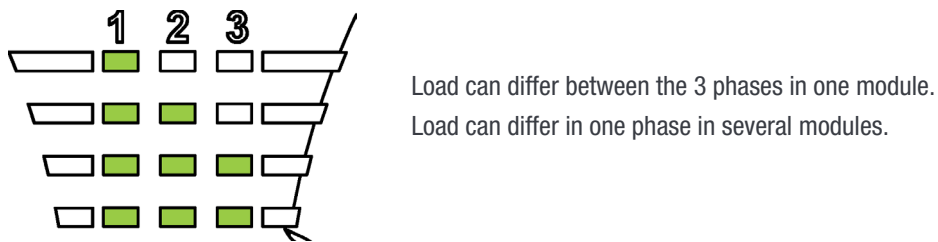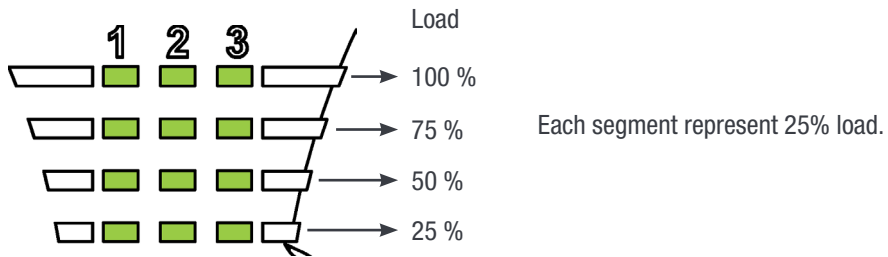
3.4.2 Module status LEDs interface

AC input LEDs interface
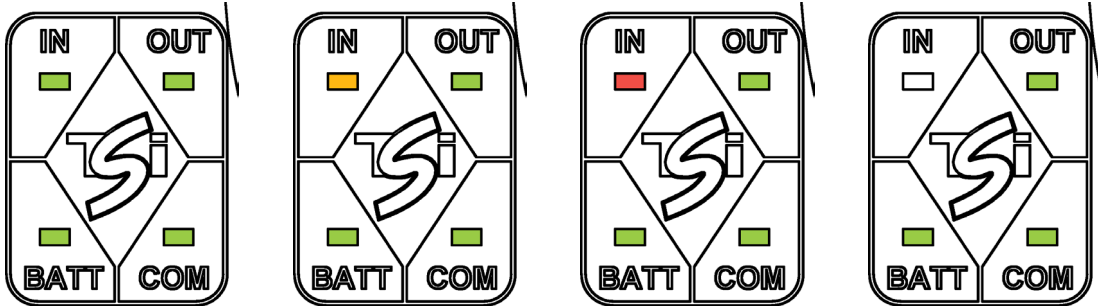
Starting up		GREEN Blink	
AC Input OK	(within limits)	GREEN	
AC Input not OK	(out of limits)	ORANGE	
	(Auto restart)	ORANGE Blink	
	(Manual restart)	RED Blink	
	(Non recoverable)	RED	
AC failure		OFF + external alarm	

AC output LEDs interface
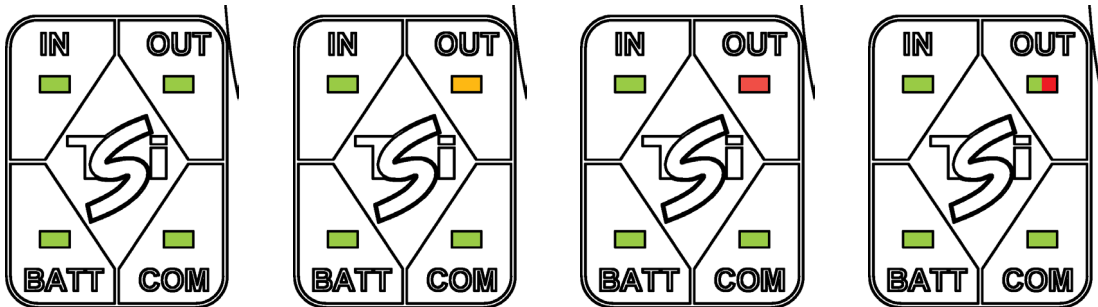
Starting up		GREEN Blink
AC Output OK	(within limits)	GREEN
AC Output not OK	(out of limits)	ORANGE
	(Auto restart)	ORANGE Blink
	(Manual restart)	RED Blink
	(Non-recoverable)	RED
Remote OFF	(Manual restart))	OR/GR/OR/GR
		sequence every x seconds

DC Input LEDs interface
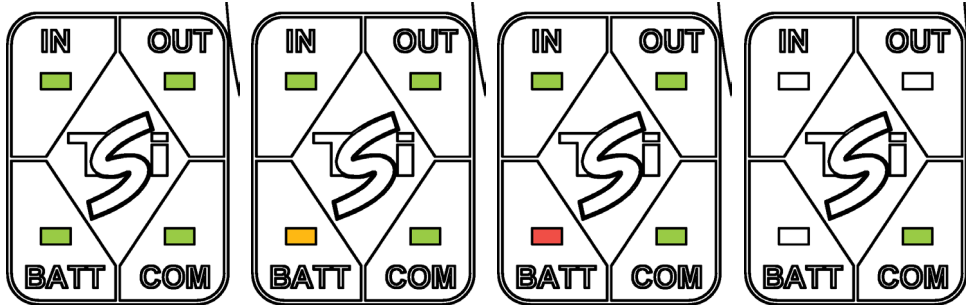
Starting up		GREEN Blink	
DC OK	(within limits)	GREEN	
DC not OK	(out of limits)	ORANGE	
	(Auto restart)	ORANGE Blink	
	(Manual restart)	RED Blink	
	(non-recoverable)	RED	
No battery connected		OFF	

Communication LEDs interface
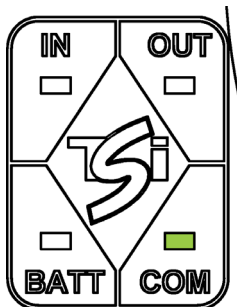
COM OK		GREEN
COM ERROR	(Bus A or B)	GREEN Blink still one bus present
COM ERROR	(Bus A & B)	RED Blink

Module and system will continue working with one BUS failing with two bus failing the module/system will isolate and shut down.

3.5 Pegasus controller description

Pegasus terminal is a DIN rail mountable controller that acts as a link between the system and the user. The control of the system and the modules are distributed on each module:

The Pegasus allows to:

- Configure and set the system parameters.
- Consult information, alarm, measure through USB port.
- Control of output Alarm relay (8) and digital input (8).

The internal battery management system of the Pegasus allows float charge, boost charge, temperature compensated charging, discharge measurements… with lead-acid batteries.

Other battery chemistries can be also used. An external BMS is then used interfacing with the Pegasus controller through a CAN bus protocol.
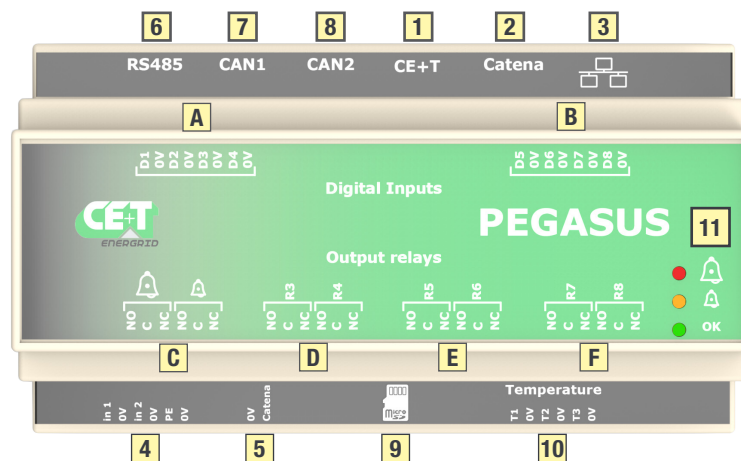
Pegasus supervisor monitors the Hercules modules as well as system environment. It is connected to:

- The Hercules modules through the CE+T proprietary bus [1].
- [2] is no more used.
- The optional Catena 7" display on left ETH port - see section 3.6, page 14.

Pegasus terminal has:

- 8 "digital input, D1 to D4 [A] and D5 to D8 [B].
- 8 output relays Major Alarm, Minor Alarm [C], R3 to R8 [D,E & F].
- 3 temperature probes T1 to T3. T1 should be used for battery when internal BMS is used, T2 and T3 are not used for now [10].
- Dual DC input 12 V power supply (not included) [4].
- [5] is not more used.
- An external TCP/IP interface [3] if optional Catena display is not used. If Catena is used, this external TCP/IP interface is available directly on Catena display.
- Modbus RTU is available on RS485 port [6]. See section 11, page 46 for more information.

- CAN bus is available on CAN port [7]. See section 12, page 50 for more information.
- [8] is not used.

Pegasus status shown on [11]

- Green LED → No alarm
- Orange LED → Minor alarm
- Red LED → Major alarm

Please note the Pegasus equipment are not master and therefore can be removed during operation without affecting the operation of the PCS.

3.5.1 Software Overview

The software embedded in Pegasus allows complete system supervision through "touchscreen display" on optional Catena display or via web browser through TCP/IP interface, and provides functionalities such as:

- System setting and configuration (password protected).
- System status and information display.
- System alarms and events log file.
- System self-maintenance

3.6 Catena 7" display interface description

Catena 7" display GUI interface allows the user to easily access the system monitoring via a powerful web based graphic display.
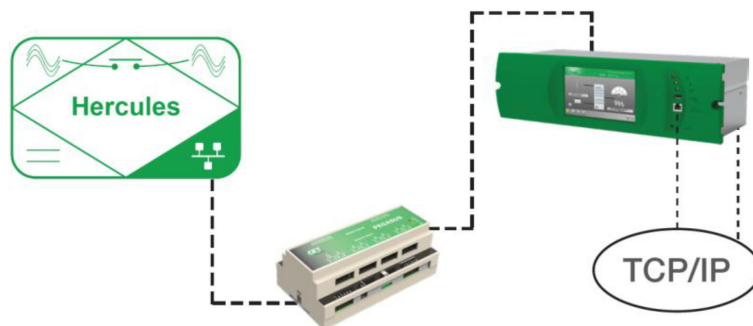
In addition to the touchscreen display the user can also access to the same GUI using an Ethernet port present on the Pegasus terminal or on the optional 7" display. Two Ethernet port are available on the Catena display: one on the rear face and one on the front face.

The Catena display in connected to the Ethernet port of the Pegasus controller.

Optional Catena 7" display comes in two versions:

- Rack mount
- Door or panel mount

3.6.1 Rack mount

Rack mounted where the unit takes 3U inside the cabinet flush mounted.
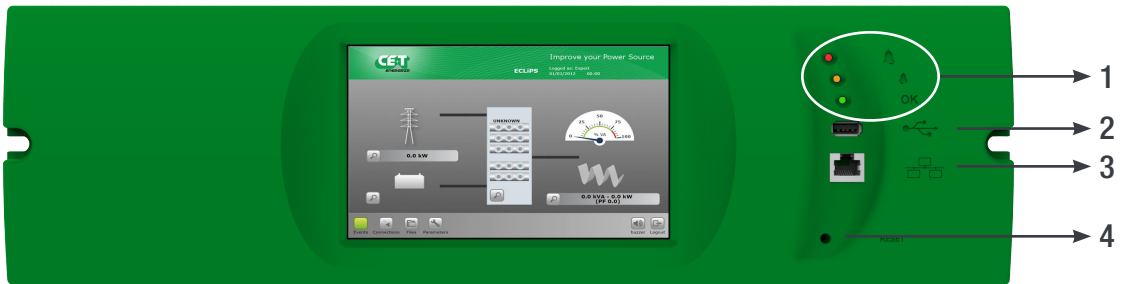
Catena Rack Mount - Front view

1 → Red LED - Major Alarm, Orange LED - Minor Alarm, Green LED - No Alarm

2 → USB port   3 → ETH port on front face   4 → Reset button

Catena Rack Mount - Rear view

5 → Ethernet port to be connected to Ethernet port of the controller

6 → Dual DC input 12 V power supply   7 → Ethernet port on back side

Remark: Reset will only reset the Catena display, not the Pegasus terminal and will have no effect on the system. Power supply and connectivity are provided on the back of the unit.

3.6.2 Door or Panel mount

Door or Panel mounted where the unit is fixed to the door or panel.

Catena Door Mount - Front view

1 → Red LED - Major Alarm, Orange LED - Minor Alarm, Green LED - No Alarm

2 → USB port   3 → ETH port on front face   4 → Reset button

To access the user interface, user must connect through Ethernet port.

Installing the Door mount 7" display in the Hercules Cabinet door:

Step 1. In the Cabinet Door, make 8 x M3 holes as per the catena support sheet dimensions.
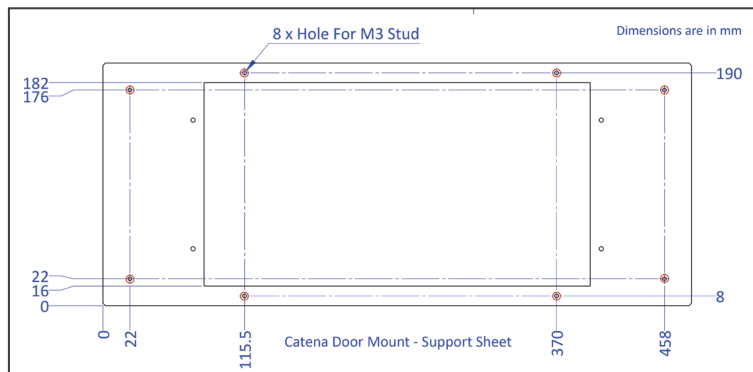
Step 2. Assemble the Door mount catena with the Catena support sheet using 4 x M3 Studs.

Step 3. Place the assembled catena into the cabinet door and fix it using 8 x M3 Studs.
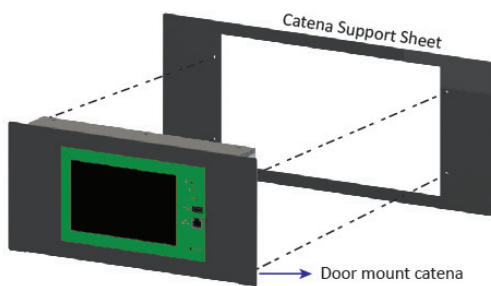
Assemble the Catena   Fix Catena Assembly in the Cabinet door
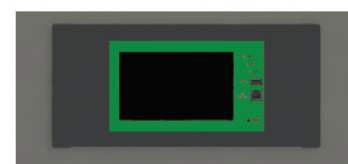
4. Pegasus start-up

If you have installed the Pegasus equipment by yourself, make sure to respect the connections as indicated in this user manual and, if available, in the schematic provided with the Hercules cabinet.

If you have ordered the complete solution with cabinet and module from CE+T Energrid, both controllers are installed, wired, tested and preconfigured according to the system.

4.1 Applying start-up power

NOTE: The controller will perform a short self-test as it boots up. Alarm alerts are normal.

- Initiate the start-up routine by applying power to the Pegasus terminal.
- Use the touchscreen or a laptop to connect to the system.

NB: if you are connecting with your laptop, default IP address of user interface is *http://192.168.0.2*

There are two access levels:

- Basic: basic access does not require password.
- Expert: default password is *pass456* but it's strongly advised to users to change that password.

In case of lost password, please refer to section"13.4 FAQ", page 66
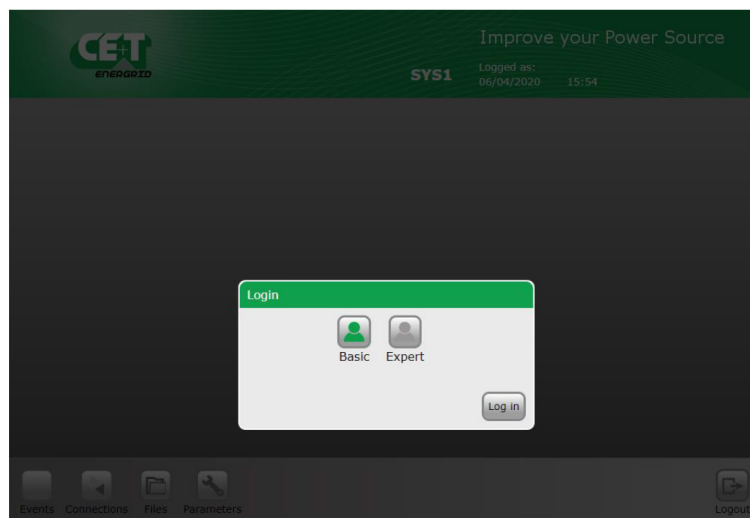
- Check and adjust alarms and control levels in the controller sub-menus.
- Check and adjust battery settings in the battery sub-menus; e.g. float, equalize voltage, etc.
- Check the communications settings for remote access as needed.

