



# *SUNSYS PCS<sup>2</sup> IM UL*

Power Conversion System and Storage  
with Islanding Mode  
from 33 to 200 kVA

EN



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# 1. SAFETY STANDARDS

















This user manual specifies installation and maintenance procedures, technical data and safety instructions for SOCOMEC products. For further information visit the Socomec website: [www.socomec.com](http://www.socomec.com).

|   |   |
|---|---|
|    | The input and output circuits are isolated from the enclosure; the system grounding, when required by Sections 690.41, 690.42, and 690.43 of the National Electric Code, ANSI/NFPA 70, is the responsibility of the installer.                                  |
|    | The wiring methods in accordance with the National Electrical Code, ANSI/NFPA 70 and Canadian Electric Code (CEC) are to be used.<br>All national standards applicable to batteries must be observed.   |
|    | <b>CAUTION!</b><br>To reduce the risk of fire, connect only to a circuit provided with 170 amperes maximum branch-circuit overcurrent protection in accordance with the National Electrical Code, ANSI/NFPA 70.   |
|    | This inverter complies with Part 15 of the FCC Rules Operation so it must be able to handle any interference and it must accept any interference received, including interference that may cause undesired operation.   |
|    | Overcurrent protection for the AC circuit is to be provided by others.  |
|    | Before carrying out any operations read the interconnection manual and Battery Energy System (BES) safety instructions carefully, in order to work under safe conditions.   |
|   | If the Battery Energy System (BES) is not supplied by SOCOMEC, overcurrent protection for the BES is to be provided by others.  |
|  | <b>NOTE!</b><br>Any work carried out on the equipment must be performed by skilled, qualified technicians.  |
|  | <b>NOTE!</b><br>Before carrying out any operations on the unit read the installation and operating manual carefully.<br>Keep this manual safe for future reference.   |
|  | <b>DANGER!</b><br>Failure to observe safety standards could result in fatal accidents or serious injury, and damage equipment or the environment.   |
|  | <b>CAUTION!</b><br>If the unit is found to be damaged externally or internally, or any of the accessories are damaged or missing, contact SOCOMEC.<br>Do not operate the unit if it has suffered a violent mechanical shock of any kind.                        |
|  | <b>NOTE!</b><br>Install the unit in accordance with clearances in order to prevent access to handling devices and guarantee sufficient ventilation (see Environmental requirements chapter).  |
|  | <b>NOTE!</b><br>Only use accessories recommended or sold by the manufacturer.   |
|  | <b>NOTE!</b><br>When the equipment is transferred from a cold to a warm place wait approx. two hours before operating the unit.   |
|  | <b>DANGER! Live device! RISK OF ELECTRIC SHOCK!</b><br>SUNSYS PCS <sup>2</sup> IM is connected to two separately protected power supplies:<br>1) DC cable - BES power supply<br>2) AC cable - Power from the mains network, supplied by the electricity company |
|  | <b>NOTE!</b><br>Before cleaning, performing maintenance work or connecting appliances to the unit, switch the unit off and disconnect all power sources.  |

|   |  |
|---|--|
|  | <p><b>DANGER! Live device! RISK OF ELECTRIC SHOCK!</b><br/> <b>Carry out the following steps before SUNSYS PCS<sup>2</sup> IM maintenance:</b></p> <ul style="list-style-type: none"> <li>- Disconnect the battery system's main DC switch.</li> <li>- Disconnect the AC power supplies.</li> <li>- Disconnect the DC disconnection switches.</li> <li>- Make sure the cable is fixed in position securely.</li> <li>- Make sure the system cannot be restarted.</li> <li>- Make sure the electricity supply (AC and DC voltages) has been disconnected.</li> <li>- Cover or separate nearby live device units.</li> </ul> |
|  | <p><b>DANGER! RISK OF ELECTRIC SHOCK!</b><br/> <b>After disconnecting all power sources wait approx. 5 minutes for the complete discharge of the unit.</b></p>   |
|  | <p><b>CAUTION! RISK OF BURNS!</b><br/> <b>During operation the casing can reach high temperatures. Do not touch the surfaces!</b></p>  |
|  | <p><b>NOTE!</b><br/> <b>Use AWG, 90 °C copper wire.</b></p>  |
|  | <p><b>NOTE!</b><br/> <b>The tightening torque for DC and AC terminals must be 180 lb-in (20.3 Nm).</b></p>   |
|  | <p><b>NOTE!</b><br/> <b>Any use other than the specified purpose will be considered improper. The manufacturer/supplier shall not be held responsible for damage resulting from this. Risk and responsibility lies with the system manager.</b></p>  |

## 1.1 DESCRIPTION OF SYMBOLS

Comply with all internal and external precautions and warnings on labels and plates on the equipment.

| Symbols   | Description  |
|---|--|
|    | UL 1741; CSA-C22.2 NO.107.1-01; MET file E113907   |
|    | General warning – Important safety information   |
|    | The circuit-breaker is ON  |
|    | The circuit-breaker is OFF   |
|    | Waiting time before operating<br>5 min   |
|    | Protective earth terminal (PE).  |
|    | Authorized personnel only.   |
|   | No smoking.  |
|  | Risk of electric shock!  |
|  | Risk of explosion! Avoid short circuits!   |
|  | Read the user instructions carefully.<br>Read the user manual before performing any operations.  |
|  | Wear protective gloves   |
|  | Wear safety shoes.   |
|  | Wear protective goggles.   |
|  | In the event of contact with the eyes, wash immediately with plenty of water and call a doctor.<br>Call a doctor immediately in the event of accidents or illness. |
|  | Do not dispose of in normal waste stream (symbol waste electrical and electronic equipment).   |



## 1.2 ABBREVIATIONS

For the purpose of this document, the following abbreviations are used:

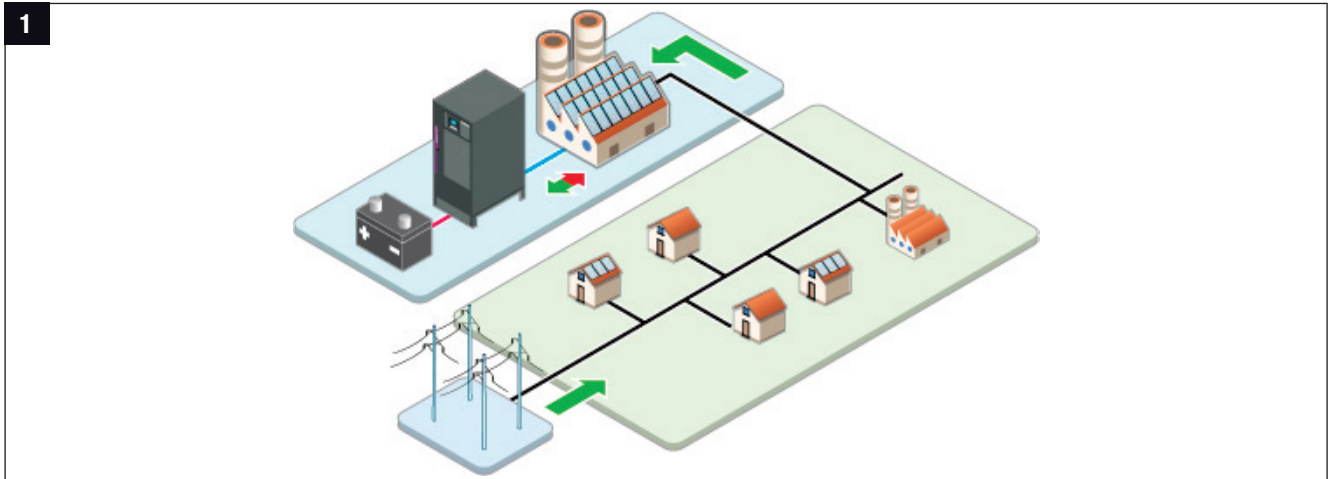
|      |   |
|------|---|
| BES  | Battery Energy Storage                    |
| BMS  | Battery Management System                 |
| EMC  | Electro Magnetic Compatibility            |
| EMS  | Energy Management System                  |
| ESS  | Energy Storage System                     |
| HMI  | Human Machine Interface                   |
| IEC  | International Electrotechnical Commission |
| IM   | Islanding Mode                            |
| IMD  | Insulation Monitoring Device              |
| PCS  | Power Conversion System                   |
| PE   | Protective Earth                          |
| PMS  | Power Management System                   |
| PV   | Photovoltaic                              |
| SBMS | System BMS                                |
| SOC  | State of Charge                           |
| SOH  | State of Health                           |
| SPD  | Surge Protection Device                   |
| THDI | Total Harmonic Distortion in Current      |
| THDV | Total Harmonic Distortion in Voltage      |
| TL   | Transformer-less                          |
| TR   | Transformer based                         |

## 2. FOREWORD

Energy storage is the key solution to meeting the challenges of energy transition, using renewable energy and providing energy cost reductions for the following 4 main applications.

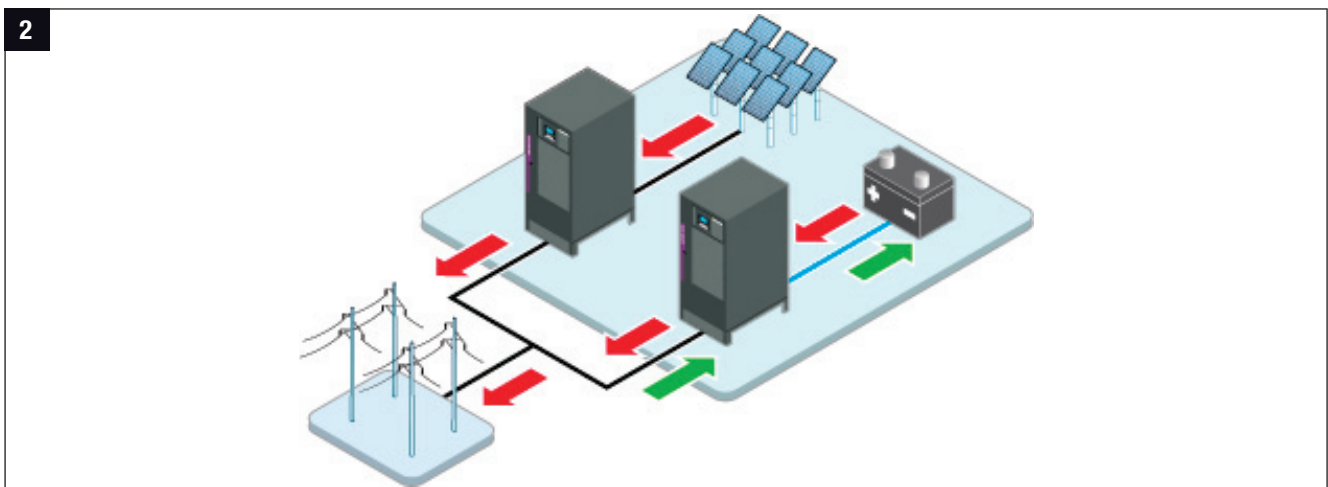
- **Behind-the-Meter Energy Storage:**

Reduce peak consumption and maximise PV energy self-consumption. SUNSYS PCS<sup>2</sup> (IM) can limit the impact of increases in the electricity retail price by supplying the load to cut peak demand (peak shaving), maximising PV energy self-consumption at building or community level. Any PV energy surplus is stored in the SUNSYS PCS<sup>2</sup> (IM) battery system. This stored energy is used later to supply the load.



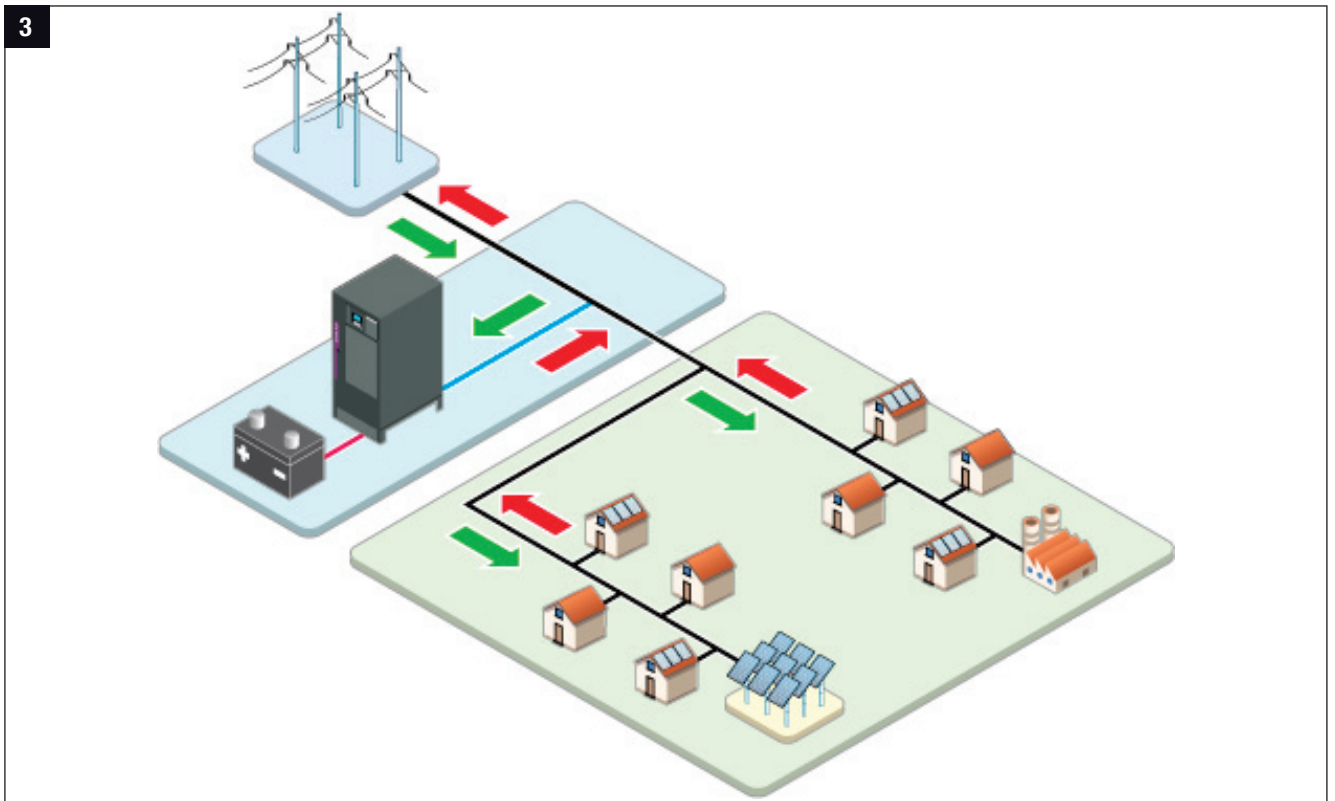
- **PV plants:**

Manage the intermittence of renewable energy production. SUNSYS PCS<sup>2</sup> (IM) ensures the production profile of an intermittent renewable energy plant by limiting production to a predefined value, injecting energy to compensate for solar variations, setting constant ramp-up or ramp-down.



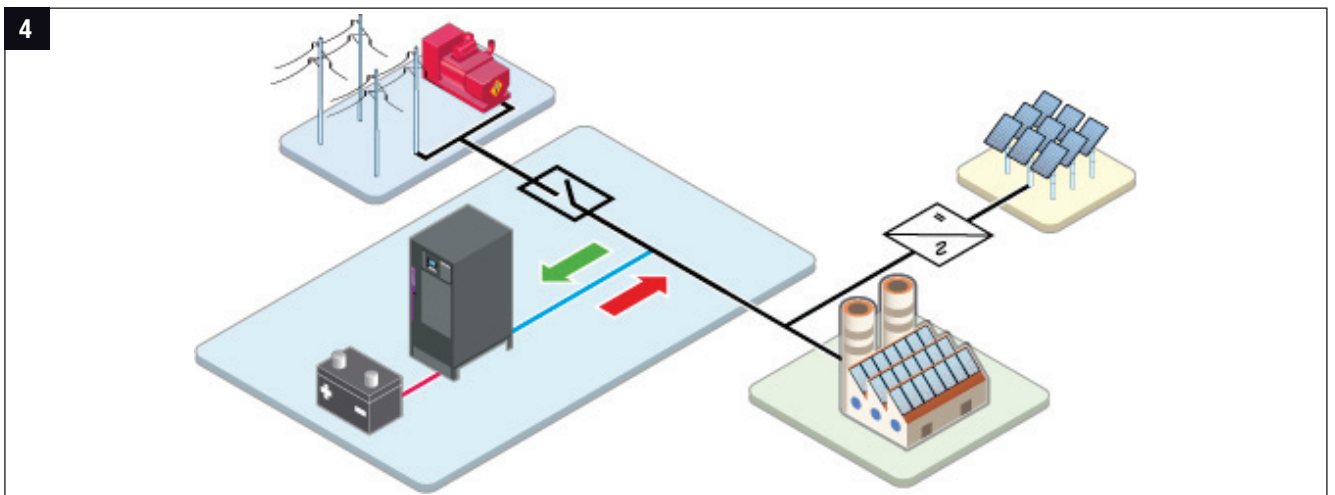
• **Grid support:**

Meet the challenge of demand-response energy balance. When directly connected to the grid, SUNSYS PCS<sup>2</sup> (IM) improves stability and management of grid operators thanks to voltage and frequency regulation, load shifting, peak shaving and ancillary services for grid support.



• **Microgrids:**

Ensure energy availability and quality. The SUNSYS PCS<sup>2</sup> IM enables the microgrid to disconnect from the main grid and be electrically autonomous thanks to local generation (PV, Wind, Diesel generators, etc.).



| To sum up:                 |         |                    |               |
|----------------------------|---------|--------------------|---------------|
| Products / Applications    | On-Grid | On-Grid + Off-Grid | Pure Off-Grid |
| SUNSYS PCS <sup>2</sup>    | •       |                    |               |
| SUNSYS PCS <sup>2</sup> IM |         | •                  | •             |

# 3. SUNSYS PCS<sup>2</sup> RANGES

## 3.1 IEC VERSIONS

|                                   | SUNSYS PCS <sup>2</sup> |        |         |         |         | SUNSYS PCS <sup>2</sup> IM |        |         |         |         |
|-----------------------------------|-------------------------|--------|---------|---------|---------|----------------------------|--------|---------|---------|---------|
|                                   | 33 kVA                  | 66 kVA | 100 kVA | 132 kVA | 200 kVA | 33 kVA                     | 66 kVA | 100 kVA | 132 kVA | 200 kVA |
| Internal transformer (TR version) |                         |        |         |         |         |                            |        |         |         |         |
| External transformer (TL version) |                         |        |         |         |         |                            |        |         |         |         |

## 3.2 UL VERSIONS

|                                   | SUNSYS PCS <sup>2</sup> |        |         |         |         | SUNSYS PCS <sup>2</sup> IM |        |         |         |         |
|-----------------------------------|-------------------------|--------|---------|---------|---------|----------------------------|--------|---------|---------|---------|
|                                   | 33 kVA                  | 66 kVA | 100 kVA | 132 kVA | 200 kVA | 33 kVA                     | 66 kVA | 100 kVA | 132 kVA | 200 kVA |
| Internal transformer (TR version) |                         |        |         |         |         |                            |        |         |         |         |
| External transformer (TL version) |                         |        |         |         |         |                            |        |         |         |         |

# 4. ENVIRONMENTAL REQUIREMENTS AND HANDLING

## 4.1 ENVIRONMENTAL REQUIREMENTS

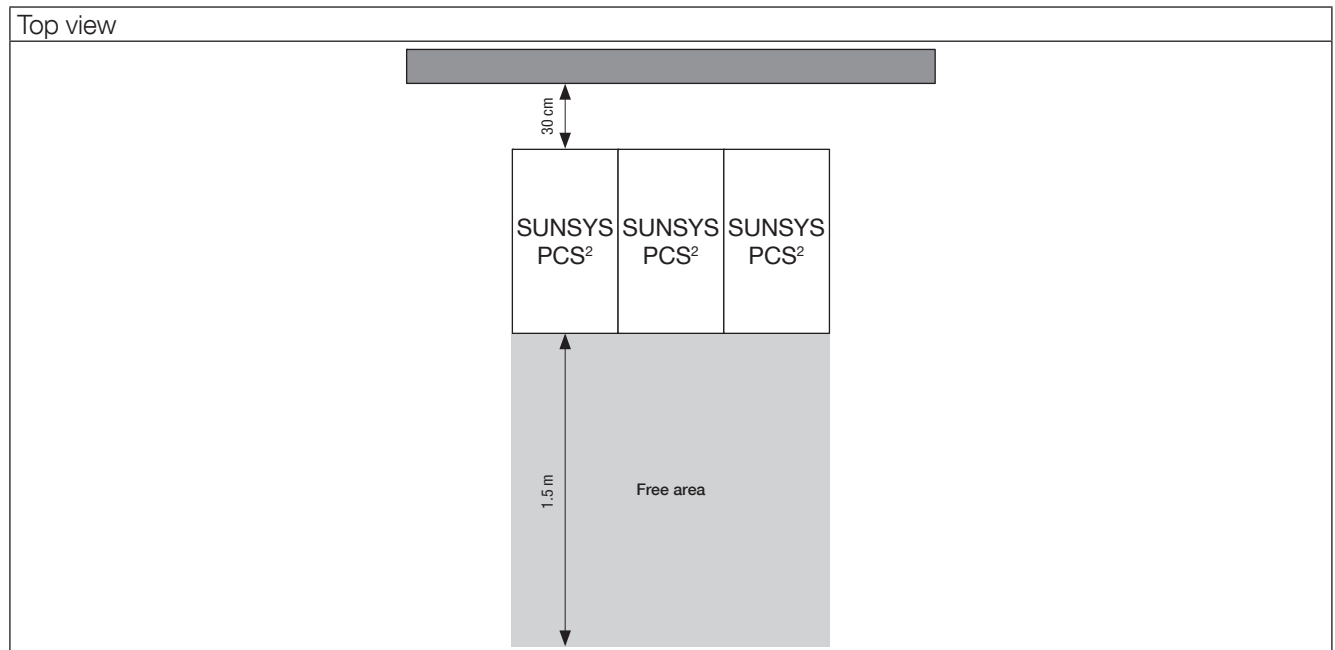
Install the unit in an equipment room.

The room must be:

- of a suitable size;
- free from conductive, inflammable and corrosive items;
- not exposed directly to sunlight.

The floor must support the weight of the unit and guarantee its stability. The unit is designed for indoor rooms only. For information regarding ambient temperature, dimensions and weights refer to 'Technical specifications' chapter. To position the unit correctly see the diagrams below.

### ROOM POSITIONING



### SPACING-AIR FREE

To ensure the full unit power up to 40°C ambient temperature, observe the following minimum distances:

- rear space: 30 cm.
- above space: 45 cm.

This distance can be reduced depending on:

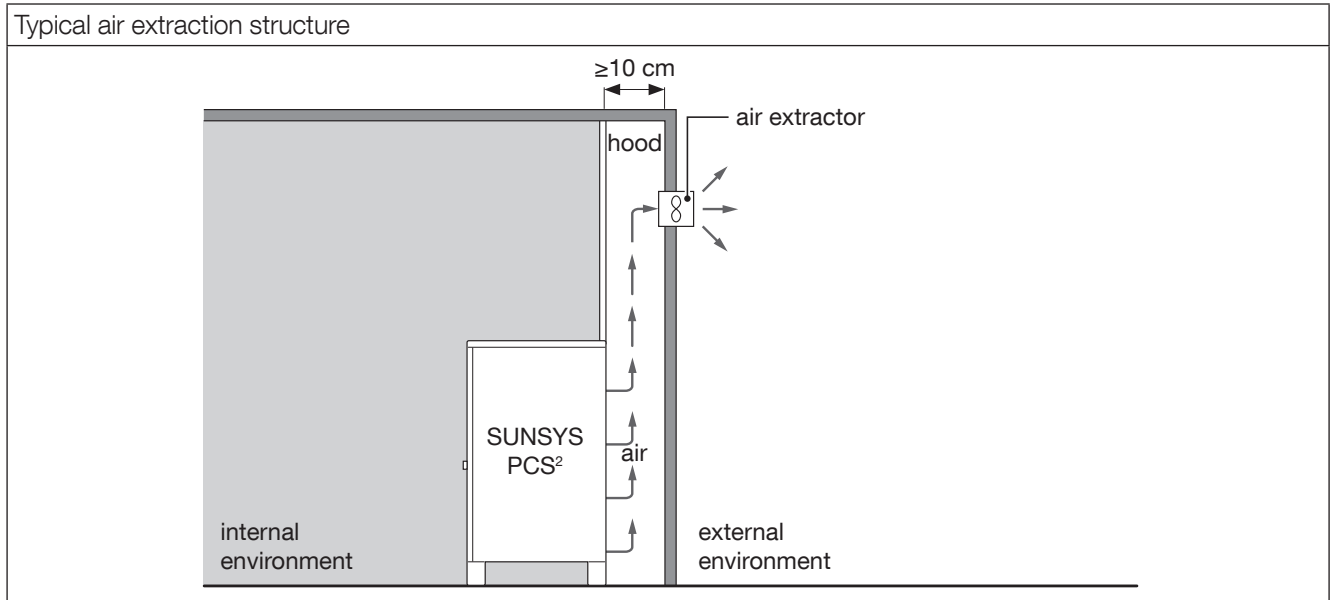
- the maximum ambient temperature accepted (Full load conditions).

| Distance from the rear wall | Space above the top panel | Ambient temperature |
|-----------------------------|---------------------------|---------------------|
| 30 cm                       | 45 cm                     | 40 °C               |
|                             | 25 cm                     | 35 °C               |
| 20 cm                       | 45 cm                     | 35 °C               |
|                             | 25 cm                     | 30 °C               |
| 10 cm                       | 45 cm                     | 25 °C               |
|                             | 25 cm                     |                     |

- the maximum power required from the load (at 40 °C ambient temperature).

| Distance from the rear wall | Space above the top panel | Power |
|-----------------------------|---------------------------|-------|
| 30 cm                       | 45 cm                     | 100%  |
|                             | 25 cm                     | 90%   |
| 20 cm                       | 45 cm                     | 90%   |
|                             | 25 cm                     | 80%   |
| 10 cm                       | 45 cm                     | 75%   |
|                             | 25 cm                     | 75%   |

### SPACING-AIR FLOW



| Minimum air extractor flow <sup>(1)</sup> |                         |
|---|-------------------------|
| Models                                    | Minimum extraction flow |
| 33 TR                                     | 600 m³/h                |
| 66 TR                                     | 1200 m³/h               |
| 100 TR                                    | 1800 m³/h               |
| 132 TL                                    | 1780 m³/h               |
| 200 TL                                    | 2700 m³/h               |

1. SUNSYS PCS² at a distance of 10 cm from the rear wall (40 °C ambient temperature and full load).






|  |   |
|--|---|
|  | <p><b>NOTE:</b> the hood must prevent air losses and enable the removal of the SUNSYS PCS²'s top panel for maintenance.</p> |
|--|---|

## CABINET LAYOUT



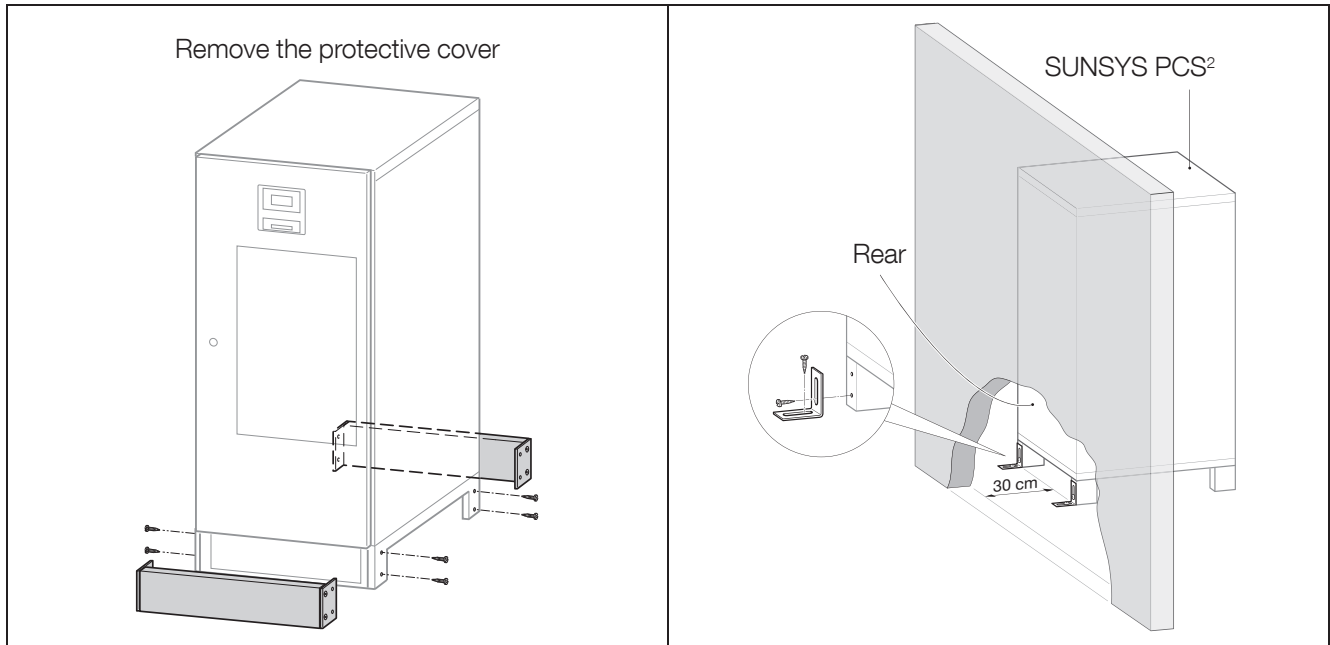
## 4.2 HANDLING

- The packaging guarantees the stability of the unit during shipping and physical transfer.
- The unit must remain in a vertical position during all shipping and handling operations.
- Ensure that the floor is strong enough to support the weight of the unit.
- Carry the packaged unit as close as possible to the installation site.

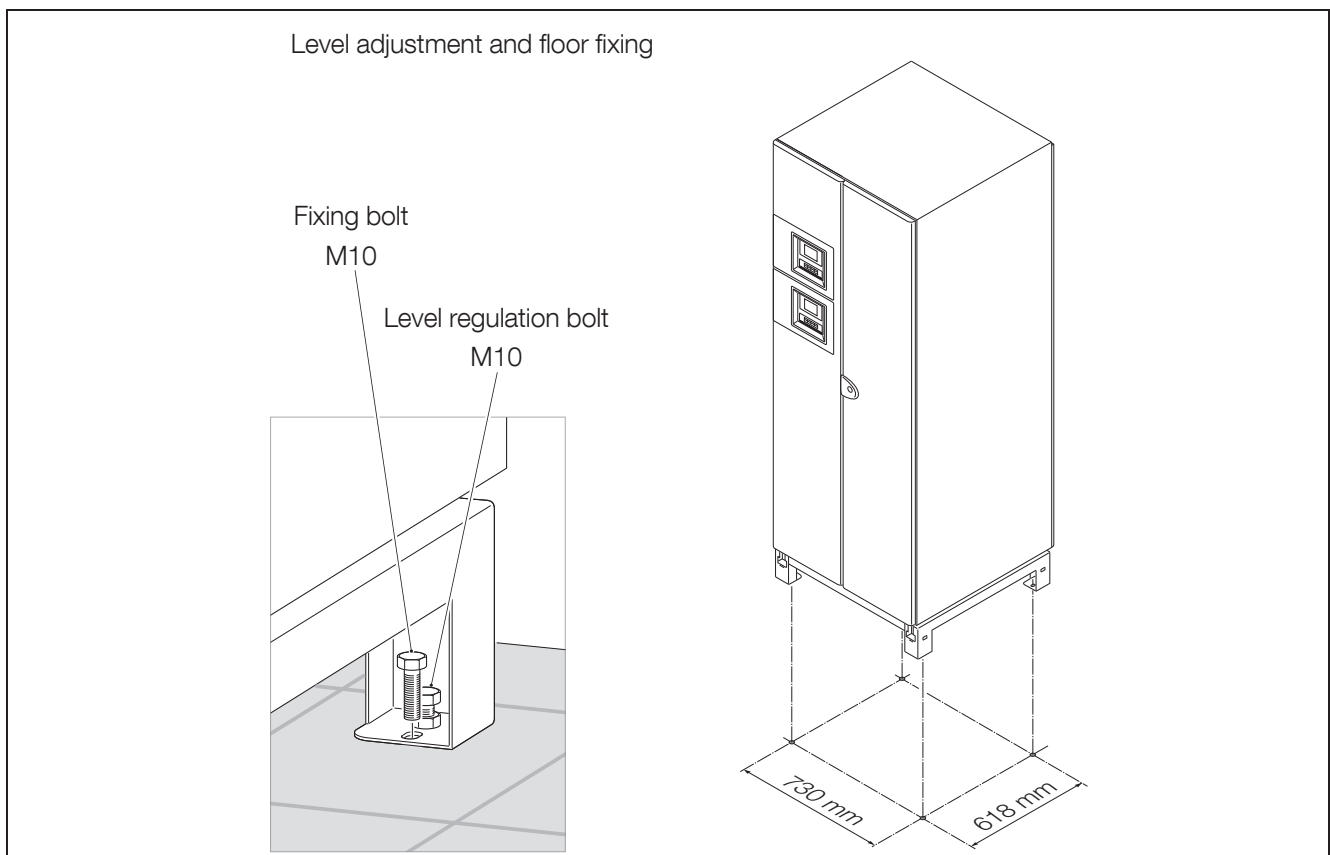
|   |  |
|---|--|
|  | <p><b>WARNING! HEAVY WEIGHT!</b><br/>Move the unit using a fork lift truck taking the utmost caution at all times.</p>   |
|  | <p>The unit <b>MUST</b> be handled by at least two people. The people <b>MUST</b> take position at the sides of the PCS with respect to the direction of movement.</p>   |
|  | <p>Do not move the unit by putting pressure on the front door.</p>   |
|  | <p>When moving the unit on even slightly sloping surfaces, use the locking equipment and braking devices to ensure that the unit does not fall over.</p>   |
|  | <p><b>WARNING!</b><br/>The following instructions must be carried out prior to moving the unit (after initial positioning). Failure to heed this warning could result in the unit falling over, equipment damage, injury and even death.</p> |

## 4.3 FLOOR ASSEMBLY

- PCS<sup>2</sup> IM range 33 - 66 - 100 TR:








- PCS<sup>2</sup> IM 132 - 200 TL:





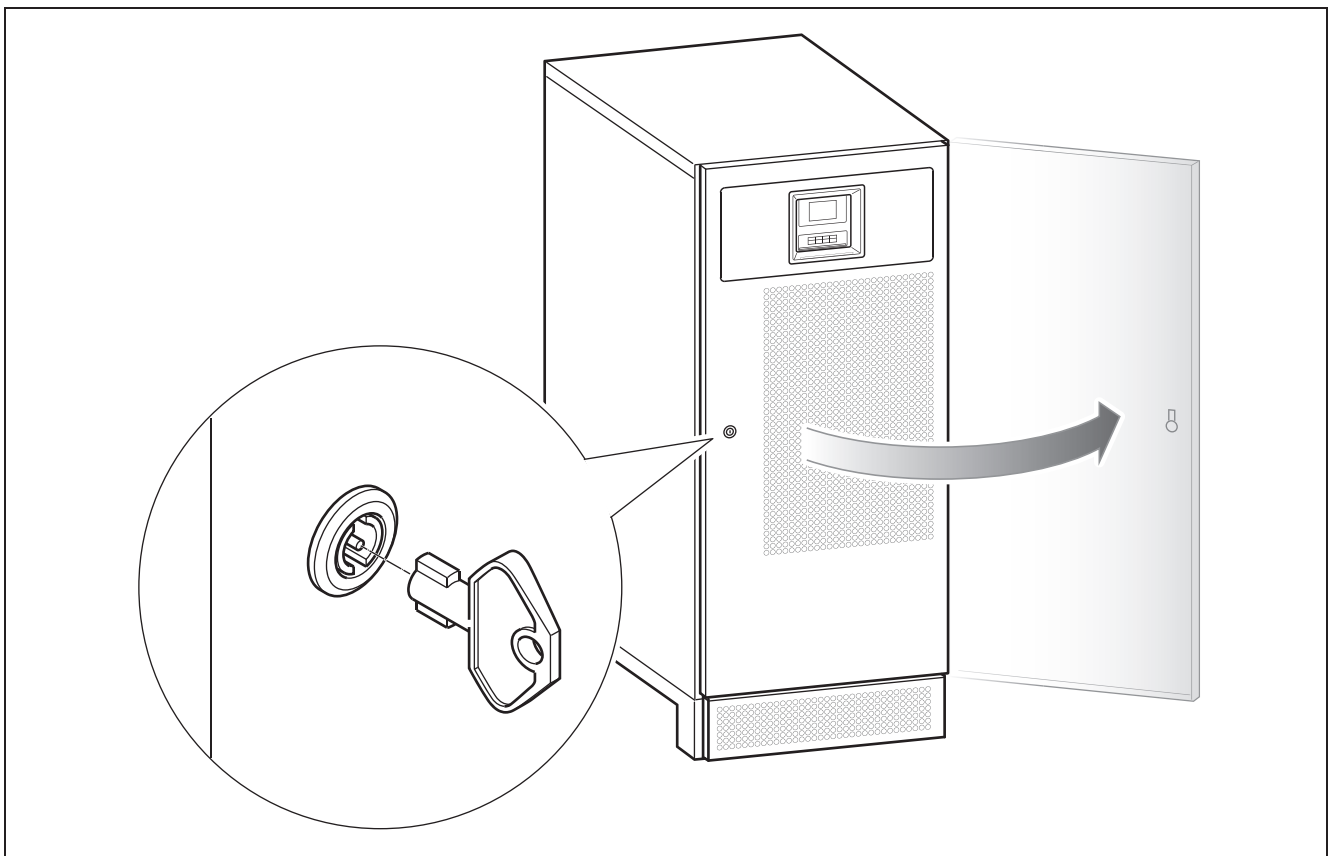
## 4.4 INSTALLATION

### POWER MODULE INSERTION

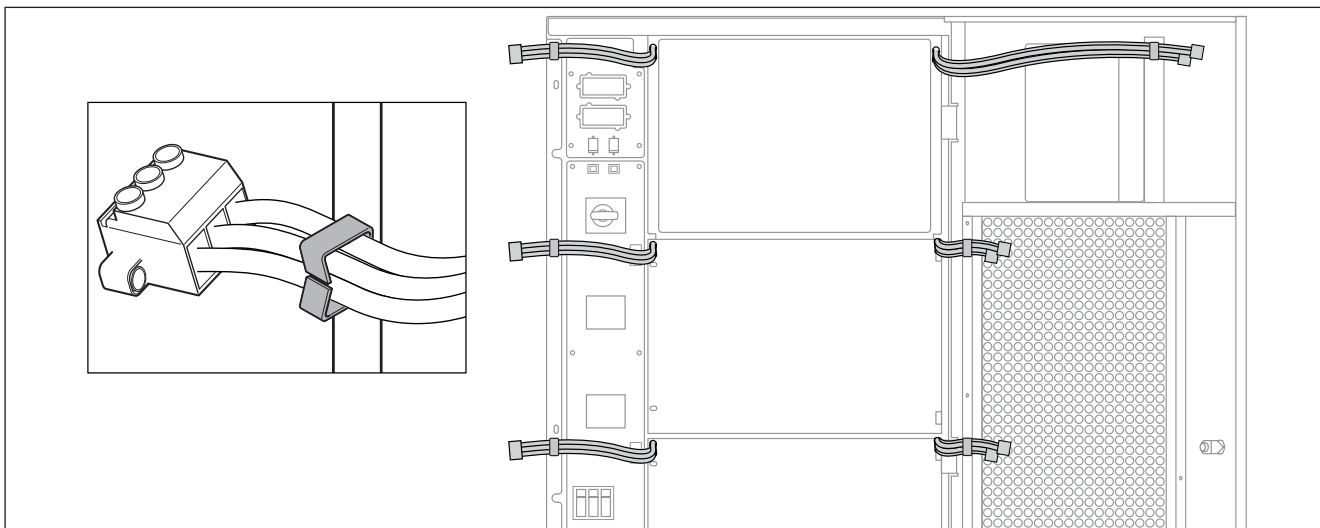
|   |  |
|---|--|
|  | <b>WARNING:</b> before installing the module ensure that there is no voltage.  |
|  | <b>NOTE:</b> the module must be handled by at least two people (34.5 kg / 76 lb).  |
|  | <b>WARNING! RISK OF TIPPING OVER:</b> before carrying out any operations, ensure the SUNSYS PCS <sup>2</sup> IM is secured at the feet.                          |
|  | <b>WARNING! RISK OF TIPPING OVER:</b> the modules must be inserted from the bottom upwards and removed from the top downwards to ensure the unit remains stable. |
|  | <b>WARNING:</b> the modules have to be moved individually. Never handle more than one module.  |

#### 4.4.1 PROCEDURE FOR PCS<sup>2</sup> IM 33 - 66 - 100 TR

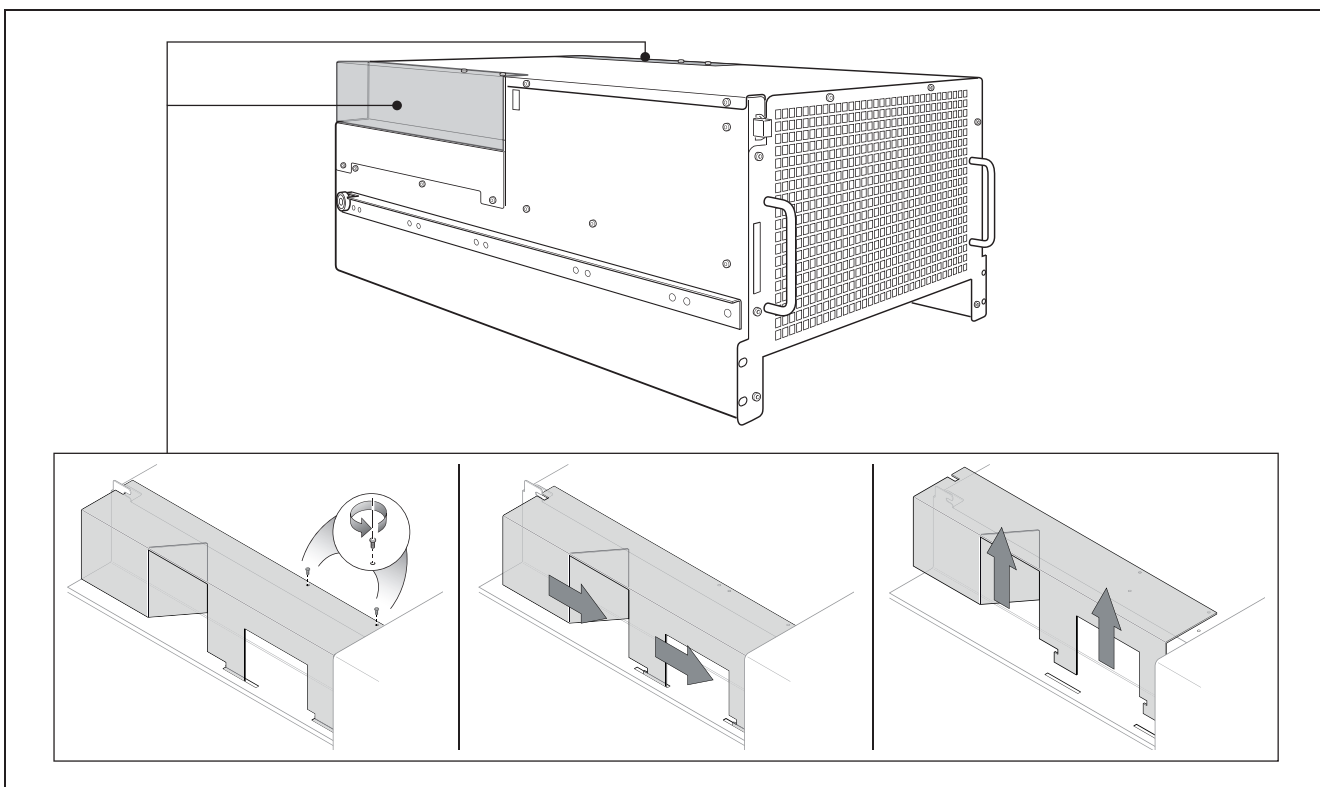
- Open the door with the appropriate key.




