



# INGECON SUN Power U

Outdoor

Installation manual

ABB2000IKI01\_B  
05/2013

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This document may be changed.

## Important safety precautions

This manual contains important instructions for the installation, handling and use of the following models:

### Units with a transformer

INGECON SUN 125 U 208 Outdoor

INGECON SUN 125 U 480 Outdoor

### Units without a transformer

INGECON SUN 125 TL U 208 Outdoor

INGECON SUN 165 TL U 275 Outdoor

INGECON SUN 200 TL U 330 Outdoor

INGECON SUN 220 TL U 360 Outdoor

Read these instructions and keep them in a safe place.

## General warnings



The operations described in the manual may be performed only by qualified personnel.

The status of qualified personnel referred to in this manual will be, as a minimum, that which meets all the standards, regulations and laws regarding safety applicable to the tasks of installing and operating this unit.

The responsibility for designating qualified personnel will always fall to the company to which the personnel belong. It is necessary to decide which workers are suitable or not for carrying out specific work to preserve their safety at the same time as complying with occupational safety legislation.

These companies are responsible for providing appropriate training in electrical equipment to their personnel and for familiarizing them with the contents of this manual.



All applicable safety-related legislation for electrical work must be complied with. Danger of electric shock.

Compliance with the safety instructions set out in this manual or in the suggested legislation does not imply exemption from other specific standards for the installation, place, country or other circumstances that affect the inverter.



Opening the door of the housing does not imply there is no voltage inside.

The risk of electric shock exists even after disconnecting from the grid, the PV array and the auxiliary supply.

Only qualified personnel may open it, following the instructions in this manual.



The entire manual must be read and understood in full prior to manipulating, installing or operating the unit.



Category III - 1000-Volt measuring instruments must be used for checking for the absence of voltage. Ingeteam accepts no liability for any damages caused by improper use of the equipment.



Carry out all control and handling without voltage.

As a minimum security measure in this operation, the so-called **five golden rules** should always be followed:

1. Disconnect
2. Prevent any possible resupply
3. Check there is no voltage
4. Ground and short circuit the equipment
5. Protect from live elements, if any, and put up safety signs around the work zone.

Until these five steps are completed, the work area cannot be considered voltage-free and any work performed will be considered to be work on live equipment.

## Potential hazards for people

Bear in mind the following warnings concerning personal safety.



**DANGER: Electric shock.**

The equipment may remain charged after disconnecting the PV array, mains power and auxiliary power.

Carefully follow the mandatory steps in the manual for removing the voltage.



**DANGER: Explosion.**

There is a very low risk of explosion in very specific cases of malfunction.

The casing will protect people and property from the explosion only if it is correctly closed.



**DANGER: Crushing and joint injuries.**

Always follow the indications in the manual on moving and placing the unit.

The weight of this unit can cause lesions, serious injury and even death if not handled correctly.



**DANGER: High temperature.**

The flow of outlet air can reach high temperatures which can cause injury to anybody exposed to it.

## Potential hazards for the equipment

Bear in mind the following warnings concerning protection of the equipment.



CAUTION: Ventilation.

The unit requires quality air flow while it is operating.

Keeping the unit in the upright position and the inlets free of obstacles is essential for this air flow to reach the inside.



CAUTION: Connections.

After all duly authorized handling, check that the equipment is ready to start operation. Only after this can it be connected following the instructions in the manual.



Do not touch boards or electronic components. The most sensitive components can be damaged or destroyed by static electricity.



Do not disconnect or connect any terminal while the unit is operating. Disconnect and check for absence of voltage first.

## Personal protection equipment (PPE)

Use all items comprising the protection equipment.

Chapter “4. Safety instructions” contains references to the use of this equipment depending on the situation.



The standard personal protective equipment is:

- Safety goggles for mechanical hazards
- Safety goggles for electrical hazards
- Safety footwear
- Helmet

## Cabling and torque requirements

Connection to the PV array must be with the following minimum types of cable; the maximum for input terminals is DC 250 kcmil (0.2 in<sup>2</sup>, 127 mm<sup>2</sup>) and for output terminals AC 300 kcmil (0.24 in<sup>2</sup>, 152 mm<sup>2</sup>):

Models	Wiring	Material	Section	Tightening torque St.st. bolts (unlubricated)	
				13/12” (M10)	31/64” (M12)
Input terminals (DC)					
All models 8 cables per polarity	4 AWG 194 °F (90 °C)	Copper	41.7 kcmil (0.03 in², 21.2 mm²)	385 lb.in (43.5 Nm)	650 lb.in (73.4 Nm)
	2 AWG 194 °F (90 °C)	Aluminium	66.4 kcmil (0.05 in², 33.6 mm²)	385 lb.in (43.5 Nm)	650 lb.in (73.4 Nm)
All models 4 cables per polarity	2/0 AWG 194 °F (90 °C)	Copper	133 kcmil (0.1 in², 67.4 mm²)	385 lb.in (43.5 Nm)	650 lb.in (73.4 Nm)
	4/0 AWG 194 °F (90 °C)	Aluminium	212 kcmil (0.17 in², 107 mm²)	-	650 lb.in (73.4 Nm)
Output values (AC)					
125 U 208, 125 TL U 208, 165 TL U 275, 200 TL U 330 220 TL U 360 2 cables per phase	250 kcmil 194 °F (90 °C)	Copper	250 kcmil (0.2 in², 127 mm²)	-	650 lb.in (73.4 Nm)
	300 kcmil 194 °F (90 °C)	Aluminium	300 kcmil (0.24 in², 152 mm²)	-	650 lb.in (73.4 Nm)
125 U 480 2 cables per phase	2 AWG 194 °F (90 °C)	Copper	66.4 kcmil (0.05 in², 33.6 mm²)	385 lb.in (43.5 Nm)	650 lb.in (73.4 Nm)
	1/0 AWG 194 °F (90 °C)	Aluminium	106 kcmil (0.08 in², 53.5 mm²)	385 lb.in (43.5 Nm)	650 lb.in (73.4 Nm)



In order to keep the nuts and bolts of the equipment in a proper condition, it is important while tightening them to make sure there is no dirt or shavings on the threads and to apply a suitable lubricant.

Cabling must comply with the following codes:

- *National Electrical Code ANSI/NFPA.*
- *Canadian Electrical Code CEC.*
- Other local or state codes if applicable.

Ingeteam recommends the use of 31/64" (M12) terminals.

## Inverter installation

The inverter must always be installed in accordance with the relevant requirements of the NEC (National Electrical Code ANSI/NFPA), CEC (Canadian Electrical Code), and other applicable codes, including those relating to circuits and equipment operating at over 600 V.

# Spares

## Units with a transformer

Reference	Quantity	INGECON SUN 125 U 208 Outdoor	INGECON SUN 125 U 480 Outdoor
U1	1	INGECON SUN 208 V 3 ph electronics block	INGECON SUN 480 V 3 ph electronics block
R1, R2, R3	3	Tubular silicon power resistor 200 W	
C1, C2, C3	3	Single phase condenser 1 x 150 uF - 440 Vac	
Q2	1	Thermomagnetic protection K 45 A 400 V 3P 30 kA	
IQ2	1	Lateral auxiliary contact K 45 A 400 V 3P 30 kA	
F1, F2, F3, F4	4	Fuses gPV 1000 V 250 A 50 kA	
PF1, PF2, PF3, PF4	4	Base fusible 1200 V 400 A	
F5, F6, F7	3	1000 Vdc 4 A 33 kA fuse, cylindrical 10 x 38	
PF5, PF6, PF7	3	Fuse holder 1000 V 1P cylindrical 10 x 38	
+ 15 Vdc Supply	1	AC/DC and DC/DC supply 230 Vac-12 Vdc 48 W	
RVDC	1	DC arrester 1000 VDC 2 Class II 40 kA	
QDC	1	Isolating switch 1000 V 630 A 4P	
QAUX	1	Thermomagnetic circuit breaker K 10 A 400 V 2P 6 kA	
IQAux	1	Lateral auxiliary contact K 10 A 400 V 2P 6 kA	
Q4	1	Thermomagnetic protection K 0.5 A 400 V 4P 7.5 kA	
Lmc	1	Toroidal magnetic core 3 or 4 cores 1 step	
K1, IK1	1	Contactor with closing coil 1000 V 305 A 100-250 V AC/DC 3P	Contactor with closing coil 1000 V 145 A 100-250 V AC/DC 3P
CC1	1	EMI 480 Vac 400 A CN filter	EMI 480 Vac 180 A CN filter
RVAC	1	AC ARRESTER 120 VAC 4+0 Class II 40 kA	AC ARRESTER 277 VAC 4+0 Class II 150 kA
Q1	1	Thermomagnetic circuit breaker 600 A 600 V 3P 65 kA	Thermomagnetic circuit breaker 225 A 600 V 3P 25 kA
EMI DC	1	Filter MC DC 470 nF	
VENT1, VENT2	2	Radial fan 230 VAC 170 W 2510 rpm	
LS	1	Limit switch	
AAS0091	1	HW matrix display, keyboard, LEDs.	
AQE0131	1	Three-phase cover	

Contact the Ingeteam telephone customer assistance with any questions.

**Units without a transformer**




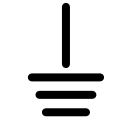
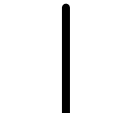
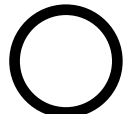
Reference	Quantity	INGECON SUN 125 TL U 208 Outdoor	INGECON SUN 165 TL U 275 Outdoor	INGECON SUN 200 TL U 330 Outdoor	INGECON SUN 220 TL U 360 Outdoor
U1	1	INGECON SUN Trifásico 208 V TL electronics block	INGECON SUN Trifásico 275 V TL electronics block	INGECON SUN Trifásico 330 V TL electronics block	INGECON SUN Trifásico 360 V TL electronics block
R1, R2, R3	3	Tubular silicon power resistor 200 W			
C1, C2, C3	3	Single phase condenser 1 x 150 uF - 440 Vac			
Q2	1	Thermomagnetic protection K 45 A 400 V 3P 30 kA			
IQ2	1	Lateral auxiliary contact K 45 A 400 V 3P 30 kA			
F1, F2, F3, F4	4	Fuses gPV 1000 V 250 A 50 kA			
PF1, PF2, PF3, PF4	4	Base fusible 1200 V 400 A			
F5	1	1000 Vdc 4 A 33 kA fuse, cylindrical 10 x 38			
F6, F7	2	1000 Vdc 15 A 33 kA fuse, cylindrical 10 x 38			
PF5, PF6, PF7	3	Fuse holder 1000 V 1P cylindrical 10 x 38			
+ 15 Vdc Supply	1	AC/DC and DC/DC supply 230 Vac - 12 Vdc 48 W			
RVDC	1	DC arrester 1000 VDC 2 Class II 40 kA			
QDC	1	Isolating switch 1000 V 630 A 4P			
QAUX	1	Thermomagnetic circuit breaker K 10 A 400 V 2P 6 kA			
IQAUX	1	Lateral auxiliary contact K 10 A 400 V 2P 6 kA			
Q4	1	Thermomagnetic protection K 0.5 A 400 V 4P 7.5 kA			
K1, IK1	1	Contactor with closing coil 1000 V 305 A 100-250 V AC/DC 3P			
RVAC	1	AC ARRESTER 750 VAC 4+0 Class II 40 kA			
Q1	1	Thermomagnetic circuit breaker 600 A 600 V 3P 65 kA			
EMI DC	1	MC DC 3 µF filter			
VENT1, VENT2	2	Radial fan 230 VAC 170 W 2510 rpm			
LS	1	Limit switch			
AAS0091	1	HW matrix display, keyboard, LEDs.			
AQE0131	1	Three-phase cover			

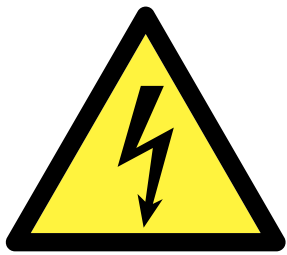

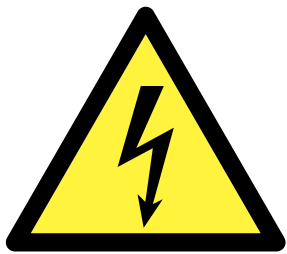

Contact the Ingeteam telephone customer assistance with any questions.

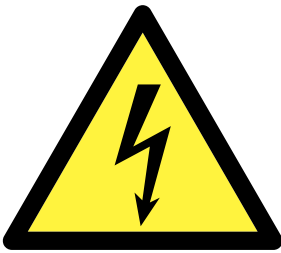

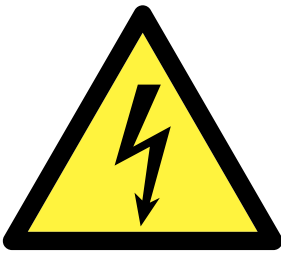





## Symbols on the inverters

Warning symbols on the inverter are as follows:

Ø 1	Connection from cable and phase 1 terminal.
Ø 2	Connection from cable and phase 2 terminal.
Ø 3	Connection from cable and phase 3 terminal.
	DC outlet.
	AC outlet
	Ground terminal
	Grounded points
	On
	Off

	 <b>WARNING</b>
	For Continued Protection Against Risk Of Fire Replace Only With Same Fuse Type And Rating.
	 <b>WARNING</b>
	<b>RISK OF ELECTRIC SHOCK.</b> Normally grounded conductors may be ungrounded and energized when a ground-fault is indicated.

	<div data-bbox="775 237 874 327"></div> <div data-bbox="916 255 1174 309"><b>WARNING</b></div> <div data-bbox="799 349 1153 412">RISK OF ELECTRIC SHOCK DO NOT REMOVE COVER.</div> <div data-bbox="778 432 1171 524">No user serviceable parts inside. Refer servicing to qualified service personnel.</div>
	<div data-bbox="775 573 874 663"></div> <div data-bbox="916 591 1174 645"><b>WARNING</b></div> <div data-bbox="775 685 1177 748">RISK OF ELECTRIC SHOCK FROM ENERGY IN CAPACITOR.</div> <div data-bbox="810 768 1142 860">Do not remove cover until 5 minutes after disconnecting all sources of supply.</div>
	<div data-bbox="775 909 874 999"></div> <div data-bbox="916 927 1174 981"><b>WARNING</b></div> <div data-bbox="866 1055 1082 1084">HOT SURFACES.</div> <div data-bbox="815 1104 1133 1167">To reduce the risk of burns do not touch.</div>

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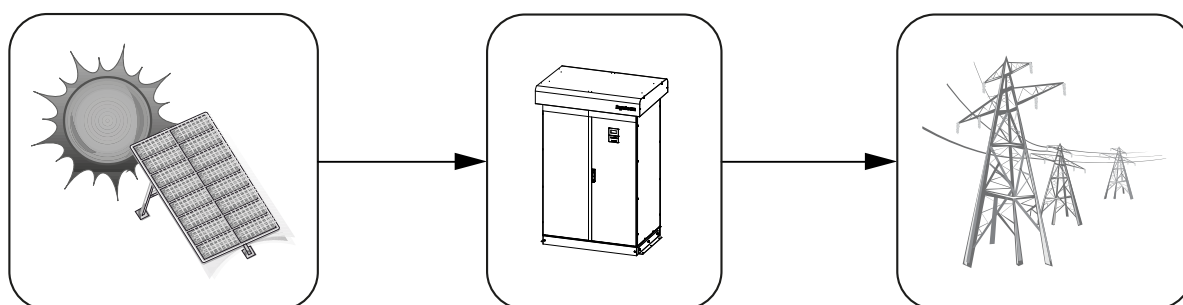
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# 1. Overview

The purpose of this manual is to describe the INGECON SUN Power U and to give appropriate information for its correct receipt, installation, start-up, maintenance and operation.

## 1.1. Equipment description

An inverter is a circuit used to convert direct current to alternating current. The function of these units is to convert the direct current generated by photovoltaic solar panels to alternating current and so enable it to be fed to the electricity grid.



Depending on installation requirements, the unit may be ordered:

- With ground connection on the positive pole.
- With ground connection on the negative pole.
- No grounding.

### 1.1.1. Models

The INGECON SUN Power U product family comprises units without a transformer (TL) and units with a transformer:

Units with a transformer	Units without a transformer (TL)
INGECON SUN 125 U 208 Outdoor	INGECON SUN 125 TL U 208 Outdoor
INGECON SUN 125 U 480 Outdoor	INGECON SUN 165 TL U 275 Outdoor
	INGECON SUN 200 TL U 330 Outdoor
	INGECON SUN 220 TL U 360 Outdoor

### 1.1.2. Options

These models may include the following options:

- Nighttime power supply.
- Remote triggering kit.
- Heating element kit.
- Auxiliary services kit.
- Voltage fall-out kit.
- Synchronization kit.

## 1.2. Configuration parameters

### 1.2.1. Units with a transformer

DC input	125 U 208	125 U 480
Range of input operating voltage	330 ~ 920 V	
Maximum input voltage	1000 V <sup>(1)</sup>	
Maximum input current	390 A	
Maximum input short circuit current	250 A (4 fused inputs)	
Maximum input source backfeed current to input source	0 A	

AC output	125 U 208	125 U 480
Output power factor rating	> 0.99	
Operating voltage range (ac) (L-L)	183 ~ 229 V	422.5 ~ 528 V
Operating frequency range or single frequency	57 ~ 60.5 Hz	
Number of phases	3	
Nominal output voltage (AC)	208 V	480 V
Normal output frequency	60 Hz	
Maximum continuous output current (AC) per line	347 A	151 A
Rated power (AC)	125 kW	
Maximum output fault current (ac) and duration	860 A at 11 ms	372 A at 6.5 ms
Maximum output overcurrent protection	600 A (MCB setting Q1)	225 A (MCB setting Q1)
Reconnection time	5 minutes	
Normal operation temperature range	-4 ° F (-20 °) ~ 149 ° F (65 °C)	
Maximum full power operating ambient	122 ° F (50 °C)	
Enclosure Rating Type	NEMA 3R	

Utility interconnection voltage and frequency trip limits and trip times			
Condition	Simulated utility source		Maximum time (sec) at 60 Hz before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	< 0.50 V <sub>nor</sub>	Rated	0.16
B	0.50 V <sub>nor</sub> ≤ V < 0.88 V <sub>nor</sub> (Adjustable Set Points, default 0.88 V <sub>nor</sub> )	Rated	0.16 ~ 2 (Adjustable Set Points, default 0.16)
C	1.10 V <sub>nor</sub> < V < 1.20 V <sub>nor</sub> (Adjustable Set Points, default 1.10 V <sub>nor</sub> )	Rated	0.16 ~ 1 (Adjustable Set Points, default 0.16)
D	1.20 V <sub>nor</sub> ≤ V	Rated	0.16
E	Rated	f > 60.5	0.16
F	Rated	f < (59.8 ~ 57.0) (Adjustable Set Points, default 59)	0.16 ~ 300
G	Rated	f < 57	0.16

Precision of values and disconnection time of the voltage and frequency protections.	
Voltage	± 1%
Frequency	± 0.1 Hz
Time	0.06 s

<sup>(1)</sup> above 920 V the unit remains in standby.

## 1.2.2. Units without a transformer (TL)

DC input	125 TL U 208	165 TL U 275	200 TL U 330	220 TL U 360
Range of input operating voltage	330 ~ 920 V	440 ~ 920 V	525 ~ 920 V	570 ~ 920 V
Maximum input voltage	1000 V <sup>(1)</sup>			
Maximum input current	390 A			
Maximum input short circuit current	250 A (4 fused inputs)			
Maximum input source backfeed current to input source	0 A			

AC output	125 TL U 208	165 TL U 275	200 TL U 330	220 TL U 360
Output power factor rating	> 0.99			
Operating voltage range (ac) (L-L)	183 ~ 229 V	242 ~ 303 V	290 ~ 319 V	317 ~ 396 V
Operating frequency range or single frequency	57 ~ 60.5 Hz			
Number of phases	3			
Nominal output voltage (AC)	208 V	275 V	330 V	360 V
Normal output frequency	60 Hz			
Maximum continuous output current (AC) per line	347 A			
Rated power (AC)	125 kW	165 kW	200 kW	220 kW
Maximum output fault current (ac) and duration	860 A at 11 ms			
Maximum output overcurrent protection	600 A (MCB setting Q1)			
Reconnection time	5 minutes			
Normal operation temperature range	-4 ° F (-20 °) ~ 149 ° F (65 °C)			
Maximum full power operating ambient	122 ° F (50 °C)			
Enclosure Rating Type	NEMA 3R			

Utility interconnection voltage and frequency trip limits and trip times			
Condition	Simulated utility source		Maximum time (sec) at 60 Hz before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	< 0.50 V <sub>nor</sub>	Rated	0.16
B	0.50 V <sub>nor</sub> ≤ V < 0.88 V <sub>nor</sub> (Adjustable Set Points, default 0.88 V <sub>nor</sub> )	Rated	0.16 ~ 2 (Adjustable Set Points, default 0.16)
C	1.10 V <sub>nor</sub> < V < 1.20 V <sub>nor</sub> (Adjustable Set Points, default 1.10 V <sub>nor</sub> )	Rated	0.16 ~ 1 (Adjustable Set Points, default 0.16)
D	1.20 V <sub>nor</sub> ≤ V	Rated	0.16
E	Rated	f > 60.5	0.16
F	Rated	f < (59.8 ~ 57.0) (Adjustable Set Points, default 59)	0.16 ~ 300
G	Rated	f < 57	0.16

Precision of values and disconnection time of the voltage and frequency protections.	
Voltage	± 1%
Frequency	± 0.1 Hz
Time	0.06 s

<sup>(1)</sup> above 920 V the unit remains in standby.



## 1.3. Compliance with regulations

### UL 1741

UL Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, Second Edition, Dated January 28, 2010.

### CSA

CAN/CSA-C22.2 No. 0-M91 - General Requirements - Canadian Electrical Code - Part II.

0.4-04 - Bonding of Electrical Equipment.

107.1-01 - General Use Power Supplies.

### IEEE 1547.1<sup>TM</sup>

IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.

### FCC Part 15 B (class A) EMC tests

## 2. System description

### 2.1. Location

These units must be installed in environments with specific characteristics.

Guidelines are provided in this section for choosing a suitable environment and adapting the unit to it properly.

#### 2.1.1. Environment



Place the units in a place which is accessible for installation and maintenance work and which permits use of the keyboard, the display and the reading of the front indicator LEDs.

A minimum space of 40 in (1 m) must be maintained on both sides and in front and behind the unit to allow the free circulation of air through the circulation vents.



The air vents and part of the cabinet close to them can reach 185 °F (85 °C). Do not place any material nearby which is sensitive high air temperatures.



Avoid corrosive environments that may affect the proper operation of the inverter.



Never place any object on top of the unit.

#### 2.1.2. Protection class

These units meet NEMA type 3R degree of protection against external agents.

They are therefore designed to be suitable for outdoor location.

#### 2.1.3. Ambient temperature

These units are designed to operate in a temperature range from -4 °F (-20 °C) to 149 °F (65 °C). Nominal power may be input at up to 122 °F (50 °C). Above this temperature the unit limits input power in order to cool the internal temperature of the electronics.

## 2.1.4. Atmospheric conditions

The ambient air must be clean and relative humidity must not exceed 50% at over 104 °F (40 °C). Higher levels of relative humidity, up to 95%, can be tolerated at below 86 °F (30 °C).

It should be borne in mind that moderate condensation may occasionally occur as a consequence of temperature variations. For this reason, apart from the unit's own protection, vigilance of these units is necessary once they have been started up on sites where the conditions described above are not expected to be present.

In the event of condensation, never apply voltage to the unit.

## 2.1.5. Contamination class

The pollution class for which the units have been designed is grade 3.

Suitable measures should be taken to provide dust-free air of sufficient quality in the vicinity of the inverter.

## 2.1.6. Acoustic contamination

When on, the inverter generates a buzzing sound.

Do not place it in an occupied room, or on light supports which might amplify this buzz. The mounting surface must be firm and appropriate for the weight of the unit.

## 2.1.7. Ventilation

These units intake air through the sides of the housing and expel it from the front and back.

A minimum obstacle-free space of 40 in (1 m) must be maintained on both sides as well as in front of and behind the unit to allow the free circulation of air.

