Systems Installation Manual

Model: microCOMPACT PSX

Version 1.1

enatel
energy

Warranty

Enatel provides a one year limited warranty, details as stated under the manual section Appendix V Enatel Energy Standard Limited Warranty Policy on page 44.

Product Compliance

CE

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1 ADMONISHMENTS

The admonishments are the symbols and wording used in this manual to alert readers to specific dangers and instructions. The meanings of the various admonishments are explained as follows:

Warning = risk to life or personal injury and equipment damage

Caution = risk of equipment damage.

 = risk of electrical shock potentially causing death or injury.

 = alert of risk potentially causing death or injury.

 = risk of burn injury from hot surfaces

 = an alert that must be understood and undertaken.

 = instruction of mandatory reading of product manual.

  = risk of electrostatic damage to components. Proper precautions must be taken.

 = access for children prohibited.

 = restricted access area.

2 SAFETY

All installation and maintenance must be carried out by suitably qualified personnel.

For your protection, the product manual should be read and thoroughly understood before unpacking, installing and using the equipment.

The equipment is intended only for use in a restricted access area. The equipment is not suitable for use in locations where children are likely to be present.

3 RECEIVING INSTRUCTIONS

Enatel provides all equipment to the delivering carrier securely packed and in perfect condition. Upon acceptance of the package from Enatel, the delivering carrier assumes responsibility for its safe arrival. Once the equipment is received, it is the recipient's responsibility to document any damage the carrier may have inflicted, and to file the claim promptly and accurately.

NOTE: the period to make a claim against damage by a transport carrier can be short, a matter of days, and varies by transport method, the transport contract, and local laws.

3.1 Package Inspection

Examine the shipping crate or carton for any visible damage: punctures, dents and any other signs of possible internal damage.

Describe any damage or shortage on the receiving documents and have the carrier sign their full name.

3.2 Equipment Inspection

Open the crate or carton and inspect the contents for damages. While unpacking, be careful not to discard any equipment, parts or manuals. If any damage is detected, call the delivering carrier to determine the appropriate action. They may require an inspection.

NOTE: Save all the shipping materials for the inspector to see.

After the inspection has been made, if damage has been found, contact Enatel. We will determine if the equipment should be returned to our plant for repair or if some other method would be more expeditious. If it is determined that the equipment should be returned to us, ask the delivering carrier to send the packages back at the delivering carrier's expense.

If repair is necessary, we will invoice you for the repair so that you may submit the bill to the delivering carrier with your claim forms.

It is your responsibility to file a claim with the delivering carrier. Failure to properly file a claim for shipping damages may void warranty service for any physical damages later reported for repair.

3.3 Handling

Handle the equipment with care. Do not drop or lean on front panel or connector. Keep away from moisture.

3.4 Identification Labels

Model number and serial number are clearly marked on all equipment. Please refer to these numbers in all correspondence with Enatel. Ideally provide a photograph of the product label for reference.

4 SCOPE

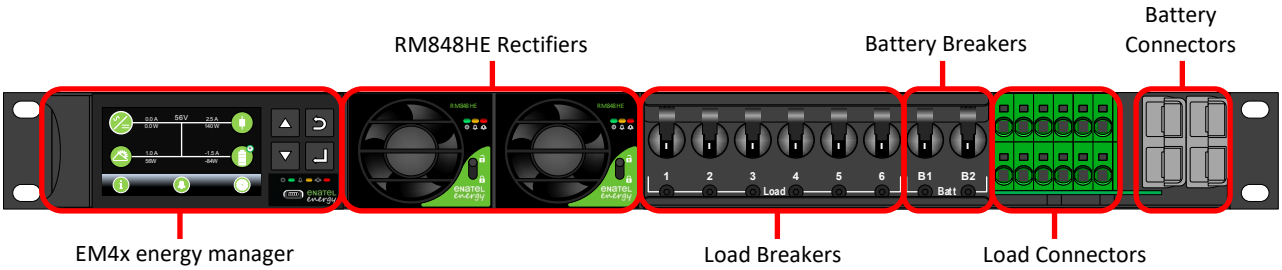
This manual covers essential information for the installation and commissioning of the 1U microCOMPACT Enatel DC power system range.

System set-up for the rectifiers, alarms and so forth are provided in separate manuals for the EM4x energy manager and RM848HE rectifier.

NOTE: The 1U microCOMPACT system is available with positive earthing (fixed) as default. Should negative earthing be required contact your Enatel representative.

5 SYSTEM OVERVIEW

Figure 1: Example system front view (PSX122E1A-00-00)



EM4x energy manager : refer to the energy manager manual for details on operation

RM848HE Rectifier : refer to the rectifier manual for details on operation

Load Breakers : 2-30amp load breakers (customer configurable)

Battery Breakers : 30 amp battery breakers (customer configurable)

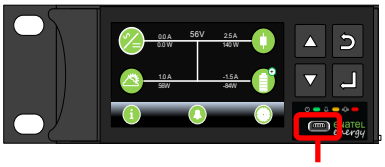
Load Connectors : 6mm^2 "push-in" load connectors

Battery Connectors : SB50 style power-pole battery connectors

IMPORTANT: system documentation can be accessed via the micro-USB port on the front panel of the energy manager. See Figure 2 and 8.3 USB Connection.

Rectifier manuals and other relevant product information such as controller firmware updates, application notes on how to include breakers and so forth are available on the Enatel website partner portal at www.enatel.net .

Figure 2: micro-USB documentation storage access



5.1 System Summary

Systems with a model number beginning with PSX12 can hold two rectifier modules and have a maximum power output of 1.6kW, producing a maximum current output of 29.6A at 54V DC. The system is intended to be a complete power system in a box, so no connections need to be made internally. AC connection is via rear exiting lead with all the DC (Load and Battery) connections are made at the front of the unit. Alarm connections are accessible from the front.

- Overall size is 483mm wide (19" standard mounting) x 44.5mm high (1U) x 280mm deep (within ETSI specification).
- Optional ETSI mounting tabs included.
- Up to 3* x RM848HE or RM348HE series rectifiers - may be packaged separately.
- EM4x energy manager (fully integrated in the system)
- Battery Low Voltage Disconnect fitted as standard (80A rating).

- Up to 2*x 30A Battery Circuit Breaker, this may be specified as different values (from 2A to 30A) at time of order.
- Up to 6*x Load Circuit Breaker, this may be specified as different values (from 2A to 30A) at time of order. If only one Battery Circuit Breaker is fitted, a 7th load breaker can be specified at time of order.
- System weight is approximately 3.8kg without rectifiers, and 5.3kg with two rectifiers fitted.
- Captive single phase lead supplied for input termination (phase, neutral and earth).
- Front or rear cable access.

*values shown are maximum values and depend upon model selected. See 5.2 System Part Numbers.

NOTE: This system is supplied with the AC and DC earths connected. The standard system (+ve earth system) output has the DC Common (earth connection) in the positive side of the circuit.

5.2 System Part Numbers

Table 1 : microCOMPACT Part Numbering

Base	Distribution	Part Number	Rectifier | Load | Battery	Comment
PSX133E	PSX13E1	PSX133E1A-00-00	3R | 4L | 2B	3 rectifier system, standard distribution
		PSX130E1-BLANK	0R | 4L | 2B	Blank 3 rectifier system, customer installs MCBs
	PSX13E2	PSX133E2A-00-00	3R | 5L | 1B	3 rectifier system, alternative distribution
		PSX130E2-BLANK	0R | 5L | 1B	Blank 3 rectifier system, alternative distribution, customer installs MCBs
PSX122E	PSX12E1	PSX122E1A-00-00	2R | 6L | 2B	2 rectifier system, standard distribution
		PSX120E1-BLANK	0R | 6L | 2B	Blank 2 rectifier system, customer installs MCBs
	PSX12E2	PSX122E2A-00-00	0R | 7L | 1B	2 rectifier system, alternative distribution
		PSX120E2-BLANK	0R | 7L | 1B	Blank 2 rectifier system, alternative distribution, customer installs MCBs

5.2.1 System Examples

Part number	Description	Load MCBs	Battery MCBs	Voltage VDC	DC Earth	Monitor
PSX122E1A-00-00	1U 2 bay microCOMPACT	6	2	-48V	+VE	EM4x

PSX122E2A-00-00	1U 2 bay microCOMPACT	6	1	-48V	+VE	EM4x

PSX133E1A-00-00	1U 3 bay microCOMPACT	4	2	-48V	+VE	EM4x

5.2.2 EM4x energy manager Features

The EM4x microcontroller-based DC system energy manager provides the control and monitoring functions for all Enatel Energy's power systems. More advanced battery monitoring with individual monobloc voltage and string current measurement can be attained with Enatel's ancillary BMS boards. With an appropriate communications connection third party lithium batteries can also be managed.

The EM4x monitors all power system conditions including DC voltage, rectifier current, battery current, battery temperature, distribution failure and energypak status. It has an in-built web based configurator allowing setup of system parameters, monitoring, updating and download of logs using a web browser as well as a front panel interface through which key parameters are also configurable. Visual notification of alarm conditions is given by LEDs and a display mounted on the front of the EM4x, with remote notification being enabled by relay contacts, RS232 or TCP/IP (using SNMP).

The EM4x utilizes a USB communications port which allows for local monitoring of system operations as well as pre-commission and power down configuration of the Web UI.

The EM4x also incorporates the following features:

- Support for Enatel's energypak battery modules with optimized battery backup functions
- Support for third-party external batteries, both lead-acid and lithium based
- Support for AC-DC rectifiers (24V, 48V, and 60V Outputs)
- Support for DC-DC converters (12V, 24V, 48V and 60V Outputs)
- Support for Enatel's range of solar and wind converter modules plus associated inverters
- Support for Enatel's range of ancillary devices including fan controllers, AC metering and battery monitors
- Control of up to two low voltage disconnects (magnetically-latched contactors) per I/O board*
- Network connectivity (web access)
- System voltage metering for primary system DC supply. (e.g. 48V primary DC output)
- Load, battery and rectifier current metering and alarms
- Active rectifier and converter current share
- Automatic system voltage control
- Effectively unlimited alarm thresholds as standard, for use with multiple DC outputs
- Advanced monitoring, display and logging of energypaks, and system performance data
- Advanced hybrid site control and monitoring with patented anti-stall feature for generators.
- Phase balance controls for multi-phase and single phase AC input management
- Sophisticated programmable logic control
- Grid tariff optimization – the ability to program schedules for battery assumption of load during peak grid tariff rates
- For lead-acid external batteries -
    - Battery and room temperature metering and alarms (when fitted with optional temperature sensors)
    - Optional complete or battery mid-point monitoring (when fitted with optional battery monitor cards)
    - Temperature compensation of float voltage (when fitted with optional temperature sensors)

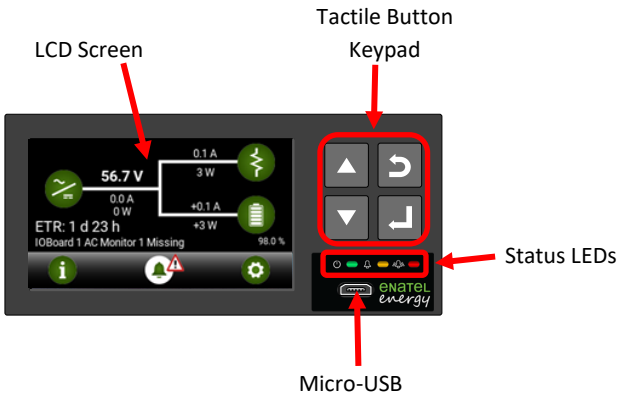
- Manual equalise charging to prolong the life of the batteries
- Periodic equalise charging to prolong the life of the batteries
- Fast charging after battery discharge
- Battery capacity remaining indication
- Battery testing facility
- Battery current limit

- Six user defined General Purpose Inputs ("GPIPs") which can be software configured as either digital **or** analogue inputs* (up to 10 may be made available under special circumstances)
- Six relay outputs*
- I/O Expansion card capability*
- Expanded serial and CAN communications – up to 5 I/O boards can be connected to a single EM4x

*** Note:** the addition of an I/O Expansion card to the EM4x allows for analogue inputs and increases the number of digital inputs and relay outputs available. The controller allows for these new inputs/outputs to be logically combined allowing a degree of control of peripheral functions. For example, a temperature triggered room fan or humidity detection.

5.2.3 1U EM4x-02 Interface

Figure 3: 1U EM4x-02 Front Panel Interface



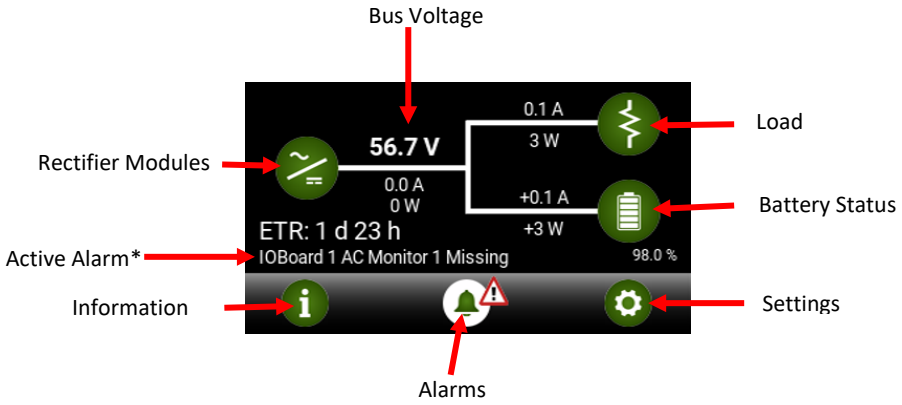
- Keypad tactile buttons to navigate through the menu. Local adjustments to operating parameters and alarm functions can be made using the menu options.
- Status LEDs:
  - Red LED Urgent alarm state.
  - Orange LED Non-Urgent alarm
  - Green LED DC power is connected to the unit; Energy Manager is functioning

  NOTE: The LED mapping can be user modified.
- The energy manager is fitted with an audible buzzer which can be configured to alert to any alarm depending on the alarm mapping.
  NOTE: To disable the buzzer when active, press any key.
- Micro-USB Connector: can independently power the EM4x and provides access to the Web UI

5.2.4 Energy Manager 1U Front LCD

The front screen description is as follows:

Figure 4: Energy Manager 1U LCD Screen



*NOTE: when there are multiple alarms raised the Active Alarm display cycles through the list. The complete list can be viewed in the Alarms menu.