- Position the cables in the hose clamp to enable correct module insertion.

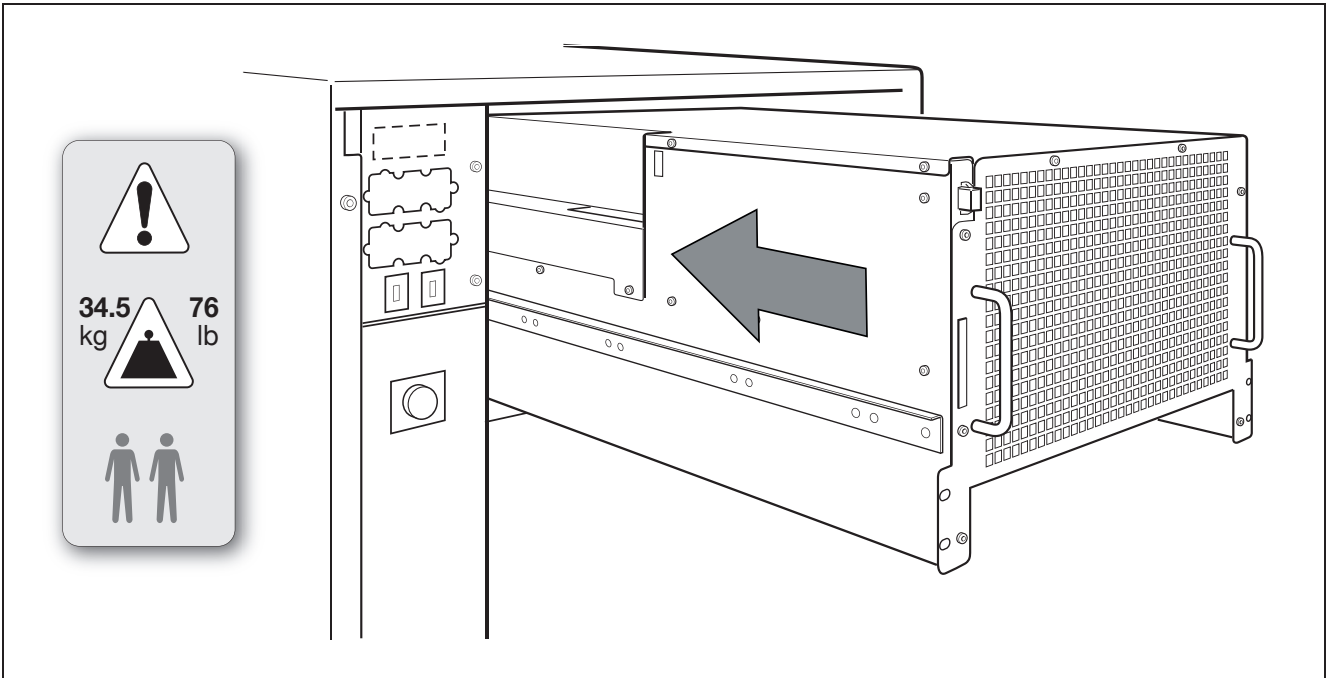


- Remove the Lexan protection on the connectors.

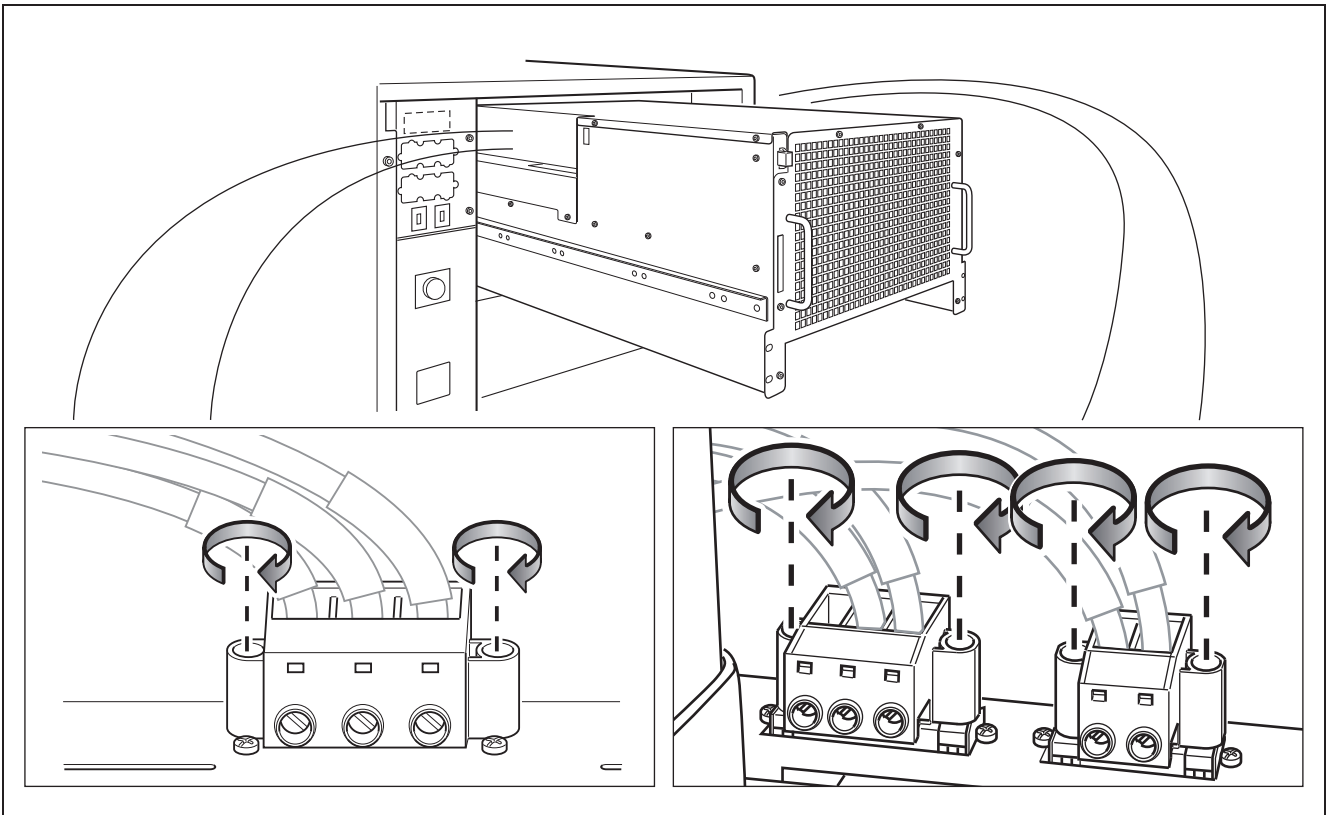


- Place the module on the guides and insert it up to the limit starting by the lower one.

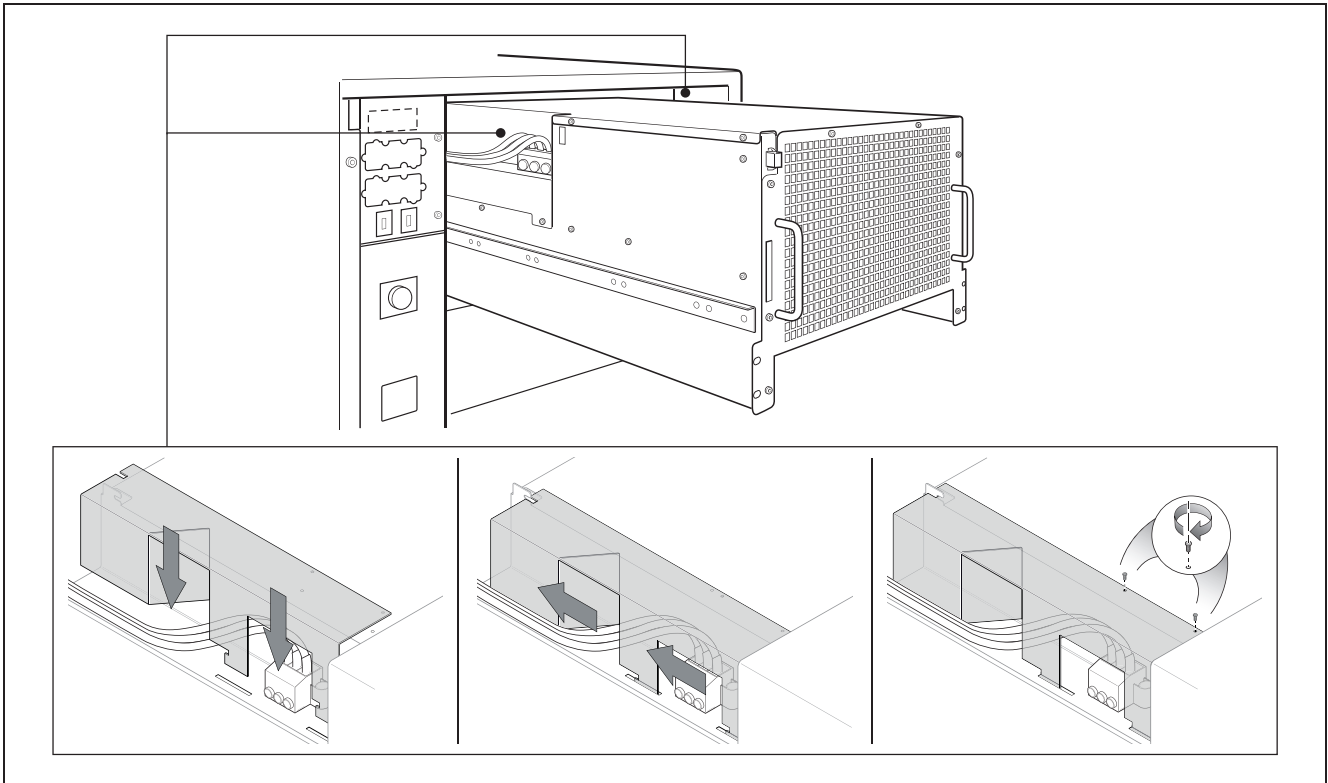
|   |   |
|---|---|
|  | In order to ensure the safety of installers, installers shall be at least two people to process the installation (34.5 kg / 76 lb). |
|---|---|



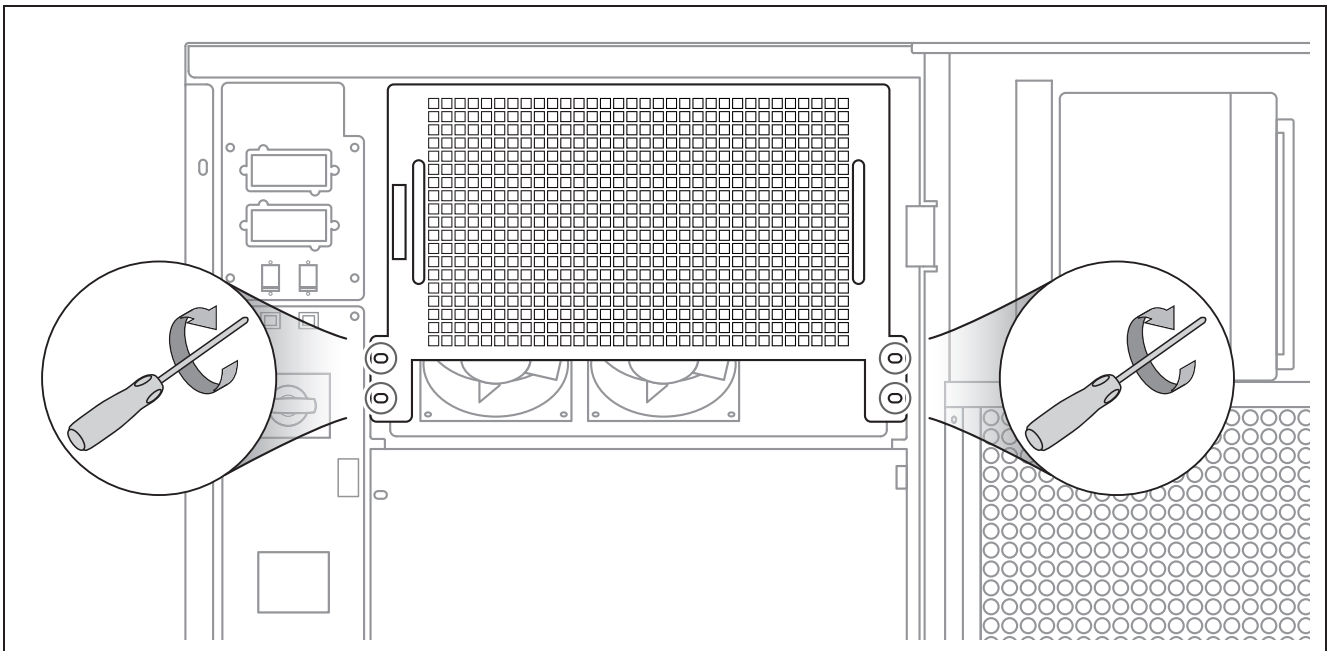
- Insert the connectors and secure them.



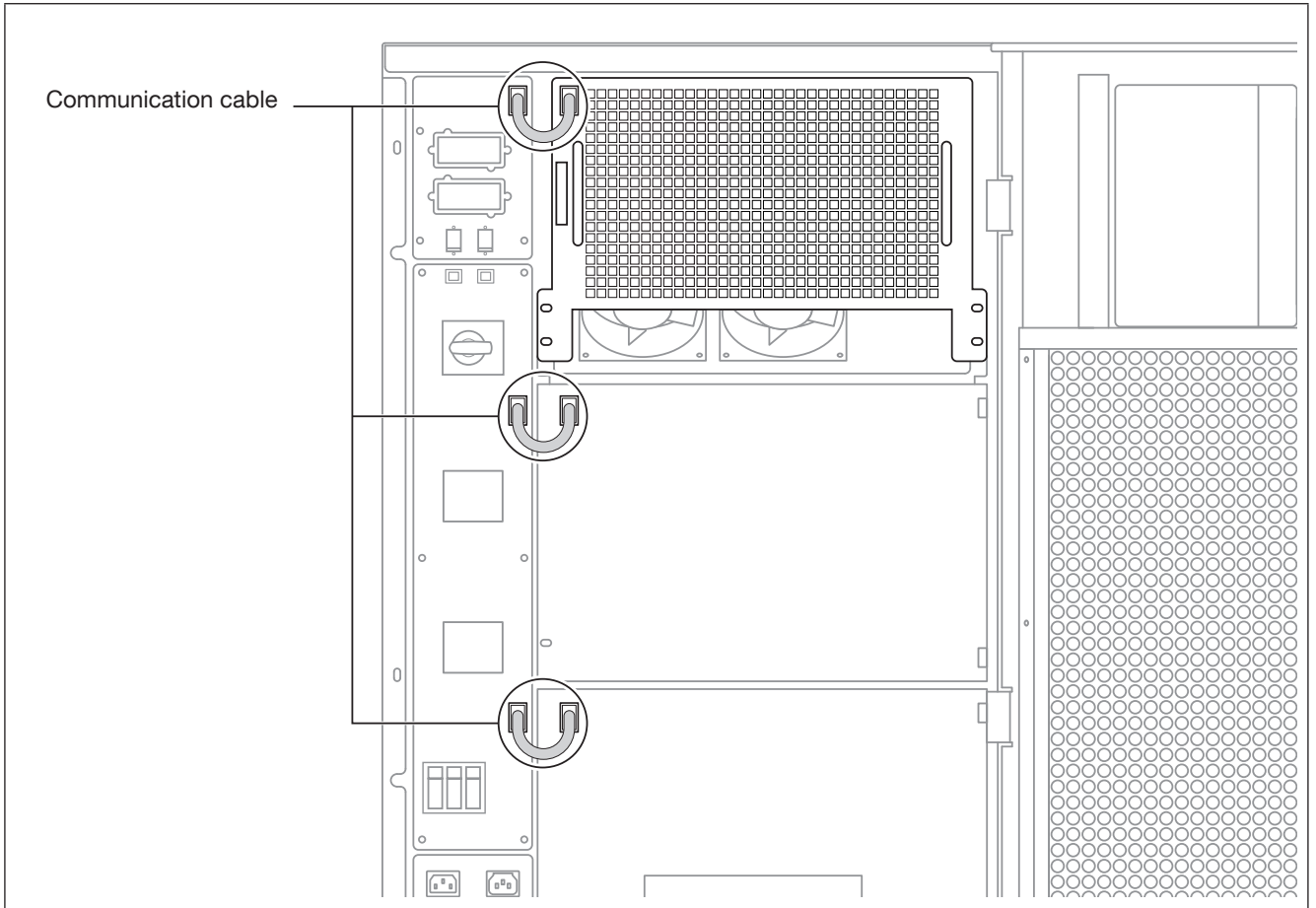
- Position the Lexan protection and secure it.



- Insert the module completely.
- Tighten the screws to secure the module to the SUNSYS PCS² IM.

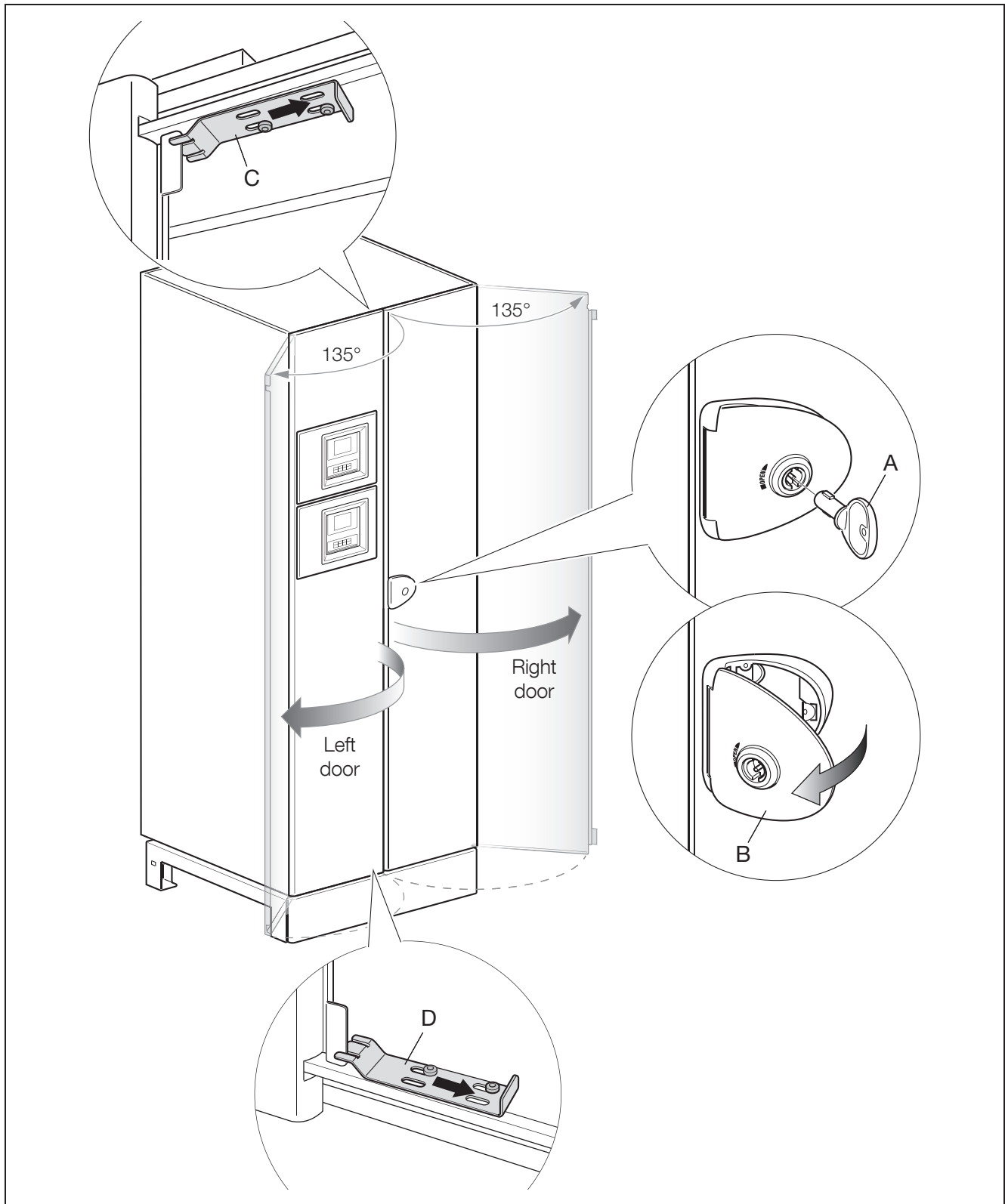


- Connect the communication cable.



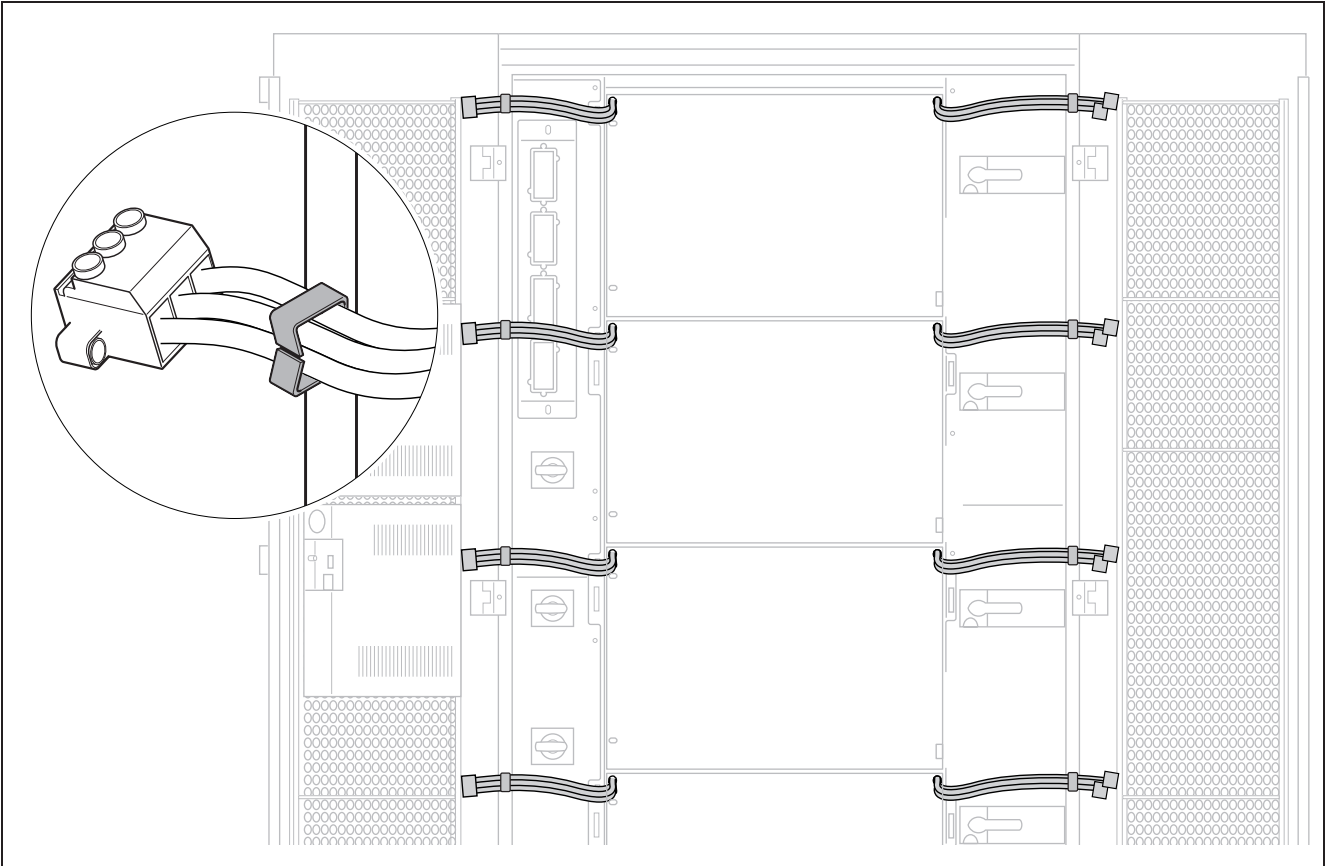
#### 4.4.2 PROCEDURE FOR PCS<sup>2</sup> IM 132 - 200 TL

- Open the doors:
  - With the appropriate key A open the lock, then pull the hook B and open the right door.
  - Unhook the upper latch C and lower latch D and open the left door.

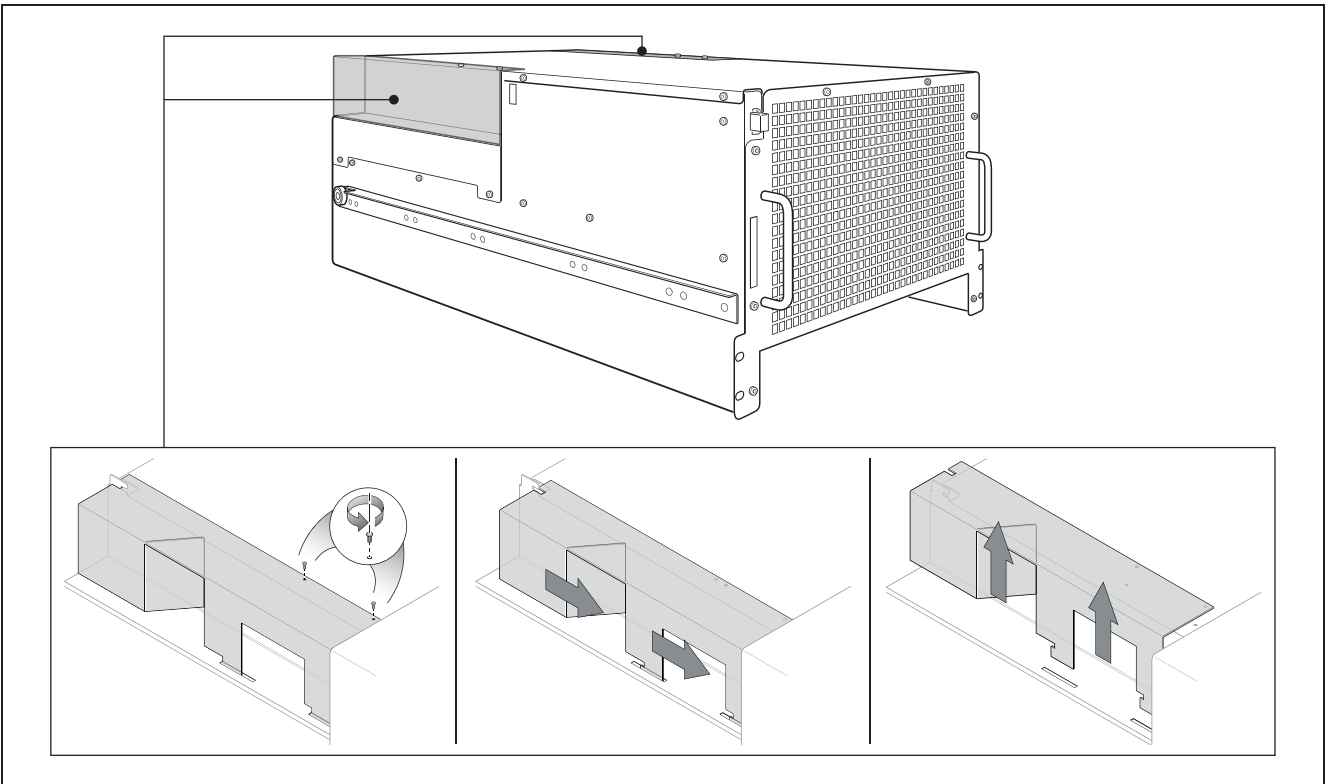


NOTE: in PCS2 132 TL, module A and D are not present.

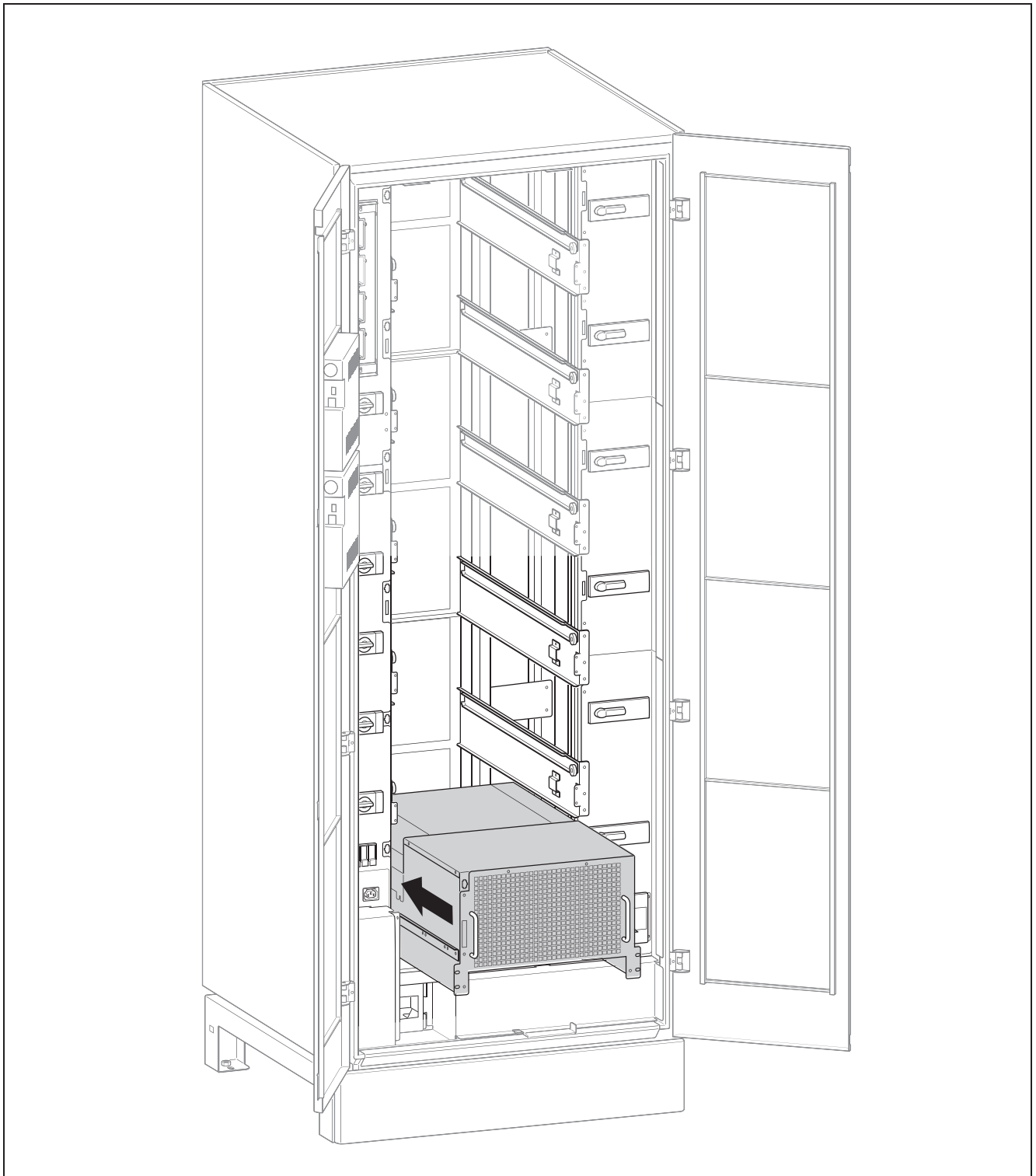
- Position the cables in the hose clamp to enable correct module insertion.



- Remove the Lexan protection on the connectors.

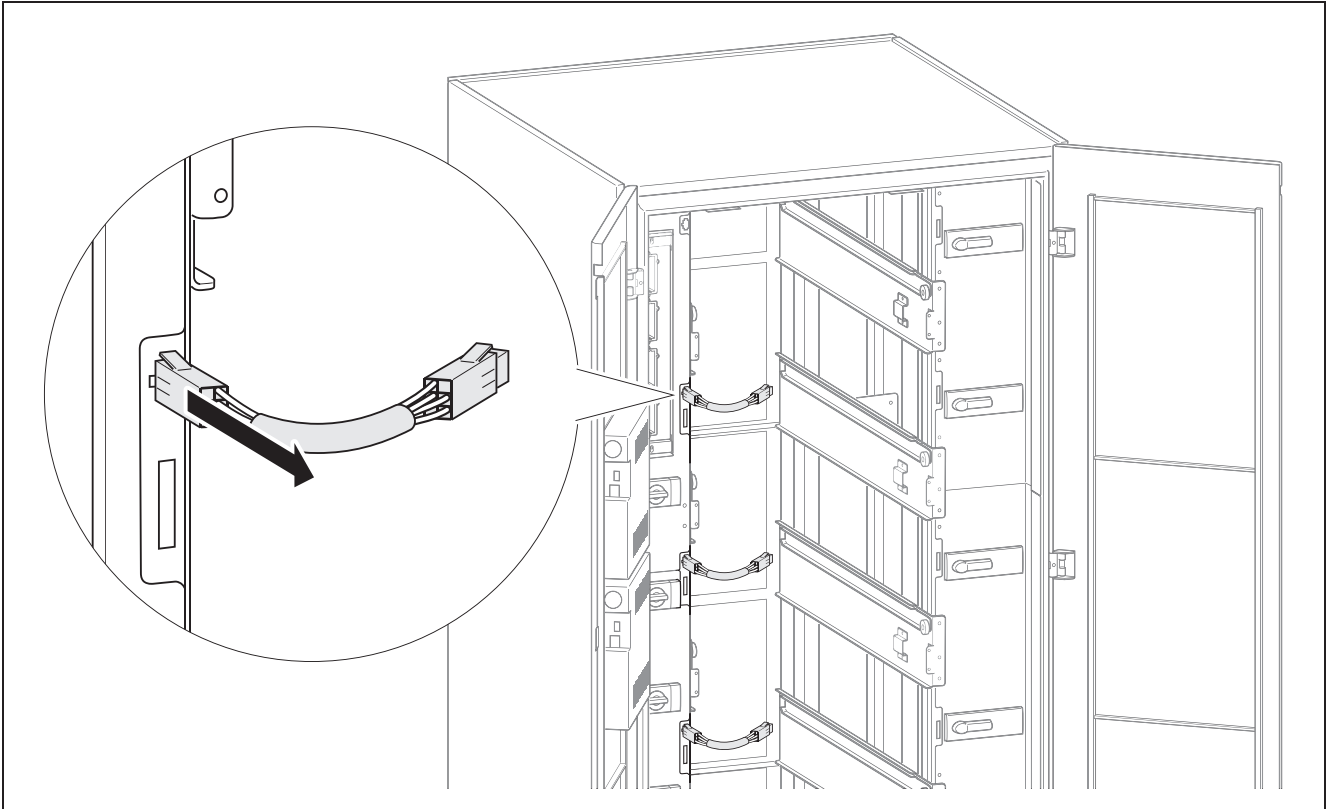


- Insertion of the lower three modules. Place the module on the guides and insert it up to the limit starting by the lower one.