NOTE: System modification and setting may result in alarm event. Make sure you are applying modification carefully.

5. Standard Features
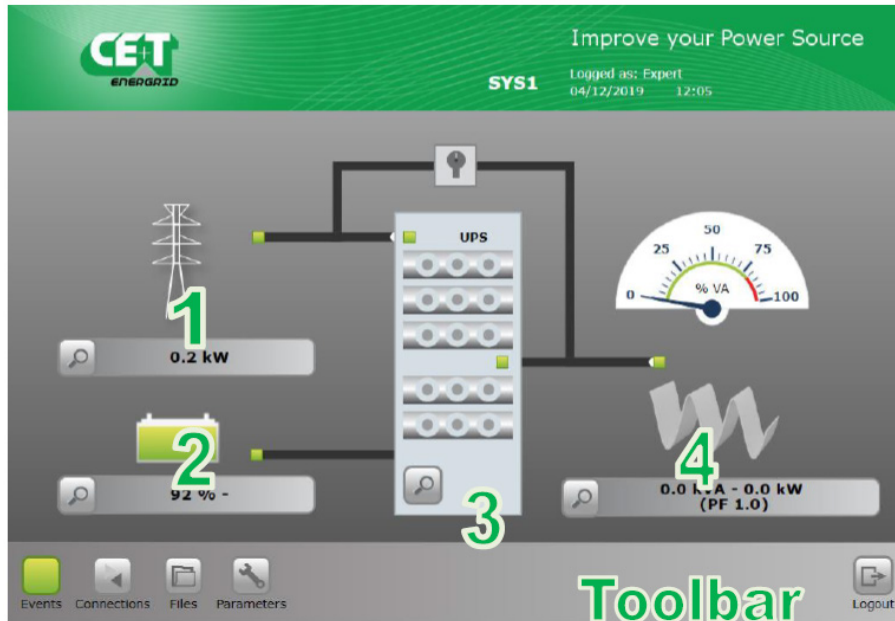
The main screen presents an overview of the system where any "click" on the magnifying glass icon will result to access the selected sub-menu:

> **1** → AC Input sub-menu.
>
> **2** → DC Battery sub-menu.
>
> **3** → Hercules Modules sub-menu.
>
> **4** → AC Output load sub-menu.

A click on an icon in the toolbar will give you, respectively, access to the event, communication, files, and parameter sub- menu.

The main screen shows the status of each of your power system's components.

- AC input: Green, Red.
- Battery: Green, Orange, Red.
- Hercules module(s): 2 LEDs (AC input, AC output).
- AC output / Load: Green, Red.

The energy flow direction is indicated by the "moving" white point on the power lines.

5.1 AC Input Sub-menu
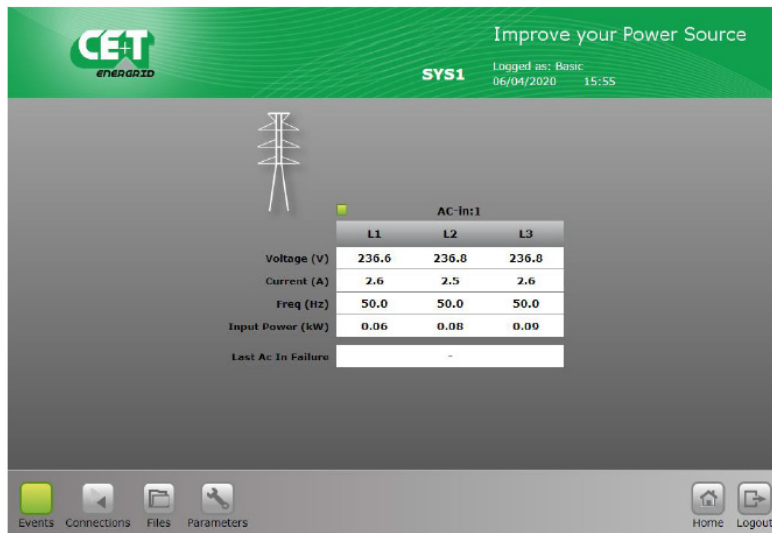
Provides AC Input information (up to 3 phases):

- AC input voltage
- AC input current
- AC input frequency
- AC input power (kW).

5.2 DC Battery Sub-menu
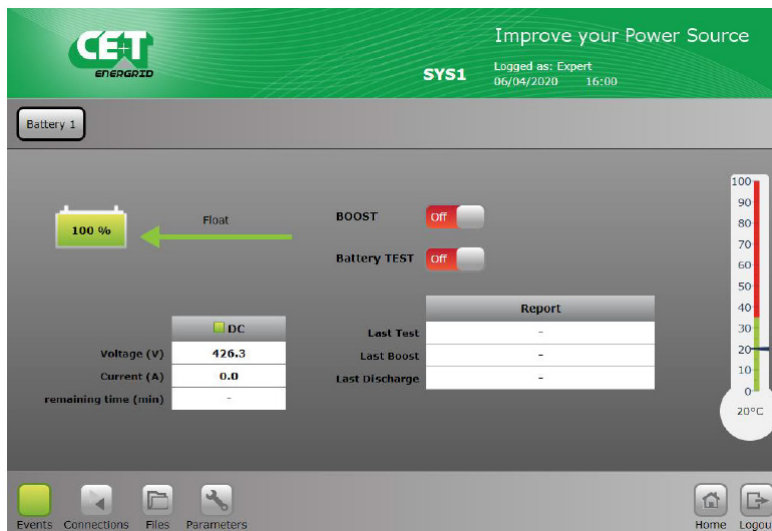
Only if internal BMS is used

Battery 1 provides information on batteries status. Estimated autonomy and info on last test, boost charge, discharge.

It allows also to manually start

- BOOST ON or OFF
- Battery Test ON or OFF

Note: at first start-up of a Hercules system using internal BMS, the State-of-Charge (SoC) of the battery is unknown.

The alarm « Battery capacity is unknown » is raised.

The battery must be charged until being fully charged. Then the internal BMS will know that current SoC is 100%. Two possibilities to make this battery charge:

- Fix a charge setpoint using Modbus RTU if parameter "Control Interface" (Communication tab → Storage) is fixed to Modbus RTU.

- Choose "No Control" for parameter "Control Interface" (Communication tab → Storage), then battery will be charged as explained in "Floating mode" slide.
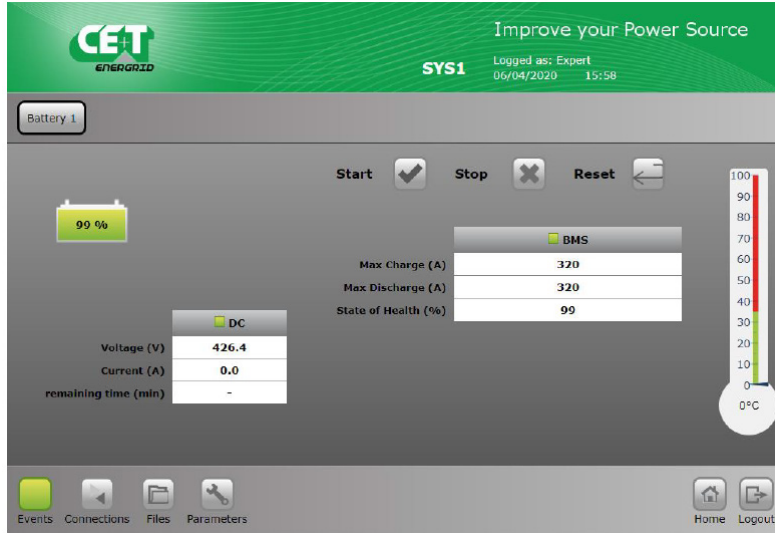
Only if external BMS (or EMS) is used

Battery 1 provides information on battery provided by BMS.

If BMS allows it, it is possible also to manually.

- Connect battery contactors, "Start"
- Disconnect battery contactors, "Stop"
- Reset battery alarms

Refer to holding register 6002 in Modbus RTU tables.

5.3 Hercules Modules Sub-menu
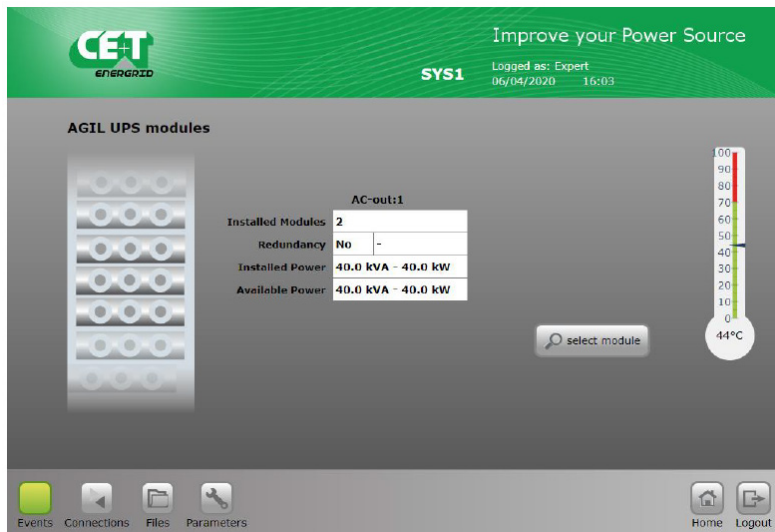
Provides Hercules module info

- Number of modules installed
- Redundancy level
- Installed power
- Available power
- Temperature of the warmest module.

5.3.1 Hercules Modules Sub-menu

Clicking on the "Select Module" icon will open a module selection table. Each number represents the address of a module in the system.

- A green indicates an installed and running module.
- An orange indicates an installed but in recoverable error module.
- A red indicates an installed but in non-recoverable error module.
- A grey indicates a module manually turned OFF. Only available in "Expert" mode.
- A white indicates an empty slot.
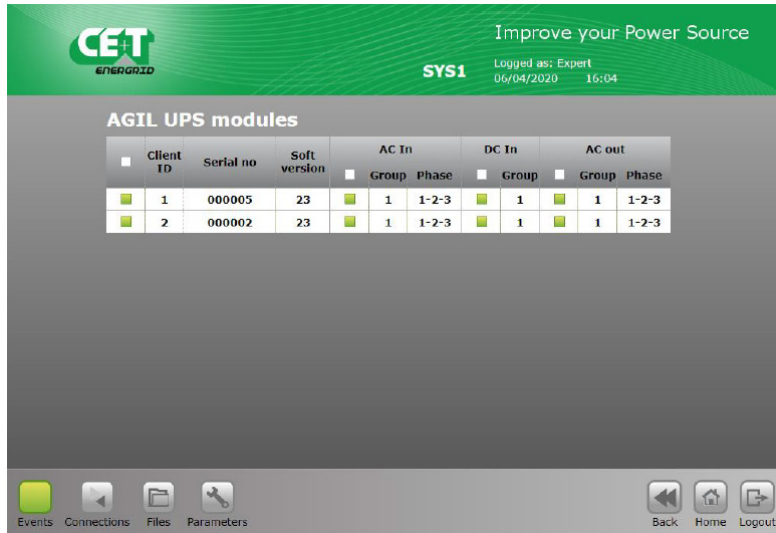
Table indicates the number of modules installed / not installed in the system.

Click on an installed module to access the specific information of the selected module.

Selected Module information

Click "identify icon" to see the corresponding module in the cabinet (all LEDs blinking).

Module status indicated through the LED color on:

- AC input.
- DC input.
- AC output.
- Green: OK.
- Organe: Recoverable error.
- Red: Non recoverable error.

	When a module is removed from the system, it must be uninstalled by clicking this icon.
	When fan is replaced in the module, the alarm "fan replaced" should be cleared by clicking this icon.
	Module can be switched off by software by clicking this icon. The current state (on or off) of the module is also given by this icon.
	Module AC-in, DC-in group and AC-out phase can be change by clicking this icon. Note: while changing the AC-out phase, the module should be in OFF condition.
	It will identify the current module in the system by clicking this icon. (All LEDs will blink in the module).

5.4 AC Output Load Sub-menu
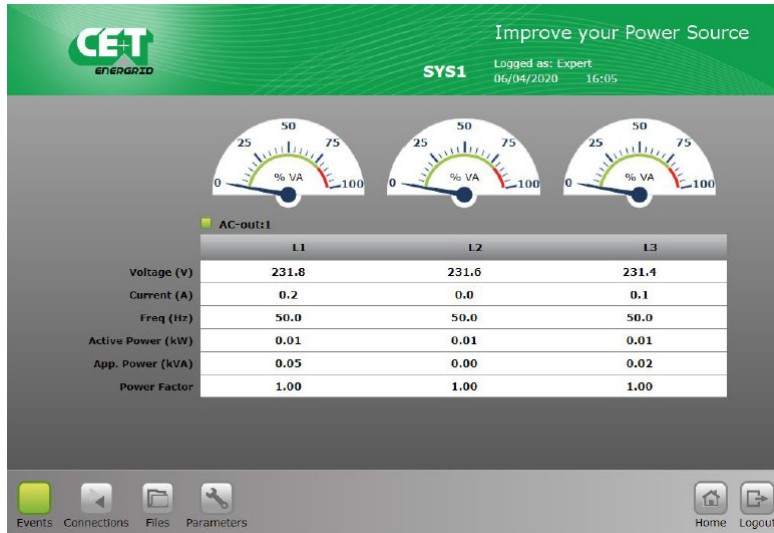
Level of power bar graph.

Individual phase measurements:

- Voltage
- Current
- Frequency
- Active Power
- Apparent Power
- Power Factor

6. Toolbar

6.1 Events and Log

Please note "text alarm page" is refreshed every minute for easy reading while LED's are active immediately.
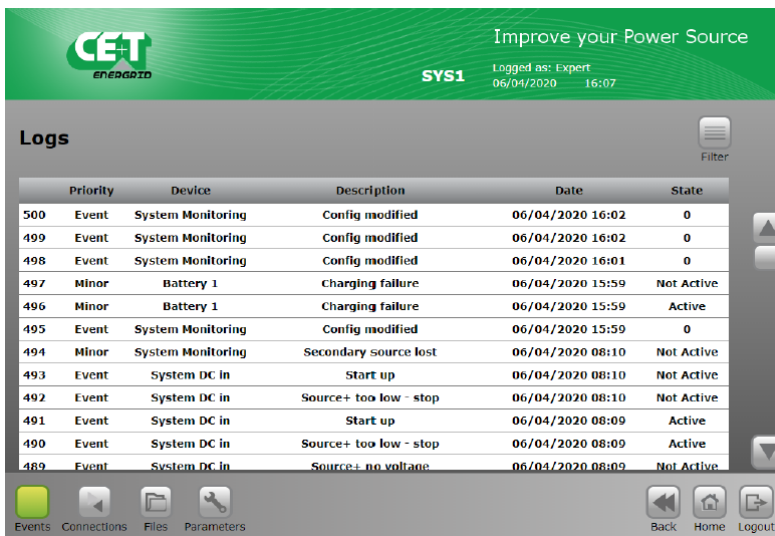
Display the active event/alarm present on the system.

- Red: Major alarm.
- Orange: Minor alarm.
- White: No alarm.

Click on "Log" to view the history log file presented below.

Log file can be filtered using the filter menu.
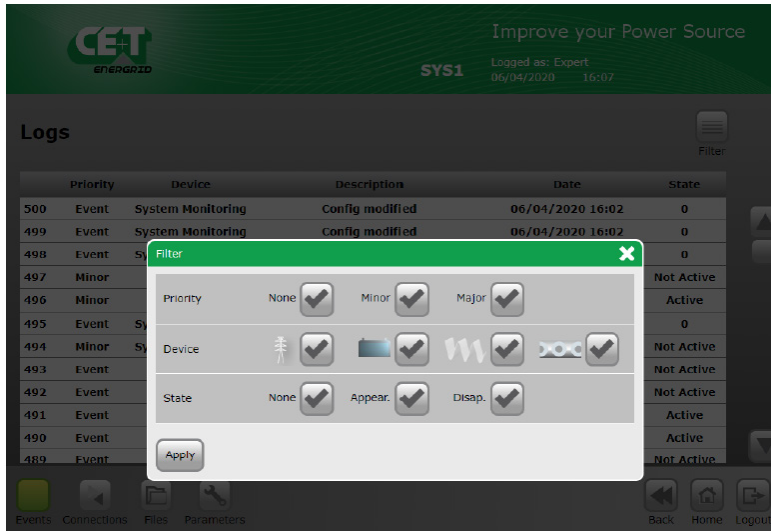
Do not forget to click apply to activated the selected filter.