NOTE: ETR = Expected Time Remaining which is the estimated back-up time in days (d) and hours (h) of the batteries given their state of charge and the active load.

Use the keypad to navigate through the menus.

▲	Up
▼	Down
↩	Go back
↵	Enter

5.2.5 RM848HE Rectifier

The RM848HE is a telecommunications grade rectifier with the following features:

- Hot pluggable
- Forced Air Cooled
- Thermally Protected
- Wide input AC Voltage
- Constant Power Output Limit
- Input/Output Voltage and Current Protected
- Active Load Sharing
- Serial alarm and control interface
- Microprocessor controlled

Indicators

There are 3 LED indicators on the front panel that show the operational state of the rectifier.

⏻ ● This green LED indicates that mains power is connected to the unit and that the primary stages of the rectifier are operating.

A flashing green LED indicates the RM848HE is in power saving mode.

Please refer to the SM3x Manual or EM4x manual as appropriate for detailed operation description of the power saving mode.

This yellow LED indicates a non-urgent alarm state within the rectifier. This could be caused by the following:

- Rectifier in output power/current limit
- Rectifier over temperature
- Fan failed
- Rectifier soft starting

This red LED indicates an urgent alarm state within the rectifier. This could be caused by the following:

- Rectifier failed
- The AC input voltage is outside the operating range
- Rectifier shut down due to output over voltage or over temperature

6 INSTALLATION

WARNING **All upstream AC, Load and Battery breakers must be switched OFF prior to installation. The system must be completely de-powered.**
All circuit breakers in the system must be in their OFF position prior to installation.

WARNING **Use extreme care when fitting batteries & their connections. Remove all conductive materials from yourself such as watches, jewellery and rings prior to commencing the installation. DO NOT short terminals when working on them.**

CAUTION **Avoid resting cables on sharp edges.**

The energy manager contains static sensitive components that require careful handling and proper precautions to be taken. A grounding strap should be worn.

6.1 AC Surge Suppression

The fitment of a Type 2 AC Surge Suppression Device is mandatory.
If a Type 2 SPD is NOT fitted, the warranty is void.
The user is responsible to ensure the appropriate AC surge suppression protection is in place.

If further advice is required, and/or for supply of an appropriate Type 2 SPD, contact your nearest Enatel representative.

6.1.1 Upstream Over-current Protection

There are two considerations to take into account when selecting an appropriate fuse/circuit breaker.

- The upstream protection should protect the downstream cable from overload situations.

- Discrimination should be maintained with the downstream device fuses.

(i) Cable Rating

The maximum current drawn by the DC power system is 13.3A (4.4A per rectifier at a minimum input voltage of $207V_{ac}$ and full output power). The upstream protection device must be able to supply this load under all conditions without tripping. Therefore, typically at least 20% headroom is allowed for in the protection device, making its minimum rating 16A.

NOTE: The current carrying capacity of cables is dependent on the type of cable used. Please check with your local supplier and local regulations for appropriate sizing.

For convenience, the system is supplied with a 1.0m long, 3-core, $2.5mm^2$ flex already attached. This has a current carrying capacity of 20A.

(ii) Discrimination

Discrimination ensures that the upstream circuit breaker or fuse does not blow if a rectifier input fails (short circuit). Therefore it is important to ensure the upstream protection discriminates with the internal fuse of the rectifier. The fuse used in the RM848HE is a slow-blow 10A fuse, and on the RM348HE, it is a 3.15A fuse. The tripping curves for these are shown at I.A Rectifier Input Fuse Characteristics.

For RM848HE Rectifiers

A minimum circuit breaker to use for this system is a 20A, D-curve (note, a 20A C-curve breaker does **not** discriminate with the rectifier fuse). Therefore, when used with the $2.5mm^2$ cable supplied, a 20A, D-curve breaker should be used.

Alternatively, a 32A C-curve breaker, or greater, can be used. However, the AC cable provided may have to be replaced for a larger cable.

NOTE: A larger breaker may be used even though in theory it may appear that the 2.5mm2 wire is not fully protected. In fact it is protected on two accounts. Firstly it is protected by the rectifier input fuse (which is only a short distance away). Secondly, the rectifiers are power-limited on their input. Therefore, they can never be overloaded. As a result, the wire can never be over-loaded by the rectifier – it can only see fault current. As a result, depending on local authorities, only fault current protection may be catered for by the upstream protective device.

If a fuse is used upstream then any BS88 or NH g style fuse of 20A or greater rating will discriminate.

For RM348HE Rectifiers

A minimum circuit breaker to use for this system is a 16A, B-curve, or a 10A C-curve (Note: a 10A B-curve breaker does **not** discriminate with the rectifier fuse). Therefore, when used with the $2.5mm^2$ cable supplied, a maximum 20A breaker of any curve may be used.

If a fuse is used upstream then any BS88 or NH g style fuse of 16A or greater rating will discriminate.

6.2 Unpacking & Installing in 19" Rack

Upon unpacking, check that the unit is not damaged, and that you have the required number of rectifiers.

Remove the transport bracket supplied attached to the top of the system.

The unit fits into a standard 19" mounting frame. The mounting screws should be M6, however M5 may be used with washers. Be sure to mount the unit in the 19" frame squarely if M5 screws are used.

Mount the system in the cabinet rack using the bottom two screws. The rack will be able to securely hold the 1U system with just the bottom two screws fitted. Brace the cabinet mounting if necessary.

Use the top two screws to connect the cover to the cabinet rail.

Please note the complete system weight is 5.3kg. Ensure the 19" mounting rails are able to withstand mounting of the system. The supplied transport bracket can be utilised in cabinets with 19" mounts at the rear of the cabinet to increase the system mounting rigidity if required.

6.3 Installing in ETSI Rack

Fit ETSI mounting tabs to each side of the compact system chassis. Attach the tabs to the desired depth with the included M5 Screws. Screws are accessible from the inside of the system and as such ETSI mounting tabs can only be fitted prior to installing in a rack.

Figure 5: Fitting of ETSI rack mount tabs

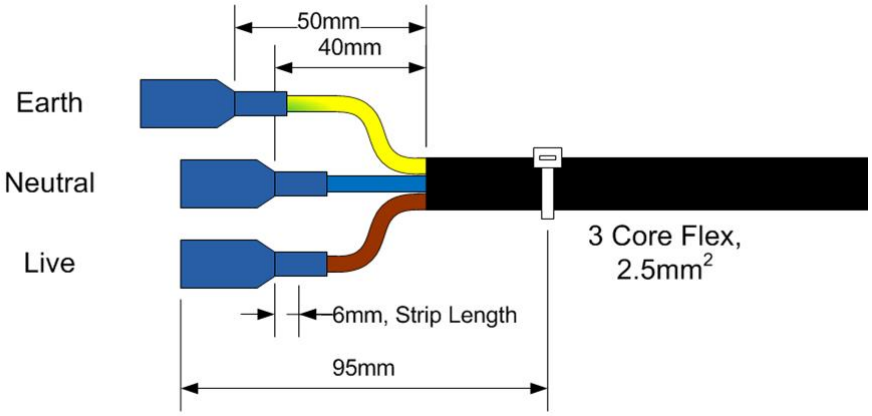
Figure 6: Fitting of ETSI rack mount tabs

NOTE: Fitment of tabs in some positions require the temporary removal of the DC Battery connectors and EM4x controller. These can be replaced once fitment is complete.

6.4 AC Cabling

The AC cables are clearly labelled at the rear of the system, see Figure 7. The AC cable provided is 2.5mm^2 cable and suitable terminals should be used.

Figure 7: AC cable detail

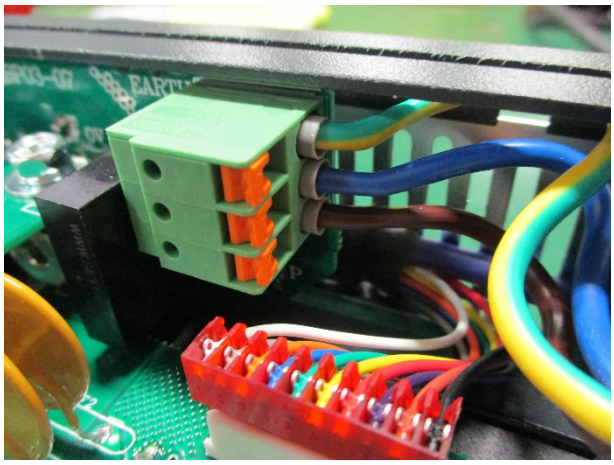


Connections should allow for a maximum single phase AC supply of 10A (@ 175VAC). See 6.1.1 Upstream Over-current Protection.

The AC earth is internally bonded to the system chassis.

NOTE: Please refer to Appendix II AC Input Transient Protection.

AC connection internally is via tool-less phoenix terminals. Longer cables can be easily fitted by replacing the existing cable. Check that the AC colour coding is correct for the country of fitment.



6.5 DC Cabling

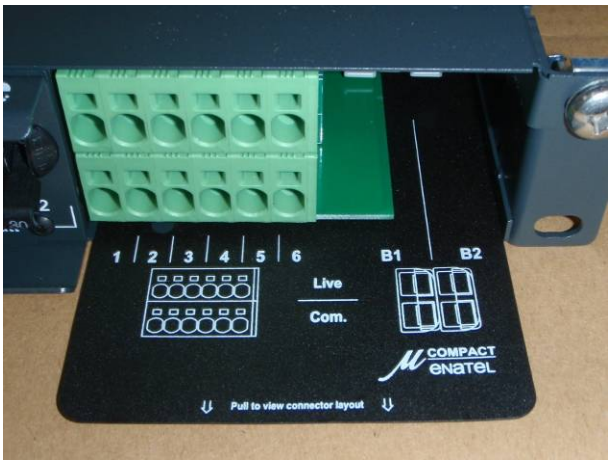
Use extreme care when fitting batteries & their connections. Remove all jewellery and rings before commencing the installation. Always use insulated tools when fitting batteries and take extreme care not to short terminals when working on them.

All DC Load cables terminate to the connectors at the front of the unit as shown in Figure 8. These terminals are all 6mm^2. Load connections are of a 'push in' design and cables can be simply inserted into the connector for termination after stripping to the appropriate length.

Removal requires a small screwdriver to be pushed into the rectangular hole above the connector whilst pulling on the cable.

Connector designators are available on the pull-out guide. See Figure 8 and Figure 9.

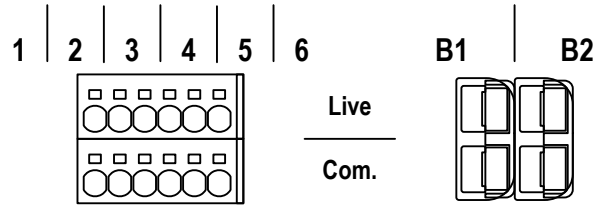
Figure 8: DC Connector detail and pull-out guide



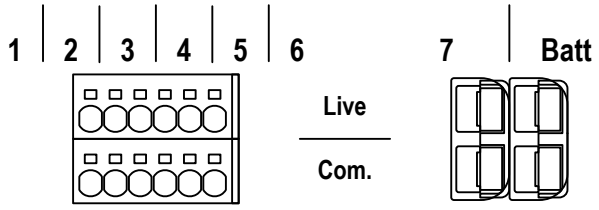
The battery cabling connects through the SB50 style power-pole connectors. From there it goes directly to the appropriate circuit breaker, then via a Low Voltage Disconnect relay and current shunt to the internal live bus. This is shown in the appropriate wiring diagram in Appendix IV System Wiring Diagrams.

NOTE: Systems with only one battery breaker specified can be fitted with an additional load breaker. Connection to the output from this breaker is made through the remaining SB50 power-pole.

Figure 9: DC Connector detail



Connector layout for PSX122E1



Connector layout for PSX122E2

6.6 Alarm/Ancillary Cabling

Alarm and communication cables terminate directly into the connectors of the energy manager, whose terminals are assessable by pulling the controller forward to expose connections, see Figure 10 and Figure 11.

Cables can be routed through the front of the system via the cable exit indicated. When routing the cables, ensure they are kept away from the AC and DC power cables when possible.

The system monitor contains static sensitive components that require careful handling and proper precautions to be taken – an electrostatic discharge protection device must be worn.