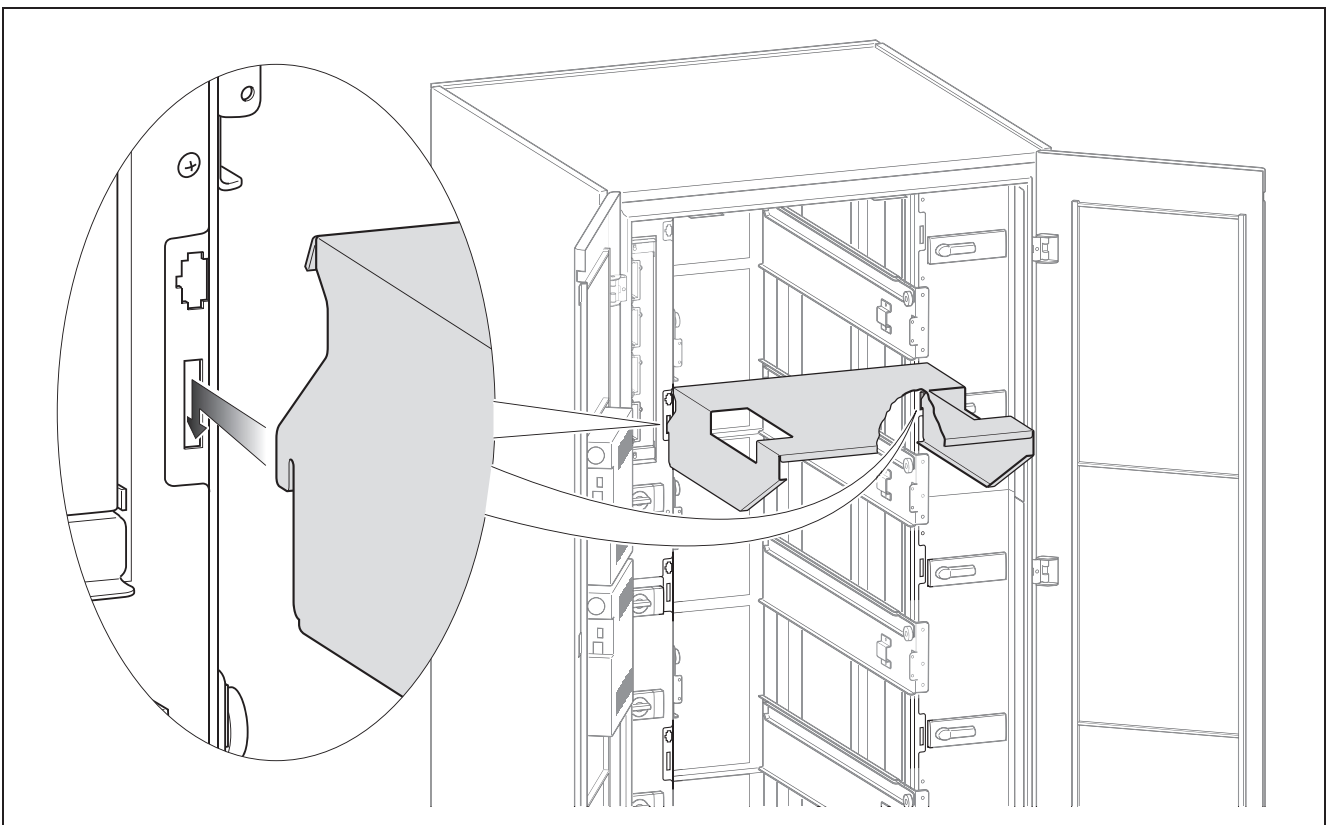




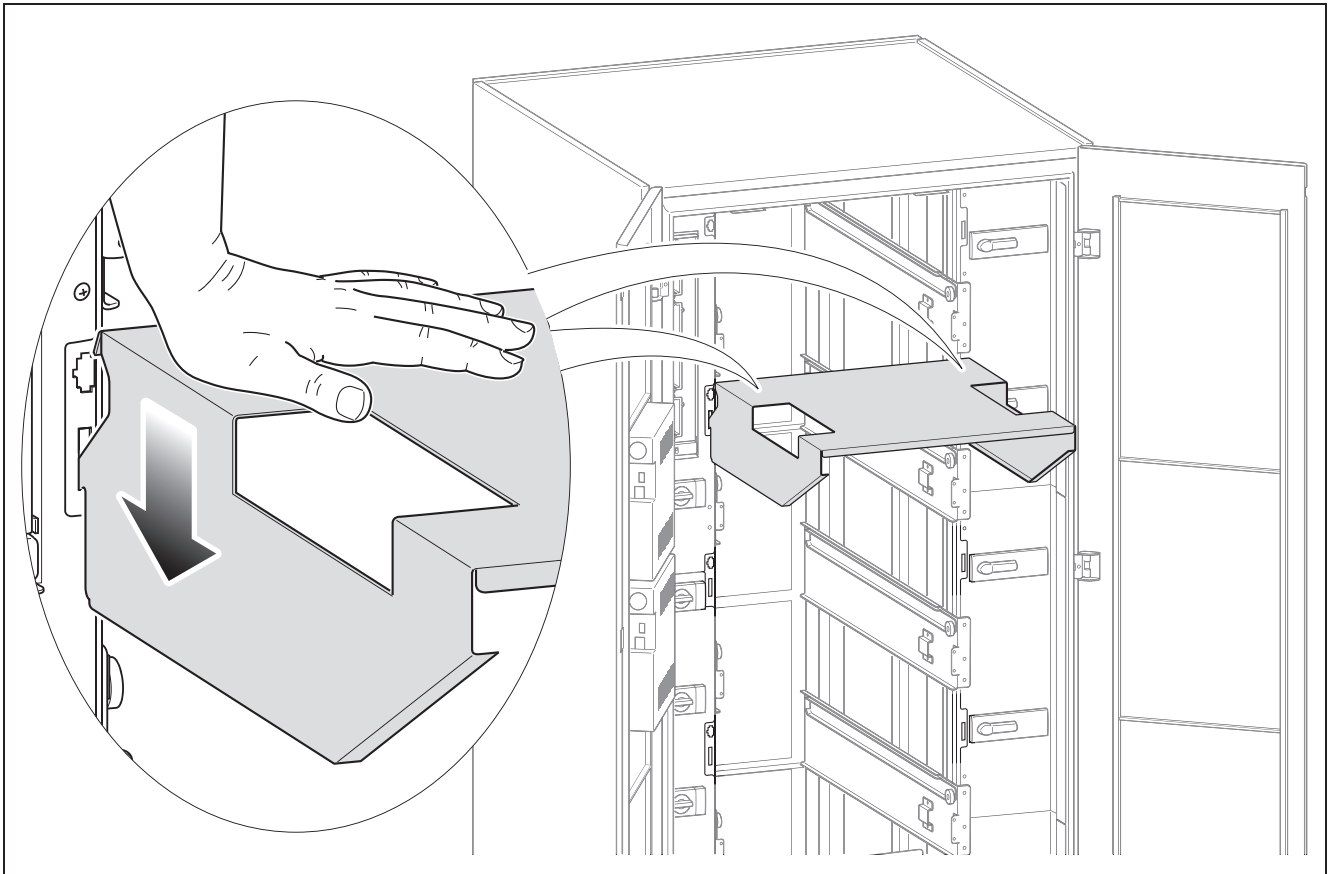
- Insertion of the upper three modules starting by the lower one.  
The Socomec shelf can be used to facilitate the insertion of the upper three modules.  
The shelf can be used only by persons authorized by Socomec.  
Keep this shelf available to service people for commissioning or future maintenance activities.  
- Disconnect the CAN-BUS cables.



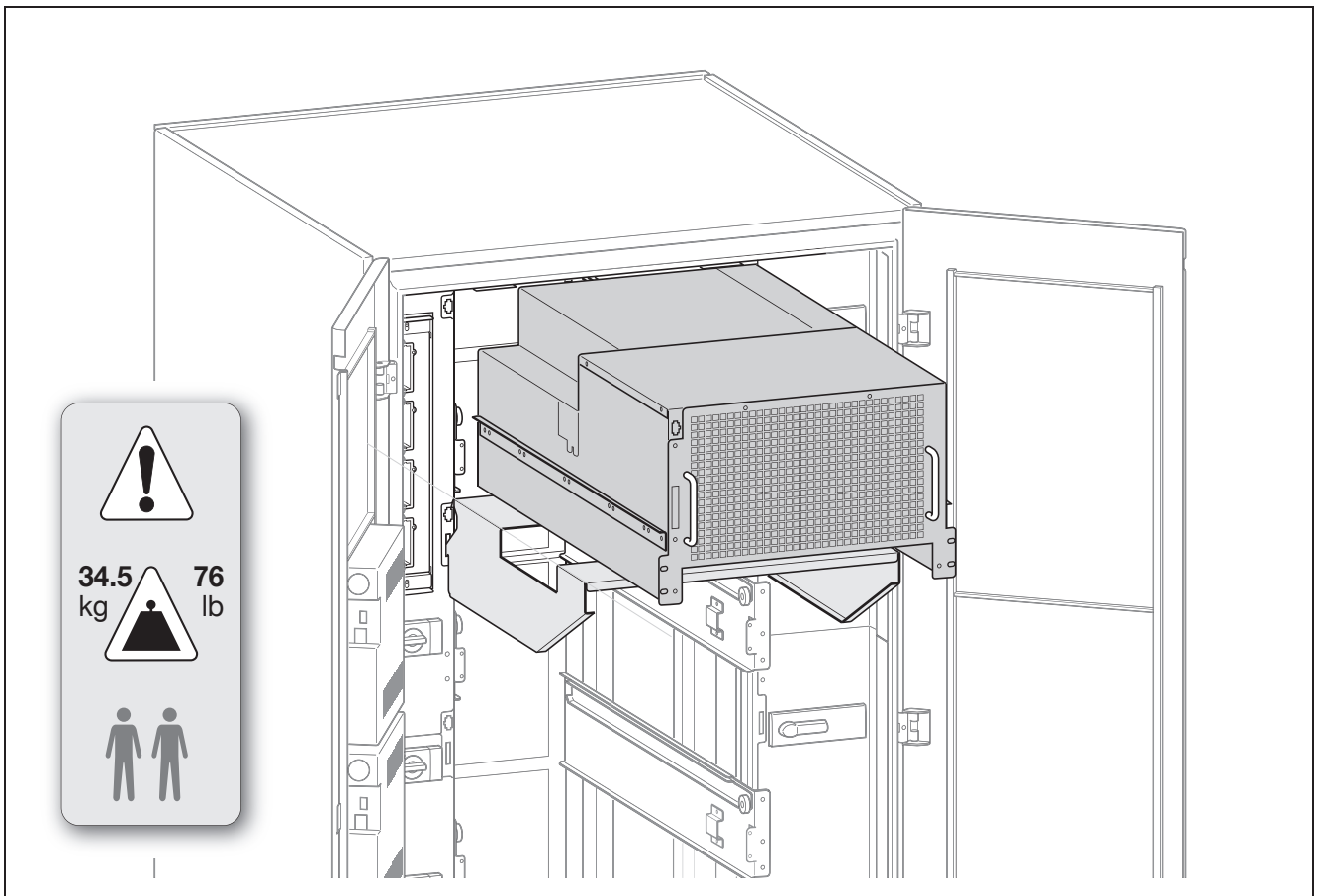
- Assemble the shelf on the PCS<sup>2</sup> IM frame inserting its joints into the PCS<sup>2</sup> IM frame holes.



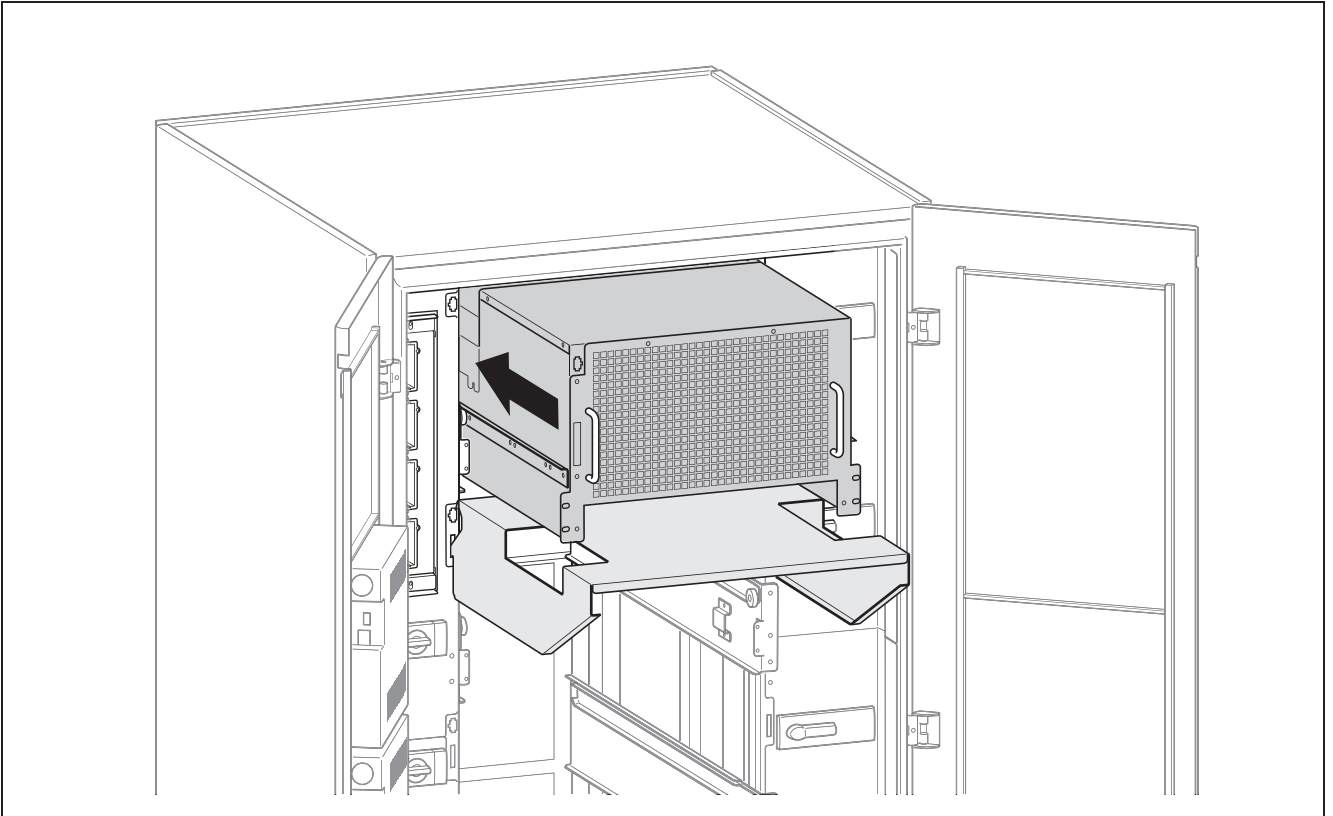
- Make sure the shelf is properly assembled.



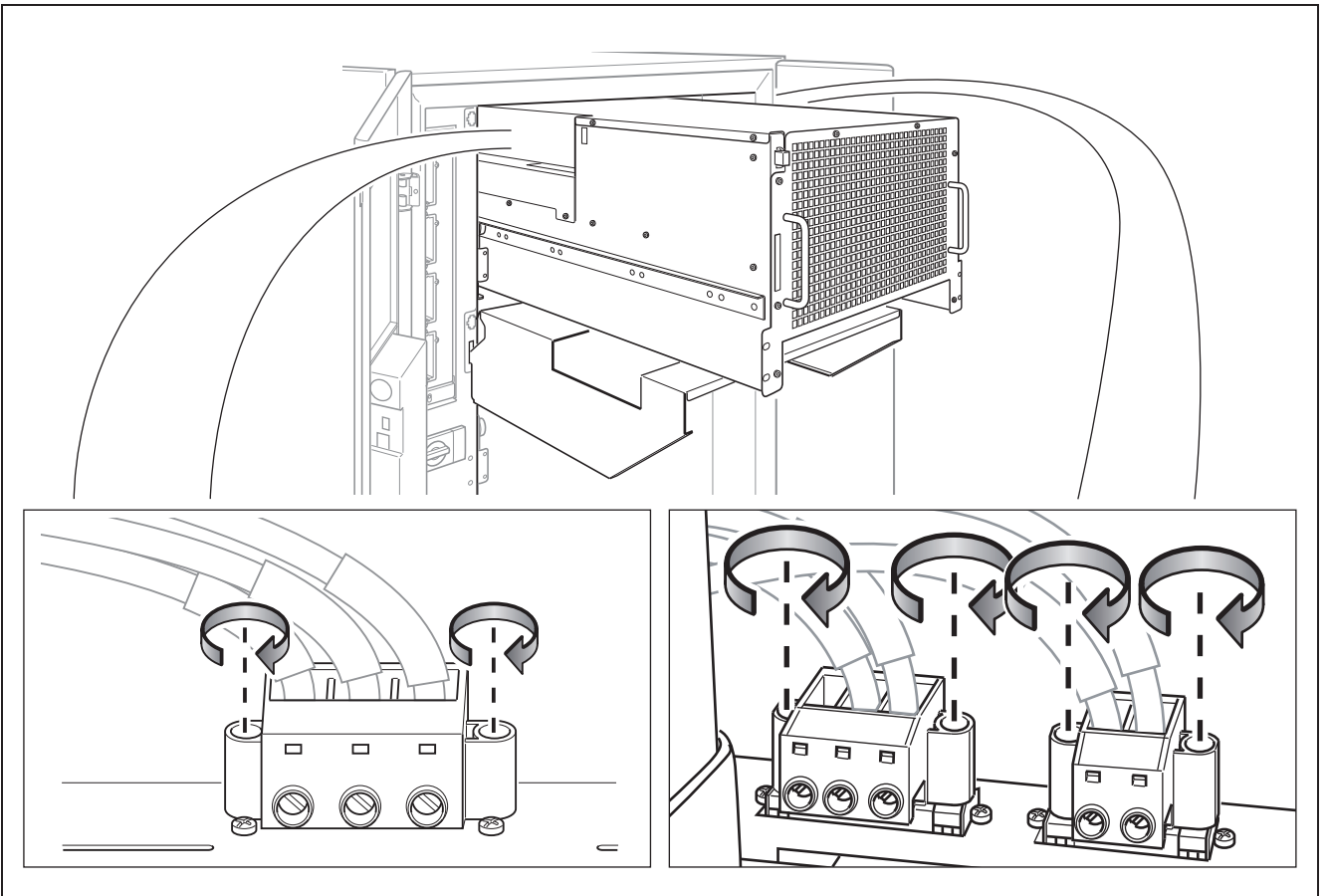
- Place the module on the shelf.



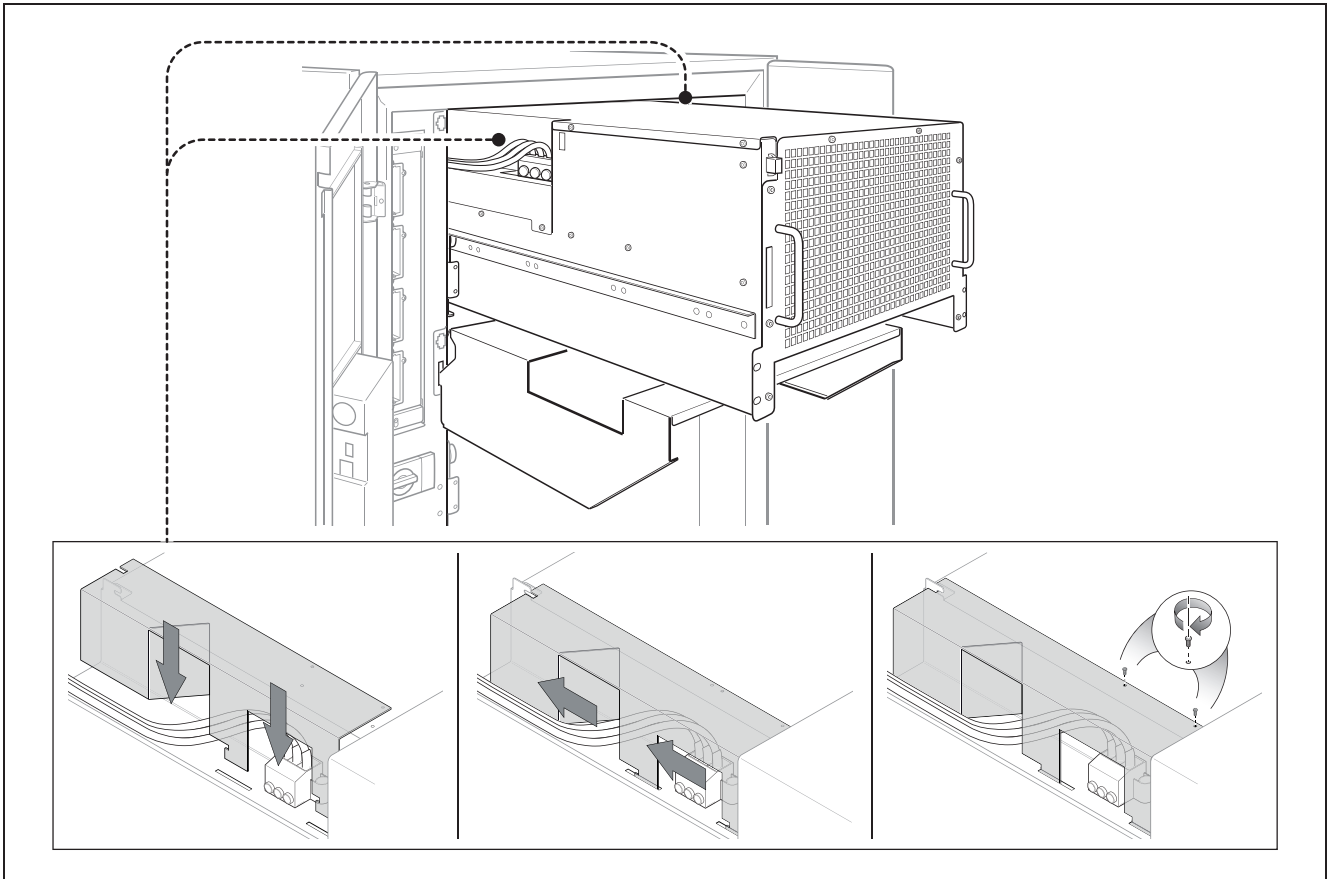
- Place the module on the guides and insert it up to the limit.



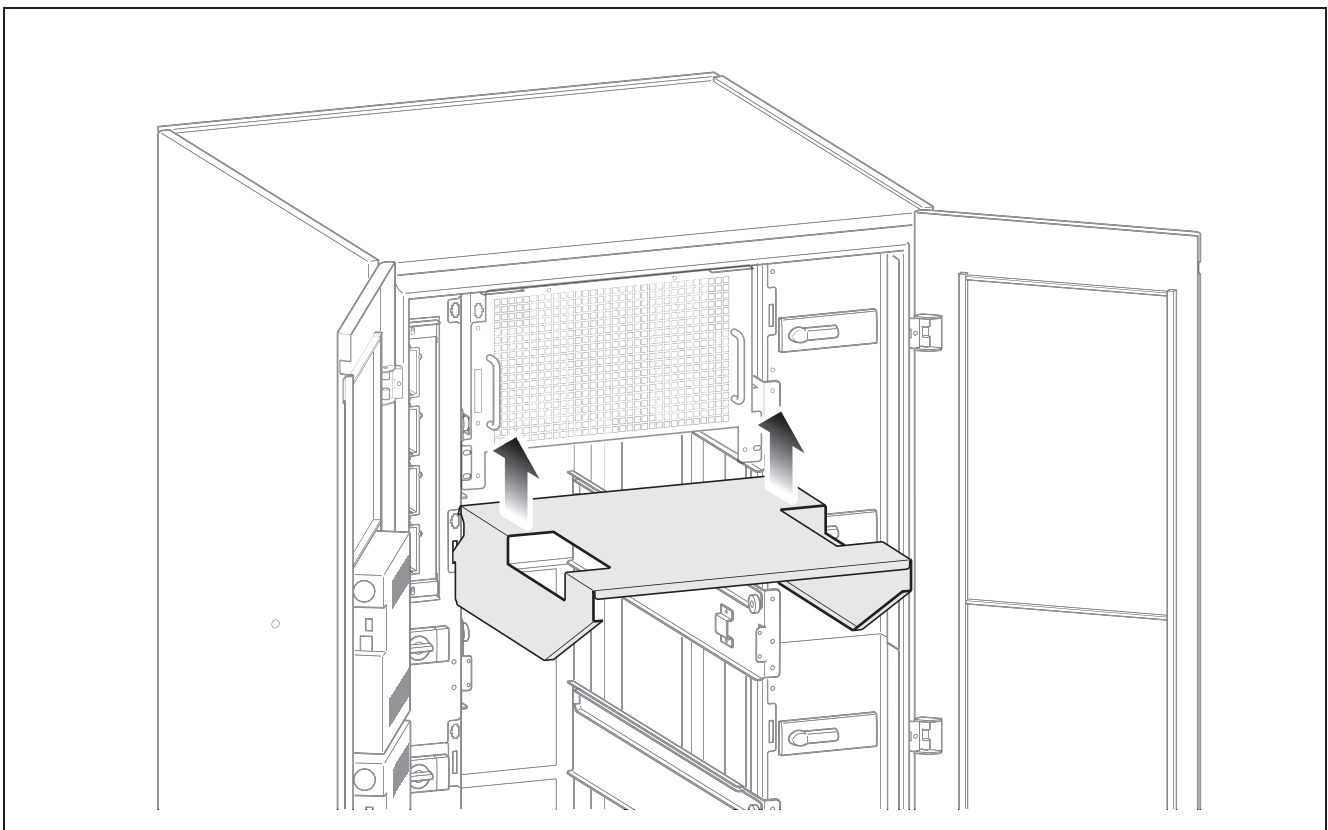
- Insert the connectors and secure them.



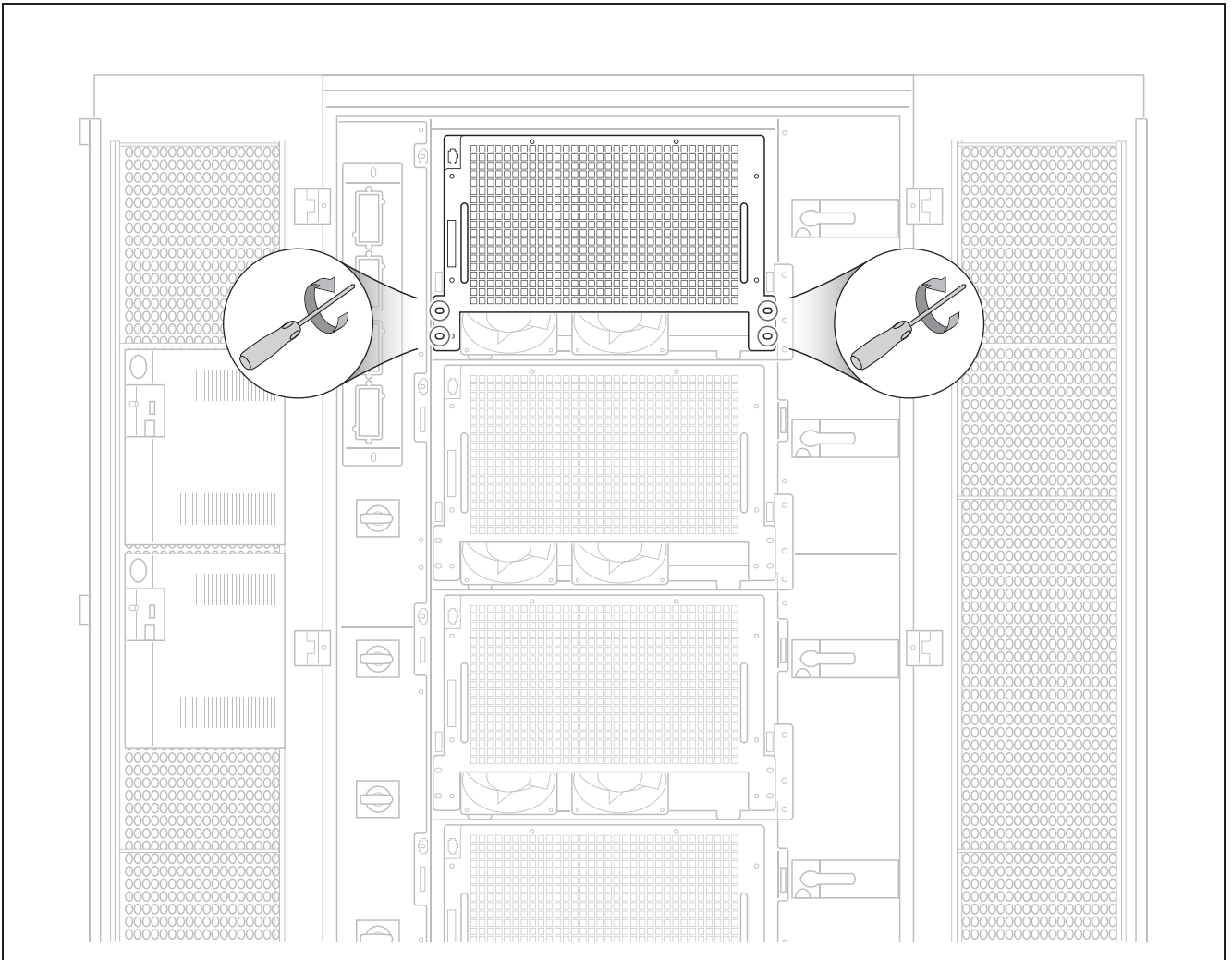
- Position the Lexan protection and secure it.



- Insert the module completely.
- Remove the shelf.

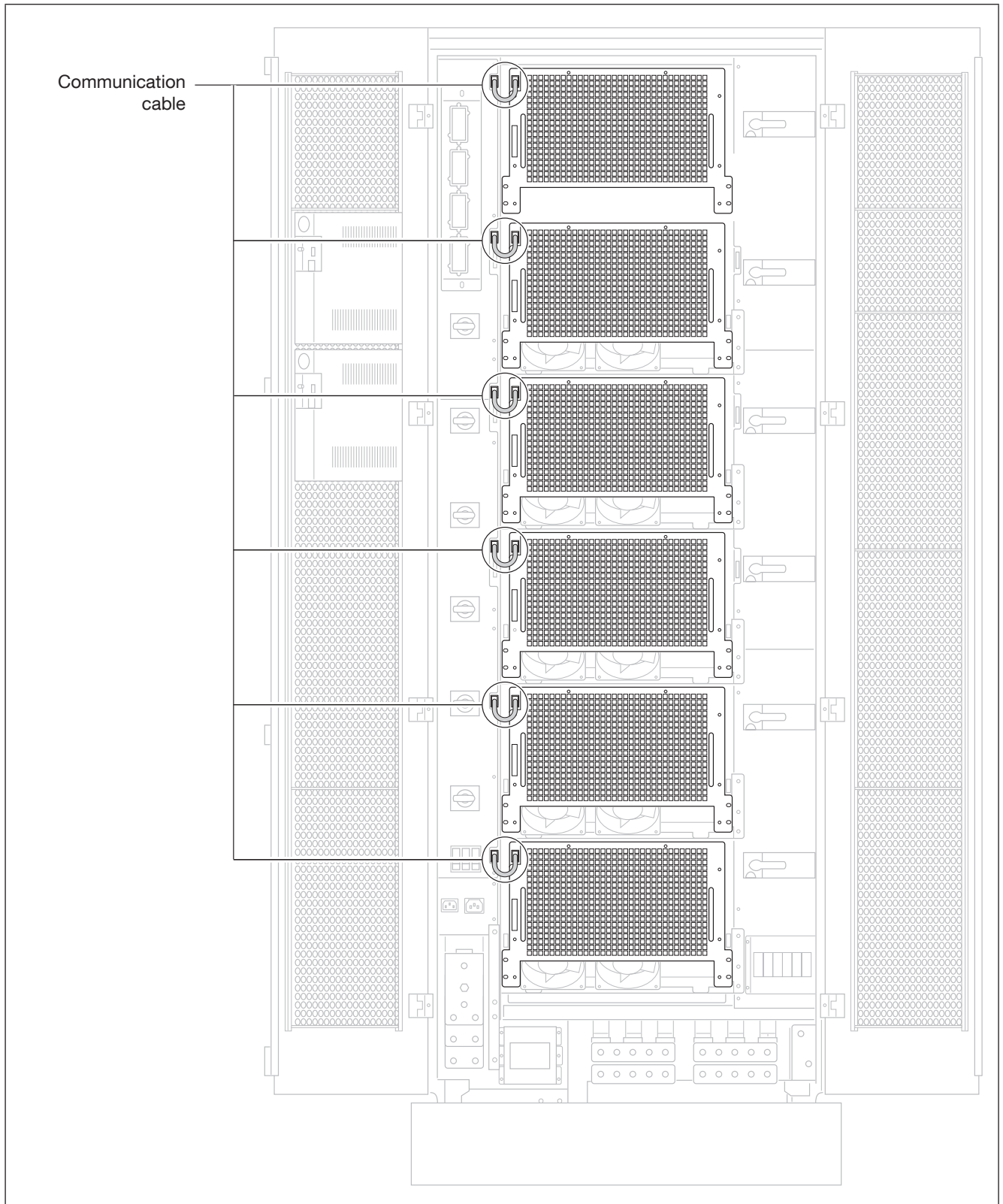


- Tighten the screws to secure the module to the SUNSYS PCS<sup>2</sup> IM.

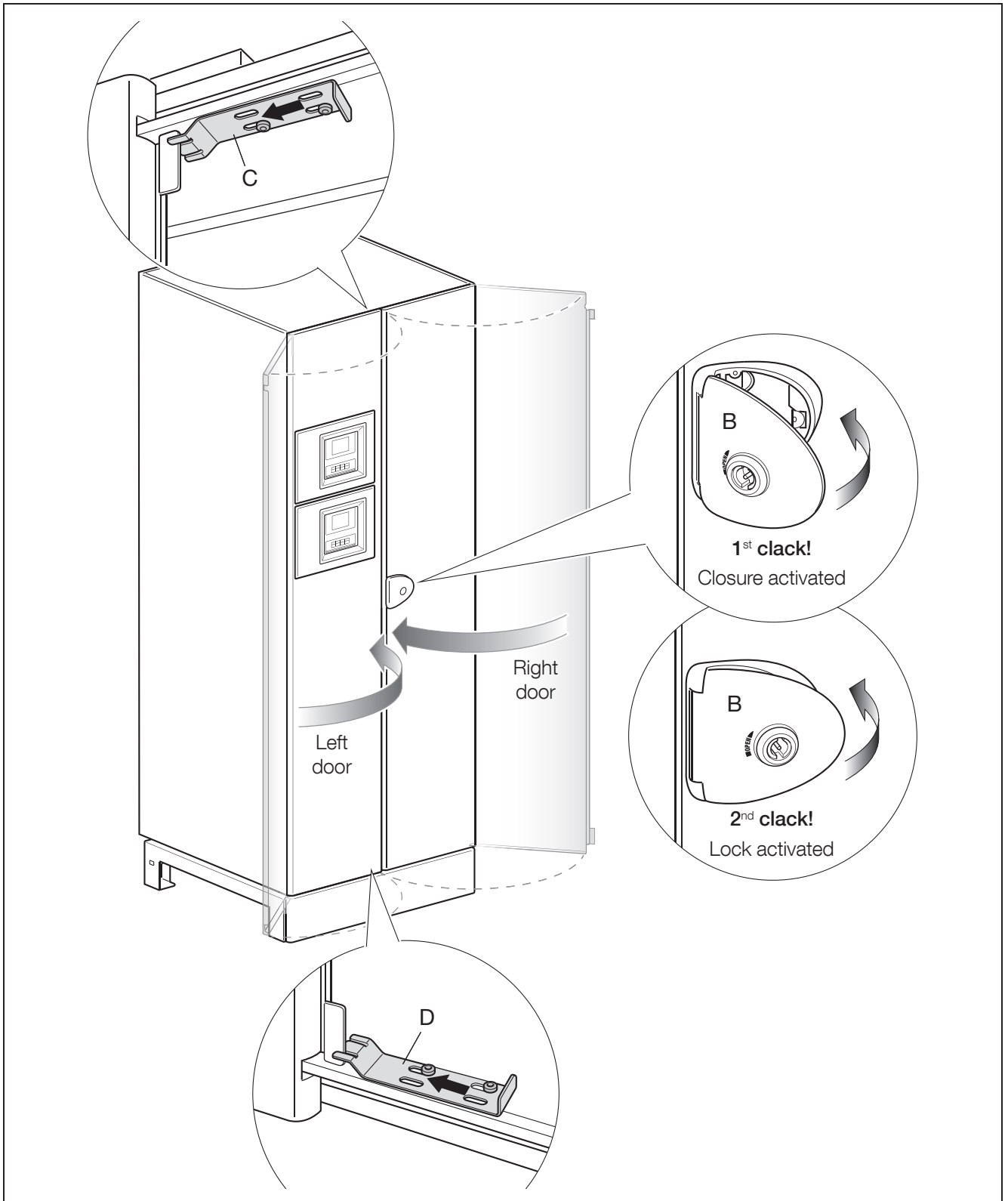


In PCS2 132 TL, the unused slots are covered with a panel, do not remove this protection.

- Connect the communication cable.



- Close the doors:
  - Close the left door and hook it with the both upper latch C and lower latch D.
  - Close the right leaf and close the hook B until the first clack. The door is locked but the lock is not activated.
  - To lock the door, press the coupling B fully.



## 5. ELECTRICAL INSTALLATION



### NOTE!

Before carrying out any operations on the unit read the 'Safety standards' chapter carefully.

### 5.1 ELECTRICAL REQUIREMENTS

The installation and system must comply with national plant regulations.

The electrical distribution panel must have a sectioning and protection system installed for AC mains.

The tables below show the connection features and the size of the protection devices recommended for correct installation.

| Size of AC input protection |                                 |   |                            |                      |                   |
|-----------------------------|---------------------------------|---|----------------------------|----------------------|-------------------|
| Models                      | Required overcurrent protection | Recommended Insulation fault device                             | AC cable Max cross-section | Type of cable        | Tightening torque |
| 33 TR                       | 50 A type D                     | Differential switch (RCD) <sup>1</sup><br>0.3 A<br>Type AC or A | 300 kcmil<br>3 x 4/0 AWG   | 90 °C<br>copper wire | 20 Nm             |
| 66 TR                       | 100 A type D                    |   |                            |                      |                   |
| 100 TR                      | 160 A type D                    |   |                            |                      |                   |
| 132 TL                      | 315 A type C                    | Insulation Monitoring Device (IMD)                              |                            |                      |                   |
| 200 TL                      | 500A type C                     |   |                            |                      |                   |

1. It is advisable to carry out a preliminary check on the earth current leakage with the PCS installed and operational with the definitive configuration (batteries, etc.), so as to prevent the RCD tripping.