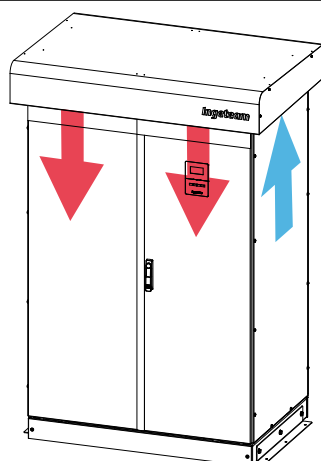


These units are fitted with two cooling fans on the top of the cabinet. These fans start up for a few seconds each time the inverter is connected to the mains and is about to inject power. This procedure makes it possible to easily check proper operation.

The fans require an adequate flow of clean, dust-free air for proper operation.



Do not place any object on top of the unit.



## 2.1.8. Environmental characteristics

The environmental conditions for operation are:

Ambient conditions	
Minimum temperature <sup>(1)</sup>	-4 °F (-20 °C)
Minimum surrounding air temperature <sup>(1)</sup>	-4 °F (-20 °C)
Minimum surrounding air temperature	149 °F (65 °C)
Temperature at which power limiting commences	122 °F (50 °C)
Maximum relative humidity without condensation	95%

<sup>(1)</sup> Units including a heating element kit may be installed in locations with a minimum temperature of -13 °F (-25 °C).

For further information see Chapter “2.4. Location of the components”.

## 2.2. Characteristics of the electrical installation

These units are designed to be connected to the low voltage public grid.

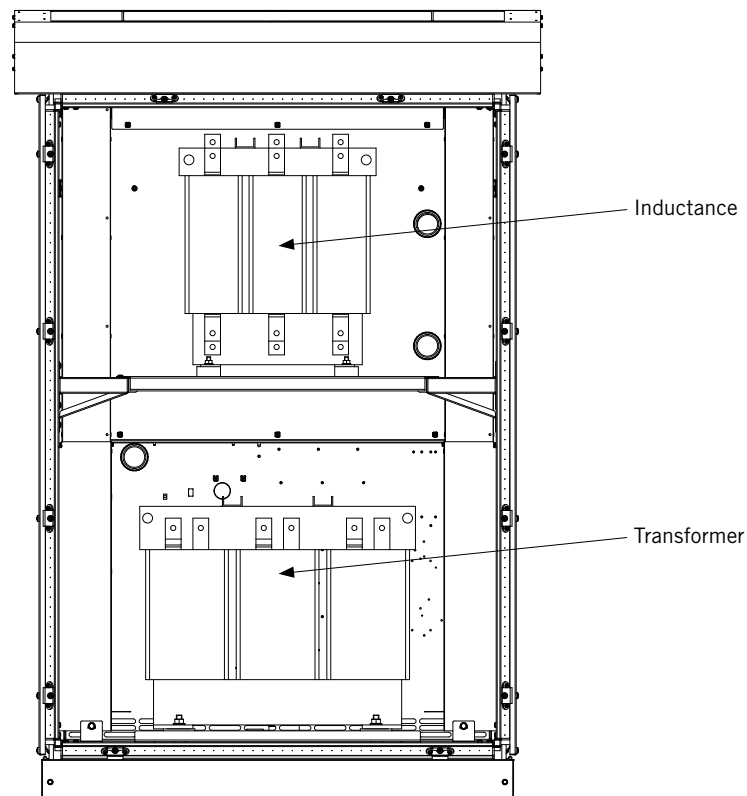
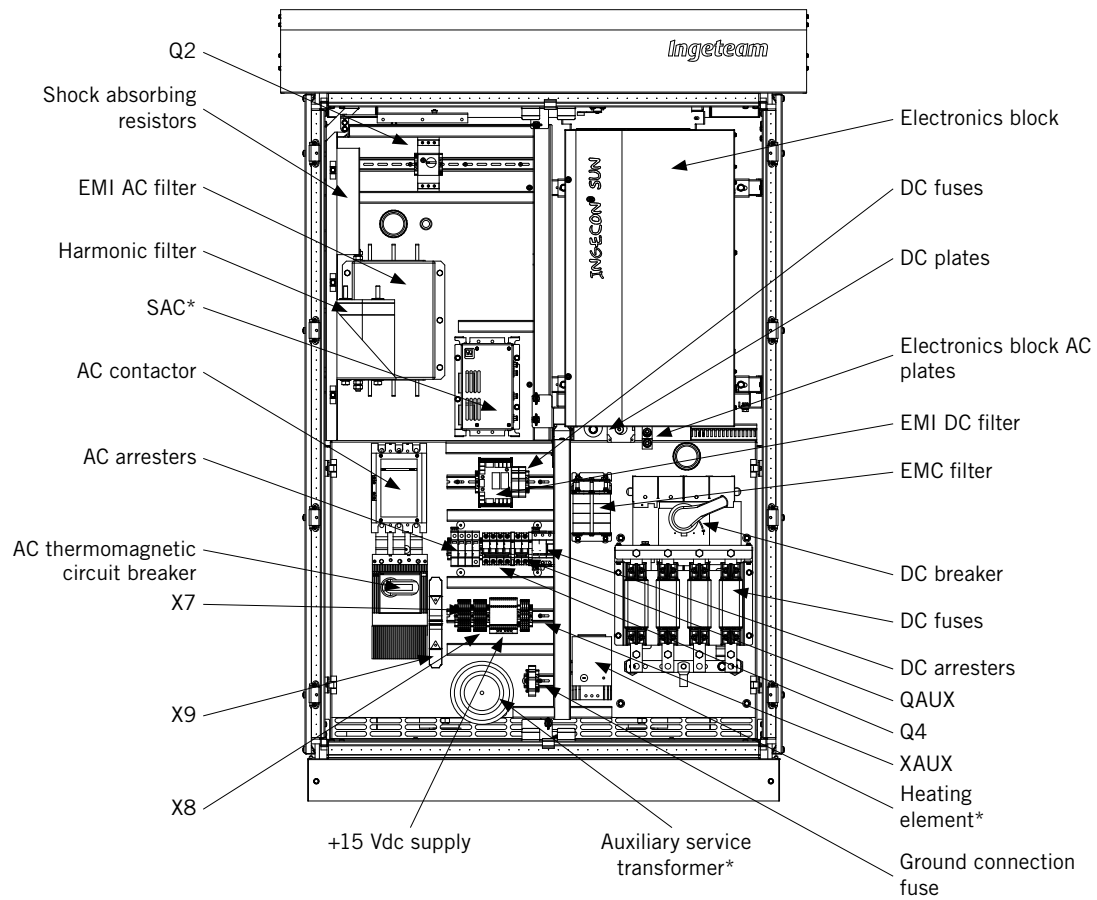
## 2.3. EMC requirements

These units are equipped with the necessary filtering elements to comply with EMC requirements for industrial applications in order to prevent disturbances in other equipment outside the installation.

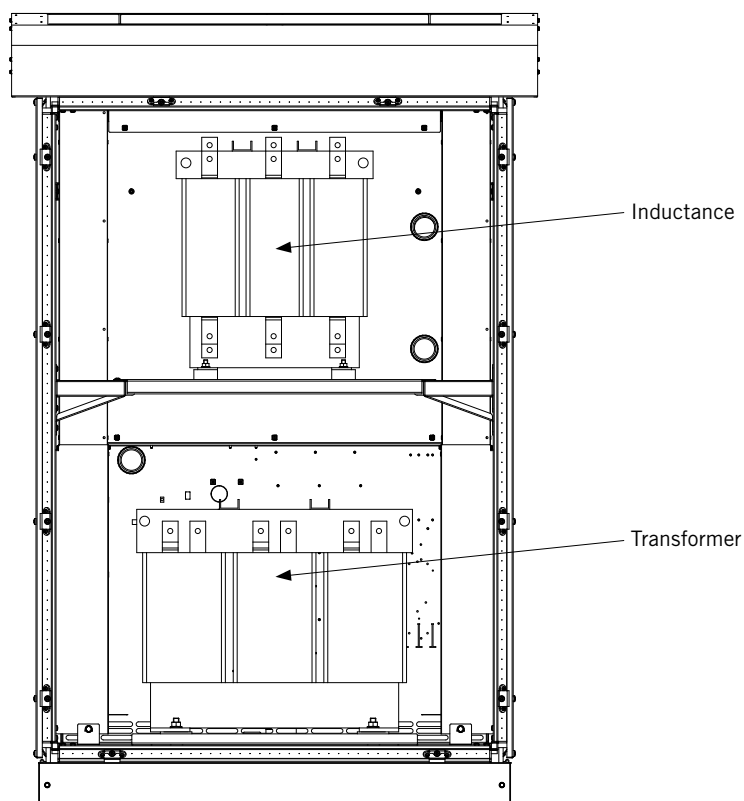
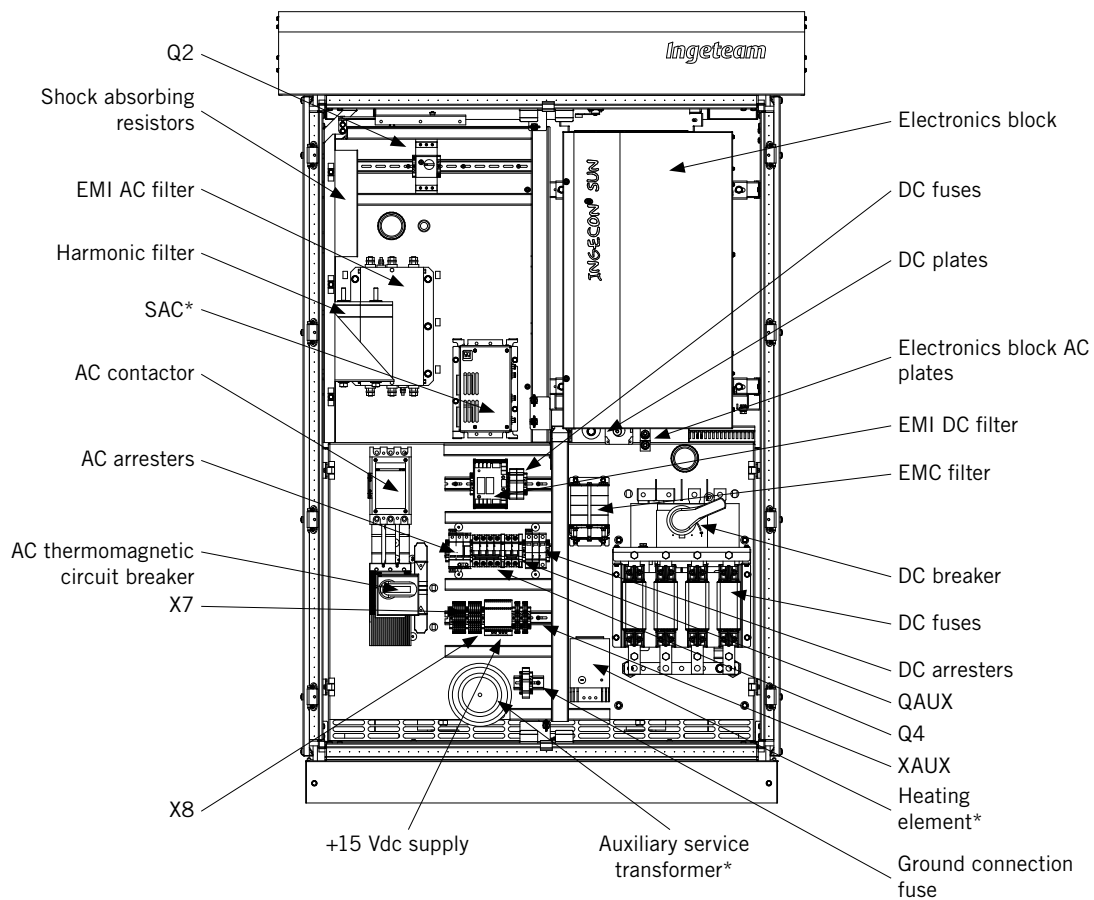
## 2.4. Location of the components

See next pages.

# INGECON SUN 125 U 208 Outdoor

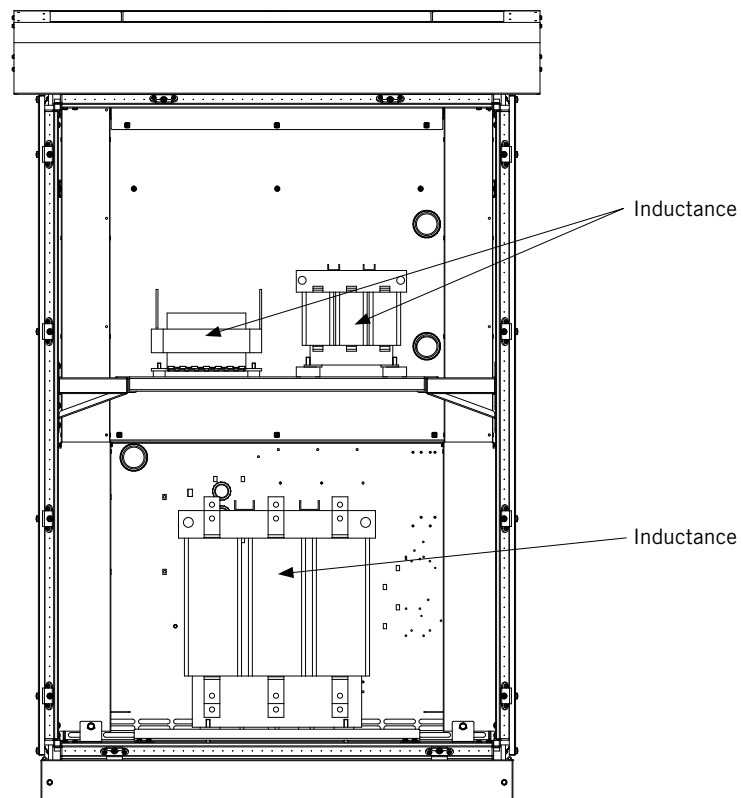
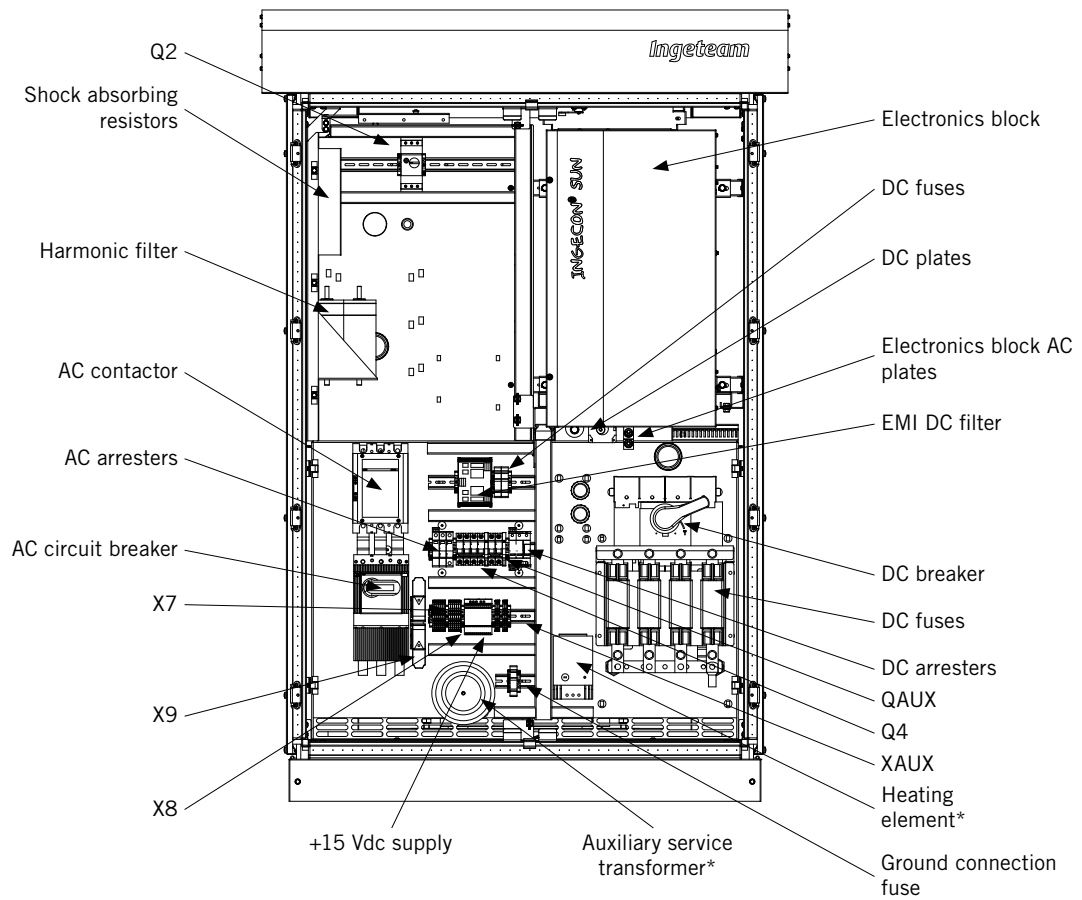


\* Optional

**INGECON SUN 125 U 480 Outdoor**

\* Optional

# **INGECON SUN 125 TL U 208, 165 TL U 275, 200 TL U 330 y 220 TL U 360 Outdoor**



\* Optional

### 3. Operating, conservation and transport conditions



Failure to follow the instructions provided in this section may lead to damage to the equipment.  
Ingeteam accepts no liability for damage resulting from the failure to follow these instructions.

#### 3.1. Symbols

Bear in mind the following symbols:



Move transport packaging with this side up.



Do not use sharp tools to open the shipping packaging.



Prevent the unit from becoming wet.



Do not place anything on top of the shipping packaging.



The contents of the shipping container are fragile.

#### 3.2. Equipment reception

##### Reception

Upon receipt of the shipment, check the terms specified in the *Delivery Note*, sign the *Signature Receiver Goods* field and return the copy to the return address.

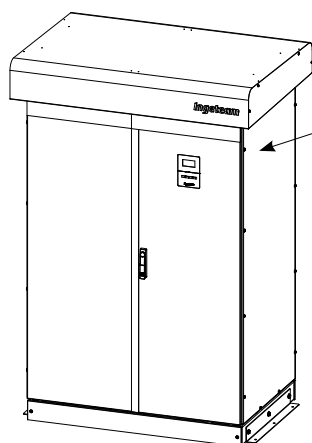
Keep the unit in its packaging until immediately before installation. Maintain the unit **upright** at all times.

The unit is delivered with the following features:

Model	Packing pallet	Weight	Dimensions (H x W x D)
Units with a transformer			
INGECON SUN 125 U 208 Outdoor	Bubble wrap and plastic bag on wooden pallet	2601.45 lb (1180 kg)	85.04 x 49.6 x 39.37 in (2160 x 1260 x 1000 mm)
INGECON SUN 125 U 480 Outdoor			
Units without a transformer (TL)			
INGECON SUN 125 TL U 208 Outdoor	Bubble wrap and plastic bag on wooden pallet	1565.28 lb (710 kg)	85.04 x 49.6 x 39.37 in (2160 x 1260 x 1000 mm)
INGECON SUN 165 TL U 275 Outdoor			
INGECON SUN 200 TL U 330 Outdoor			
INGECON SUN 220 TL U 360 Outdoor			

##### Identifying the unit

The serial number of the equipment is its unique identifier. This number must be quoted in any communication with Ingeteam.



<b>Ingeteam</b> Master Project: XXXXXX File Number: XXXXXX		<b>Ingeteam INC.</b> 5201 Great American Parkway, Suite 320 SANTA CLARA, CA 95054 - USA Tel.: +1 (415) 450 1869 +1 (415) 450 1870 Fax.: +1 (408) 824 1327 e-mail: solar.us@ingeteam.com	
Model/ Type	INGECON SUN 125 TL U 208 Outdoor	Date of Manufacture	2012/03
Rated Power	125 kW	Normal operating temperature range	-4 °F (-20 °C) ~ -149 °F (65 °C)
Voltage (AC)	208 V (183 ~ 229 V) ± 1% 0.06 s	Type of enclosure	3R
Frequency	60 Hz (57 Hz ~ 60.5 Hz) ± 1 Hz 0.06 s	Range of input operating voltage	330 ~ 920 V
Output power factor rating	> 0.99	Max. input short circuit current	250 A
Max. output fault current (AC) and duration	860 A at 11 ms	Max. input source backfeed current to input source	0 A
Max. output over-current protection	600 A		
Serial Number	XXXXXXXXXXXX		

Location of the name plate inside the unit

There is another ratings plate in a visible internal location.

### Transport damage

If the equipment has been damaged during transport, proceed as follows:

1. Do not proceed with the installation.
2. Notify the distributor immediately within 5 days of receipt of the equipment.

If ultimately the unit has to be returned to the manufacturer, you must use the same original packaging.

## 3.3. Handling and unpacking

Correct handling of the units is vitally important in order to:

- Prevent damage to the packaging which enables them to be kept in optimum condition from shipping until they are unpacked.
- Avoid knocks and/or falls which may harm their mechanical characteristics, e.g. cause incorrect closure of doors, loss of IP rating, etc.
- Avoid, as far as possible, vibrations which may cause subsequent malfunction.

If you observe any anomaly, please contact Ingeteam immediately.

### Separating the packaging

All the packaging can be delivered to a non-hazardous waste management company.

In any event, each part of the packaging may be recycled as follows:

- Plastic (polystyrene, bag and bubble wrap): appropriate container.
- Cardboard: appropriate container.



## 3.4. Moving the equipment

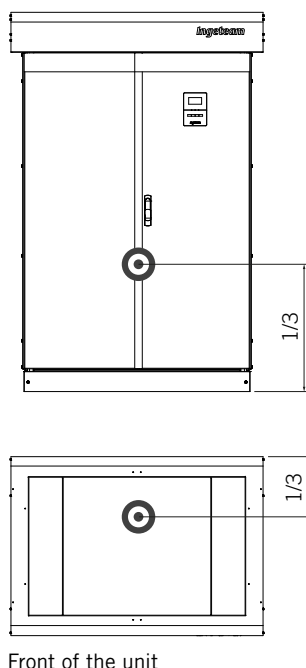
Appropriate transport and storage of the unit are the necessary first steps for correct use and operation. Taking the above section into account and as a preventive measure, Ingeteam recommends the use of transport companies specialized in the transport of special and/or fragile equipment.

The unit must be protected, during transport and storage, from mechanical knocks, vibrations, water splashes (rain) and any other product or situation which may damage it or alter its behavior.

Failure to observe these instructions may lead to loss of warranty on the product, for which Ingeteam is not responsible.

When transporting the units it is essential to maintain the unit in the upright position, even if it is being returned to the factory.

Bear in mind the centre of gravity of the unit whenever it is moved.



### Transport using goods vehicles

During transport, units must be kept in an upright position and properly secured in accordance with their weight and size to avoid tipping and bumps.

### Transport using a forklift truck

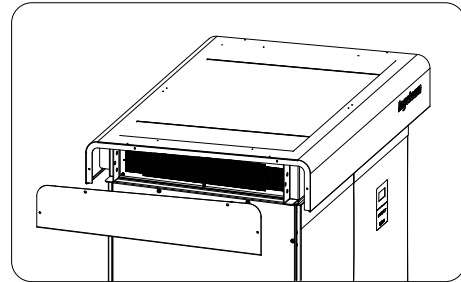
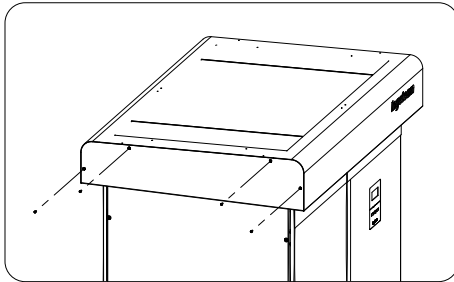
At least the following requirements should be observed:

1. Place the packaged unit centred with respect to the forks.
2. Try to locate it as close as possible to the connection between the forks and the chassis.
3. Ensure that the forks are perfectly level to avoid overturning the unit.
4. In any case, observe the instructions in the forklift truck's user manual.
5. If it is transported after having been unpacked, unscrew the base being moving it.