Figure 10: For removal, pull the controller forward

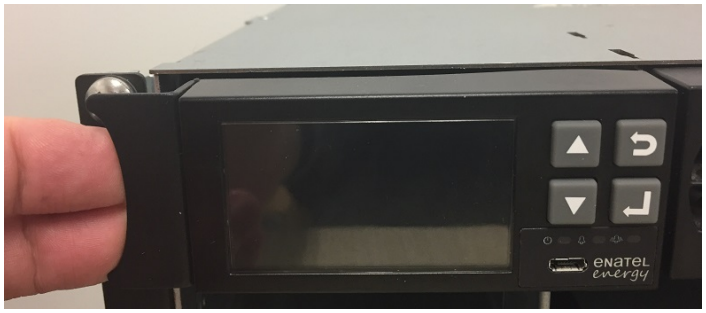
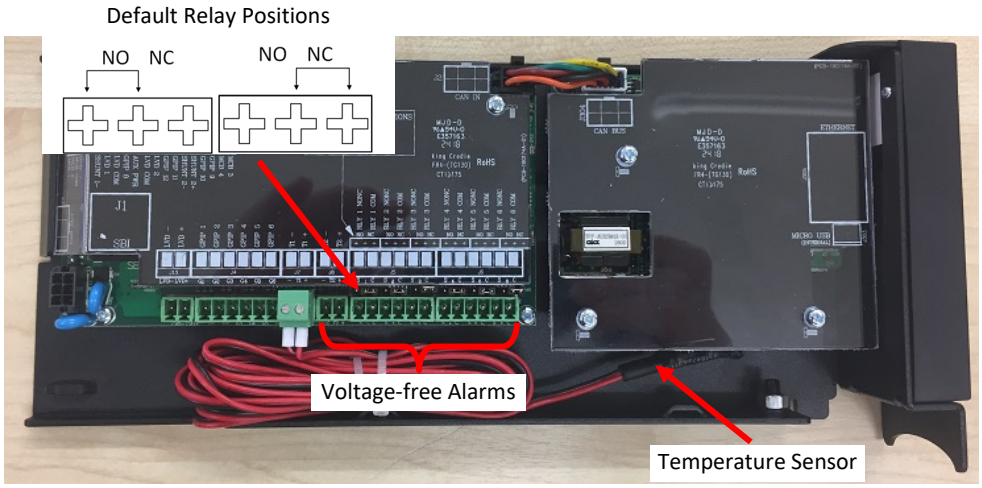


Figure 11: EM4x cable access



Relays 1- 6 can be used for normally open or normally closed states by jumper selection. The relay states labelled NO or NC are for their de-energised state. If an alarm is programmed for the relay to be normally energised (as may be required in the case of a low voltage alarm where loss of power will put the alarm into its active state), then be sure to connect the remote wiring appropriately.

For full controller functionality and operation information refer to the energy manager installation and operation manual.

Uncoil the battery temperature sensor and place it in the middle of the middle battery string. If the lead is not long enough, ordinary 2-core copper (approx. 0.75mm^2) wire can be used as an extension. The purpose of the battery temperature sensor is to monitor the ambient temperature of the batteries over long periods of time and adjust the rectifier output (float) voltage accordingly. As a result, it is not necessary to have the temperature sensor touching the batteries. If the battery temperature sensor is removed a "Battery Temperature Faulty" alarm is generated.

For remote communications and direct computer connection to the microCOMPACT system, refer to the energy manager manual. These connections can be made via the micro-USB port on the front panel of the controller (local computer connection), and the Ethernet port (EM4x web-based communications only). See 8 Energy Manager Connectivity and the Web UI for details on accessing the energy manager.

6.7 Alarm Mapping to Volts-free Relays

Relay 1 is pre-configured as the "Monitor Fail" alarm. This alarm activates is the monitor has a hardware fault or if software becomes corrupted.

All other relays can be mapped to different alarm conditions. The monitor manual details how these may be changed. On the standard Compact Systems alarms are preconfigured as follows:

Relay 2: Summary Non-urgent alarm

Relay 3: Summary Urgent alarm

Relay 4: User Configurable

Relay 5: User Configurable

Relay 6: User Configurable

As mentioned, if these mappings are not appropriate, they can be changed in the field to suit customer requirements.

6.8 Circuit Breaker Fail Monitoring

The load circuit breakers are monitored electronically through an internal general purpose input on the monitor. The digital input will trigger an alarm when it is pulled to the system common rail. This means that to operate the load must be connected. In this way, false alarms are avoided when no load is connected and all load circuit breakers are in the "off" position.

NOTE: This also means that a residual voltage can be measured at the load terminal even when the circuit breaker is turned off. This is high impedance and does not present a hazard to the user.

The battery circuit breakers however, use voltage sense to detect tripping or whether they are turned off. This is because when a battery breaker is tripped, there may be very little voltage difference across the breaker, making electronic fail detection problematic. Hence, if no battery is connected, the breaker must be "on" to clear the MCB Off alarm.

6.9 LVD Operation

This system is configured with a single Low Voltage Disconnect contactor in the battery side of the circuit. See Appendix IV System Wiring Diagrams.

The energy manager unit is powered from both the rectifier side of the LVD contactor and battery source. Therefore when the low voltage threshold is reached and the LVD disconnects the battery, the EM4x loses voltage sense (as voltage sense is measuring rectifier bus voltage) but still maintains operation to monitor the system. The LVD contactor does not re-engage until the rectifier power is restored (i.e., until the DC bus voltage is restored).

7 INSTALLING THE RECTIFIER

1. Check the polarity of the load and battery cables to the system are correct.
2. Plug the rectifier into the rectifier shelf using the following steps:
    a. Locate the chosen slot in the system.
    b. Push the rectifier into the system slot until the connector is fully engaged. (an audible click will be heard, the RM848HE uses an automatic locking catch)

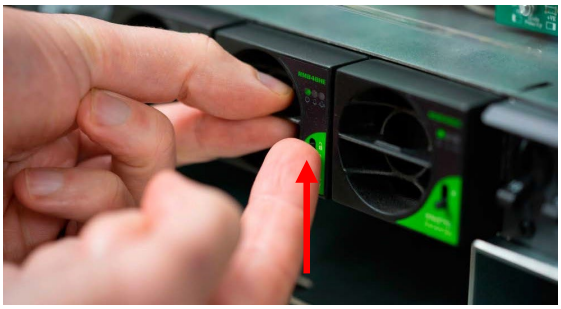
3. Once the rectifier is installed into the rectifier shelf, the AC power can be turned on. After the initial start up period the rectifier will be set to the desired system parameters by the monitor module via the serial communications.

7.1 Removing the Rectifier

WARNING **Hold the rectifier by the plastic cover. The rectifier metal case in extreme operating conditions becomes hot.**

To remove the rectifier:

1. Lift and hold the unlock button.



2. Gently pull on the front panel.

7.2 Ventilation

The performance of the rectifier can be limited if the ventilation is restricted. The rectifier is cooled by drawing air into the front of the unit with a single fan. This air passes through the rectifier cooling the electronics and exiting the rectifier at the rear. To ensure this happens as efficiently as possible check the following:

- The air at the front of the rack is at ambient temperature and not being heated by other equipment.
- Check the rectifier shelf has at least 50mm clear horizontal space behind it. This space must be clear of cables and any other components that may restrict air movement.
  NOTE: if multiple rectifier systems are installed then there should be at least 75mm clear horizontal space per shelf.
- The free space in the rack should continue vertically to the exhaust point at the top of the rack, without impediment.
- The hot exhaust air should not be allowed to re-circulate to the front of the rack as this will be drawn into the rectifiers again, in effect raising the apparent ambient temperature.

The rectifier must be operated in a low dust and fibre environment. If this cannot be guaranteed, then the rack should be fitted with air filters to prevent dust passing into the rectifier units. These filters need to be designed for adequate air volume and regularly maintained.

NOTE: Care must be taken to maximise the flow of cooling air. All cables and other obstructions must be kept clear of the front and rear of the rectifier.

Pay particular attention to the quality of rectifier air intake. Insects, sand, and other extraneous matter ingress seriously impacts the performance of the rectifiers.

8 ENERGY MANAGER CONNECTIVITY AND THE WEB UI

The energy manager is configured via a web browser-based user interface (Web UI). There are two methods to access the Web UI:

1. Ethernet connection from the J305 ethernet connector
2. Front panel micro-USB local connection

8.1 Access Levels

There are 3 access levels for the Energy Manager Web UI:

enaguest : can only view status of system

enabasic : reduced privilege, can view settings and system status

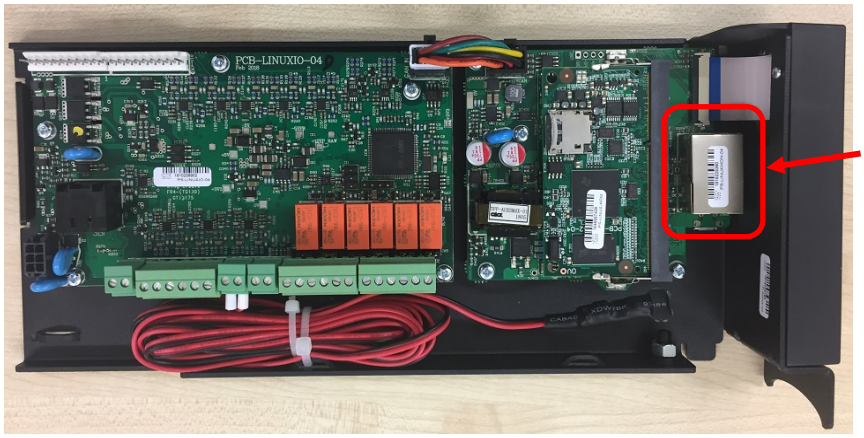
enaadvanced : this user has full control access of the system

The default password for all levels = **ena123**

8.2 Ethernet Port Connection

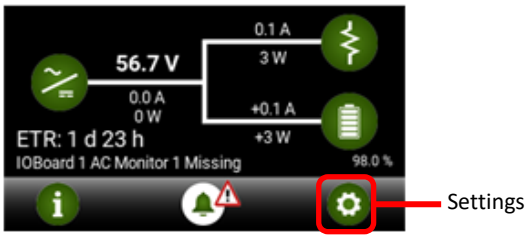
The energy manager contains static sensitive components that require careful handling and proper precautions to be taken – an electrostatic discharge protection device must be worn.

Figure 12: 1U Energy Manager Ethernet Port (pcb cover removed)

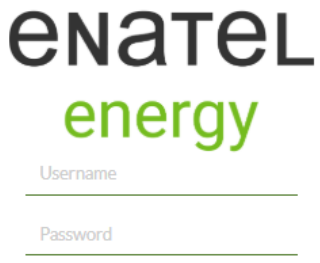


1. Connect the communicating device to the J305 Ethernet port inside the Energy Manager.
2. Open an internet browser such as Edge, Chrome, Firefox or similar on the device.
3. Enter the Ethernet default IP address into the internet browser.

NOTE: the Energy Manager IP address can be located from the front panel LCD menu under: Settings>Networking>Ethernet.



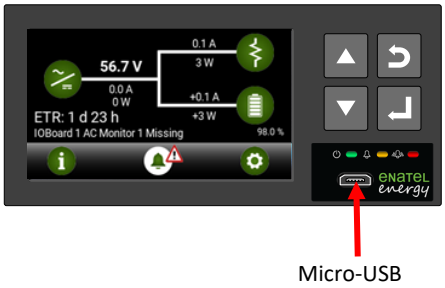
4. The Energy Manager log in page appears.



5. Enter the user name and password. See 8.1 Access Levels.

8.3 USB Connection

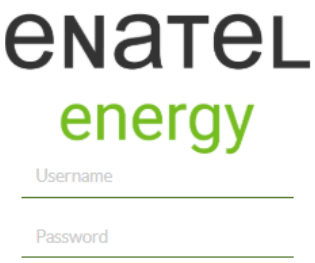
Figure 13: 1U EM4x-02 Front Panel Interface



1. Connect the communicating device to the micro-USB port on the front of the Energy Manager. See Figure 13.
   A driver installation prompt appears.

Enatel Linux Products USB Installer (32-bit)	20/05/2018 9:46 PM	Windows Installer ...	1,188 KB
Enatel Linux Products USB Installer (64-bit)	20/05/2018 9:46 PM	Windows Installer ...	1,556 KB

2. Double-click the appropriate USB driver (32bit or 64 bit).
3. Follow the installation wizard instructions to install the driver.
4. Open an internet browser such as Edge, Chrome, Firefox or similar.
5. Enter the USB default IP address into the internet browser: 172.31.250.1
6. The Energy Manager log in page appears.



7. Enter the username and password. See 8.1 Access Levels.

NOTE: USB connection to the energy manager is possible without AC, battery or other external power supply. The EM4x operates drawing power through the USB port. However USB supply does not power the IO Board. In this scenario there is a set of alarms that display depending on the system configuration relating to the non-operation of the IO board.

For example:

Relay Logic Error	Input and Relay...
IOBoard 1 Missing	IO Board
Battery Temperature Faulty	Battery
Ambient Temperature Low	General Alarms

9 ENERGY MANAGER & IO PCB ALARM OUTPUT CONFIGURATION

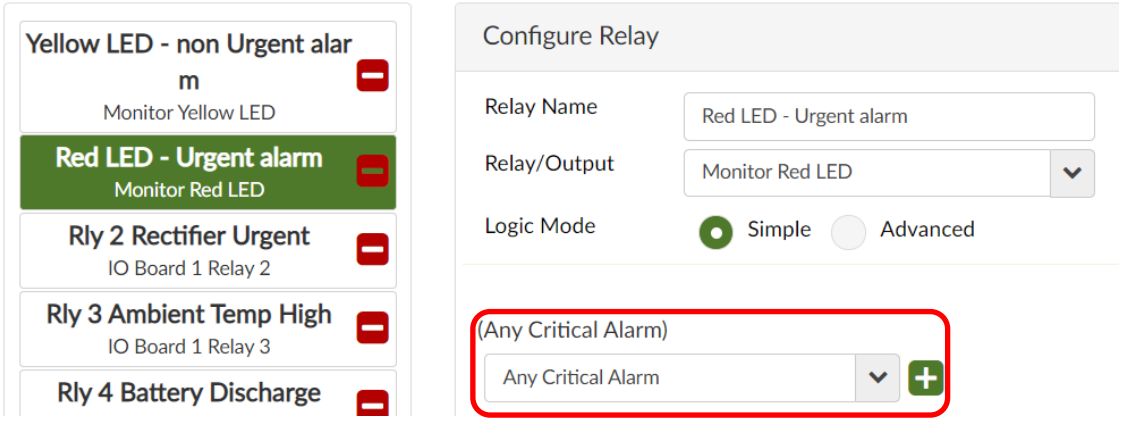
For full EM4x functionality and operation information, refer to the EM4x Installation and Operation Manual.

