Ingeteam

INGECON SUN SMART U

INSTALLATION AND OPERATION MANUAL

AAS2000IKI05 Rev_

Ingeteam Energy S.A. 01/2011

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About This Manual

Purpose

The purpose of this manual is to describe the Ingecon Sun SMART 15U 208, 15U 480, 25U 208 and 25U 480 and to provide the information required for its correct operation, from reception to start-up, in addition to the preventive maintenance during operation.

Scope

This manual provides safety guidelines, equipment information and requirements and procedures for installation and operation.

Audience

All installator who plans to use our equipment in a PV installation according to the requirements of the “National Electrical Code. ANSI/NFPA70” and any other local codes or laws. The installer itself has to meet all local and state code requirements.

Scheme

Please read this manual carefully and follow the installation instructions precisely.

Symbol Identifications in this Manual

The following symbols are used in this manual:

WARNING

Warnings advise about situations that could cause personal injury or death.

CAUTION

Cautions advise from situations that could cause damage to the unit or it environment.

IMPORTANT SAFETY INSTRUCTIONS

SAVE THIS INSTRUCTIONS - DO NOT DISCARD

This manual contains important instructions for Models Ingecon Sun 15U 208, Ingecon Sun 15U 480, Ingecon Sun 25U 208 and Ingecon Sun 25U 480 that shall be followed during installation and maintenance of the (blank space is to indicate inverter or charge controller as appropriate).

WARNING

The operations detailed below should only be carried out by suitably qualified personnel, trained to work with electrical equipment, familiar with this present manual and the electrical drawings associated with the control panel (hereinafter referred to as qualified personnel). You are reminded that it is compuslory to comply with applicable legislation in terms of security for electrical work. There is an electrical discharge hazard.

It is essential to read the manual before operating the equipment!

WARNING

The opening of the various compartment enclosures in no way implies that no voltage is present inside. Access is therefore restricted to qualified personnel following the safety conditions set out in this document.

WARNING

The set of conditions detailed below should be considered to be the minimum requirements. It is always preferable to disconnect from the mains and check that no voltage is present. Faults in the installation could produce undesirable voltage returns. There is an electrical discharge hazard.

WARNING

In addition to the safety measures indicated in this manual, it is also necessary to observe the general measures applicable to this field (specific to the installation, country, etc)

WARNING

Compulsory to verify that no voltage is present: Use CAT III - 600 V measuring equipment.

Work always without voltage.
To consider an installation “without voltage”, at least the following five steps have to have been executed:

WARNING

1ª) Disconnect both DC and AC connections

2ª) Prevent any other feed.

3ª) Verify that the installation is “without voltage”.

4ª) Short-circuit AC connection and DC connection and connect it to Earth on the side “without voltage”.

5ª) Guard the installation from electric active elements phisically close, and establish security signals to limit the work zone and protect from any danger present in that zone.

Potential Risks for people

Here we resume the main hazards that an incorrect use of the inverter can cause on people. Inside the manual they are better explained.

DANGER: Electric Shock

The inverter can be charged even after being disconnected from Grid and PV Array for 5 minutes.
Be sure that the 5 steps needed to work without voltage have been correctly made.

DANGER: Explosion

There is a very low risk of explosion in case of a major malfunction.
Enclosure will protect persons and goods from explosions, but only if it is correctly closed.

DANGER: Crush

Follow always the instructions for moving the equipment and placing it. The high weight of this equipment can cause severe damage or death if it is not manipulated correctly.

DANGER: Injures caused by Moving parts

Don’t touch or manipulate fans when inverter is working..

DANGER: High Temperature

Radiators and some parts inside the enclosure reach high temperatures that can be a burn hazard for people.
Respect advisory marks and instructions.

Potential Risks for the Equipment

Here we resume the main hazards that an incorrect use of the inverter can cause on itself. Inside the manual they are better explained.

WARNING: Ventilation
The inverter needs a flow of quality air to work in all the situations of its working conditions

WARNING: Connections
After an authorized manipulation, make sure that the inverter is completely fit to start to work until connecting.

WARNING: Electronics Damage
Avoid touching or electrostatically charging electronics. More sensitive components can be damaged or destroyed.

WARNING: Operating
Don't connect or disconnect any terminal while the inverter is working. Disconnect and check that the equipment is without voltage first.

Service personnel

WARNING
These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than specified in the operating instructions unless you are qualified to do so.

INGETEAM ENERGY S.A. don't asume any responsability derived from not observance of this statement

Personal Safety Equipment (PSE)

The minimal required Safety Equipment will be:

CAUTION

- Safety glasses against mechanical risk damage.
- Safety glasses homologued for electrical risk.
- Safety footwear
- Helmet
- CAT III - 600 V measuring equipment.

Wiring requirements

The correct wiring of the equipment to any PV installation will be done respecting the mandatory minimum section types of wire. We provide the minimum size standarized types of wire. Wider wires can be used whenever the wires would be compatible with the terminals, would have enough space to go through the conduit.