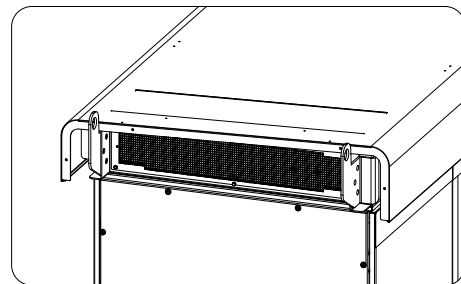
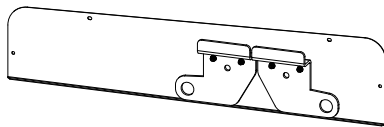
### Transport using a crane

When moving with a crane, use the strips supplied for this purpose. To access these:

1. Remove the side roofs of the unit by removing the 4 bolts on each side as shown below:



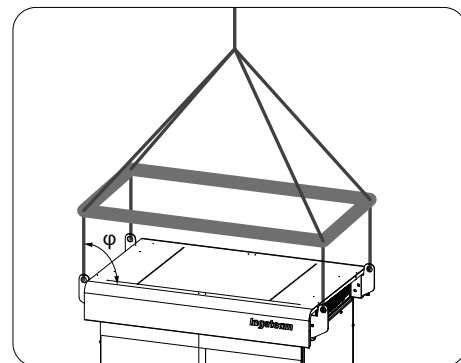
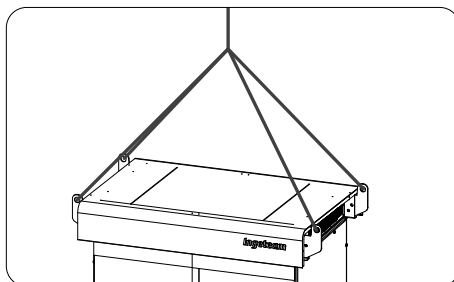
2. Turning the lateral metal sheet will reveal the strips supplied for moving the unit with a crane. Remove them and place them as shown in the figures below, anchoring them with the bolts supplied.



3. Anchor the unit with ropes at the points shown.

Ensure that the load is distributed evenly between these points. Ensure this by fixing individual cables, chains or ropes to each of the points, taking into account that the angle formed by each pair of cables on the same side is less than or equal to  $45^\circ$  and ensuring that the cables are as vertical as possible.

It is always advisable to use a load frame as in the adjoining figure for a proper distribution of the loads, bearing in mind that the angle  $\varphi$  should be equal to  $90^\circ$ .



## 3.5. Storage

If the unit is not installed immediately after receipt, the following points should be taken into account in order to prevent damage:

- The package must be stored in the vertical position.
- Keep the unit free of dirt (dust, shavings, grease, etc) and away from rodents.
- Keep away from water splashes, welding sparks, etc.
- Cover the unit with a breathable protective material in order to prevent condensation due to ambient humidity.
- Units in storage must not be subjected to climate conditions other than those indicated in Section "2.1.8."

#### *Environmental characteristics".*

- It is very important to protect the unit from chemical products which can cause corrosion, as well as from salty atmospheres.
- Do not store the unit outdoors.

## 3.6. Conservation

In order to permit correct conservation of the units, they must not be removed from their original packaging until it is time to install them.

In case of prolonged storage, the use of dry places avoiding, as far as possible, sharp changes in temperature is recommended.

Deterioration of the packaging (tears, holes, etc.) prevents the units from being kept in optimum conditions before installation. Ingeteam accepts no liability in the case of failing to observe this condition.

## 3.7. Waste handling

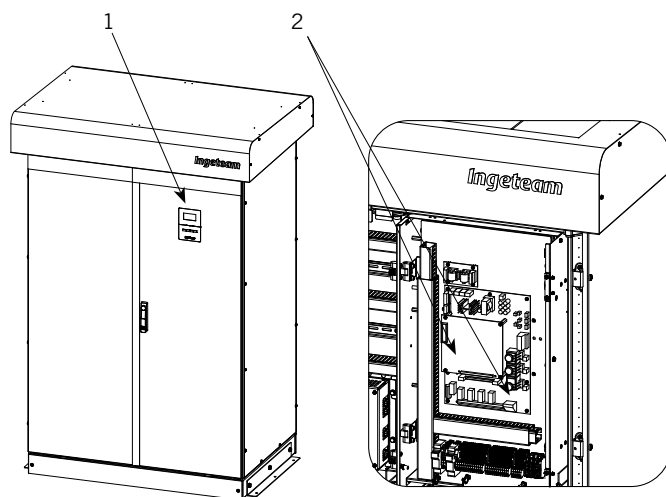
During the various processes for installation, start-up and maintenance, waste is generated which must be handled appropriately according to the regulations in the corresponding country.

At the end of the unit's life, the waste must be processed by an authorized waste management company.

Ingeteam, in accordance with its policy of respect for the environment, will inform the authorized manager, via this Section, of the location of components to be decontaminated.

The elements within the unit that must be handled individually are:

1. Liquid crystal displays
2. Printed circuit cards.



Current environmental legislation and any client requirements must be complied with in all actions performed. Close attention should be paid to the handling of hazardous materials and proper waste separation.

#### **Waste that can be handled by conventional waste collection means**

Most of this waste is from the unit's packaging, which must be properly separated and processed.

All the packaging can be delivered to a non-hazardous waste management company.

In any event, each part of the packaging may be recycled as follows:

- Plastic (polystyrene, bag and bubble wrap): Appropriate container (plastic and bottles).
- Cardboard: Appropriate container (paper and cardboard).

## 4. Safety instructions

This section contains safety instructions which must be followed when installing, operating and accessing the unit.

Failure to comply with the Safety instructions may cause injury or even death or cause damage to the unit.

Read the Safety instructions carefully before working on the unit.

### 4.1. Symbols

The warnings advise of conditions which may cause serious injury or death and/or damage to the equipment. The means of avoiding the hazard to both people and the unit is indicated along with the warning.

The symbols and an explanation of their meaning can be seen below.



**DANGER: High voltage**

Dangerous voltage warning: Warns of high voltage which may cause injury or even death and/or damage to the equipment.



General warning. Warns of conditions which can cause injury and/or damage to the equipment.



**WARNING: Hot surface**

Warns of the existence of hot parts which may cause serious burns.

The specific safety warnings and notes which affect specific tasks are included in each affected chapter and are repeated and completed within each chapter in the corresponding critical points.

Please read this information carefully as it is written for your personal safety and to ensure the longest possible service life for the unit and the devices to which it is connected.

### 4.2. General safety precautions



Installation, start-up, inspection and maintenance operations may only be carried out by personnel appropriately qualified and trained in electrical subjects (hereinafter qualified personnel). You are reminded of the obligation to comply with safety regulations applicable to electrical work.



The fact that the various compartment housings are open in no way implies the absence of voltage. Only qualified personnel following the safety guidelines described in this document may access the compartments.



The set of conditions listed below should be considered as minimum requirements. It is always preferable to shut off the main power supply. Installation defects may result in unwanted feedback. Danger of electric shock.



In addition to the safety measures indicated in this manual, the general measures that apply in this area (specific to the installation, country, etc) must be taken into account.



The electrical installation must not involve a risk of fire or explosion. Workers must be duly protected against accident risks from direct or indirect contact. The electrical installation and protection devices must take the voltage, the external determining factors and the competence of the people who have access to parts of the installation into account.



In compliance with basic safety legislation, all equipment must be appropriate to protect exposed workers against the risk of direct or indirect contacts. In any case, the electrical parts of the work equipment must comply with that laid down in the corresponding specific regulations.



In compliance with Electric Risk basic legislation, all workers who carry out work outdoors will suspend their work in the case of storms, rain or strong winds, snow or any other unfavorable environmental condition which makes visibility or handling tools difficult. Work on installations directly connected to overhead electricity lines must be interrupted in the case of storms.



Ingeteam accepts no liability for any damages caused by improper use of the equipment. Any work carried out on any equipment which implies a modification of the original electrical arrangements must be proposed in advance to Ingeteam. These must be studied and approved by Ingeteam.



The necessary means must be arranged to prevent people from outside the installation approaching or handling the equipment.



These instructions must be easily accessible close to the unit and located within reach of all users. Before installation and start-up, please read these safety instructions and warnings carefully as well as all the notices located on the unit. Ensure that all the notices are perfectly legible and that those which are damaged or have disappeared are restored.

### 4.3. General

This section defines the preventive measures to take to carry out all types of tasks on the unit, working safely and controlling risks which cannot be avoided.

Protection against direct contact is by means of the housing, which has NEMA 3R protection class.

There are additional protections on the feeds, which must be removed in order to connect the unit but refitted before the supplies are powered up.

The unit has been tested according to the applicable regulations to comply with the safety requirements, the values for insulation distances and leakage paths for the voltages used.

The tools and/or equipment used in handling tasks must as a minimum have double reinforced insulation (Class II).

### 4.3.1. General risks existing and preventive measures

#### Impact against immovable objects

- Inform workers of the risk
- Adequate lighting
- Work with care
- Keep sufficient distance to prevent contact with the part causing the risk (control rod in the isolating switch door).

#### Knocks, punctures and cuts from objects and/or tools

- Keep the door closed unless working inside
- Adequate lighting
- Order and cleanliness
- Mandatory use of hard hat, safety footwear and gloves when necessary.

#### Flying particles (fan)

Recommended use of anti-impact glasses when accessing the fan area.

#### Electrical risk

- Follow the instructions in the section on PPE and “4.2. General safety precautions”
- Inform the worker of the risk
- Comply with applicable regulation and legislation.

### 4.3.2. Additional risks and measures in handling tasks

#### Thermal contact

- Inform workers of the risk
- Recommended use of gloves
- Disconnect the power and wait 10 minutes for the hot parts inside the unit to cool down.

## 4.4. Type of tasks to be carried out

The preventive maintenance tasks for the electrical panels involve Inspection, Control and Handling actions, depending on the case.

Accessing the housing through any access point other than that described in this manual is strictly prohibited.

To open any of the covers of the enclosure (side, rear, top or door) the main power supply outside of the box must be switched off.

### 4.4.1. Inspection tasks

Definition: Involves opening the enclosure for visual inspection tasks.

### 4.4.2. Handling tasks

Definition: Tasks involving the assembly and/or replacement of parts as well as changes to the setting of panel components. Any task that does not fall under Inspection or Control is considered Handling.



It is always necessary to first disconnect and check for absence of voltage.  
The “5 Golden Rules” must be adhered to.



#### 5 GOLDEN RULES

1. Disconnect

Switching on the possible voltage sources. Bear in mind that any capacitors or other elements powered from uninterruptible power supplies (UPS) are still live.

2. Prevent any possible feedback.

The switching devices used to switch off the equipment must be protected against any possible reconnection.

3. Check there is no voltage.

Check that there is no voltage in all the active elements of the electrical system or as close as possible to the work area.

4. Ground and short circuit.

In the low voltage installations that by induction or for other reasons may be accidentally live. And always in high voltage installations.

5. Rope off and mark the work area.

### 4.4.3. Personal protection equipment (PPE)

#### Inspection

The use of safety footwear is mandatory and work clothing must be cotton and be free of conducting or metallic elements in compliance with Federal and national legislation.

#### Handling

The use of a helmet and safety footwear is mandatory in compliance with Federal and national legislation.

It is also mandatory to use dielectric gloves and a helmet with protective face mask against electric arcs in compliance with Federal and national legislation for tasks involving voltage checking or voltage-related tasks in general, whenever there are directly accessible elements under load.

### 4.5. Safety measures while working



It is strictly forbidden to gain access to the inside of the electrical panel through any other point than the front access door provided for the purpose. Opening any of the enclosure covers and/or accessing them (from the side, rear or top) triggers a general shutdown of all power to the panel (PV array, 3-phase feed and auxiliary single-phase feed, if any). Always access when the unit is voltage-free.



Any work carried out which implies a modification of the original electrical settings must be proposed to and accepted by Ingeteam.

Below are the obligatory safety standards and the various tasks that may be performed on the unit.

Opening system: the door is opened and closed by a handle with a double-bit lock. Mechanically interlocked door via controls in the isolating switch door.

**Inspection:** The protective elements (methacrylates) of the terminals and connection strips should be properly positioned at all times (avoid direct access to live parts).

#### Handling

To carry out handling on the unit, the voltage must be disconnected.

The following points must be taken into account to disconnect the unit from the power supply:

1. Stop the inverter from the display by switching status to stop.
2. Open the DC circuit breaker (PV array). (\*)

3. Open the thermomagnetic circuit breaker (\*).
4. Isolate the PV array powering the unit, from outside the panel. (\*\*)
5. Switch off three-phase protection from the corresponding protection outside the units.
6. Open the QAUX switch.
7. Wait 10 minutes for the internal capacitances to discharge (harmonic filter, etc.), for the existing internal resistors to cool and the fan blades to stop turning.
8. Check that there is no voltage by using an appropriate multimeter. This measurement is made at terminals XAC and X8 and on the AC positive and negative strips in the electronics block. See Section *"4.2. General safety precautions"*. Use the PPE listed in section *"Important safety precautions"*.
9. Signal cut-off points (DC/AC) with a sign indicating the type.

(\*) When the DC circuit breakers and the automatic AC switches are switched to the OFF position (no voltage) a consignment lock will be placed on the door knobs (mechanical lockdown) and a sign reading "Do not touch. Personnel at work" will be posted.

(\*\*) If the PV array cannot be isolated from outside the panel, bear in mind that the feeds to the CD circuit breakers will be live and work must be carried out using the appropriate PPE (dielectric gloves suitable for the working voltage, face shield, safety boots, working clothes, recommended fireproof clothes, etc.).

Any work carried out which implies a modification of the original electrical settings must be proposed to and accepted by Ingeteam.



## 5. Installation

Before installing the unit, the packaging must be removed, taking special care not to damage the housing.

Check that there is no moisture inside the packaging. If there are signs of moisture, the unit must not be installed until you are sure it is completely dry.



All installation operations must comply with current regulations.

### 5.1. General requirements for installation

Ventilation and the space for work, which must be suitable for maintenance tasks according to current regulations.

The external connection devices, which must be suitable and sufficiently close as set forth in current regulations.

The connecting cables must be of the appropriate section for the maximum current.

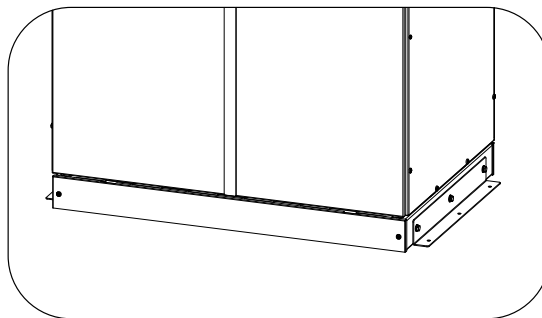
Special care must be taken to ensure that there are no external elements near the air inlets and outlets to obstruct proper ventilation of the unit.

### 5.2. Fixing the unit to the floor

These units have a system for anchoring to the wall, using fixing platex.

The system comprises a few metal strips that bolt the sides of the base to the concrete pad where the inverter sits.

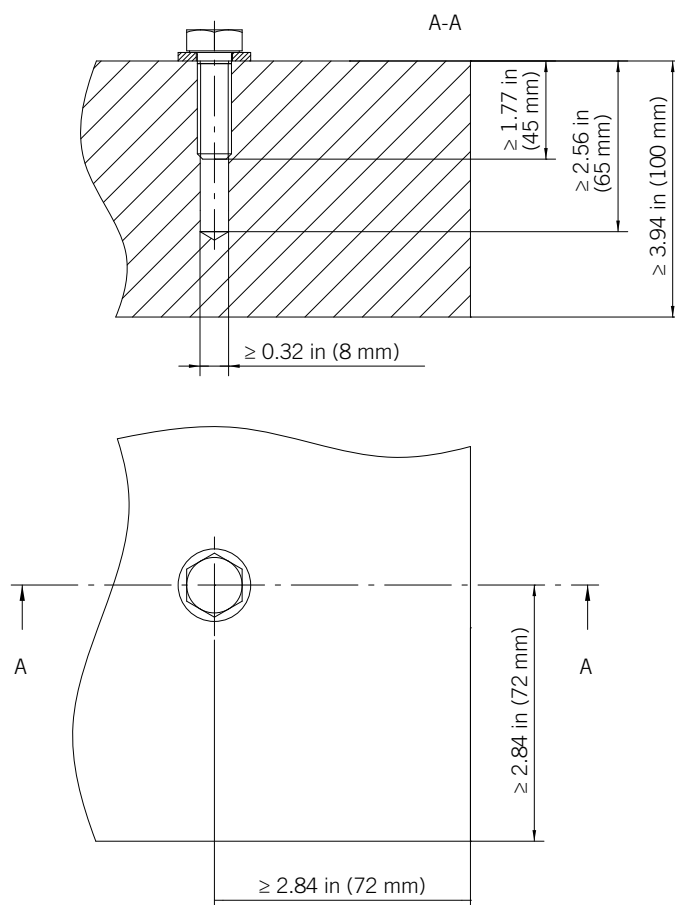
The figure below shows the shape of these strips and how they bolt onto the enclosure.



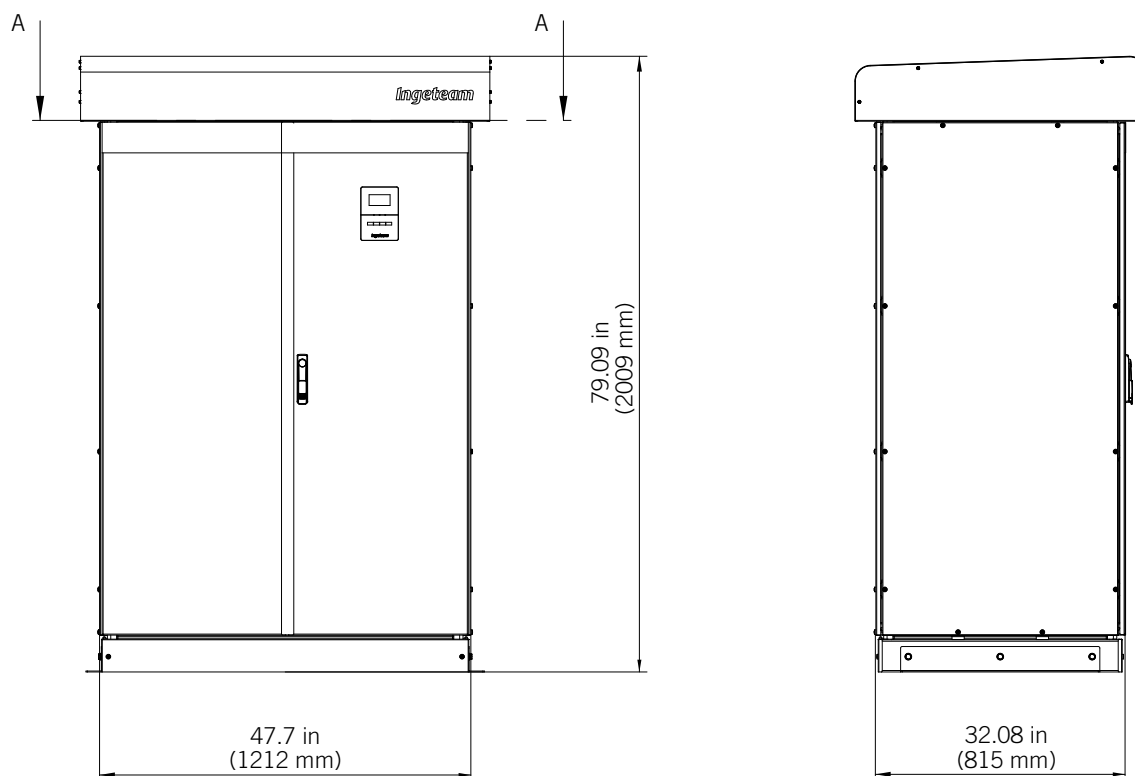
In order to avoid fixing problems, the base on which the inverter is fitted must be properly levelled.

Please observe the following requirements in all cases when fastening the fixing system:

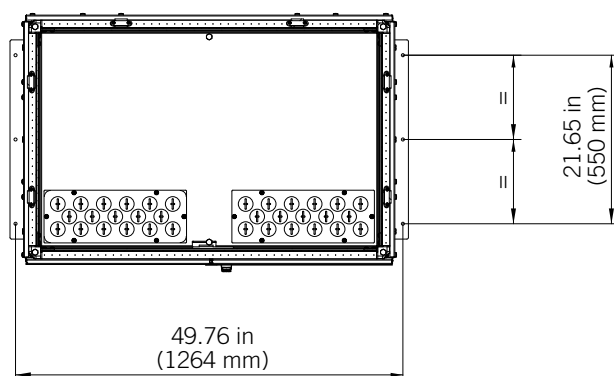
- Minimum distance from the centre of the bore to the edge of the concrete pad: 2.84 in (72 mm).
- Minimum diameter of the hole drilled in the concrete pad: 0.32 in (8 mm).
- Minimum depth of the hole drilled in the concrete pad: 2.56 in (65 mm).
- Minimum thickness of the concrete pad: 3.94 in (100 mm).
- Tightening torque: 177 lb.in (20 Nm).
- Minimum depth of anchoring bolt: 1.77 in (45 mm).



The dimensions of the unit are as follows. Bear in mind the clearance between the pins of the fixing strips and the floor (if they are fitted):



#### SECTION A-A



Once the location of the equipment has been selected, follow these steps:

1. Mark the fixing points for the strips on the floor.
2. Drill the floor with a recommended drill for the fixture supplied with the fastening plate.
3. Anchor the fixing strips to the floor.
4. Check that the unit is properly secured.

### 5.3. Requirements for transformers and insulation monitor

### 5.3.1. Grid connection transformer (units without a transformer)

This section lists the technical features of the grid connection transformer which converts the medium or high supply voltage to the operating voltage of the INGECON SUN Power U unit.

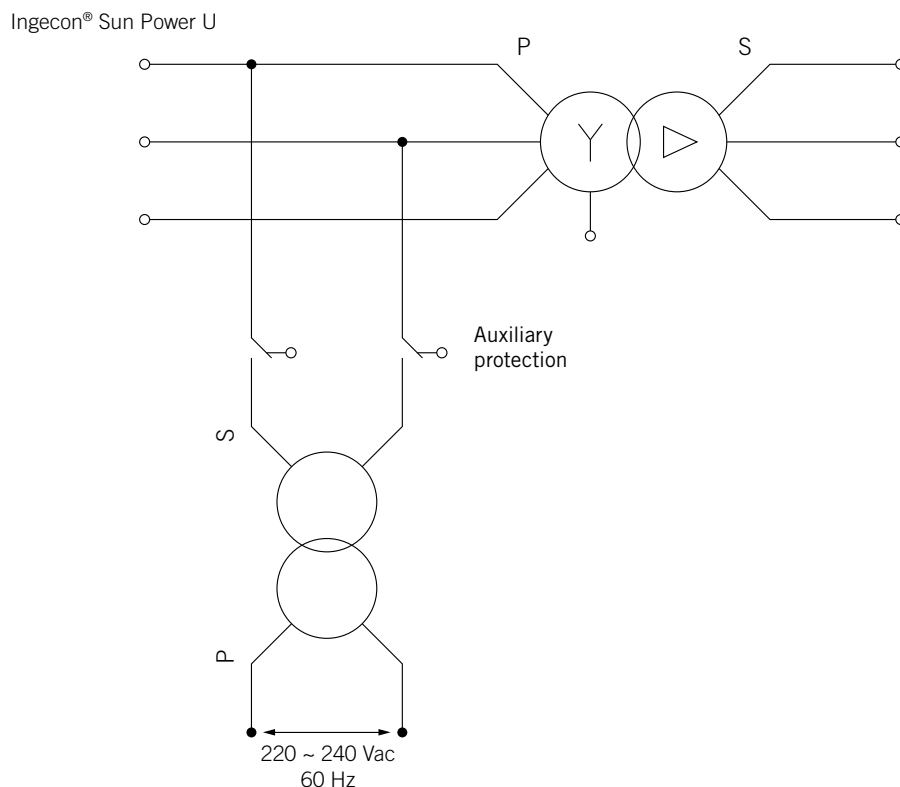
1. The transformer's power must be greater than the sum of the power ratings of the connected inverters. Take into account the environmental conditions of the site.
2. INGECON SUN Power U inverters connected to the inverter's low voltage winding must be synchronized.
3. MPPTs connected via INGECON SUN Power U to the same transformer must have the same voltage settings.
4. The  $U_{cc}$  short circuit voltage of the transformer must be equal or less than 6%.
5. We recommend inserting a grounded metal screen between the high voltage winding and low voltage winding.
6. The low voltage winding must withstand pulsating voltage components with  $dU/dt$  of 500 V/ $\mu$ s voltage.
7. Because of inverter operation, the voltage between a phase and ground can reach 3/2 of the open circuit voltage of the PV array.
8. We recommend using the Dy11 connection.
9. The neutral of the low voltage winding **must not be grounded**.
10. The connection to the medium voltage network will be the nominal connection point.
11. We advise using transformers equipped with five-point voltage regulators, with the possibility of selecting the following options:

5%                      2.5%                      0%                      -2.5%                      -5%

No electronic equipment may be connected to the power grid. All auxiliary loads must be isolated from the power grid through a transformer with galvanic isolation.