9.1.1 EM4x LED Alarm Mappings

Refer to the Alarm Configuration>Alarm Configuration page of the Web UI to see the priority setting of each alarm.

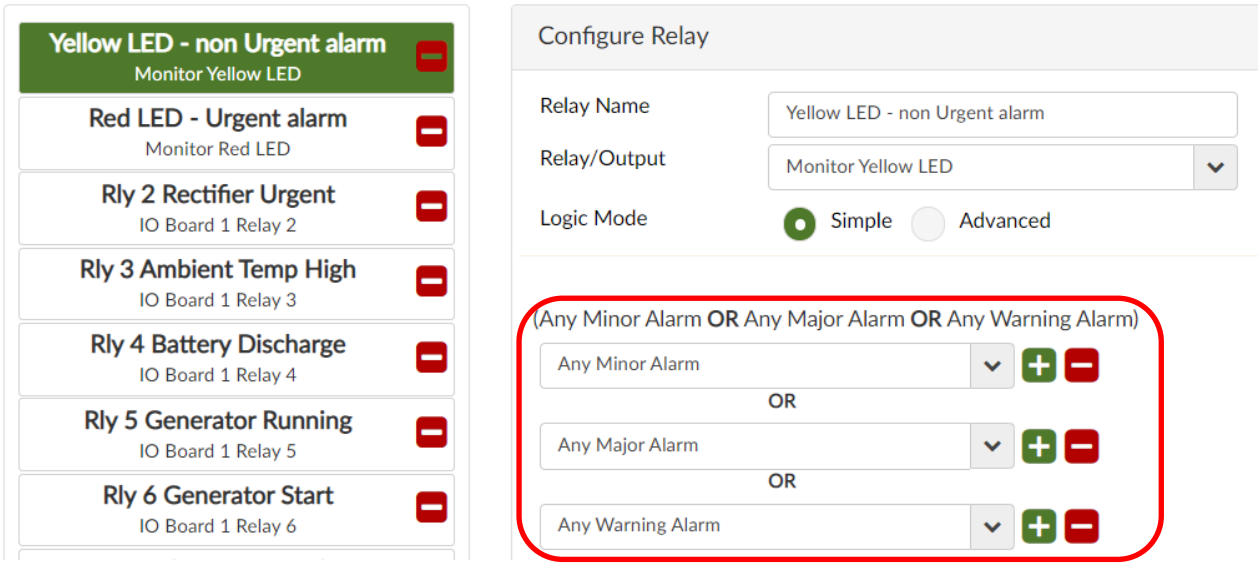
Refer to the Relay/Output page Configure Relay section of the Web UI to understand the how the Alarm Configuration is mapped to the EM4x LEDs.

9.1.2 EM4x Red LED Urgent Alarm Mapping



(For reference only. Actual system alarm mapping may vary)

9.1.3 EM4x Yellow LED non-Urgent Alarm Mapping



(For reference only. Actual system alarm mapping may vary)

9.1.4 EM4x Main PCB Alarm Mappings

Alarms can be mapped to any of the voltage free output relays fitted to the EM4x. Output states of either Normally Open or Normally Closed can be selected (NO and NC states are for the de-energised relay). A jumper is fitted to nominate the required output state, ensure the jumper is placed in the correct configuration for installation requirements.

If an alarm is programmed for the relay to be normally energised (such as a low voltage alarm where loss of power will put the alarm into its "active" state), then be sure to connect the remote wiring appropriately.

Table 2 lists alarm assignment for the EM4x controller as matches the relay outputs shown in Figure 14.

Figure 14: EM4x Relay Outputs

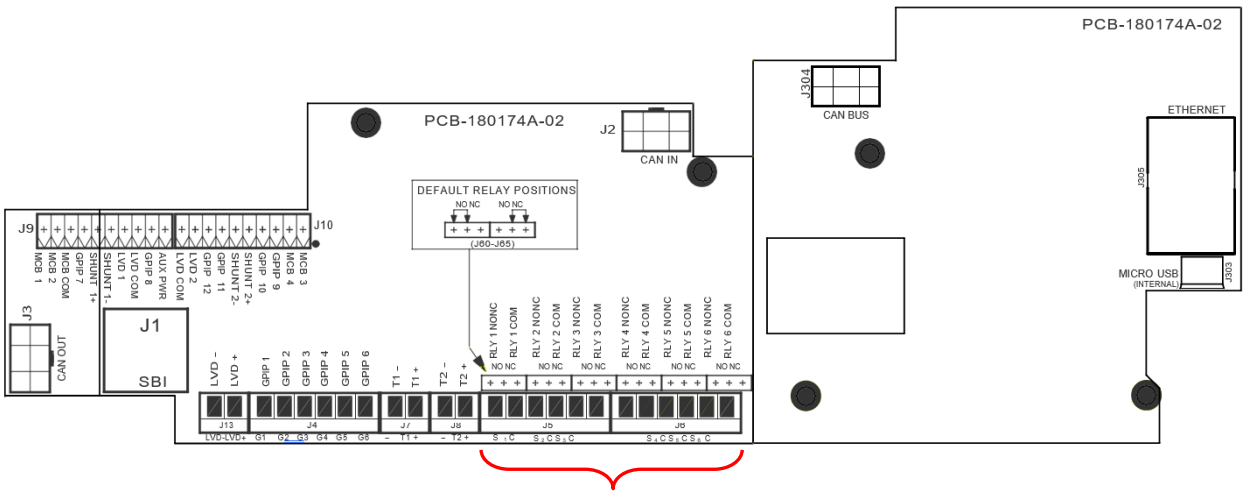


Table 2: IO Board 1 Relay Alarm Assignments

Relay Output	Relay Label (in Enatel Config.)	Alarms Mapped to Relay/Output (all multiple states "OR-ed")
Relay 1	CPU Fail	
Relay 2	Non-Critical Alarms	Orange LED
Relay 3	Critical alarms	Red LED
Relay 4	Spare	
Relay 5	Spare	
Relay 6	Spare	
Buzzer		Red LED

9.1.5 EM4x Main PCB Digital Input Alarm Mappings

General purpose inputs allow the flexiCOMPACT system to monitor any external equipment that includes relay or auxiliary outputs. The GPIP inputs are activated by connecting the system positive (common) to the input terminal (configuration setup in the EM4x can allow activation by connecting to system live).

General purpose inputs can also be configured as analogue inputs for purposes such as battery midpoint monitoring and voltage monitoring.

These inputs may be assigned to contribute to alarm states within the monitor. The state mapping is defined in the configuration file. Alarm mapping should be completed using the EM4x software. Please refer to the EM4x manual for detailed information.

The inputs are normally activated by connecting system positive (usually system common) to the input.

9.1.6 Circuit Breaker Fail Monitoring

Comment: Load circuit breakers are monitored electronically via a diode to a digital input on the EM4x. The digital input will trigger an alarm when it is pulled to the system common (positive) rail. The Breaker Fail alarm will only operate if a load is connected to the output to provide a return circuit for the sense wire. Therefore, for breakers that do not have a load connected, the breaker can remain in an **OFF** position without causing a false alarm.

The battery circuit breakers however, use voltage sense to detect tripping or whether they are turned off. This is because when a battery breaker is tripped, there may be very little voltage difference across the breaker, making

electronic fail detection problematic. Hence, if no battery is connected, the breaker must be ON to clear the Battery Breaker Fail alarm.

10 COMMISSIONING

Use the following set of instructions as a guide, unless different procedures are recommended by local authorities.

NOTE: Refer to 11 Enatel Essential System Set-up Parameters to check important system setup parameters while commissioning. This should be checked for all systems installed.

10.1 System Pre-check:

1. System installation is completed.
2. Battery and load circuit breakers are turned off, and upstream AC has been turned off (i.e., system is completely de-powered).
3. Rectifier modules have been inserted into their shelf positions, and pulled forward enough to disconnect them from the system.
4. Check that the protective AC Earth is connected as per local regulations.

NOTE: This system is available by default as positive earthing (-48VDC). Before connecting batteries or rectifiers ensure that the correct system has been specified and earthing is correct for your application.

5. Turn on AC upstream and check that voltage from phase to neutral are as expected.

10.2 Rectifier Start-up

1. Turn the upstream AC circuits on.
2. Fully insert first rectifier, wait for the rectifier to start and its power on LED to remain green.
3. Check the EM4x powers up and indicates the system default float voltage on its display. If the audible alarm activates, press any button to silence it.
4. If a different system float voltage has been specified, set this at this time using the procedure specified in the EM4x Manual (either from the front panel or connected computer).
5. Fully insert the rest of the rectifiers, check the rectifiers power up with only their green "power on" LED illuminated.
6. Check that the load and battery currents on the EM4x are 0 amps (+/- 1 or 2 amps).
7. Check that all EM4x configuration settings are correct (as per customer specification) with respect to:
   - Voltage levels
   - Alarm settings
   - Alarm mappings to the volts-free relays

   (refer to the EM4x manual for information on how to check these via the front panel or locally connected computer).

10.3 Battery Start-up

NOTE: It is important that battery circuit breaker connections should be made when the rectifiers are turned on and the system is "live". This is because the system voltage and battery voltages will be similar, thus minimising any arcing during connection. This also prevents high current arcing due to the charging of the rectifier output capacitors.

1. Fit only one rectifier initially (to limit any damage if any connections are incorrect).
2. Measure the voltage across each battery string at the terminals of the Compact System. Ensure that the reading from the DC Common bus to the Battery Live Terminals is -48V.
3. Turn on each battery circuit breaker in succession while measuring the battery voltage and ensure that the voltage increases slightly to the system Float Voltage (typically the voltage will increase from 2-3V below float

to float voltage. At this point the batteries will be drawing some current to bring them to a full state of charge.

10.4 Load Start-up

1. Check downstream load connections have been made and there are no loose/floating cables.
2. Turn on the load circuit breaker, check that the downstream equipment is being powered up as expected.
3. Check the system float voltage on the EM4x is at the level previously noted.
4. Check the load current is at a level expected (could be zero if loads downstream have not been connected).

NOTE: Prior to leaving the system after it has been commissioned, ensure all AC, DC *and* battery circuits are off. If it is required that the system is to be left on (to power load equipment, ensure rectifiers are left in their powered up state, and batteries are in circuit. This will prevent anyone leaving the batteries only powering the load (in which case the batteries would go flat).

11 ENATEL ESSENTIAL SYSTEM SET-UP PARAMETERS

The following steps are system settings that must be checked at the time of commissioning for each system installed. You can print this section and fill it out for each site commissioned.

NOTE: these steps are battery chemistry dependent. Follow the appropriate section.

11.1 Systems with Lead Acid Batteries

Failure to correctly follow the items below may cause incorrect system functionality and in some cases ruin your battery (without the ability to claim battery replacement under warranty).

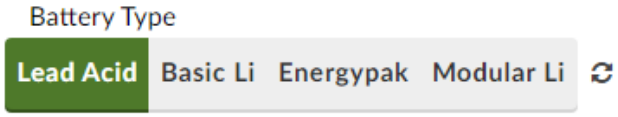
NOTE: Any values shown below are indicative only. If the values in your system differ from those shown here, write in the values relevant to your system.

Refer to the EM4x energy manager manual for more details.

11.1.1 Check the Battery Type

The system MUST be configured to the correct battery type.

EM4x Web UI page Battery>Battery Settings



Done ☐

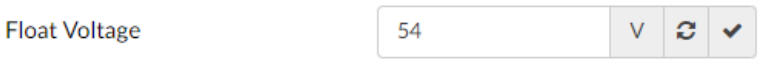
11.1.2 Check/Set Float Voltage

Consult battery manufacturer's data for proper setting.

The Float voltage is for 25°C reference temperature in Enatel systems.

EM4x Web UI page: Control

Example:



Site Setting:

Done ☐

11.1.3 Set Battery Temperature Compensation

Toggle temperature compensation On.

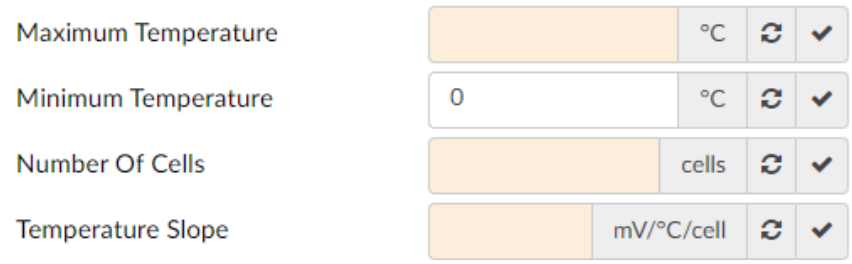
EM4x Web UI page: Battery>Battery Settings

You **must** consult the battery manufacturer's data to obtain the correct Slope setting. Note that in many Hybrid applications where the battery is constantly being cycled, having temperature compensation enabled may not be necessary as the voltage on the battery is constantly changing anyway.

EM4x Web UI page: Battery>Battery Settings

Example:

Site Settings:



Done ☐

If you choose **not** to enable Temperature Compensation, then set the Rectifier Float Voltage to that required by the battery manufacturer for the average long-term temperature you anticipate your system to operate at.