Clear Filter will remove all selected filter and view all log file.

6.2 Input and output mapping
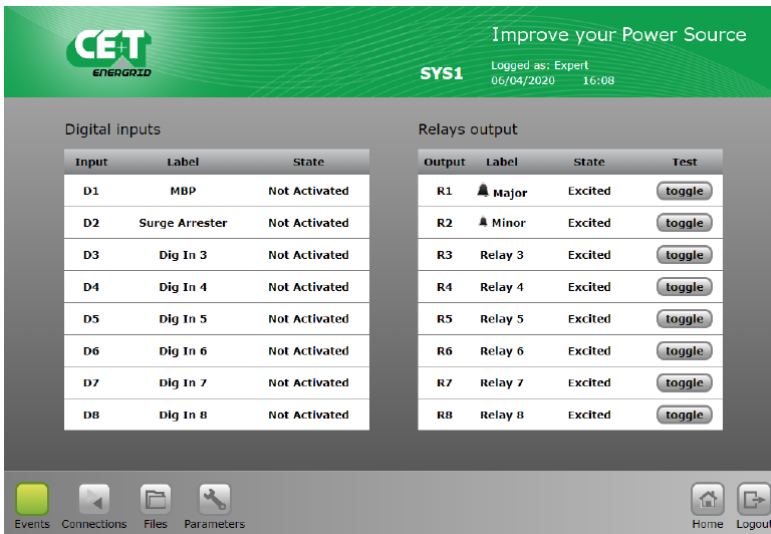
Present the output relay mapping with possibility to test each relay with the "toggle" button. Click and check relay status with an ohmmeter.

Note:
Only available in expert mode through laptop web browser.

6.3 Files

Transfer screen allow to export the log file and export or import configuration file.
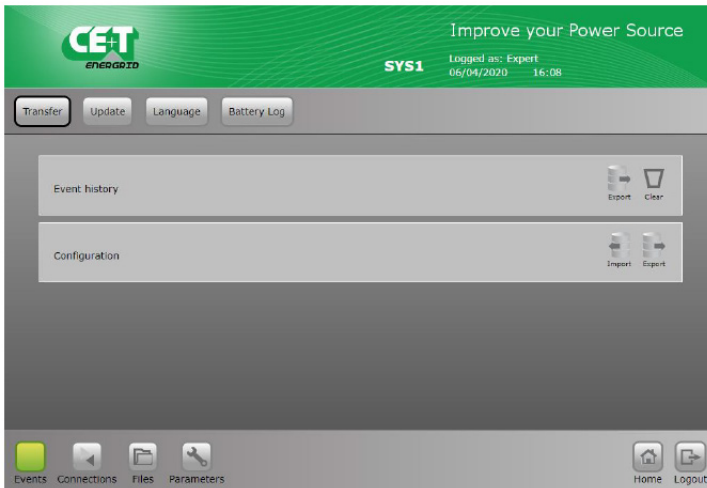
Event History

Both Event log and configuration file can be exported.

Event file name cet.log is a text format *.txt file.

Log size limited to 500 lines.

Click on "clear" will erase the CET log file. Password protected.

Configuration

Configuration file can be exported or imported from to the Pegasus.
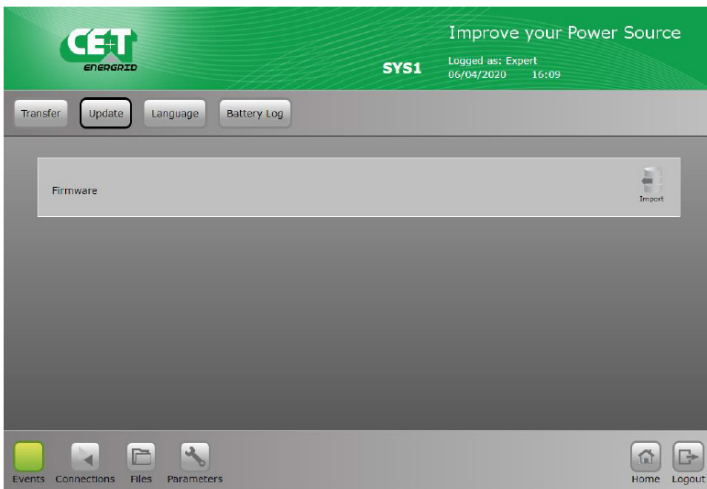
To upgrade Pegasus firmware. Import the file from computer and download to Pegasus.
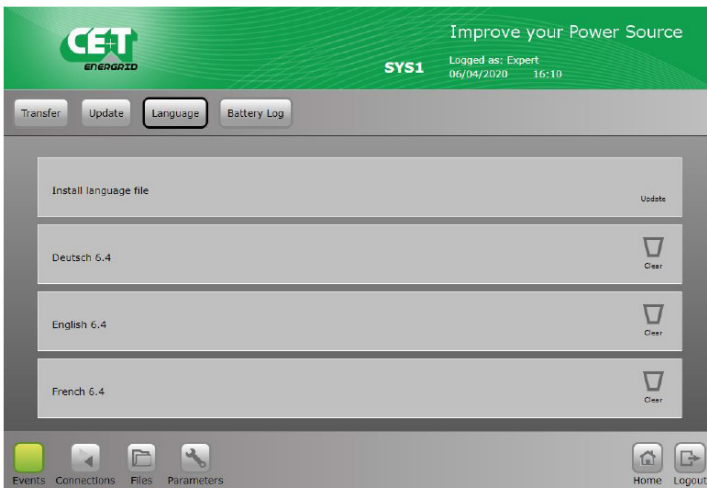
Pegasus stores maximum 3 languages that can be changed, updated or cleared.
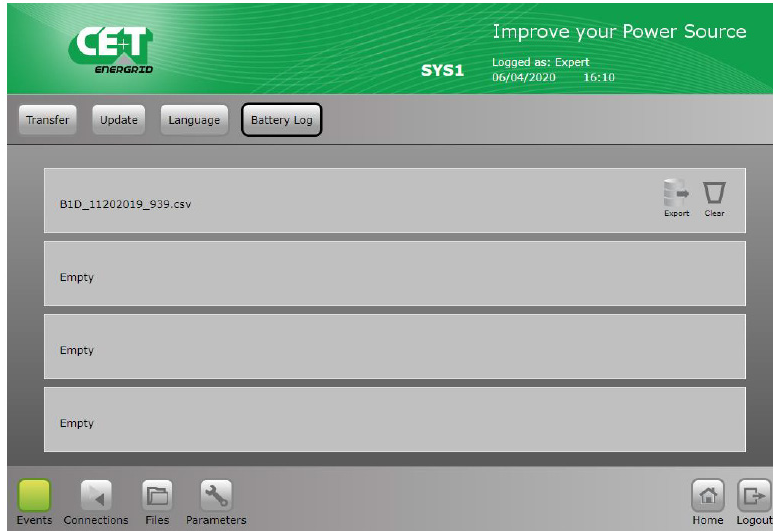
To export or clear the battery log files.

6.4 Parameters

WARNING !

All values present are default values! User shall consult and change default value with caution. Wrong parameters can affect the system operation, reliability, battery life duration and system autonomy.

6.4.1 Monitoring

NOTE: Once the new parameter has been entered click « save » to record the data otherwise the previous value will be retained.

This menu allows to Set time and region settings, Change password, Set Temperature sensor, and Define the alarm mapping.
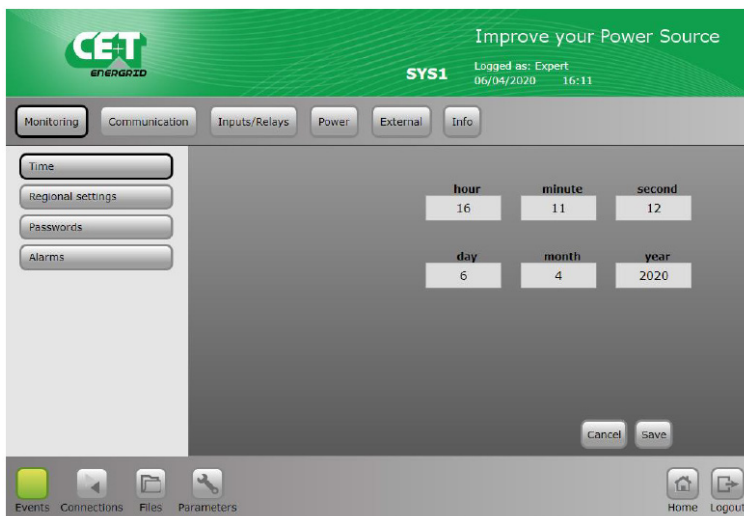
Allow to set Time and Date.
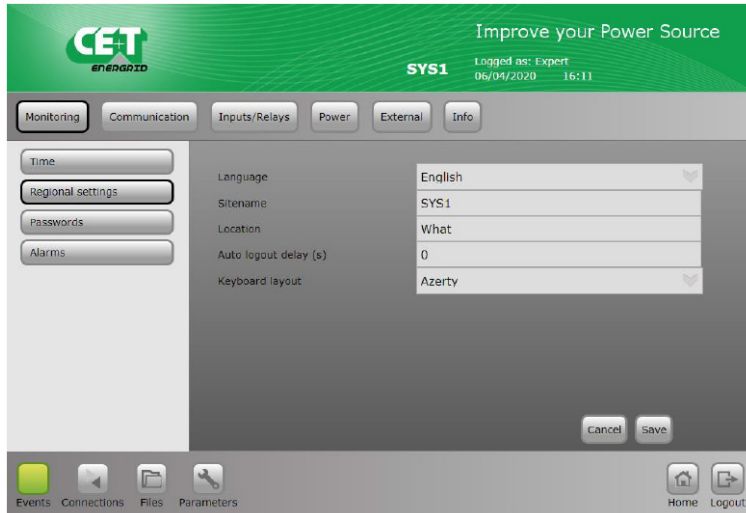
- Choose language.
- Site name.
- Site Location.
- Auto logout delay (will disconnect user after defined seconds).
- Keyboard layout.
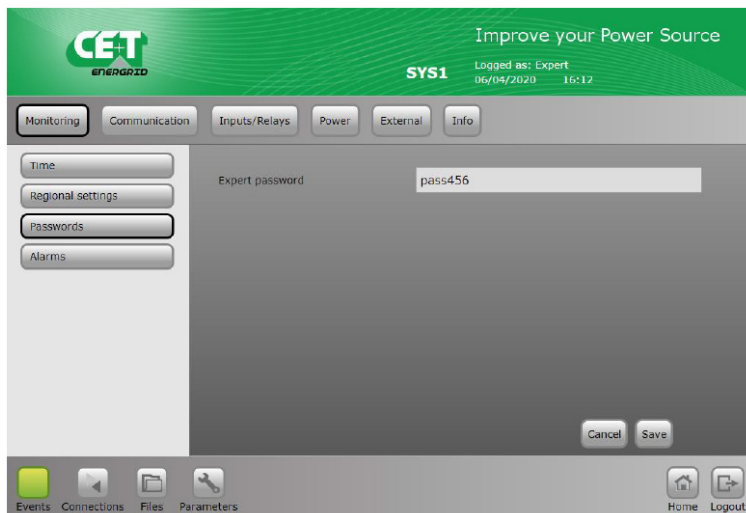
Choose password. Read the information carefully at section 4.1, page 17.
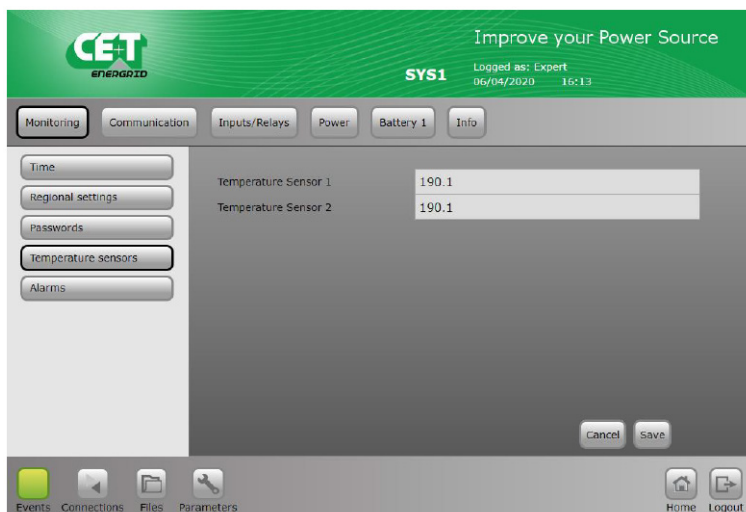
Only if internal BMS is used

Allow to configure the temperature probe for battery compensation or ambient temperature.
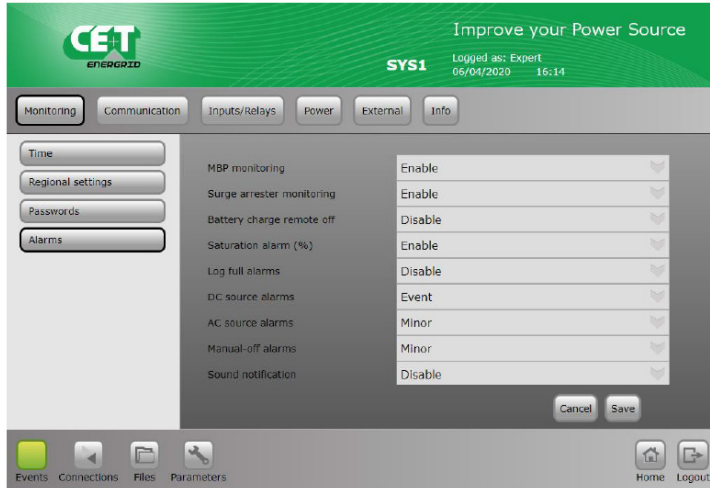
Allow to enable and disable the alarms.

6.4.2 Communication

Allow to configure the LAN Network parameters
(Note: Default IP address is 192.168.0.2)

You can configure all SNMP and Trap related settings. For more details refer section 10, page 44.

Remark: Catena Network configuration is mandatory for having the screen working.

It should be on the same network as Pegasus.
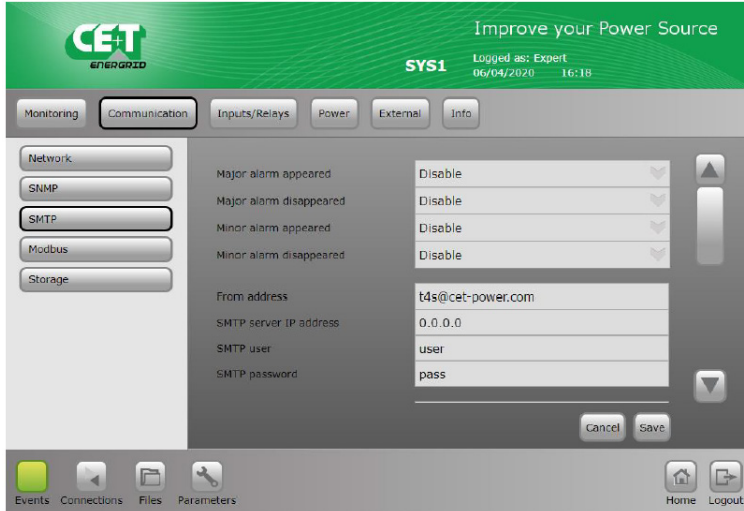
Allow to define a SMTP interface.
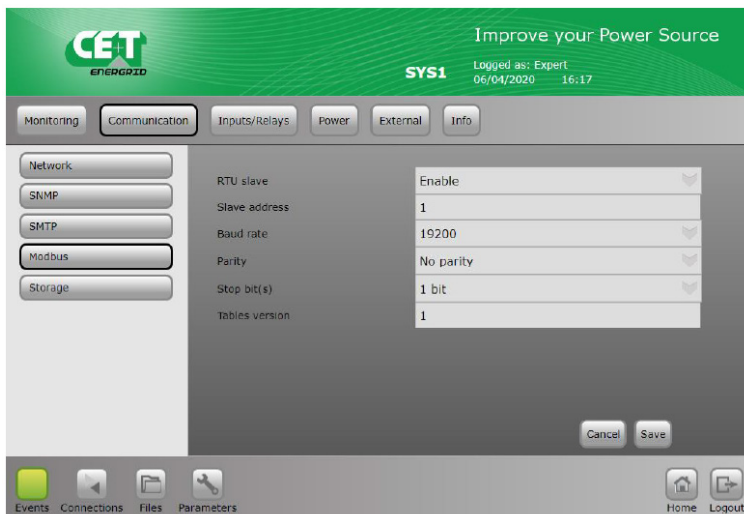
You can view Modbus settings. For more details refer section 11, page 46.