### 5.3.2. Auxiliary transformer

The auxiliary transformer transforms the voltage from the power part of the unit to its control and consumption part.



The primary circuit is connected to the power input. We recommend installing protection and switching components to protect this transformer.

The technical requirements of the auxiliary transformer are:

1. The transformer's power should be suitable for the loads connected to it. Take into account the environmental conditions of the site.
2. The power winding must withstand pulsating voltage components with  $dU/dt$  of 500 V/ $\mu$ S. Because of inverter operation, the voltage between a phase and ground can reach 3/2 of the open circuit voltage of the PV array.

## 5.4. Insulation monitor (units without an ungrounded transformer)

For installations that so require, the installer will connect an IT network insulation monitor.

The insulation monitor should withstand and be able to measure the maximum DC voltage of the installation.

The unit's insulation monitor controls the IT network when the unit is powered up.

## 5.5. Electrical connection

Once the unit has been mounted in its final position and has been solidly secured, make the electrical connections to it.

Care must be taken to ensure the equipment is not live when accessing its interior.



Opening the inside doors of the cabinet is conditional on both the AC thermomagnetic circuit breaker and the DC circuit breaker being in the open position.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.



Once the inside doors are open, remove the auxiliary supply by opening QAUX.



After setting the AC thermomagnetic circuit breaker, the DC circuit breaker and any auxiliary external supplies to OFF, wait at least 10 minutes before opening the door. Internal capacitances may still hold hazardous voltages.

During inspection and handling work:



Take care, since even with the AC thermomagnetic circuit breaker and the DC circuit breaker on OFF, cables directly connected to the grid or panels may still hold hazardous voltages. This includes feed strips and wires between switches/breakers.



As long as the panels are exposed to the light, the DC cables will carry potentially dangerous voltage levels.

During handling work:



Remove all sources of voltage to the equipment: grid, PV array and any auxiliary supply.

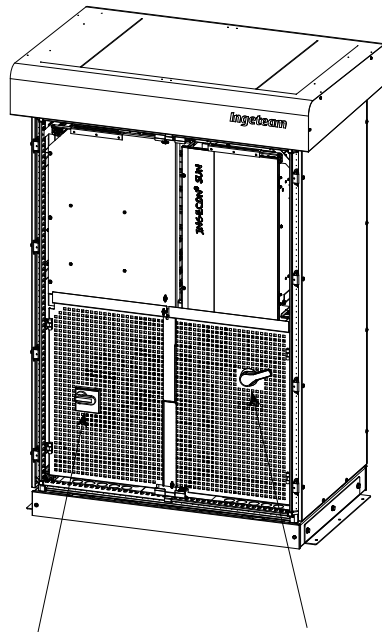


After setting the AC thermomagnetic circuit breaker and DC circuit breaker to OFF, wait at least 10 minutes before opening the door. Internal capacitances may still hold hazardous voltages.



Once the equipment is open, check there is no electrical hazard in the voltage inputs from the grid, the PV array or any auxiliary supply.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.



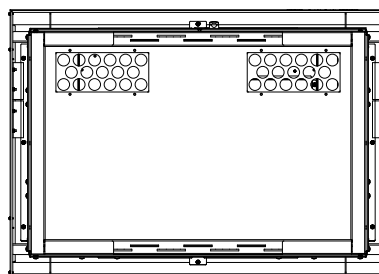
Grid connection thermomagnetic circuit breaker

Panel circuit breaker

### 5.5.1. Description of cable inlets

All power cables access the units through conduit located on the bottom of the cabinet.

As many conduits as necessary must be fitted, depending on installation requirements. To retain the unit's degree of protection, the plugs should be replaced with conduit, leaving plugs wherever conduit is not going to be fitted.



Bottom view of the unit

**Conduit should be 1 ¼ in and NEMA 4.**

Care must be taken to ensure the equipment is not live when accessing its interior.



Opening the inside doors of the cabinet is conditional on both the AC thermomagnetic circuit breaker and the DC circuit breaker being in the open position.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

After setting the AC thermomagnetic circuit breaker and DC circuit breaker to OFF, wait at least 10 minutes before opening the inside doors. Internal capacitances may still hold hazardous voltages. Then disconnect the current at the auxiliary supply QAUX.

During inspection and handling work:

Take care, since even with the AC thermomagnetic circuit breaker and the DC circuit breaker on OFF, cables directly connected to the grid or panels may still hold hazardous voltages. This includes feed strips and wires between switches/breakers.

As long as the panels are exposed to the light, the DC cables will carry potentially dangerous voltage levels.

### 5.5.2. Description of cabling connections

These units have the following cabling connections:

- Plates for DC connection.
- Plates for AC connection.
- Terminal strips for connecting the insulation fault indicator.
- Copper bar with threaded holes for earthing connection.
- Connecting the auxiliary supply (optional depending on the model and kit included).



As long as the panels are exposed to the light, the DC cables will carry potentially dangerous voltage levels.

Never handle the connections before disconnecting the inverter from the grid and the PV array.

### 5.5.3. Order of connecting the unit

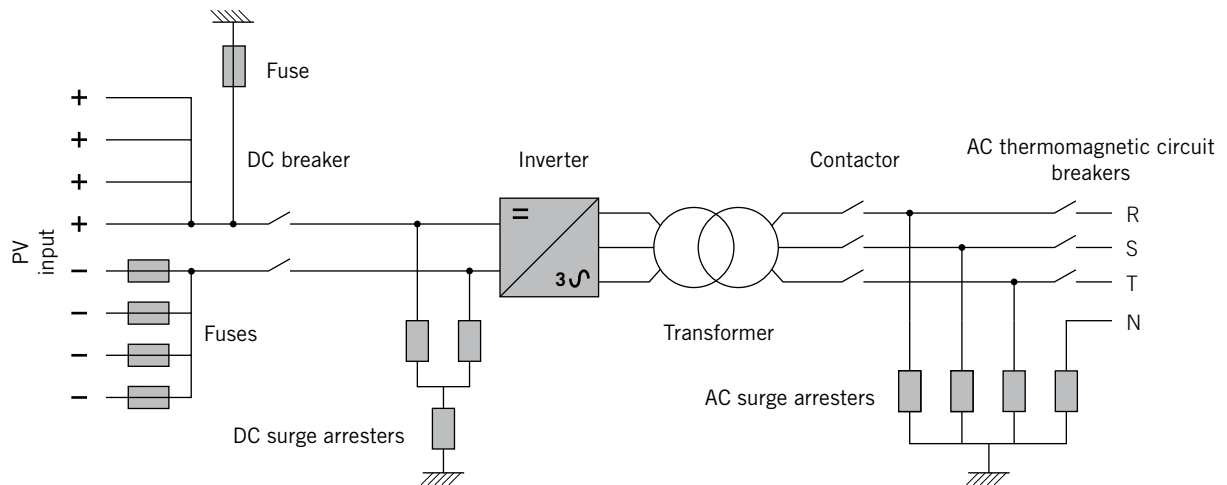
The basic connections to be made with the units are as follows, in this order:

1. Connecting the insulation failure detection switch (optional)
2. Communication line (optional)
3. Connecting the various grounding connections
4. Connecting the auxiliary supply (optional depending on the model and kit included)
5. Connecting the 3-phase inverter system to the power grid
6. Connecting the DC cables from the PV array

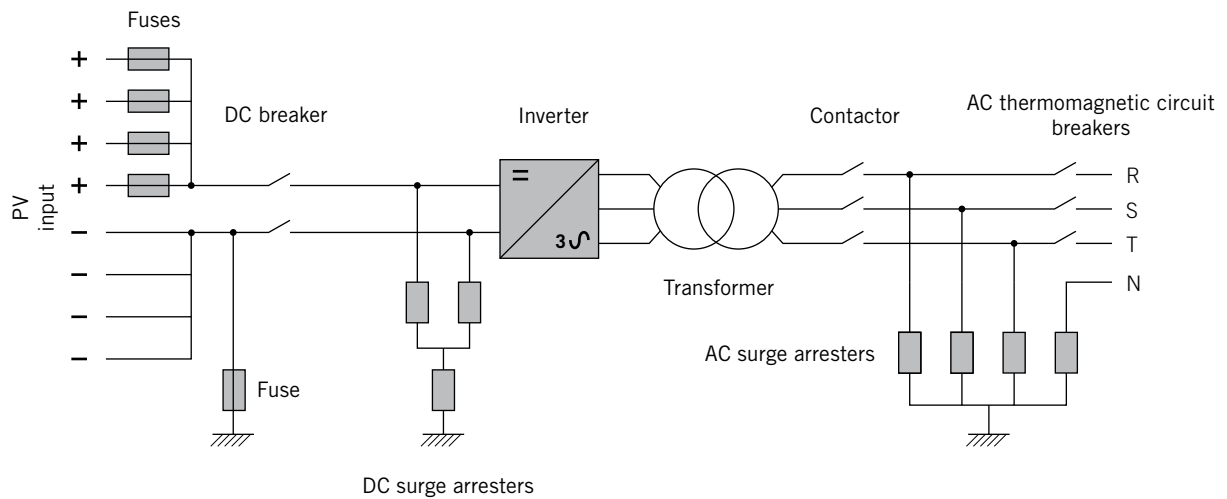
The following sections describe how to make these connections.

## 5.5.4. Inverter wiring diagram

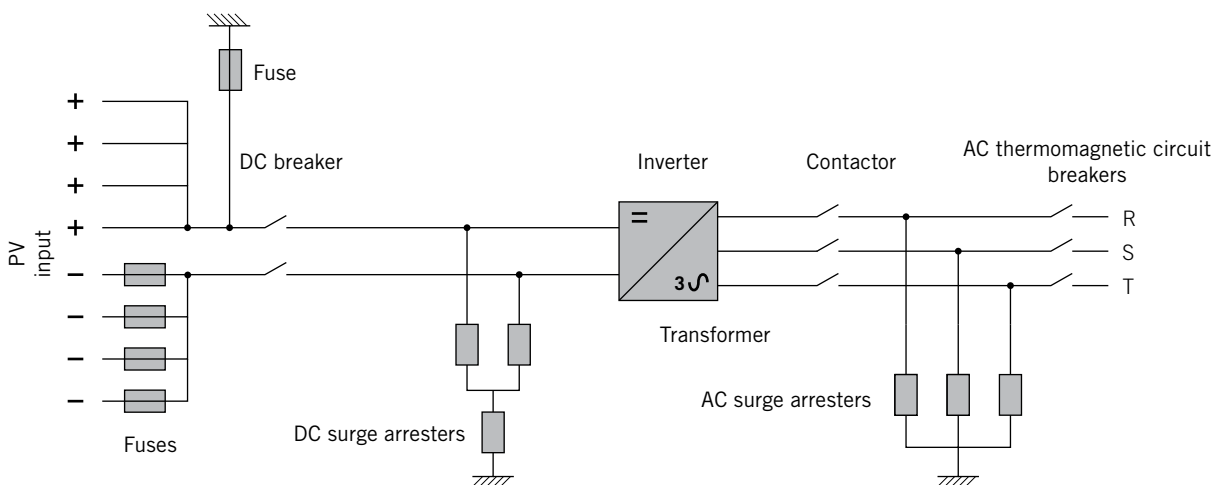
### Units with a transformer and positive grounding



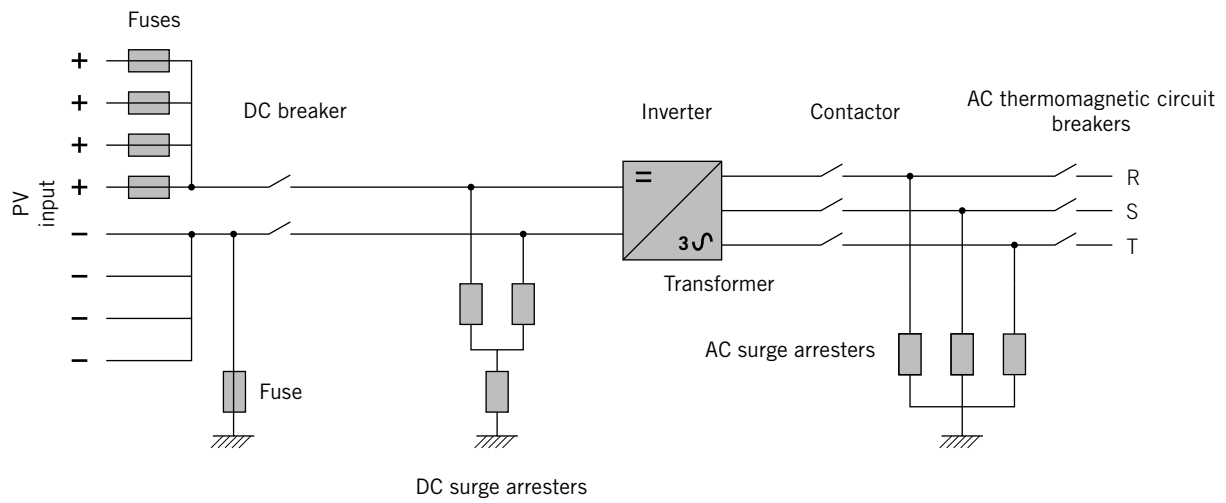
### Units with a transformer and negative grounding



### Units without a transformer (TL) and positive grounding



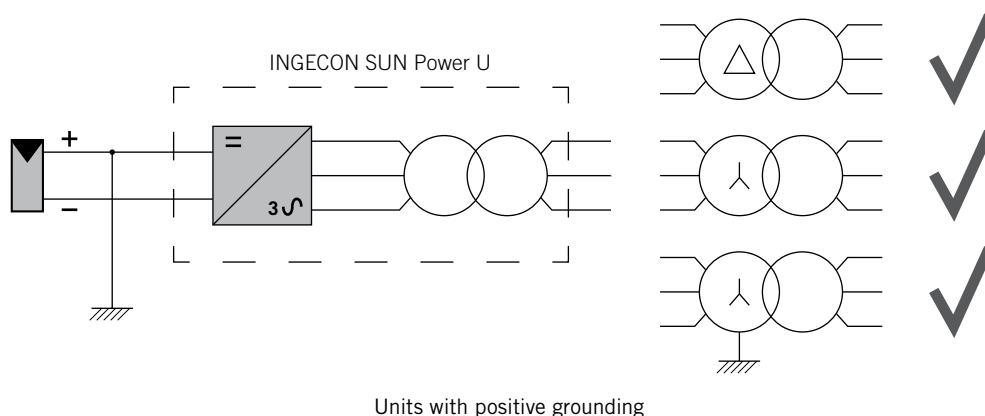
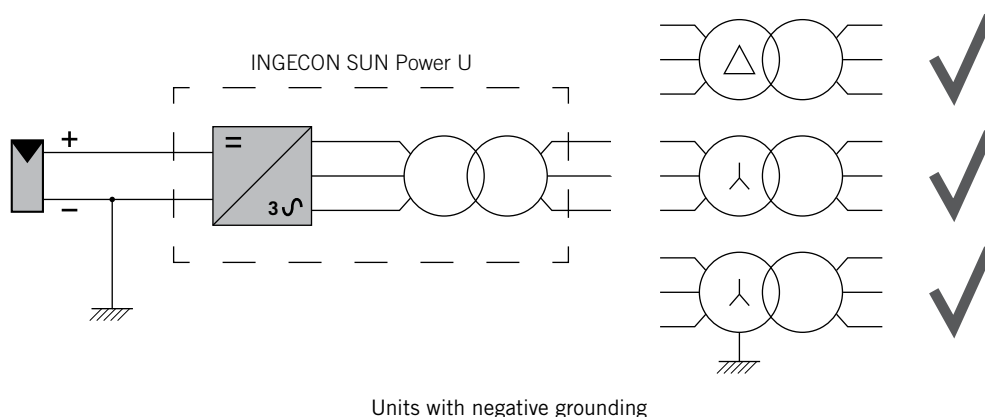
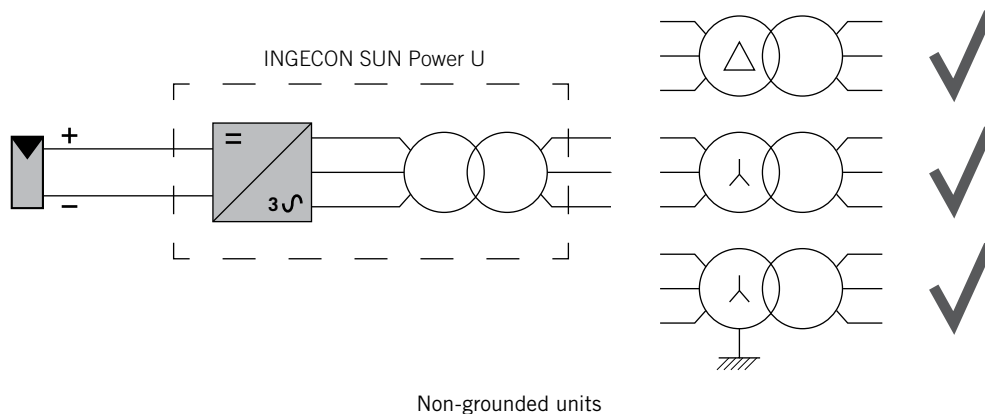


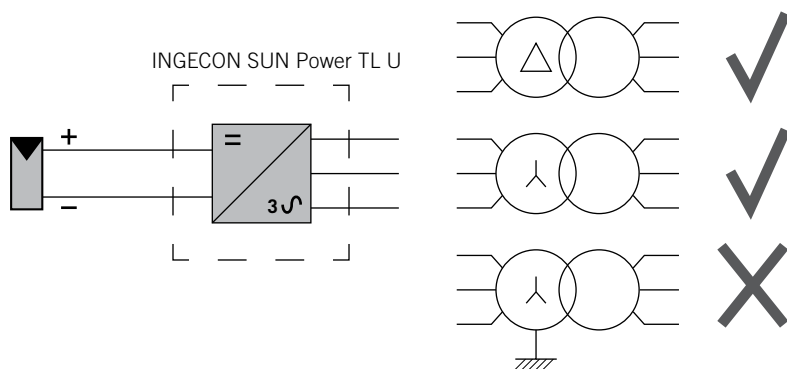
**Units without a transformer (TL) and negative grounding**

### 5.5.5. System wiring diagram

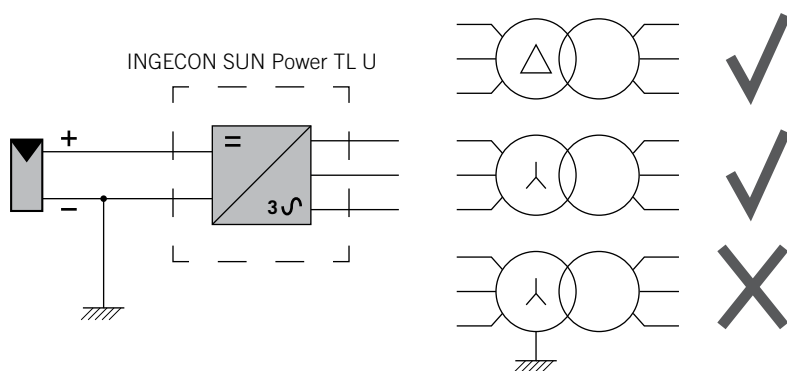
The various grid connection options are described below.

