Watt&Well
CONVERTING POWER INTO CONFIDENCE

HIGH POWER SERIES

100 kW Bidirectional Power Unit for ESS

HIGH POWER | ENERGY STORAGE | INVERTER

OVERVIEW

PCS-100 is a grid-tied active front end capable of bidirectional conversion between AC grid network and DC battery.

It features a modular design capable of parallel operation and can be used as a part of a very high-power system.

Typical application: Grid tied inverter connected to stationary battery

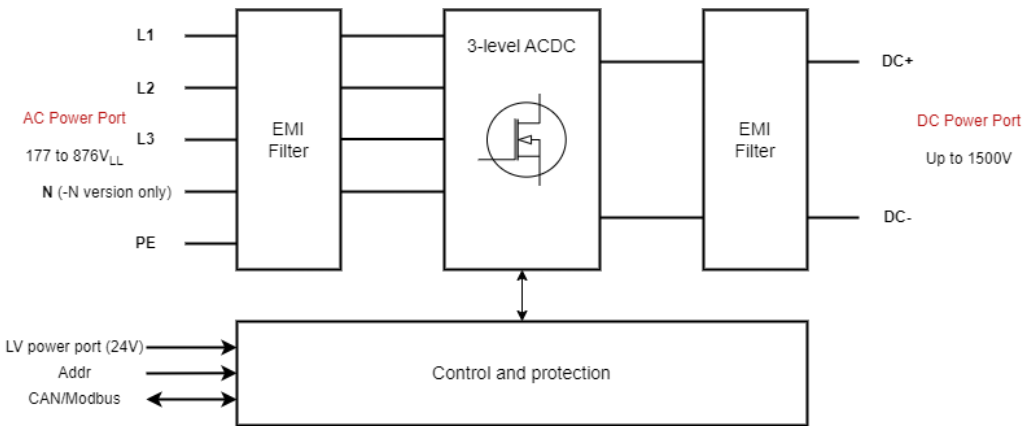
VERSIONS

	POWER	AC WIRES
PCS-100	**100kW**	**3P**
PCS-100-N	**100kW**	**3P+N**

FEATURES

- Input AC grid connection from 177V to 876V line to line
- 83A_{RMS} per phase
- 100kW at 730V_{LL}, 57kW at 400V_{LL}
- Grid configuration
  - 3-Phase without neutral for 3 wires version
  - 3-Phase with neutral for 4 wires version
- Grid forming capability
- Liquid cooling
- 19" rack, 2U
- CAN open, Modbus TCP/UDP
- Integrated protections: AC precharge, OCP, OTP, OVP and UVLO
- Designed for: VDE-AR-N 4105, IEEE 1547 2018, EN 50549-1, AS-NZS 4777.2

BLOCK DIAGRAM



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wattandwell.com
Revision date: 05/2025

Important note: this datasheet contains advanced information about an unreleased product. Values are susceptible to change in significant ways without prior notice (preliminary design)

WARNING

This equipment operates at voltages and currents that can result in electrical shock, fire hazard and/or personal injury if not properly handled or applied. Equipment must be used with necessary caution and appropriate safeguards employed to avoid personal injury or property damage.

This board must be used only by qualified engineers and technicians familiar with risks associated with handling high voltage electrical and mechanical components, systems, and subsystems.

Table of Contents

1. Safety instructions

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS - This manual contains important instructions for **PCS-100** model that shall be followed during installation, operation and maintenance of the unit.

1.1. Caution

The following safety instruction must be observed during all phases of operation, service and repair of this equipment. Failure to comply with the safety precautions or warnings in this documentation violates safety standards of design, manufacture and intended use of this equipment and may impair the built-in protections within. WATT & WELL shall not be liable for users to comply with these requirements.

1.2. Installation

PCS-100 device must be installed following installation chapter.
This product is a safety **Class 1** instrument. To minimize shock hazard, the instrument chassis must be connected to the ESS frame which is in turn connected to earth ground.

The protective earth terminal must be connected to the safety electrical ground before another connection is made. Any interruption of the protective ground conductor, or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury.

PCS-100 device is designed to be accessible only for trained staff operators in **restricted access locations.**

1.3. AC grid rating

CAUTION - To reduce the risk of fire, connect only to a circuit provided with **125** amperes maximum branch circuit overcurrent protection in accordance with the National Electrical Code, ANSI/NFPA 70.
Do not use power supplies which exceed the input voltage rating of this instrument. The electrical rating of this instrument is given into the chapter 4 of this document.