Control Interface:

- No control = UPS Mode
- Modbus RTU (Recommended choice)
- SNMP

Consign Timeout in second

Timeout response when EMS is lost (= no more power setpoints)

- Do nothing: keep the consign.
- UPS Mode: set the setpoint back to 0W, DC is still available for AC output when grid is in failure.

Consign Target
- Battery or AC Input

Start Stop enable
- Give the EMS the ability to connect/disconnect contactors in the battery system.
- Useful only when in external BMS mode.

6.4.3 Digital Input and output relay mapping

Allow to define a label that will be used for any digital input activated.

Example:

Label 1: Door open will report the event "Door open" every time the digital input 1 is active.

By default,

- Digital Input 1 is assigned to "Manual Bypass"
- Digital Input 2 is assigned to "Surge protection SPD" if it presents in the system.
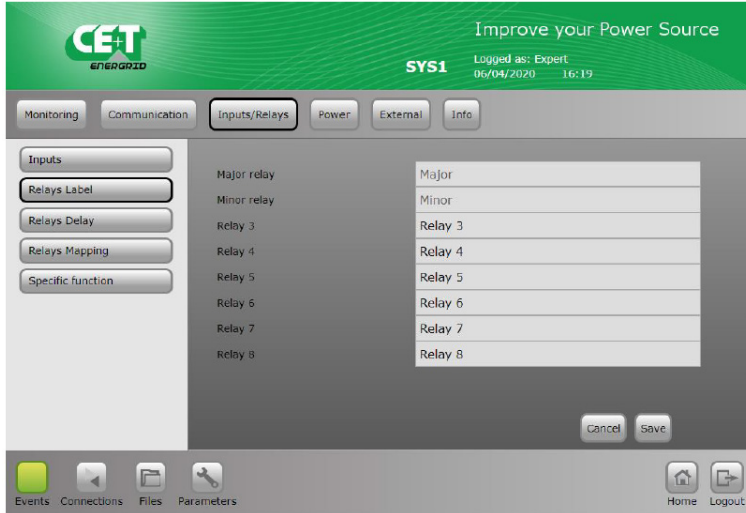
Relay label define the text that will be used for output relay.

Relay 1 and 2 are reserved for Major and Minor alarm. Relay 3 to 8 are free for any alarm definition.
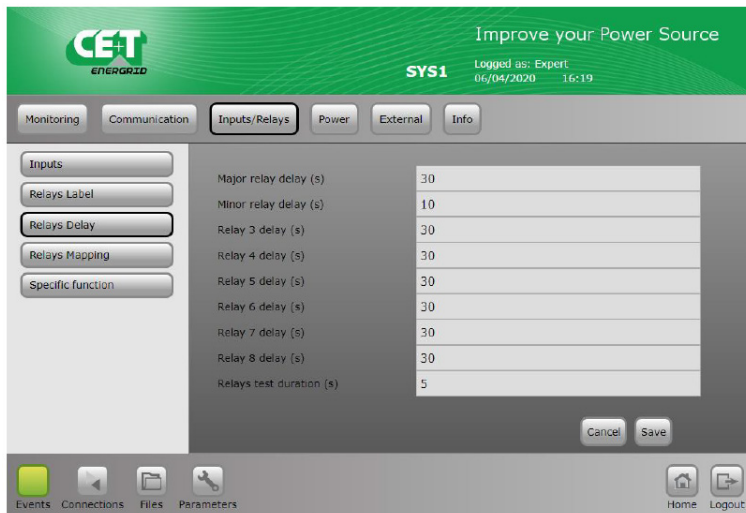
Relays delay allow to define to delay in sec after which the relay will change status once the event has occurred.

Range from 2 seconds to 60 seconds.
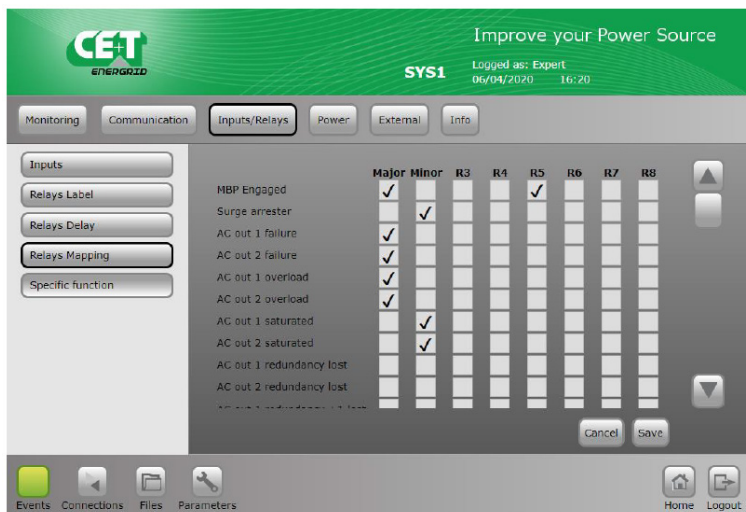
Allow to perform the mapping of any alarm to any relay association.

One alarm can be allocated to more than one relays.
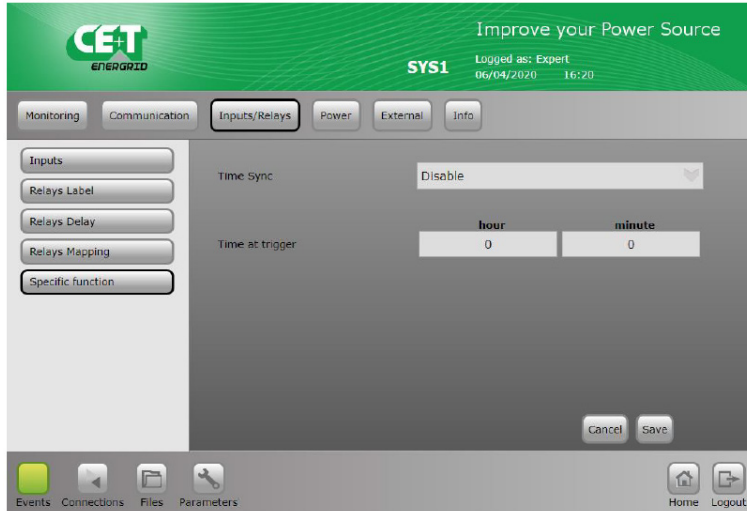
Specific function that can be used to synchronized time of Pegasus controller through an impulse on one digital input.

Please contact CE+T if you want to know more about this functionality.

6.4.4 Power parameter setting

The menu "Power" allows to perform the setting of the system, AC input, DC battery, AC output and Others.
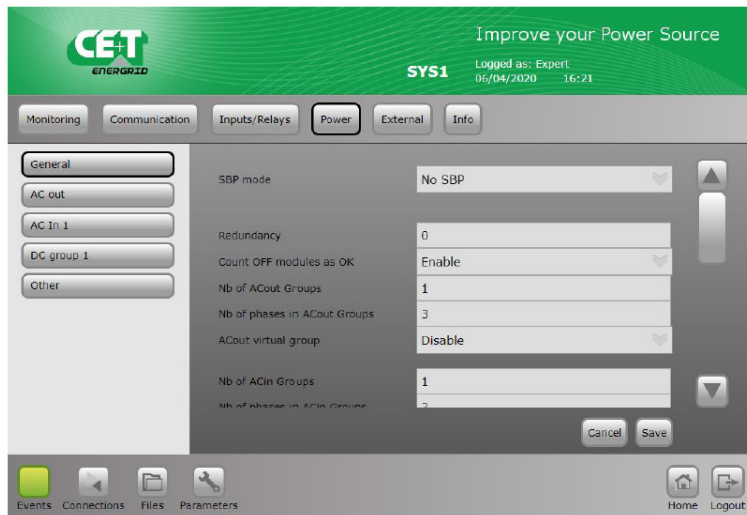
To configure:

• Redundancy
• AC IN Groups and Phases
• AC Out Groups and Phases
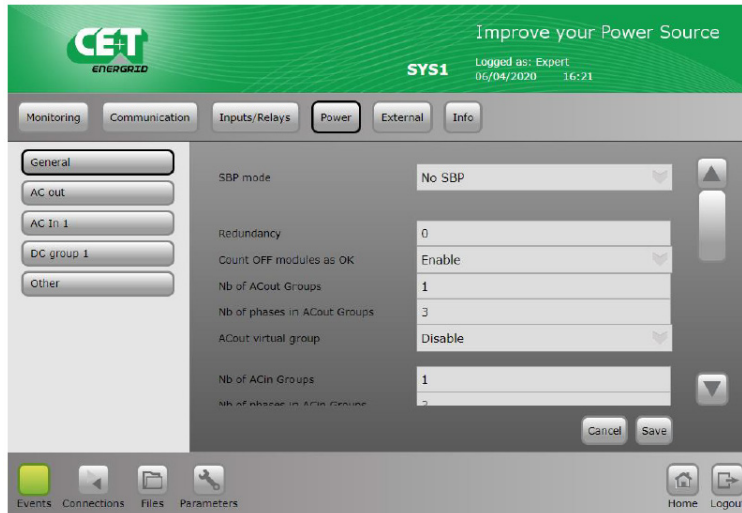
When choosing Battery in DC Mode, you can select the BMS:

- Internal BMS, only with lead acid battery
- External BMS, for Li-Ion battery as an example
- EMS, battery is handled by the EMS

Battery systems require the use of a Battery Management System (BMS). Hercules allows three situations:

- Internal BMS

  - A BMS is implemented inside the Pegasus controller.
  - Modbus RTU table in « Internal BMS data » tab.
  - Internal BMS can be used only with Lead-Acid batteries.
  - Refer to « Internal BMS » chapter of this presentation.

- External BMS

  - The BMS of the battery is connected to the Pegasus controller through CANBUS.
  - Modbus RTU table in « External BMS data » tab.
  - The communication protocol of a BMS must be implemented inside the Pegasus. Refer to holding register 6005 (« ESS data » tab) to know which BMS are already managed.

- Included in EMS

  - BMS function is included in the EMS or the EMS directly interface with the BMS without passing though the PCS controller.
  - No information about battery in the controller except following holding registers that must be updated by the EMS through Modbus RTU interface:
    - Holding register 5134 "Battery floating voltage setpoint"
    - Holding register 5145 "Instantaneous maximum battery charge current"
    - Holding register 5146 "Instantaneous maximum battery discharge current"

To configure AC output parameters:

- AC out Phase sequence
- AC out phase shift.
- Nominal AC out frequency.

Note:

The parameter "Out voltage consign" set by default to 230 Vac shall be adjusted according nominal AC input voltage. This will limit the inrush current when operating on Manual Bypass.

The phase sequence must be respected between AC IN and AC Out. Improper phase sequence might damage equipment during MBP procedure.
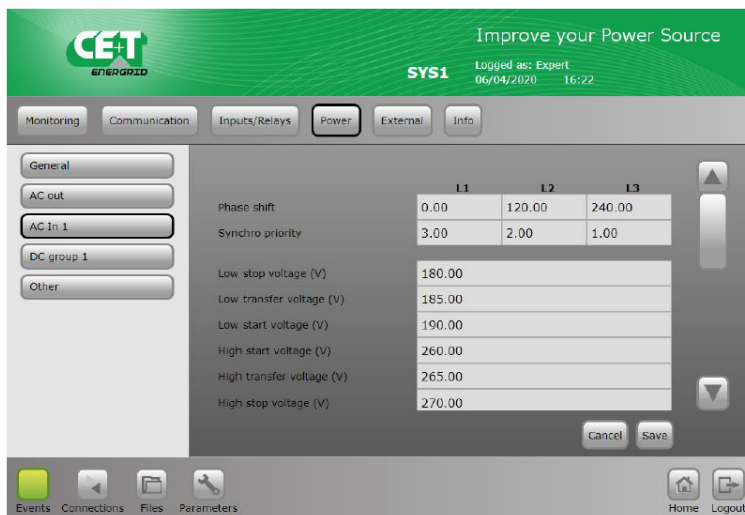
To configure AC input parameters:

- Phase shift (120° for 3 phase)
- Sync Priority: Define on which Phase - if all present – the module will synchronize the AC output.
- "Low transfer" and "High transfer" defined voltages to configure the voltage boundaries min and max from where Hercules will transfer to DC battery and vice versa.

To configure DC input parameters:

- Min, max battery voltages
- "Low transfer" and "High transfer" define voltages to configure boundaries min and max from where Hercules will STOP to preserve battery from deep discharge.

Note: Default value are related to 408VDC nominal lead-acid battery (204 x 2V cells).

Note: When those value need to be changed, please respect the rules below:

300V < Vdc low stop <= Vdc low transfer < [20V hysteresis] < Vdc low start < Vdc ref < Vdc high start < [10V hysteresis] < Vdc high transfer <= Vdc high stop < 495V

Not respecting the rules above will result is parameters not accepted.

Note: When those value need to be changed, we recommend to proceed as below (respect the sequence):

- To define the new value of Low start voltage, Low transfer voltage, Low stop voltage and save.
- To define the new value for Battery cells, Float voltage, Capacity, Current limit in section 6.4.5, page 36
- To define the new value for High start voltage, High transfer voltage, High stop voltage and save.

Customer repartition:

- 0 to 100% to define the ratio from AC in and battery
- 0% - AC input as primary source
- 100% - Battery as primary source

Commutation time: define the duration to return from DC to AC.

Synchro speed: To define the speed for synchronization (0 is a default value).

- Fast Synchronization: - 2
- Slow Synchronization: + 2

AC reinjection: can select either Enable or Disable.

Vout min ovrl too long: to define the value before alarm Over Load Alarm appear.

Delay ovrl too long: to define the timeout to generate Over Load Alarm.

6.4.5 Battery 1 (Only if internal BMS is used)

Warning!!!

Battery configuration is extremely important. There must be correct value entered for battery. Those parameters will define:

- The floating charging voltage

- The boost charging voltage (if enabled)

- The current limitation to protect battery from overcharging current

- The prediction of the battery capacity when battery tests are performed

Wrong value will affect the operation of the system and might have an impact on the battery lifetime.

Hercules needs always odd number as there is middle point.

- Cell floating voltage at 20°C
- Max current to limit during charging. Never exceed C10/4
- Cells capacity: if more than one string please multiply the cell capacity x number of strings.
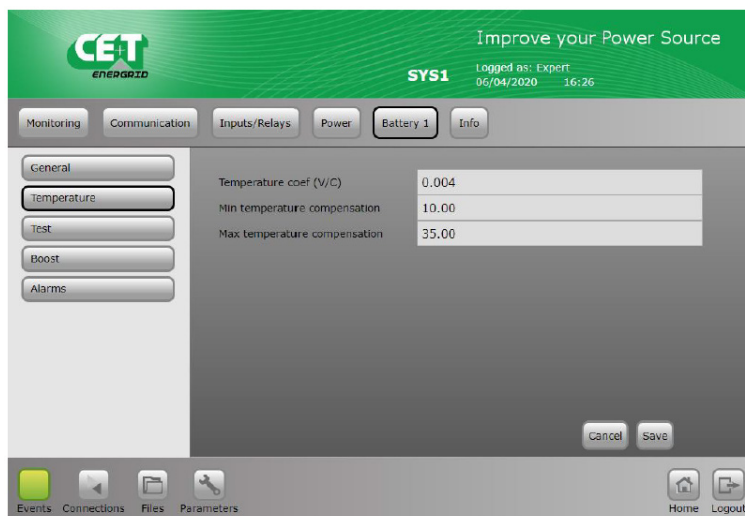
Temperature compensation:

- Enter the value from manufacturer mV/°C
- Min: from where the compensation starts
- Max: from where compensation stops
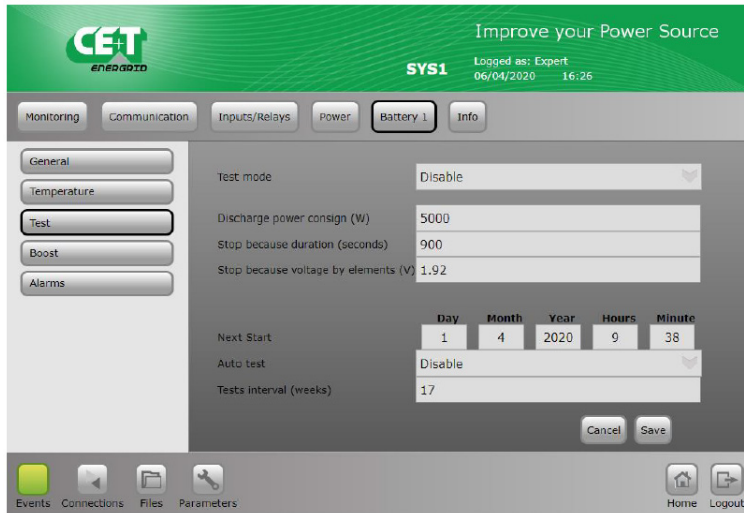
To set up the battery test parameters:

- Power
- Time duration
- Voltage stop

Auto test to define the periodicity of the test.
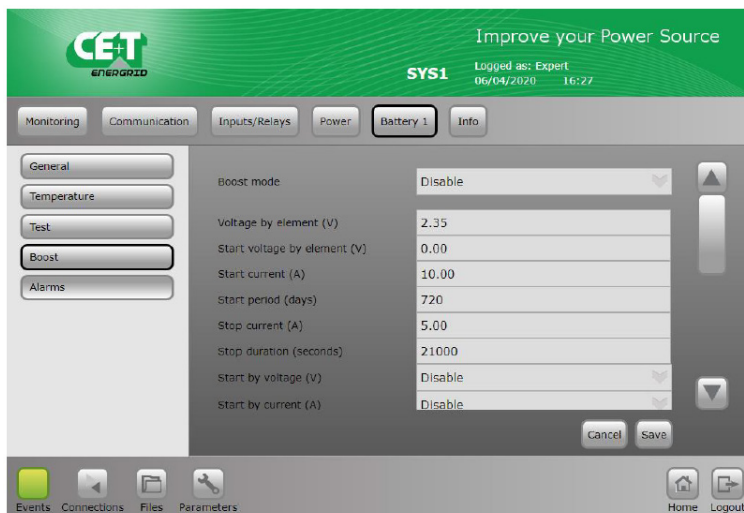
To set up Boost. First enable it and then set up the parameters:

- Voltage per cell (from manufacturer).