11.1.4 Set Battery Capacity

Consult the battery manufacturer's data for correct battery capacity settings.

For the EM4x to set the correct Battery Current Limit current, it is essential that this is filled out correctly. These figures are also used for estimating the Battery Time Remaining during a discharge.

For Telecom applications, the 10 hour rate is usually the name-plate rating of the battery. However, once again, check the battery manufacturer's data sheets as some manufacturers state the 20 hour rate (which is usually a little more "optimistic").

The second rate is required specifically for the time-remaining algorithm. A 4 hour rate is usually a good one to use. This information is available from the battery manufacturer's data sheet.

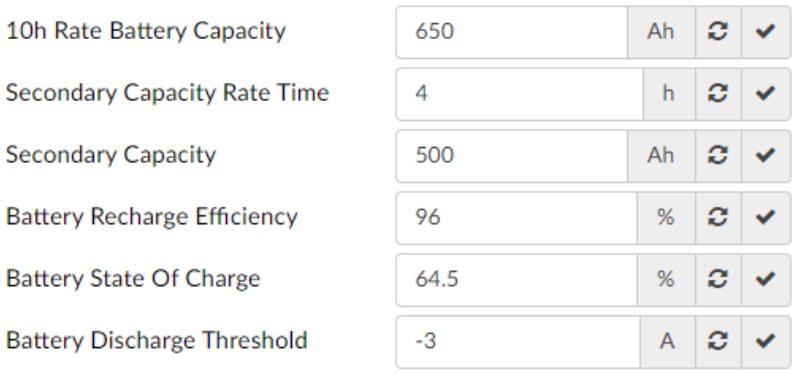
The Battery SoC adjust can be used at the time of installation (or for testing purposes) in case the installed battery is not initially fully charged. If you think the battery is only 80% charged, then simply enter that value. The value displayed here will correct itself once the battery has been on charge for some time or gone through a few charge/discharge cycles.

Battery Recharge Efficiency considers the ohmic and any other losses in the battery charge/discharge cycle. The effect is that more energy (Ah) needs to be put back into the battery than was taken out. With the efficiency set to 96%, then 4% more Ah is needed to be returned to the battery before the EM4x will register that the battery is at 100% SoC.

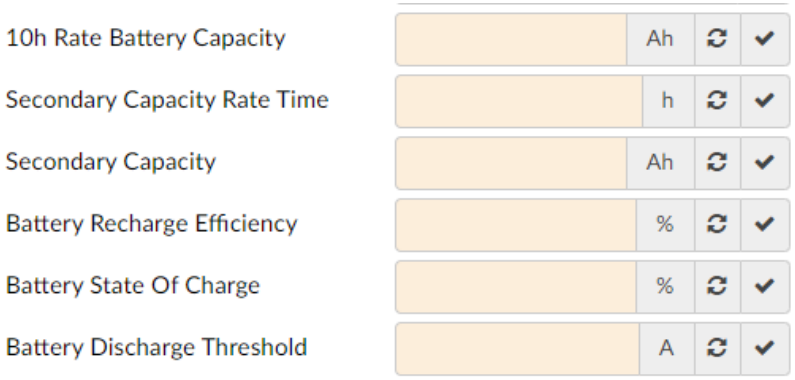
The Battery Discharge Threshold is a buffer to prevent false triggering of discharge notification and is usually related to the size of the battery shunt. A larger shunt requires a larger discharge threshold.

EM4x Web UI page: Charge

Example:



Site Settings:



Done ☐

NOTE: Both the 10 hour and secondary battery capacity hour rates should be set at the same time. The EM4x compares rates to ensure the battery data is accurate and may not accept the setting if an inaccuracy is detected.

11.1.5 Set Battery Current Limit

Consult battery manufacturer's data for maximum battery recharge current settings.

The Battery Current Limit is set as a percentage of the 10 hour rate entered above.

It is recommended this value is set at the highest rate allowable to ensure the battery is recharged as fast as possible.

In some systems, especially larger systems, this may require limiting further because of the number of rectifiers available, rather than the maximum setting.

EM4x Web UI page: Battery>Battery Settings

Enable Battery Current Limit by clicking on the tick icon beside the field.

Example:

Site Settings:

Done ☐

For telecom settings, this limit is often set to 10% (or 0.1C10, i.e. a 10A current limit for a 100Ahr battery). This is more typical of a design parameter than the need for the setting to be at this level but a setting higher than this

level should be considered to enable the fastest recharge possible without exceeding the battery manufacturer's maximum value.

Ensure sufficient rectifier capacity is available to cover battery recharge and load requirements.

11.1.6 Low Voltage Disconnect Settings

The LVD disconnect set points are usually a customer generated setting.

As the discharge time increases, the higher the end voltage should be set. For a discharge of <1hr, this may be as low as 1.75Vpc (42.0V for a "48V" battery), or for an 8 hour discharge, it may be 1.85Vpc (44.4V for a "48V" battery).

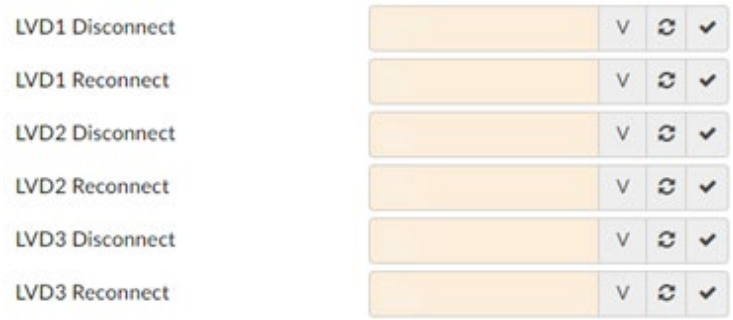
Note that if only one LVD is fitted (as is the case in all of the Enatel microCOMPACT systems, LVD2 and LVD3 thresholds are set outside of possible tripping voltages. This avoids any confusion over which LVD signal is being used by the EM4x energy manager.

EM4x Web UI page: IO Configuration>IO Boards

Toggle LVD latching On

Example:

Site Settings:



Done ☐

11.2 DC System Lead Acid Battery Commissioning Check-List

This section is for a more detailed commissioning process than the Essential Set-up Parameters. It may be printed out separately and filed for record keeping.

DC System Lead Acid Battery Commissioning Check-List

Site Name:_____ Date:_____

Tests Without Batteries Connected	Value	Results	
Check Float Voltage	Meter:_____	_____ V	✓ / ×
Check Load Current	Meter:_____	_____ A	✓ / ×

Alarms

Voltage thresholds can either be checked using an external power supply, or by adjusting the EM4x float voltage 0.1V above (or below for the low voltage alarms). It is recommended to have the batteries **disconnected**.

1. Adjust the supply/float voltage to 55.7V & observe the "High Float" alarm.
2. Adjust the supply/float voltage to 57.7V & observe the "High Load" alarm.
3. Adjust the supply/float voltage to 52.7V & observe the "Low Float" alarm.
4. Adjust the supply/float voltage to 46.9V & observe the "Low Load" alarm.

High Load Volts (urgent)	57.6V	_____ V	✓ / ×
High Float Volts (non-urgent)	55.6V	_____ V	✓ / ×
Low Float Volts (non-urgent)	52.8V	_____ V	✓ / ×
Low Load Volts (urgent)	47.0V	_____ V	✓ / ×

Depending on the test load available, it may be necessary to adjust the High Load Current alarm threshold down to suit. For example, with 40A test load, adjust the Load Current High Setpoint threshold (Web UI page Alarm Configuration>System Alarms) to 35A. Then simply apply the 40A load and observe the alarm change state.

Once the test is complete, be sure to rest the Load Current High Setpoint to its previous value (or check with the customer for the correct value they require).

Load Current High Setpoint	_____ A	✓ / ×

Temperature alarm tests are performed by heating up (using a heat gun or other source) and cooling down (using an aerosol can of freeze, or a tub of ice) the temperature sensors.

Battery Temperature High (urgent)	_____°C	✓ / ×
Battery Temperature Low (non-urgent)	_____°C	✓ / ×
Room Temperature High (non-urgent)	_____°C	✓ / ×
Room Temperature Low (non-urgent)	_____°C	✓ / ×

When an AC Monitoring PCB is not fitted at system level (as in most cases), the AC Fail alarm is generated from the rectifiers. The rectifiers sense if AC is present, and extend an AC fail alarm to the EM4x. Therefore, to test this alarm, simply turn off the rectifier AC breakers. To allow the controller to continue to read alarms there must be DC present on the output of the system.

As this causes the rectifier output to cease, a Rectifier Fail alarm is also generated. To generate the Urgent Rectifier Fail, turn off the required number to make this

occur (usually set to 2, but check via the EM4x Web UI for the setting (Control page>Rectifier Urgent Fail Threshold).

AC Fail (urgent)	Urgent	✓ / ✗
Rectifier Fail (non-urgent)	Non-urgent	✓ / ✗
Urgent Rectifier Fail (urgent)	No. Modules:___	✓ / ✗

To check Load MCB fail, connect a load, but with no load turned on. Then switch the breaker to its off position, and turn on some load (any amount will do). This will cause the alarm to occur as the load side to the circuit will be taken to system common voltage. Turn off the load, and then return the breaker to its on position.

Load MCB Fail (urgent) ✓ / ✗

Tests with Batteries

- Turn off Battery Breaker/s
- Connect battery/batteries
- Check the correct Battery Capacity (Ahrs) has been entered (EM4x Web UI Battery>Battery Settings). This is the total capacity, so for example 100Ahr strings in parallel, this should be 200.
- Go to EM4x Web UI Battery>Battery Settings>Battery Charge Current Limit. Check Battery Charge Current Limit (BCL) is set to desired level (usually $0.25C_{10}$, (25%)). This means that for a single 100Ahr battery, the BCL will be 25A, or if two 100Ahr batteries are connected in parallel, the BCL will be 50A.
- Connect load (but turn off).
- Check V_f is set to 54.0V. (Web UI Control>Float Voltage)
- Turn on Battery Breaker/s

Check Battery current is positive if charging ✓ / ✗

For systems fitted with Battery Monitoring (BCM) cards:

Go to EM4x Web UI Battery>Battery Status. Check cell voltages are approximately the same, at about 2.25V (or 13.5V for 12V monoblocs). ✓ / ✗
If any are out by a large amount, then check the BCM sense wiring is correct.

Set load to required level (e.g., 30A), Initiate a Battery Test. Click the Start Battery Test button on EM4x Web UI Charge page.	Check operates	✓ / ✗
Check Battery Current is negative (discharging). Note the overview data in the header of the Web UI.		✓ / ✗
Check Battery Current	Meter:_____ _____ A	✓ / ✗

After several minutes, or until the battery voltage has dropped below approx. 47V,
click the Stop button at the top of the Web UI Charge page.
During this time the Battery Condition Monitor (if fitted) is logging.

Battery Current Limit (BCL)

Check that the battery recharge current is limited to the Battery Current Limit level (usually $0.25C_{10}$, (25%)). See Web UI Battery Settings>Calculated Charge Current Limit for Amp value.	BCL functions _____%	✓ / ✗

Note: as the BCL is based on fine voltage control of the system bus, the BCL make take one or two minutes to "settle", i.e., you

may observe a brief excursion of the battery recharge current beyond the BCL setting.

Check Manual Equalise (if configured). Click the Start Manual Equalise button on the Charge page to initiate a battery equalisation. Click the Stop button at the top of the Charge page to end. ✓ / ×

A Battery MCB Fail alarm is generated from the voltage measured across the battery MCB.

Therefore, to check a Battery MCB Fail alarm, simply open one of the battery MCB's. If batteries are connected to the system at this time, the alarm may take a few moments to activate. Once test is complete, turn breaker back on.

Battery MCB Fail (urgent) ✓ / ×

Temperature Compensation

Check Temperature Compensation is enabled. ✓ / ×

Web UI Battery>Battery Settings>Rectifier Compensation>On.

Apply heat or cold to the Battery Temperature Sensor/s. Check the float voltage moves up or down as expected. ✓ / ×

If actual measurement is required, apply a known heat or cold to the sensor. Allow it to fully come to temperature and record the amount of voltage movement.

Temp._____°C

Voltage offset: _____ V OK? ✓ / ×

Check Alarm Relay Contacts

To generate these alarms, refer to the procedures described earlier in the Commissioning Check-list.
Spare relays will not be able to be tested unless an alarm is mapped to them. As these are tested in the factory, it is not essential to test them at time of commissioning.

On main EM4x PCB

Relay 1 (Monitor Fail) ✓ / ×
(pull out the RJ45 lead connecting the monitor to the system rectifier shelf – this simply de-powers the monitor)

Relay 2 (Summary Non-urgent) ✓ / ×

Relay 3 (Summary Urgent) ✓ / ×

Relay 4 (Spare) ✓ / ×

Relay 5 (Spare) ✓ / ×

Relay 6 (Spare) ✓ / ×

NOTE: *Prior to leaving the system after it has been commissioned, check all AC, DC <u>and</u> battery circuits are off. If it is required that the system is to be left on (to power load equipment, ensure rectifiers are left in their powered up state, and batteries are in circuit. This will prevent anyone leaving the batteries only powering the load (in which case the batteries go flat).*

11.3 Systems with Lithium Batteries

The term lithium batteries includes a wide range of chemistry types. Regardless of the chemistry used the energy manager differentiates lithium (and other non-lead acid batteries) by whether the battery BMS can be communicated to via Modbus RTU or not. These 'smart' batteries are termed modular, where the energy manager is receiving information on alarms and status from the battery internal electronics.