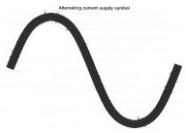
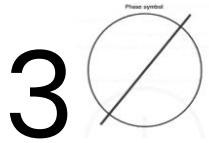
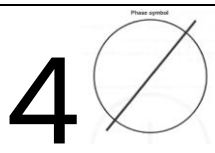
1.4. Live circuits

Operating personnel are not allowed to open the case of this equipment. Internal adjustment or component replacement is not allowed by non-WATT & WELL qualified personnel. Never replace components with cable connected to this instrument. To avoid injuries, always disconnect power and remove external voltage sources before touching components.

1.5. Hot surface

Surface of the product could be hot during and after operation.
To reduce the risk of burns - Use adequate protection before touching the device.

1.6. Marking

Symbol	English	French
	Input alternating current	Courant d'entrée alternatif
	Number of phases input phase[1]	Nombre de phase AC
	Number of phases input phase[2]	Nombre de phase AC
	Grounding	Prise de Terre
	CAUTION – Risk of electric shocks Capacitor stores hazardous energy. Do not remove cover until 5 minutes after disconnecting all sources of supply.	Attention – Risque de choc électrique Le condensateur accumule de l'énergie dangereuse. Ne pas retirer le couvercle jusqu'à 5 minutes après le débranchement de toutes les sources d'alimentation.
	CAUTION – HOT SURFACES To reduce the risk of burns – Do not touch	ATTENTION – SURFACES CHAUDES Pour réduire le risque de brûlures – Ne pas toucher

1.7. Maintenance

[1] For PCS-100 version
[2] For PCS-100-N version

Capacitors inside the unit store hazardous energy. Do not remove the cover until 5 minutes after disconnecting all sources of supply.

1.8. Safety related functions

All safety related mechanisms and functions are implemented by hardware. The software does not provide or perform safety-related functions.

Parts substitution and modifications
Parts substitutions and modifications are allowed by authorized WATT & WELL service personnel only.
For repairs or modification, the unit must be returned to WATT & WELL's After Sale Service. Contact After Sale Service (aftersales@wattandwell.com) to obtain a return merchandise authorization (RMA) number.

WATT & WELL
After Sale Service
121 Rue Louis Lumière
84120 PERTUIS
France

1.9. Environmental condition

PCS-100 device safety approval applies to the following operating conditions:

- Integrated into ESS system (in a 19" cabinet or a custom build enclosure)
- Maximum relative humidity : 95% at 40°C non-condensing
- Altitude : up to 2000m
- Pollution degree : 3[3]
- Overvoltage category : III on the AC side
  II on the DC side
- IP degree of enclosure : IP4X


Protective ground conductor terminal

The ESS where **PCS-100** will be installed should meet the requirements of environmental protection as defined in IEC62477-1.
Avoid using the inverter in the offshore environment near the sea or near a pollution source or in a corrosive and damaging environment. Otherwise it may lead to the failure of **PCS-100**. This damage caused will not be covered by the warranty.

[3] Attention should be paid to avoid ingress of water, metallic or conductive particles, dust or corrosive atmospheric that may cause early failures of equipment.

1.10. Normative compliance

PCS-100 meets the intent of directives:

- Low Voltage: 2014/35/UE
- CEM 2014/30/UE
    - NF EN IEC 61000-6-2: Electromagnetic compatibility (EMC) Part 6-2: Generic standards – Immunity standard for industrial environments
    - NF EN IEC 61000-6-4: Electromagnetic compatibility (EMC) Part 6-4: Generic standards – Emission standard for industrial environments
- RoHS: 2011/65/UE
- WEEE: 2012/19/EU

Please also note that **PCS-100** is designed to be compatible with the following norms:

Normative	Name	Note
IEC 62477-1:2022	Safety requirements for power electronic converter systems and equipment – Part 1: General	
UL 1741	Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources	

However, it is the user's responsibility to ensure that **PCS-100** is installed and used in compliance with all local country laws and regulations. The product will be marked CE starting from version 1.0.