AC Terminals Ingecon Sun 15U 208. Use 194ºF (90ºC) wire, either 8/AWG copper or 6/AWG aluminium:

- Copper wires: Minimun 8/AWG 0.012 in² (8.35 mm²)
- Aluminium wires: Minimun 6/AWG 0.02 in² (13.3 mm²)

The wiring have to comply with the provisions of the National Electrical Code ANSI/NEPA70, Canadian Electrical Code CEC and other Local or State Codes.

AC Terminals Ingecon Sun 15U 480. Use 12/AWG 194ºF (90ºC) wire:

- Copper wires: Minimun 12/AWG 0.012in² (8.35 mm²)
- Aluminium wires: Minimun 12/AWG 0.02in² (13.3 mm²)

The wiring have to comply with the provisions of the National Electrical Code ANSI/NEPA70, Canadian Electrical Code CEC and other Local or State Codes.

DC Terminals Ingecon Sun 15U 208 and Ingecon Sun 15U 480.Use 194ºF (90ºC) wire, either 8/AWG copper or 6/AWG aluminium:

- Copper wires: Minimun 8/AWG 0.012in² (8.35 mm²)
- Aluminium wires: Minimun 6/AWG 0.02in² (13.3 mm²)

The wiring have to comply with the provisions of the National Electrical Code ANSI/NEPA70, Canadian Electrical Code CEC and other Local or State Codes.

DC Terminals Ingecon Sun 15U 208 and Ingecon Sun 15U 480 with multi input. Use 194ºF (90ºC) wire, either 10/AWG copper or 10/AWG aluminium:

- Copper wires: Minimun 11/AWG 0.006in² (4.14 mm²)
- Aluminium wires: Minimun 11/AWG 0.006in² (4.14 mm²)

Multi input connectors admit a maximun current of A.

The wiring have to comply with the provisions of the National Electrical Code ANSI/NEPA70, Canadian Electrical Code CEC and other Local or State Codes.

AC Terminals Ingecon Sun 25U 208. Use 194ºF (90ºC) wire, either 6/AWG copper or 4/AWG aluminium:

- Copper wires: Minimun 6 AWG 0.02in² (13.3 mm²)
- Aluminium wires: Minimun 4/AWG 0.032in² (21.2 mm²)

The wiring have to comply with the provisions of the National Electrical Code ANSI/NEPA70, Canadian Electrical Code CEC and other Local or State Codes.

AC Terminals Ingecon Sun 25U 480. Use 194ºF (90ºC) wire, either 10/AWG copper or 8/AWG aluminium:

- Copper wires: Minimun 10/AWG 0.008in²
- Aluminium wires: Minimun 8/AWG 0.012in²

The wiring have to comply with the provisions of the National Electrical Code ANSI/NEPA70, Canadian Electrical Code CEC and other Local or State Codes.

DC Terminals Ingecon Sun 25U 208 and Ingecon Sun 25U 480.Use 194ºF (90ºC) wire, either 4/AWG copper or 2/AWG aluminium:

- Copper wires: Minimun 4/AWG 0.032in²
- Aluminium wires: Minimun 2/AWG 0.052in²

The wiring have to comply with the provisions of the National Electrical Code ANSI/NEPA70, Canadian Electrical Code CEC and other Local or State Codes.

Tightening torques

AC Terminals Ingecon Sun 15U 208:

- Copper wires 8/AWG: 8.5 pound-in (9 Nm).
- Aluminium wires 6/AWG: 12.4 pound-in (18.6 Nm).

AC Terminals Ingecon Sun 15U 480:

- Copper wires 12/AWG: 8.5 pound-in (9 Nm).
- Aluminium wires 12/AWG: 8.5 pound-in (9 Nm).

DC Terminals Ingecon Sun 15U 208 and Ingecon Sun 15U 480:

- Copper wires 8/AWG: 8.5 pound-in (9 Nm).
- Aluminium wires 6/AWG: 12.4 pound-in (18.6 Nm).

AC Terminals Ingecon Sun 25U 208:

- Copper wires 6 AWG: 12.4 pound-in (18.6 Nm).
- Aluminium wires 4/AWG: 12.4 pound-in (18.6 Nm).

AC Terminals Ingecon Sun 25U 480:

- Copper wires 10/AWG: 8.5 pound-in (9 Nm).
- Aluminium wires 8/AWG: 8.5 pound-in (9 Nm).

DC Terminals Ingecon Sun 25U 208 and Ingecon Sun 25U 480:

- Copper wires 4/AWG: 12.4 pound-in (18.6 Nm).
- Aluminium wires 2/AWG: 16.9 pound-in (31.3 Nm).