The auxiliary power supply socket must be protected with a 10 A magneto-thermal switch, curve C, and from category II overvoltages or greater.

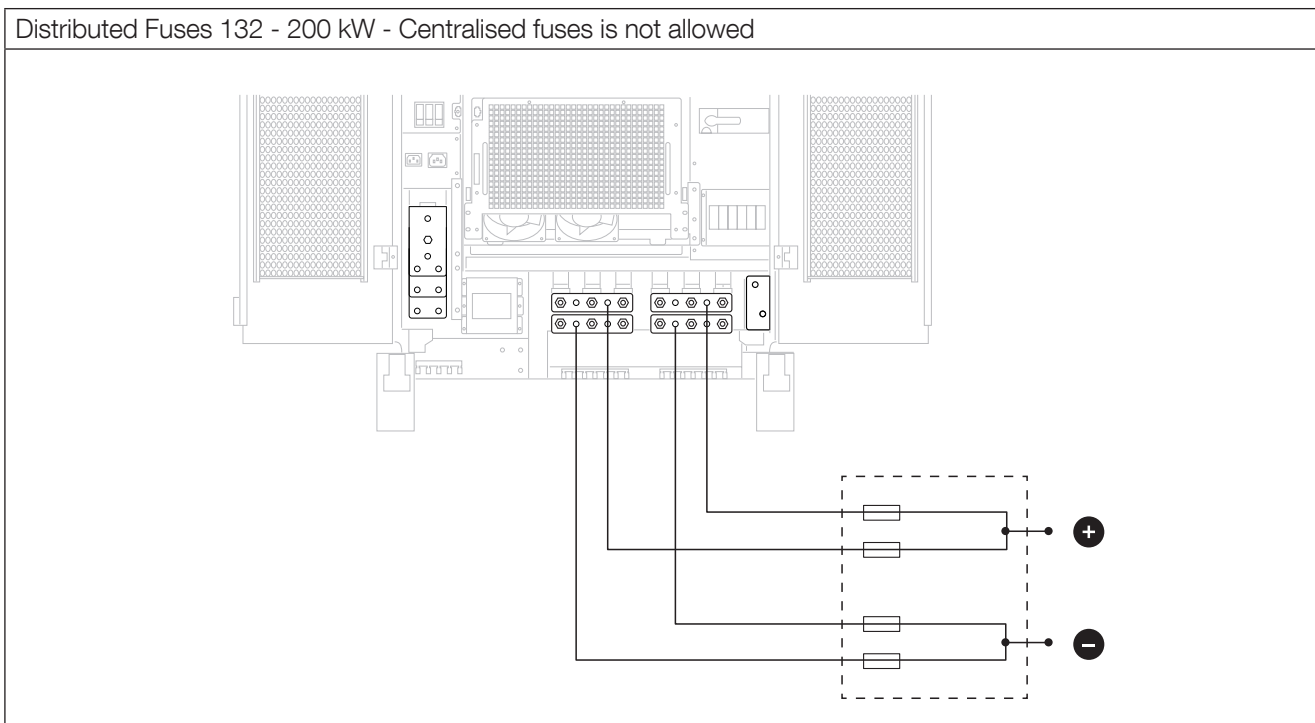
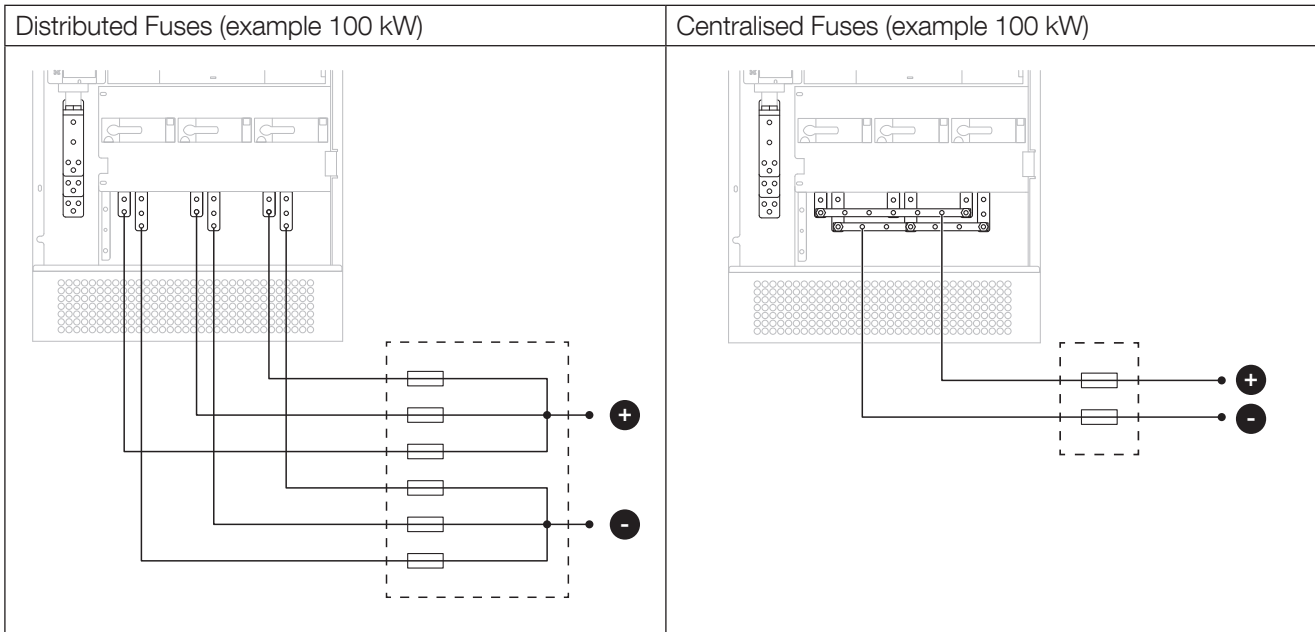
DC input protection can be achieved either with a distributed or centralised fuse configuration (see example below).

| Size of DC input protection |   |                      |                   |                            |                                |
|-----------------------------|---|----------------------|-------------------|----------------------------|--------------------------------|
| Models                      | DC cable Max cross-section <sup>1</sup> | Type of cable        | Tightening torque | Distributed fuses          | Centralised fuses <sup>2</sup> |
| 33 TR                       | 2 x 4/0 AWG                             | 90 °C<br>Copper wire | 20 Nm             | 80 A – 1000 V<br>Ultrafast | 80 A - 1000 V Ultrafast        |
| 66 TR                       |   |                      |                   |                            | 160 A - 1000 V Ultrafast       |
| 100 TR                      |   |                      |                   |                            | 250 A - 1000 V Ultrafast       |
| 132 TL                      |   |                      |                   |                            | 2 x 160 A - 1000 V Ultrafast   |
| 200 TL                      |   |                      |                   |                            | 2 x 250 A - 1000 V Ultrafast   |

1. Determined by the size of the terminals.

2. Standard configuration delivered with the product.

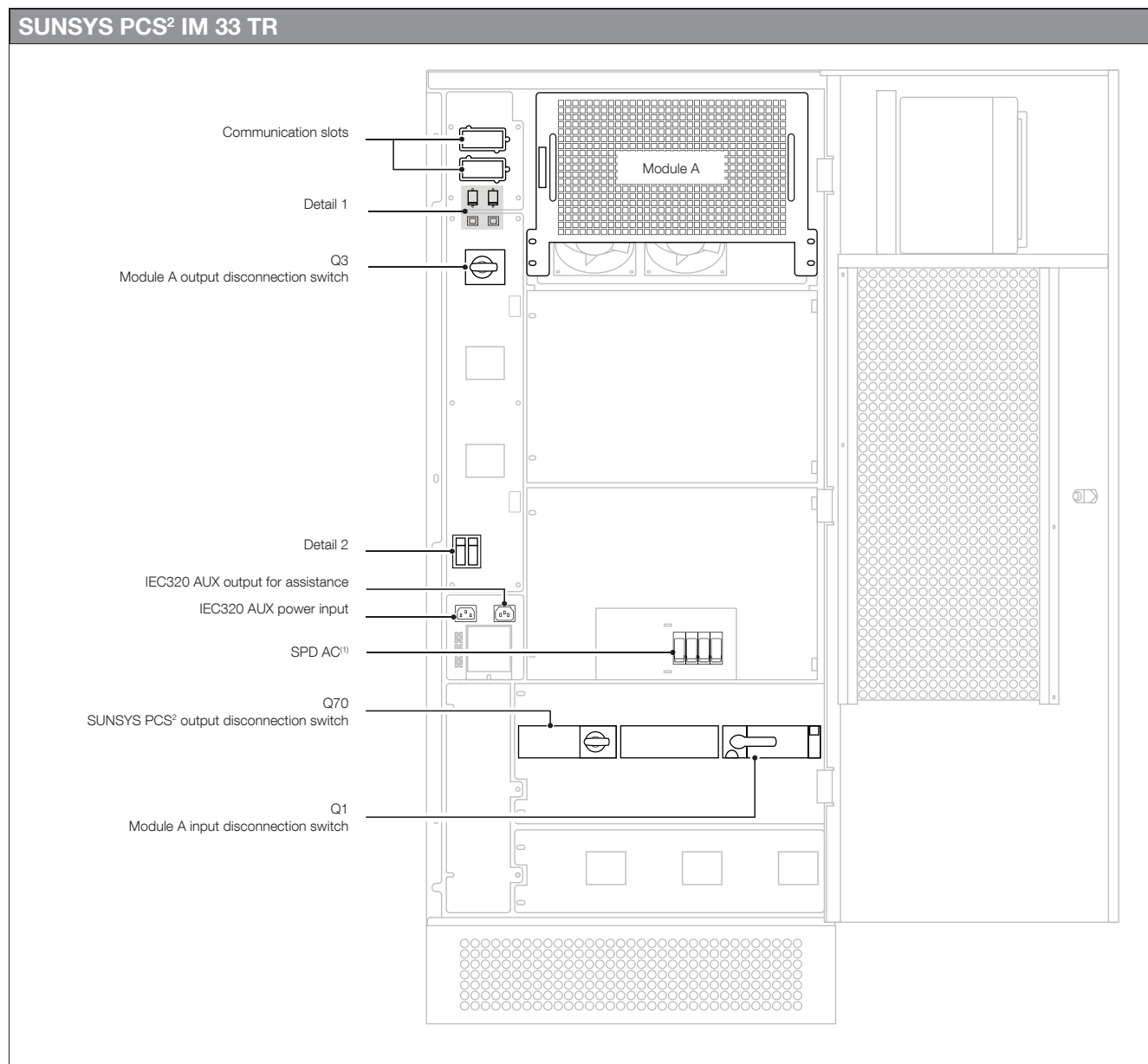


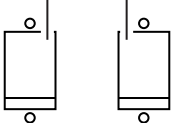
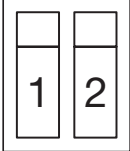


|  |   |
|--|---|
|  | <p><b>NOTE:</b> If Socomec also provides the batteries the centralised fuse connection will be used and the fuses will be provided.</p>   |
|  | <p><b>WARNING:</b> the SUNSYS PCS<sup>2</sup> IM is designed for transient over-voltages in category II installations for DC terminals. If the SUNSYS PCS<sup>2</sup> IM can be subjected to transient over-voltages in category III installations, or if the distance from the SPDs of the battery cabinet is excessive, protective SPDs must be fitted near the SUNSYS PCS<sup>2</sup> IM. The SPD DC option can be fitted to the SUNSYS PCS<sup>2</sup> IM directly.</p> |

# 6. OVERVIEW

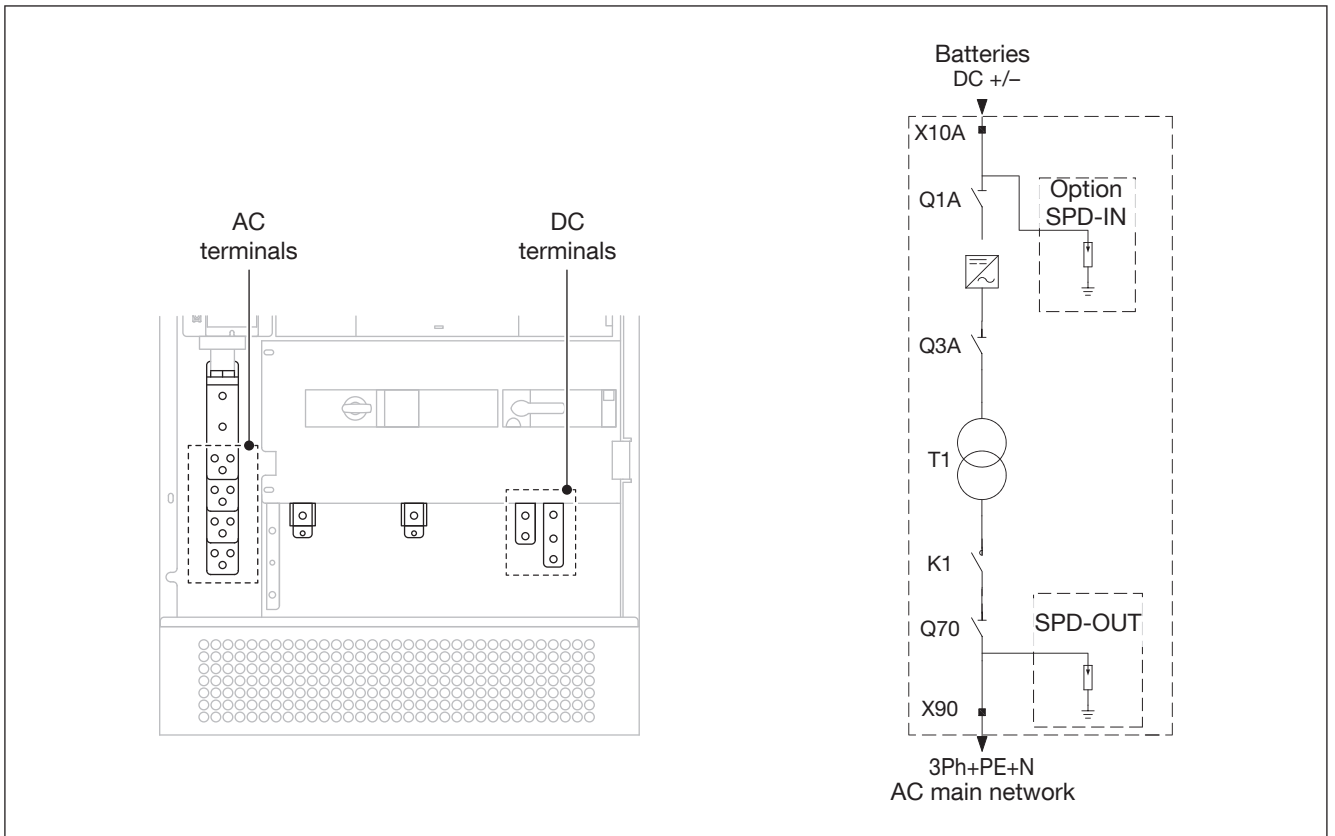
## 6.1 SWITCHES AND INTERFACES

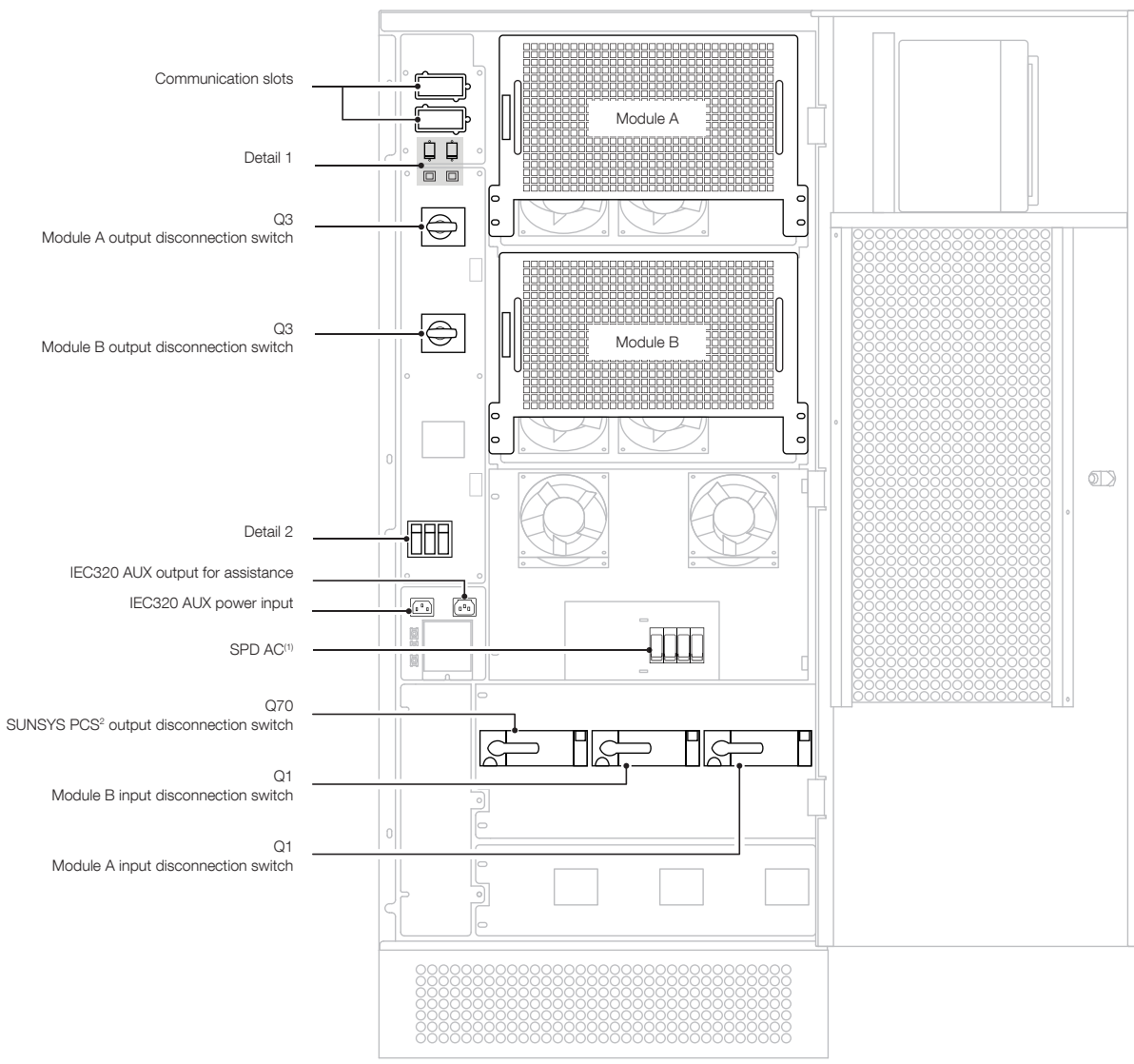


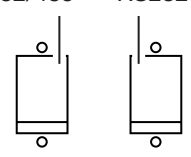
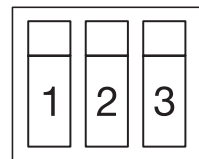
| Detail 1  | Detail 2: disconnection switches with fuse   |
|---|--|
| <p>RS232/485      RS232</p>  |  <ol style="list-style-type: none"> <li>1. Disconnection switch for IEC320 connector AUX power supply.</li> <li>2. Disconnection switch for IEC320 connector for assistance.</li> </ol> |

1. Refer to 'Standard features and options' chapter for details.

# WIRING DIAGRAM FOR SUNSYS PCS<sup>2</sup> IM 33 TR

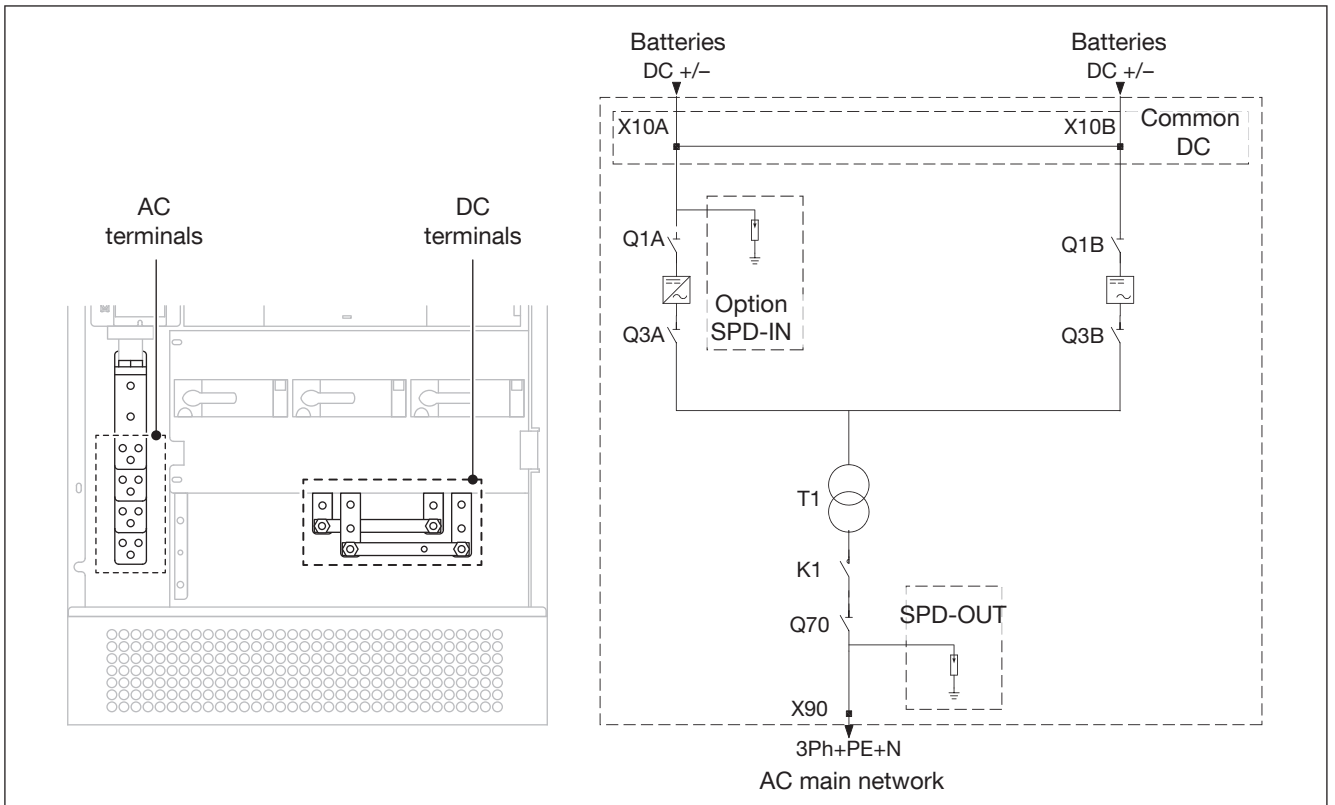




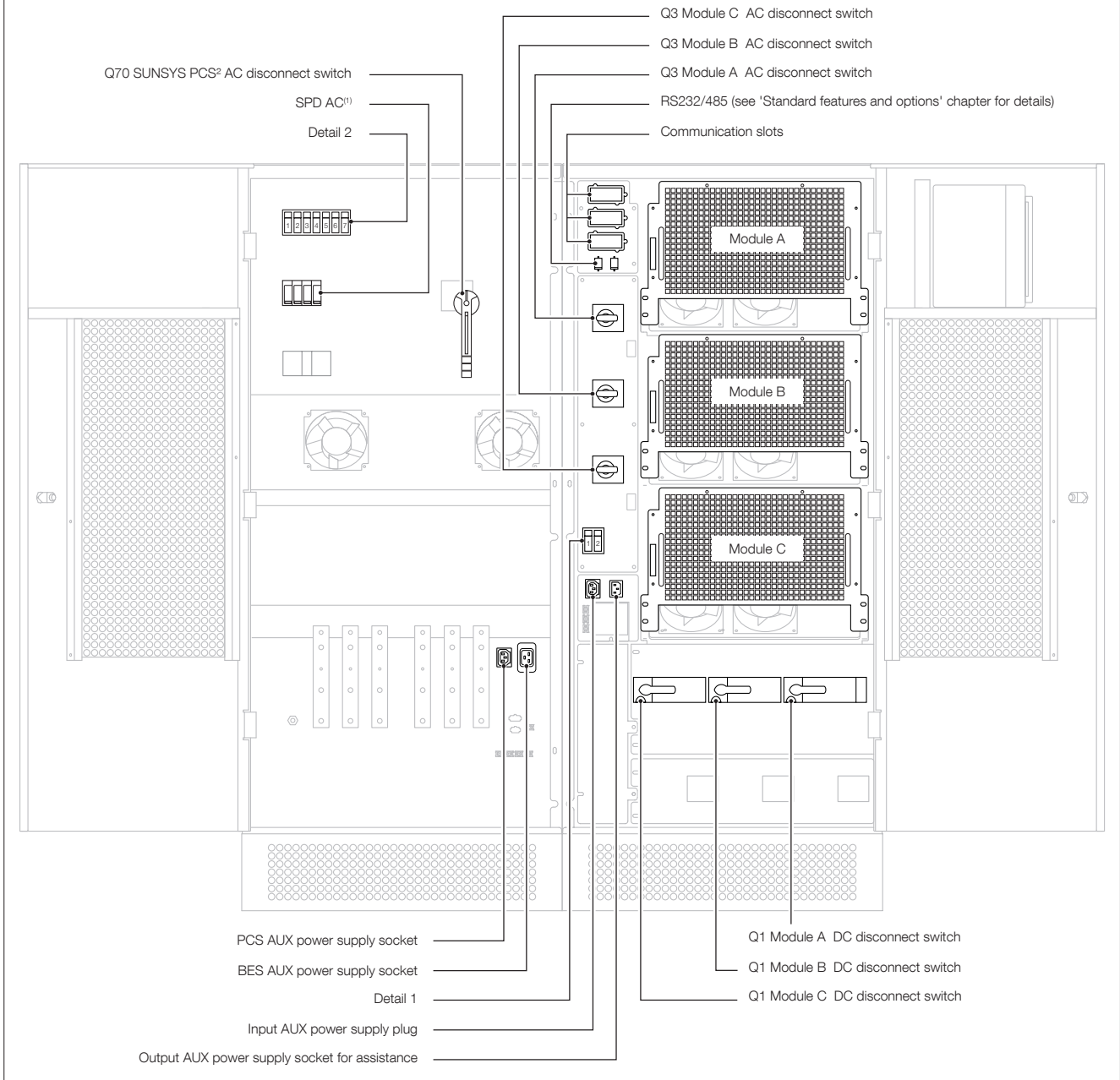
| Detail 1  | Detail 2: disconnection switches with fuse   |
|---|--|
| <p>RS232/485    RS232</p>  |  <ol style="list-style-type: none"> <li>1. Disconnection switch for IEC320 connector AUX power supply.</li> <li>2. Disconnection switch for IEC320 connector for assistance.</li> <li>3. Fan fuse.</li> </ol> |

1. Refer to 'Standard features and options' chapter for details.

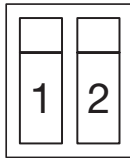
WIRING DIAGRAM FOR SUNSYS PCS<sup>2</sup> IM 66 TR



# SUNSYS PCS<sup>2</sup> IM 100 TR

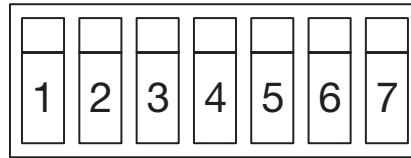


Detail 1: disconnect switches with fuse



1. Disconnect switch for input AUX power supply plug.
2. Disconnect switch for output AUX power supply socket for assistance.

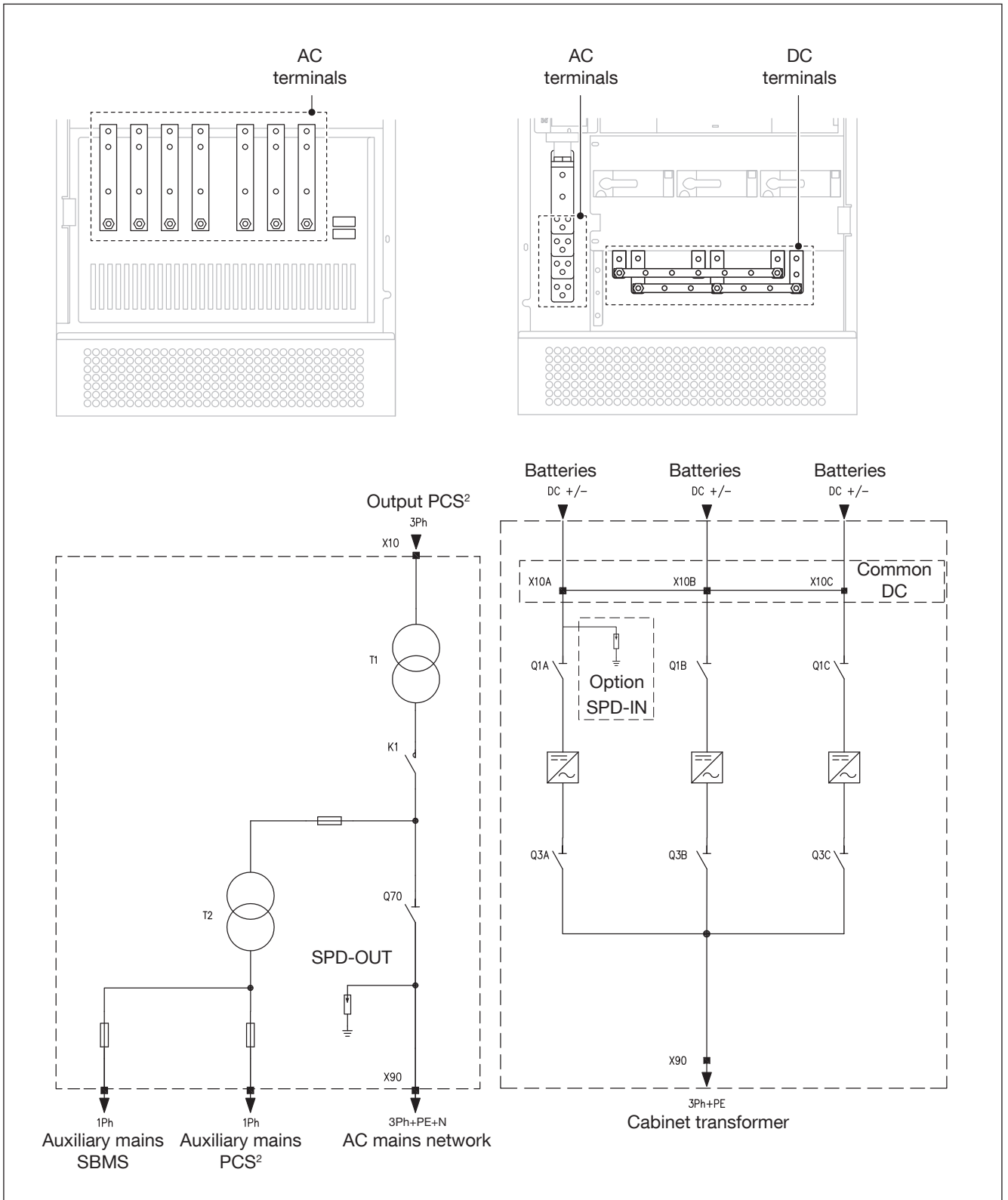
Detail 2: disconnection switches with fuse

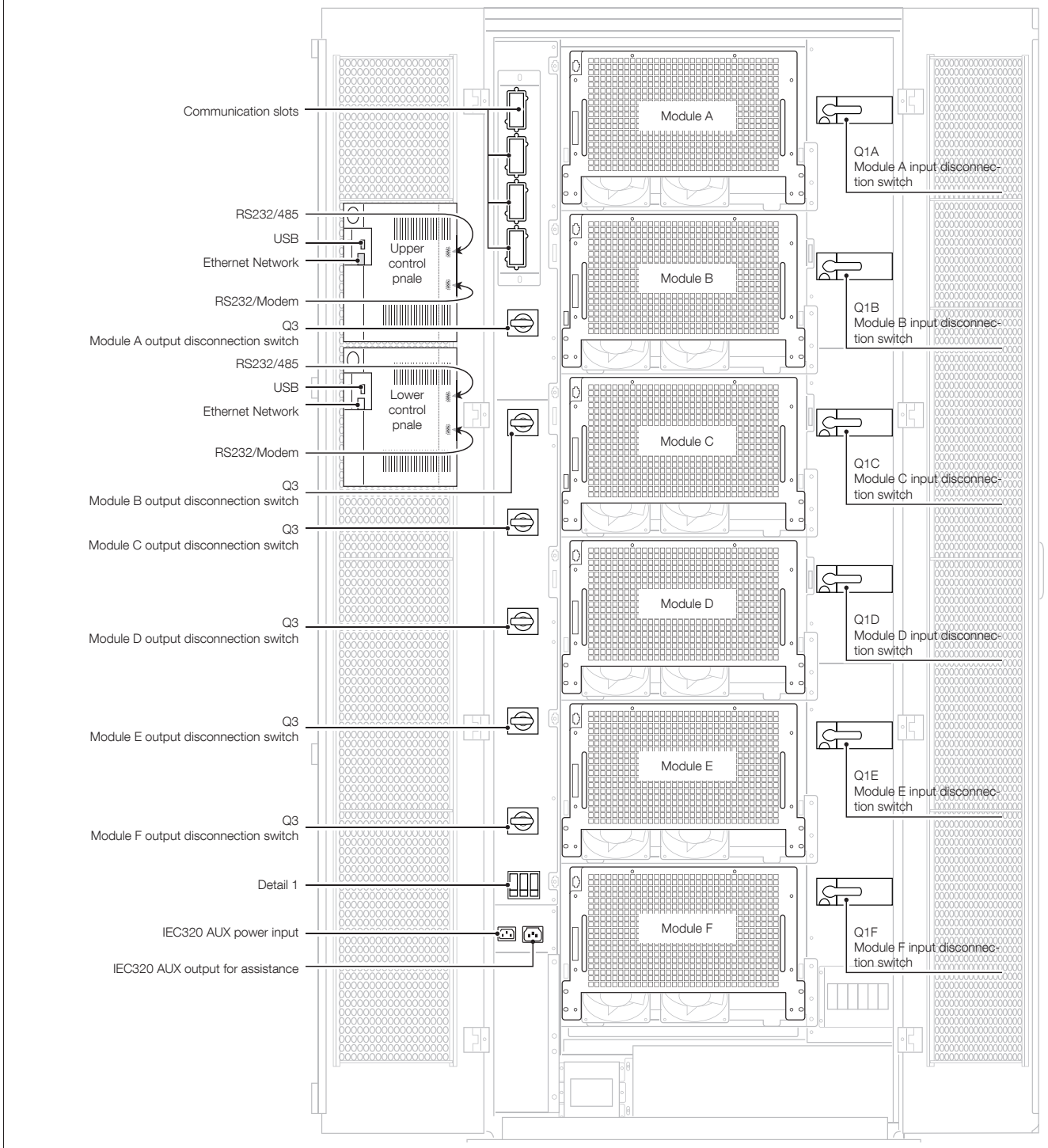


1. Disconnect switch for AUX power supply.
2. Disconnect switch for AUX power supply.
3. Disconnect switch for PCS AUX power supply socket.
4. Disconnect switch for PCS AUX power supply socket.
5. Disconnect switch for BES AUX power supply socket.
6. Disconnect switch for BES AUX power supply socket.
7. Transformer cabinet fans fuse.

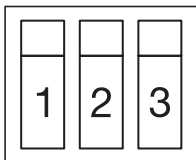
1. Refer to 'Standard features and options' chapter for details.