PCS-100 is also designed to be compatible with the following grid codes:

- VDE-AR-N-4105
- EN 50549-1
- IEEE 1547:2018
- AS-NZS 4777.2

Please contact us for detailed information

2. Moving and storage instruction

To ensure the safe handling and storage of the inverter and to prevent risks of fire, electric shock, or injury to people during subsequent use, please follow these instructions carefully:

Moving the Unit:

- Before moving the inverter, ensure it is powered off and disconnected from all electrical connections.
- Use proper lifting techniques and equipment to handle the weight of the unit.
- Avoid dropping, tipping, or applying excessive force to the unit during movement. Sudden impacts can damage internal components, potentially leading to safety hazards.
- Protect the unit from exposure to moisture, dust, and extreme temperatures during transportation.
- Use the original packaging or equivalent protective materials to minimize the risk of physical damage.

Storage Guidelines:

- Store the inverter in a clean, dry, and well-ventilated area.
- Avoid environments with high humidity or exposure to corrosive chemicals.
- Maintain the storage temperature within the range specified in the technical specifications of this manual
- Ensure the unit is stored in its upright position.

Inspection Before Reuse:

- Before reusing the unit after storage, inspect it for visible damage, including cracks, corrosion, or loose connections.
- Check all electrical terminals and connections for signs of damage or wear. Tighten any loose connections as per the installation guidelines.
- If any damage is observed, do not power on the unit. Contact a qualified technician or the manufacturer for further assistance.

3. Absolute maximum ratings

Table 1: Absolute maximum ratings

Parameter	Condition	Min	Max	Units
LV Input Voltage			26	V
Output DC voltage			1500	V
Input AC voltage (phase – phase)			1000	V_{RMS}
Operating coolant temperature		-40	70	°C
Long term storage air Temperature		-30	70	°C
Temperature change rate			5	°C/min

Recommended maximum coolant temperature is 50°C. Beyond 50°C, linear derating on AC grid current is applied.

4. Electrical Characteristics

All specifications are given for coolant temperature up to 50°C unless otherwise noted.

Table 2: Electrical characteristics

Parameter	Condition	Value			Units
		Min	Typ	Max	
AC grid side					
Voltage (phase - phase)		177	400 480 690 730	876	V_{RMS}
Voltage (phase - neutral)		102	230 277 400 421	506	V_{RMS}
Current (per phase)		0		83	A_{RMS}
Current surge withstand capability (2 sec per hour)	Coolant temperature not more than 25°C			100	A_{RMS}
Grid frequency		42.5	50/60	69	Hz
Maximum power at $400V_{LLRMS}$				57	kVA
Maximum power at $690V_{LLRMS}$				99	kVA
Maximum power at $730V_{LLRMS}$				105	kVA
Current measurement accuracy	@83A			1	%
Voltage measurement accuracy	@$730V_{LL}$			1	%
Switching frequency			45		kHz

Response time	From full power charge to full power discharge		20		ms
Power factor[1]	Reactive power control	0 UE 0 OE		1	-
DC side					
Voltage		250[2]		1500	V_{DC}
Current	Battery charge Battery discharge			-110 110	A_{DC}
CAN communication					
CAN baud rate			500		kbps
CAN common mode range[3]		-7		7	V
Modbus TCP/IP communication					
Ethernet rate			100		Mbps
Digital Inputs					
Positive going input current (EMS, GPIO)		2		10	mA
Negative going input current (EMS, GPIO)				0.1	mA
Maximum reverse voltage				5.5	V
LV input					
Supply voltage		19	24	26	V
Input current standby			0.2		A
Input current start-up (inrush)	@24V input during 1ms			3	A
Under Voltage Shutdown (programmable)				16	V
Over Voltage Shutdown (programmable)				30	V
Power consumption		5[4]		15	W

4.1. Earthing system compatibility

The inverter is compatible with TT, TN and IT earthing systems.

4.2. Safe Operating Area

PCS-100 automatically adjusts its operation to the typical operating zone of a battery.
A Safe Operating Area (SOA) in three-phase mode ($400V_{LL}$ @50Hz) is given in **Figure 1** where two modes can be identified:

- Inverter mode: current flow from battery to grid - Positive battery current
- Rectifier mode: current flows from grid to battery – Negative battery current

PCS-100 can change between both operating modes and go to full power in either direction.