Spare parts

During the life of the equipments, they may need some maintenance, that could involve replacing some parts. Here is shown the list of the parts that has to be provided only by Ingeteam Energy S.A.:

Ingecon Sun 15U 208

Reference	units	Description
BF3, BF4	2	DC Fuseholders
F4 (F3)	1	Fuse to connect from one of DC poles to Earth.
Q1, Q2	2	6-10A Contactor
IQ1, IQ2, IQ3	2	Signaller for GV2-P MT Circuit Breaker
Q3	1	0,1-0,16A MT Breaker
QAC	1	TMAX T2 AC 3P 50A 50kA MT Circuit Breaker
QAC.AUX	1	TMAX T2 auxiliary MT Circuit Breaker
QAC.B	1	TMAX T2 terminal accessories
QAC.MANDO	1	Rotary handle TMAX
R1, R2, R3	3	0.1R 90W silicon coverered resistor
R4	1	220 2w 5% RC resistor, RC fans
RVAC	1	40 kA 130V 4P AC voltage surge arrester with signal
RVDC	1	DC 600V 2+1 DC voltage surge arrester monitored
VENT1, VEN2	2	119x119x38mm 230Vac fan
AAS0091	1	Display hardware, keyboard and LED with CAN.
AAS0109	1	Harmonic filter hardware 40uF string
AAS7137	1	Ingecon Sun 15U 208 Electronics Block
AQG0081	1	130/230 75VA auxiliary transformer
C1	1	300Vac 220nF polypropilene capacitor
CCC	1	EMI AC 50A filter
F1 (F2)	1	700V 90A 100kA DC fuse fast acting
KA	1	75A UL contactor device
BF1 (BF2)	1	Fuse holders
QDC	1	DC breaker 4 poles 100A
QDC.PR	1	Coupling stick
QDC. MAN-DO	1	Rotary handle for DC breaker
QDC.E	1	Trim for DC breaker

Ingecon Sun 15U 480

Reference	units	Description
BF3, BF4	2	DC Fuseholders
F4 (F3)	1	Fuse to connect from one of DC poles to Earth.
Q1, Q2	2	6-10A Contactor
IQ1, IQ2, IQ3	2	Signaller for GV2-P MT Circuit Breaker
Q3	1	0,1-0,16A MT Breaker
QAC	1	
QAC.AUX	1	TMAX T2 auxiliary MT Circuit Breaker
QAC.B	1	TMAX T2 terminal accessories
QAC.MANDO	1	Rotary handle TMAX
R1, R2, R3	3	0.1R 90W silicon coverered resistor
R4	1	220 2w 5% RC resistor, RC fans
RVAC	1	
RVDC	1	DC 600V 2+1 DC voltage surge arrester monitored
VENT1, VEN2	2	119x119x38mm 230Vac fan
AAS0091	1	Display hardware, keyboard and LED with CAN.
AAS0165	1	Harmonic filter hardware 40uF string
AAS7136	1	Ingecon Sun 15U 480 Electronics Block
AQG	1	auxiliary transformer
C1	1	300Vac 220nF polypropilene capacitor
CCC	1	
F1 (F2)	1	700V 150A 100kA DC fuse fast acting
BF1 (BF2)	1	Fuse holders
KA	1	
QDC	1	DC breaker 4 poles 200A
QDC.PR	1	Coupling stick
QDC. MAN-DO	1	Rotary handle for DC breaker
QDC.E	1	Trim for DC breaker

Ingecon Sun 25U 208

Reference	units	Description
BF3, BF4	2	DC Fuseholders
F4 (F3)	1	Fuse to connect from one of DC poles to Earth.
Q1, Q2	2	6-10A Contactor
IQ1, IQ2, IQ3	2	Signaller for GV2-P MT Circuit Breaker
Q3	1	0,1-0,16A MT Breaker
QAC	1	TMAX T2 AC 3P 90A 50kA MT Circuit Breaker
QAC.AUX	1	TMAX T2 auxiliary MT Circuit Breaker
QAC.B	1	TMAX T2 terminal accessories
QAC.MANDO	1	Rotary handle TMAX
R1, R2, R3	3	0.1R 90W silicon coverered resistor
R4	1	220 2w 5% RC resistor, RC fans
RVAC	1	40 kA 130V 4P AC voltage surge arrester with signal
RVDC	1	DC 600V 2+1 DC voltage surge arrester monitored
VENT1, VEN2	2	119x119x38mm 230Vac fan
AAS0091	1	Display hardware, keyboard and LED with CAN.
AAS0165	1	Harmonic filter hardware 40uF string
AAS7135	1	Ingecon Sun 25U 480 Electronics Block
AQG0081	1	120/230 75VA auxiliary transformer
C1	1	300Vac 220nF polypropilene capacitor
CCC	1	EMI AC 80A filter
F1 (F2)	1	700V 150A 100kA DC fuse fast acting
KA	1	75A UL contactor device
BF1 (BF2)	1	Fuse holders
QDC	1	DC breaker 4 poles 200A
QDC.PR	1	Coupling stick
QDC. MAN-DO	1	Rotary handle for DC breaker
QDC.E	1	Trim for DC breaker