# WIRING DIAGRAM FOR SUNSYS PCS<sup>2</sup> IM 100 TR





Detail 1: disconnection switches with fuse

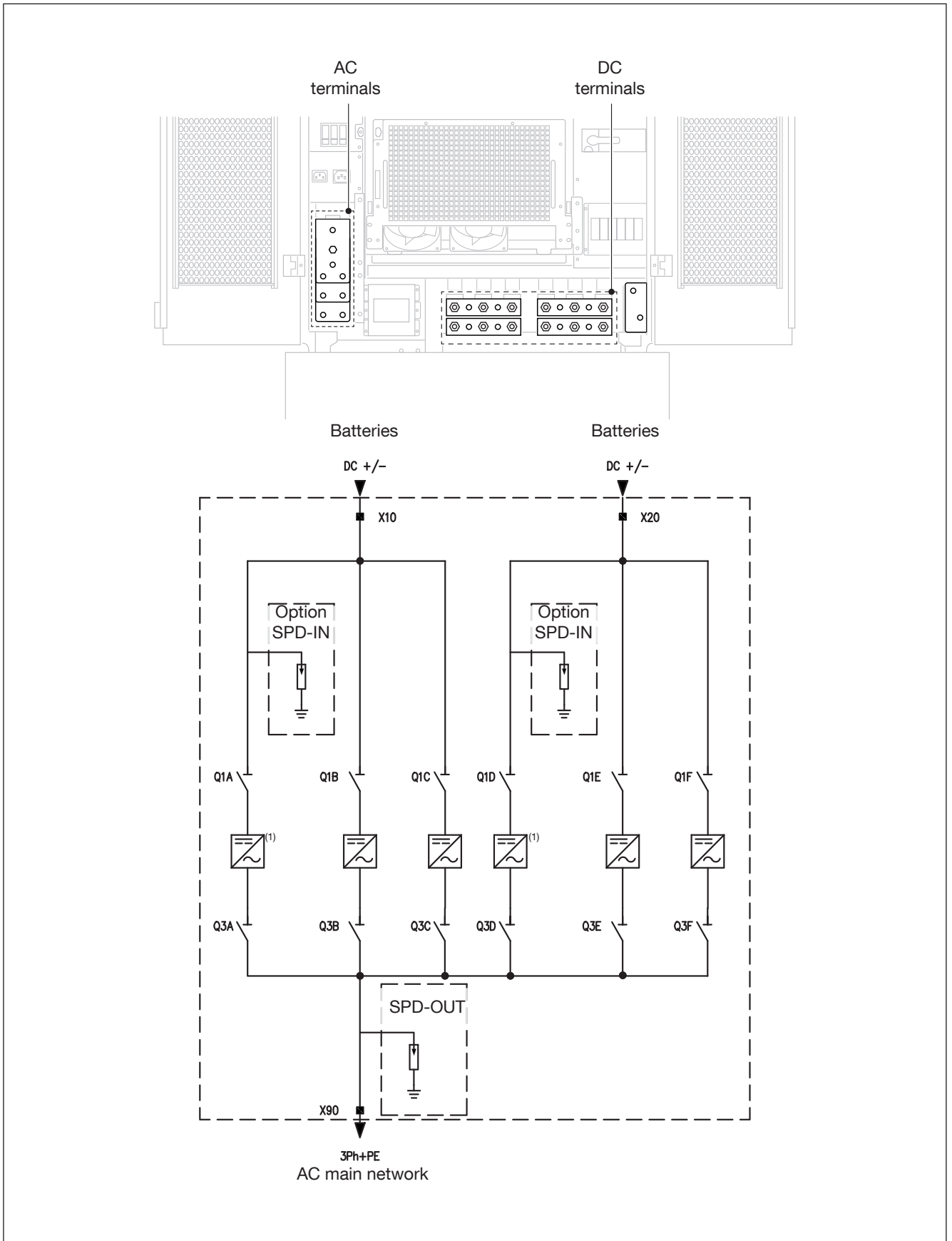


1. Disconnection switch for IEC320 connector AUX power supply (Upper Control Panel)
2. Disconnection switch for IEC320 connector AUX power supply (Lower Control Panel)
3. Disconnection switch for IEC320 connector for assistance

1. In PCS<sup>2</sup> 132 TL, module A & D are not present.



# WIRING DIAGRAM OF SUNSYS PCS<sup>2</sup> IM 132 - 200 TL

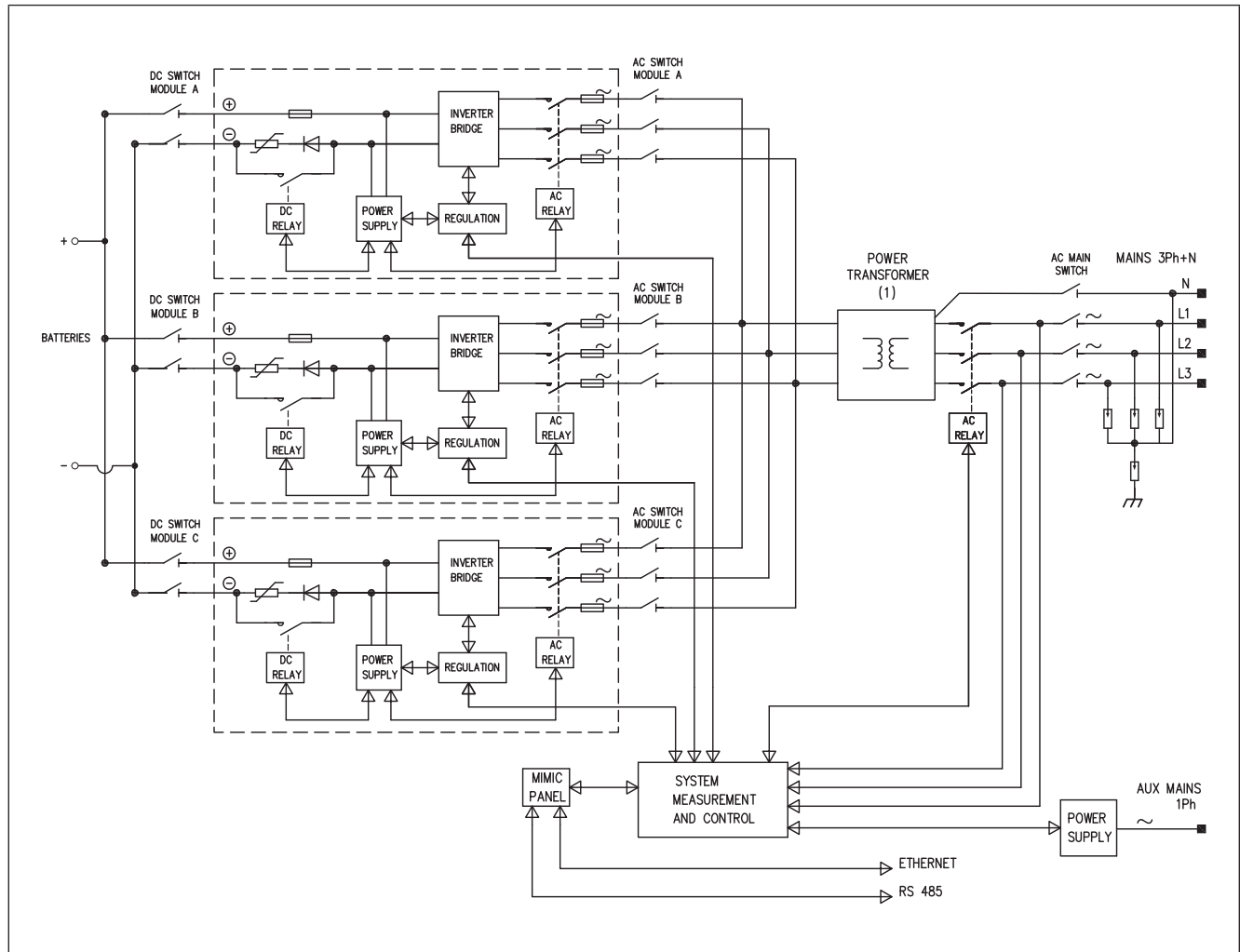


1. Module A not present in PCS 132 TL
2. Module D not present in PCS 132 TL

## 6.2 DIAGRAM OF MAIN SYSTEM EXAMPLE FOR VERSION 100 TR

The SUNSYS PCS<sup>2</sup> system is constructed using power electronics modules. Each power module incorporates circuit protection, sine filter, cooling fans and EMI filtering as shown in the diagram below.

- Example for PCS<sup>2</sup> 100kW with transformer



1. AC voltage is set according to the country electric code.

# 7. CONNECTIONS



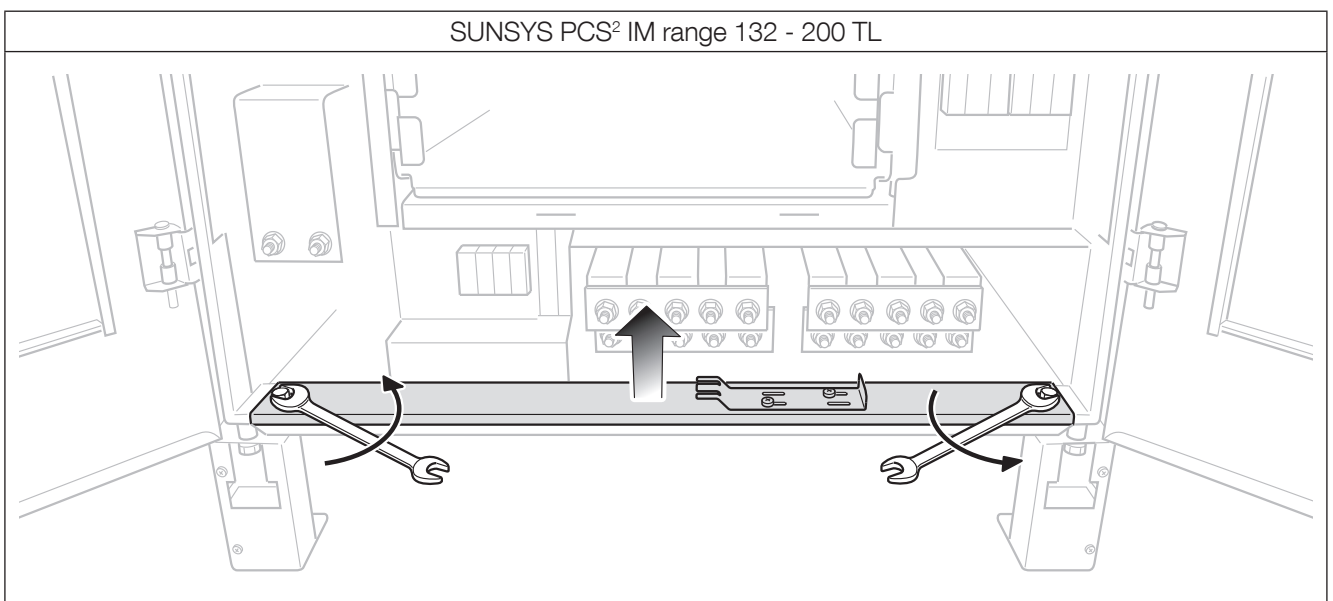
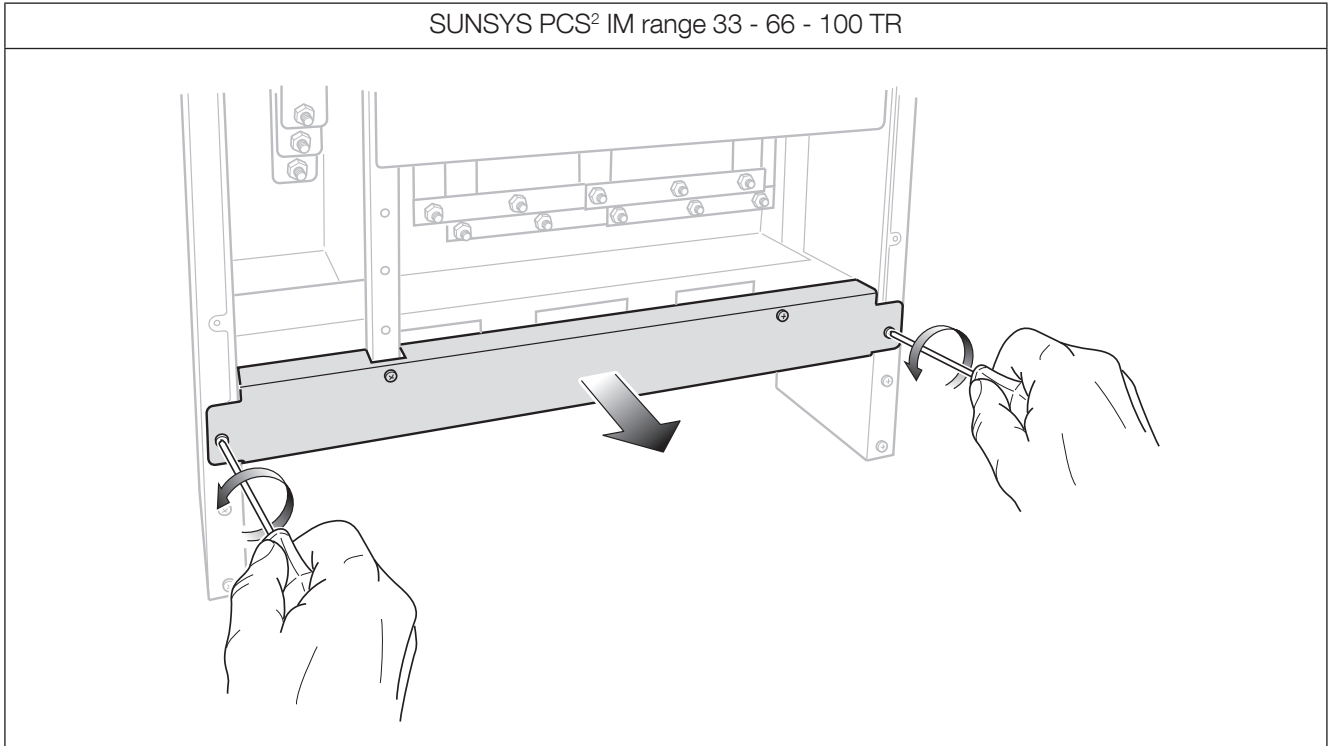
**NOTE!**  
Before carrying out any operations on the unit read the 'Safety standards' chapter carefully.

## 7.1 INPUT CONNECTION

The SUNSYS PCS<sup>2</sup> IM is connected to the batteries via the DC terminals.

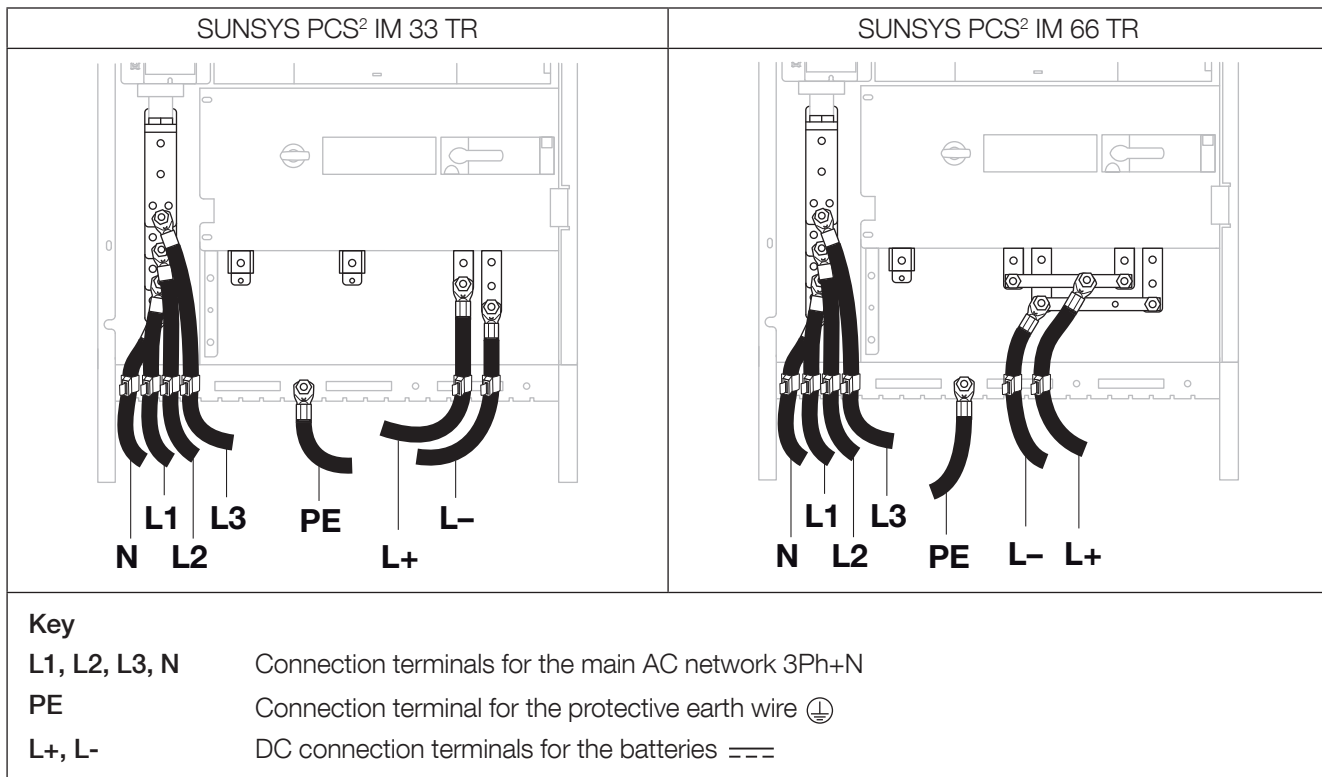
The SUNSYS PCS<sup>2</sup> IM is connected to the AC mains via the AC power terminals.

- Remove the panels protecting the connection area in front of the terminals.
- Remove the horizontal support in order to facilitate the cable connections.

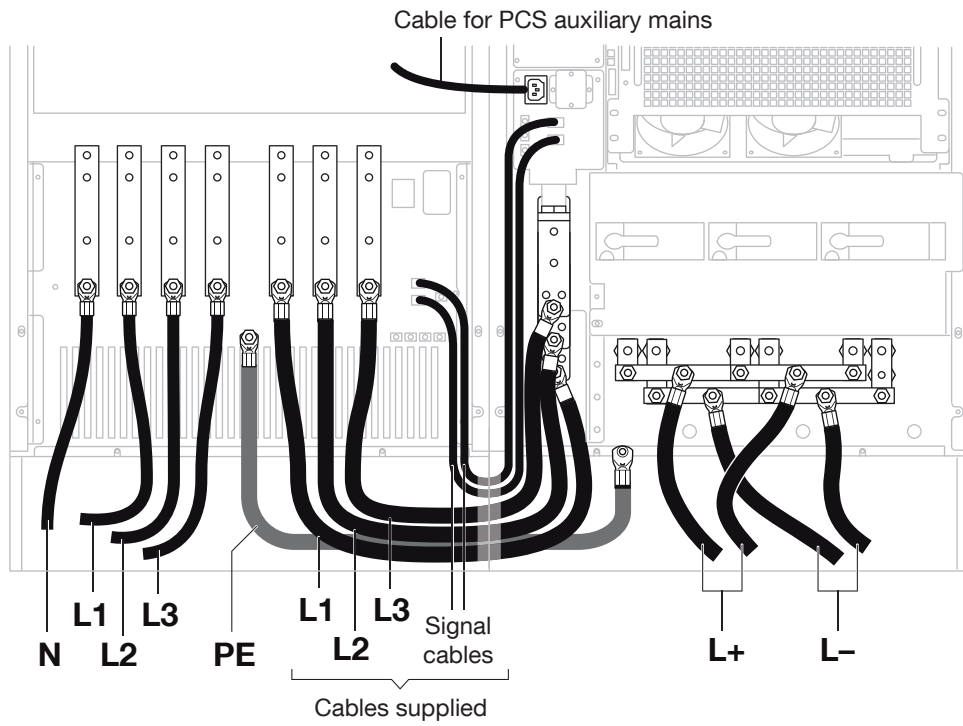


- Fix the protection wire  $\oplus$  to the connection terminal.
- Fix the wires L1, L2, L3, N to the connection terminals.
- Fix the wires L+,L- to the connection terminals.
- Secure the power cables supplied between the transformer cabinet and the PCS<sup>2</sup> IM (only for 100 TR).

- Secure the signal cables supplied between the transformer cabinet and the PCS<sup>2</sup> IM (only for 100 TR).
- Secure the auxiliary mains cable supplied between the transformer cabinet and the PCS (only for 100TR).
- Secure the auxiliary mains cable supplied between the transformer cabinet and the BES (only for 100TR).
- Use only cables supplied by SOCOMEC for bridging connections between transformer cabinet and PCS<sup>2</sup> IM (only for 100 TR).
- If desired fix the cables to the cable support guide using cable strapping.



SUNSYS PCS<sup>2</sup> IM 100 TR



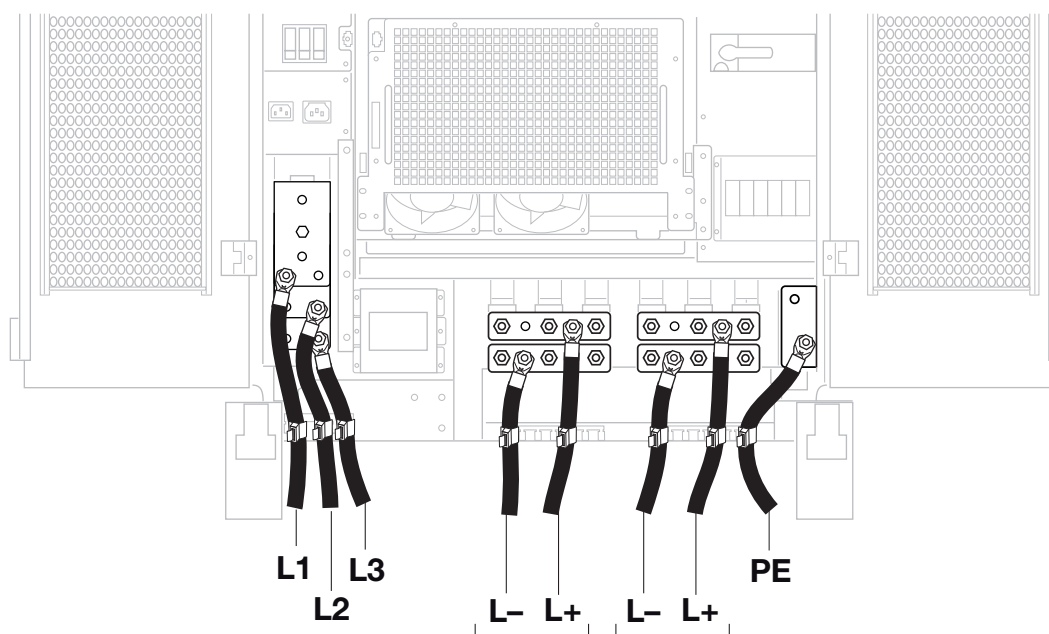
**Key**

**L1, L2, L3, N** Connection terminals for the main AC network 3PH+N~

⊕ Connection terminal for the protective earth wire ⊕

**L+, L-** DC connection terminals for the batteries ==

SUNSYS PCS<sup>2</sup> IM 132 - 200 TL



**Key**

**L1, L2, L3** Connection terminals for the AC mains - 3 phase

 Connection terminal for the protective earth wire 

**L+, L-** DC connection terminals for the batteries 

- Replace the horizontal support.
- Replace the panels protecting the connection area in front of the terminals.



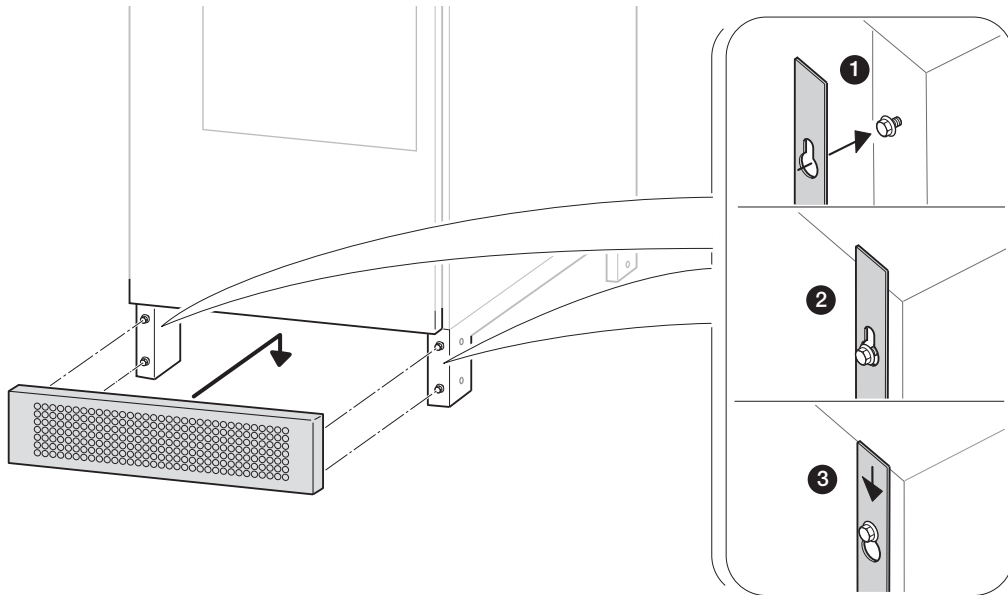
For safety reason, the mounting of the protecting panels is compulsory.

- Fix the front base.

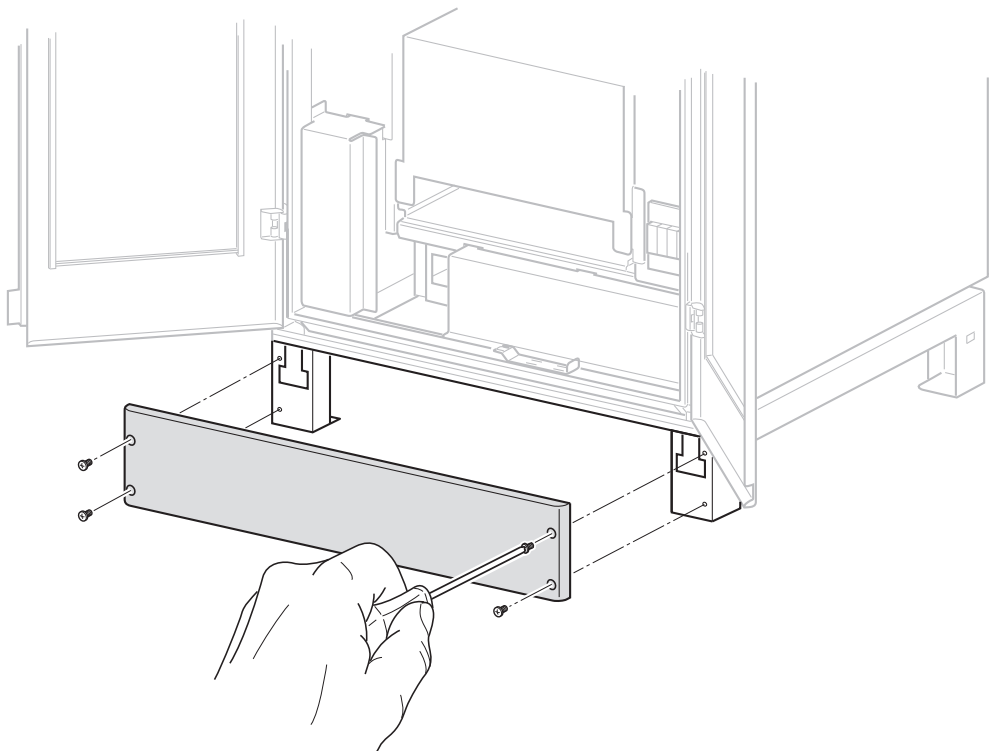


For safety reason, the mounting of the protecting panels is compulsory.

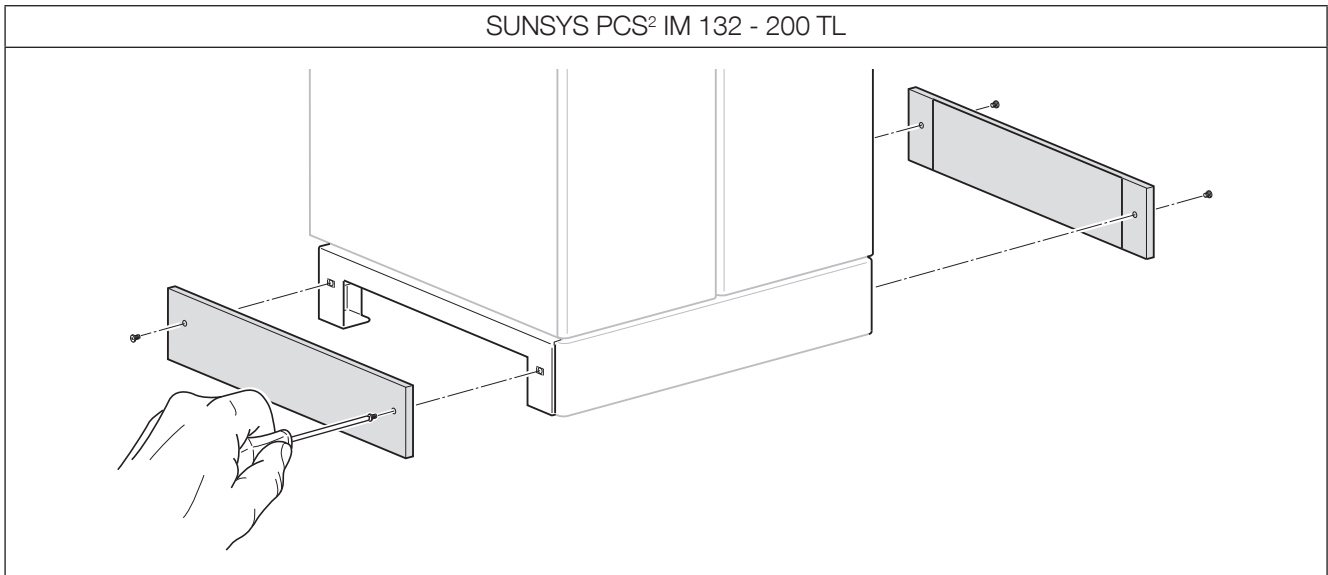
### SUNSYS PCS<sup>2</sup> IM range 33 - 66 - 100 TR



### SUNSYS PCS<sup>2</sup> IM 132 - 200 TL



- Fix both the lateral bases



### AUXILIARY CONNECTION

The SUNSYS PCS<sup>2</sup> IM equipment is powered by a special single-phase voltage (refer to 'Technical specifications' chapter). The auxiliary voltage must be connected to the relevant socket.

|  |   |
|--|---|
|  | <b>WARNING: risk of damage to the system if not observed!</b> |
|--|---|

|  |  |  |  |
|--|--|--|--|
| <p>SUNSYS PCS<sup>2</sup> IM 33 - 66 TR</p>  | <p>SUNSYS PCS<sup>2</sup> IM 100TR</p>   |  |  |
| <table border="1" style="border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center; vertical-align: middle;"> </td> <td style="padding: 5px;"> <b>NOTE!</b> The auxiliary voltage is generated in the transformer cabinet and supplied to the PCS and BES through the cables supplied by SOCOMEC, as shown in figure.         </td> </tr> </table> |  |  | <b>NOTE!</b> The auxiliary voltage is generated in the transformer cabinet and supplied to the PCS and BES through the cables supplied by SOCOMEC, as shown in figure. |
|  | <b>NOTE!</b> The auxiliary voltage is generated in the transformer cabinet and supplied to the PCS and BES through the cables supplied by SOCOMEC, as shown in figure. |  |  |



### OPTIONAL INPUT FOR EXTERNAL INTERFACE PROTECTION

If local electricity supply company connection rules specify that external interface protection must be used, the external protection output signal (dry contact) can be used to control the internal contactor for the Sunsys PCS<sup>2</sup> IM, removing the jumper in figure.



**NOTE:** the auxiliary power supply cable must be fitted with a 10 A max. protection device.

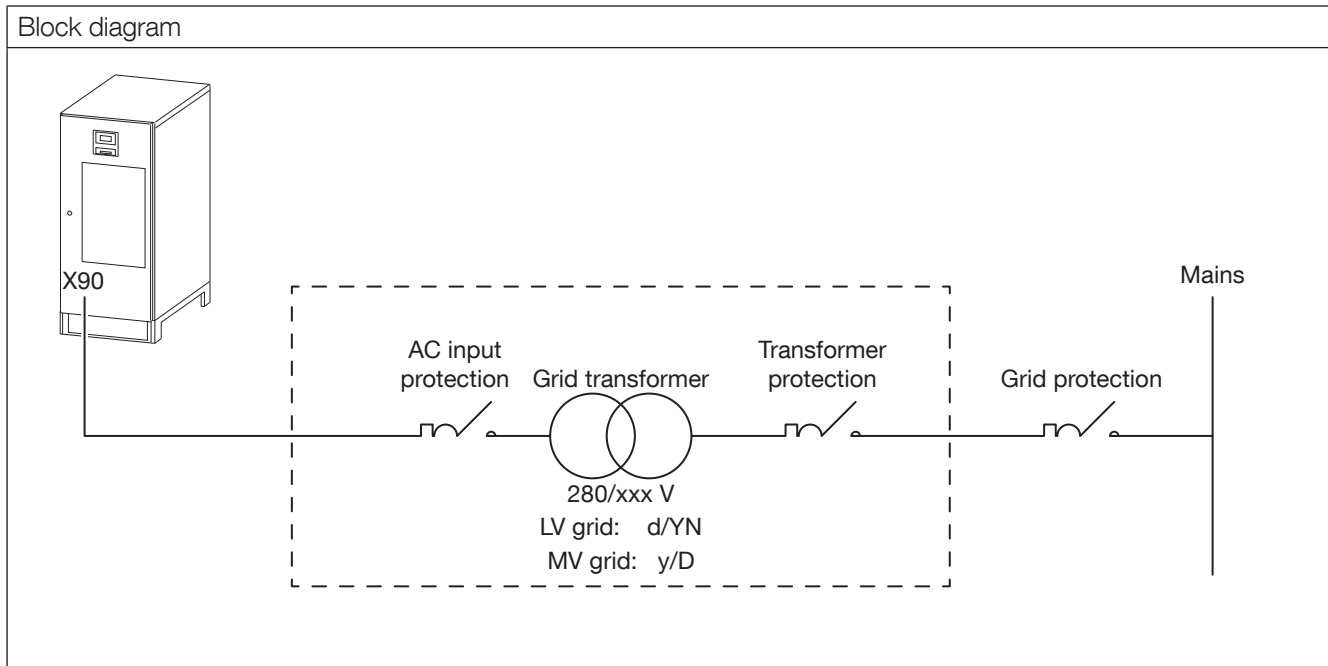
SUNSYS PCS<sup>2</sup> IM 132 - 200 TL



**NOTE:** the auxiliary power supply cable must be fitted with a 10 A max. protection device.

## 7.2 INSTRUCTIONS FOR SUNSYS PCS<sup>2</sup> IM 200 TL

The SUNSYS PCS<sup>2</sup> IM TL versions require the installation of a transformer coupling to the mains, in addition to the AC input protection.



### AC INPUT PROTECTION

Refer to 'Electrical installation' chapter.

### GRID TRANSFORMER

The transformer is necessary to connect the PCS<sup>2</sup> IM to mains.

The main technical characteristics are outlined in the following specification.

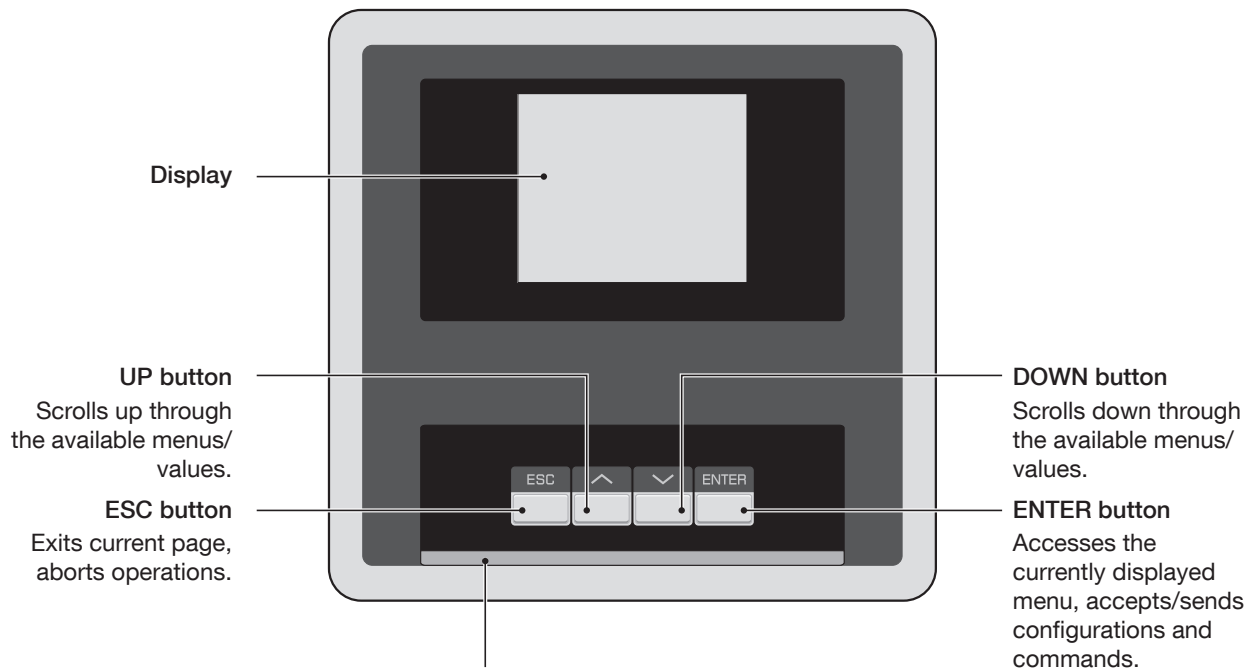
| Ratings                            |  |        |
|------------------------------------|--|--------|
| Parameter                          | 132 TL   | 200 TL |
| Rated power                        | 140 kW   | 210 kW |
| Rated frequency                    | 60 Hz  |        |
| Number of phases                   | 3  |        |
| Winding connection unit            | LV=> YNd<br>MV=> Dy  |        |
| Primary voltage - grid side        | Same of grid voltage (LV => Y + N   MV => D)                       |        |
| Secondary voltage - PCS side       | 280V (LV => d   MV => y)   |        |
| Grid voltage range                 | +10% / -10%  |        |
| Primary rated current - grid side  | Depends on grid voltage  |        |
| Secondary rated current - PCS side | 285.8 A  | 433 A  |
| Shielded                           | Yes<br>Between primary and secondary winding, connected to ground. |        |
| Overvoltage category               | Depends on grid overvoltage category                               |        |

### TRANSFORMER PROTECTION

The transformer protections must be chosen by the installer or plant designer.

## 8. CONTROL PANEL

The control panel displays information regarding operating status, electrical measurements, access to control functions and configuration parameters. It includes a colour graphic display and a luminous status bar.



### LUMINOUS STATUS BAR

Changes colour according to SUNSYS PCS<sup>2</sup> status.

- **Red:** SUNSYS PCS<sup>2</sup> off due to alert.
- **Flashing yellow:** at least one warning is present and SUNSYS PCS<sup>2</sup> is switched on.
- **Yellow:** at least one warning is present and SUNSYS PCS<sup>2</sup> is switched off or first maintenance period has elapsed.
- **Flashing green:** SUNSYS PCS<sup>2</sup> in startup procedure phase.
- **Green:** SUNSYS PCS<sup>2</sup> switched on.

## 8.1 EXCEPTION FOR PCS<sup>2</sup> IM 132 - 200 TL

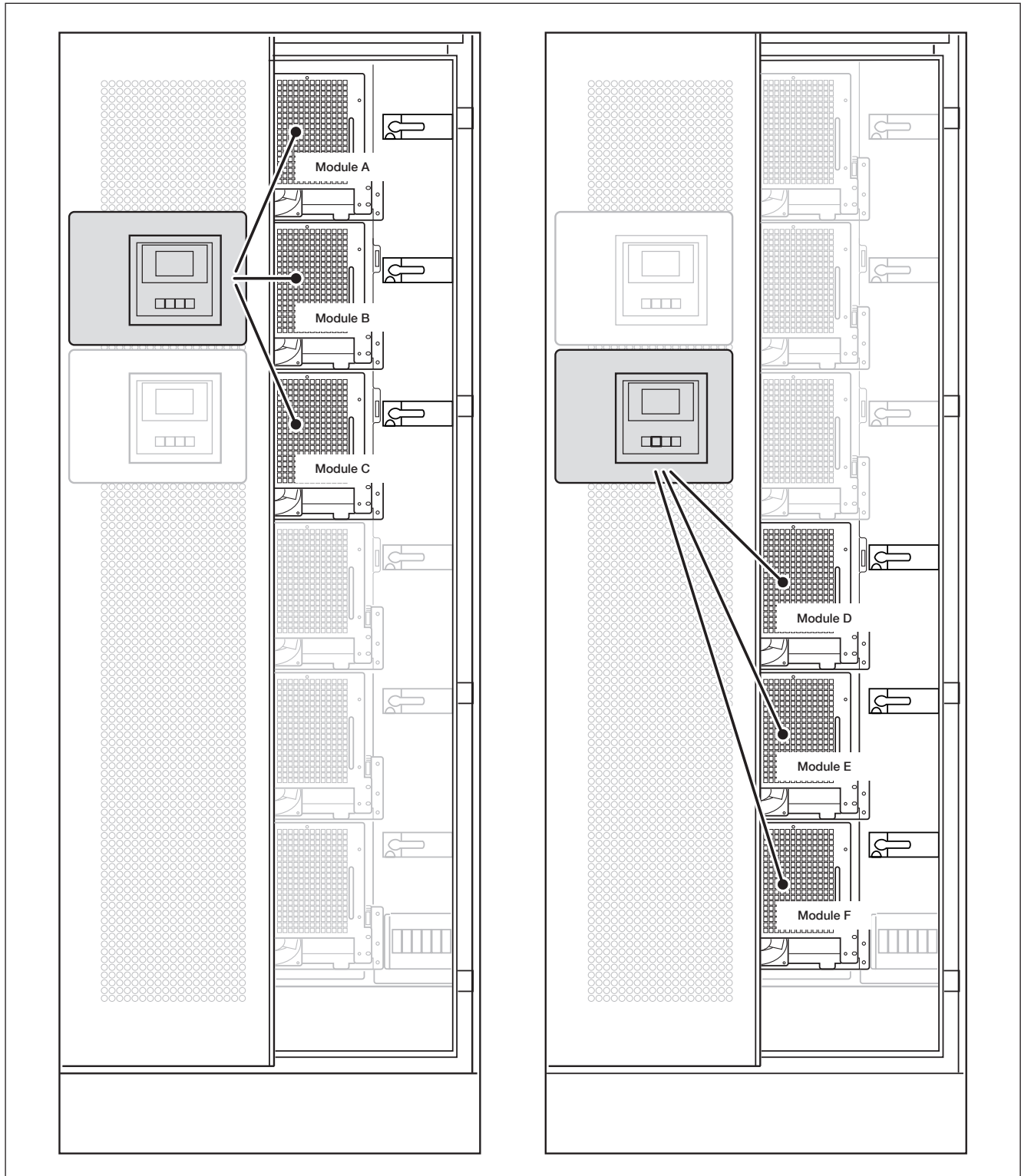
The PCS<sup>2</sup> IM 132 - 200 TL has two control panels:

- the upper one controls the upper three power modules (Module A, Module B, Module C).
- the lower one controls the lower three power modules (Module D, Module E, Module F).