Failure to correctly follow the items below may cause incorrect system functionality and in some cases ruin your battery (without the ability to claim battery replacement under warranty).

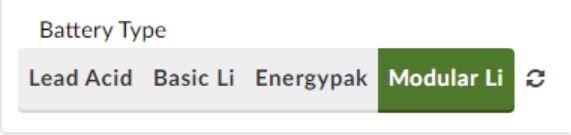
NOTE: Any values shown below are indicative only. If the values in your system differ from those shown here, write in the values relevant to your system.

Refer to the EM4x energy manager manual for more details.

11.3.1 Check the Battery Type

The system MUST be configured to the correct battery type.

EM4x Web UI page Battery>Battery Settings



Done ☐

11.3.2 Modular Smart Lithium Battery Selection

If the system is connected via Modbus RTU to a battery BMS check the correct specific battery is selected from the **Product** drop down list and mapped to the correct address.

EM4x Web UI page: IO Configuration>Modbus Master>Device Map

Done ☐

11.3.3 Check/Set Float Voltage

Consult the battery manufacturer's data for the proper setting. Note that the float voltage directly impacts the state of health of batteries after multiple cycles. The consequences of the float voltage setting **must** be understood.

The Float voltage is for 25°C reference temperature in Enatel systems.

EM4x Web UI page: Control

Example:

Site Setting:

Done ☐

12 MAINTENANCE

As ENATEL Power Systems are state of the art electronic systems, very little routine maintenance is required.

System

- Check all load and battery & alarm cable connections are tight.

Energy manager controller

- The controller can give a good indication of the condition of the system. Alarm logs can show issues with the system and rectifiers and should be regularly checked.
- As a minimum, check that the float voltage and load current is as expected.
- If the batteries are fully charged, check the battery current is zero or near to zero amps, and also check that the amp-hours remaining is 100%.

Rectifiers

- During normal operation some dust will build-up on the front of the rectifiers. This should be kept to a minimum by regularly wiping the rectifiers to avoid accumulation within the rectifiers and blocking the airflow to the units. The positioning of the system and surroundings will determine the regularity of this requirement.
- In extremely dusty positions it is recommended that the units are removed and cleaned with compressed air to prevent airflow blockages.
- Check the air flow front and back to the rectifiers is unimpeded by cables or otherwise.
- Check nothing has entered the rectifiers such as insects or geckos.
- Reference 7.2 Ventilation for further information.

Batteries

- Battery maintenance depends on the individual manufacturer's specification, please contact the battery supplier for recommendations.
- Periodic discharge tests may be beneficial to ensure reliable system operation and may be recommended by the battery manufacturer.

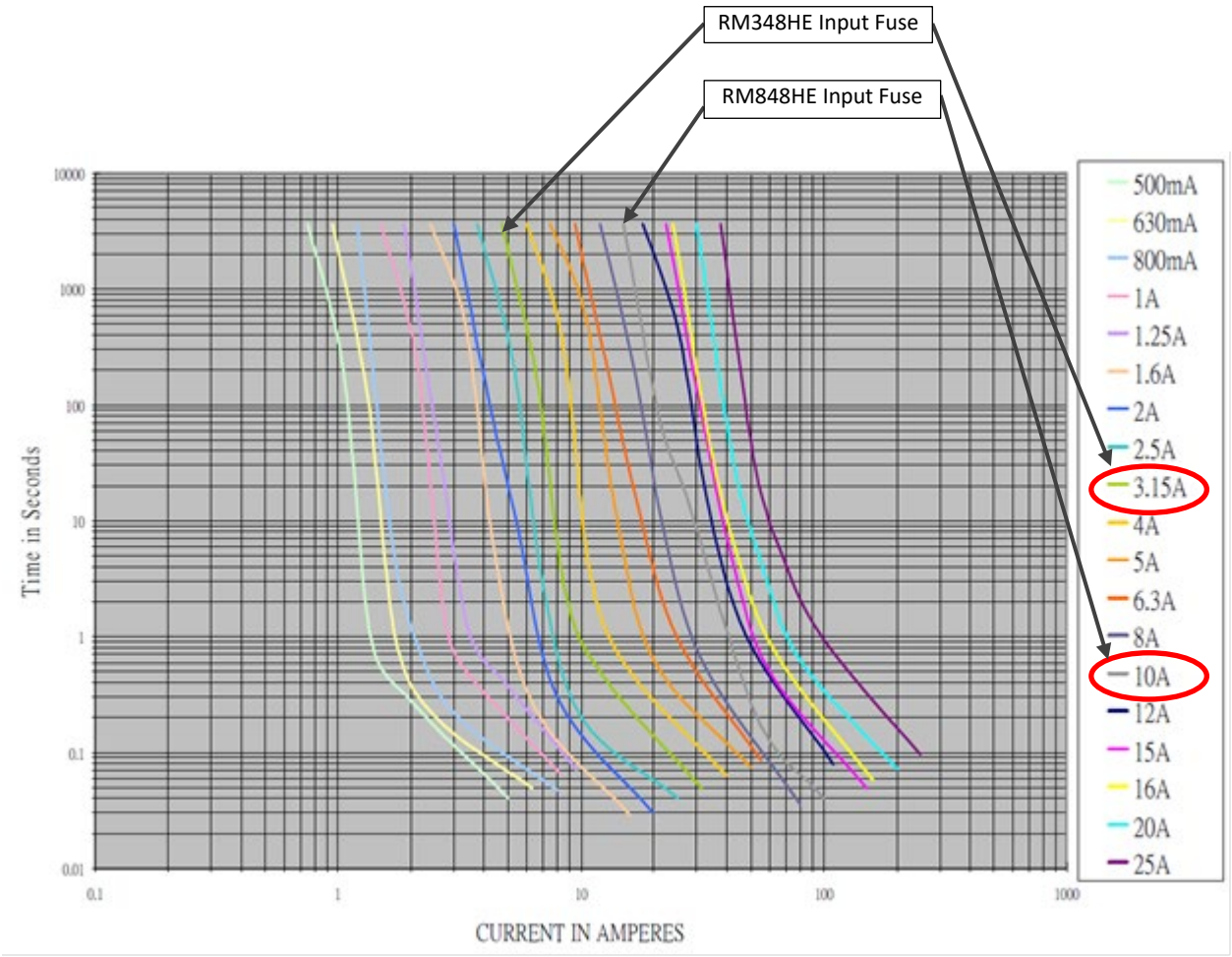
CAUTION **The user must be aware of the consequences of battery State of Health (SoH) with regards their specific load requirements and implement their own policy regards the end of life of the batteries.**

Appendix I RECTIFIER FUSE AND FRONT PANEL BEHAVIOUR

I.A Rectifier Input Fuse Characteristics

NOTE: The curves are for average value, for reference only.

Figure 15: Rectifier input fuse tripping curves



I.B RM848HE and RM348HE Front Panel Indications

There are three LED indicators on the front panel to indicate the operational state of the rectifier.

This green LED indicates that input power is connected to the unit and that the primary stages of the rectifier are operating.

This yellow LED indicates a non-urgent alarm/notification state within the rectifier.

This could be caused by the following:

- rectifier in output power/current limit
- rectifier over temperature
- fan failed
- rectifier soft starting

This red LED indicates an urgent alarm state within the rectifier.

This could be caused by the following:

- rectifier failed
- the AC input voltage is outside the operating range.
- rectifier shut down due to output over-voltage or over-temperature.

Appendix II AC INPUT TRANSIENT PROTECTION

Figure A:

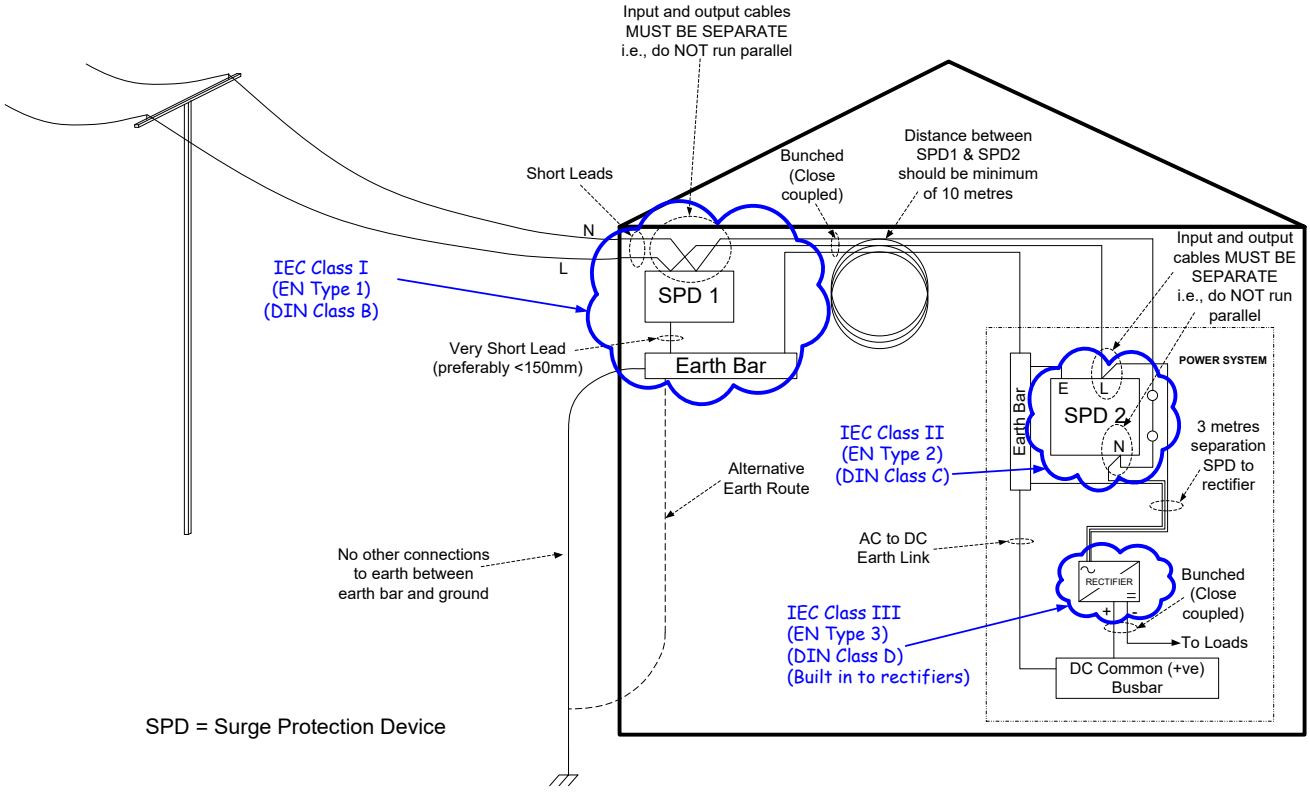
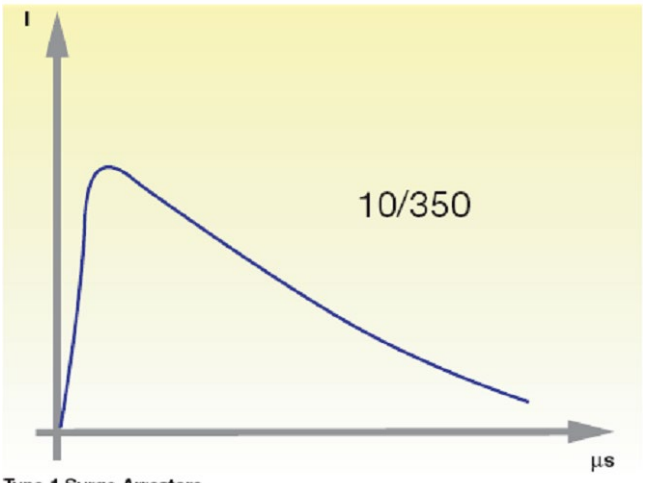


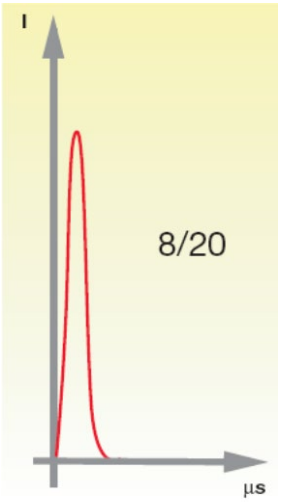
Figure A illustrates the surge protection installation principles, utilising the 3 stage protection zone concept.

The **Type 1** (SPD1) surge arrester, fitted in the installation's main incoming electrical switchboard, is capable of diverting the energy of a direct lightning strike. This is the first stage of the electrical network's protection. It is important that upstream Type 1 protection is provided on site. Although the actual surge capability of the device used can vary depending on the severity of lightning in any particular installation, the typical maximum discharge current of a Type 1 surge suppressor will be in the order of 50kA to 100kA (10/350µs impulse)

The 10/350µs current wave as shown below is the standardized current waveform which passes through equipment when subjected to an overvoltage due to a direct lightning strike.



Type 1 Surge Arresters
I_{imp}: current wave



Type 2 Surge Arresters
I_{max}: current wave

A **Type 2** surge arrester (SPD2) should be used in coordination with the incoming **Type 1** surge arrester. This is the second stage of protection. The Type 2 Surge arrester is designed to run-off energy caused by an overvoltage comparable to that of an indirect lightning strike or an operating overvoltage (this is effectively the "left-over"

surge from the Type 1 protection device). To provide sufficient de-coupling between the Type 1 and Type 2 devices, impedance is required. This is typically stated to be 10m of cable (approximately 10µH). This cable may be looped if the distance available is too short. Alternatively various manufacturers have devices which act as filter elements or provide active spark ignition for applications where 10m of cable is not practical (such as outdoor enclosures).