Ingecon Sun 25U 480

Reference	units	Description
BF3, BF4	2	DC Fuseholders
F4 (F3)	1	Fuse to connect from one of DC poles to Earth.
Q1, Q2	2	6-10A Contactor
IQ1, IQ2, IQ3	2	Signaller for GV2-P MT Circuit Breaker
Q3	1	0,1-0,16A MT Breaker
QAC	1	TMAX T2 AC 3P 40A 50kA MT Circuit Breaker
QAC.AUX	1	TMAX T2 auxiliary MT Circuit Breaker
QAC.B	1	TMAX T2 terminal accessories
QAC.MANDO	1	Rotary handle TMAX
R1, R2, R3	3	0.1R 90W silicon coverered resistor
R4	1	220 2w 5% RC resistor, RC fans
RVAC	1	40 kA 385V 4P AC voltage surge arrester with signal
RVDC	1	DC 600V 2+1 DC voltage surge arrester monitored
VENT1, VEN2	2	119x119x38mm 230Vac fan
AAS0091	1	Display hardware, keyboard and LED with CAN.
AAS0165	1	Harmonic filter hardware 40uF string
AAS7135	1	Ingecon Sun 25U 480 Electronics Block
AQG0080	1	277/230 75VA auxiliary transformer
C1	1	300Vac 220nF polypropilene capacitor
CCC	1	EMI AC 35A filter
F1 (F2)	1	700V 150A 100kA DC fuse fast acting
BF1 (BF2)	1	Fuse holders
KA	1	40A UL contactor device
QDC	1	DC breaker 4 poles 200A
QDC.PR	1	Coupling stick
QDC. MAN-DO	1	Rotary handle for DC breaker
QDC.E	1	Trim for DC breaker

Inverter Marking

The identifying marks of the inverter are:

Phase 1 terminal and wire connection

Phase 2 terminal and wire connection

Phase 3 terminal and wire connection

Neutral terminal and wire connection

DC input.

Grounding.

Related documentation

CATALOGUES

Ingecon® Sun
Commercial Catalogue

PC00ISA01_A

MANUALS

Ingecon® Sun LITE U

Installation & Operator Manual

AAY2000IKI02

Ingecon® Sun SMART U

Installation & Operator Manual

AAS2000IKI05

Ingecon® Sun POWER U
Installation & Operator Manual

AAS2000IKI04

Ingecon® Sun Manager
User's Manual

AAX2005IKL01

Communication
Accessories
Installation Manual

AAX2002IKI01

0 Index

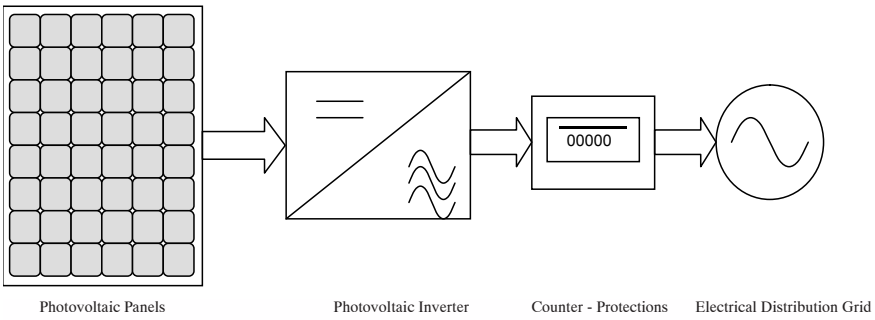
1 Overview

1.1 Introduction

The purpose of this manual is to describe the INGECON® SUN SMART U equipments and to provide adequate information for its correct location, installation, commissioning, maintenance and operation.

1.2 Description of the equipments

An inverter is a circuit used to convert direct current into alternating current. The INGECON® SUN SMART U therefore serves to convert the direct current generated by the PV solar panels into alternating current to be delivered to the electricity grid.



1.2.1 Models

The models included in the INGECON® SUN SMART U range are as follows:

- INGECON® SUN 15 U 208V
- INGECON® SUN 15 U 480V
- INGECON® SUN 25 U 208V
- INGECON® SUN 25 U 480V

1.2.2 Options

The models from the INGECON® SUN 15 U 208V and INGECON® SUN 15 U 480V can include DC multi-input or DC copper plate.

1.3 Technical data

Product feautures

Wide input voltage range (300 – 600 Vdc).
Advanced system for maximum power point tracking (MPPT).
Easy to install, with no need for additional components.
DC, AC and communication quick plug-in.
Built-in electrical protection.
Galvanic AC isolation transformer.
Steel enclosure NEMA 3R.
Manual grid disconnect feature.
Status LEDs, LCD screen and keyboard for data monitoring at the front of the unit.
Protection against reverse polarity, voltage surges, short circuits, insulation defects.
Anti-islanding monitoring system with automatic disconnection.
Internal data logger offering 3 month store capacity.