[1] Converter can deliver full inductive or capacitive reactive power
[2] See "Operating battery voltage" section
[3] CAN common mode: CAN_H and CAN_L versus CAN_GND
[4] Standby mode operation

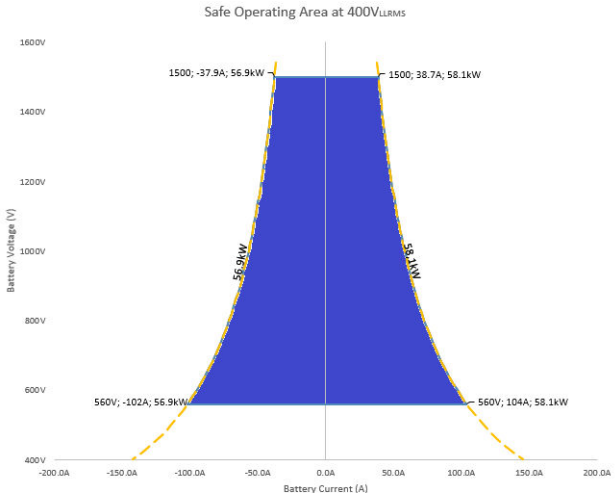


Figure 1: Safe Operating Area at 400V_{LL}

SOA is also given for 690V_{LL} @50Hz and 730V_{LL} @50HZ:

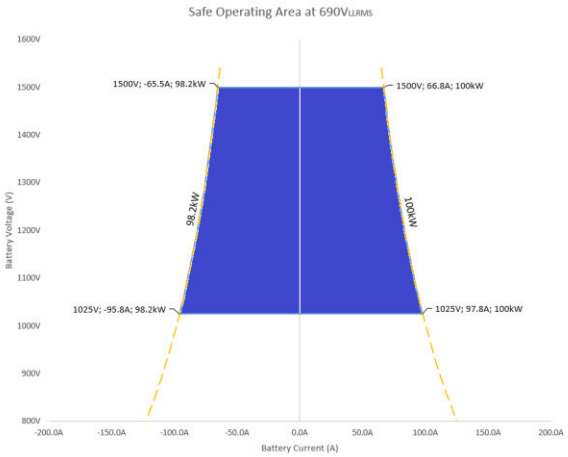


Figure 2: Safe Operating Area at 690V_{LL}

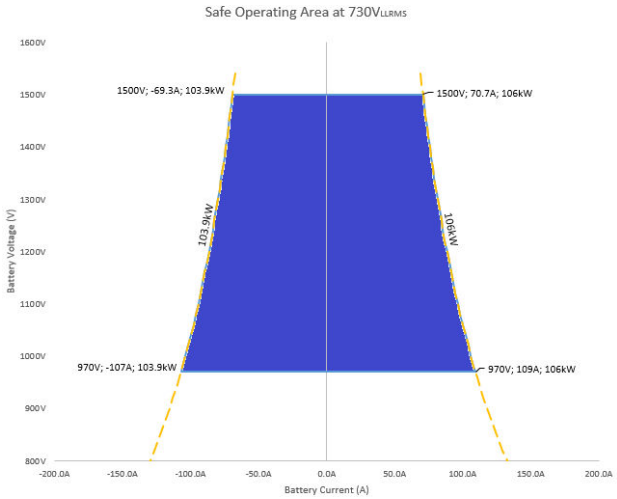


Figure 3: Safe Operating Area at 730V_{LL}

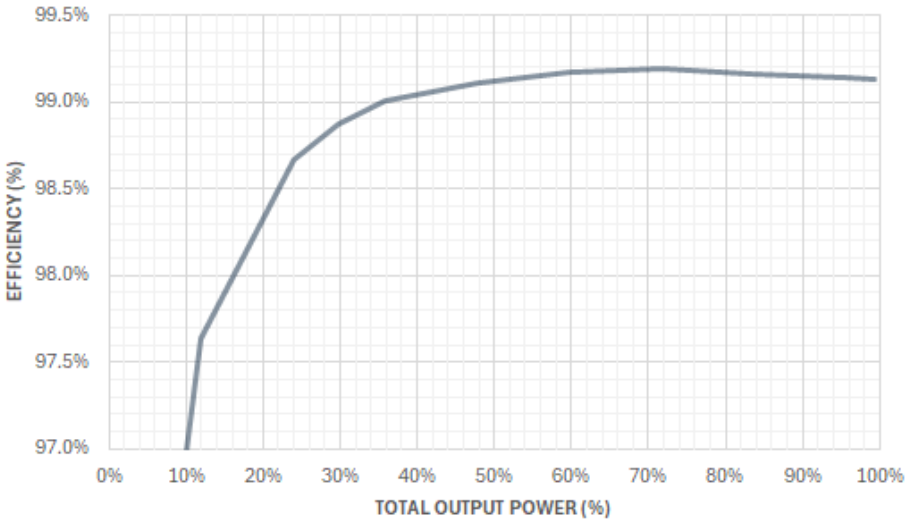
4.3. Reliability

Table 3: Reliability characteristics

Parameter	Condition	Value			Units
		Min	Typ	Max	
MTBF	Coolant temperature 50°C		500,000		hours

4.4. Typical efficiency

PCS-100 is based on highly efficient full SiC (Silicon Carbide) technology. Peak efficiency reaches 99%.