#### ELECTRICAL DIAGRAM FOR UNITS WITH TRANSFORMERS

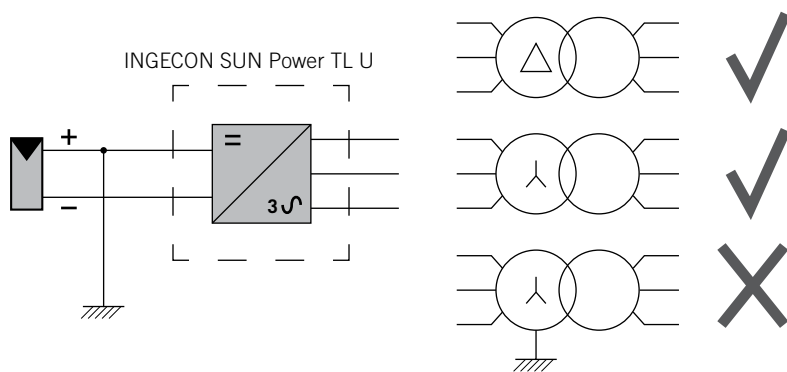


**Wiring diagram for units without a transformer (TL)**

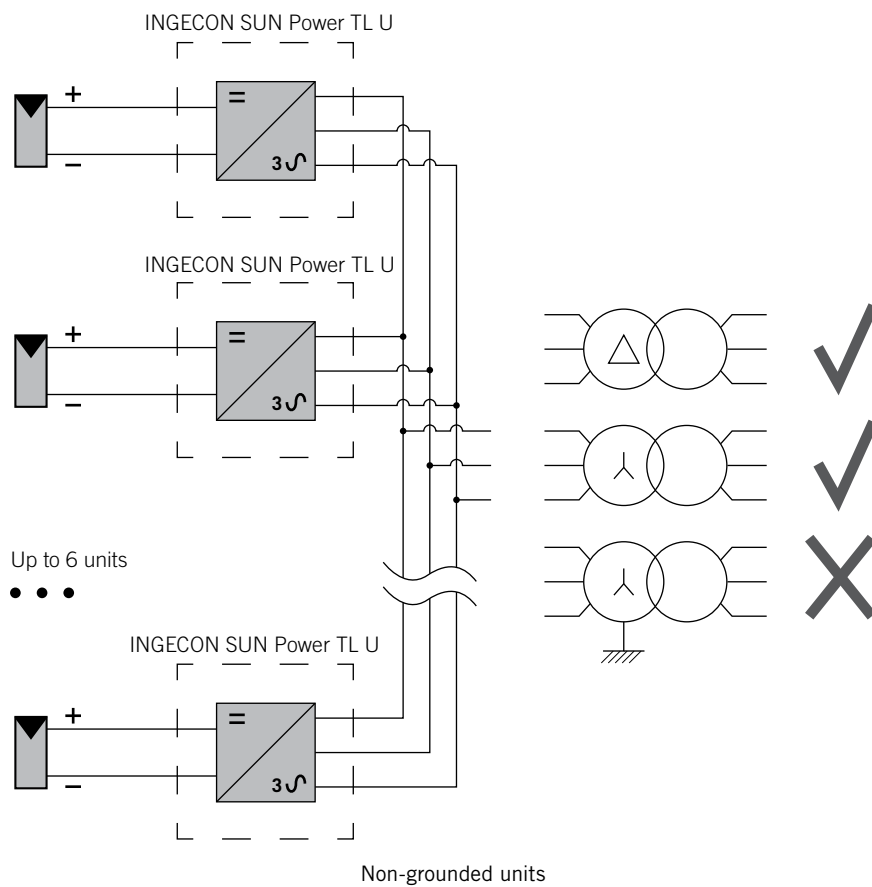
Non-grounded units

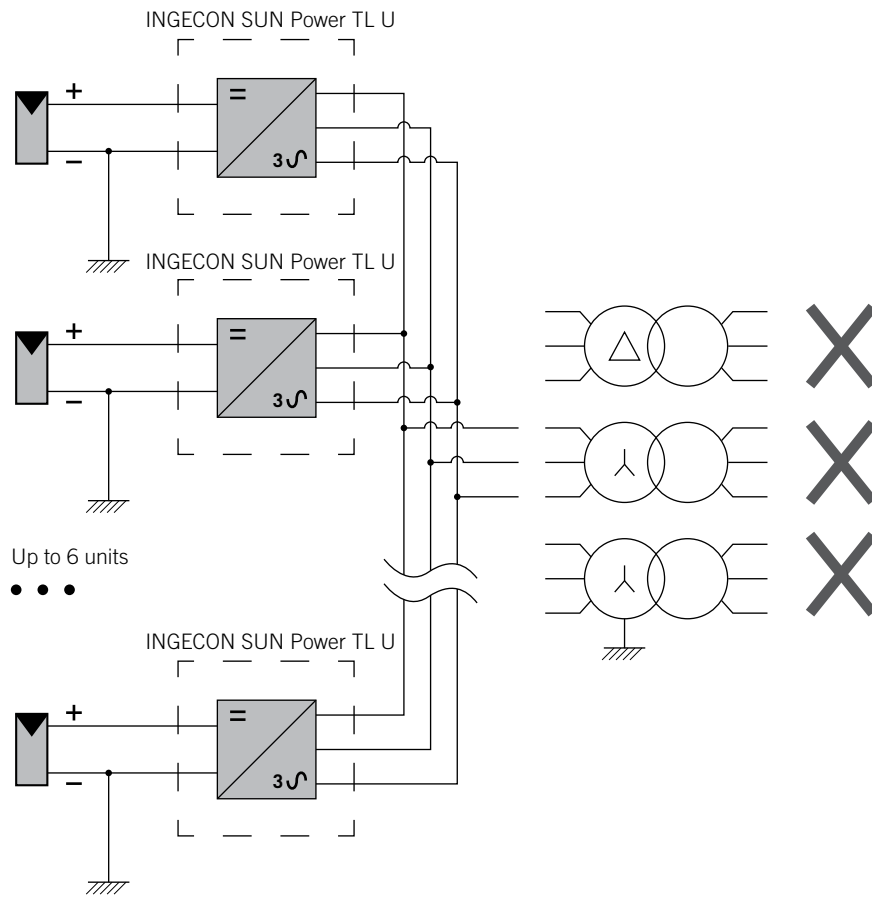


Units with negative grounding

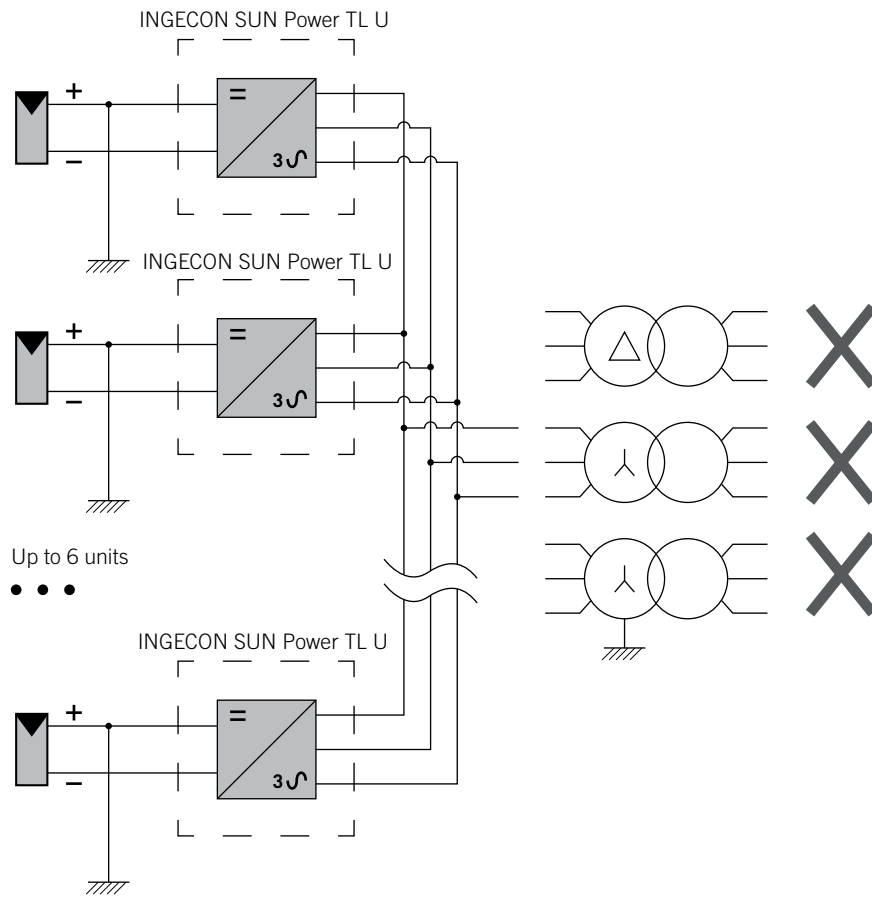


Units with positive grounding

**Wiring diagram for synchronized units without a transformer (TL)**

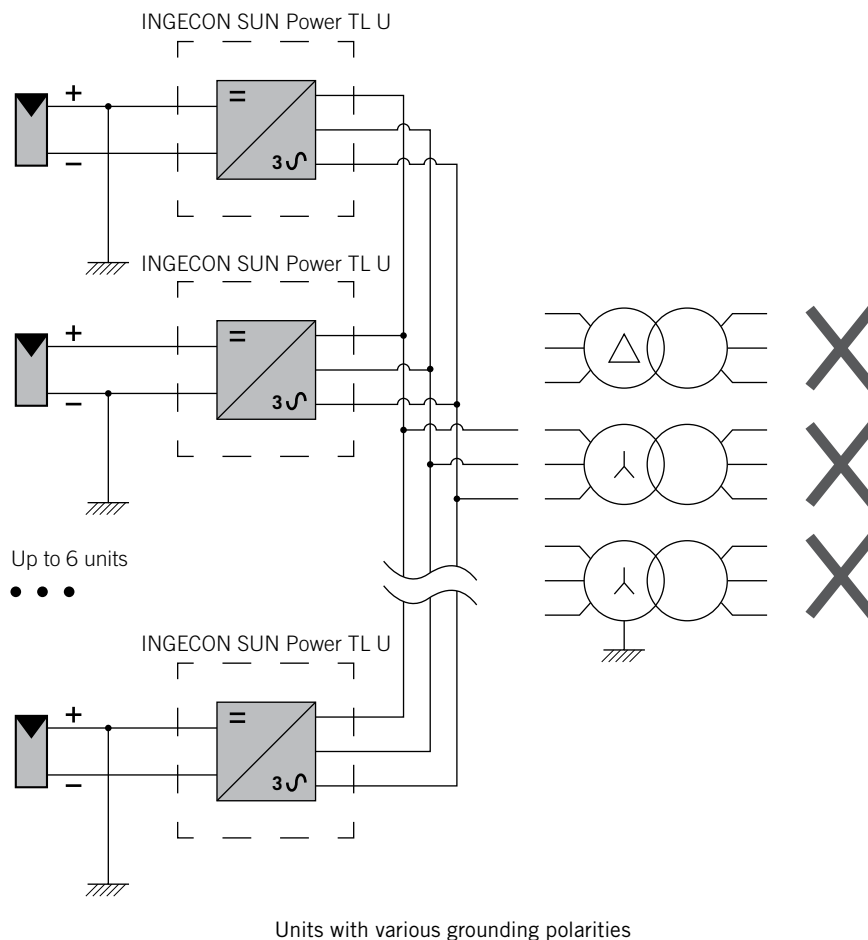


Units without a transformer with negative grounding cannot be synchronized.



Units with positive grounding

Units without a transformer with positive grounding cannot be synchronized.



Units without a transformer with various polarity grounding cannot be synchronized.

### 5.5.6. Insulation fault contact / grid connection indicator

The inverter incorporates a normally open volt-free auxiliary contact. It can be used for one of two functions:

- Detection of insulation fault in the DC circuit.
  - Open contact: There is no insulation fault in the DC circuit.
  - Closed contact: There is an insulation fault in the DC circuit.
- Indicator showing that the unit is connected to the mains via its internal contactor.
  - Open contact: Internal contactor for connecting to the grid is open; the inverter is not connected to the grid.
  - Closed contact: Internal contactor for connecting to the grid is closed; the inverter is connected to the grid.

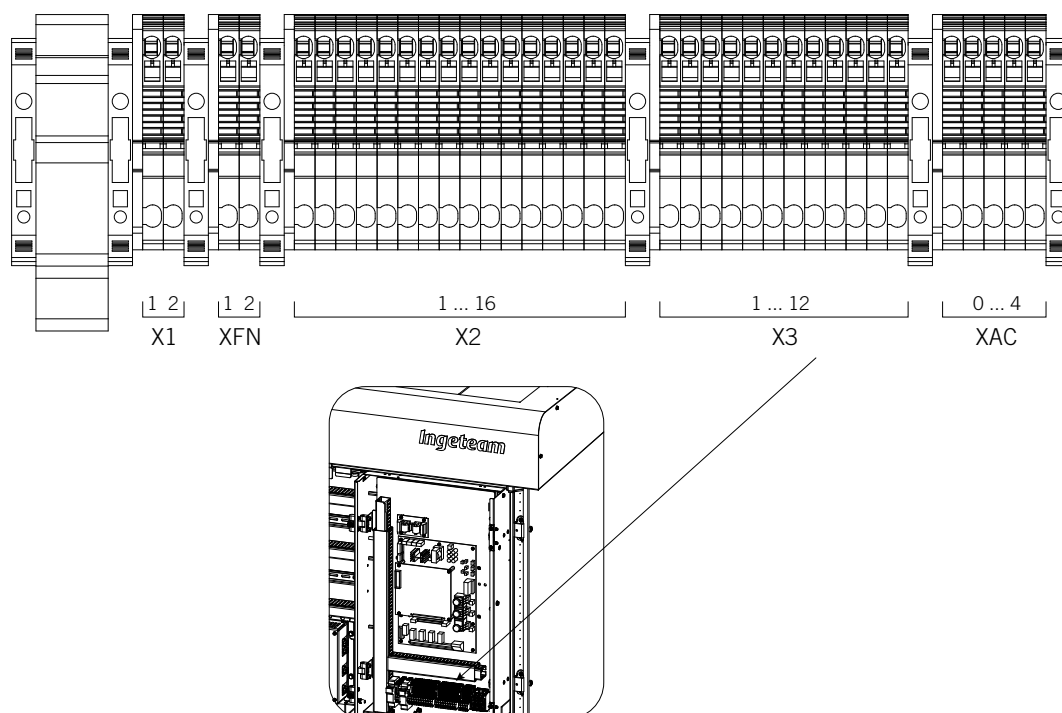
The unit always measures the insulation separately from the contact configuration.



The configuration of the equipment to make the contact perform one or another function is factory set and must be specifically requested from Ingeteam at the time of ordering.

This normally open contact withstands a voltage of 240 Vac and a maximum current of 10 A.

The terminals used are X2.5 and X2.6



### 5.5.7. Access to auxiliary connections

Some PV installations require the inverter to be connected to auxiliary equipment, such as solar radiation sensors, heat sensors and anemometers.

Consult the manufacturer when ordering.



For best performance, the cables carrying these auxiliary signals will be removed from the power cables.

### 5.5.8. Connection for communication via RS-485 serial port

These units incorporate hardware for communicating via an RS-485 serial line. This hardware is made up of an “AAP0022 Com RS-485” board supplied ready mounted in the control board in the electronics block. To access the board, use the access points indicated in section “5.5.1. Description of cable inlets”.



The unit is provided with a >211 Ohm ferrite rod. The cable coming out of the “AAP0022 Com RS-485” board must be inserted as close as possible to the board, turning it twice around the hole at its centre.

For more information on board operation, see «AAX2002IKI01 Installation Guide for Communications Devices».

### 5.5.9. Connection for communication via modem-GSM/GPRS + RS-485

At the request of the installer, inverters may optionally be equipped with hardware for communication via GSM/GPRS phone. This hardware is made up of an “AAX0001 Com GSM/GPRS + RS-485” board and the antenna for the modem.



The unit is provided with a >211 Ohm ferrite rod. The RS-485 cable coming out of the “AAX0001 Com GSM/GPRS + RS-485” board must be inserted as close as possible to the board, turning it twice around the hole at its centre.

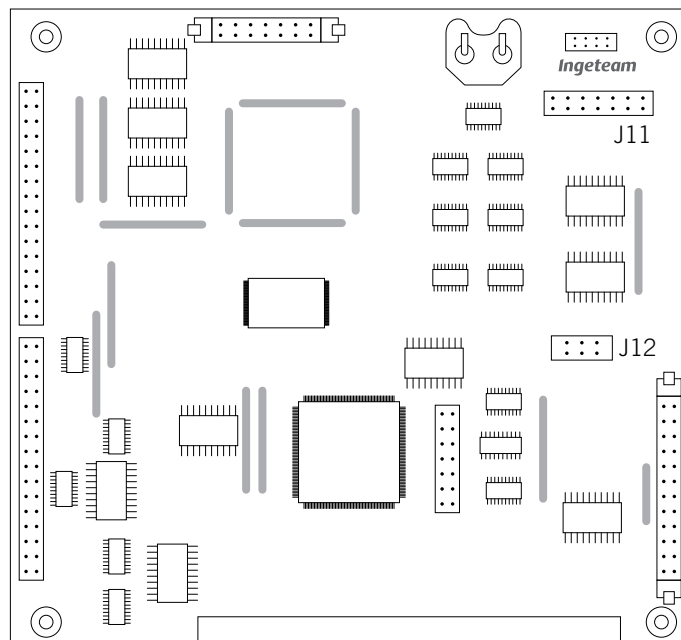
The board is provided with a bag (attached with a plastic tie) containing the modem antenna and cable. Connect the rod cable to the cable’s rod output, and feed it out through the holes on the upper left side of the enclosure. Connect the end that goes outside to the rod and attach it via its magnet to the unit’s enclosure.



Connect the rod cable to the cable's rod output, and feed it out through the holes on the upper left side of the enclosure. Connect the end that goes outside to the rod and attach it via its magnet to the unit's enclosure.

See AAX2002IKI01 Installation Guide for Communications Devices".

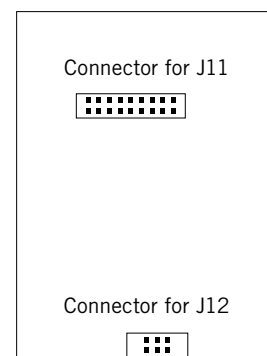
The modem should be connected to the control board using connectors J11 and J12 on the board.



Control board. Fix to connectors J11 and J12

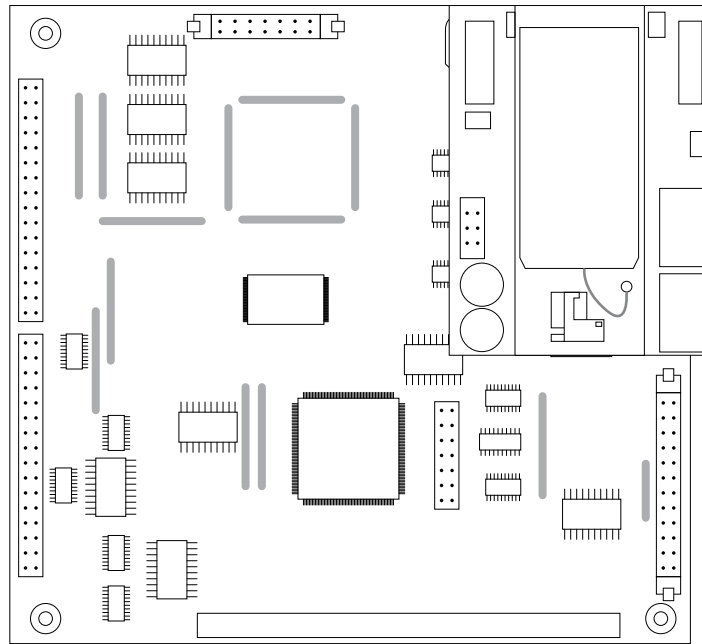
The control board can be found in the electronics block cabinet.

Turn the comms board so that the connectors can be seen.



Communications board, rear view

Connect the communications board exactly as shown in the following illustration.



### 5.5.10. Connection for Ethernet communication

At the request of the installer, inverters may optionally incorporate hardware for communicating via ethernet. This hardware is made up of an “AAX0004 Com Ethernet + RS-485” board.



The unit is provided with a  $>211$  Ohm ferrite rod. The cable coming from the “AAX0004 Com Ethernet + RS-485” board (RS-485 output) must be inserted as close as possible to the board, turning it twice around the hole at its centre.

The board is provided with a bag (attached with a plastic tie) containing the Ethernet cable. Connect the cable to the board's Ethernet output and feed it out through the holes on the upper left side of the enclosure.

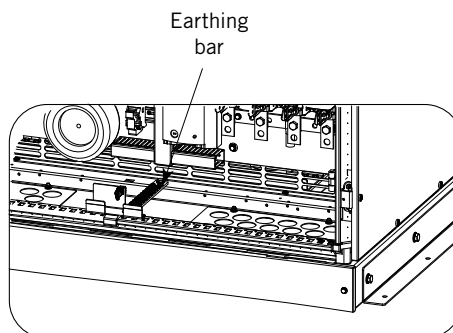
See “AAX2002IKI01 Installation Guide for Communications Devices”.

Follow the same instructions given in the previous point for the connection of the board to the control board.

### 5.5.11. Ground connections

The metal parts of the inverter (equipment ground) are electrically connected to the grounding bar on the front of the cabinet.

To ensure the safety of personnel, this terminal must be connected to the installation's ground.



## 5.5.12. Grid connection

The cables for connecting the unit to the grid enter through conduits at the base of the cabinet. They must withstand at least the phase voltage and 1000 V between a phase and ground.

These units have three strips (phases) and a terminal (N) for connection to the grid. The maximum admissible gauge is two 0.19 in<sup>2</sup> (127 mm<sup>2</sup>) cables per pole.

If the inverter and the grid connection point are far enough apart to require the use of longer cables, an external distribution box must be used close to the investor to make this connection.



The cable gauge must be suitable in each case for the power rating of the unit and site conditions.

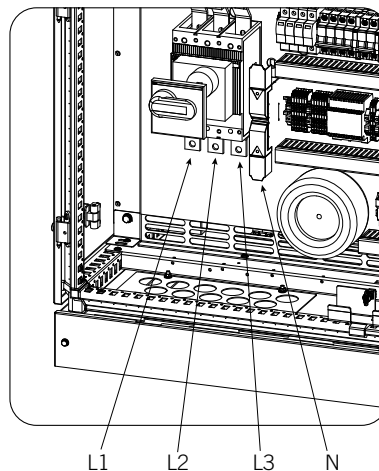
Protections for the connection of inverters to the electrical grid can withstand a short-circuit current of up to 65 kA, depending on the model.



Before any handling, check that there is no electrical hazard in the voltage input from the grid.



When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.



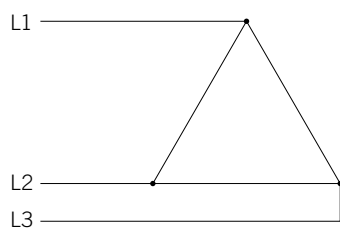
To avoid arcing, once the wires are connecting to the strips, check the safety clearances between live parts on each strip or any other metal point on the unit. We recommend a clearance of 0.79 in (20 mm).



After working on the terminals the polycarbonate guard must be put back into place.

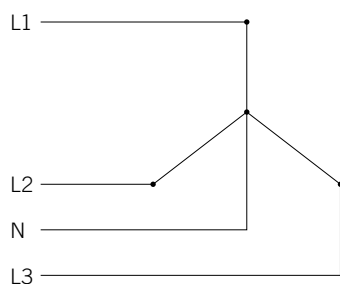
Depending on the type of transformer connection (star or delta), the following points should be borne in mind.

### Delta electrical connection

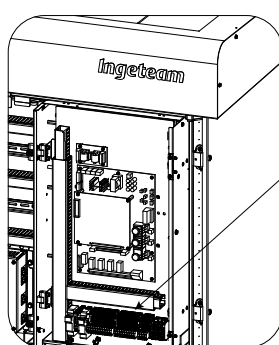
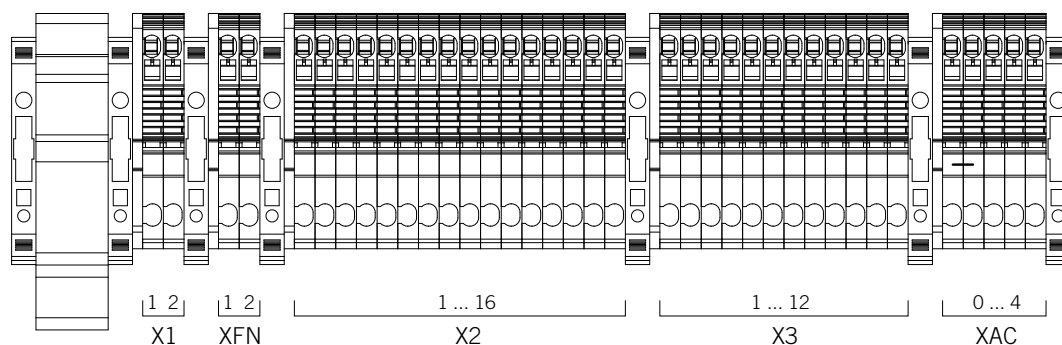


If you decide on this connection, do not connect the neutral or make any modification to the XAC terminal strip.

### Star electrical connection



In this case the neutral must be connected. In addition, a link must be inserted on the XAC terminal strip between terminals 0 and 1, as shown in the following figure.



Ingeteam recommends a star connection for the transformer for INGECON SUN Power U units.

### 5.5.13. Connecting to the PV array

The cables for connecting the unit to the PV array enter through conduits in the base.



Before any handling, check that there is no electrical hazard in the voltage input from the PV array. Never forget that whenever they receive solar radiation, the panels' terminals generate voltage. The inverter can therefore have voltages of up to 1000 V inside even when not connected to the grid. When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.



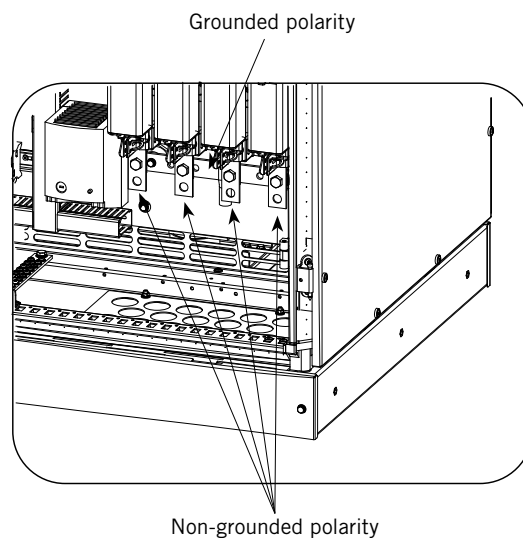
Depending on the configuration of the unit ordered the following cases should be considered:

- With ground connection on the positive pole.
- With ground connection on the negative pole.
- No grounding.

The equipment has two copper strips with four 0.51 mm (13 mm) diameter orifices for entering with 31/64" M12 size ring-terminated cables. **This strip corresponds to the grounded polarity.**

The equipment has four strips with 0.51 mm (13 mm) diameter orifices to take 31/64" M12 size ring-terminated cables. **These strips correspond to the non-grounded polarity.**

The various strips can be seen below.



The maximum admissible gauge is two 0.19 in<sup>2</sup> (127 mm<sup>2</sup>) cables per pole. In each hole a cable can be connected from each side of the strip. So up to eight cables can be connected to the non-grounded strip and a further eight to the grounded one.

To avoid arcing, once the wires are connecting to the strips, check the safety clearances between live parts on each strip or any other metal point on the unit. We recommend a clearance of 0.79 in (20 mm), with a minimum of 0.40 in (10 mm).

If the distance between the inverter and the PV array connection point requires the use of longer cables, an external distribution box must be used close to the inverter to make this connection.

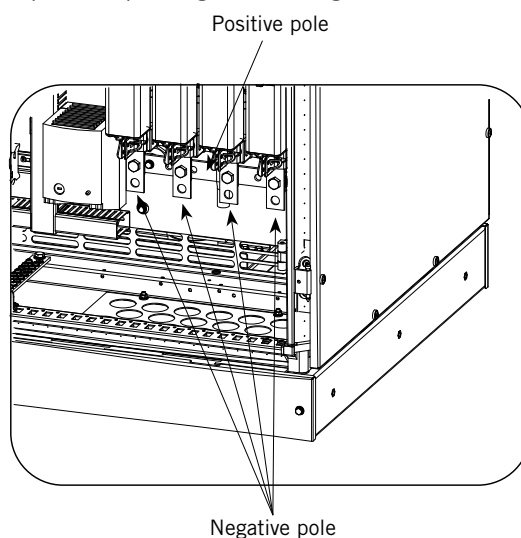
To access these terminals the terminal cover must be removed.



After working on the terminals the polycarbonate guard must be put back into place.

### Units fitted with ground connection on the positive pole

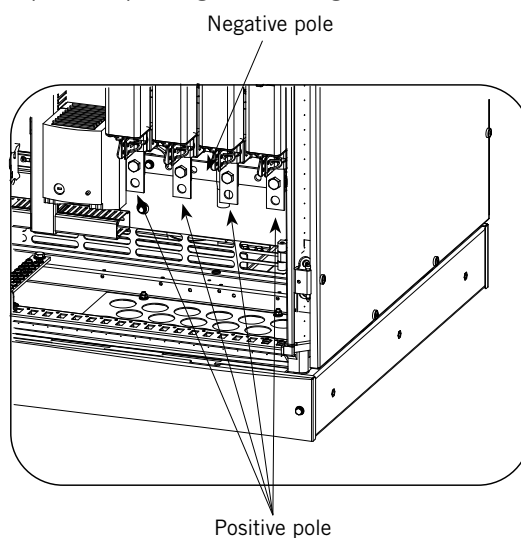
In this case the positive polarity of the PV array should be connected to the strip corresponding to the grounded side and the negative polarity to the strips corresponding to the non-grounded side.