So, the first start-up procedure must be applied to both control panels ('First start-up' chapter) and both have to be used to monitor measurements, alarms, etc. ('Menu' chapter).

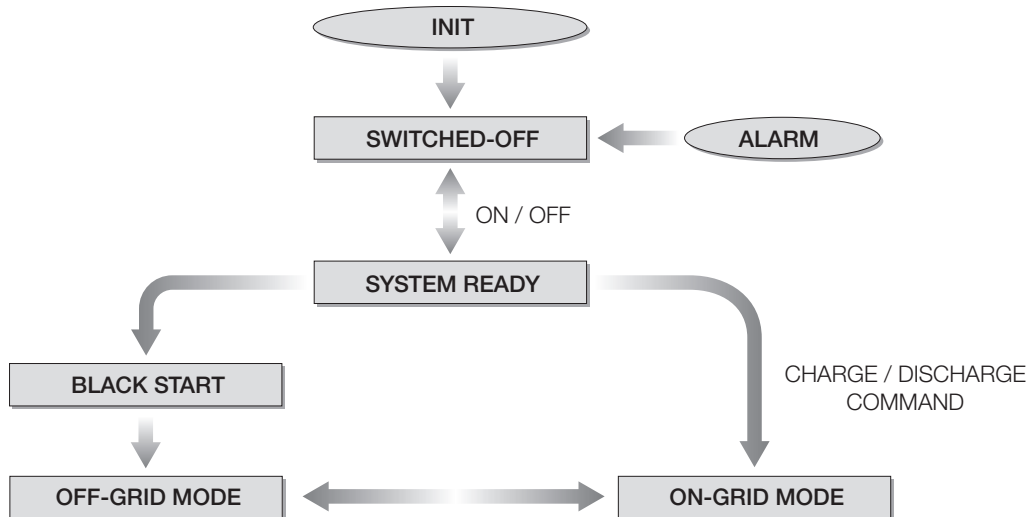


**NOTE:** in PCS<sup>2</sup> 132 TL, module A and D are not present.



## 8.2 CONVERTER STATE MACHINE

The SUNSYS PCS<sup>2</sup> IM implements the following state-machine concept:



At system power-on by the auxiliary power supply, the SUNSYS PCS<sup>2</sup> IM automatically enters the **SWITCHED-OFF** status: the Control Panel shows the message SWITCHED-OFF on the Status line on the display and the luminous status bar is switched-off.

An *ON* command connects the DC source to the SUNSYS PCS<sup>2</sup> IM and it enters the **SYSTEM READY** status, after checking the battery conditions are satisfactory. On the control panel, the battery icon is green (or yellow if a Battery Warning is present<sup>(1)</sup>) and the number of powered-on power modules appears.

The system can then operate in two modes, following two different paths:

- OFF-GRID MODE, operating in islanding conditions, as a grid-former;
- ON-GRID MODE, grid-tied and operating as a grid-follower.

From the SYSTEM READY status, a **BLACK START** procedure can be performed, in order to energise an isolated micro-grid by the battery system. After the black start procedure has completed, the SUNSYS PCS<sup>2</sup> IM enters **OFF-GRID MODE** status, generating the proper voltage and frequency references for the micro-grid.

From the SYSTEM READY status, with a *Charge/Discharge* command, the SUNSYS PCS<sup>2</sup> IM synchronizes and connects to the AC grid and enters **ON-GRID MODE** status. The SUNSYS PCS<sup>2</sup> IM follows P/Q references coming from an external control device.

The direction of the power flow on the display shows the instantaneous charging/discharging operation. The message INVERTER ON is displayed on the Status line on the display and the luminous status bar is switched-on with a green or flashing yellow light (if at least one warning is present<sup>(1)</sup>).

Transitions from OFF-GRID MODE to ON-GRID MODE and vice versa are supported by the SUNSYS PCS<sup>2</sup> IM: additional external devices and components shall be provided (e.g. synchronisation device, circuit breaker, measurement system). Contact SOCOMEC for further information.

In the event of an alarm, the system enters **ALARM** status and switches-off to ensure conditions are safe. The luminous status bar is switched-on with a red light and an alarm message appears on the display panel.

1. A Warning does not cause the ESS to stop.

## 9. FIRST START-UP



Before carrying out any operations on the unit read the 'Safety standards' chapter carefully.

When the SUNSYS PCS<sup>2</sup> IM is switched on for the first time the commissioning wizard is activated.

The commissioning wizard is an interactive procedure that guides the user through the SUNSYS PCS<sup>2</sup> IM 's first start-up procedure.

The most important steps are described below.

### LANGUAGE SETTING



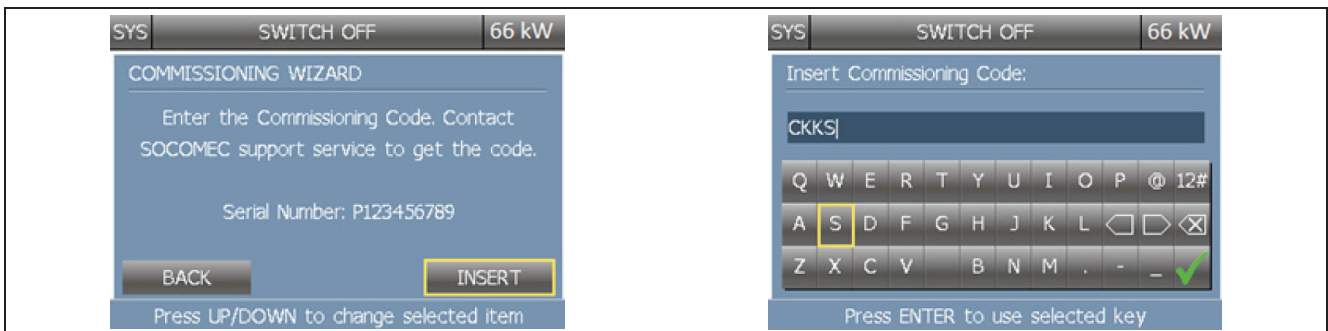
### ACTIVATION CODE

The Activation code - four-digit code - must be entered to operate the SUNSYS PCS<sup>2</sup> IM in both control panels.



**WARNING:** If the code is not entered the 'initial startup' procedure cannot be completed and the equipment will not operate.

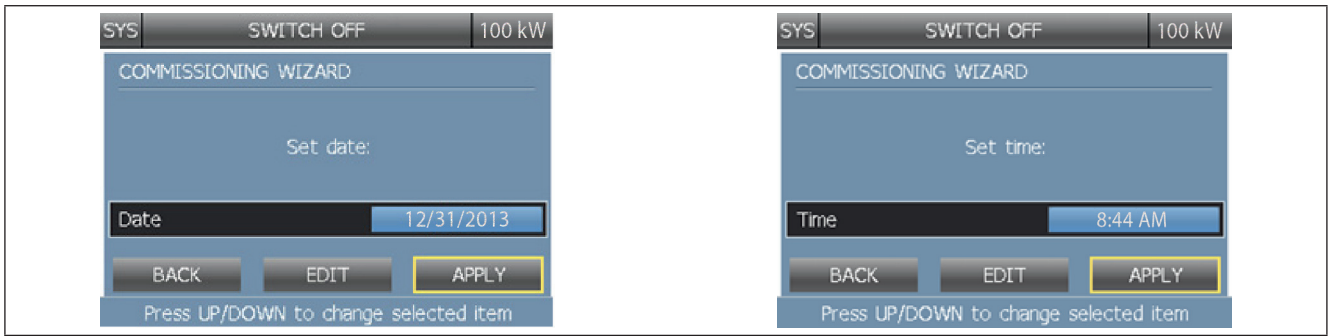
To get the activation code call the Service Centre and give the Serial Number, displayed on the control panel.



To insert the Activation Code:

- press INSERT (a screen keyboard appears);
- insert the Activation Code;
- press ✓;
- press ENTER.

## DATE & TIME



## SYSTEM SETUP

Set the number of modules installed (1, 2 or 3).



## TRANSFORMER TYPE

Set the type of transformer connected to SUNSYS PCS<sup>2</sup> IM.

- SOCOMEC: if standard transformer is used.
- External: if a custom transformer is provided by the customer.



## BATTERY TYPE

Set the type of battery connected to the SUNSYS PCS<sup>2</sup> IM (Generic, Lithium, Lead-acid, etc.).

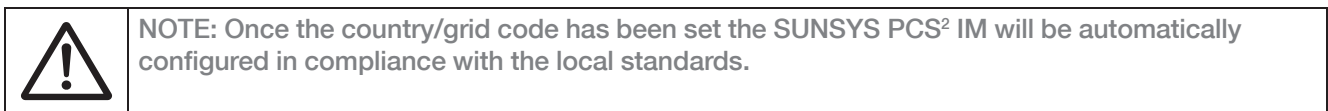
Depending on the type of battery, after commissioning, some specific items will be shown in the Battery Setting Menu to guarantee the correct SUNSYS PCS<sup>2</sup> IM set up.



## COUNTRY/GRID CODE SETTING

Set the proper country/grid code according to local regulation.

Grid code compatibility is always being upgraded, please contact SOCOMEC for grid code compatibility (subject to change without notice).



## OPTIMISATION MODE SETTING

Not present if Generic Battery is selected.

Set the battery mode of use. It is possible to choose between:

- PERFORMANCE: maximises battery performance (full SOC operating range);
- LIFE: maximises battery life (reduced SOC operating range).

## CONTROL MODE SETTING

Set the SUNSYS PCS<sup>2</sup> IM control mode. It is possible to choose between:

- local (using the control panel);
- external EMS (Energy Manager System);



# 10. MENU

## 10.1 DISPLAY OVERVIEW

Status bar

Labels and descriptions for the status bar:

- Energy direction:** Indicated by arrows above the battery and grid icons.
- Battery Status:** Represented by a battery icon.
- Charge status as a %:** SOC 0%
- SUNSYS PCS² IM module:** Indicated by module selection buttons (1, 2).
- ESS<sup>(1)</sup> Status:** SWITCH OFF
- SUNSYS PCS² IM Rated Power (kW):** 66 kW
- Grid status:** Represented by a grid icon.
- Instantaneous Power (kW):** 0.0 kW
- System view:** SYS button
- Help message area:** Press UP/DOWN to change module

Always present, displays a help message to guide the user through the display functions.

1. Energy Storage System (includes SUNSYS PCS² IM and Battery System).

Alarms area

Labels and descriptions for the alarms area:

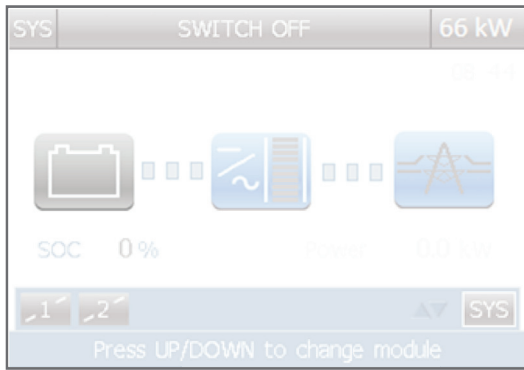
- Alarms area:** Present when an alarm is active. Enter ALARMS menu to display the complete alarms list.





Status icons

Labels and descriptions for the status icons:

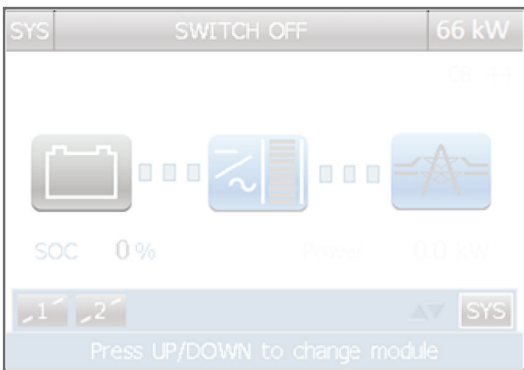
- Time:** SUNSYS PCS² IM current time.
- Commissioning Code not inserted or Scheduled Inspection warning:** machine inspection required. Call SOCOMEC support service
- Key icon:** Displayed if the keypad has been locked.
- USB icon:** Displayed if a USB memory stick is inserted. It must be formatted with a FAT32 file system.
- Modem icon:** reserved for technical service.
- Network icon:** Displayed if a valid link has been established on the ethernet. Flashes when a remote host is communicating with the SUNSYS PCS² IM.






## SUNSYS PCS<sup>2</sup> IM Status



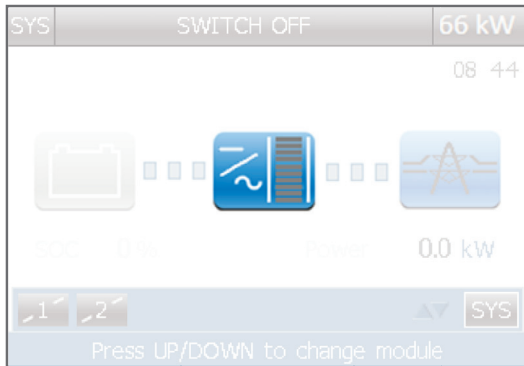
-  (grey icon) Battery not present
-  (green icon) SUNSYS PCS<sup>2</sup> IM normal operation
-  (yellow icon) SUNSYS PCS<sup>2</sup> IM warning flagged
-  (red icon) SUNSYS PCS<sup>2</sup> IM alarm flagged











## Battery status



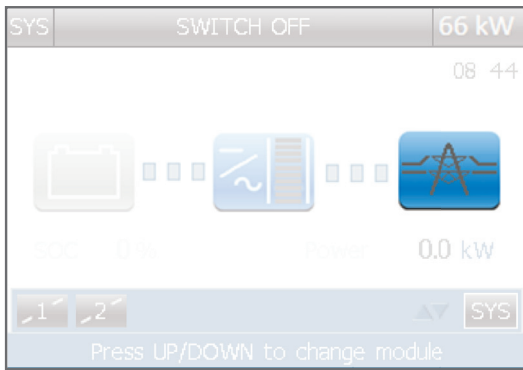
-  SOC ≥ 87.5 %
-  62.5 % ≤ SOC ≤ 87.5 %
-  37.5% ≤ SOC ≤ 62.5 %
-  12.5 % ≤ SOC ≤ 37.5 %
-  SOC ≤ 12.5 %

## Instant power level



- |   |   |   |   |   |
|---|---|---|---|---|
|  |  |  |  |  |
| ≤ 10%   | ≤ 20%   | ≤ 30%   | ≤ 40%   | ≤ 50%   |
|  |  |  |  |  |
| ≤ 60%   | ≤ 70%   | ≤ 80%   | ≤ 90%   | > 90%   |

## Grid status



On-Grid mode

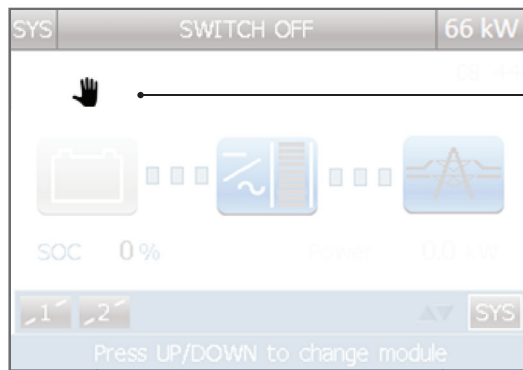


Off-Grid mode



Black-Start in progress

## Local command



Local Command  
charge/discharge sequence



**NOTE:** the procedures available depend on the type of battery setting.



**NOTE:** the 'Stop sequence' command must be selected to change the procedure.

## 10.2 MENU TREE

| FIRST LEVEL         | SECOND LEVEL                    | THIRD LEVEL  |
|---------------------|---------------------------------|--|
| STATISTICS          | COUNTERS                        |  |
|                     | PRODUCTION GRAPHS               | DAILY TREND  |
|                     |                                 | DOD DISTRIBUTION   |
|                     |                                 | DISCHARGE DURATION   |
|                     |                                 | BATTERY TEMPERATURE  |
| MEASUREMENTS        | PCS POWER                       |  |
|                     | AC MEASURES                     |  |
|                     | BATTERY MEASUREMENTS            |  |
|                     | SENSORS                         |  |
| ALARMS AND WARNINGS | ALARMS                          |  |
|                     | WARNINGS                        |  |
| HISTORY LOG         |                                 |  |
| COMMANDS            | LOCAL PROCEDURE                 | Start charge/discharge <sup>(5)</sup>                                |
|                     |                                 | PCS calibration <sup>(6)</sup>                                       |
|                     |                                 | Stop procedure <sup>(6)</sup>  |
|                     | ALARM RESET                     | Alarm reset  |
|                     | TEST PROCEDURES                 | Led bar test   |
|                     |                                 | AC contactors test   |
|                     |                                 | Start fan test   |
|                     | RESET STATISTICS                | Reset all production data  |
| RESTART DISPLAY     | Restart display                 |  |
| SISTEM CONFIG       | Start config procedure          |  |
| SETTINGS            | PREFERENCES                     | LANGUAGE   |
|                     |                                 | DATE AND TIME  |
|                     |                                 | BUZZER   |
|                     |                                 | DISPLAY  |
|                     |                                 | PASSWORDS  |
|                     | SYSTEM CONFIGURATION            | Local/remote control   |
|                     |                                 | N° of modules  |
|                     |                                 | Transformer type   |
|                     |                                 | AC Interface Protection [Internal/External]                          |
|                     |                                 | Energy saver mode  |
|                     | PCS SETTINGS                    | NOMINAL VOLTAGE/FREQUENCY  |
|                     |                                 | COUNTRY/NETWORK CODE   |
|                     |                                 | CONNECTION PARAMETERS  |
|                     |                                 | EQUIPMENT PROTECTION THRESHOLDS                                      |
|                     |                                 | Additional items depending on the Country/<br>Network Code selection |
|                     | BATTERY SETTINGS <sup>(1)</sup> | BATTERY TYPE   |
|                     |                                 | BATTERY PARAMETERS <sup>(2)(3)</sup>                                 |
|                     |                                 | BATTERY PARAMETERS MODE <sup>(3)</sup>                               |
|                     |                                 | CHARGE THRESHOLDS  |
|                     |                                 | DISCHARGE THRESHOLDS   |
|                     |                                 | MAINTENANCE PARAMETERS <sup>(2)</sup>                                |
|                     |                                 | SOH CALCULATION <sup>(2)</sup>                                       |
|                     |                                 | OPTIMIZATION MODE <sup>(4)</sup>                                     |
|                     | ADVANCED CONFIGURATION          |  |
|                     | OPTIONAL DEVICES                | OPTIONAL DEVICES 1   |
|                     |                                 | OPTIONAL DEVICES 2   |
|                     | CONNECTIVITY                    | PERIPHERALS  |
| SERVICES            |                                 |  |

| FIRST LEVEL       | SECOND LEVEL       | THIRD LEVEL          |
|-------------------|--------------------|----------------------|
| SERVICE           | PCS DESCRIPTION    |                      |
|                   | FIRMWARE VERSION   | SYSTEM               |
|                   |                    | MODULE1              |
|                   |                    | MODULE2              |
|                   |                    | MODULE3              |
|                   | SERIAL NUMBER      |                      |
|                   | COMMISSIONING CODE |                      |
|                   | UPGRADE FIRMWARE   | UPGRADE HMI FIRMWARE |
| UPGRADE LANGUAGES |                    |                      |

1. Password protected.
2. Shown only if Lead-Acid battery type is set.
3. Shown only if generic battery type is set.
4. Shown only if Lithium Samsung or Lithium Saft is set.
5. Access is allowed if Local mode is enabled: SETTING > SYSTEM CONFIGURATION > Local/remote control

### KEYPAD LOCKING

The keypad can be locked by pressing the buttons in the following sequence:

**ESC > UP > DOWN > ENTER**

To unlock the keypad the buttons must be pressed in the reverse sequence:



**ENTER > DOWN > UP > ESC**

These sequences only work on the Mimic Panel page.

### ENTERING PASSWORDS

Some operations and settings require a password in order to be performed.

If this is the case, a padlock is displayed. When a password is required, a virtual keyboard is displayed. After inserting a valid password, the padlock opens and the operation can be performed. The default password is **SUNS**.

|   |  |
|---|--|
|  | <p><b>WARNING:</b> the password protects important settings and parameters which are essential for correct SUNSYS PCS<sup>2</sup> IM operation.</p> <p>Only skilled and qualified technicians are allowed to access the protected parameters. Incorrect settings may damage the equipment.</p> |
|  | <p><b>NOTICE:</b> It is advisable to change the password to prevent unauthorised access.</p>   |

## 10.3 MENU DESCRIPTION

### DISPLAY MENU

It is possible to view information corresponding to individual modules on the mimic panel by selecting the SUNSYS PCS<sup>2</sup> IM serial number.

### LANGUAGE UPGRADE

The SUNSYS PCS<sup>2</sup> IM is delivered with the following built-in languages: English, French, Italian, German, Spanish. Further language packages can be provided by SOCOMEC, in case new markets are approached.

Text translations are held in files with the \*.lng extension which are provided by SOCOMEC. Language upgrades must be performed through the USB port, using a standard USB memory stick. The USB device must be formatted with FAT16 or FAT32.

#### Step 1

The language file to be installed must be copied onto a USB stick and placed in the standard folder:

{USB stick}\socomec\wghi

#### Step 2

Insert the USB stick into the USB port on the back of the SUNSYS PCS<sup>2</sup> IM door.

#### Step 3

Enter the menu: SERVICE > UPGRADE FIRMWARE > UPGRADE LANGUAGES. The SUNSYS PCS<sup>2</sup> IM has to be selected beforehand on the main page.

#### Step 4

The list of files in the \socomec\wghi folder in the USB memory stick is shown. Select the file you want to install and follow the instructions displayed.

#### Step 5

At the end of the process select Yes to restart the display.

#### Step 6

Remove the USB stick when requested.

#### Step 7

The new language is available after restarting.

To change the language go to the SYSTEM menu: SETTINGS > PREFERENCES > LANGUAGE.

*To restore English as the default language press the ESC button for at least 4 seconds on the main page (mimic panel page).*

## STATISTICS MENU

This menu displays the COUNTERS and the PRODUCTION GRAPH:

- Counters store the Running Time [Hrs] and the Tot. Num. Of Cycles.
- Production graph illustrates the:
  - Daily Trend, (last 7 days of SOC and Active Power).
  - Depth of Discharge Distribution, (numbers of cycles with a specific DOD).
  - Discharge Duration, (number of cycles with a specific discharge period).
  - Battery Temperature (number of working hours at specific temperature).

## COMMANDS

The menu contains a list of commands that the user can activate through the display:

- Local Procedure:
  - Charge/discharge battery.
  - Stop procedure.
  - Calibration procedure of SUNSYS PCS<sup>2</sup> IM.
  - Commissioning procedure (only for Lead Acid Battery).
  - Equalisation procedure (only for Lead Acid Battery).
  - SOH estimation (only for Lead Acid Battery).

## SETTINGS

This menu contains the System Configuration Parameters, all of them are password protected and it contains parameters for the PCS and battery configuration.

Please contact SOCOMEC for the correct configuration of the PCS according to the specific plant requirements.

Please contact SOCOMEC for the correct configuration of the Battery according to the specific battery installed.

## 10.4 DEFAULT SETTINGS



### NOTE!

Changes to the threshold parameters listed below can lead to changes regarding conformity with the standard and must be approved by the on site electric utility company and/or the appropriate authority.

The system is qualified as a "Grid Support Utility Interactive Inverter", covering grid support functions specified in UL1741 Supplement SA.

The interconnection system default response to abnormal voltages and to abnormal frequencies is set in compliance with prescriptions given by UL1741 Supplement SA. Default values and ranges of adjustability (in brackets {...}) are provided in Tab. 10.4.1 and Tab. 10.4.2.

Specific information about the grid support functions are described in Chapter 15 "UL1741SA: How to configure grid support functions".

### 10.4.1 INTERCONNECTION SYSTEM RESPONSE TO ABNORMAL VOLTAGES

| UL1741 Supplement SA |                     |                    |
|----------------------|---------------------|--------------------|
| Threshold            | Voltage (% of UNOM) | Clearing time (s)  |
| UV3                  | < 50 {5 - 100}      | 1.50 {0.01 – 300}  |
| UV2                  | < 70 {5 - 100}      | 11.00 {0.01 – 300} |
| UV1                  | < 88 {5 - 100}      | 21.00 {0.01 – 300} |
| OV1                  | > 110 {100 – 120}   | 13.00 {0.01 – 300} |
| OV2                  | ≥ 120 {100 – 120}   | 0.16 {0.01 – 300}  |

### 10.4.2 INTERCONNECTION SYSTEM RESPONSE TO ABNORMAL FREQUENCIES

| UL1741 Supplement SA |                  |                   |
|----------------------|------------------|-------------------|
| Threshold            | Frequency (Hz)   | Clearing time (s) |
| UF2                  | < 57 {53 - 60}   | 0.16 {0.01 – 300} |
| UF1                  | < 58.5 {53 - 60} | 300 {0.01 – 300}  |
| OF1                  | > 60.5 {60 - 65} | 300 {0.01 – 300}  |
| OF2                  | > 62 {60 - 65}   | 0.16 {0.01 – 300} |

The system default response to abnormal voltages and to abnormal frequencies can be set to be compliant with IEEE 1547-2003 (Tab. 10.4.3 and Tab. 10.4.4) or with IEEE 1547a-2014 (Tab. 10.4.5 and Tab. 10.4.6), as well. Default values and ranges of adjustability (in brackets {...}) are provided in the tables.

### 10.4.3 INTERCONNECTION SYSTEM RESPONSE TO ABNORMAL VOLTAGES

| IEEE 1547-2003 |                     |                   |
|----------------|---------------------|-------------------|
| Threshold      | Voltage (% of UNOM) | Clearing time (s) |
| UV1            | < 50 {50 - 100}     | 0.16 {0 - 0.16}   |
| UV2            | < 88 {50 - 100}     | 2.00 {0 - 21.00}  |
| OV1            | > 110 {100 - 120}   | 1.00 {0 - 13.00}  |
| OV2            | ≥ 120 {100 - 120}   | 0.16 {0 - 0.16}   |

### 10.4.4 INTERCONNECTION SYSTEM RESPONSE TO ABNORMAL FREQUENCIES

| IEEE 1547-2003 |                    |                   |
|----------------|--------------------|-------------------|
| Threshold      | Frequency (Hz)     | Clearing time (s) |
| UF1            | < 57 {57 - 59.8}   | 0.16 {0 - 0.16}   |
| UF2            | < 59.3 {57 - 59.8} | 0.16 {0 - 300.00} |
| OF1            | > 60.5 {60 - 64}   | 0.16 {0 - 0.16}   |




#### 10.4.5 INTERCONNECTION SYSTEM RESPONSE TO ABNORMAL VOLTAGES

| IEEE 1547a-2014 |                     |                   |
|-----------------|---------------------|-------------------|
| Threshold       | Voltage (% of UNOM) | Clearing time (s) |
| UV1             | < 45 {45 - 100}     | 0.16 {0 - 0.16}   |
| UV2             | < 60 {45 - 100}     | 1.00 {0 - 11.00}  |
| UV3             | < 88 {45 - 100}     | 2.00 {0 - 21.00}  |
| OV1             | > 110 {100 - 120}   | 1.00 {0 - 13.00}  |
| OV2             | ≥ 120 {100 - 120}   | 0.16 {0 - 0.16}   |

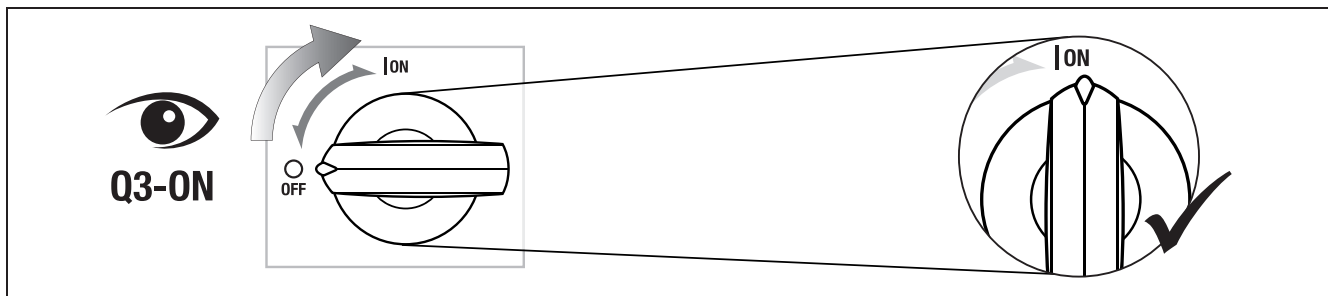
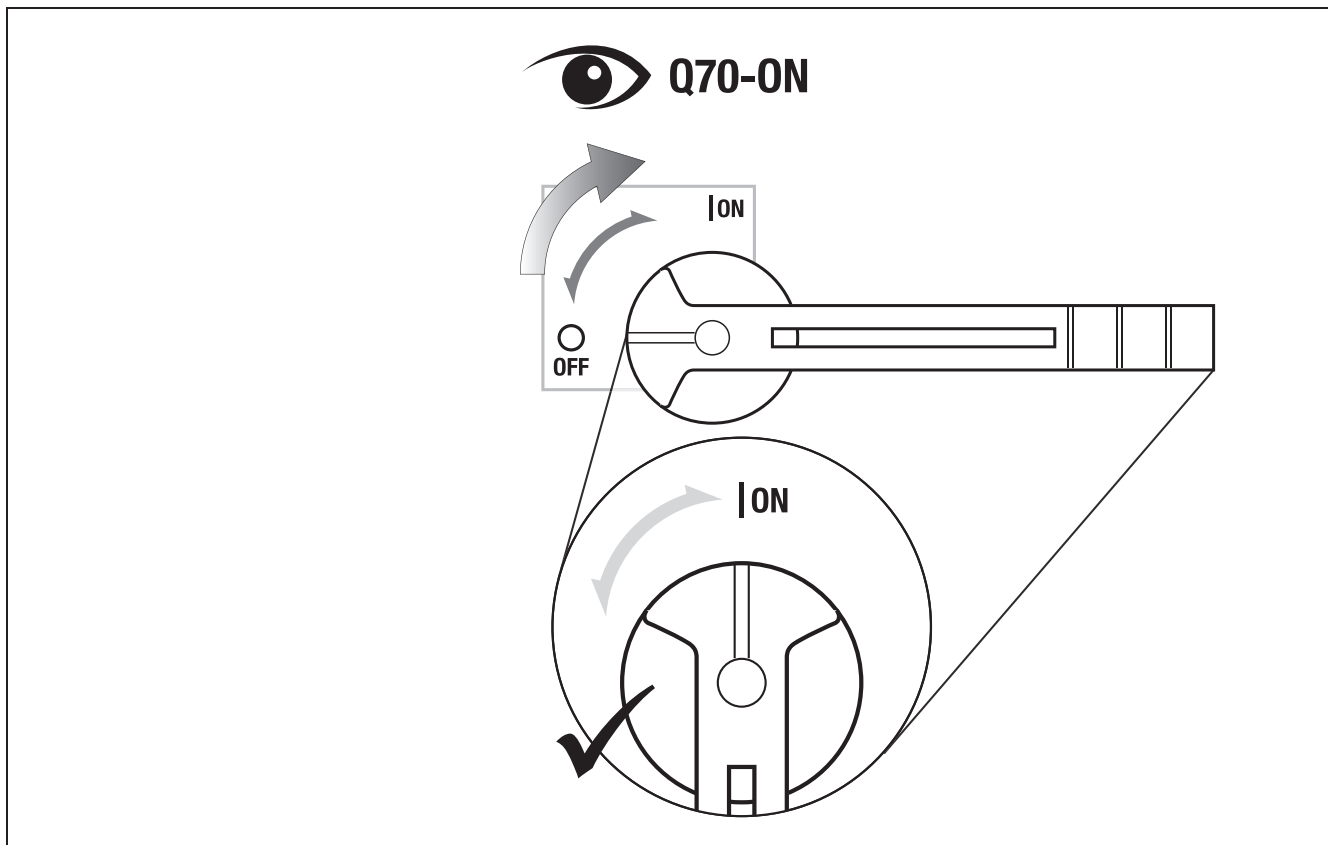
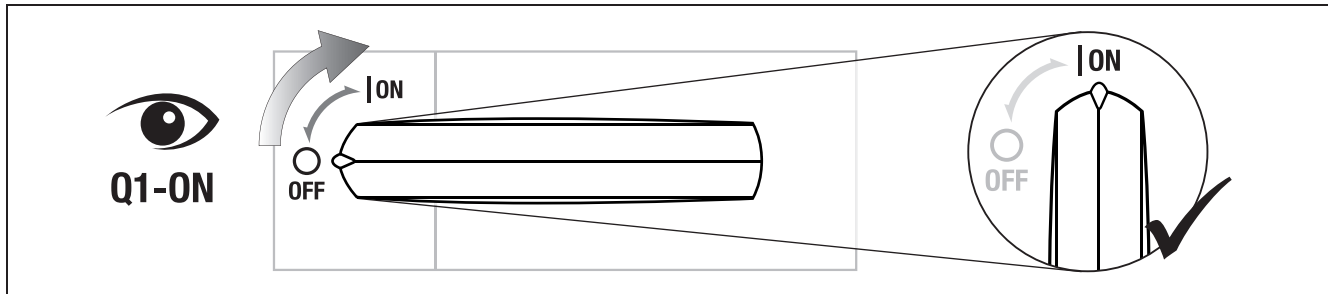
#### 10.4.6 INTERCONNECTION SYSTEM RESPONSE TO ABNORMAL FREQUENCIES

| IEEE 1547a-2014 |                  |                   |
|-----------------|------------------|-------------------|
| Threshold       | Frequency (Hz)   | Clearing time (s) |
| UF1             | < 57 {56 - 60}   | 0.16 {0 - 10.00}  |
| UF2             | < 59.5 {56 - 60} | 2.00 {0 - 300.00} |
| OF1             | > 60.5 {60 - 64} | 2.00 {0 - 300.00} |
| OF2             | > 62 {60 - 64}   | 0.16 {0 - 10.00}  |

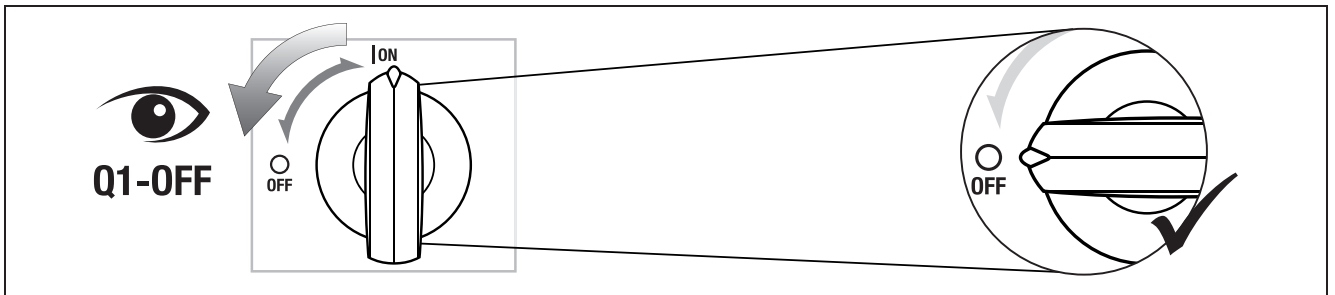
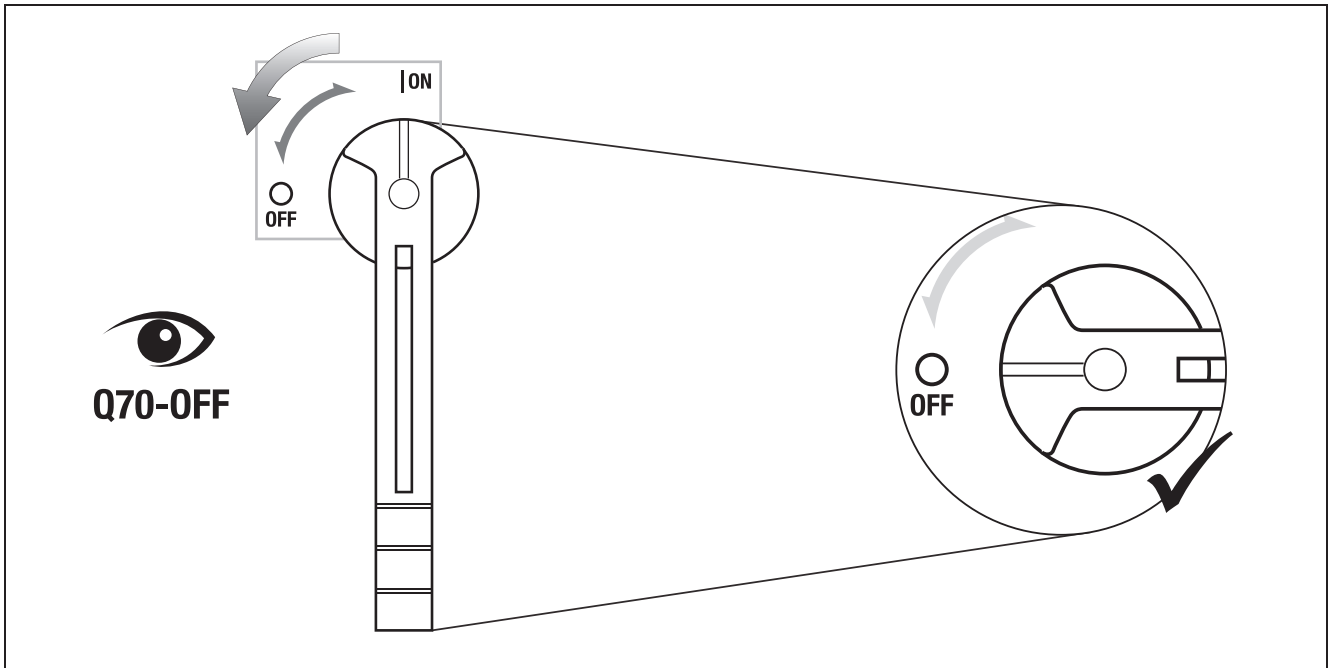
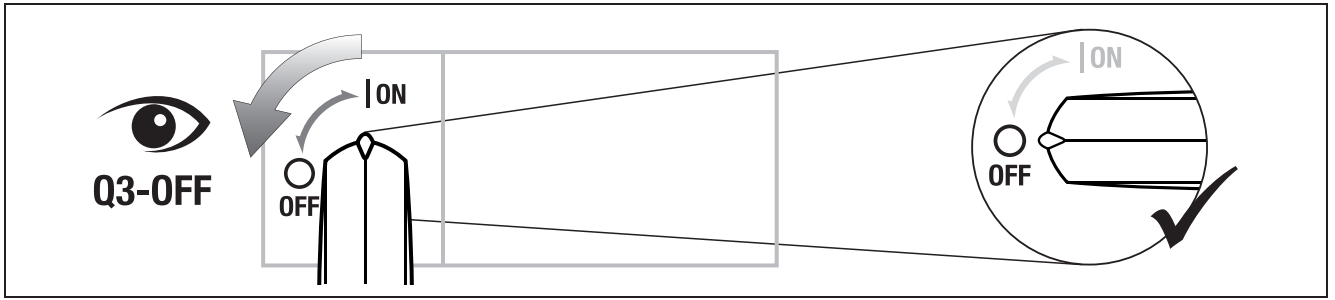
# 11. OPERATING PROCEDURES

 NOTE: before carrying out any operations on the unit read the 'Safety standards' chapter carefully.