4.5. AC power

PCS-100 is sized for 83Arms per phase in both directions. Power increase or decrease linearly according to the grid voltage and the maximum phase current. Above 730V_{LL}, power is kept constant at 105kW

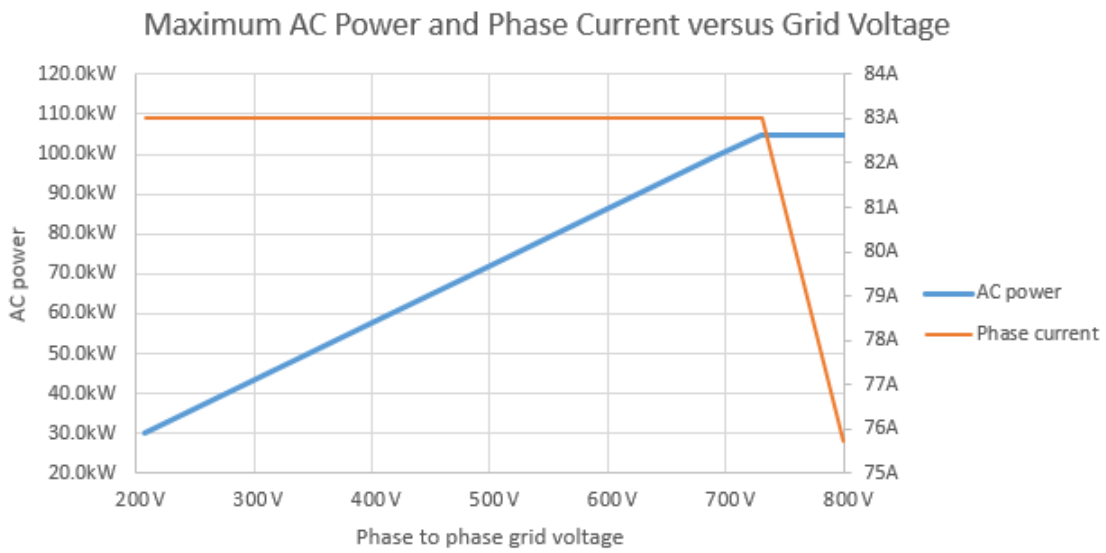


Figure 4: AC power vs AC phase to phase voltage

4.6. Operating voltage battery

The battery connected to the **PCS-100** shall have its minimum voltage rated according to the grid voltage:

Table 4: Minimum battery voltage versus line to line grid voltage

Maximum grid voltage (phase - phase)	Minimum battery voltage
$876V_{RMS}$	1230V
$730V_{RMS}$	1025V
$690V_{RMS}$	970V
480 V_{RMS}	675V
400 V_{RMS}	560V
208 V_{RMSv}	295V

Formula can be expressed as the following: $VDC_{min}=1.4*V_{LLRMS}$

5. Installation

The unit must be properly assembled in accordance with the assembly instructions before it is used.
Do not use or install **PCS-100** product in case of visible physical damage.

5.1. Mechanical installation

5.1.1. Handling

PCS-100 product has a weight of about 30 Kg. For correct handling, follow instruction below:

- The product must be handled flatly.
- For operator safety use personal protective equipment.
- Do not stack units (each unit should be self-supported and secured with the front and rear brackets)

5.1.2. Mounting

PCS-100 can be mounted on standard 19" cabinets.
Note that **PCS-100** is a heavy instrument and requires the cabinet to be equipped with slides or rails that support the chassis along the depth.

5.1.3. Cooling system

PCS-100 is liquid cooled. The following table shows the cooling system parameters.