Check the existence of a grounding fuse. See “2.4. Location of the components”.

### Units fitted with ground connection on the negative pole

In this case the positive polarity of the PV array should be connected to the strip corresponding to the grounded side and the negative polarity to the strips corresponding to the non-grounded side.



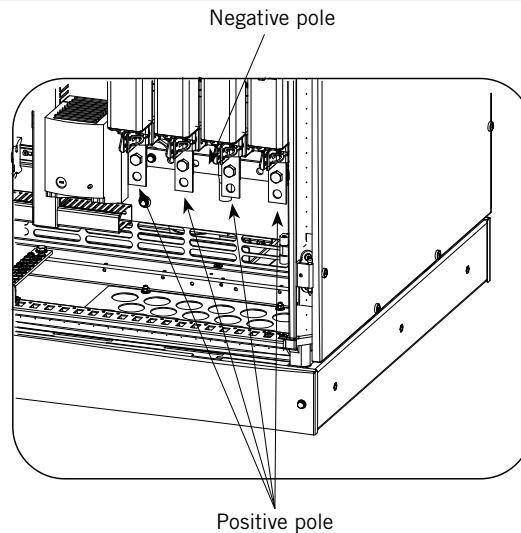
Check the existence of a grounding fuse. See “2.4. Location of the components”.

## Non-grounded units

IN this case the connection should be the same as for units with negative grounding.



Check for the absence of a grounding fuse. See “2.4. Location of the components”.



## 5.6. Available kits

The main kits that can be added to the various versions of the equipment are shown below.

- Nighttime power supply.
- Remote triggering kit.
- Heating element kit.
- Auxiliary services kit.
- Voltage fall-out kit.
- Synchronization kit.

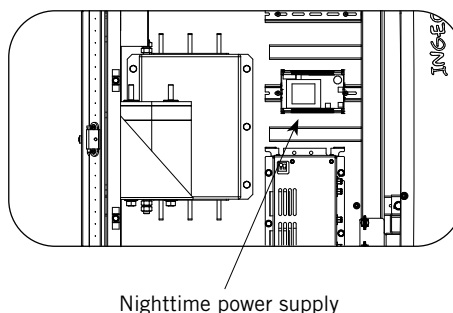
They must be ordered at the time of placing the order with Ingeteam.

### 5.6.1. Nighttime power supply kit

The control of the inverters feeds from the PV array. Therefore, when the PV array has no power, the inverter control turns off. To communicate with the unit at night, you have the option of ordering the night power supply kit, which feeds the inverter control from the mains.

To supply the inverter from the grid, an auxiliary supply of 230 Vac at 50/60 Hz must be supplied.

The kit comprises the power supply for the control and the necessary cabling for installing it.



When this kit is installed in the unit and powered by 220 ~ 240 Vac 50/60 Hz, the display will be operational, allowing users to navigate through the menus and access the inverter via communications, but the inverter settings may not be changed until the voltage of the PV array is within the MPPT range.

### 5.6.2. Remote triggering kit

Supplied as an optional kit designed to open the grid connections remotely (by triggering the grid connection thermomagnetic circuit breaker).

To activate the coil that trips the thermomagnetic circuit breaker, just close a volt-free contact in the remote activation terminals. The contact must be able to work with 220 ~ 240 Vac 50/60 Hz and 150 VA power, except for the INGECON SUN 125 U 480 Outdoor, where the power is 50 VA.

This kit does not provide remote resetting. The unit must be reconnected manually.

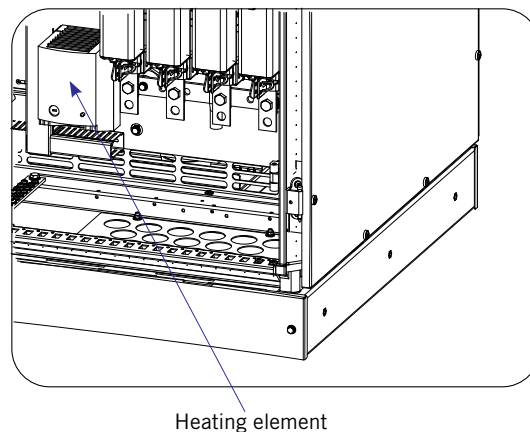
### 5.6.3. Heating element kit

In installations in which the minimum ambient temperature may be less than -4 °F (-20 °C), it is recommended that a heating element kit be installed. (1) Units including this kit may be installed in locations with a minimum temperature of -13 °F (-25 °C).

The heating element is supplied from 220 ~ 240 Vac 50/60 Hz; should the unit not have an auxiliary services kit, this supply should be connected to terminal strip XAUX. It is protected by a thermomagnetic circuit breaker, with a circuit-closing current of about 8.5 A. The current when the circuit is closed is approximately 8.5 A. The temperature regulator should be set to 32 °F (0 °C).

The heating element power is 550 W.

The connection terminals allow 0.10 mm (2.5 mm) cables.



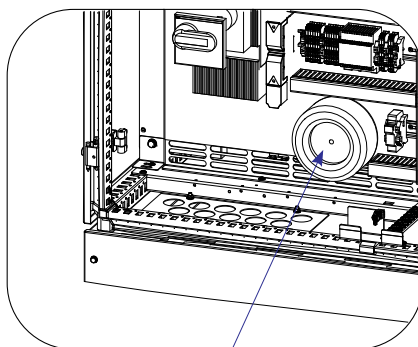


### 5.6.4. Auxiliary services kit.

For the operation of the unit's auxiliary services and some of the optional kits, a single-phase auxiliary supply is needed at ~ 240 Vac 50/60 Hz, to be provided by the installer.

The purpose of this kit is to generate the necessary supply for the operation of the inverter's auxiliary services, thus avoiding the need to supply the unit externally.

This kit comprises a transformer with a suitable ratio for each model in the INGECON SUN Power U family.



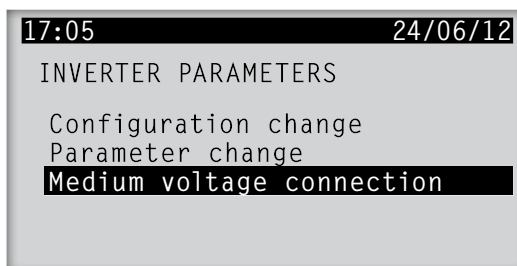
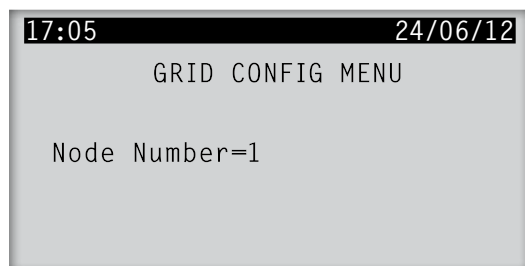
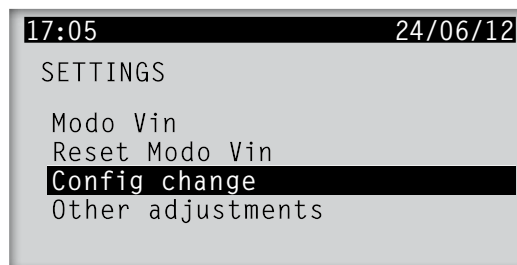
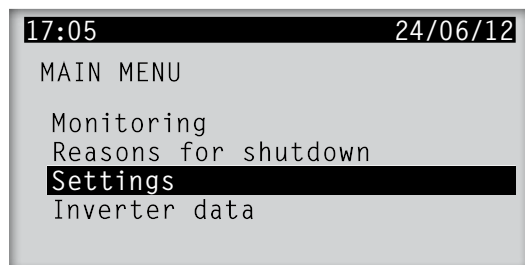
Auxiliary service transformer

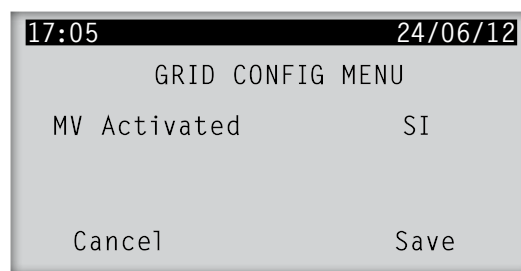
### 5.6.5. Voltage fall-out kit

This kit is supplied for cases where federal or national regulations require that the inverter be capable of withstanding grid voltage fall outs.

For the operation of this kit activation via a display and additional hardware are required.

To configure it it is necessary to perform the following steps via the display:





### 5.6.6. Synchronization kit

When several INGECON SUN Power TL U units are connected to the same medium voltage transformer, they must be synchronized.



Care must be taken to ensure the equipment is not live when accessing its interior.



The configuration of PV array voltages should be the same.



MPPTs connected by TL inverters to the same transformer should have the same voltage settings.

To synchronize INGECON SUN Power TL U units, a synchronization signal generator kit must be added, capable of synchronizing up to 6 units.

In the following example, 4 INGECON SUN 125 TL U 208 Outdoor units are synchronized:

The following will have been needed:

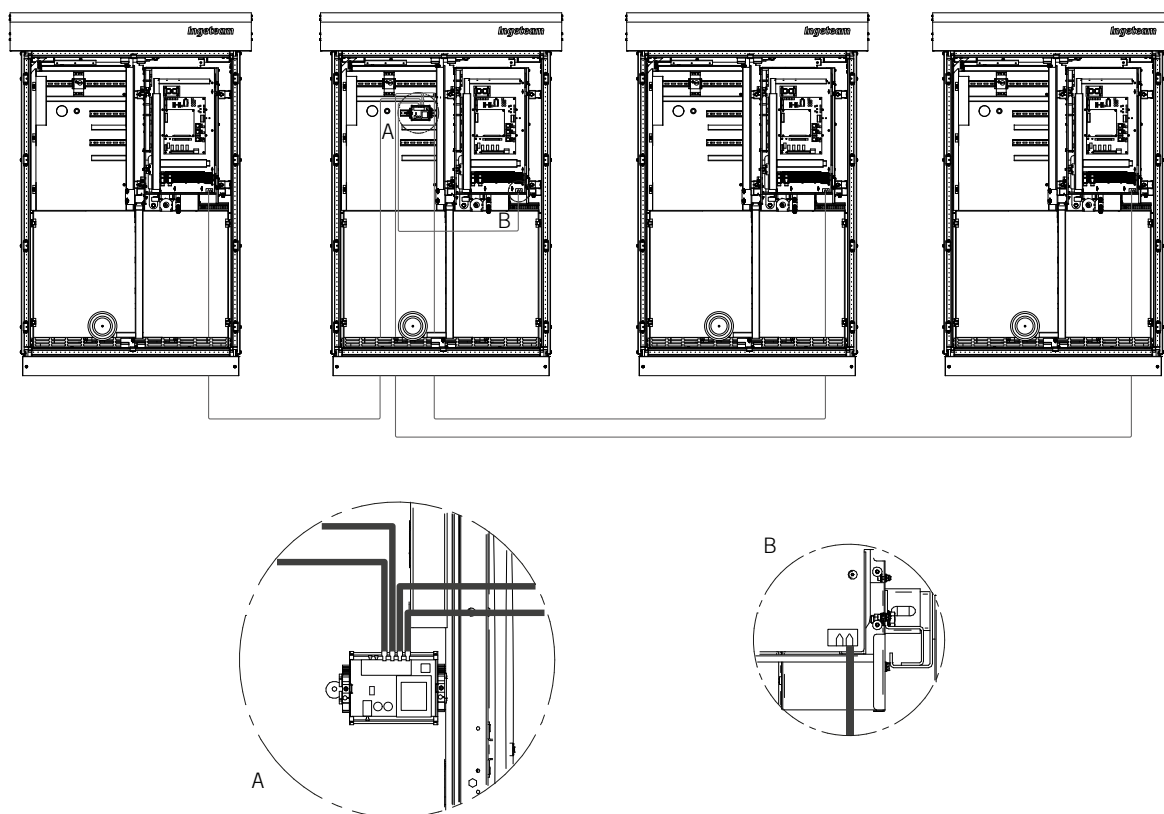
- 3 INGECON SUN 125 TL U 208 Outdoor inverters.
- 1 INGECON SUN 125 TL U 208 Outdoor inverter and synchronization kit.

Given that the kit consists of a synchronization board and 6 fiber optic cables, factory fitted into the unit, the following will be needed when the synchronization is carried out:

- 1 INGECON SUN 125 TL U 208 Outdoor inverter with the synchronization board fitted, connected via 1 cable to its electronics block.
- 3 cables to connect the synchronization card to the electronics blocks of the other three units. The connection of these 3 cables must be carried out by the installer.
- 2 cables, included in the kit but not needed in this case.

The synchronization or synchronization repetition kits are to be found in the lower right-hand part of the pre-installed unit. Cables must lead from here to each of the electronics blocks which are to be synchronized.

The fibre optic cable is connected to the intake board of each of the electronics blocks as shown in the figure:



In this type of configuration the PV array may be grounded.

In this example the synchronization signal is generated in the synchronization kit, located in the lower right-hand corner of the intake board, and which distributes the signal to 4 units (maximum 6). The inverters are connected via the fiber optic cables supplied.



If any of the units loses synchronization it will shut down, giving a 0X0040 HW DESC alarm.



MPPTs connected by TL inverters to the same transformer should have the same voltage settings.

## 6. Commissioning

### 6.1. Equipment inspection

The units are equipped with a series of thermomagnetic circuit breakers to protect their various components. These should be closed prior to unit start-up.



Before working on the thermomagnetic circuit breakers, check that there are no electrical hazards inside the unit.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

#### 6.1.1. Inspection

Before inverter start-up, a general inspection of the units must be carried out involving mainly:

##### Wiring

- Check that there are no loose wires. The insulation clearance is 0.79 in (20 mm) between cables.
- Check that the protective switchgear such as thermomagnetic circuit breakers, switches, arresters and fuses in general are in the correct position and in proper working condition.

Removing the perspex-type protections for performing this inspection is strictly forbidden.

##### DC feed

Check that the DC arresters are properly inserted into the base and that their “status window” is not red.

##### Equipment

- Check that the protective thermomagnetic circuit breakers are in the correct position.

##### AC feed

The following checks must be made to the AC feed.

- Auxiliary thermomagnetic circuit breaker switched to ON.
- Arresters correctly inserted into their sockets. Check that the status window is not red.

#### 6.1.2. Shutting down

During installation, make sure that the protection grade of the equipment has not been altered.

In all connections through cable glands, give cabling enough length inside the unit so they don't pull on the internal electrical connection terminals.

Ensure that unused holes have been properly sealed.

## 6.2. Start-up

First carry out a general visual inspection and wiring check, then proceed to connect power to the unit while keeping it switched off, following the guidelines in the instruction manual of the unit.

The tasks outlined for this step must be carried out with the unit door always closed, thus avoiding possible contact with live parts without NEMA 3R protection.

### 6.2.1. Start-up

Check that the inverter switches on and gives no alarm except for manual shutdown. Next, check that the variables on the monitoring menu are consistent; in particular the Vac Vdc levels.

The Vdc reading shows the voltage of the PV array at any given moment.

In the case of units with no grounding, it is possible to check that the PV array is balanced; to do this, click “OK” on the Vdc display screen and confirm that the displayed PVP and PVN values (indicating the voltage of each PV array pole to ground) are similar.

In the case of units with grounding of the positive pole, it is possible to check that the PVP value is 0 and that PVN indicates the PV array voltage; to do this, click “OK” on the Vdc display screen and confirm that the displayed PVP and PVN values (indicating the voltage of each PV array pole to ground) are as shown.

In the case of units with grounding of the positive pole, it is possible to check that the PVP value is 0 and that PVN indicates the PV array voltage; to do this, click “OK” on the Vdc display screen and confirm that the displayed PVP and PVN values (indicating the voltage of each PV array pole to ground) are as shown.

Finally, check that the inverter only displays the manual stop alarm (Alarm 1000H) on the monitoring menu.

Once the tasks described above are performed, you may proceed to start the inverter. Failure to comply with the verification tasks described above releases Ingeteam from any liability for possible damage to the system or the inverter itself caused by such failure.

Proceed to start the inverter.

### 6.2.2. Checking and measurement

Once connected to the unit network, the LED “Start” is lit, verify that no error LED display is on.

Check that the monitoring menu parameters are consistent:

- The voltage of the PV array should be within the values shown in Section “6.2.1. Start-up”.
- Vac tension shown on the display must fall within operating ranges.
- The RMS value of currents Iac1, Iac2 and Iac3 displayed should be similar.
- There are no alarms in the inverter (0000H).

It is always advisable to check the waveform of the current generated in the three phases using an ammeter clamp. Use the PPE listed in the “Personal Protective Equipment” section (working with voltage) to get this reading.

## 7. Preventive maintenance

The recommended preventive maintenance tasks must be carried out at least **annually**, except for the checking the fans and filters, which must be done **monthly**.



The various maintenance tasks must be performed by qualified personnel. Danger of electric shock.



To access the various compartments, take into account the safety recommendations in previous chapters.



All maintenance checks listed here should be done **with no voltage on the inverter** and in safe conditions for handling.

The following sections describe the actions to follow for proper installation of the inverters.

### 7.1. Maintenance tasks

#### Check status of the enclosure

A visual check of the status of the enclosure must be performed, verifying the status of locks, doors and handles and the unit fixings at both lower and, if any, upper anchorage points. In addition, the condition of the enclosure must be checked for dents, scratches or rust that might degrade the cabinet or cause it to lose its protection classification. If this type of defects are noticed, the parts affected must be substituted.

#### Check the status of the cables and terminals

- Check the correct path of the cables so they do not come into contact with live parts.
- Check for insulation faults and hot spots by checking the color of the insulation and terminals.

#### Tightness of strip fasteners and power cables

Check tightness in accordance with the following torques:

Threads dimensions	Tightening torque
13/12" (M10)	416 lb.in (47 Nm)
31/64" (M12)	567 lb.in (64 Nm)



In order to keep the nuts and bolts of the equipment in a proper condition, it is important while tightening them to make sure there is no dirt or shavings on the threads and to apply a suitable lubricant.

#### Check strips

Visually check that the AC feeds comply with safe distances and maintain their initial electrical properties.

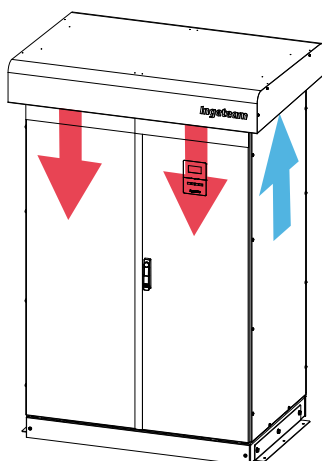
#### Check that there is no moisture inside the cabinet

If moisture exists, dry before making electrical connections.

#### Fixings

Check the correct fixing of the cabinet components to their corresponding anchorage points.

## Ensure adequate ventilation of the unit



Checking the status of exhaust fans, cleaning and replacing them if necessary.

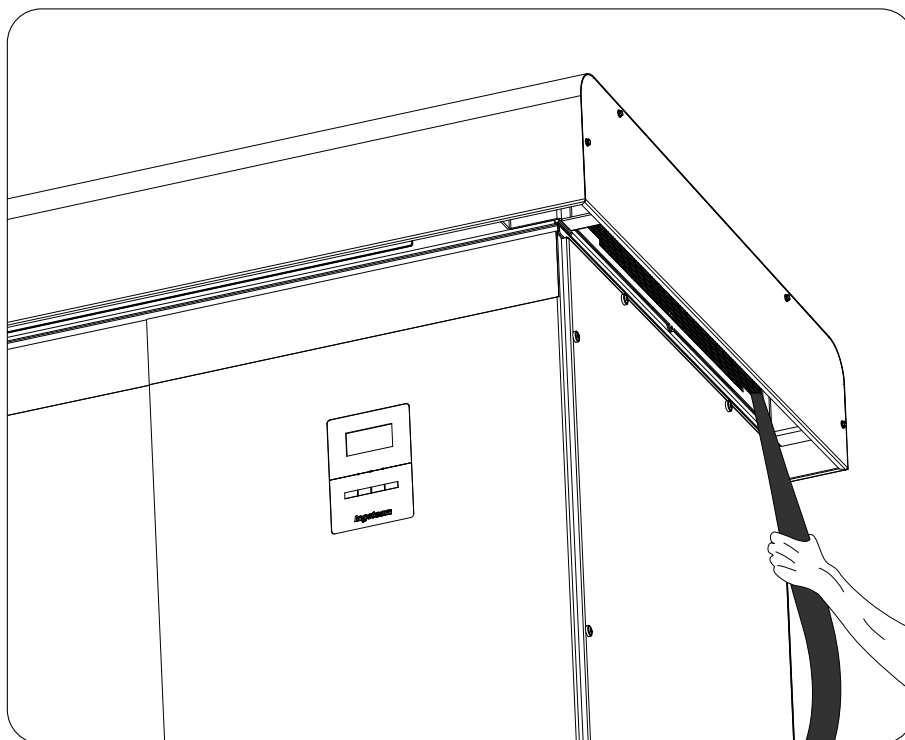


The useful life of the fans is 4 years, so they must be replaced after this time even if they seem to be functioning normally.

### Clean vents grids

Check the state of the filters in the side, front and rear ventilation grids. Accumulated dust and dirt in these may adversely affect the cooling ability of the fans and result in overheating of the equipment.

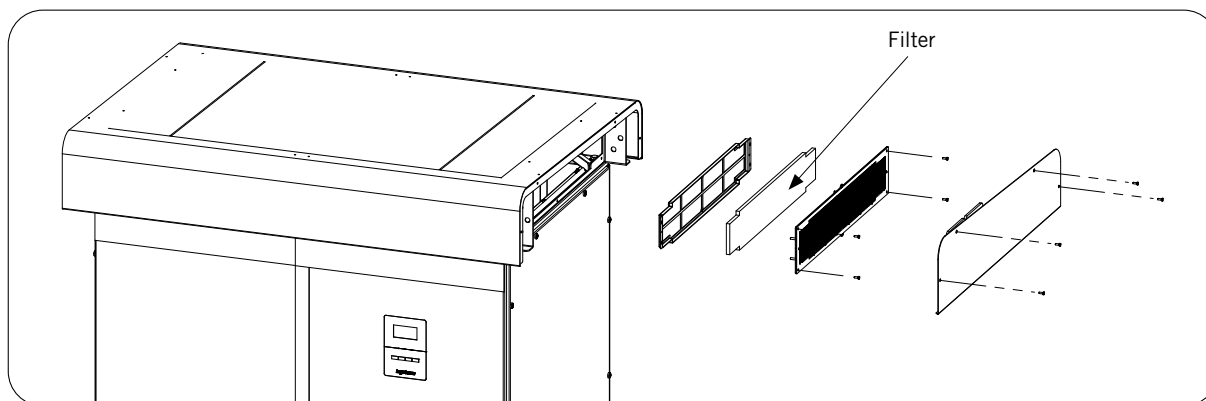
At regular one month intervals accumulated dust and dirt must be removed from the outside of the side, front and rear grids using a vacuum cleaner, as shown in the figure below.



### Clean the ventilation filters

Check the state of the side filters in the ventilation system. Accumulated dust and dirt in these may adversely affect the cooling ability of the fans and result in overheating of the equipment.

Every three months the filters must be removed for cleaning. The figure below shows how to remove them (there is a filter with similar characteristics fitted on the opposite side of the unit).



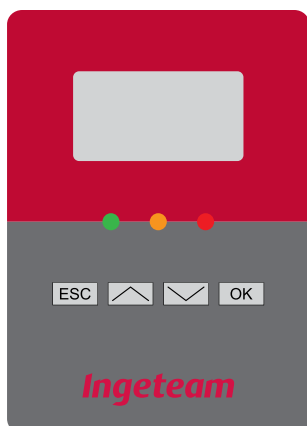
In order to keep the nuts and bolts of the equipment in a proper condition, it is important while tightening them to make sure there is no dirt or shavings on the threads and to apply a suitable lubricant.

- With a moderately dirty, dry filter, lightly tap until the dirt has been removed.
- If the dirt does not disappear, wash in water at 104 °F (40 °C).
- If the filter is soiled with grease or oil, replace it with a new one.

If the problem persists, contact Ingeteam.



## 8. Display control



These inverters incorporate a display and keypad unit to interface with the installer and the user.