## 11.1 SWITCHING ON



## 11.2 SWITCHING OFF



Q70 isn't present on PCS 100kW, 132kW and 200kW.

If the auxiliary power supply also needs to be cut off, disconnect the cable from the auxiliary power supply input socket or break the fuse connection.

This procedure will switch off all the auxiliary SUNSYS PCS<sup>2</sup> IM equipment, including the system controller and the control panel.

The general AC power contactor for the machine will also be opened.


# 12. STANDARD FEATURES AND OPTIONS

| Features                             | Type          | Description   | Availability                     |
|--------------------------------------|---------------|---|----------------------------------|
| AC surge protection devices (SPD AC) | Electrical    | This feature provides protection against AC overvoltage | Available as option <sup>1</sup> |
| DC surge protection devices (SPD DC) | Electrical    | This feature provides protection against DC overvoltage | Available as option              |
| Serial communication interface       | Communication |   | Available as standard            |
| Modbus TCP interface                 | Communication |   | Available as standard            |
| ADC card                             | Communication |   | Available as standard            |
| Communication card                   | Communication |   | Available as option              |

1. Standard on 33-66-100 TR and 132, 200 TL.

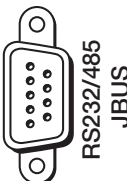
## 12.1 SERIAL COMMUNICATION INTERFACE

RS232/485 is a serial communication channel which can be used to connect to an external EMS or to a BMS (Battery Management System), depending on the battery type.

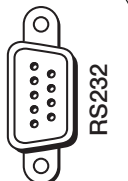
|   |  |
|---|--|
|  | <b>NOTE: RS485 cable has to be shielded.</b> |
|---|--|

SUNSYS PCS<sup>2</sup> IM 33-66-100 TR

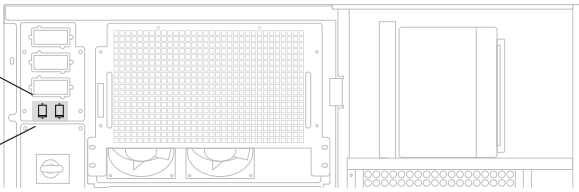
Only for service



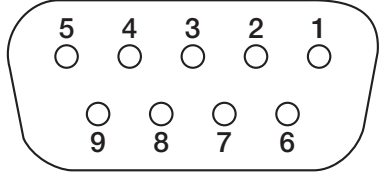
RS232/485  
JBUS

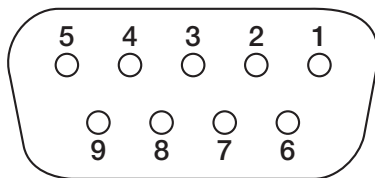
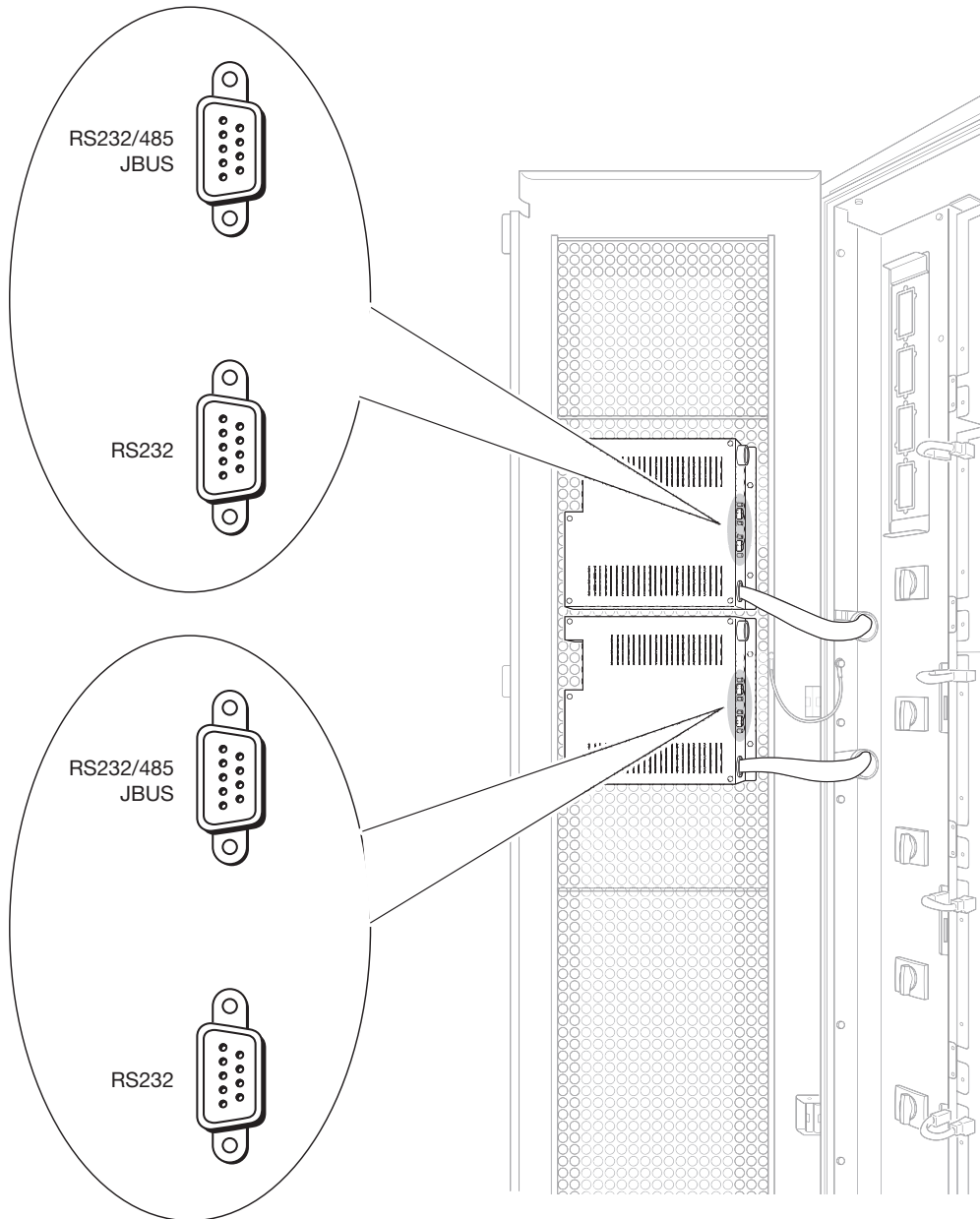


RS232



| RS232/485 C1 pin key | RS232 pin key   |
|----------------------|-----------------|
| 1 Not connected      | 1 Reserved      |
| 2 RX for RS232       | 2 RX for RS232  |
| 3 TX for RS232       | 3 TX for RS232  |
| 4 Data +             | 4 Reserved      |
| 5 GND                | 5 GND for RS232 |
| 6 Data -             | 6 Not connected |
| 7 Reserved           | 7 RTS           |
| 8 Not connected      | 8 CTS           |
| 9 +12V               | 9 +12V          |





**RS232/485 C1 pin key**

- 1 Not connected
- 2 RX for RS232
- 3 TX for RS232
- 4 Data +
- 5 GND
- 6 Data -
- 7 Reserved
- 8 Not connected
- 9 +12V

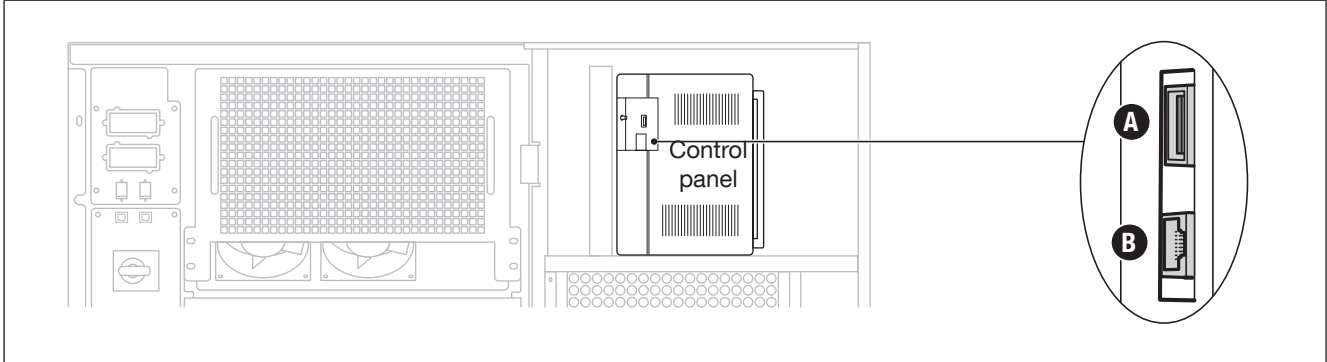
**RS232 pin key**

- 1 Reserved
- 2 RX for RS232
- 3 TX for RS232
- 4 Reserved
- 5 GND for RS232
- 6 Not connected
- 7 RTS
- 8 CTS
- 9 +12V

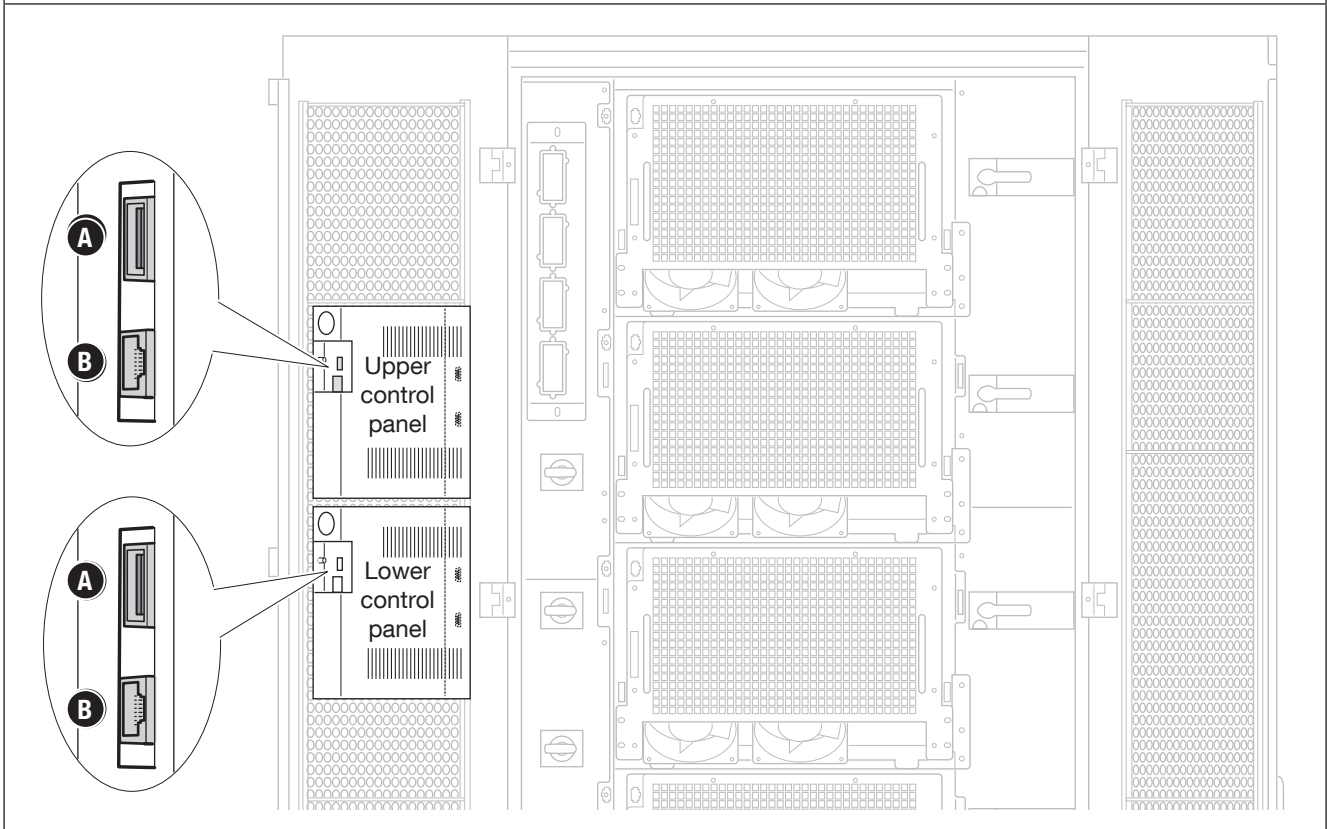
## 12.2 MODBUS TCP INTERFACE

The SUNSYS PCS<sup>2</sup> IM can be managed from remote stations using MODBUS TCP network protocol. See menu **SETTINGS > CONNECTIVITY > PERIPHERALS > NETWORK PARAMETERS** to **Enable/Disable DHCP** setting. Restart the HMI after modifying the parameters. IP Addresses can be changed only if DHCP is disabled.

SUNSYS PCS<sup>2</sup> IM 33 TR - 66-100 TR



SUNSYS PCS<sup>2</sup> IM 132 - 200 TL



### Key

- A USB connector
- B LAN RJ45 connector for ethernet



**NOTE:** Ethernet cable has to be shielded.

## 12.3 ADC CARD

This card manages four normally closed or normally open outputs and three digital inputs in configurable mode.

- Electrical data.
  - Permitted rated current and voltage of normally open or normally closed contacts: 2 A 250 Vac depending on the terminal used.
  - Inputs are activated on loop closing.
- External ESD connection.

A remote emergency shutdown system (ESD) can be installed by means of the ADC card. Connect a normally closed zero-potential contact to terminals IN1+ and IN1- of the ADC card.



**Intervention of the ESD input switches off the SUNSYS PCS<sup>2</sup> IM output.**

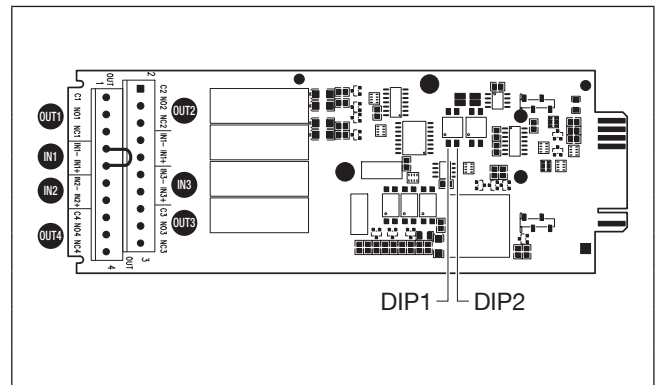
**To restore the SUNSYS PCS<sup>2</sup> IM to operation:**

- Close the ESD contact on 'IN 1' on the ADC board.
- Send the Alarms Reset command.

The configuration and the designation of function for the card's IN/OUT depends on the kind of batteries connected to the SUNSYS PCS<sup>2</sup> IM, whose configuration table is included in the battery cabinet manual.

The following table refers to Lead-Acid batteries only.

| ADC CARD CONFIGURATION<br>DIP1: OFF - DIP2: OFF |                      |                             |
|---|----------------------|-----------------------------|
| IN/OUT  | Description          | Filter level <sup>(1)</sup> |
| OUT 1   | General Alarm        | 0                           |
| OUT 2   | DC contactor command | 1                           |
| OUT 3   | Battery low          | 0                           |
| OUT 4   | Fan command          | 0                           |
| IN 1 <sup>(2)</sup>                             | ESD                  | 0                           |
| IN 2 <sup>(3)</sup>                             | Thermal protection   | 2                           |
| IN 3  | Temperature sensor   | /                           |

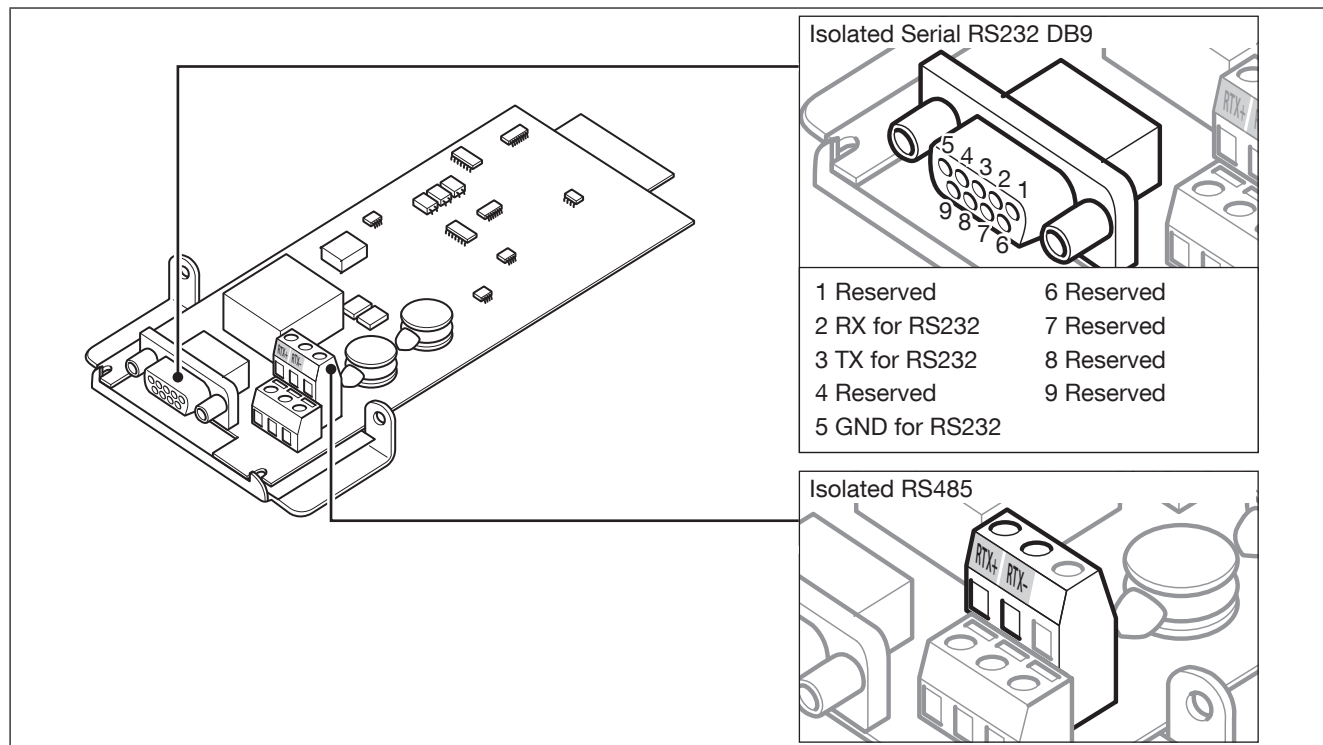


1. The filter level indicates the activation delay: 0 (no delay), 1 (1 s delay), 2 (60 s delay).
2. If the external ESD button is not used always insert a jumper to short circuit input IN 1.
3. If the external thermal protection is not used always insert a jumper to short circuit input IN 2.

If used in 132, or 200 TL the ADC cards must be n°2.

## 12.4 SERIAL COMMUNICATION INTERFACE

Isolated Serial RS232 DB9 and RS485 connectors are available on the card.

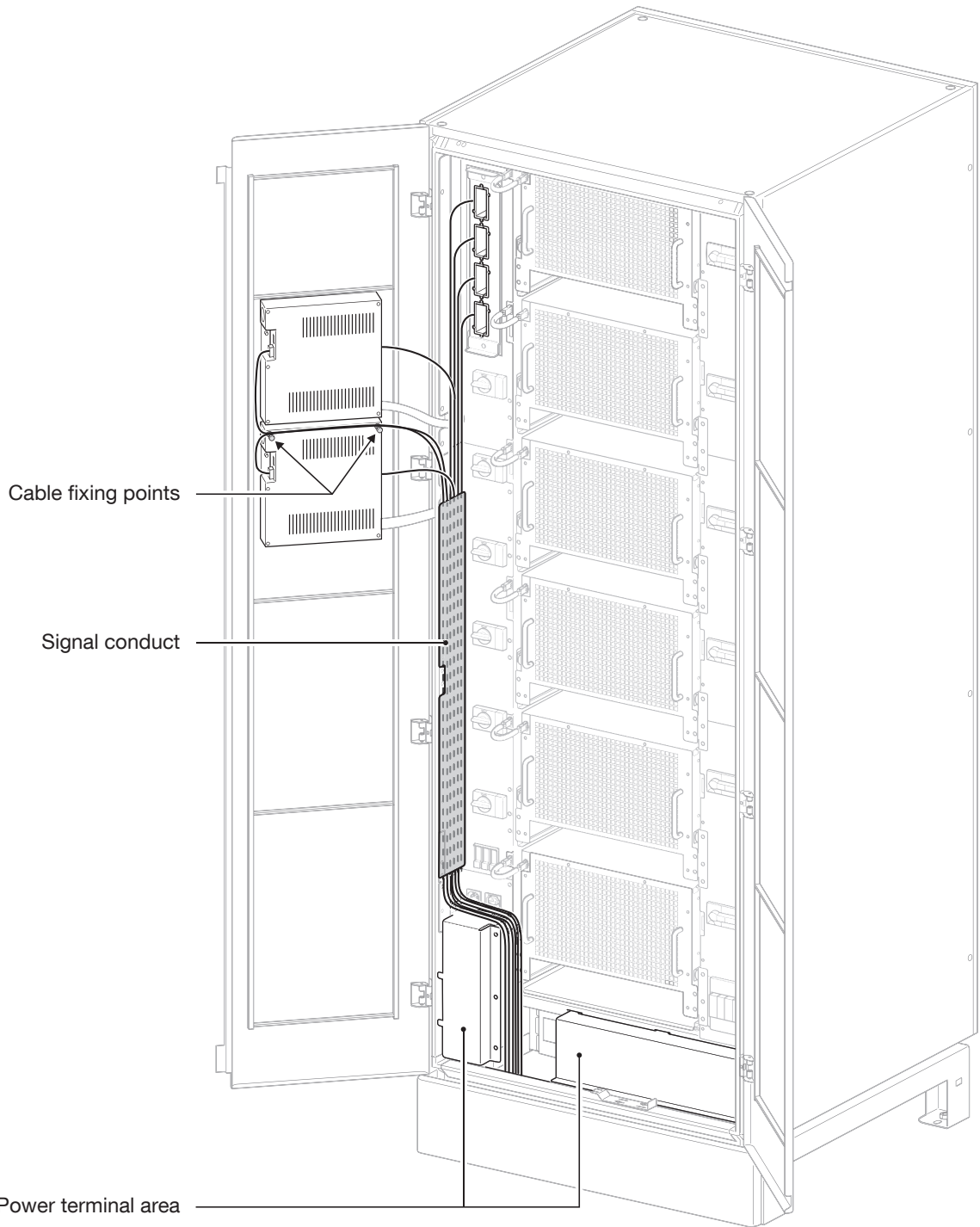


If used in 132, or 200 TL the serial communication interface cards must be n°2.



## 12.5 SIGNAL CABLES ROUTE

PCS<sup>2</sup> IM 132 - 200 TL



**WARNING:** Signal cables must not entry inside the power terminal area.

# 13. WARNINGS AND TROUBLESHOOTING

The alarm messages offer immediate diagnosis of any faults, malfunctions or breakdowns in the batteries.

The following events are indicated:

- Warning: non-serious alarm condition that causes the unit stop. This can be reset automatically.
- Alarm: serious alarm conditions that cause the unit stop. These alarm conditions require a manual reset.

Alarm and warnings are divided into two categories:

- System Alarms/Warnings: these alarms/warnings relate to external parts of the unit (mains power network, output line, ambient temperature). Corrective actions are activated by the user (system installer or operator) or by the Support team.
- Unit Alarms/Warnings: these alarms/warnings relate to parts of the unit. Corrective actions are carried out by the Support Service.

| System warnings    |   |  |   |
|--------------------|---|--|---|
| Warning            |   | Cause  | Remedy  |
| W01                | Ambient over-temperature                              | The ambient temperature recorded by the unit is over 45° (see values on mimic panel).  | Check the ventilation or air-conditioning system in the unit room.                      |
| W02                | Ambient temperature under the minimum threshold       | The ambient temperature recorded by the unit is under 15° (see value on mimic panel).  | Check the ventilation or air-conditioning system in the unit room.                      |
| W04                | Internal over-temperature                             | The temperature of the unit power structure is over 110° (see value on mimic panel).   | Check the ventilation or air-conditioning system in the unit room.                      |
| W66                |   |  |   |
| W20                | High impedance to earth                               | The isolation controller and resistance to earth values recorded are too high.   | Check the protective fuses. If the problem persists contact the support service.        |
| W21 <sup>(2)</sup> | Active Power reference too low for charging batteries | The active power set point is too low to charge battery.   | Increase the value of active power set point to allow correct battery charging current. |
| W23                | Battery fully discharged                              | Battery is fully discharged.   | Recharge the battery.   |
| W24 <sup>(2)</sup> | Battery Low Voltage                                   | Battery cell voltage is critically low.  | Recharge the battery.   |
| W25 <sup>(2)</sup> | Battery Low Capacity                                  | Battery charge is critically low.  | Recharge the battery.   |
| W26 <sup>(2)</sup> | Battery Rest Time request                             | Battery has to wait for the Rest Time before charging/discharging.   | Wait for the rest time.   |
| W27 <sup>(2)</sup> | Battery Full Charge request                           | Battery requires a Full Charge before discharging.   | Full recharge of the battery.   |
| W28 <sup>(2)</sup> | Battery Over-temperature                              | Battery temperature too high.  | Reduce ambient temp.  |
| W29 <sup>(2)</sup> | Calibration Procedure request                         | Execution of Calibration procedure is required.  | Execute calibration procedure.  |
| W30 <sup>(2)</sup> | Equalisation Procedure request                        | Execution of Equalisation procedure is required.   | Execute equalisation procedure.   |
| W31                | Local Mode Enabled                                    | ESS is locally controlled through HMI.   | Use HMI to control.   |
| W32                | General Battery Warning                               | Other battery warnings are present.  | Solve the specific battery warning.   |
| W33                | AC input network outside voltage on frequency range   | Input network is missing or insufficient (voltage and/or frequency values incorrect with reference to the information provided in the technical data table). | Check for the disconnection of protective devices upstream of the unit.                 |
| W34                |   |  | Check the applied voltage and frequency comply with the values set on the HMI.          |
| W36                | Inverter overload condition                           | Inverter is working in overload conditions.  | Reduce the load.  |
| W77                |   |  |   |
| W38                | Active power limitation                               | Active power request by EMS isn't satisfied (due to temperature or elapsed overload condition).  | Reduce the active power request.  |
| W81                |   |  |   |
| W39                | Reactive power limitation                             | Reactive power request by EMS not satisfied (due to temperature or elapsed overload condition).  | Reduce the reactive power request.  |
| W82                |   |  |   |

| System warnings    |                           |   |   |
|--------------------|---------------------------|---|---|
| Warning            |                           | Cause                                   | Remedy  |
| W40                | Low Insulation Resistance | Detection of low insulation resistance. | Check the Insulation to earth.                                |
| W41                | Insulation Sensor Fault   | Insulation sensor feedback not correct. | Check the Insulation Monitoring Device is properly connected. |
| W42 <sup>(1)</sup> | Module 1 on Alarm         | Module 1 stopped by alarm.              | Check Module 1.   |
| W43 <sup>(1)</sup> | Module 2 on Alarm         | Module 2 stopped by alarm.              | Check Module 2.   |
| W44 <sup>(1)</sup> | Module 3 on Alarm         | Module 3 stopped by alarm.              | Check Module 3.   |



| Unit warnings |  |  |  |
|---------------|--|--|--|
| Warning       |  | Cause  | Remedy   |
| W65           | Unit in Derating                         | The unit is reducing the power supplied/ drawn by the network.   | Check the other alarms and/or visual warnings.                                 |
| W69           | AC input network outside frequency range | Input network is missing or insufficient (voltage and/or frequency values incorrect with reference to the information provided in the technical data table). | Check for the disconnection of protective devices upstream of the unit.        |
| W70           |  |  | Check the applied voltage and frequency comply with the values set on the HMI. |
| W81           | Unit Active power limitation             | Active power request by EMS not satisfied (due to temperature or elapsed overload condition).  | Reduce the active power request.   |
| W82           | Unit Reactive power limitation           | Reactive power request by EMS not satisfied (due to temperature or elapsed overload condition).  | Reduce the reactive power request.   |

| System alarms      |                                    |  |   |
|--------------------|------------------------------------|--|---|
| Alarms             |                                    | Cause  | Remedy  |
| A01 <sup>(3)</sup> | Switch-off due to external command | The PCS is switched off due to an external instant switch-off command. | Check if the external contact is properly connected to ADC card. A manual reset could be needed.                  |
| A05 <sup>(3)</sup> | SPD AC triggered                   | AC overvoltage.  | Check and replace if necessary.   |
| A06 <sup>(3)</sup> | SPD DC triggered                   | DC overvoltage.  | Check and replace if necessary.   |
| A07                | Output contactor alarm             | The output contactor status has not complied with machine command.     | Contact the support service.  |
| A08                | Transformer over-temperature       | Over-temperature of the transformer.                                   | Check the ventilation or air-conditioning system in the unit room.  |
| A13                | Watchdog elapsed                   | External EMS communication watchdog elapsed.                           | Check the cable between PCS and External EMS device.  |
| A15                | Incorrect system configuration     | System configuration wrong.  | Check the configuration setting.  |
| A22                | Battery Overvoltage                | Battery voltage too high.  | Check the battery configuration.  |
| A23                | Battery Communication fault        | No battery communications.   | Check the cable between PCS and battery.  |
| A24                | General Battery Alarm              | Other battery alarm are present.                                       | Solve the specific battery Alarm.   |
| A25 <sup>(2)</sup> | BES Thermal protection fault       | Over temperature inside the cabinet.                                   | Check the thermal protection is properly connected to the ADC Card and verify temperature inside battery cabinet. |
| A26                | DC Connection Fault                | Battery DC Contactor test failed.                                      | Check battery DC Contactor is properly connected to the ADC Card.   |
| A27 <sup>(2)</sup> | Battery Over Temperature           | Battery temperature too high.  | Reduce ambient temperature.   |

| Unit alarms |                                  |   |  |
|-------------|----------------------------------|---|--|
| Alarms      |                                  | Cause                                       | Remedy   |
| A68         | Unit off due to over-temperature | Over-temperature cause.                     | Reduce ambient temperature.  |
| A69         | Fan fault                        | Ventilation system breakdown.               | Make sure the air inlets and outlets on the front and rear of the unit are free from obstructions. |
| A72         | Unit locked                      | Internal cause.                             | Check the specific alarm.  |
| A73         | Input over-voltage               | The DC input voltage has exceeded 900 V.    | Check the connections.   |
| A76         | Ambient under-temperature        | Ambient temperature is too low.             | Check the ventilation or air-conditioning of the unit room.  |
| A77         | Ambient over-temperature         | Ambient temperature is too high.            | Check the ventilation or air-conditioning of the unit room.  |
| A78         | Wrong phases rotation            | Wrong AC voltage phases rotation.           | Check the phases rotation upstream of the unit.  |
| A84         | AC Voltage Fault                 | AC voltage fault during Off-Grid operation. | Check the load or faults downstream of the unit  |
| A85         | Overload elapsed                 | Inverter stopped for elapsed overload.      | Reduce the load.   |

1. Only Power Module N° (1,2,3) has flagged an alarm, but the system is still operational.
2. Shown only if lead-acid battery type is set.
3. Available as option.

# 14. PREVENTIVE MAINTENANCE

|   |  |
|---|--|
|  | <b>NOTE:</b> before carrying out any operations on the unit read the 'Safety standards' chapter carefully.           |
|  | <b>NOTE:</b> any work carried out on the equipment must be performed by qualified technicians authorised by SOCOMEC. |

Routine maintenance carried out annually is recommended in order to provide optimum operating efficiency and avoid equipment downtime.

Maintenance consists of thorough functionality checks on:

- Electronic and mechanical parts;
- Dust removal;
- Software updating;
- Environmental checks.




## 14.1 BATTERIES

The condition of the battery is fundamental to ESS operation.

During the operating lifetime of the battery, the Sunsys PCS<sup>2</sup> stores statistics on the conditions of use of the battery for analysis.

Expected battery lifetime is very much dependent on operating conditions:

- Number of charging and discharging cycles;
- Load rate;
- Temperature.

|   |  |
|---|--|
|  | <b>NOTE:</b> batteries must only be replaced with batteries recommended or sold by the manufacturer. Batteries must only be replaced by qualified technicians. |
|  | <b>BEWARE:</b> used batteries contain harmful substances. Do not open the cover!   |
|  | <b>NOTE:</b> used batteries must be placed in appropriate containers. They should only be entrusted to a specialist waste disposal company.                    |

## 14.2 FANS & CAPACITORS

The lifespan of consumable parts such as fans and capacitors (AC and DC) depends on whether or not the use and environmental conditions (premises, usage or load type) are abnormal or harsh for the equipment.

It is advisable to replace consumables as follows<sup>(1)</sup>:

| Consumable part     | Years |
|---------------------|-------|
| Fan                 | 5     |
| AC and DC capacitor | 7     |


1. Based on operation of the unit according to the manufacturer's specification.

# 15. UL1741SA: HOW TO CONFIGURE GRID SUPPORT FUNCTIONS

## 15.1 INTRODUCTION

Supplement SA to UL1741 standard covers grid support functions that are required to grid support utility interactive inverters and converters.

Installers are responsible for setting parameters according to the prescriptions defined in the local utility SRD(s) (Source Requirement Document). The wide range of parameter programmability covers the California Rule 21 and HECO Rule 14H.

|   |   |
|---|---|
|  | <b>NOTE:</b> for transformer based models (PCS <sup>2</sup> IM 33-66-100TR), formal compliance to UL1741SA standard requires 3-wire output only (w/o neutral connection), while operating in grid-tied mode. Contact Socomec for further information. |
|---|---|

## 15.2 TRIP THRESHOLDS

MENU > SETTINGS > PCS SETTINGS > AC INTERFACE PROTECION

Voltage and frequency trip thresholds can be set following the table below.

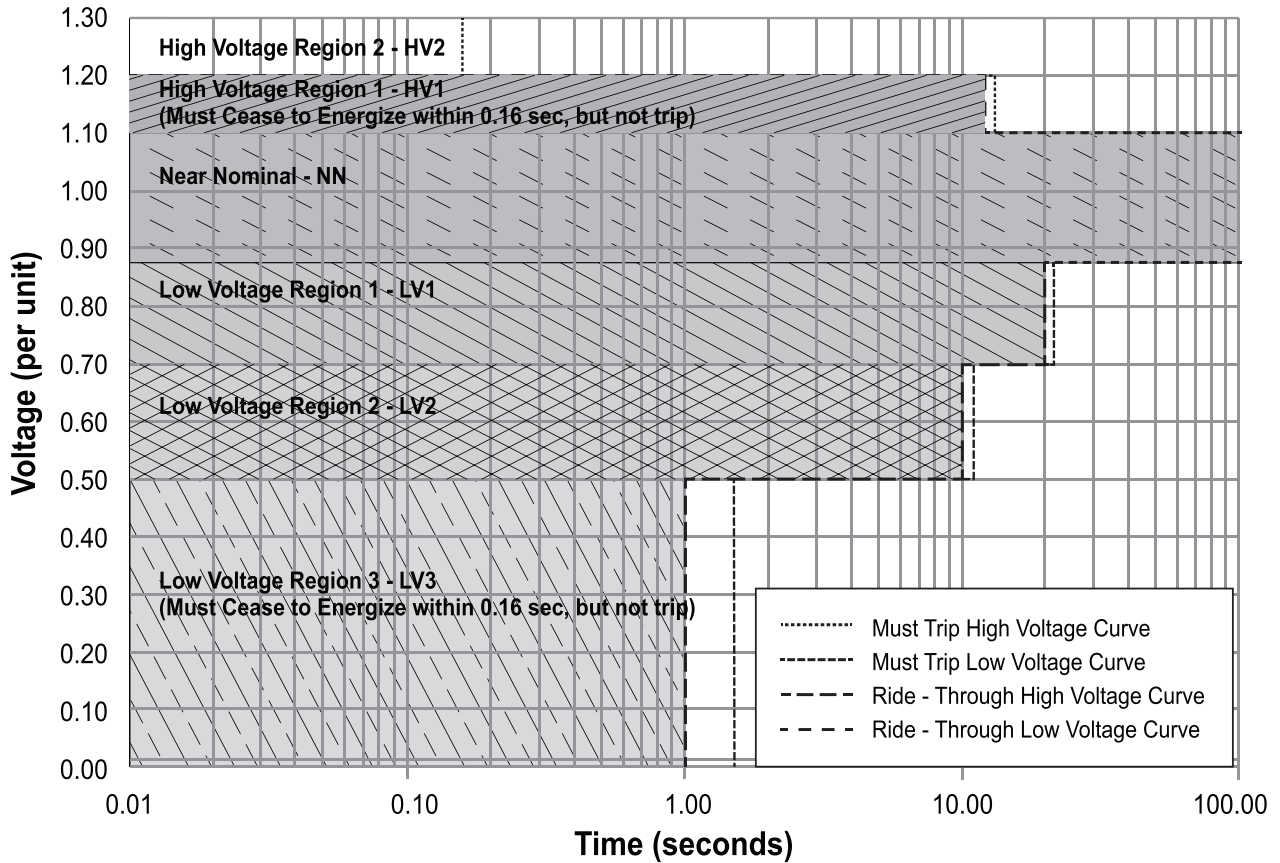
| Name of parameter group | Name of parameter | Default value | Programmable range | Description                               |
|-------------------------|-------------------|---------------|--------------------|---|
| IP - VOLTAGE RANGE      |                   |               |                    |   |
|                         | UV3               | 50%           | 5 ÷ 100            | Absolute minimum voltage admitted %Vn     |
|                         | UV2               | 70%           | 5 ÷ 100            | Intermediate minimum voltage admitted %Vn |
|                         | UV1               | 88%           | 5 ÷ 100            | Minimum voltage admitted %Vn              |
|                         | OV1               | 110%          | 100 ÷ 120          | Maximum voltage admitted %Vn              |
|                         | OV2               | 120%          | 100 ÷ 120          | Absolute maximum voltage admitted %Vn     |
| IP - VOLTAGE TIMINGS    |                   |               |                    |   |
|                         | TimeOut UV3       | 1.50 s        | 0,01 ÷ 300         | Trip time under UV3 voltage thr.          |
|                         | TimeOut UV2       | 11.00 s       | 0,01 ÷ 300         | Trip time under UV2 voltage thr.          |
|                         | TimeOut UV1       | 21.00 s       | 0,01 ÷ 300         | Trip time under UV1 voltage thr.          |
|                         | TimeOut OV1       | 13.00 s       | 0,01 ÷ 300         | Trip time over OV1 voltage thr.           |
|                         | TimeOut OV2       | 0.16 s        | 0,01 ÷ 300         | Trip time over OV2 voltage thr.           |
| IP - FREQUENCY RANGE    |                   |               |                    |   |
|                         | UF2               | 57.0 Hz       | 53,0 ÷ 60,0        | Absolute minimum frequency admitted %fn   |
|                         | UF1               | 58.5 Hz       | 53,0 ÷ 60,0        | Minimum frequency admitted %fn            |
|                         | OF1               | 60.5 Hz       | 60,0 ÷ 65,0        | Maximum frequency admitted %fn            |
|                         | OF2               | 62.0 Hz       | 60,0 ÷ 65,0        | Absolute maximum frequency admitted %fn   |
| IP - FREQUENCY TIMINGS  |                   |               |                    |   |
|                         | TimeOut UF2       | 0.16 s        | 0,01 ÷ 300         | Trip time under UF2 frequency thr.        |
|                         | TimeOut UF1       | 300.00 s      | 0,01 ÷ 300         | Trip time under UF1 frequency thr.        |
|                         | TimeOut OF1       | 300.00 s      | 0,01 ÷ 300         | Trip time over OF1 frequency thr.         |
|                         | TimeOut OF2       | 0.16 s        | 0,01 ÷ 300         | Trip time over OF2 frequency thr.         |

## 15.3 RIDE THROUGH MODE & TIMINGS

The L/HVRT (Low and High Voltage Ride-Through) and L/HFRT (Low and High Frequency Ride-Through) define the behavior of the system in response to low and high voltage and frequency excursions outside the normal range of operation of the PCS.