Options

Inter-inverter communication via an RS-485, fiber optics, wireless or Ethernet card.
Modem for GSM/GPRS remote communications.
Internet data display.
Remote access and fault diagnostics.
Analog input electronics for the measurement of weather variables.
Software Ingecon®Sun Manager for the parameter display, data recording, etc.
Contact relay to act in case of DC earth fault.

1.4 Ratings

DC Input Ratings

Ingecon®Sun	15U 208	15U 480	25U 208	25U 480
Range of input operating voltage	300 - 600 V dc			
Maximun input voltage	600 V dc			
Maximum input current	52.6 A	52.6 A	87.7 A	87.7 A
Maximum input short circuit current	100 A	100 A	200 A	200 A
Maximum input source backfeed current to input source	30 A	70 A	50 A	100 A
Maximum current to input source (A)	0			

Ac Output

Ingecon®Sun		15U 208	15U 480	25U 208	25U 480
Output power factor rating		>0.99			
Operating voltage range (ac) (L-L)1		183 - 229 V ac	422.5 - 528 V ac	183 - 229 V ac	422.5 - 528 V ac
Operating frequency range		59.3 - 60.5 Hz			
Number of phases		3F + N			
Nominal output voltage (ac)		208 V	480 V	208 V	480 V
Normal output frequency		60 Hz			
Maximum continuous output current ac per line		41.6	18	69.4A	30.1 A
Power		15 kVA (15 kW)	15 kVA (15 kW)	25 kVA (25 kW)	25 kVA (25 kW)
Maximum output fault current (ac) and duration		159A @ 9.6ms	74A @ 9ms	206A @ 11.2ms	266A @ 8.8ms
Maximum output overcurrent protection		70 A	30 A	100 A	50 A
Utility interconnection voltage and frequency trip limits and trip time accuracy.					
Trip limit and trip time accuracy	Voltage:	+/-1%			
	Frequency:	+/-0.1 Hz			
	Time	0.060 secs			
Normal operation temperature range		-15 - +55°C			
Maximum full power operating ambient		+55°C		+45°C	
Enclosure Rating Type		3R			

Notes:

1. 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 Vnor	Rated	0.16
B	0.50 Vnor ≤ V < 0.88 Vnor (Adjustable Set Points)	Rated	0.16 to 2.667 (Adjustable Set Points)
C	1.10 Vnor < V < 1.11 Vnor (Adjustable Set Points)	Rated	0.16 to 2 (Adjustable Set Points)
D	1.20 Vnor ≤ V	Rated	0.16
E	Rated	f > 60.5	0.16
F	Rated	f < (59.8 – 57.0) (Adjustable Set Points)	0.16 to 300
G	Rated	f < 57	0.16

2. Utility interactive evaluations were conducted with the following firmware:

15 kW.
DSP Firmware versions (208V): AAS1038 Check sums: 0x1DF3
MICRO Firmware versions (208V): NA Check sums: NA

DSP Firmware versions (480V): AAS1037 Check sums: 0xB734
MICRO Firmware versions (480V): NA Check sums: NA

25 kW.
DSP Firmware versions (208V): AAS1036 Check sums: 0x59OA
MICRO Firmware versions (208V): NA Check sums: NA

DSP Firmware versions (480V): AAS1035 Check sums: 0x2981
MICRO Firmware versions (480V): NA Check sums: NA

3. Surge Testing for Combination Wave (1.2/50us) was done at 6 kV/3 kA, 2 ohms effective impedance, and Ringwave (0.5us-100kHz) was done at 6 kV/0.5 kA, 12 ohms effective impedance. Tests were performed using both polarities, for common mode and differential mode coupling, 20 pulses each test. After surge testing the unit was operational with control functionally verified by frequency and voltage disconnect tests.

1.5 Compliance with Standards

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
UL Std No. 1741 - First Edition - Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources (Including Revisions through and including November 7, 2005)

2 Description of the system

2.1 Location

The INGECON®-SUN SMART U units need to be located at a site offering specific characteristics.
This section provides guidelines for selecting and correctly adapting the equipment to a suitable site

2.1.1 Site

Locate the units in a place which is easily accessible for installation and maintenance work, with sufficient room to operate the keyboard and to read the front LED indicators.

It is forbidden to leave objects on the equipment.

Caution:

Air outlets and part of the nearby cabinet can reach temperatures of 85 ºC. Do not leave high temperature sensitive material in the vicinity.

Avoid corrosive environments.

2.1.2 NEMA rating

The Ingecon® Sun Three-phase inverters has NEMA Type 3R Degree of Protection.

The inverter protection rating against external agents allows it to be installed outdoors.

Dust free air must be provided in the enviroment of the equipment. Air quality will be asured.