Some of the Enatel's larger power systems are provided with Type 2 Surge Protection Devices (SPDs) (as defined by IEC 61643-11), however, due to size limitations, Enatel's micro power systems are not. These devices are rated for repeated strikes of 20kA (8/20µs waveform as shown above), and single shot protection of 40kA.

NOTE: Enatel's microCOMPACT systems are compliant with EN61000-4-5, Level 4 without any external/upstream surge suppression. To maintain a coordinated approach to surge suppression, a Type 2 SPD must be installed upstream, and preferably Type 1 as well.

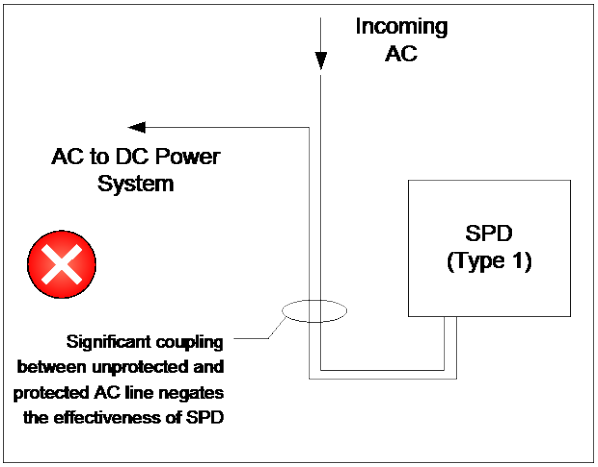
The fitment of a Type 2 AC Surge Suppression Device upstream of the power system is mandatory.
If a Type 1 AC Surge Suppression Device is upstream a Type 2 AC Surge Suppression Device must be used in combination.
If a Type 2 SPD is NOT fitted and wired as per the "Notes on AC Cable Installation & SPDs" below, the warranty is void

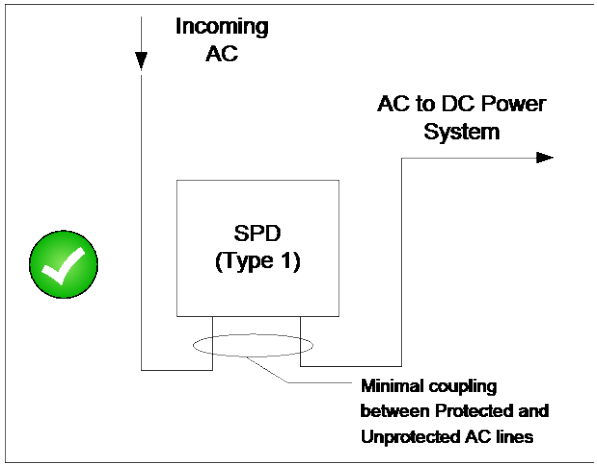
If further advice is required and/or for supply of an appropriate Type 2 SPD, contact your Enatel representative.

Notes on AC Cable Installation and SPDs

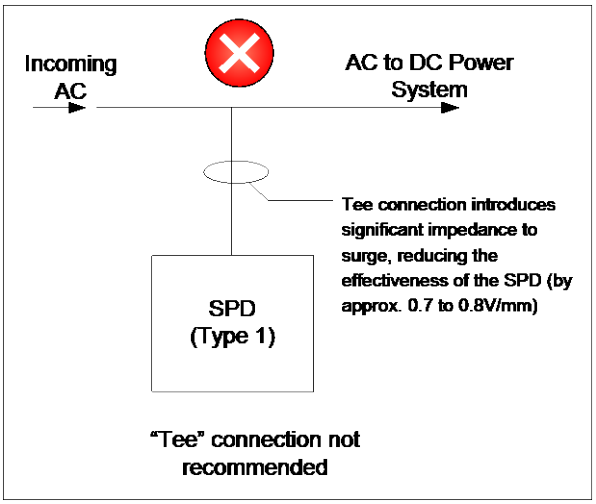
The following precautions **must** be adhered to when installing AC cabling.

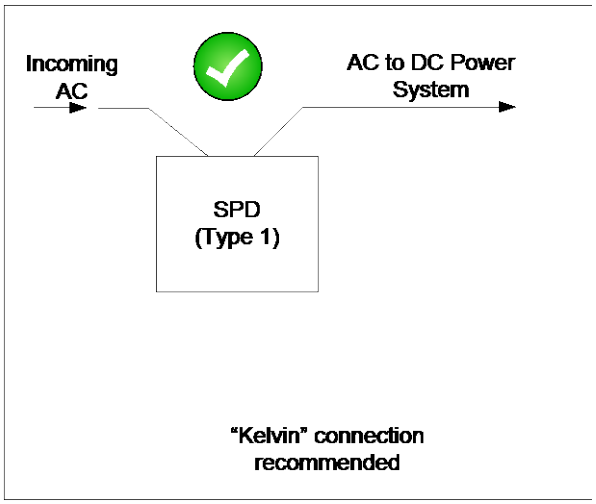
1. Avoid running input and output cables from AC Surge Protection Devices together:





2. Avoid "Tee'd" Connections:





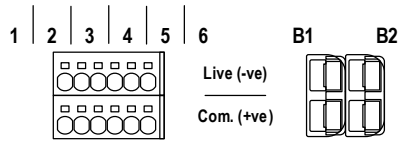
Appendix III SPARE PARTS LIST

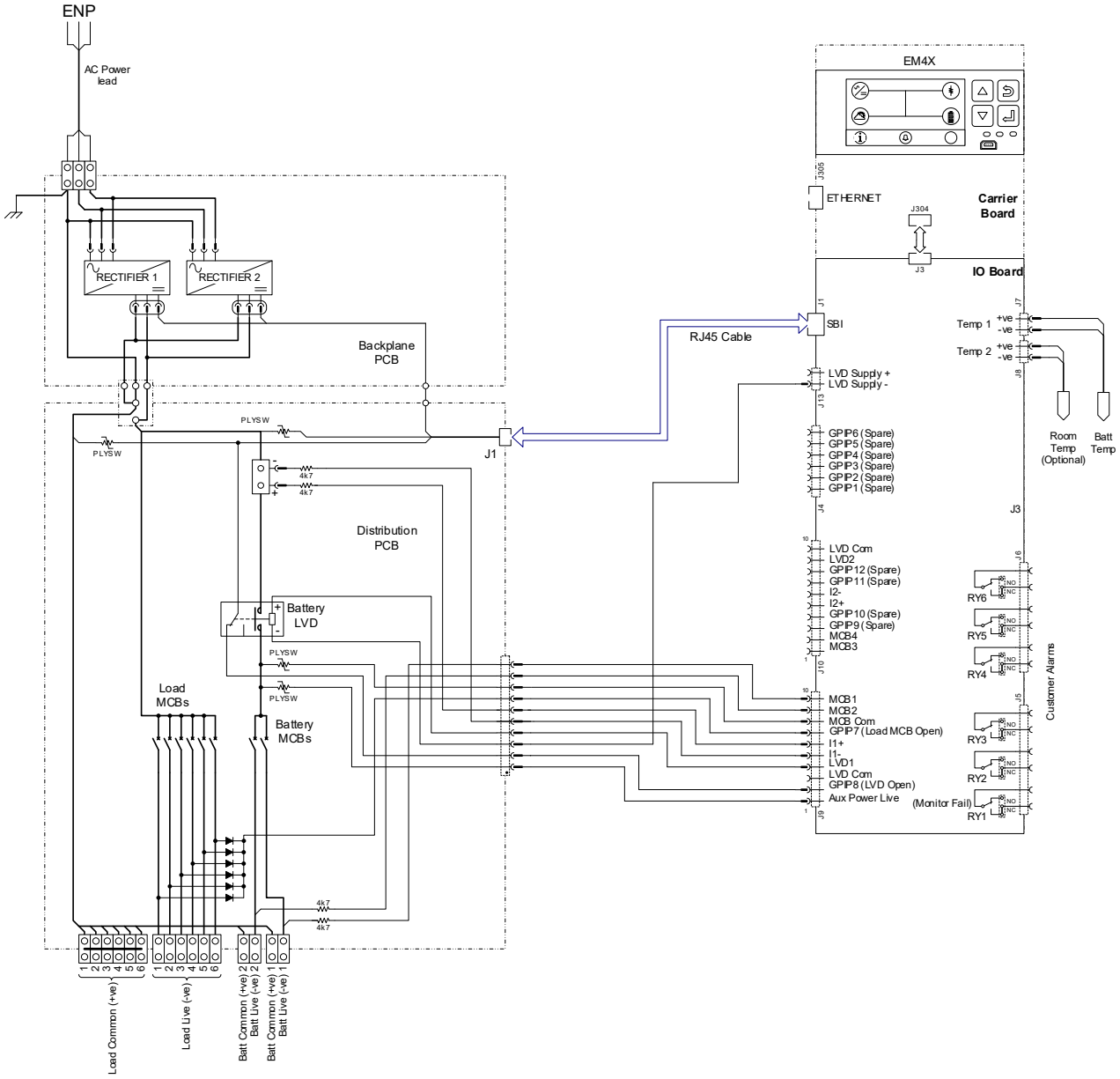
The following parts are available through your Enatel representative:

Part Description	Part Number	Image
EM4x-01 energy manager	MEC-EM40T100-00	
RM848HE rectifier	RM848HE-08	
10A breaker	MCB-0103KA1P-30	
20A breaker	MCB-0203KA1P-30	
30A breaker	MCB-0303KA1P-30	

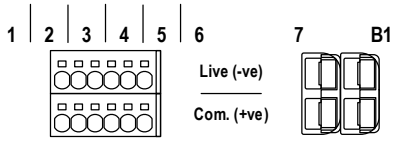
NOTE: more spare part options are available. Please contact your Enatel representative for details.