The following pictures report an example of ride-through profiles that correspond to Rule 21 prescriptions.

**Figure SA9.1**  
Example operating parameters that correspond to Rule 21 ride-through and must trip regions in the time-voltage domain



**Table SA9.1**  
Example operating parameters that correspond to Rule 21 L/HVRT<sup>a</sup>

| Region               | Voltage (% Nominal Voltage) | Ride-Through Until | Operating Mode       | Maximum Trip Time (s) |
|----------------------|-----------------------------|--------------------|----------------------|-----------------------|
| High Voltage 2 (HV2) | $V \geq 120$                | Not Applicable     | Not Applicable       | 0.16 s                |
| High Voltage 1 (HV1) | $110 < V < 120$             | 12 s               | Momentary Cessation  | 13 s                  |
| Near Nominal (NN)    | $88 \leq V \leq 110$        | Indefinite         | Continuous Operation | Not Applicable        |
| Low Voltage 1 (LV1)  | $70 \leq V < 88$            | 20 s               | Mandatory Operation  | 21 s                  |
| Low Voltage 2 (LV2)  | $50 \leq V < 70$            | 10 s               | Mandatory Operation  | 11 s                  |
| Low Voltage 3 (LV3)  | $V < 50$                    | 1 s                | Momentary Cessation  | 1.5 s                 |

<sup>a</sup> While these operating parameters correspond to the Rule 21 parameters, they may be substituted with operating parameters for other area EPS requirements.

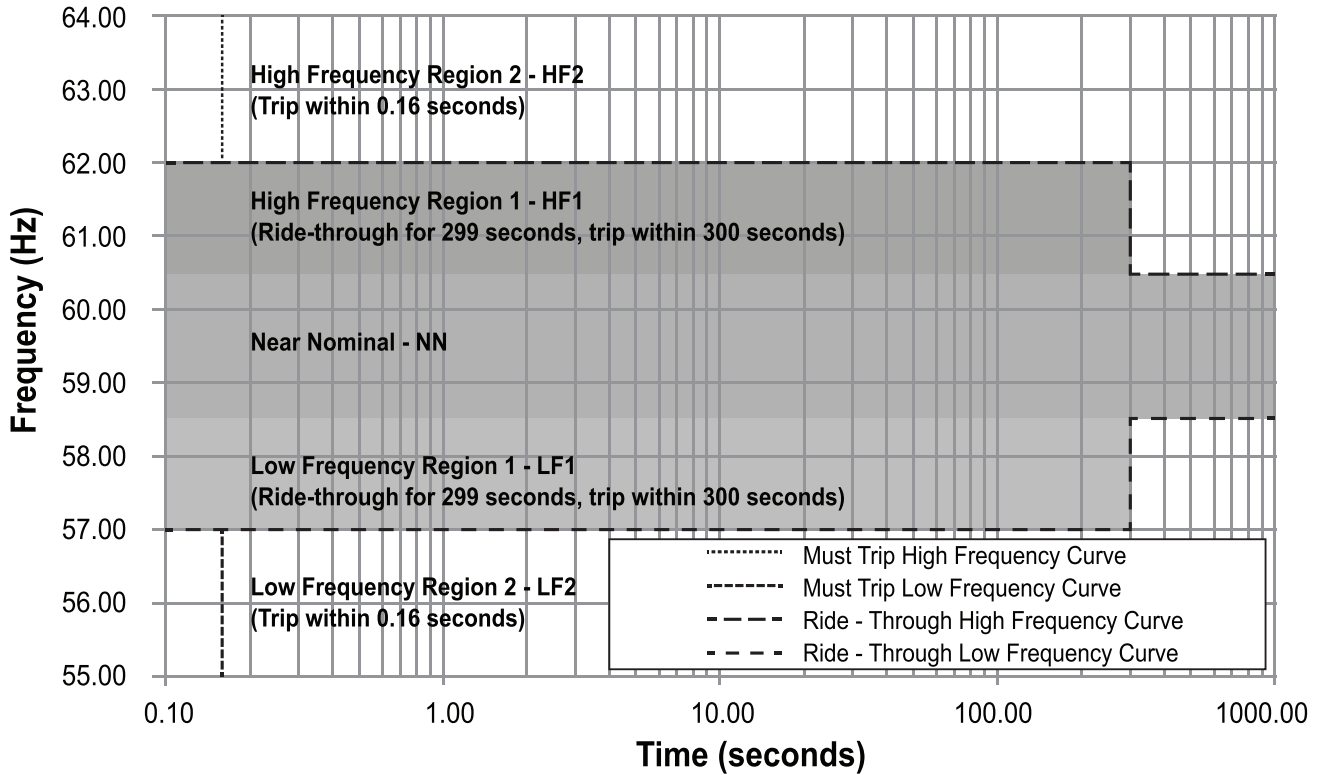
Note 1: Manufacturer may evaluate product over wider ranges of adjustment than those within the table.

Note 2: The table voltage could be either at the PCC or equipment terminals.

Note 3: For LV3 or HV1 the EUT shall cease to energize in not more than 0.16 s (and not trip). This may differ in other SRD(s).

**Figure SA10.1**

**Example operating parameters that correspond to Rule 21 default ride-through and must trip regions in the time-frequency domain**



**Table SA10.1**  
**Example operating parameters that correspond to Rule 21 L/HFRT<sup>a</sup>**

| Region                 | System Frequency Default Settings | Minimum Range of Adjustability (Hz) | Ride-Through Until (s) | Ride-Through Operational Mode | Trip Time (s)  |
|------------------------|-----------------------------------|-------------------------------------|------------------------|-------------------------------|----------------|
| High Frequency 2 (HF2) | $f > 62$                          | 62.0 – 64.0                         | No Ride-Through        | Not Applicable                | 0.16           |
| High Frequency 1 (HF1) | $60.5 < f \leq 62$                | 60.1 – 62.0                         | 299                    | Mandatory Operation           | 300            |
| Near Nominal (NN)      | $58.5 < f \leq 60.5$              | Not Applicable                      | Indefinite             | Continuous Operation          | Not Applicable |
| Low Frequency 1 (LF1)  | $57.0 < f \leq 58.5$              | 57.0 – 59.9                         | 299                    | Mandatory Operation           | 300            |
| Low Frequency 2 (LF2)  | $f \leq 57.0$                     | 53.0 – 57.0                         | No Ride-Through        | Not Applicable                | 0.16           |

<sup>a</sup> While these operating parameters correspond to the Rule 21, 2015 parameters they may be substituted with operating parameters for other area EPS requirements.

Note 1: Manufacturer may evaluate product over wider ranges of adjustment than those within the table.

Note 2: Frequency / Watt functionality is an option under the Rule 21, 2015 filing.

**MENU > SETTINGS > PCS SETTINGS > AC INTERFACE PROTECION**

Ride-through parameters can be set following the table below.



| Name of parameter group | Name of parameter sub-group     | Name of parameter   | Default value       | Programmable range  | Description                     |
|-------------------------|---------------------------------|---------------------|---------------------|---|---------------------------------|
| RIDE THROUGH MODE       | RIDE TROUGH ENABLE              |                     |                     |   |                                 |
|                         |                                 | Ride Through Enable | Enabled             | Enabled/Disabled  | Enable Ride-Through mode        |
|                         | VOLTAGE RIDE THROUGH BEHAVIOR   |                     |                     |   |                                 |
|                         |                                 | HVR2 Mode           | Not Applicable      | Not Applicable/Momentary Cessation/Mandatory Operation/Permissive Operation | Behaviour in HV2 region         |
|                         |                                 | HVR1 Mode           | Momentary Cessation | Not Applicable/Momentary Cessation/Mandatory Operation/Permissive Operation | Behaviour in HV1 region         |
|                         |                                 | LVR1 Mode           | Mandatory Operation | Not Applicable/Momentary Cessation/Mandatory Operation/Permissive Operation | Behaviour in LV1 region         |
|                         |                                 | LVR2 Mode           | Mandatory Operation | Not Applicable/Momentary Cessation/Mandatory Operation/Permissive Operation | Behaviour in LV2 region         |
|                         |                                 | LVR3 Mode           | Momentary Cessation | Not Applicable/Momentary Cessation/Mandatory Operation/Permissive Operation | Behaviour in LV3 region         |
|                         | VOLTAGE RIDE THROUGH TIMINGS    |                     |                     |   |                                 |
|                         |                                 | HVR2 Time           | 0s                  | Not adjustable  | Ride-Through time in HV2 region |
|                         |                                 | HVR1 Time           | 12.00 s             | 0.01 ÷ 300  | Ride-Through time in HV1 region |
|                         |                                 | LVR1 Time           | 20.00 s             | 0.01 ÷ 300  | Ride-Through time in LV1 region |
|                         |                                 | LVR2 Time           | 10.00 s             | 0.01 ÷ 300  | Ride-Through time in LV2 region |
|                         |                                 | LVR3 Time           | 1.00 s              | 0.01 ÷ 300  | Ride-Through time in LV3 region |
|                         | FREQUENCY RIDE THROUGH BEHAVIOR |                     |                     |   |                                 |
|                         |                                 | HFR2 Mode           | Not Applicable      | Not Applicable/Momentary Cessation/Mandatory Operation/Permissive Operation | Behaviour in HF2 region         |
|                         |                                 | HFR1 Mode           | Mandatory Operation | Not Applicable/Momentary Cessation/Mandatory Operation/Permissive Operation | Behaviour in HF1 region         |
|                         |                                 | LFR1 Mode           | Mandatory Operation | Not Applicable/Momentary Cessation/Mandatory Operation/Permissive Operation | Behaviour in LV1 region         |
|                         |                                 | LFR2 Mode           | Not Applicable      | Not Applicable/Momentary Cessation/Mandatory Operation/Permissive Operation | Behaviour in LV2 region         |
|                         | FREQUENCY RIDE THROUGH TIMINGS  |                     |                     |   |                                 |
|                         |                                 | HFR2 Time           | 0.16 s              | 0.01 ÷ 300  | Ride-Through time in HF2 region |
|                         |                                 | HFR1 Time           | 299.00 s            | 0.01 ÷ 300  | Ride-Through time in HF1 region |
|                         |                                 | LFR1 Time           | 299.00 s            | 0.01 ÷ 300  | Ride-Through time in LV1 region |
|                         |                                 | LFR2 Time           | 0.16 s              | 0.01 ÷ 300  | Ride-Through time in LV2 region |

## 15.4 RAMPS

Two types of ramp rate characteristics are defined:

- Soft-start ramp-up rate that defines the behavior of the device to ramp from zero to operating power after a trip or at first system power-on.
- Normal ramp-up rate when the inverter is adjusting the output power.

Parameters can be set in the following menu:

**MENU > SETTINGS > PCS SETTINGS > CONNECTION PARAMETERS**

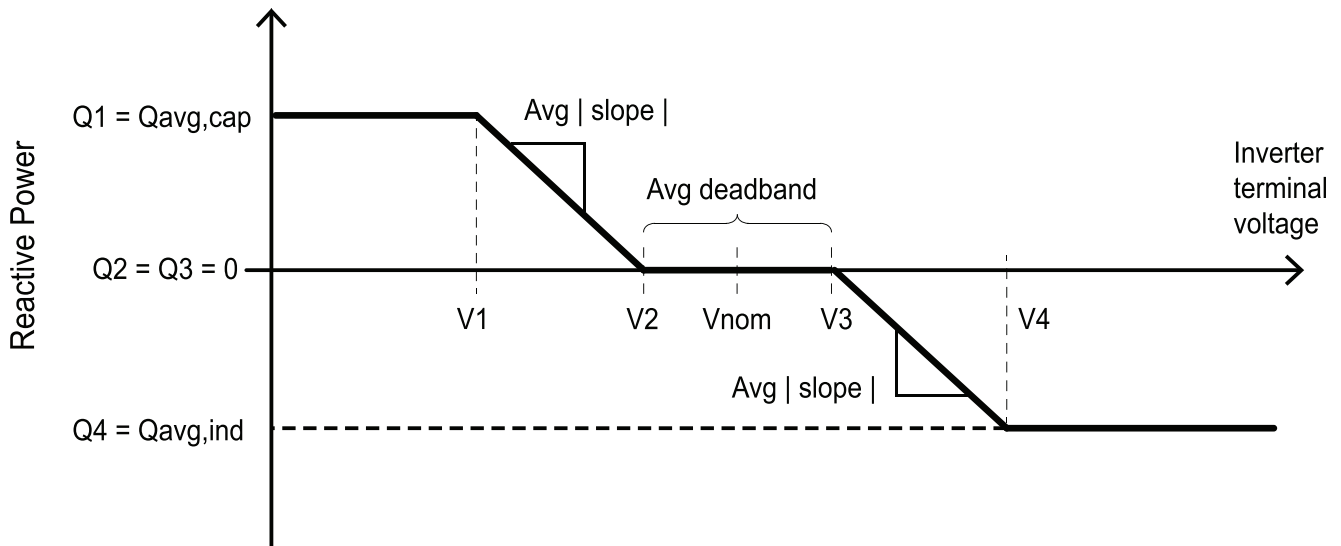
| Name of parameter group   | Name of parameter | Default value | Programmable range | Description  |
|---------------------------|-------------------|---------------|--------------------|--|
| CONNECTION TIMINGS/RANGES |                   |               |                    |  |
|                           | Soft Start Ramp   | 0,33 %Pn/s    | 0.10 ÷ 100.00      | Ramp rate from zero to operating power after a trip              |
|                           | Normal Mode Ramp  | 100,00 %Pn/s  | 0.10 ÷ 100.00      | Normal ramp rate when the inverter is adjusting the output power |

## 15.5 ACTIVE/REACTIVE POWER CONTROL

Active and reactive power control represents one of the most important features of the Grid Support Utility Interactive Inverters. Reactive power can be controlled using the Specified Power Factor (SPF) or the Volt-VAr Mode (Q(V)) functionalities, while active power can be performed using the Frequency-Watt (P(f)) or Volt-Watt (P(V)) functions.

- 1) **SPF - Specified Power Factor:** the inverter operates at a specified, non-unity power factor
- 2) **Volt/VAr Mode (Q(V)):** the inverter supplies or absorbs reactive power in response to fluctuations in grid voltage. The figure below shows an example as reported in UL1741 Supplement SA standard.

**Figure SA13.2**  
**“Average” Volt-VAr curve for Q(V), Test 2**



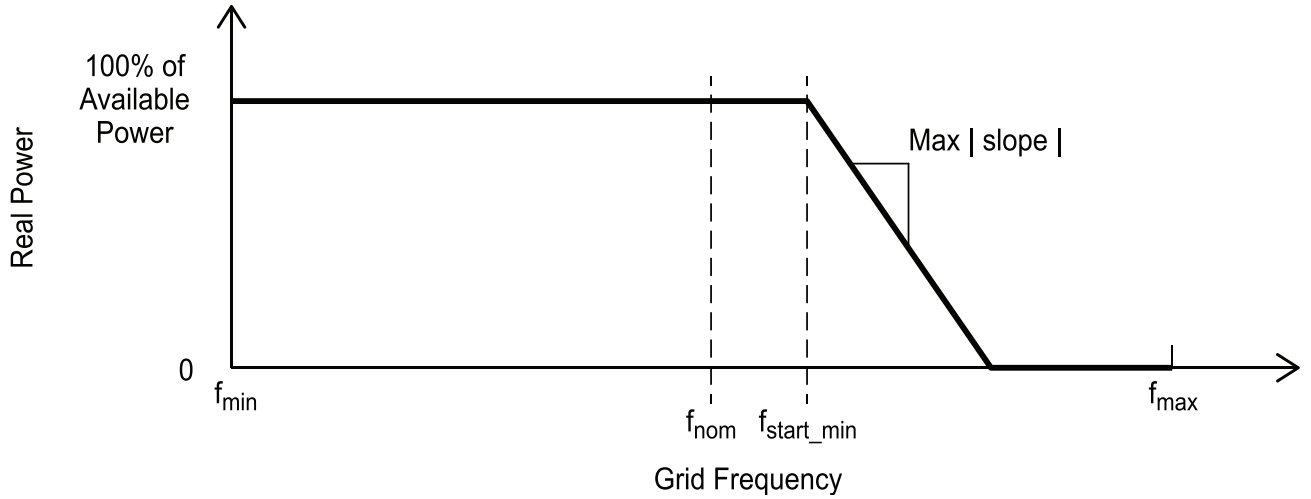
- 3) **Frequency-Watt (FW) function:** the inverter may change its active power output with changes in grid frequency. The figure below shows an example as reported in UL1741 Supplement SA standard.

**Figure SA14.1**  
**Freq-Watt characteristic #1 (maximum slope)**

Characteristic 1

$$f_{start} = f_{start\_min}$$

$$K_{Power-Freq} = K_{Power-Freq\_Max}$$



- 4) **Volt-Watt (VW) function:** the inverter may change its active power output with changes in grid voltage. The figure below shows an example as reported in UL1741 Supplement SA.

**Figure SA15.2**  
**Volt-Watt characteristic #2**

Characteristic 2

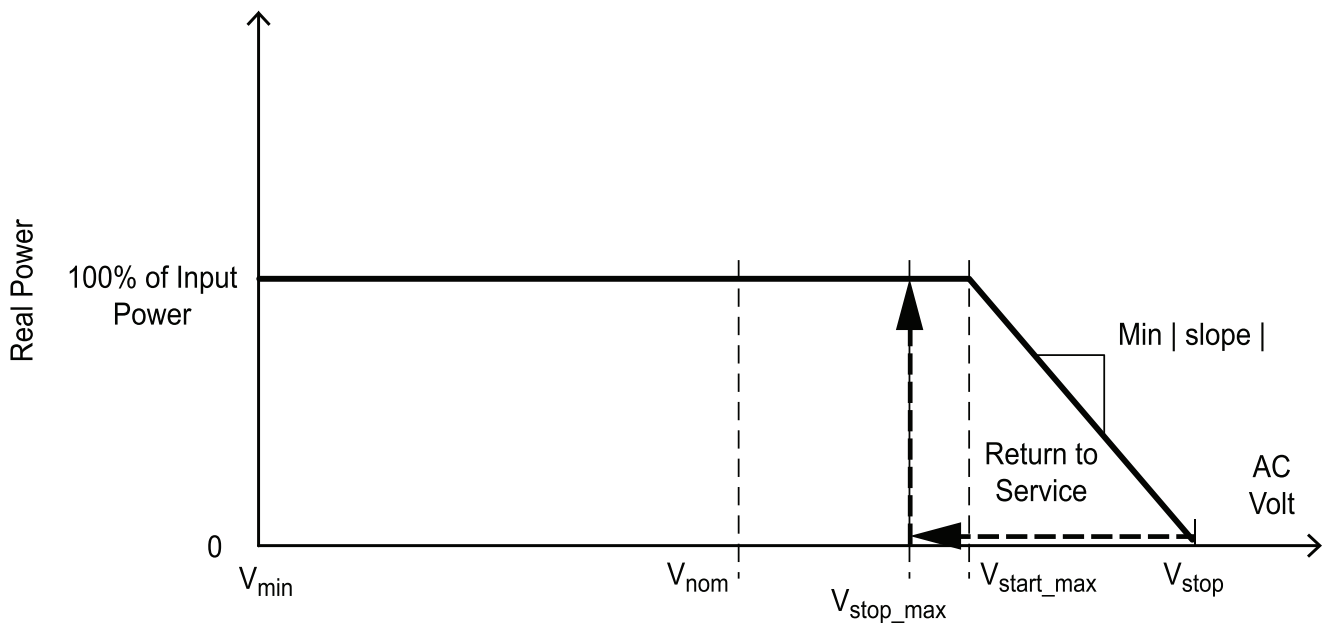
$$V_{start} = V_{start\_max}$$

$$K_{Power\_Freq} = P_{rated} / (V_{stop} - V_{start\_max})$$

$$V_{stop} = V_{stop\_max}$$

$$K_{Power\_Rate} = K_{Power\_Rate\_Min}$$

$$t_{return} = t_{return\_min}$$



The user must adjust the relevant parameters for each of the user modes as outlined below.

**MENU > SETTINGS > PCS SETTINGS > POWER SETTINGS**

| Name of parameter group       | Name of parameter sub-group | Name of sub menu | Name of parameter                | Default value  | Programmable range | Description  |
|-------------------------------|-----------------------------|------------------|----------------------------------|----------------|--------------------|--|
| ACTIVE POWER                  |                             |                  |                                  |                |                    |  |
| FREQ/WATT PARAMETERS          |                             |                  |                                  |                |                    |  |
| FREQ/WATT PARAMETERS 1        |                             |                  |                                  |                |                    |  |
|                               |                             |                  | P(f) Function                    | Disabled       | Enabled/Disabled   | Frequency/Watt function enable/disable   |
|                               |                             |                  | P(f) over frequency threshold    | 60.50 Hz       | 60.04 ÷ 65.00      | F <sub>start</sub> threshold to start over-frequency F/W function  |
|                               |                             |                  | P(f) statism over frequency      | 1.60%          | 0.1 ÷ 6.0          | Over-frequency F/W cruve slope defined as<br>$\frac{\Delta f}{\frac{f_{Nom}}{\frac{\Delta P}{P_{Nom}}}} \times 100$  |
|                               |                             |                  | P(f) under frequency threshold   | 59.50 Hz       | 55.00 ÷ 59.90      | F <sub>start</sub> threshold to start under-frequency F/W function   |
|                               |                             |                  | P(f) stat-ism under frequency    | 1.60%          | 0.1 ÷ 6.0          | Under-frequency F/W curve slope defined as<br>$\frac{\Delta f}{\frac{f_{Nom}}{\frac{\Delta P}{P_{Nom}}}} \times 100$ |
| FREQ/WATT PARAMETERS 2        |                             |                  |                                  |                |                    |  |
|                               |                             |                  | P(f) Delay                       | 0 ms           | 0 ÷ 1000           | Time delay before F/W function start to avoid artifacts (short variation of frequency)                               |
|                               |                             |                  | Wait Time after Freq/Watt        | 0 s            | 0 ÷ 900            | Time delay to accept any new command ( power set point) after exiting from F/W function                              |
| VOLT/WATT PARAMETERS          |                             |                  |                                  |                |                    |  |
|                               |                             |                  | P(V) Function                    | Disabled       | Enabled/Disabled   | Volt/Watt function enable/disable  |
|                               |                             |                  | Min V                            | 106 % Vn       | 100 ÷ 119          | Minimum voltage to start the algorithm   |
|                               |                             |                  | Max V                            | 110 % Vn       | 100 ÷ 120          | Maximum voltage, corresponding to the power set below  |
|                               |                             |                  | Histeresis on V Min              | 1% Vn          | 1 ÷ 5              | Voltage hysteresis %Vn around minimum voltage  |
|                               |                             |                  | P(Max V) Charge %Pn              | 100 % (charge) | 1 ÷ 100            | Power level to work with when voltage exceeds the Max V set above  |
| ACTIVE POWER EXTERNAL CONTROL |                             |                  |                                  |                |                    |  |
|                               |                             |                  | External Communication Watch-Dog | Disabled       | Enabled/Disabled   | Watchdog alarm enable to control the reception of the external watchdog  |
|                               |                             |                  | Watch-Dog timeout                | 60 s           | 0 ÷ 120            | Watch-Dog alarm timeout, if an extenrnal trigger is not received the machine stops                                   |
| REACTIVE POWER                |                             |                  |                                  |                |                    |  |

| Name of parameter group | Name of parameter sub-group | Name of sub menu | Name of parameter           | Default value      | Programmable range  | Description  |
|-------------------------|-----------------------------|------------------|-----------------------------|--------------------|---|--|
|                         | CONTROL TYPE                |                  |                             |                    |   |  |
|                         |                             |                  | Reactive Power Control Type | Remote Q reference | Remote Q reference/Fixed Q setpoint/Q=f(V) type A/Fixed cosPhi/Disabled | Reactive power management strategy                                       |
|                         | CONSTANT POWER FACTOR       |                  |                             |                    |   |  |
|                         |                             |                  | Behaviour                   | Capacitive         | Capacitive/Inductive  | System behaviour in reactive power production when SPF is selected       |
|                         |                             |                  | Fixed cosPhi                | 1.000              | 0.850 ÷ 1.000   | CosPhi value for the SPF function  |
|                         |                             |                  | Min P                       | 5% Pn              | 0 ÷ 100   | Minimum power that allows the system to operate with SPF                 |
|                         | VOLT/VAR Q(V)               |                  |                             |                    |   |  |
|                         | VOLT/VAR Q(V) PARAMS-1      |                  |                             |                    |   |  |
|                         |                             |                  | V1 superior                 | 108 % Vn           | 100 ÷ 120   | Volt/Watt curve voltage, point 1 superior                                |
|                         |                             |                  | V2 superior                 | 110 % Vn           | 100 ÷ 120   | Volt/Watt curve voltage, point 2 superior                                |
|                         |                             |                  | V1 inferior                 | 92 % Vn            | 80 ÷ 100  | Volt/Watt curve voltage, point 1 inferior                                |
|                         |                             |                  | V2 inferior                 | 90 % Vn            | 80 ÷ 100  | Volt/Watt curve voltage, point 2 inferior                                |
|                         | VOLT/VAR Q(V) PARAMS-2      |                  |                             |                    |   |  |
|                         |                             |                  | Q Max                       | 100.00 %Sn         | 0.00 ÷ 100.00   | Maximum reactive power production setting                                |
|                         |                             |                  | Q(V) Delay                  | 0 s                | 0 ÷ 30  | Delay to avoid unintentional reactive in case of short voltage variation |
|                         |                             |                  | Q(V) - K                    | 0.000 %Qmax        | -1.000 ÷ 1.000  | Reactive power offset for the Volt/VAr curve                             |
|                         | VOLT/VAR Q(V) PARAMS-3      |                  |                             |                    |   |  |
|                         |                             |                  | P lock-in                   | 20 % Pn            | 10 ÷ 100  | P to start Volt/VAr function   |
|                         |                             |                  | P lock-out                  | 5 %Pn              | 0 ÷ 5   | P to stop Volt/VAr function  |
|                         | CONSTANT REACTIVE POWER     |                  |                             |                    |   |  |
|                         |                             |                  | Q value                     | 0.00 %Pn           | 0.00 ÷ 100.00   | Set point of Q for fixed Q set point control type                        |
|                         |                             |                  | Behaviour                   | Capacitive         | Capacitive/Inductive  | Reactive power behaviour   |
|                         |                             |                  | Q Max                       | 100.00 %Sn         | 0.00 ÷ 100.00   | Absolute Q max that can be set   |
| GENERAL SETTINGS        |                             |                  |                             |                    |   |  |
|                         |                             |                  | P_Cmax                      | 100.0 %Pn          | 0.00 ÷ 100.00   | P Charge max (batteries)   |
|                         |                             |                  | P_Dmax                      | 100.0 %Pn          | 0.00 ÷ 100.00   | P Discharge max (batteries)  |
|                         |                             |                  | Priority Power              | Reactive           | Reactive/Active   | Power production priority in case of over-load                           |

## 16. SAFEGUARDING THE ENVIRONMENT

Do not dispose of electrical appliances with normal waste, use separate collection facilities.

Follow local council waste regulations for proper disposal arrangements to reduce the environmental impact of waste electrical and electronic equipment or contact your local government for information regarding the collection arrangements available.

If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging health and wellbeing. Depleted batteries are considered as toxic waste. When battery replacement becomes necessary, only give rundown batteries to certified and licensed waste disposal companies. In accordance with local legislation, it is prohibited to dispose of batteries together with other industrial waste or household refuse.



The crossed-out trash bin symbol is placed on this product to encourage users to recycle components and units whenever possible. Please be environmentally responsible and recycle this product through your recycling facility at the end of its lifetime.



For any questions regarding the disposal of the product, contact local distributors or retailers.

# 17. TECHNICAL SPECIFICATIONS

| Model  |     | 33 TR   | 66 TR                            | 100 TR                           | 132 TL   | 200 TL                           |
|--|-----|---|----------------------------------|----------------------------------|--|----------------------------------|
| DC Section   |     |   |                                  |                                  |  |                                  |
| Range of DC operating voltage  |     | 450 to 825 Vdc without derating<br>350 to 850 Vdc with derating                 |                                  |                                  |  |                                  |
| Number of power modules  |     | 1   | 2                                | 3                                | 4  | 6                                |
| Maximum discharging current  | A   | 80  | 160                              | 240                              | 160 + 160  | 240 + 240                        |
| Maximum recharging current   | A   | 80  | 160                              | 240                              | 160 + 160  | 240 + 240                        |
| Battery Section  |     |   |                                  |                                  |  |                                  |
| Lithium, Lead acid, Vanadium Redox, Generic Battery                                      |     | Supported in combination with PMS.<br>Please contact Socomec for compatibility. |                                  |                                  |  |                                  |
| AC Section   |     |   |                                  |                                  |  |                                  |
| Maximum continuous power   | kW  | 33  | 66                               | 100                              | 132  | 200                              |
| Maximum continuous apparent power  | kW  | 33  | 66                               | 100                              | 132  | 200                              |
| On-grid overload   |     | 110% - 30 minutes   |                                  |                                  |  |                                  |
| Off-grid symmetrical overload  |     | 110% - 30 minutes<br>125% - 10 minutes<br>150% - 30 seconds                     |                                  |                                  |  |                                  |
| Off-grid asymmetrical overload (mono phase load)   |     | 190% - 30 minutes<br>215% - 10 minutes<br>260% - 30 seconds                     |                                  |                                  | Not applicable   |                                  |
| Nominal voltage (Un)   | VAC | 480 (3ph + N)   |                                  |                                  | 280 (3ph)  |                                  |
| Operating voltage range  | VAC | 423 to 528 (3ph + N)  |                                  |                                  | 246 to 308 (3ph)   |                                  |
| Active power droop   |     | -0.24 Hz @ nominal kW supplied<br>+0.24 Hz @ nominal kW absorbed                |                                  |                                  |  |                                  |
| Reactive power droop: percentage voltage variation                                       |     | +3% Vnom @ Load cosφ 0.8 cap. (neg.)<br>-7% Vnom @ Load cosφ 0.8 ind. (pos.)    |                                  |                                  | +2% Vnom @ Load cosφ 0.8 cap. (neg.)<br>-7% Vnom @ Load cosφ 0.8 ind. (pos.) |                                  |
|  |     | +9% Vnom @ nominal kVAR cap. (neg.)<br>-11% Vnom @ nominal kVAR ind. (pos.)     |                                  |                                  | +5% Vnom@nominal kVAR cap. (neg.)<br>-10% Vnom@nominal kVAR cap. (pos.)      |                                  |
| Rated frequency (Fn)   | Hz  | 60  |                                  |                                  |  |                                  |
| Operating frequency range  | Hz  | 59.3 to 60.5  |                                  |                                  |  |                                  |
| Rated current  | A   | 40  | 80                               | 120                              | 272  | 412                              |
| Maximum current at nominal voltage   | A   | 60  | 120                              | 180                              | 408  | 618                              |
| Overcurrent protection device  |     | 50 A - Type D   | 100 A - Type D                   | 160 A - Type D                   | 315 A - Type C   | 500 A - Type C                   |
| Off-grid short-circuit current 3-phase (Ik3 IEC60909-0) and phase-phase (Ik2 IEC60909-0) |     | 75 A x 40 ms +<br>62 A x 60 ms  | 150 A x 40 ms +<br>125 A x 60 ms | 225 A x 40 ms +<br>187 A x 60 ms | 462 A x 40 ms +<br>383 A x 60 ms   | 700 A x 40 ms +<br>580 A x 60 ms |

| Model  |           |       | 33 TR   | 66 TR                            | 100 TR                           | 132 TL                            | 200 TL |  |
|--|-----------|-------|---|----------------------------------|----------------------------------|-----------------------------------|--------|--|
| Off-grid short-circuit current phase-neutral (Ik1 IEC60909-0)  |           |       | 121 A x 40 ms +<br>96 A x 60 ms                             | 242 A x 40 ms +<br>192 A x 60 ms | 362 A x 40 ms +<br>287 A x 60 ms | Not applicable                    |        |  |
| Output power factor rating   |           |       | -1.00 to +1.00  |                                  |                                  |                                   |        |  |
| THDI On-grid mode  |           | %     | < 3   |                                  |                                  | < 4                               |        |  |
| Topology   |           |       | Single conversion with Output transformer                   |                                  |                                  | Single conversion transformerless |        |  |
| Parallel operation   |           |       |   |                                  |                                  |                                   |        |  |
| On-grid  |           |       | With any kind of generator (voltage or current type)        |                                  |                                  |                                   |        |  |
| Off-grid   |           |       | With other SUNSYS PCS <sup>2</sup> IM (power extension)     |                                  |                                  |                                   |        |  |
|  |           |       | With generic current/power generators                       |                                  |                                  |                                   |        |  |
|  |           |       | Not operated in parallel with isochronous voltage generator |                                  |                                  |                                   |        |  |
| Other features   |           |       |   |                                  |                                  |                                   |        |  |
| Islanding detection  |           |       | Yes   |                                  |                                  |                                   |        |  |
| Scheduled On-grid to Off-grid transition   |           |       | Without break   |                                  |                                  |                                   |        |  |
| Capable of receiving frequency and voltage reference in islanding mode from external device (PMS)  |           |       | Yes   |                                  |                                  |                                   |        |  |
| Capable of receiving frequency and voltage reference from external device (PMS) to synchronise the microgrid with the grid to perform off-grid to on-grid transition |           |       | Yes   |                                  |                                  |                                   |        |  |
| Black start mode: capable of supplying the microgrid from power cut conditions   |           |       | Yes   |                                  |                                  |                                   |        |  |
| Efficiency   |           |       |   |                                  |                                  |                                   |        |  |
| Dissipated power (max)   |           | W     | 1810  | 3620                             | 5710                             | 4930                              | 7470   |  |
| Dissipated power (max)   |           | BTU/h | 6180  | 12360                            | 19490                            | 16830                             | 25500  |  |
| Maximum efficiency   | Charge    | %     | 95.8  | 96.1                             | 96.0                             | 97.4                              |        |  |
|  | Discharge | %     | 96.0  | 96.2                             | 96.3                             | 97.6                              |        |  |
| Typical Efficiency   | Charge    | %     | 94.8  | 94.8                             | 94.6                             | 96.4                              |        |  |
|  | Discharge | %     | 95.1  | 95.2                             | 95.0                             | 96.7                              |        |  |
| Auxiliary AC power supply  |           |       |   |                                  |                                  |                                   |        |  |
| Rated voltage  |           |       | from 120 to 240 VRMS  |                                  |                                  |                                   |        |  |
| Rated frequency  |           | Hz    | 60  |                                  |                                  |                                   |        |  |
| Consumption during operation   |           | W     | < 30  |                                  |                                  |                                   |        |  |
| Consumption on standby   |           | W     | < 10  |                                  |                                  |                                   |        |  |
| General data   |           |       |   |                                  |                                  |                                   |        |  |
| Pollution class in accordance with UL 840 and IEC 60664-1  |           |       | 3   |                                  |                                  |                                   |        |  |
| Over Voltage Category (OVC) in accordance with UL 840 and IEC 60664-1 (AC terminals)   |           |       | OVC IV  |                                  |                                  |                                   |        |  |



| Model  |                   | 33 TR  | 66 TR  | 100 TR         | 132 TL | 200 TL |
|--|-------------------|--|--------|----------------|--------|--------|
| External Over Voltage protection type (AC terminals) |                   | SPD type 2<br>1.8 kVPK [L-G] / 2.5 kVPK [L-L]  |        |                |        |        |
| Enclosure rating                                     |                   | NEMA 1   |        |                |        |        |
| Environmental category                               |                   | Non-air-conditioned indoor space   |        |                |        |        |
| Operating ambient temperature                        |                   | -5 °C to +50 °C (23 °F to 122 °F)<br>-5 °C to 0 °C (23 °F to 32 °F) with derating<br>40 °C to 50 °C (104 °F to 122 °F) with derating               |        |                |        |        |
| Rated temperature                                    |                   | 0 °C to +40 °C (32 °F to 104 °F)   |        |                |        |        |
| Storage temperature                                  |                   | -20 °C to +60 °C (-4 °F to 140 °F)   |        |                |        |        |
| Relative humidity                                    |                   | 5% to 95% condensation-free  |        |                |        |        |
| Cooling system                                       |                   | Smart cooling  |        |                |        |        |
| Required cooling capacity                            | m <sup>3</sup> /h | 480  | 1280   | 1760           | 1742   | 2880   |
| Acoustic noise at 1 m                                | dB                | < 60   | < 64   |                | < 65   | < 67   |
| Altitude (max)                                       | m                 | 1000   |        |                |        |        |
| Dimensions and Weight                                |                   |  |        |                |        |        |
| Dimensions   | Width             | mm   | 600    |                | 1200   | 805    |
|  | Depth             |  | 795    |                |        | 806    |
|  | Height            |  | 1400   |                |        | 2150   |
| Weight   | kg                | 355  | 530    | 206 + 610      | 486    |        |
|  | lb                | 782.6  | 1168.4 | 454.1 + 1344.8 | 1071.5 |        |
| Power module weight                                  | kg                | 34.5   |        |                |        |        |
|  | lb                | 76   |        |                |        |        |
| Certifications                                       |                   |  |        |                |        |        |
| Safety   |                   | UL 1741<br>STANDARD FOR SAFETY. Inverters, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources. |        |                |        |        |
| EMC  |                   | FCC Part 15<br>Radio frequency devices: measurement of disturbance voltage.  |        |                |        |        |
| Grid Code  |                   | IEEE 1547-2003, IEEE 1547a-2014, IEEE 1547.1-2005<br>IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems.          |        |                |        |        |
| Software   |                   | UL 1998<br>Standard for Software in Programmable Components  |        |                |        |        |

1. Depending on the specific country setting and regulations.





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