Table 5: Cooling system parameters

Parameter	Value
Liquid Flow	10L/min
Water pressure drop	<0.5 bar @10LPM
Maximum inlet pressure	2.5 bar
Coolant	Water plus ethylene glycol (20% minimum, 50% maximum)
Inlet temperature	-40 to 70°C (current derating @50°C)

5.2. Electrical installation

5.2.1. Legal installation

Electrical installation shall comply with international standards such as IEC or the requirements in national standards of each country.

5.2.2. Safety Notice

Never invert the polarity of the connector. Never force to place a connector. Use only approved manufacturer parts for electrical or mechanical connection.
It is strongly recommended to fix the cables to avoid any stress on the connection. All high-power connectors must be screwed up to avoid any disconnection.
Be careful if other devices are connected, there is a risk of electrical charge transfer.
It is forbidden to open the cover. Only WATT & WELL approved personnel are allowed to do maintenance operations. Waiting time after complete suppression of input voltage before opening the device should be respected.

5.2.3. Protective earth

PCS-100 should be referenced to the ESS frame which is in turn is connected to earth ground.
Any interruption of the protective ground conductor, or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury or death. Protective earth connection is made through earth connection point (threaded stud with nut).
In addition, all parts of the chassis where **PCS-100** is to be installed (i.e., the 19" cabinet) need to be grounded. An electrical connection to "G" through mechanical parts must be done.
PCS-100 is only allowed to be operated by skilled personnel or instructed personnel.

5.2.4. AC Input

AC input is defined as three phases (with neutral line for -N only).
PCS-100 product must be protected against short circuit, overload protection and earth leakage current protection with external devices.

An overvoltage protective circuit that consists of a combination of varistors and surge arrestor is included on the AC side of the inverter. The circuits protects the inverter from power surges and voltage transients

5.2.5. LV DC input

LV input must be connected to 24Vdc bus. This input must be protected with a rapid fuse 3A rating. This cable must be shorter than 3 m.

5.2.6. DC Input

PCS-100 DC input must be protected with a rapid fuse.
This cable must be shorter than 30 m.

5.2.7. EMI requirements

Converters are designed to be compliant with IEC 61000-6-2 standards.

- EMI emissions
  - Conducted emissions: class A (industrial environments)
  - Radiated emissions: class A (industrial environments)
- EMI immunity
  - IEC EN 61000-6-2: Immunity standard for industrial environments

However, Integrator is responsible to use best practice for final system to avoid high EMI emissions.

5.2.8. Series operation

No series operations is allowed.

5.2.9. Disposal

- (Mandatory application within the European Union)
- Do not dispose of electronic tools tighter with household waste material. In accordance with WEEE European Directive (2012/19/UE), Electric material that has reached the end of their life must be collected separately and return to an environmentally compatible recycling facility. Please contact WATT & WELL for any questions about WEEE

6. Hardware specifications

6.1. Theory of operation

PCS-100 consists of a bidirectional 3-level inverter that interfaces the AC grid and performs DC regulation. Product is available with (-N option) or without neutral control and is also designed for grid forming.

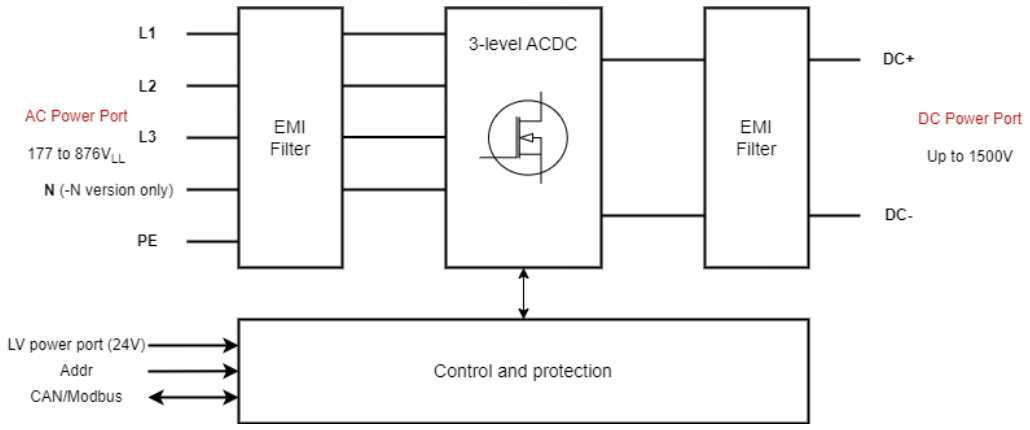


Figure 5: PCS high level synoptic

Here are the possible grid configuration for each mode:

- Inverter mode: **PCS-100** is connected to a grid
  - 3-phase without neutral for PCS-1500-110-N product
  - 3-phase with neutral PCS-1500-110 product
- Grid forming: **PCS-100** is creating a grid
  - 3-phase without neutral for PCS-1500-110-N product
  - 3-phase with neutral for PCS-1500-110 product

6.2. Interfaces and supply cables

Please note that the supply cables of the inverter shall be chosen to have an ampacity based on Table 310-16 of the National Electrical Code, ANSI/NFPA 70 of no less than 125 percent of the maximum current that the circuit carries during rated conditions; and that a wiring terminal are provided with a pressure terminal connector that is securely held by a screw.

Please use an ordinary tool for securing all conductors.

6.2.1. Low voltage connector

Located on the front panel. Cable connected to these ports must be less than 3m long.
Connector Reference (converter side):

- Phoenix Contact MSTB 2,5/ 2-GF-5,08 1776508 (UL approval 300V/15A)

- TIELEE: TLPHW-200R-02P-G12 (UL approval 300V/16A)

Recommended matting connectors (wire harness side):

Side	Connector	Manufacturer	Wire	Ferrule	Crimping tool
LV	MSTB 2,5/ 2-STF-5,08 – 1777989 (Screw terminal)	Phoenix contact	1 mm2	A 1 -6 Ref 3200247	Phoenix contact CRIMPFOX 6 Ref 1212034
	TLPSW-200V-02P-G12S	TIELEE	1 mm2	A 1 -6 Ref 3200247	

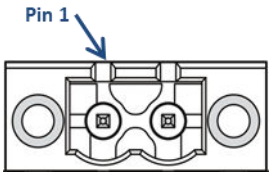


Figure 6: Low voltage connector

PIN	FUNCTION	DESCRIPTION	Preferred wiring color
1	LV_IN-	Low Voltage supply return (0V typ)	**Black**
2	LV_IN+	Low Voltage supply (24V typ)	**Red**

6.2.2. AC grid side connector

Located on the front panel.

Connector Reference (converter side):
Amphenol Industrial SurLok Plus connector (UL1977/4128 and TUV 2PfG2740 certified), with a quick lock and press to-release design.
RADSOK® size = 5.7mm (120A)., 25mm² cable

6.2.3. DC side connector

Located on the front panel.

Amphenol Industrial SurLok Plus connector (UL1977/4128 and TUV 2PfG2740 certified), with a quick lock and press to-release design.
RADSOK® size = 5.7mm (120A)., 25mm² cable

6.2.4. Liquid cooling connector

Located on the front panel.

A Universal Quick Disconnects, UQD06 connector.
Liquid flow for a speed of 5 m/s = 11.55 l/min.

6.2.5. Modbus connector

PCS-100 features Modbus TCP/IP for digital communications with other system components. The Modbus connector is an RJ45 connector. The cable connected to these ports must be less than 3m long.

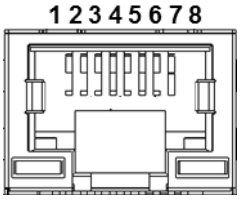


Figure 7 : Modbus connector front view

Table 6 – Modbus connector pinout

PIN	FUNCTION	DESCRIPTION
1	TX+	Transmit +
2	TX-	Transmit -
3	RX+	Receive +
4	NC	Not Connected
5	NC	Not Connected
6	RX-	Receive -
7	NC	Not Connected
8	GND	Ground reference

6.2.6. CAN connector

PCS-100 features a galvanically isolated CAN bus for digital communications with other boards. The CAN connector is an RJ45 connector. The cable connected to these ports must be less than 3m long.

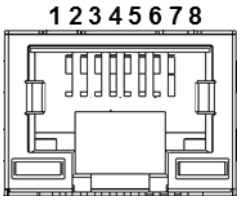


Figure 8 : CAN connector front view

Table 7 – CAN connector pinout

PIN	FUNCTION	DESCRIPTION
1	CAN H	CAN differential +
2	CAN L	CAN differential -
3	GND_ISO	Ground reference for CAN
4	EM_SHUT_RTN	Emergency Shutdown return line (negative)
5	EM_SHUT	Emergency Shutdown (positive)
6	NC	Not Connected

7	GND_ISO	Ground reference for CAN
8	NC	Not Connected

Note on CAN bus termination: CAN bus is expected to be terminated at each bus end with a 120 Ω resistance. Wiring should be selected to have an intrinsic impedance of the twisted that match this 120 Ω.
By default, **PCS-100** does not include any 120 Ω resistor to avoid overloading the bus when multiple nodes are presents.