2.1.3 Ambient temperature

The INGECON®-SUN SMART U, are designed to operate between –4ºF (-20ºC) and +131ºF (+55ºC).
Maximum full power operating ambient temperature is +113ºF (+45ºC).

2.1.4 Atmospheric conditions

The surrounding air should be clean and the relative humidity should not exceed 50%, at more than +104ºF (+40ºC). Higher percentages of relative humidity, up to 95%, are tolerable at temperatures below +86ºF (+30ºC).

Account should be taken of the fact that, occasionally, moderate condensation may occur as a result of temperature variations. For this reason, in addition to the inverter's own protection system, the equipment should also be monitored when operating at sites which may not come within the atmospheric conditions described above.

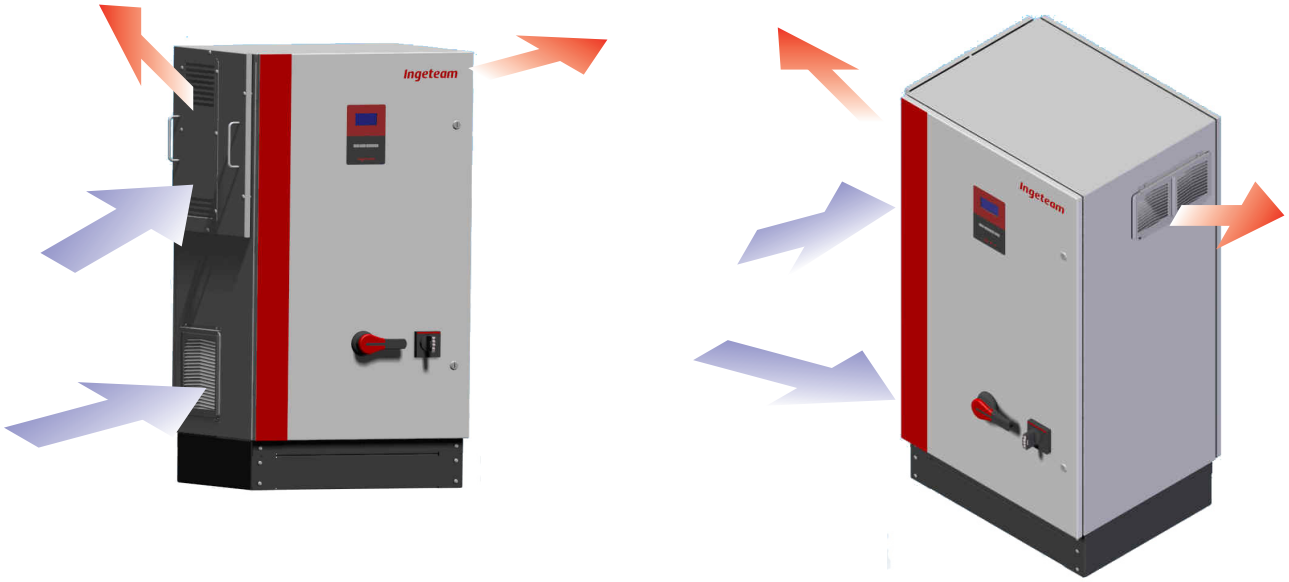
When condensation is present, never power up the equipment.

2.1.5 Ventilation

There must be a 8 in (20.3 cm) clearance at the sides and front of the equipment, to promote the free circulation of air through the grids.

Facilitate the circulation of incoming air through the vents and through the lower pit, if present, and also the outgoing air through the upper vents.

It is forbidden to leave objects on the equipment.



The fans move an air flow of 674m^3/h that has to be available in the environment of the equipment to make sure a correct cooling.

2.1.6 Contamination rating

The equipment has been designed for a grade 3 contamination rating. Appropriate measures should be taken to ensure that the inverter air supply is dust free and of sufficient quality.

2.1.7 Noise contamination

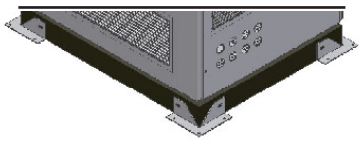
When operating, the inverters give off a slight buzzing sound.

Do not locate the inverters in an occupied room, or on lightweight supports which could amplify this noise. The mounting surface must be firm and adequate for the weight of the equipment.

2.1.8 Anchorage

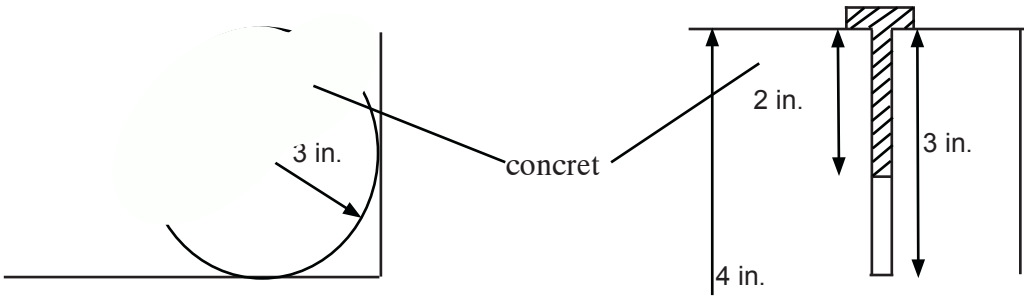
INGECON®-SUN SMART U can be equipped with an optional docking system.