This interface allows the display of the main internal parameters and the configuration of the entire system during installation.

Parameters, variables and commands are organized as menus and submenus.

### 8.1. Keypad and LEDs

The keypad has four keys:



**Esc.** To exit a parameter, leave a menu and returning to the next level up in the structure, to not confirm a change or not accept a suggestion.



**Up.** With this key you can scroll up the list of parameters or folders within the same level or increase the value of an editable parameter by one base unit.



**Down.** With this key you can scroll down the list of parameters or folders within the same level or decrease the value of an editable parameter by one base unit.



**OK.** Serves to accept a parameter as valid, to enter a lower level menu in the structure, to confirm a change or accept a suggestion.

The front panel has three LEDs:



#### Green LED

- Slow flashing: Standby due to low irradiance.
- Fast flashing: Start-up process.
- On: Inverter connected to the grid.



#### Orange LED

Fast flashing: Alarm set off which does not shut down the inverter.



#### Red LED

On: Alarm set off which shuts down the inverter.



#### Special combinations

Rapid flashing of all three LEDs: Fatal error status.

## 8.2. Display

The current date and time on the top line. The internal clock automatically changes the time from summer to winter and vice versa.

The node number for which data is being viewed appears beneath the top line on the left.

The central section provides instantaneous PV array voltage, power fed in by the inverter and output voltages.

The bottom line displays the functions for each of the keys.

If the inverter is manually shut down, the display will read “STOPPED” instead of displaying the power fed in by the inverter.

In the initial screen, in normal operation, the keypad functions are as follows:



Manual shutdown.

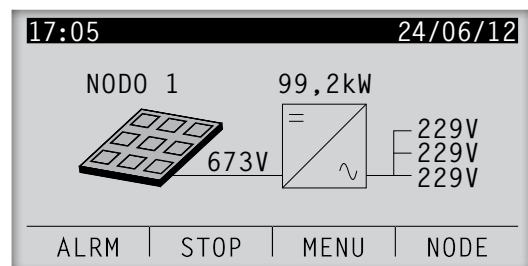
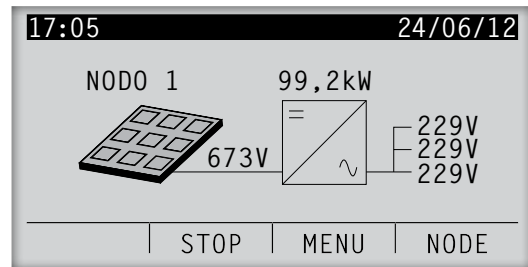


Main menu access.



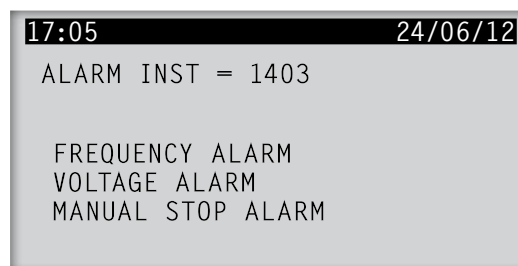
Change node.

If there are any active alarms in the inverter, the bottom, empty box will flash “ALRM” and the **ESC** key will also have its function:



You can see all the alarms which are active at that moment.

For example:

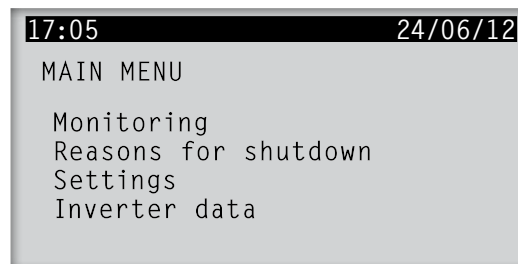


To exit this screen, press **ESC** again.

## 8.3. Main menu

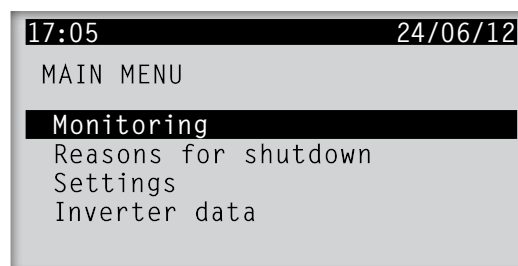
The main menu contains the following submenus:

- Monitoring. This displays the main internal parameters and variables that indicate the operation status of the unit.
- Reasons for shutdown. This option shows the reasons why the inverter was shut down the last five times.
- Settings. This menu displays all the settings that affect the inverter.
- Inverter data. This option offers inverter-specific data.



## 8.4. Monitoring

This menu is accessed by pressing the **OK** key in the Monitoring menu.



See below for the structure and interpretation of the variables in this menu:

### Screen 1

<b>Pac</b>	Power inverter is delivering into the grid, in kW.
<b>Pdc</b>	Power supplied by solar panels, in kW.
<b>Etot</b>	Total energy in kWh delivered by the inverter to the grid from the date it was manufactured.
<b>ParE:</b>	Total energy in kWh delivered by the inverter to the grid since the last time the counter was reset.

### Screen 2

<b>Vdc</b>	Voltage supplied by solar panels to the inverter.
<b>Vac1</b>	Inverter output voltage in phase one of the grid.
<b>Vac2</b>	Inverter output voltage in phase two of the grid.
<b>Vac3</b>	Inverter output voltage in phase three of the grid.

### Screen 3

<b>Idc</b>	Current supplied by solar panels to the inverter.
<b>Iac1</b>	Inverter output current in phase one.
<b>Iac2</b>	Inverter output current in phase two.
<b>Iac3</b>	Inverter output current in phase three.

### Screen 4

<b>Frec1</b>	Phase one frequency.
<b>Frec2</b>	Phase two frequency.
<b>Frec3</b>	Phase three frequency.
<b>Cos.Phi</b>	Cosine of Phi. Cosine of the phase shift angle between grid voltage and current supplied by the inverter.

## Screen 5

<b>Rpv</b>	Impedance of the entire PV array to ground.
<b>Rpv+</b>	Impedance of the positive pole of the PV array to ground.
<b>Rpv-</b>	Impedance of the negative pole of the PV array to ground.

## Screen 6

<b>Alarms</b>	Status of inverter alarms.
<b>0000H</b>	No alarms.
<b>0001H</b>	Grid frequency out of range.
<b>0002H</b>	Grid voltage out of range.
<b>0004H</b>	PI current saturation.
<b>0008H</b>	Unexpected reset.
<b>0010H</b>	Continuous overload at output.
<b>0020H</b>	Temperature alarm in the power electronics.
<b>0040H</b>	Hardware fault. Synchronization fault.
<b>0080H</b>	Instantaneous overload at output.
<b>0100H</b>	AC circuit protection.
<b>0200H</b>	DC circuit protection.
<b>0400H</b>	Insulation fault.
<b>0800H</b>	Power electronics fault.
<b>1000H</b>	Manual shutdown alarm.
<b>2000H</b>	Configuration change alarm.
<b>4000H</b>	Panel input overvoltage.
<b>8000H</b>	Low voltage in the PV array.

**Alarmas Hist** Alarms since the last connection. This value is reset each time the inverter is connected to the grid. It has the same code as the “alarms” variable.

**Templnt** Inverter power electronics temperature.

**TempCI** Inverter control electronics temperature.

## Screen 7

**Conn.N** Number of grid connections made during all hours of operation.

**ParConn.N** Number of grid connections since counter was last reset.

**ConnT** Number of hours the inverter has been connected to the grid.

**Par.ConnT** Number of hours the inverter has been connected to the grid since the counter was last reset.

## 8.5. Reasons for shutdown

This menu shows the last five inverter shutdowns, with reasons and corresponding date and time.

<b>17:05</b>	<b>24/06/12</b>
REASONS FOR SHUTDOWN	
13:43 (08/01)	-> MANUAL SHUTDOWN
17:22 (08/01)	-> POT CURRENT
19:35 (07/01)	-> POT CURRENT
12:21 (05/01)	-> FRED
15:51 (04/01)	-> POT CURRENT

Meaning of reasons for shutdown:

MP VIN	High input voltage from the panels.
MP FRED	Incorrect grid frequency.
MP VRED	Incorrect grid voltage.
MP VARISTORES	Varistor fault.
MP AISL.DC	DC insulation fault.
MP INT AC RMS	Continuous overvoltage on AC output.
MP TEMPERATURA	Overtemperature in the power electronics.
MP CONFIG	Shutdown for configuration change.
MP PARO MANUAL	Manual shutdown.
MP B VPV MED	Low input voltage from the panels.
MP HW_DESCX2	Internal fault.
MP IAC INST	Voltage surge on AC output.
MP CR. FIRMWARE	Shutdown due to firmware change.
MP LEC ADC	AD converter (internal) reading fault.
MP CONSUMO POT	Insufficient solar radiation. Does not trigger alarm.
MP FUSIBLE DC	Input fuse fault.
MP TEMP AUX	Redundant temperature sensor fault.
MP PROTECCION AC	AC Protection.
MP MAGNETO AC	Thermomagnetic circuit breaker error.
MP CONTACTOR	Contactor failed to close.
MP RESET_WD	Stopped for Watch Dog reset (internal).
MP LAT ADC	Converter (internal) fault.
MP ERROR FATAL	Fatal error in the inverter.
MP FALLO RAMA1	Power electronics fault.
MP FALLO RAMA2	Power electronics fault.
MP FALLO RAMA3	Power electronics fault.
MP PI CORR SAT	PI current saturation (internal).
MP LATENCIA SPI	Communication fault with redundant system.
MP REDUNDANTE	The redundant system has caused a shutdown.
MP PROTECCIÓN PIB	The PIB has caused a shutdown.

## 8.6. Settings

### Date and Time

From this menu you can change the date and time. The internal clock automatically changes the time from summer to winter and vice versa.




### Inverter number change




From this menu you can assign the node number to the inverter. This is required for configuring communications.

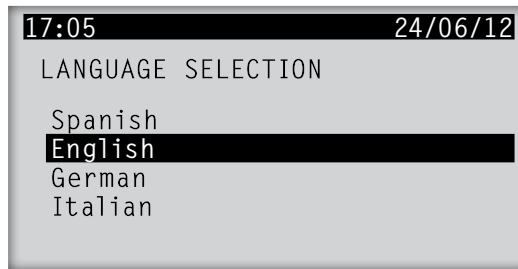
### Language



With this option, you can select the display language.

In the main screen, press the “down” key (an arrow pointing downwards). Main menu access.

From the main menu, by pressing the  or  keys or navigating through the menu to “SETTINGS”. Once highlighted, press  to access the submenu.

Within the “SETTINGS” submenu with the  or  keys or navigating through the menu to the “Language” option. Once highlighted, press  to access the language change screen.



Press the  button to scroll through the various languages and  to confirm the selection.

## Grid quality

In this menu, you can change the grid quality parameters. This menu is only active after the security code has been input.

## Ground connection

Through this option, you can change the type of grounding for the PV array. This menu is only active after the security code has been input.

## Connection time

This menu allows you to modify the delay before the inverter connects to the grid. This menu is only active after the security code has been input.

## Total reset

With this option, the user can reset all inverter counters. This menu is only active after the security code has been input.

## Other adjustments

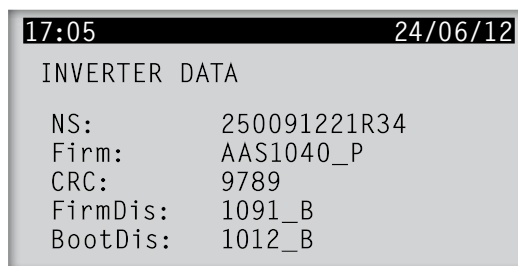
Various internal adjustments.

## Change NumCAN

From this menu you can change the node number. This is useful for units with more than one electronics block, and should not be changed on the unit unless so instructed by Ingeteam.

## 8.7. Inverter data

This window displays inverter-specific data:



### Serial Number (NS)

Number that identifies the inverter.

### Firmware Version (Firm)

Shows the name and version of the inverter firmware.

### Display firmware version (FirmDis)

Shows the name and version of the inverter display.

### Boot version of the display (BootDis)

Shows the name and version of the display Boot.

## 8.8. Change inverter number

From this menu you can assign the inverter a number. This is required for configuring communications.

With keys  and  you can change the inverter number. Press  to confirm the number selected.

## 9. Troubleshooting

This is a guide for troubleshooting problems that may arise in the installation of your unit.

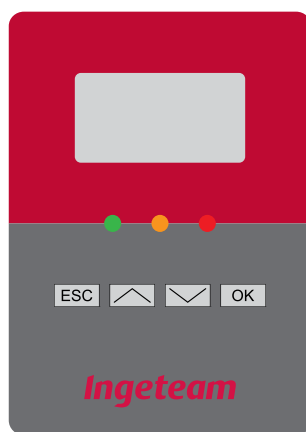
It also explains how to perform simple operations such as component replacement and unit configuration.



Troubleshooting for the inverter must be performed by qualified personnel in compliance with the general safety instructions in this manual.

### 9.1. LED messages

Some of the LEDs indicate some kind of problem in the PV installation.



Display INGECON SUN Power U

#### 9.1.1. Green LED

This is the LED that should light up in normal start-up and operating conditions, while the others remain off. It has three modes:

##### Slow flashing

Standby due to low solar radiation. Flashing every 3 seconds. This alarm is triggered when the PV array does not receive enough solar radiation to supply the minimum voltage required by the inverter to inject power. This occurs commonly between sunset and sunrise, or at times when rain, clouds or other atmospheric phenomena produce overcast conditions above the PV array.

If this situation occurs on a day which is not particularly dark, check that the panels are clean and properly installed.

##### Fast flashing

This type of blinking indicates that the PV array is feeding the right amount of voltage to the inverter and it is about to start up. In this state, the inverter checks the grid parameters to feed current into the grid at the latter's precise voltage and frequency. This process takes about 1 minute (adjustable).

##### Steady light

Inverter connected to the grid.

### 9.1.2. Orange LED

This LED indicates that alarms have been set off in the inverter.

#### Fast flashing

This flashing indicates that an alarm has occurred in the inverter, but the anomaly in the operation does not require stopping the inverter. The most frequent alarm of this type is the high temperature protection:

The inverter is in self-limiting mode because it has reached the maximum permissible temperature.

In this situation, check that the fans are running, that the air inlets and vents are free from obstacles, and that there are no sources of intense heat near the inverter. If the problem persists, contact Ingeteam.

### 9.1.3. Red LED

This LED indicates that alarms have been set off in the inverter.

#### Steady light

The inverter shuts down. This flashing indicates that an alarm has occurred in the inverter which requires it to shut down. The most common alarms that require inverter shutdown are:

- |              |   |
|--------------|---|
| <b>1000H</b> | Manual shutdown. The unit has been stopped manually. Check that the emergency push buttons have not been pressed accidentally, and try to restart from the display by removing the manual shutdown. |
| <b>0001H</b> | Grid frequency out of range.  |
| <b>0002H</b> | Grid voltage out of range.  |
|              | Chances are that the problem is a power failure. When power returns, the inverter will restart. If not, check the connections to the grid.  |
|              | If the grid has the appropriate grid quality parameters, check the grid connections.  |
|              | If the problem persists, contact Ingeteam.  |
| <b>0400H</b> | Insulation fault in DC circuit.   |
|              | There are two possible causes:  |
|              | <ul style="list-style-type: none"> <li>• There is an insulation fault on the panel circuit.</li> <li>• An arrester has triggered.</li> </ul>  |
| <b>0020H</b> | Temperature alarm in the power electronics.   |
|              | The temperature of the unit is too high and has stopped feeding current to the grid. When the temperature drops, the unit will reconnect.   |



An insulation fault can pose a hazard to personnel.

The repair of an insulation fault must be carried out by qualified personnel.

#### Procedure to determine the cause of the insulation fault

1. Open the DC circuit breaker. If the voltages of the PV array with respect to ground are in balance, the insulation fault is outside the inverter.
2. If the insulation fault persists, the fault is inside the unit. Check the surge arresters.
3. Disconnect the unit from the power grid and the PV array.
4. Wait at least 10 minutes for the capacitances to discharge.
5. Open the inverter and check the status of the DC arresters. Each of these arresters has an visual indicator. If the indicator is black, the arrester has been triggered.
6. Replace defective components if necessary.
7. Close the inverter, reconnect the unit to the grid and to the PV array.
8. If the fault indicator persists, check the PV array insulation. Pinpoint the fault and correct it.



## 9.2. List of alarms and reasons for shutdown

The following table details the possible reasons for each alarm.

Code	Alarm	Reason for shutdown	Description
0000H		None	No alarm, the unit must be connected whenever it has enough power.
0001H	Frequency	Grid frequency out of range.	Grid frequency out of range.
0002H	Voltage	Grid voltage out of range	Grid voltage out of range
0004H	Current loop	Internal current loop fault.	Internal current loop fault.
0008H	Reset	Reset	Indicates that the inverter has reset, inverter firmware fault
0010H	Effective grid current	Effective grid current	RMS current exceeds maximum allowed
0020H	Temperature	Power electronics temperature.	The temperature of power electronics exceeds 176 °F (80 °C).
		Auxiliary temperature sensor	The auxiliary temperature sensor has triggered an alarm
0080H	Instantaneous grid current	Instantaneous grid current	Instantaneous current value out of range
0100H	AC protections	Varistors	Error in AC varistors
		Contactors	The state of the contactor is not correct for the current inverter status.
		AC protections	Error in some of the AC protectors, arresters, fuses, etc.
		Thermomagnetic circuit breaker	Error in the three-phase input thermomagnetic circuit breaker.
0200H	DC protections	DC protections	Blown DC input fuse or DC arresters
0400H	AC insulation	AC insulation	Insulation fault in the PV array on inside the inverter
		Varistors	Error in DC varistors
0800H	Branch fault alarm	Fault in branch #1	Fault in branch #1 of the power electronics
		Fault in branch #2	Fault in branch #2 of the power electronics
		Fault in branch #3	Fault in branch 3 of the power electronics
1000H	Manual shutdown	Manual shutdown	Manual shutdown due to the limit switch, via the display or communications
2000H	Configuration	Configuration	Shutdown due to a change in firmware
		Firmware	Shutdown due to firmware load
4000H	High input voltage	High input voltage	High DC input voltage
8000H	Panel voltage	Low input voltage	Shutdown due to low input voltage.
		Hardware fault	Reason for internal shutdown, hardware failure
		Low power	Shutdown due to low power, (typical at nightfall)
		Fatal error	Due to five consecutive errors in the branches, or consecutive contactor shutdowns.

### 9.3. Inverter alarms due to protections

Code	Description
0100H	<p>This alarm goes off when an AC protection element is triggered.</p> <p>The items monitored are:</p> <p><math>Q_1, Q_2, Q_{AUX}, Q_4, RV_{ac}, K_1</math></p> <p>Which are the protections for the filters and AC intakes and DC intakes and contactor.</p> <p>In normal operation, all contacts should be closed, except for the contactor circuit. Check the signalling circuit to see where it is broken. The causes may be broken cables in the circuit, a triggered protection, fused arresters or a connector out of its base.</p>
0200H	<p>This alarm goes off when a DC protection element is triggered.</p> <p>The items monitored are:</p> <p><math>RV_{DC}</math></p> <p>In normal operation all contacts must be closed. Check the signalling circuit to see where it is broken. The causes may be broken cables in the circuit, fused arresters or a connector out of its base.</p>
4000H	<p>Overvoltages in the panel inputs.</p> <p>This alarms indicates an out-of-range voltage at the PV input.</p> <p>A voltage greater than 900 VDC will cause the equipment to shut down. Voltages greater than 1000 VDC will damage the equipment.</p>
8000H	<p>Very low voltage on the input from the panels.</p> <p>This alarms indicates an out-of-range voltage at the PV input.</p> <p>The equipment will be on standby until the panel voltage reaches the necessary value for a connection.</p>
0020H	<p>Temperature alarm in the power electronics.</p> <p>The temperature of the unit is too high and has stopped feeding current to the grid. When the temperature drops, the unit will reconnect.</p>

### 9.4. Action protocol for responding to incidents

If the unit should stop interacting with the network due to the emergence of issues relating to the installation and/or the inverter, the fastest way to resolve the issue is as follows:

1. Check on the display the alarm and the reason for shutdown reported by the unit. Search in this guide's index to see if the alarm or reason for shutdown is indicated. If it is covered, proceed to step 2; if on the contrary it is not covered, take note of the unit's serial number and contact Ingeteam's telephonic technical service, the number of which is listed on a sticker on the document pocket behind the door.
2. Disconnect the unit from the supply. This will disconnect both the AC and auxiliary connections by opening the thermomagnetic circuit breaker and the DC section by opening the PV array breaker. After AC and DC power is switched off, wait 10 minutes before opening the unit, to ensure that their internal capacitance is discharged.



Only in the event of an insulation fault triggered by alarm 0400H will the AC power be switched off and the DC power be left.

3. Open the unit and find the section in this guide that deals with the alarm or reason for shutdown recorded in the first step.
4. Use a category III, 1000 V<sub>DC</sub> multimeter which can measure continuity, resistance and capacitance, and proceed to carry out the checks listed here.
5. If unable to solve the problem using this guide, take note of the unit's serial number and contact technical service.

Below is a list of possible reasons for shutdown, their associated alarms and troubleshooting guidelines. If more than one alarm takes place, the alarm on the display will be the sum of all active alarms.

E.g.:

Code	Alarm
0001H	Grid frequency
0002H	Voltage
0003H	Grid frequency + voltage

### 9.4.1. Voltage and/or frequency out of range

One reason for shutdown associated with out-of-range voltage and/or frequency features the alarm codes listed below:

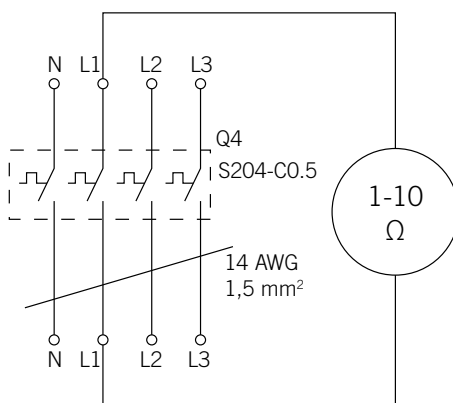
Code	Alarm	Reason for shutdown	Description
0001H	Grid frequency	Grid frequency	Grid frequency out of range
0002H	Voltage	Voltage	Voltage out of range
0003H	Grid frequency + voltage	Grid frequency + voltage	Grid frequency out of range + Voltage out of range

In the event of a 0001H and/or 0002H alarm, you must check the status of the Q4 thermomagnetic protection and all the wiring associated with it. This check requires verifying the correct status of the following areas of the unit:

1. Check that Q4 is in the ON position.
2. Status of RVAC arrester located at the AC feed of the unit on the right. To verify its correct status, verify that they are properly attached to their base and that the status window of none of them is red.
3. Once the arresters have been checked, check that the Q1 thermomagnetic protection (AC circuit breaker of the inverter) is ON.

In the event that Q4 is ON, the next step will be to ensure that both the AC voltage intake XAC and the electronics block are powered. The procedure requires performing the following checks:

1. Check that the Q4 thermomagnetic circuit breaker is not damaged. With Q4 switched ON, measure the flow resistance offered by Q4 for each phase. The resistance of each of the phases must be within the 1 to 10 Ohm range. The following figure details the test to be performed.



The figure has verified the resistance of phase 1, L1. Testing required for L2 and L3.

2. Check for continuity between Rcapt, Scapt and Tcapt terminals of the inverter's Q4 thermomagnetic circuit breaker and XAC terminal strip on the electronics block, according to the following sequence of terminals (see figure):

- Ncapt – XAC.0
- Rcapt – XAC.4.
- Scapt – XAC.3.
- Tcapt – XAC.2.

3. Check for continuity between the XAC terminal on the electronics block and the intake board as per the following list:

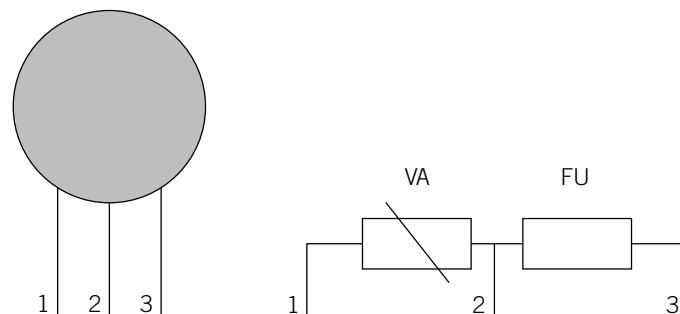
- XAC.1 – J8.2
- XAC.2 – J8.1
- XAC.3 – J7.1
- XAC.4 – J6.1

Another task to be performed is a visual inspection of the varistors on the intake board. Check that the thermal fuse is not damaged.