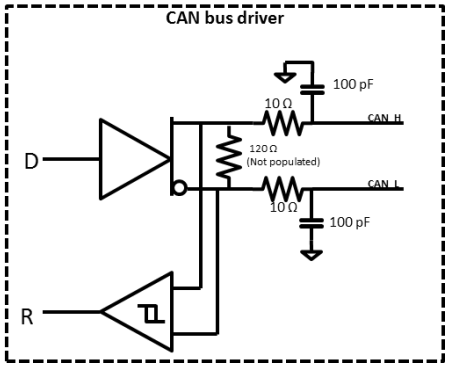


Figure 9: CAN transceiver simplified diagram

Note on CAN bus shield: Although ISO 11898-2 does not specify the wires type or the need for a shield, a shielded cable is recommended for electronically harsh environments.
It is recommended to ground the shield at a single point on the dedicated shield pin of the COM connector to avoid ground loops.
Also, remember that the CAN bus being isolated, the CAN_GND should be wired between nodes.

6.2.7. Address selector

Each **PCS-100** device takes its Modbus address or its CAN address at boot based on the Addressing dip switch on the front panel.

6.2.8. Emergency Shutdown

The COM connector also transmits an **Emergency Shutdown** (EM_SHUT) signal. This signal can be used to trigger an unconditional shutdown of the **PCS-100** operation. See Table 6 for the pinout of EM_SHUT within the COM connector.

EM_SHUT logic is as follows:

- "floating": Emergency Shutdown triggered (EM_SHUT=1)
- 12V or 24V: normal operation (EM_SHUT=0)

The simplified circuit of the EM_SHUT is given in Figure 10.

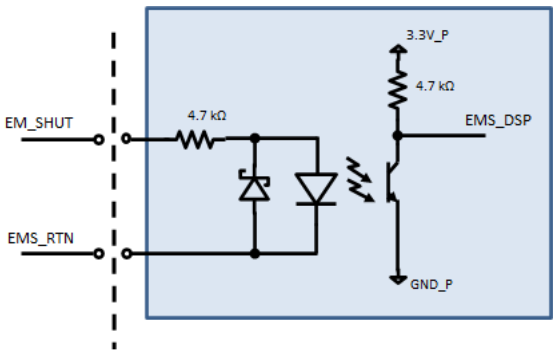


Figure 10 DSI input circuit

LEDs

4 LEDs on front panel indicate the status of the system

Table 8: LED overview

LED	COLOR	FUNCTION	Description
1	Red	Fault	Indicates a fault in the system. System stops as a result
2	Green	DC output	**Continuous:** System in charge mode
3	Green	Safe C	**Blinking at 5Hz:** Safe C mode. Input DC voltage is out of range. Output power is set off and the charger remains waiting for input DC voltage to return within acceptable range
4	Yellow or Orange	Voltage presence	**Slow blink:** Auxiliary voltage only (24V) **Continuous**: Grid voltage and Auxiliary voltage

7. Mechanical specifications

PCS-100 is packaged in a 2U standard 19'' rack.
The total length, from front to rear panel is 540mm.

8. Maintenance

It is forbidden to open the product.

8.1. Cleaning

Use a soft cloth for cleaning the device. Do not use cleaning agent.
Internal dust could be removed with vacuum cleaner or dry air cleaning.

9. Ordering information

9.1. Product Reference

	Status	P	Battery side	Grid	Other
PCS-100	Under development	100 kW	1500V, 110A	3P	x
PCS-100-N	Under development	100 kW	1500V, 110A	3P+N	x

9.2. Product accessories

WA016 – Pre-wired LV harness With color-coded 4mm insulated banana plug Cable length: 1m	
WA007 – CAN bus adaptor from RJ45 to DB9 including 120 Ω termination resistance	
WA009 – USB to CAN transceiver (Kvaser) Compatible with **PCS-100** Monitor	
WA049 – MPU monitor license (USB license dongle) A Windows based GUI (Graphical User Interface) for easy access to measurements, monitoring and configuration parameters. It can be used to control **PCS-100** as a PC based master or to speed-up integration of a dedicated system master.