Boost can be activated

- on voltage value. After discharge below set volt per cell the boost will be activated.
- on charging current value.
- Periodically.

Boost stop always if the duration exceeds the Stop value (seconds).
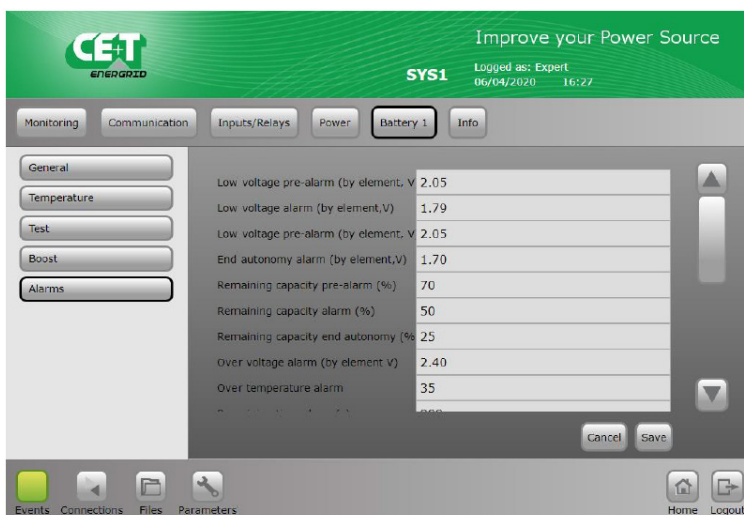
To define threshold values of battery alarms:

- Cell Low voltage: end of autonomy alarm. Hercules will shut down very shortly by LVD.
- Low Pre alarm: Pre-notification of low battery voltage.
- Autonomy pre-alarm: Set the % of capacity available after the alarm.
- Remaining capacity alarm % of autonomy available.

6.4.6 External (Only if external BMS is used)
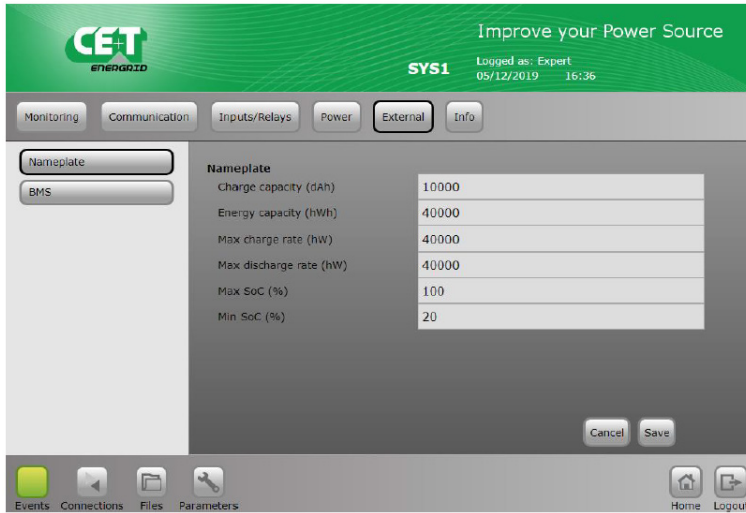
Nameplate values for SunSpec Standard

6.4.7 Info
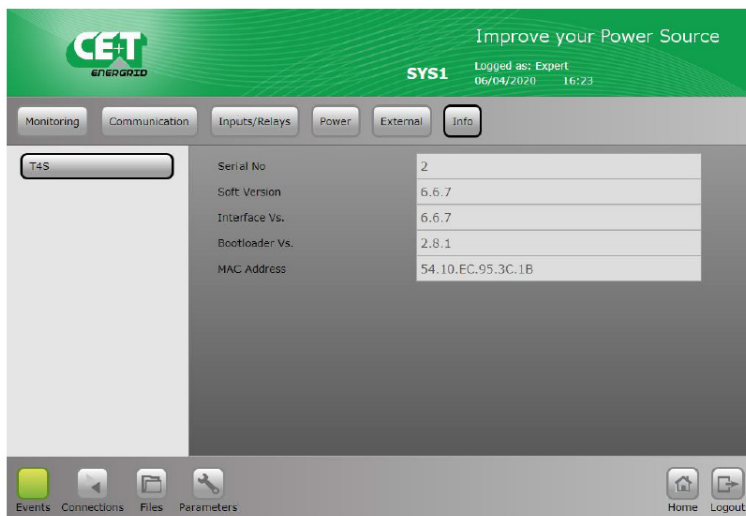
Provide information about Pegasus

- Serial number
- Software version
- Interface version
- Bootloader version
- MAC Address

7. Hercules use case examples

7.1 Discharging

- Battery discharge power fixed to Pdis.
- AC Input power is consuming power if Pdis < Pcl, or it is injecting power if Pdis > Pcl. If maximum AC Input power is reached (consumption or injection), Pdis will decrease to avoid over-voltage in the DC buffer of the Hercules module.

$P_{cl}+P_l-P_{dis}-P_{der}$ DER $\downarrow P_{der}$ P_l

$\updownarrow P_{cl} - P_{dis}$

Hercules P_{cl} Critical Loads

P_{dis}
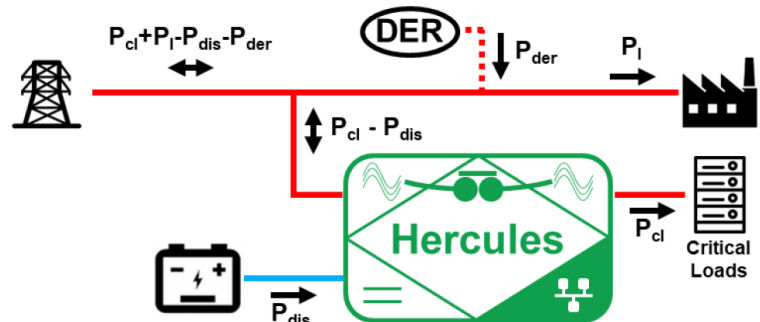
7.2 Charging

- Battery charge power fixed to Pch.
- AC Input power is consuming power. If maximum AC Input power is reached, Pch will decrease to guarantee power Pcl for critical loads.

$P_{cl}+P_l+P_{ch}-P_{der}$ DER $\downarrow P_{der}$ P_l

$\downarrow P_{ch} + P_{cl}$

Hercules P_{cl} Critical Loads

P_{ch}
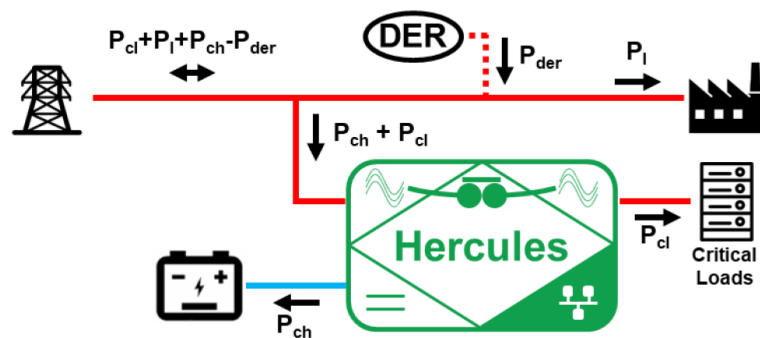
7.3 Back-up

- Grid failure → Noncritical load and DER are lost.
- Critical loads are supplied by the battery (supposing that some capacity is remaining inside)

Hercules P_{cl} Critical Loads

P_{dis}
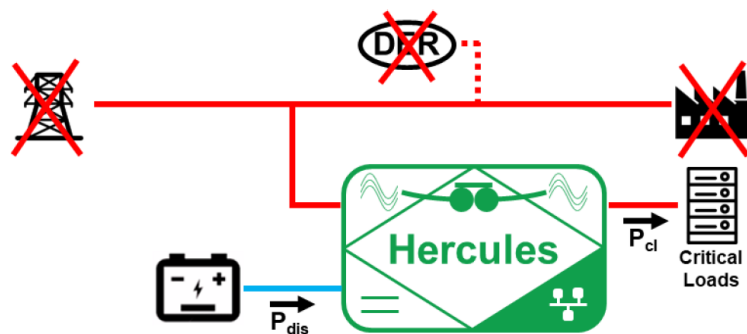
7.4 Peak shaving

When we are talking about peak shaving with Hercules module, we can address two situations:

- Peak shaving on output load connected to AC Output of Hercules modules
  - Peak shaving limit fixed to $P_{out,peak}$
  - Hercules modules discharges battery to limit power on AC input at $P_{out,peak}$
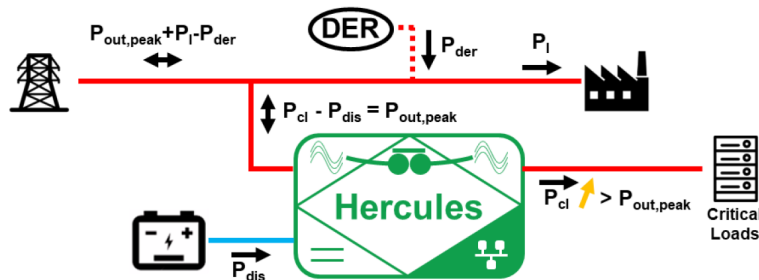
- Peak shaving on the entire building installation
  - Peak shaving limit fixed to Ppeak.
  - Total building consumption $= Pl + Pcl$, and measured by an EMS (or another supervisor).
  - An EMS (or another supervision) is required to perform measurement and send power setpoint to Hercules system.
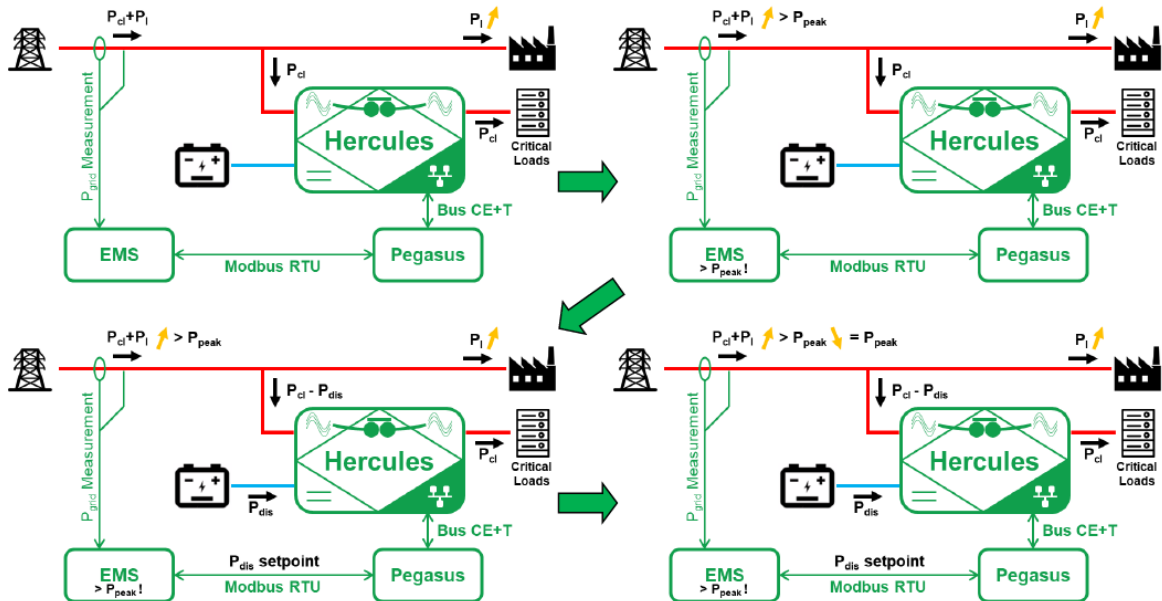
8. Hercules module and Fan replacem

8.1 Hercules module replacement

Caution:

Before sliding the module into the cabinet, make sure nothing is blocking the module such as objects, Catena wires and other wires..

Step 1. Place the module in the cabinet.

Step 2. Using the front handle, slide in firmly until the module is properly engaged.
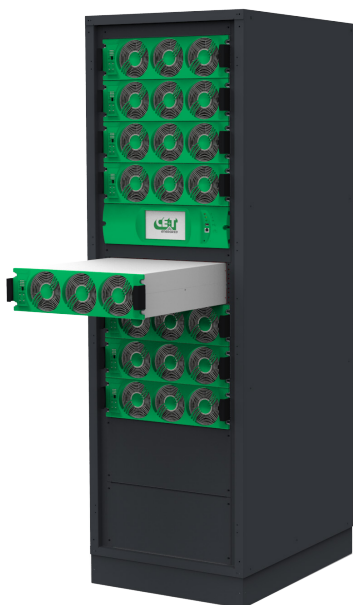
Place the module   Slide in Firmly

8.2 Fan Replacement

The FAN pre-alarm "FAN life elapse" has been set to 5 years. An event will appear on the Catena to remind the "FAN life elapse"..

Perform the following steps to replace the Hercules Fan Kit:

1. Order and receive a replacement Hercules Fan Kit which consist of a metallic front plate on which the new three fans are already fixed (T451030001).

2. Remove the module from the system and let it rest at least five minutes prior to initiating the work.

3. Remove the **Front Green Plastic** by releasing all the five latches (3 latches at top and 2 latches at bottom) in the module.

4. Remove the **Hercules Fan Kit** (Front Metallic Plate) by unscrewing the eight screws.
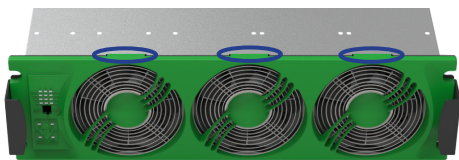
Figure 1: Remove Front Plastic

Figure 2: Remove FAN Kit

5. Unplug the **Fan wires** from the terminal in the module.

6. Remove the **Synoptic Board** and **Mylar sheet** from the Hercules Fan Kit by unscrewing the four screws.

Figure 3: Disconnect the fan wires
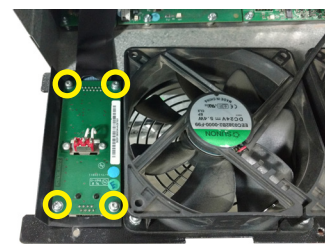
Figure 4: Remove Synoptic Board

7. Take the new **Hercules Fan Kit** (T451030001).

8. Fix the **Synoptic Board** into the new Hercules Fan Kit by using four screws, refer "Figure 4".
   Note: Place the Synoptic Board and Mylar sheet in exact position before tightening the screws.