The system consists of 4 plates bolted to the four corners of the inverter's base to secure the inverter to the concrete pad.



The system requires following next screwing prescriptions:

- Minimun distance between the center of thedrill on the concrete slab to its borders of 3 in (76 mm).
- Diameter of the drill on the concrete slab to its borders of 0.31 in (8 mm).
- Minimun depth of thedrill on the concrete slab of 3 in (76 mm).
- Minimun thickness of the concrete slab of 4 in (102 mm).
- Torque of 14.75 lb-ft (20 Nm).
- Minimun depth of the screw of 2 in (51 mm).



2.2 Ground Requirements

The Ingecon® Sun equipments have to be integrated in a permanently grounded electrical system conforming the provisions of the National Electrical Code ANSI / NFPA 70 and any other statal or local code requirements.

2.3 System Neutral Requirements

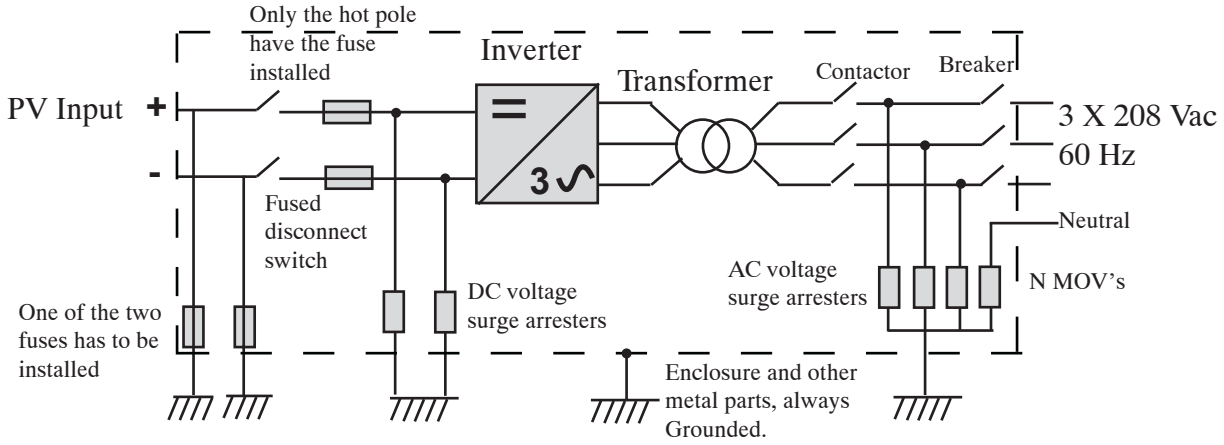
The INGECON® SUN 15 U 208V and INGECON® SUN 15 U 480V are designed to be installed to four-wire systems (3 phases+neutral) with 208 V line-to-line.

The INGECON® SUN 25 U 208V and INGECON® SUN 25 U 480V are designed to be installed to four-wire systems (3 phases+neutral) with 480 V line-to-line.

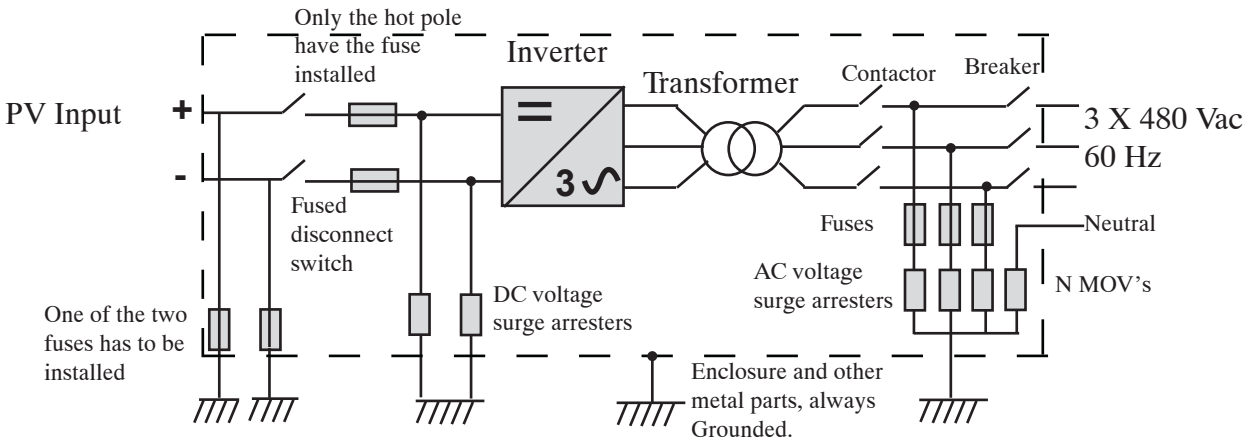
It's mandatory to connect the neutral wire.