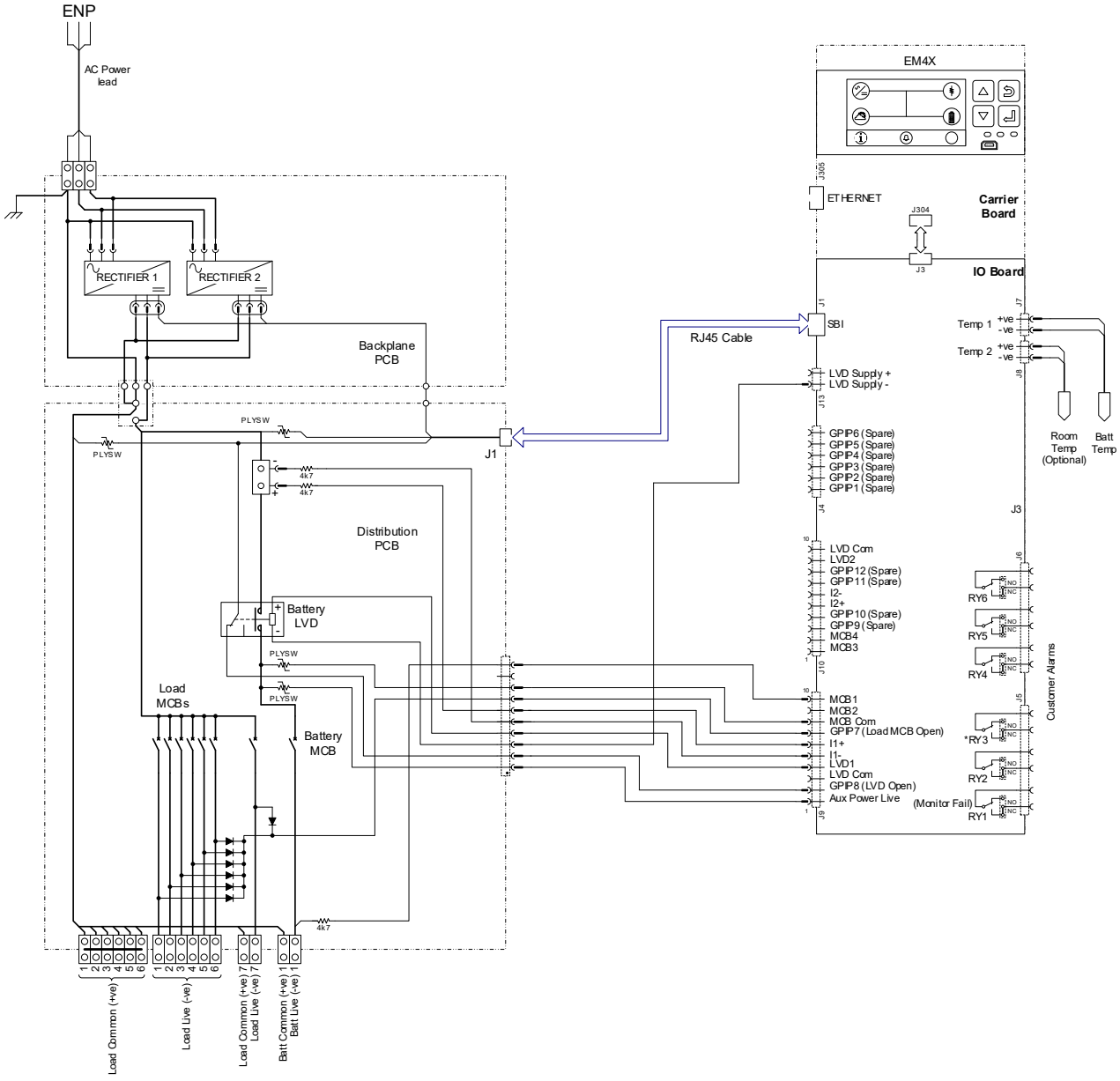
Appendix IV SYSTEM WIRING DIAGRAMS



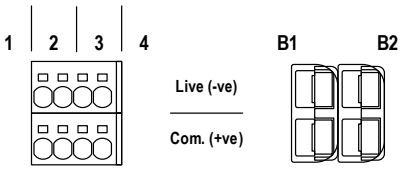


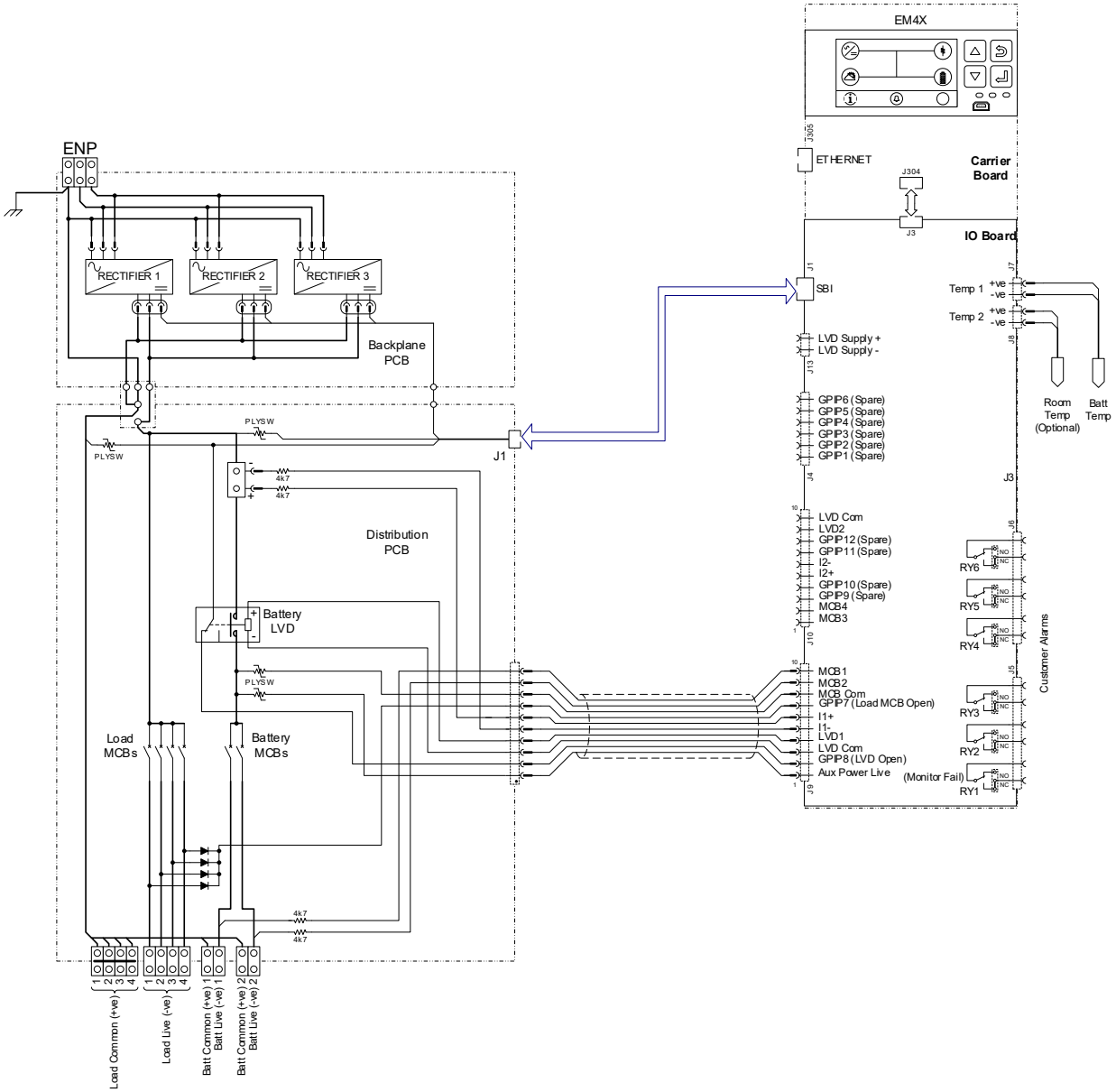
enatel	TITLE: -48V, EM4X 1U Micro Compact (2R/6L/2B)			DRAWN: PML
	DRAWING NUMBER: 190571	SYSTEM NUMBER: PSX12XE1A-XX-XX	DATE: 11 Nov'19	REVISION: 1.1
			SCALE: NTS	SHEET: 1 of 1



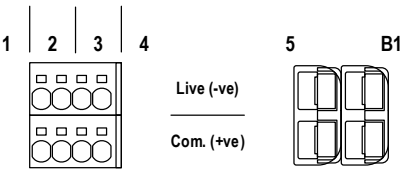


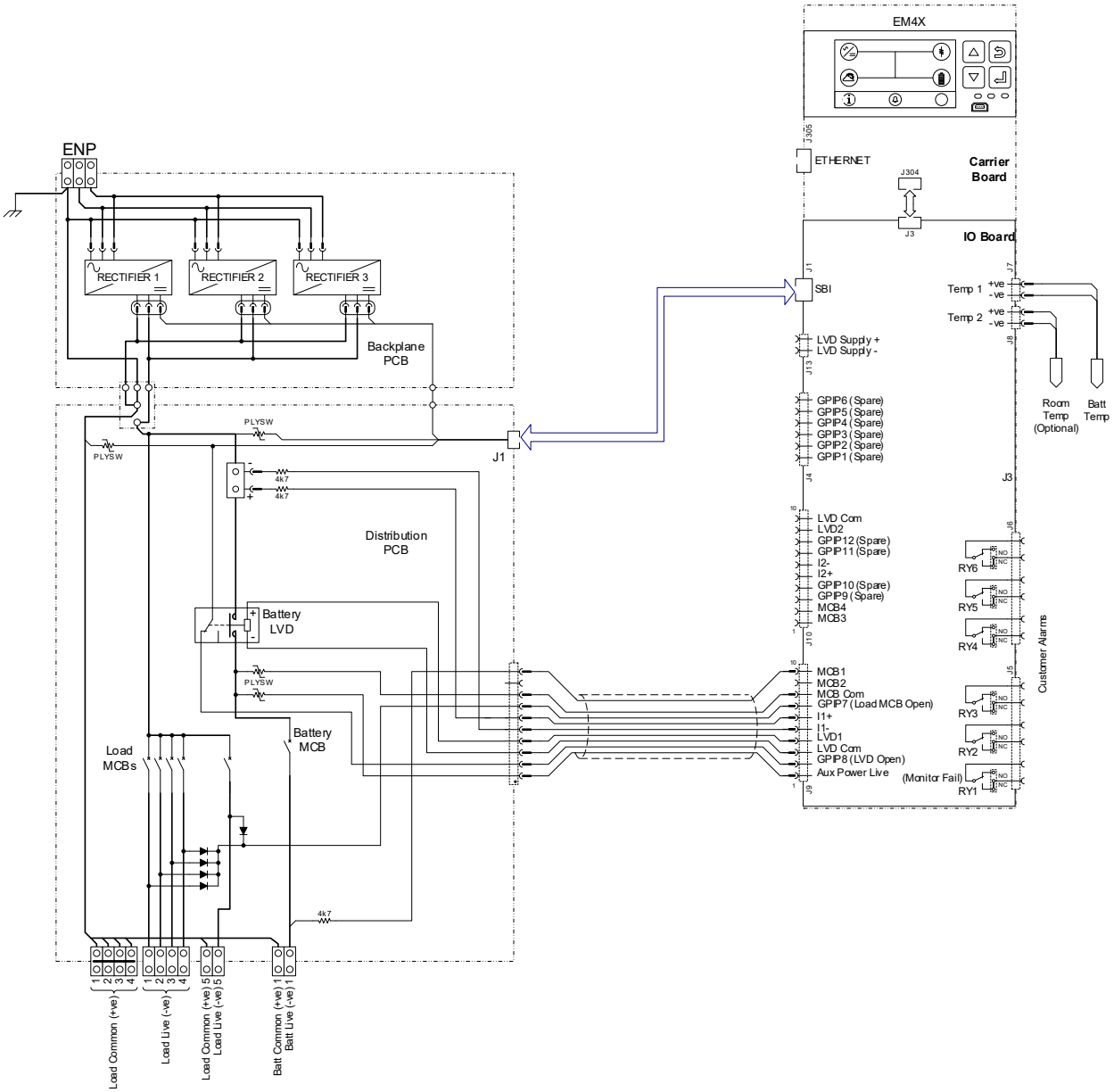
enatel	TITLE: -48V, EM4X 1U Micro Compact (2R/7L/1B)			DRAWN: PML
	DRAWING NUMBER: 190571	SYSTEM NUMBER: PSX12XE2A-XX-XX	DATE: 11 Nov'19	REVISION: 1.1
			SCALE: NTS	SHEET: 1 of 1





enatel	TITLE: -48V 1U Micro Compact (3R/4L/2B) EM4X		DRAWN: PML
	DRAWING NUMBER: 200609	SYSTEM NUMBER: PSX13XE1A-XX-XX	DATE: 21/01/21
			SCALE: NTS
			REVISION: 1.1
			SHEET: 1 of 1





enatel	TITLE: -48V 1U Micro Compact (3R/5L/1B) EM4X			DRAWN: PML
	DRAWING NUMBER: 200609	SYSTEM NUMBER: PSX13XE2A-XX-XX	DATE: 21/01/21	REVISION: 1.1
			SCALE: NTS	SHEET: 1 of 1

Appendix V ENATEL ENERGY STANDARD LIMITED WARRANTY POLICY

Enatel warrants that its products shall be free from defects of material or workmanship under use consistent with correct installation and commission, normal operation, product specifications, Enatel's written instructions, and regional standards compliance, for a period of one (1) year from the start date. The start date shall be defined as (a) the date the product is shipped from Enatel's factory; or (b) in the case of resale by an authorized Enatel reseller, whichever is the lesser of i) the date on the sales invoice or ii) ninety (90) days after original shipment by Enatel factory.

The warranty provides for repairing or replacing, at Enatel's sole discretion, those products deemed defective by Enatel after inspection of its products returned by the customer to the factory or other Enatel authorized location within the warranty period. Replaced product provided by Enatel under the terms of this warranty does not extend the original warranty, replacement product assumes the warranty of the original product. Repaired product or component thereof has a warranty period of ninety (90) days or the remainder of the unexpired term of the original product warranty, whichever is greater.

V.A Warranty Exclusions and Restrictions

Products or parts may be excluded from warranty coverage for reasons including, but not limited to: if the hardware or software has been altered or repaired by an unauthorized party; is defective due to misuse, negligence, accident, mechanical damage, improper installation or maintenance; inappropriate on-site conditions such as high humidity, dust, power surges, out-of-range temperatures, animal or insect damage, water or other liquid damage; where serial numbers or identification marks are removed or defaced in any way; Force Majeure event; has cosmetic shortcomings which do not affect normal operation; inappropriate electrical stress; for suspected fraud or abuse of Enatel's warranty policy; the account has breached or is in dispute of Enatel's commercial terms and conditions.

Note Enatel warranty does not cover data loss, regular back-ups to separate storage is required.

V.B Battery Warranty

Battery warranty is NOT covered under this warranty. Where Enatel supplies batteries a separate warranty statement shall govern the battery warranty, or where an Enatel battery warranty is not provided the authorized battery vendor's warranty shall be assigned to the batteries.

Note that batteries' operational limits are typically more constrained than Enatel manufactured equipment, need specific care during storage and maintenance, and requirements typically vary for each battery type and vendor. Enatel product warranty is voided should improper care of associated batteries be the cause of product defect.

Unless stated otherwise in the terms and conditions of sale warranty for peripherals, attachments or apparatus not manufactured by Enatel shall be excluded from this warranty.

V.C Initiating a Warranty Claim

To make a warranty claim please complete a Request for RMA Number form:

https://www.enatelenergy.com/support/rma/

Issuance of an RMA number means your RMA request has been approved and the product or part warranty claim may now be managed as instructed by Enatel.

Shipping Defective Product to Enatel: All shipments must be shipped prepaid and include proof of the date of your original purchase along with the RMA number of the approved RMA clearly indicated with the shipment – see the Request for RMA Number form for further details.

Note Enatel will pay the cost of shipping replacement or repaired units from warranty claims from Enatel back to the customer, only, unless otherwise approved by Enatel during the RMA Number application process.

V.D Disclaimer

Enatel's warranties and remedies set forth above are exclusive and in lieu of all other warranties, remedies and conditions, whether oral or written, express or implied. Enatel specifically disclaims any and all implied warranties, including but not limited to warranties of merchantability and fitness for a particular purpose. In no event shall

Enatel be responsible for indirect or consequential damages or lost profits even in the case of negligence and if Enatel has been advised of the possibility of such damages. Enatel's sole obligation shall be the repair or replacement of a non-conforming product. In no case shall Enatel's liability under this warranty exceed the value of the unit provided. If the law prohibits Enatel from disclaiming implied warranties or warranties of merchantability, all such warranties are limited to the greatest extent permitted by law. Enatel reserves the right to change the information detailed within this statement without notice.

The benefits conferred by these warranties are in addition to other rights you may have depending on your country, state or province of residence. Furthermore, some countries, states and provinces do not allow the exclusion or limitation of incidental or consequential damages or exclusions or limitations on the duration of implied warranties, so the above limitations or exclusions may not apply to you. If any provision of these warranties is unlawful, void or unenforceable, that provision shall be deemed severable and shall not affect any remaining provisions. This warranty shall be governed by and interpreted in accordance with the laws of New Zealand.

V.E Remark

Enatel is a registered company name. New Zealand Company Number: 1202388

Enatel Energy® is a registered trademark of Enatel.