9. Connect the **Fan wires** from Hercules Fan Kit to terminal in the module, refer "Figure 3".

10. Fix the **Hercules Fan Kit** back in place by tightening the eight screws, refer "Figure 2".

11. Fix the **Front Green Plastic** back in place, make sure all the five latches are fixed properly, refer "Figure 1".

12. Insert the module in the system.

13. Once it has started, access the fan counter through the Pegasus/Catena and reset it (see page 20).

9. Factory Ranges and Defaults

9.1 Internal BMS

Submenu Item	Programmable range	Default values 408Vdc
Float (FL) Voltage	408 – 490	463 Vdc
Equalize (BOOST) Voltage	408 – 490	480 Vdc (2,35V/per cell)
Test Batterie (BT) Voltage	315 – 490	391 Vdc
Battery current limit	0-1000	=C10/5 (Battery capacity/5)
Battery in discharge	315 – 490	430 Vdc
Battery Low 1 alarm	315 – 490	360 Vdc
Battery Low high	315 – 490	340 Vdc
System Saturation alarm	0 – 100	80%
Equalize Timeout	0 - 48	24 hours
Test Batterie Duration	0-8	8.0 hours

9.2 Network

Submenu Item	Programmable range	Default values
Subnet Mask	N/A	255.255.255.0
Adress IP Pegasus	N/A	192.168.0.2

10. SNMP V1 & SNMP V3 Configuration

SNMP is available on Pegasus supervisor and on Catena display, through an Ethernet connection.

Pay attention that SNMP interface is not the recommended one to communicate with an external supervision such as an EMS. This is because it doesn't include ESS parameters that should be managed through the Modbus RTU interface.

SNMPv1 is available on Pegasus supervisor. The MIB implemented on Pegasus SNMP agent is the standard USP MIB defined by RFC1628.

Catena display includes a SNMPv1 to SNMPv3 proxy.

The main difference between SNMPv1 and SNMPv3 is the addition of secured connection in SNMPv3.

10.1 SNMPv1 configuration

For SNMPv1 agent configuration, go to Parameters > Monitoring > Network.

See Pegasus network section for ETH port configuration:

- IP address.
- Subnet mask.
- Gateway.

See Pegasus SNMP section for SNMP agent configuration:

- Trap receivers IP addresses. Up to 5 trap receivers can be configured.
- Note that ports 161 and 162 (for traps) are used. Not configurable.

10.2 SNMPv1 MIB (RFC1628)

The MIB is the standard UPS MIB defined by RFC1628.

Meaning of "input lines": input lines are AC input groups as existing in Pegasus web interface. One tri-phase system will have 3 input lines, one for each phase.

Meaning of "output lines": output lines are AC output groups as existing in Pegasus web interface. The following features of UPS MIB are not implemented in Pegasus:

- Writable entries: the current MIB is read-only. Entries can only be edited through the web server. For this reason, the upsConfig section is also read-only.
- Bypass values: as Pegasus doesn't include the monitoring of bypass devices, bypass measurements are not available in the MIB. It is however possible to know when the system switched to MBP by reading ups Output Source value (OID .1.3.6.1.2.1.33.1.4.1).
- Well known test: only standard battery test is available. No other test is implemented in Pegasus at current state. Any feature defined in RFC1628 that is not in the previous list is available.

10.3 SNMPv3 configuration

For SNMPv3, you need a Catena display. The Catena display can be used as SNMPv1 to SNMPv3 proxy. The configuration of Catena display is managed by Pegasus supervisor.

In Pegasus web interface, go to Parameters > Monitoring > Network.

See Catena network section:

- Set IP address, subnet mask, and gateway for local network.
- Set "bridge enable" option. By default, both ETH ports of Catena are in the same LAN. If the bridge is disabled, then each port is on an independent LAN.
- If bridge is disabled, set IP address, subnet mask, and gateway for external network.
- If bridge is disabled, the most outward ETH port is connected to the local network, and the most inward ETH port is connected to the external network. The Pegasus must be on the local network.
- Please not that SNMPv1 agent and Pegasus web server have no security. For a secure connection, it is strongly recommended to use SNMPv3 interface only (Pegasus on local network and bridge disabled).

See Catena SNMP section:

SNMPv3 context can be configured.

SNMPv1 agent community can be configured. Not used for now since Pegasus agent community is not configurable (public by default).

Three users can be configured:

- Read-only user: there is no authentication and no encryption. No other parameter than username is required.
- NoPriv user: this user is authenticated but there is no encryption. Authentication protocol (MD5 or SHA) must be selected. Authentication password must be configured.
- Priv user: this user is authenticated, and connection is encrypted. Authentication protocol (MD5 or SHA) must be selected. Authentication password must be configured. Encryption protocol (DES or AES) must be selected. Encryption key must be configured.
- A user can be completely disabled by setting an empty username.

Base OID's must be configured for each user.

One trap received can be configured:

- Trap received IP address.
- Engine ID.
- Security level. You can select if the trap will use both authentication and encryption, only authentication, or none.
- Trap authentication password. Only required if authentication is enabled in security level option.

Trap authentication protocol (MD5 or SHA). Only required if authentication is enabled in security level option.

Trap encryption key. Only required if encryption is enabled in security level option.

- Trap encryption protocol (DES or AES). Only required if encryption is enabled in security level option.

11. ModBus RTU

Pegasus can act as a Modbus RTU slave with various baud rates and configuration options. Modbus RTU is the recommended interface to be used with an external supervision such as an EMS.
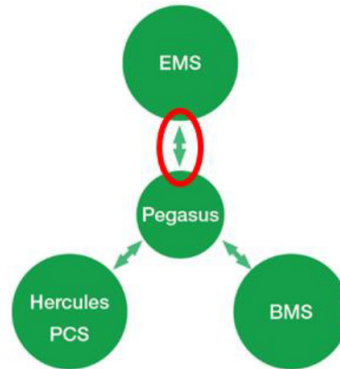
11.1 Physical Connection

To get access to the Modbus, the RJ45 labeled "RS485" on Pegasus controller unit should be connected. RJ45 pinout is as follow:
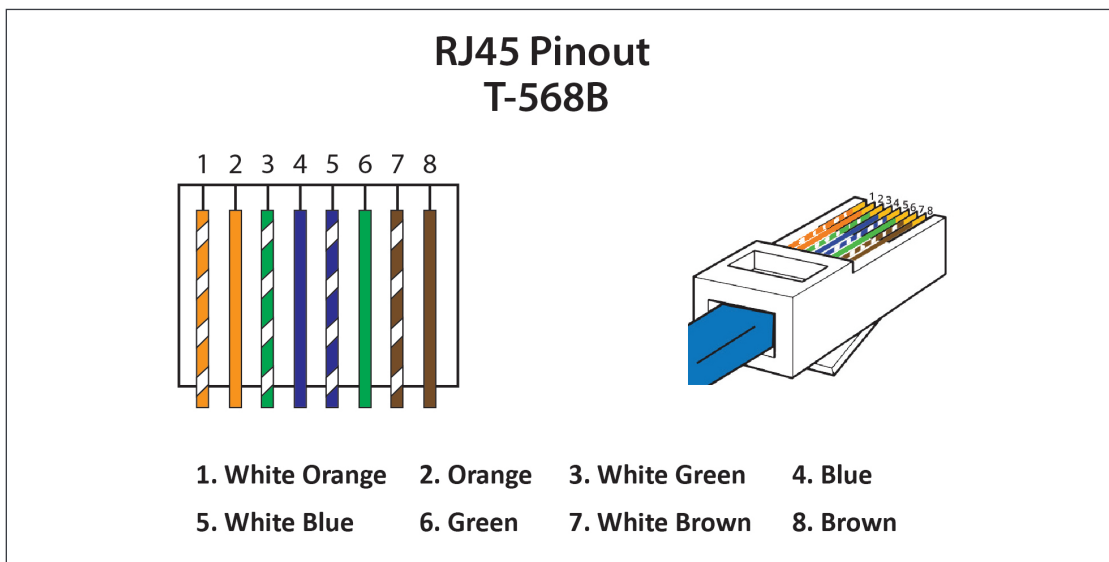
RJ45 Pinout
T-568B

1 2 3 4 5 6 7 8

| 1. White Orange | 2. Orange | 3. White Green | 4. Blue |
| 5. White Blue | 6. Green | 7. White Brown | 8. Brown |

Note: The colour of wires is irrelevant and may vary, but make sure the position of wires is exactly crimped.

- Pin 4 = D1
- Pin 5 = D0
- Pin 8 = Common (GND)

11.2 Configuration

Modbus slave configuration is accessible through user interface by browsing menu Parameters, Monitoring Tab, Modbus submenu.
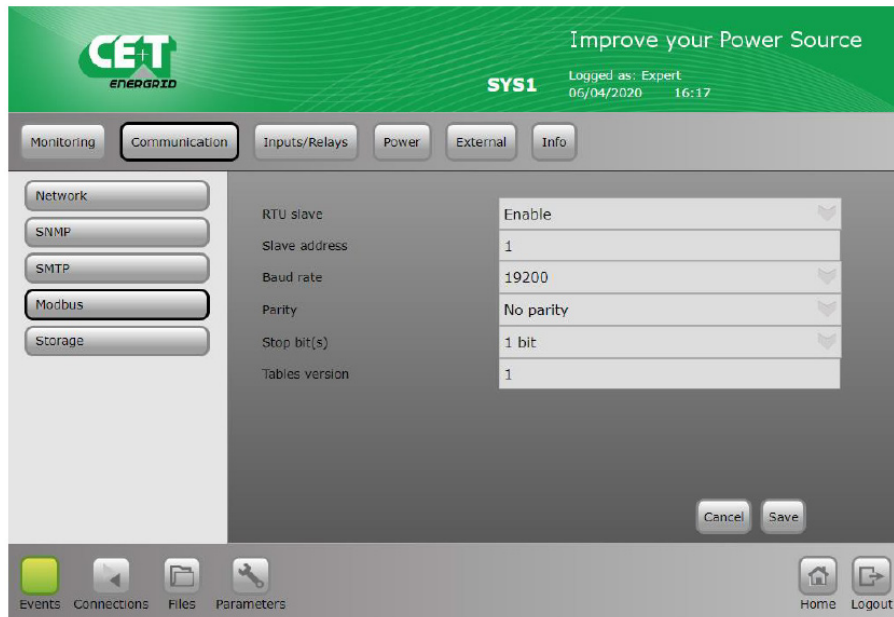
- Modbus RTU slave can be either enabled or disabled.
- Slave address ranges from 1 to 247. Default is 1.
- Supported baud rates are: 9600, 19200, 38400, 115200, or 460800. Default is 19200.
- Parity can be none, even, odd or no parity. Default is no parity.
- Stop bits can be 1 or 2. Default is 1.
- Tables version: not to be changed

Configuration is applied once save button is clicked.

11.3 Tables

Data are organized in tables which are described in an Excel file available in Hercules documentation. 10 tables in 10 tabs of an Excel file:

- « Controller data » tab: basic information about supervisor (serial number, time, …)
- « System data » tab: system level information
- « Alarms data » tab: information about alarms
- « AC Output data » tab: AC output related measures, status and configuration
- « AC Input data » tab: AC input related measures, status and configuration
- « DC Input data » tab: DC related measures, status and configuration
- « Internal BMS data » tab: internal BMS related measures, status and configuration. Only consistent if internal BMS is used.

- « External BMS data » tab: external BMS related measures, status and configuration. Only consistent if external BMS is connected on the CANBUS.

- « ESS data » tab: ESS related measures, status and configuration.

- « Ext. BMS Alarm List » tab: description of the holding register 5126 for each external BMS managed by the controller.

11.3.1 Main registers for ESS

- Holding register 6009 "ESS power setpoint target"

  - Used to define if the system follows the setpoint on the battery power (6010 register) → **0** or on the AC Input power (6012 register) → **1**.

  - Battery power setpoint is recommended!

- Holding register 6010 "ESS power setpoint – Battery power"

  - Setpoint on the power coming to/from the battery.

  - < 0 = discharging battery and > 0 = charging battery.

  - Scale factor of 2 (6011 register)! So, a value of 10 in 6010 register means a charging setpoint of 1000W on battery power.

- Holding register 6012 "ESS power setpoint – AC input power"

  - Setpoint on the power coming to/from the grid connected on AC Input.

  - < 0 = grid injection and > 0 = grid consumption.

  - Scale factor of 2 (6013 register)! So, a value of -25 in 6012 register means a power injection setpoint of 2500W on AC Input.

- Holding register 6014 "ESS power setpoint achieved"

  - Register saying if the defined setpoint is achieved. No → 0 or yes → 1.

  - Example when power setpoint is not achieved.

  - Battery charging setpoint = 7000W while AC output power is 15000W.

  - AC input should be 22000W while max is 20kW for one Hercules module.

  - Battery charging power limited to 5000W and 6014 register = 0.

- Holding register 6015 "AC input peak shaving – Percent of max grid consumption volt-ampere"

  - Define a peak shaving limit on grid consumption.

  - Managed by the Pegasus controller resulting on a reaction time of around a few seconds.

  - % value based on Volt-Ampere capability of the Hercules system. Default value is

  - 100%.

  - Example:

  - A Hercules system including 4 modules has a Volt-Ampere capability of 80kVA.

  - A value of 70% in 6015 register means a peak shaving limit of 56kVA on grid consumption.

- Holding register 6016 "AC input peak shaving – Percent of max grid injection volt-ampere"
  - Define a peak shaving limit on grid injection.
  - Managed by the Pegasus controller resulting on a reaction time of around a few seconds.
  - % value based on Volt-Ampere capability of the Hercules system. Default value is 100%.
  - Example:
  - A Hercules system including 7 modules has a Volt-Ampere capability of 140kVA.
  - A value of 30% in 6016 register means a peak shaving limit of 42kVA on grid injection.

- Holding register 6002 "Start/Stop/Reset"
  - Register only useful when an external BMS is connected on CANBUS.
  - Start/Stop = Close/Open contactors in battery system.
  - Reset = reset alarms of the battery system.

- Holding register 6003 "Start/Stop/Reset enabled through Modbus RTU interface"
  - Define if holding register 6002 can be used. No → 0 or yes → 1.

- Holding register 6006 "EMS lost - Response"
  - Define what happens if EMS stops sending power setpoints.
  - Nothing = nothing is done.
  - UPS functionality = power setpoint fixed to 0 and DC port is still available for AC Output in case of grid failure.

- Holding register 6007 "EMS lost - Time duration"
  - Define time consideration after what it is considered that EMS is lost, and action chosen in holding register 6006 is applied.

12. CANBUS

CANBUS is the interface to be used when the Pegasus controller is connected to a battery BMS.
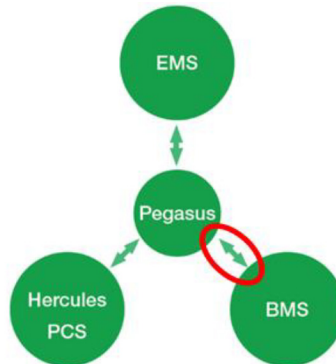
CANBUS interface is accessible through a RJ45 connector. The pinout of this RJ45 is
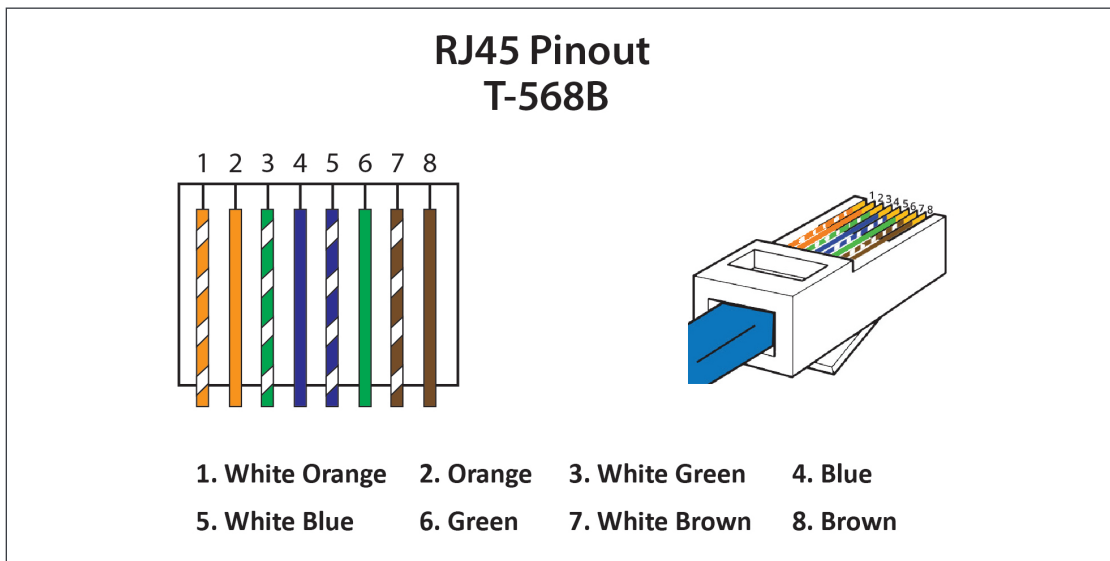
RJ45 Pinout
T-568B

1. White Orange   2. Orange   3. White Green   4. Blue

5. White Blue   6. Green   7. White Brown   8. Brown

Note: The colour of wires is irrelevant and may vary, but make sure the position of wires is exactly crimped.