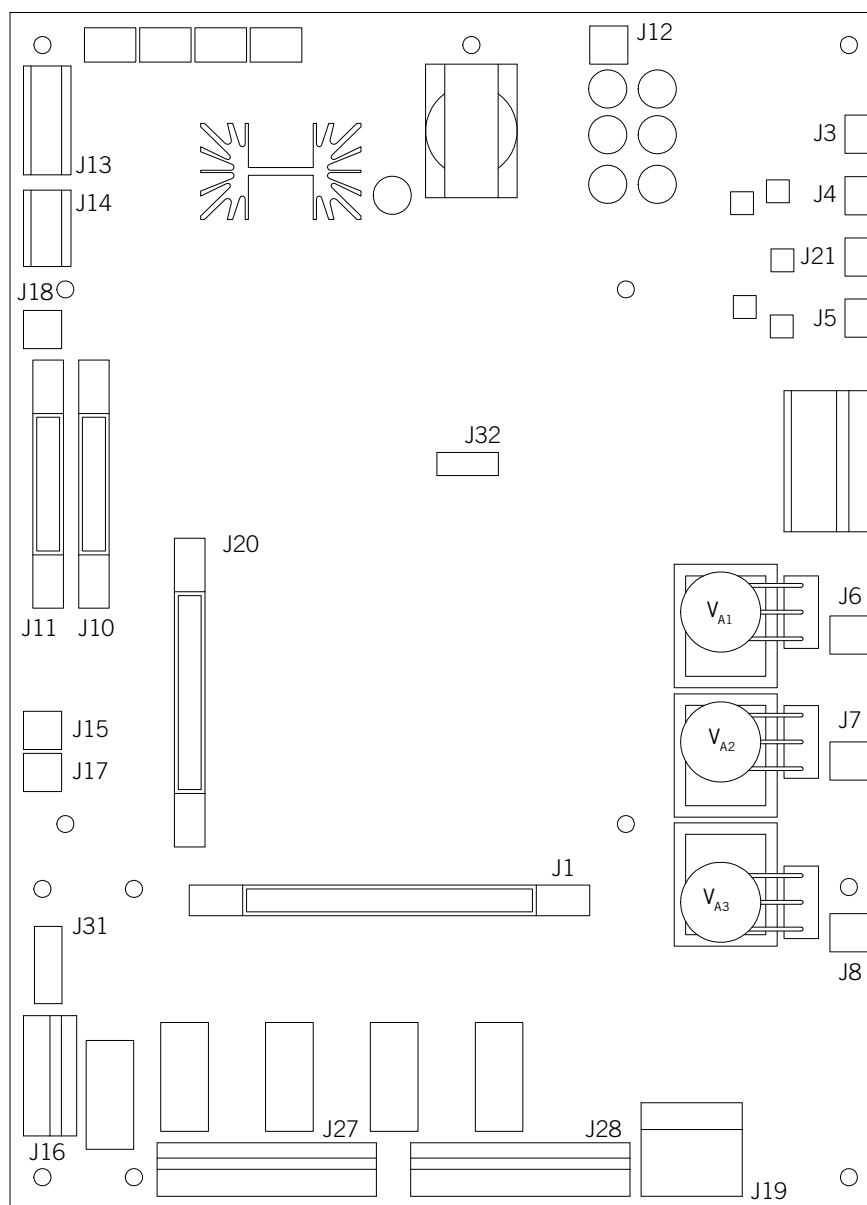
The intake board varistors comprise a thermal fuse (FU) and a varistor (VA). The way to check that the varistor is operating correctly is to perform the checks listed below:

Between pins 1 and 2, you must get a high impedance reading of around kOhm.

Between pins 2 and 3 you must get a reading of 0 ohms approximately.



If all the above checks are correct and a 0002H alarm persists, what remains to be checked is that the impedance of each phase of the inverter output to ground is very high.



Intake board

### 9.4.2. Temperature

Code	Alarm	Reason for shutdown	Description
0020H	Temperature	Power electronics temperature.	The power electronics exceeds 176 °F (80 °C).
		Auxiliary temperature sensor	The auxiliary temperature sensor has triggered an alarm

In the event of a shutdown with reason “Motivo Paro Temperatura”, the first step is to check if the 0020H alarm persists. If so, check the temperature of the unit’s radiator via the display menu:

MONITORING → TempRad

- If the temperature displayed is close to or above 80 degrees, the unit has failed to inject power as a precaution against a potentially damaging radiator temperature for the unit. The inverter will remain in this state until the radiator has cooled, and then it will reconnect to the network.

If the problem occurs frequently, you should check the ventilation (fans and air intake grills) of the inverter and the enclosure in which it is installed.

- If the temperature shown is less than 140 °F (60 °C) and the alarm persists, the problem could be in the

thermal switch built into the inverter in the radiator of the electronics block.

- If the displayed temperature is abnormally low (compared to room temperature), the root of the problem could be with the NTC built into the inverter.

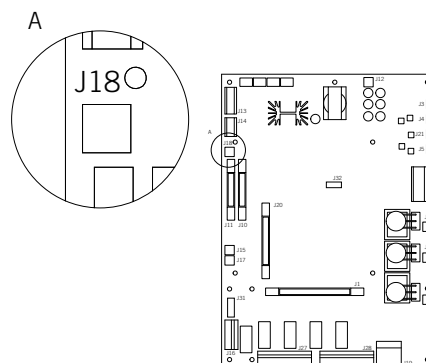
### Checking the NTC

To check the NTC of the unit you will need to access the J18 terminal of the intake board. This terminal can be found underneath the control card.

In terminal J18, do not connect wires coming into J18.1 and J18.2, and use a multimeter to measure resistance between them. The resistance measured should be approximately  $5\text{ k}\Omega$  at around  $77\text{ }^{\circ}\text{F}$  ( $25\text{ }^{\circ}\text{C}$ ) ambient temperature. It should be borne in mind that, for temperatures below  $77\text{ }^{\circ}\text{F}$  ( $25\text{ }^{\circ}\text{C}$ ), the resistance reading will be greater than  $5\text{ k}\Omega$ , whereas for temperatures above  $77\text{ }^{\circ}\text{F}$  ( $25\text{ }^{\circ}\text{C}$ ), the resistance reading will be lower than  $5\text{ k}\Omega$ .

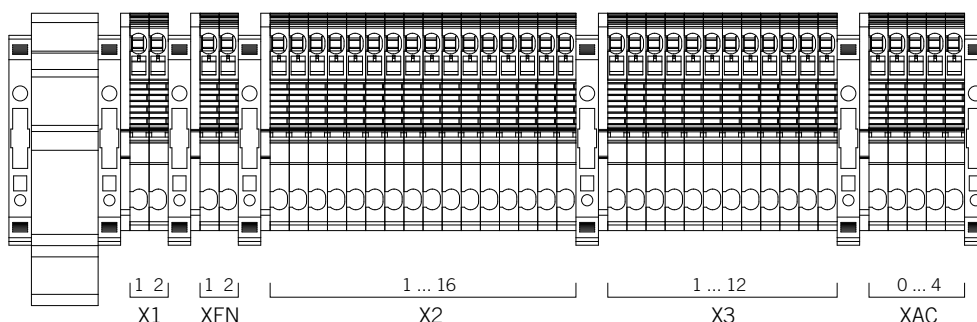
Re-wire the NTC on the J18.1 and J18.2 connector and measure resistance between connector pins themselves with the multimeter. The resistance measured should be approximately  $1\text{ k}\Omega$ .

In case any anomaly in the inverter's NTC is found, contact technical support.



### Checking the thermal switch

To check that the thermal switch is working properly, measure the continuity with a Category III multimeter between terminals X3.8 and J19.2 (intake board) in the electronics block. The figure represents the entire terminal strip to identify it more easily.



To locate the position of the terminals within the intake board, see explanatory drawing titled “Intake board” on page 77.

If you do not have continuity, you should contact technical support.

## 9.4.3. AC circuit protection

Code	Alarm	Reason for shutdown	Description
0100H	AC Protection	AC Protection	Error in some of the AC protectors, arresters.

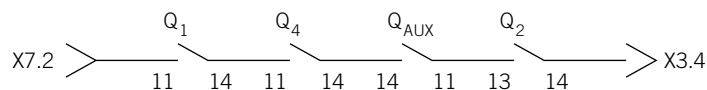
In the event of a *Motivo\_Paro\_Prot\_AC* reason for shutdown, check the status and monitoring of the AC circuit protections of the module in question.

To check the status of the protections, perform an in-depth check of section “6. Commissioning” in this document.

If the AC circuit protection status is correct, proceed to verify their monitoring. To do this, the monitoring branches must be checked:

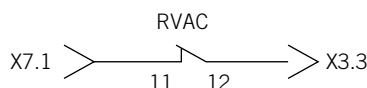
## AC PROTECTION

Consists of thermomagnetic circuit breakers Q1, Q2, QAUX and Q4.



## AC ARRESTER

Consists of RVAC.



To check the AC protection branch, you should see continuity between the ends of the monitoring circuit: Q1 11 and Q2 14. Next you should check that power is reaching the electronics block from X3.4. To do this, check that there is continuity between terminals X3.4 and J19.6.

If there is continuity between terminals X7.1 and X3.3 of the AC branch arrester, it is running properly.



To locate the position of the terminals within the intake board, see explanatory drawing titled *"Intake board"*.

### 9.4.4. Reason for contactor shutdown

Code	Alarm	Reason for shutdown	Description
0100H	AC protections	Reason for contactor shutdown	The state of the contactor is not correct for the current inverter status.

The "contactor" reason for shutdown is associated to alarm 0100H. This reason for shutdown requires checking the following points:

- Contactor coil wiring. There should be continuity between terminals X8.2 and X2.3, between X2.4 and K1.A1 and between X8.5 and K1.A2. Proceed to check that the electronics block is powered. To do this, check continuity in the following points:
  - X2.3 – J16.1
  - X2.4 – J16.3
- Signalling status. Resistance between terminals X7.1 and X3.2 should be measured as approximately 4.5 kΩ.

### 9.4.5. DC circuit protections

Code	Alarm	Reason for shutdown	Description
0200H	DC protections	DC protections	DC arresters.

In the event of a 0200H alarm, check the status of the DC arresters To check for proper status observe the following:

- Continuity between terminals X7.2 and X3.1.
- Continuity between X3.1 and J19.1.

### 9.4.6. Insulation fault

Alarm 0400h is related to an insulation fault and can be one of two types:

- External to the unit.
- Internal to the unit.

## External to the unit

### Non-grounded units

To check whether the insulation fault is external to the unit, see whether the Rpv+ and Rpv- impedances are displayed on the display screen (selecting the fifth screen from the monitoring menu). Given an insulation fault, one or both will be 0 or a low figure.

Disconnect the power and open the DC breaker. If the Rpv+ and Rpv- impedances cease to be invalid, the fault is in the PV array. If one of them is balancing out and gives an intermediate reading, the inverter is triggering the insulation fault.

Check that the grounding fuse is not installed (see Section “2.4. Location of the components”).

Inspect the installation.

### Units with positive grounding

To check whether the insulation fault is external to the unit, see whether the Rpv- impedance is displayed on the display screen (selecting the fifth screen from the monitoring menu). Given an insulation fault, Rpv- will be 0 or a low figure. (Rpv+ may give a higher value).

Disconnect the power and open the DC breaker. If the Rpv+ and Rpv- impedances cease to be invalid, the fault is in the PV array. If one of them is balancing out and gives an intermediate reading, the inverter is triggering the insulation fault.

Check that the grounding fuse is installed and working correctly (see Section “2.4. Location of the components”). Should the grounding fuse have fused, it is essential to find and correct the insulation fault before replacing it.

Inspect the installation.

### Units with negative grounding

To check whether the insulation fault is external to the unit, see whether the Rpv+ impedance is displayed on the display screen (selecting the fifth screen from the monitoring menu). Given an insulation fault, Rpv+ will be 0 or a low figure. (Rpv- may give a higher value).

Disconnect the power and open the DC breaker. If the Rpv+ and Rpv- impedances cease to be invalid, the fault is in the PV array. If one of them is balancing out and gives an intermediate reading, the inverter is triggering the insulation fault.

Check that the grounding fuse is installed and working correctly (see Section “2.4. Location of the components”). Should the grounding fuse have fused, it is essential to find and correct the insulation fault before replacing it.

Inspect the installation.

## Internal to the unit

If the insulation fault is caused by the unit, you must cut the DC power supply and wait 10 minutes before opening the inverter for the first time.

If the fault is not as specified earlier, it will be necessary to look for it in the DC and/or AC part of the unit.

In the DC part of the unit, you will need to check the arresters and wiring. Using a multimeter, check that the resistance and ground capacitance of each pole of the DC battery bus is the same.

In the AC part of the inverter, check that the resistance of each of the inverter's outputs to ground are in the MΩ range.

Check that the ground fault is not being produced by the switching filter or the cable associated with the unit's auxiliary services.

To check that the ground fault is not being produced by the switching filter, open Q2 and measure the resistance between phases and ground.

To check that the ground fault is not being produced by the auxiliary services, open QAUX and measure the resistance between phases and ground.

If the problem is identified, check the correct status of the cabling.

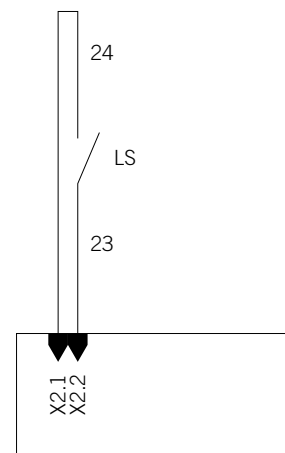
If the problem persists, contact Ingeteam.



### 9.4.7. Manual shutdown

Code	Alarm	Reason for shutdown	Description
1000H	Manual shutdown	Manual shutdown	Manual shutdown due to the limit switch, via the display or communications

To verify that the limit switch works properly, check for continuity between terminals X2.1 and J17.1, and between terminals X2.2 and J17.2.



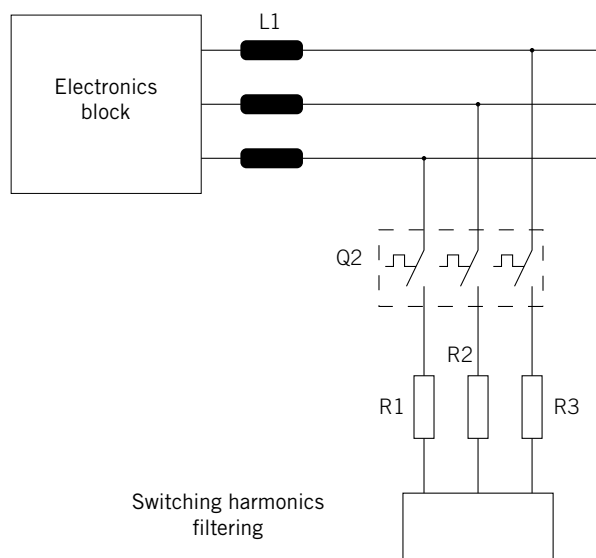
Limit switch

### 9.4.8. Protection of the switching filter

Protection of the switching filter is via the Q2 thermomagnetic circuit breaker.

To determine the reason for triggering of the Q2 thermomagnetic circuit breaker, perform the following procedure:

1. Check that the capacitance of the switching harmonics filter in each of the three phases is adequate. Use a multimeter to measure the capacitance between phases and check that all have the same value. If not the case, proceed to replace the filter.



2. If after taking the previous step above the problem persists, take note of the unit's serial number and look at what version of firmware it has. If you do not know what version of firmware the equipment has, it will be enough to power the unit with DC and check it through display by: OK → Monitoring → Status. The status will show digit coding of the form \_Letter, whereby the letter indicates the unit's firmware version. With this information, call Customer Service on the number on the cable protectors on the bottom of the unit's door.

## 9.5. Replacing the electronics block

The unit's main electronics boards (control board, power board, IGBTs, etc.) are its core element, and they are grouped in a stainless steel cabinet known as the "electronics block".

In case of equipment damage requiring the replacement of this "electronics block", proceed as follows:



The electronics block is a heavy element. We suggest that it be carried by two people or with mechanical assistance.

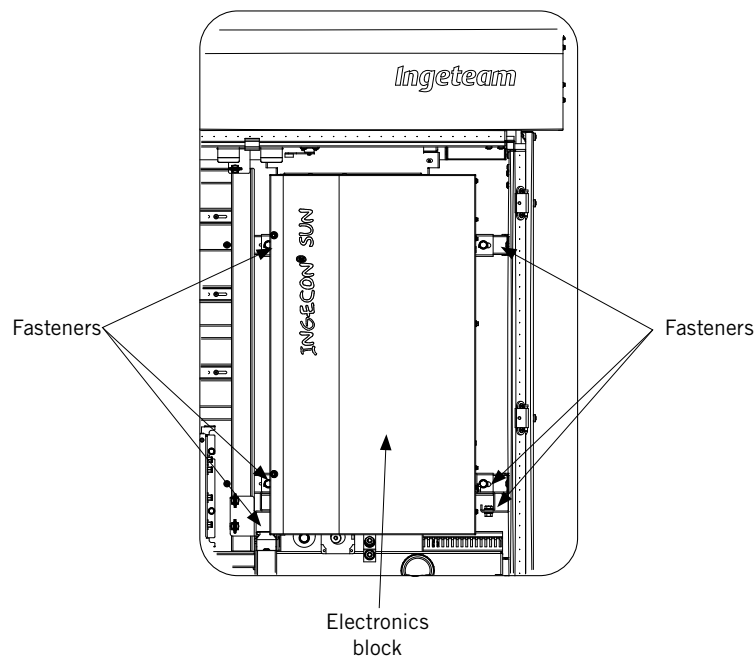
When handling the block, personal protective equipment (PPE) must be worn: helmet, glasses and safety footwear.

The tools needed to replace the electronics block are:

- Flat screwdriver for terminal connections.
- Ratchet and spanner 17 (M12) for AC and DC connections.

To fix the electronics block:

- Ratchet 13 (M8) for fixing the electronics block.
- Ratchet 7 (M4) for removing the top cover.



Proceed in the following order:

1. Disconnect the unit from the power grid and the PV array.
2. Wait at least 10 minutes for the capacitances to discharge.
3. Check that there are no voltages inside the unit.
4. Disconnect the "Power cables" at the bottom of the block.
5. Disconnect the plug-ins entering the terminal strip from outside the block.
6. Disconnect communication boards or analogue inputs.
7. Disconnect the display cable.
8. Unscrew the anchor points.
9. Remove it.

For reassembly, we will perform the same steps in reverse order and finally will need to set the electronics blocks:

1. Mount it.
2. Screw down the fasteners.
3. Connect the display cable.
4. Connect communication boards or analogue inputs.
5. Connect the plug-ins entering the terminal strip from outside the block.

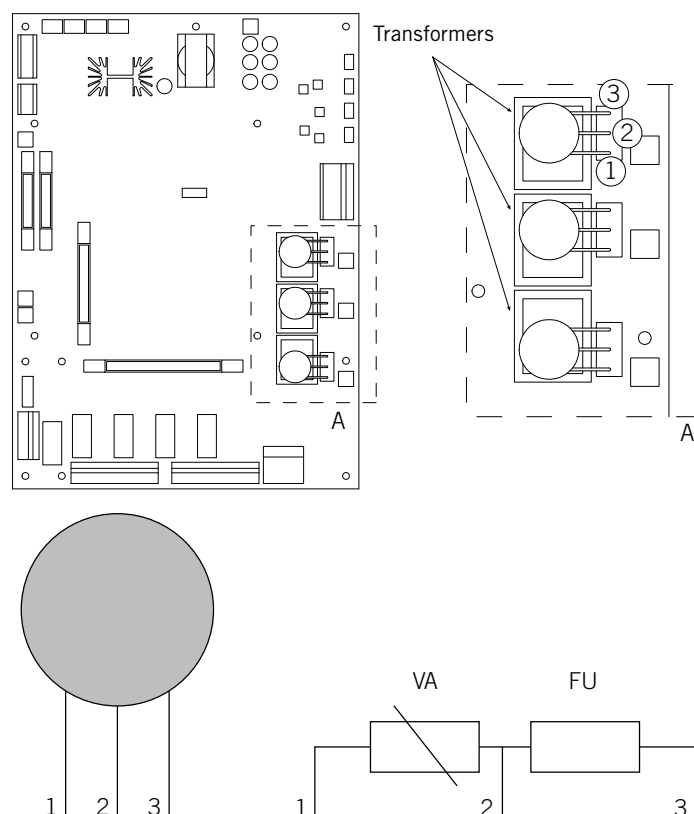
6. Connect the “Power cables” at the bottom of the block.
7. Connecting the unit to the PV array.

## 9.6. Replacing varistors in the intake board

The varistor is connected to the 3-pin connector on pins 1 and 2. Pin 3 is for connecting the thermal fuse.

The varistor must be connected as follows:

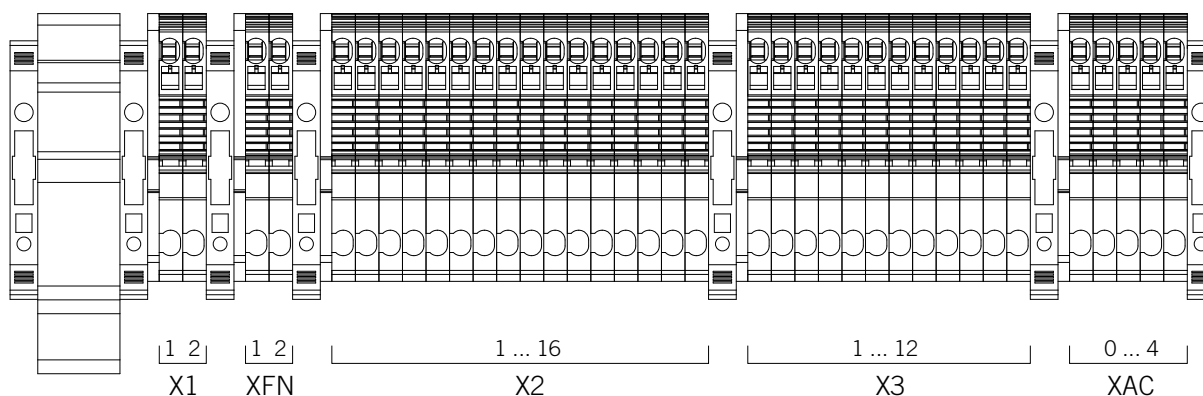
- Check continuity of the fuse with the varistor outside the board using the tester.
- Place the varistor on the board in position 1-2 varistor, 2-3 fuse.



Inserting the varistor back-to-front will destroy it.

## 9.7. Description of terminal strip

The terminal strip is made up of type ZKS plug-in connectors and type WDU screw-in terminals.



### X1

X1.1	Free	X1.2	Free
------	------	------	------

### XFN Nighttime power supply connection

XFN.1	+ nighttime supply	XFN.2	- nighttime supply
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### X2 Relays and position switches

X2.1	Limit switch	X2.9	Free
X2.2	Limit switch	X2.10	Free
X2.3	Contact coil	X2.11	Free
X2.4	Contact coil	X2.12	Free
X2.5	NO contact insulation fault/power on	X2.13	Free
X2.6	NO contact insulation fault/power on	X2.14	Free
X2.7	AC fans	X2.15	Free
X2.8	AC fans	X2.16	Free

### X3 Monitoring signals

X3.1	DC arrester monitoring	X3.7	Free
X3.2	Contact monitoring	X3.8	+15 V
X3.3	Monitoring of AC arresters	X3.9	+15 V
X3.4	Monitoring AC thermomagnetic circuit breakers	X3.10	GND
X3.5	Free	X3.11	+14 V
X3.6	Free	X3.12	GND

### XAC Grid voltage intake

XAC.0	Neutral AC grid	XAC.3	Voltage L2
XAC.1	Neutral AC inverter	XAC.4	Voltage L1
XAC.2	Voltage L3		

## Notes

This image shows a full page of blank, lined paper. It features approximately 28 horizontal blue or grey lines spaced evenly apart, typical of notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings on the page.

## Notes

This image shows a full page of blank, lined paper. It features approximately 20 evenly spaced horizontal grey lines across the entire width of the page, providing a guide for writing. The background is a solid off-white color.

## Notes

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05/2013

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