- Pin 1 = CAN High
- Pin 2 = CAN Low
- Pins 3&7 = GND

CANBUS is not useful if internal BMS is used or if the BMS is managed by the EMS.

Communication protocol of a BMS should be implemented inside the controller before connecting it.

13. Annexes

13.1 Battery Management with Hercules Technology and internal BMS

13.1.1 Introduction

Battery is critical element in a UPS. Many manufacturers offer high performances of their electronic but sometimes forgot about providing an efficient and reliable battery management.

Battery are fragile and need to be treated accordingly in discharge and recharge conditions. The purpose of this document is to provide an overview of how Hercules and Pegasus manage the batteries through its internal BMS, prevent their end of life and reduce possible occurrence of thermal runaway.

This annex gives more details about how the internal BMS of the Pegasus controller manages a lead-acid battery.

This annex is not applicable in case if an external BMS is used.

13.1.2 Battery charging and discharging Mode

The purpose of a charger is to "refill" the charge tank of the battery. There are many other features which enhance the convenience of the charger or grant protection for the battery being charged. These built-in protection features are what fundamentally elongates the battery's life, or more correctly, prevents premature failure.

TSI technology provide those features:

- higher current levels reduce recharge times (assuming the battery can accept charge at high rates).
- voltage limits, current limits, and time out to reduce excessive gassing at end-of charge, and prevent dry-out.
- modified voltage and current limits as a function of temperature reduce gassing and electrode damage.
- BOOST or Equalize mode to equalize battery blocs periodically.

Battery operating mode with internal BMS are described hereafter.

13.1.2.1 Mode 1 Boost

This mode needs to be activated and configured according the battery data from the manufacturer.

A CC-CV (constant current, constant voltage) algorithm provides a "quick and fast" recharge. Ideally to recover 80% of the battery capacity in maximum 8 hours. This mode use a Uset voltage level associated to current limit protection

Hereafter is shown typical recharge curve versus time for voltage and current.
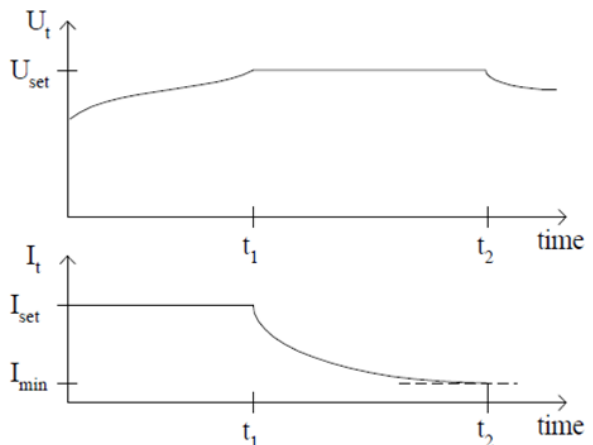
MODE 1 algorithm can be trigger based on the following parameter:

- Trig Start Voltage: Will activate MODE 1 when battery voltage goes below preset level
- Trig Start Current: will activate MODE 1 when battery current goes above the preset value
- Trig Start Period: Will activate MODE 1 periodically base on preset value.
- Manual Start: Will activate MODE 1 manually through the GUI menu in mode 1. The temperature compensation is disabled.

MODE 1 algorithm can be stopped based on the following parameter:

- Trig Stop Current: Will stop MODE 1 when battery voltage goes below preset level and MODE 1 for minimum 5 minutes (to avoid successive Start and Stop)
- Trig Stop Duration: 1H to 48H will stop MODE 1 (always active) will stop the MODE1 after the duration.

Note: If MODE1 stop based on "duration" before the "Stop current" reached an alarm will be generated as the battery need to be checked.

- Trig Start Period: Will activate MODE 1 periodically base on preset value.
- An alarm appears in the system: MODE 1 will be disabled in case of alarm presence.
- Manual stop: will STOP MODE 1 manually through the GUI menu.

13.1.2.2 Mode 2 Float

This is the normal operating mode for maintaining the battery in charge. This mode is enabled by default.
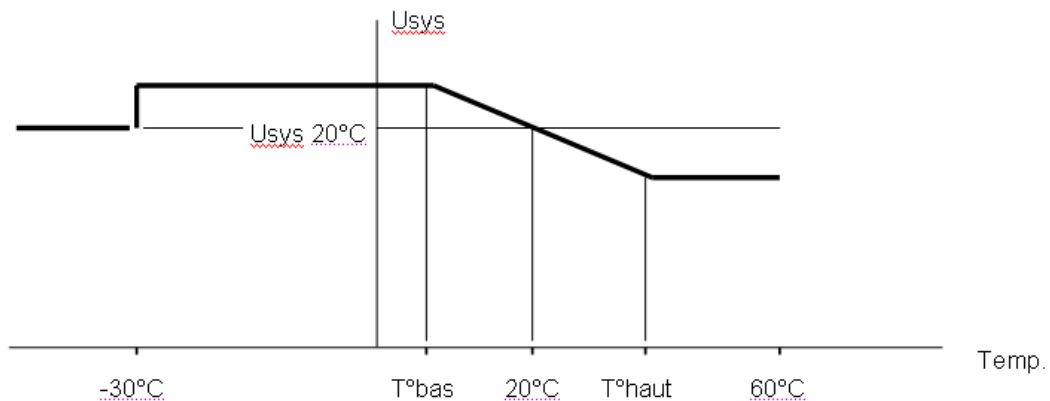
The MODE 2, charging voltage is adapted (provided it is enabled in the configuration) according the temperature. Using the charging curve below.

T° bas-low and T° haut-high are adjustable.

Note : If the temperature probe is disconnected or defective the voltage will come back to the value at 20°C. An alarm T° sensor fail" will be generated.

13.1.2.3   Mode 3 Discharge

Discharge mode is active when energy flow is taken from the battery to the DC/AC converter (inverter) of each module.

In this mode the Pegasus monitoring sent a voltage and current value to the Hercules module. This help in case of one module has AC input failure to take power from DC and is feed through the other module to avoid discharging the battery and assure the continuity of supply for the AC load.

Following alarms and time out available:

- Ubat < Ufloat
- BAT cell V low
- BAT end of autonomy
- BAT discharge time out (Battery in discharge for more than xx minutes)
- V BAT stop: Hercules will stop operating to prevent deep discharge
- Note: During discharge, Pegasus will record battery discharge value

Note: During discharge, Pegasus will record battery discharge value.

13.1.2.4   Mode 4 Battery Test

Battery test is a helpful function to get reliable information on the battery conditions and capacity.

It is recommended to perform periodic test of the battery but more important to perform those test in the same conditions in order to obtain comparative data over the years of the battery lifetime.

Starting BATTERY TEST conditions:

- Manual
- Trig Start Period: specify the day of the week to perform the periodic test and the number of weeks between 2 tests..

Note: Periodic test will start only if no discharge during last 96 hrs to guarantee the same start conditions for every test.

Stopping BATTERY TEST conditions:

- Trig Stop Duration: always active. Define the maximum time duration of a test
- Trig Stop Voltage: stop the test when battery voltage reaches the preset value
- An alarm appears in the system:
    - AC IN failure
    - Module failure
    - V BAT too low
    - System Overload
- Manually through the GUI menu

Note: During any test or battery discharge the following data will be recorded according following format.

START BAT x TEST + data and time

FIN BAT x TEST + data and time

For every delta of 1VDC record of:

- Date in seconds
- Battery voltage
- Battery current
- Bat Temperature

END BAT TEST + date+Time, VBAT, Temp+ Success,

FAIL START BAT x DISH + data and time

FIN BAT x DISH + data and time

13.2   Manual Bypass (MBP)

The purpose of this annex is to provide guidelines for customers to implement, assemble, wire and test external manual by-passes using CE+T Hercules modular PCS with Pegasus controller unit.

The CE+T cabinets already delivered with manual bypass are not concerned by this document.

13.2.1 Introduction

The purpose of the Manual Bypass also named "service by pass" is to provide the capability to completely by-pass AC input and AC output of a modular PCS Hercules system in order:

- To perform service maintenance to the equipment.
- To externally by-pass the PCS installation and allow the removal of the equipment

13.2.2 Principle of operation

The manual by-pass (MBP) is a "make before break" Bypass manual switch.

The MBP can be in 3 position mode:

OFF or NORMAL:	The MBP is not engaged (OFF) and the PCS normally feeds the critical load.
INTERIM or TRANSFER:	The MBP is in a temporary interim position where the AC load is supplied through the manual by-pass. The Hercules PCS is in startup mode and not yet connected to the AC output..
ON or BY PASS:	The MBP is engaged, the AC input feeds the AC load, the PCS modules are OFF. Disconnect DC source to turn OFF the system completely. (Note: Hercules module auxiliary power supply and monitoring are still power up by DC source once MBP is engaged)

Warning: If MBP is engaged, the neutral connection is not isolated and not voltage free.

Block wiring of the MBP
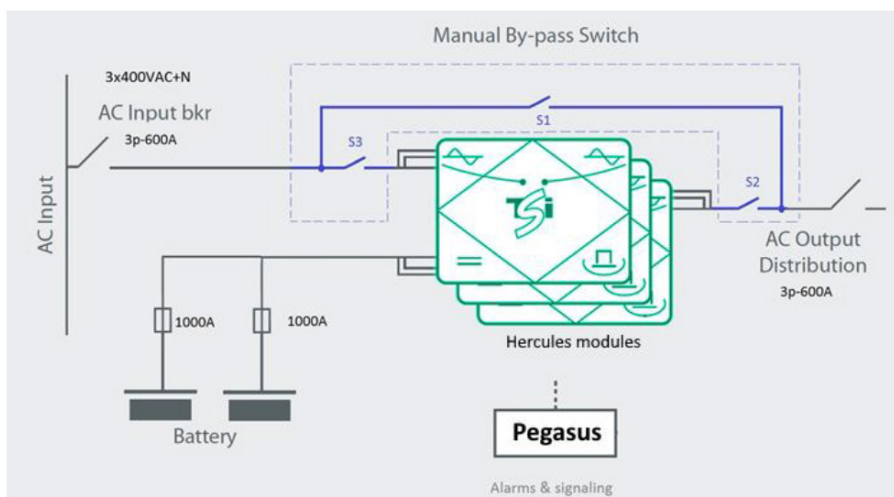
OFF or NORMAL: S1 is open, S2 and S3 are closed

INTERIM or TRANSFER: S1 is closed
                        S2 and S3 can be in position OPEN or CLOSED depending where you are in the manual
                        bypass procedure.

Note: This position is only temporary. It is used to allow the modules to start up and synchronize with the AC input.
The user should not keep the Bypass in the INTERIM position.

   BY-PASS mode or ON: S1 is closed. S2 and S3 are open.

13.2.3 Presentation

The Manual By-pass can be provided with 2 executions:

1. Rotary Switch up to 160kVA system.

2. Three power switches (S1, S2 and S3) external to the Hercules cabinet for power above 160 kVA.
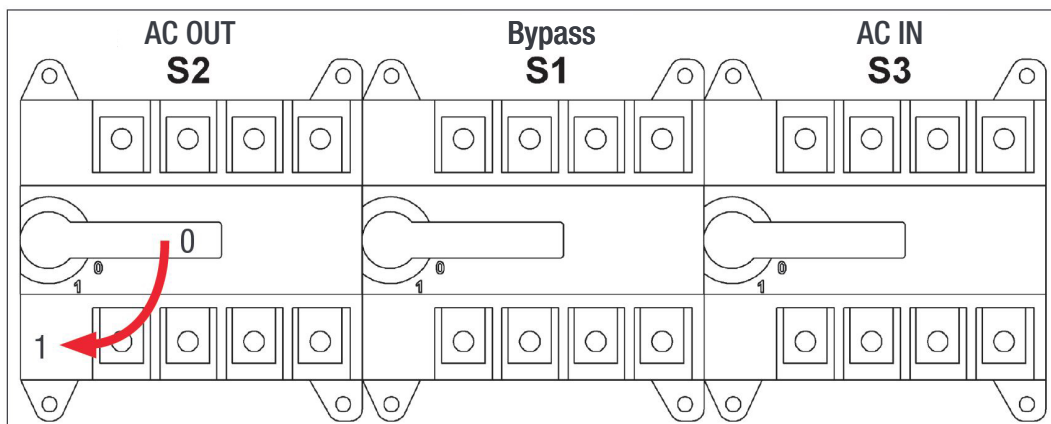
Please refer to the Hercules installation manual for more specific procedures.

13.2.4   MBP Wiring

Both solutions (rotary by-pass or separate switches) need to have auxiliary contacts that need to be wired to the Pegasus controller unit as described below.
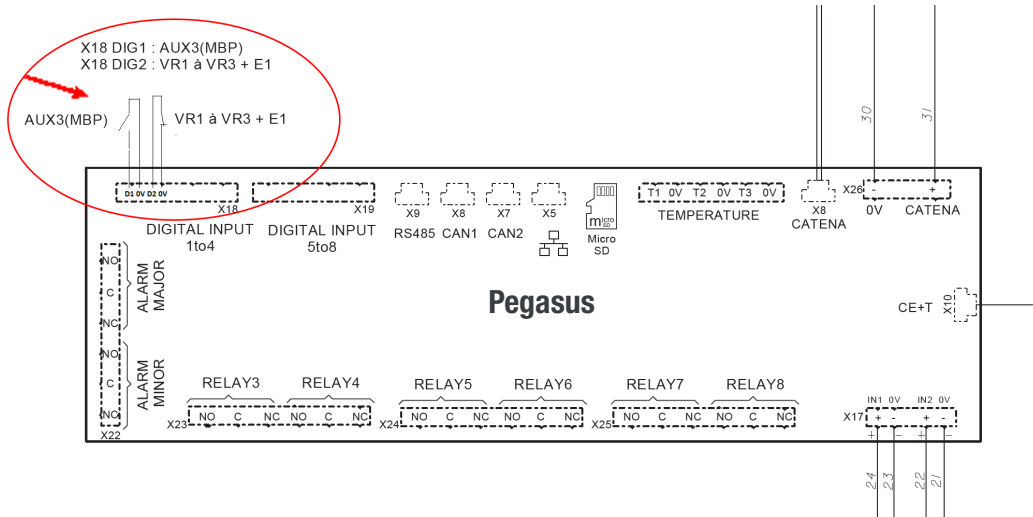
"Aux 3" (from the bypass switch): provides an input to the Pegasus controller indicating that the MBP is engaged.
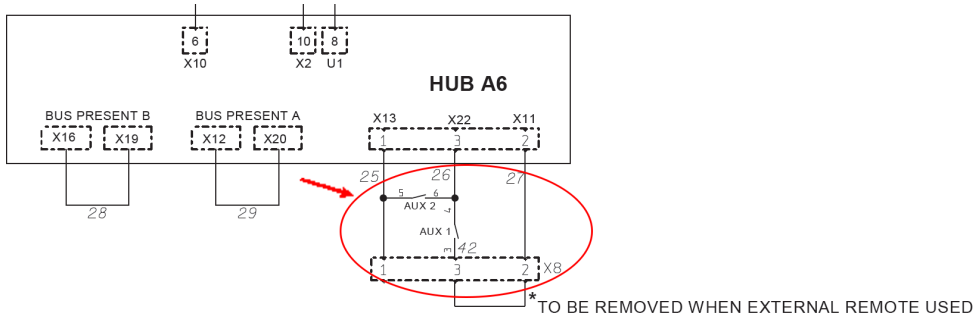
"Aux 1" (from AC input switch) and "Aux 2" (from the bypass switch):

- Switch OFF the Hercules modules once the MBP is engaged.
- Allow the Hercules modules to switch ON when the MBP placed in the INTERIM position.

Note: the parameter "Out voltage consign" set by default to 230 Vac shall be adjusted according nominal AC input voltage. This will limit the inrush current when operating on Manual Bypass.

13.3   Pegasus Alarms

13.3.1   Supervisor alarms

This is the list of alarms issued by Pegasus supervisor. Other alarms are issued by modules directly (see Hercules alarm table & OCA document). The supervisor can generate alarms that are related to the system, to Hercules modules, or to itself. Alarms related to Hercules will be seen as system alarms when module alarm is present on all Hercules.

Each alarm has a priority level. The level can be {disabled, event, minor, major}. If the level can be configured in user interface, then it is marked as "mappable", please refers to the last table for standard mapping.

Monitoring Alarms				
Text ID	**Name**	**Level**	**Def. Map**	**Description/ Possible action**
224	MBP engaged	Mappable	/	The system is in manual by pass mode. Disengaged MBP to recover normal mode
225	Surge arrester	Mappable	/	Surge protection trip. Check & replace surge protection device
226	Redundancy lost	Mappable	/	The defined redundancy for a group is lost. According to config replace or restart faulty module
227	System saturated	Mappable	/	Load power is above the defined level (settable in Saturation threshold parameter). Check load level and add modules if possible or change parameter level
228	Main source lost	Major	/	Depending on the configuration, the AC input power source is missing. Check AC input breaker or source presence
229	Secondary source lost	Minor	/	The DC source (battery) is not present or end of autonomy. Check battery fuse or voltage
230	System overloaded	Mappable	/	The load power is above 100% of the system capacity
231	Log nearly full	Event	/	The number of events in the log file is above 80% of the maximum number of events
232	Missing converter	Mappable	/	A module is not seen on the bus. It can be bus failure at module level. Unplug module and replug. If problem still present module need to be replaced
233	Aux power supply fail	Minor	/	One of the two power supply of the Pegasus is lost. Check auxiliary power supply
234	New module	Event	/	A new module is seen on the bus, it will be installed by the system automatically
235	Log cleared	Event	/	The log file has been cleared
236	Config modified	Event	/	This temparary event appears to confirm the modification of some parameters
237	System started	Event	/	The system started and is in normal operation
238	DigIn 3	Mappable	/	The digital input 3 is active (NO or NC depending of the configuration)
239	DigIn 4	Mappable	/	The digital input 4 is active (NO or NC depending of the configuration)

Monitoring Alarms				
Text ID	Name	Level	Def. Map	Description/ Possible action
240	DigIn 5	Mappable	/	The digital input 5 is active (NO or NC depending of the configuration)
241	DigIn 6	Mappable	/	The digital input 6 is active (NO or NC depending of the configuration)
242	DigIn 7	Mappable	/	The digital input 7 is active (NO or NC depending of the configuration)
243	DigIn 8	Mappable	/	The digital input 8 is active (NO or NC depending of the configuration)
244	Monitoring started	Event	/	The Pegasus/Catena has restarted
245	Log full	Minor	/	The log file has reach the maximum number of events. More events will not be recorded anymore
246	Converter off	Minor	/	The given module is off manually or remotely.
247	Converter AC out fault	Mappable	/	The given module has ACout problem. Module need replacement and repair
248	DigIn 1	Mappable	/	The digital input 1 is active (NO or NC depending of the configuration)
249	DigIn 2	Mappable	/	The digital input 2 is active (NO or NC depending of the configuration)
250	Redundancy +1 lost	Mappable	/	Means that the system has lost one module more than the configured redundancy for a group. Means that this groups could be overloaded.
254	Time synchronized	Event		Time synchronization through digital input occured
255	MBP procedure	Mappable		System is in MBP procedure
256	Battery charge remote off	Mappable		Battery charging is disabled through digital input
512	Discharge	Mappable	/	Battery is discharging.
513	Charging failure	Minor	/	Battery cannot be charged.
514	Boost in progress	Mappable	/	A boost charge is in operation on BAT1 or BAT 2
515	Test in progress	Mappable	/	A battery test is in operation on BATTERY 1 or BATTERY 2
516	Defect	Minor	/	Problem detected on a battery 1 o 2 after battery test
517	Low voltage pre	Minor	/	Battery voltage has reach the settable pre-alarm level
518	Low voltage	Mappable	/	Battery voltage has reach the settable alarm level
519	End autonomy	Mappable	/	The battery voltage has reach the settable end of autonomy level
520	Low capacity pre	Minor	/	Battery capacity is in pre-alarm condition
521	Low capacity	Minor	/	Battery capacity is in alarm condition
522	No more autonomy	Mappable	/	Battery has reach its lower level, DC converter will soon stop

Monitoring Alarms				
Text ID	Name	Level	Def. Map	Description/ Possible action
523	Overvoltage	Mappable	/	Battery is in overvoltage alarm
524	Unknown capacity	Minor	/	At startup, the battery is in unknown capacity state, the supervision system will soon detect the capacity
525	Temperature sensor fail	Mappable	/	Battery temperature sensor fail appears when the probe is disconnected
526	Over temperature	Mappable	/	Battery T° is above configured limits
527	Limited charging	Minor	/	The charger limits current to the battery according parameter.
528	Boost too long	Minor	/	Means that a boost charge of the battery exceed the specified time out. Please check battery is healthy
529	Low remaining time	Minor	/	The battery remaining time is low
530	Test: manual stop	Minor	/	Means that a test has stopped due to user manipulation
531	Test: recent discharge	Minor	/	A test will not start because battery has been in discharge within 96 hours
532	Test: voltage low	Minor	/	A test will not start because the voltage is too low
533	Test: system alarm	Minor	/	A test will not start because there is an alarm that prevent the battery test to start
534	Test: already in boost	Minor	/	A test will not start because the battery is already in boost charge.
535	Test: charger OFF	Minor	/	A test will not start because the charging is disabled and so the battery will not be charged after the test.

Mappable Events (Not alarms !!)				
Text ID	Name	Level	Def. Map	Description
632	AC in failure	/	Major + R3	
633	AC out 1 failure	/	Major	
634	Battery 1 discharge	/	Major	
636	Battery 1 low	/	Major	
638	Digital input 1	/	Event	
639	Digital input 2	/	Event	
640	Digital input 3	/	Event	
641	Digital input 4	/	Event	
642	Digital input 5	/	Event	
643	Digital input 6	/	Event	
644	Digital input 7	/	Event	

Mappable Events (Not alarms !!)				
Text ID	**Name**	**Level**	**Def. Map**	**Description**
645	Digital input 8	/	Event	
646	MBP Engaged	/	Major + R5	
647	Battery bad	/	Minor	Means that a test has failed
648	AC out 1 overload	/	Major	
649	AC out 1 redundancy lost	/	Event	
650	AC in freq out of limit	/	Minor	
651	Converter failure	/	Minor	
652	Temperature sensor 1 fail	/	Minor	Battery probe
653	Temperature sensor 2 fail	/	Minor	Battery probe
654	Not used	/	Event	
655	Module overtemperature	/	Minor	
656	Surge arrester	/	Minor	
657	AC out 1 redundancy +1 lost	/	Event	
658	AC out 1 saturated	/	Minor	System load is above the settable limit (normally 80%)
661	Battery 1 overvoltage	/	Event	
663	Battery 1 overtemperature	/	Event	
664	Battery 2 overtemperature	/	Event	
665	Battery 1 test active	/	Event	
667	Battery 1 boost active	/	Event	
722	Battery test cancelled	/	Minor	Battery test has not started because of another event (See 530 -> 535)
736	AC out 2 failure	/	Major	
737	AC out 2 overload	/	Major	
738	AC out 2 redundancy lost	/	Event	
739	AC out 2 redundancy +1 lost	/	Event	
740	AC out 2 saturated	/	Minor	
745	AC out 1 manual off	/	Event	
746	AC out 2 manual off	/	Event	
747	Log full	/	Minor	
758	MBP procedure	/	Major + R5	
759	Battery safe charging control	/	Major	

13.3.2 Module alarms

<table>
<tr><td colspan="5" align="center">Module alarms</td></tr>
<tr>
<td>Text ID</td>
<td>Name</td>
<td>Level</td>
<td>Def. Map</td>
<td>Description</td>
</tr>
<tr><td>96</td><td>Start</td><td>Minor</td><td></td><td>System is starting</td></tr>
<tr><td>100</td><td>Fan to be replaced</td><td>Minor</td><td></td><td>The timeout indicating FAN operates for 7 years</td></tr>
<tr><td>101</td><td>Fan failure</td><td>Minor</td><td></td><td>Fans are not functionning properly</td></tr>
<tr><td>102</td><td>Power disturbed</td><td>Minor</td><td></td><td>Transient power alarm with output stopped (module KO)</td></tr>
<tr><td>103</td><td>Param phase query</td><td>Minor</td><td></td><td>No assigned AC group or DC group yet (in progress)</td></tr>
<tr><td>104</td><td>Param mismatch</td><td>Minor</td><td></td><td>Param not compatible with the rest of the system</td></tr>
<tr><td>105</td><td>No source</td><td>Minor</td><td></td><td>No AC/DC input</td></tr>
<tr><td>106</td><td>Vcap too high</td><td>Minor</td><td></td><td>Internal voltage too high</td></tr>
<tr><td>107</td><td>Vcap too low</td><td>Minor</td><td></td><td>Internal voltage too low</td></tr>
<tr><td>108</td><td>Vref error</td><td>Minor</td><td></td><td>Reference voltage from auxiliary supply out of acceptable range</td></tr>
<tr><td>109</td><td>Memory eeprom error</td><td>Minor</td><td></td><td>Not implemented</td></tr>
<tr><td>110</td><td>Memory flash error</td><td>Minor</td><td></td><td>Flash continuous verification failed</td></tr>
<tr><td>111</td><td>OFF remote</td><td>Minor</td><td></td><td>Module remote OFF</td></tr>
<tr><td>112</td><td>OFF manual</td><td>Minor</td><td></td><td>Module OFF manually (ON / OFF switch)</td></tr>
<tr><td>113</td><td>BUS com fail</td><td>Minor</td><td></td><td>Too many missing bus frames</td></tr>
<tr><td>114</td><td>Bus A fail</td><td>Minor</td><td></td><td>Sync tops reception issue on bus A (com lost)</td></tr>
<tr><td>115</td><td>Bus B fail</td><td>Minor</td><td></td><td>Sync tops reception issue on bus B (com lost)</td></tr>
<tr><td>116</td><td>Bus sync filter error</td><td>Minor</td><td></td><td>Sync top filtering circuit fault (detected because sync tops are received at different times)</td></tr>
<tr><td>119</td><td>Bus A not present</td><td>Minor</td><td></td><td>bus A present signal of backplane not seen by the module</td></tr>
<tr><td>120</td><td>Bus B not present</td><td>Minor</td><td></td><td>bus B present signal of backplane not seen by the module</td></tr>
<tr><td>121</td><td>Bus frame collision</td><td>Minor</td><td></td><td>Bus A and bus B are not identical in content</td></tr>
<tr><td>122</td><td>Bus fail</td><td>Minor</td><td></td><td>Module can't see what it writes on both bus</td></tr>
<tr><td>123</td><td>Warm up too high</td><td>Minor</td><td></td><td>One of the measured temperature is above a threshold</td></tr>
<tr><td>124</td><td>Power noise</td><td>Minor</td><td></td><td>Transient power alarm (some trips happening)</td></tr>
</table>

Module DC input alarms				
Text ID	Name	Level	Def. Map	Description
128	Start up	Minor		
129	Temperature derating	Minor		Power is decreased due to high temperature
130	Temperature too high	Minor		DC converter stopped because of too high temperature
131	Temperature sensor fail	Minor		Communication with temperature probe was lost
132	Auto-calib error	Minor		Error during auto calibration of current offsets
133	Pdc too low	Minor		Pdc = f(Vdc). Alarm if Pdc < Pout
134	Impedance too high	Minor		DC input too high impedance detected
136	Current trip	Minor		Too many consecutive DC-/+ over-current trips
137	Driver error	Minor		Too many "not ready"/"fault" from DC-/+ drivers over some time
144	Source+ too low - transferred	Minor		DC+ V is under input transfer to AC threshold
145	Source- too low - transferred	Minor		DC- V is under input transfer to AC threshold
146	Source+ too high - transferred	Minor		DC+ V is over input transfer to AC threshold
147	Source- too high - transferred	Minor		DC- V is over input stop threshold
148	Source+ too low - stop	Minor		DC+ V is under input stop threshold
149	Source- too low - stop	Minor		DC- V is under input stop threshold
150	Source+ too high - stop	Minor		DC+ V is over input stop threshold
151	Source- too high - stop	Minor		DC- V is over input stop threshold
152	Source+ no voltage	Minor		DC+ V is under input not present threshold
153	Source- no voltage	Minor		DC- V is under input not present threshold
154	Source+ brownout (<150V)	Minor		DC+ V is under extended lower limit for too much time
155	Source- brownout (<150V)	Minor		DC- V is under extended lower limit for too much time

Module AC input alarms				
Text ID	Name	Level	Def. Map	Description
160	Start	Minor		
161	Temperature derating	Minor		Power is decreased due to high temperature
162	Temperature too high	Minor		ACin converter stopped because of too high temperature
163	Temperature sensor fail	Minor		Communication with temperature probe was lost
164	Auto-calib error	Minor		Error during auto-calibration of current offsets
165	Impedance Too High	Minor		AC input too high impedance detected
166	Backfeed error	Minor		Input stopped because of backfeed on it
168	Overcurrent	Minor		Too many consecutive ACin over-current trips
169	Driver not ready	Minor		Hardware driver not ready signal received
170	Driver fault	Minor		Hardware driver fault signal received
171	Driver perturbed	Minor		Too many consecutive "not ready"/"fault" from Acin driver or more than a threshold over some hours
175	Vres Absent	Minor		Fast alarm when source V is no longer present
176	Source V too low transferred	Minor		Source V is under input transfer to DC threshold
177	Source V too high transferred	Minor		Source V is over input transfer to DC threshold
178	Vres out of range	Minor		Source V is out of expected envelope
179	Source V too low stop	Minor		Source V is under input stop threshold
180	Source V too high stop	Minor		Source V is over input stop threshold
181	Source frequ too low	Minor		Source freq is under input stop threshold
182	Source frequ too high	Minor		Source freq is over input stop threshold
183	Source no voltage	Minor		Source V RMS is below 60V (SELV threshold) - no sync possible

Module AC output alarms				
Text ID	Name	Level	Def. Map	Description
192	Start	Minor		

Module AC output alarms				
Text ID	**Name**	**Level**	**Def. Map**	**Description**
193	Temperature derating	Minor		Power is decreased due to high temperature
194	Temperature too high	Minor		ACout converter stopped because of too high temperature
195	Temperature sensor fail	Minor		Communication with temperature probe was lost
196	Auto-calib error	Minor		Error during auto calibration of current offsets
197	Overload not ready	Minor		Overload capability is in cool-down
198	Overload	Minor		Output power is higher than a threshold above nominal power
199	Power derating	Minor		Derate output power because it cannot be supplied
200	Vout too Low	Minor		Output V is under a threshold (due to an overload)
201	Overload too long	Minor		Output V is under a threshold (due to an overload) for too much time
202	Vout modify	Minor		Output V setpoint was modified and is being converged on
203	Load-sharing low	Minor		Hercules module is supplying too much power to the load compared to the other modules
204	Load-sharing high	Minor		Hercules module is not supplying enough power to the load compared to the other modules
205	Mode support	Minor		Hercules is supporting the MBP output, i.e. it does not supply any current, but in case of a voltage drop will try to keep the voltage at an acceptable level
206	Igbt driver alarm	Minor		An individual driver is sending an alarm but global drivers monitoring signals are OK
208	Driver not ready	Minor		Hardware driver not ready signal received
209	Driver fault	Minor		Hardware driver fault signal received
210	Over-current	Minor		Too many consecutive ACout over-current trips
211	Igbt error	Minor		Software detected IGBT fault
212	Vout pi2 error	Minor		Output V at Pi/2 (sine max) is out of expected range with open relay
213	Vout mpi2 error	Minor		Output V at -Pi/2 (sine min) is out of expected range with open relay
214	Off (bus)	Minor		Output Off from bus request
215	Backfeed error	Minor		Output stopped because of backfeed from this module or another one
216	Too many start	Minor		Too many attempts to start output over some time
217	AC out fuse open	Minor		Output fuse open or enventualy output connector not connected

13.4   FAQ

How can I reset my admin password if I have unfortunately forgotten it?

In case of password loss, a new temporary password (valid 24 hrs after creation) can be issued by CE+T Power. To receive a temporary password, send an email with your Pegasus serial Number and the date at which you expect to go back on site to change the password to customer.support@cet-power.com specifically requesting a new temporary password. The serial number can be found on the sticker on the Pegasus, or on screen in 'Parameters' then 'Info'.