2.4 Electrical Diagrams

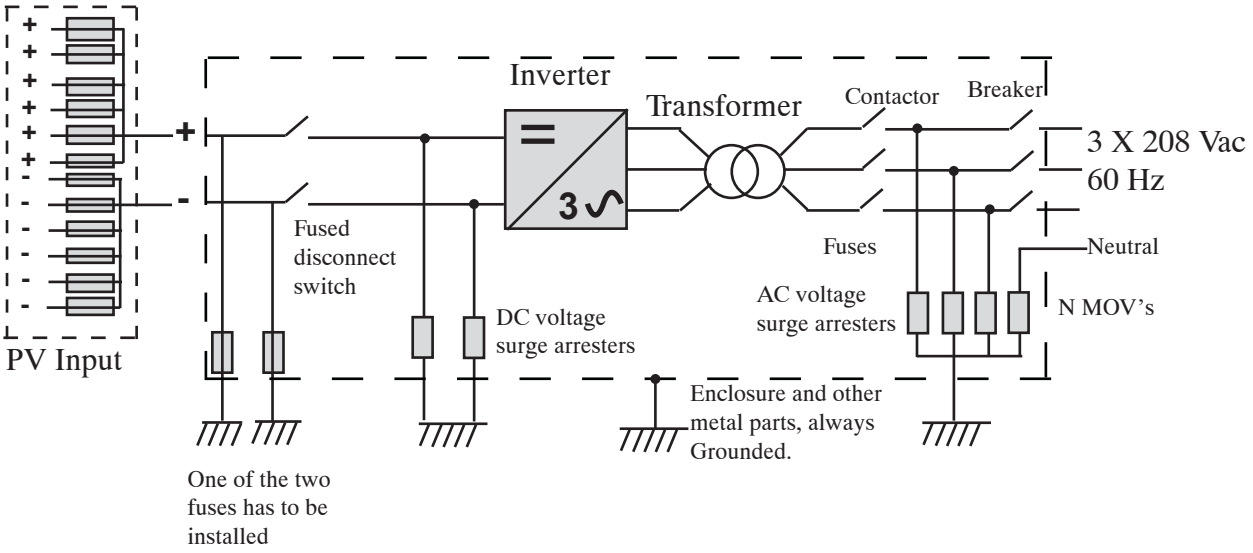
INGECON® SUN 15 U 208V



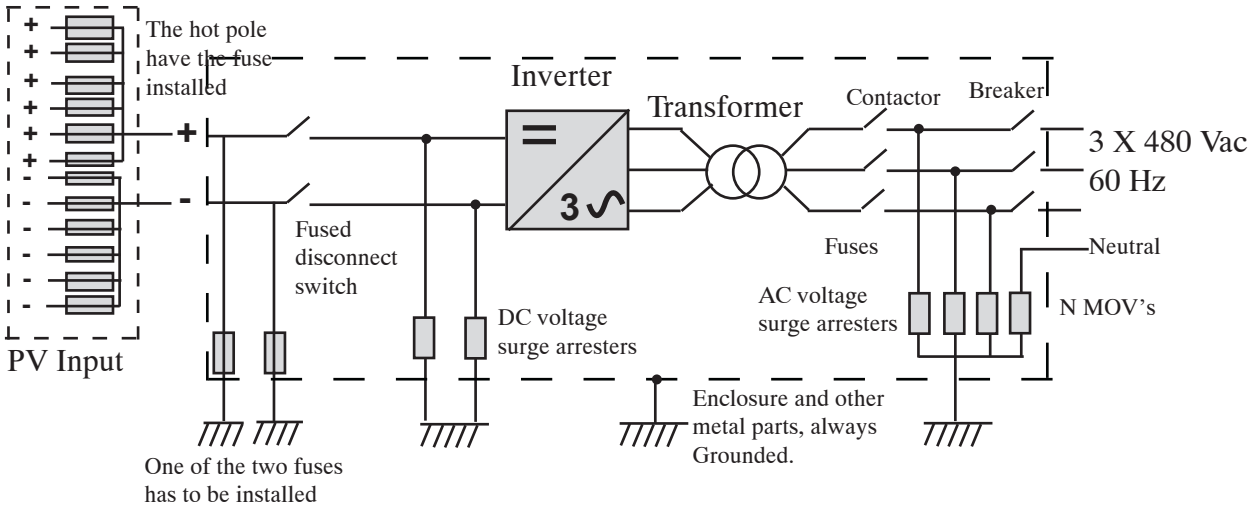
INGECON® SUN 15 U 480V



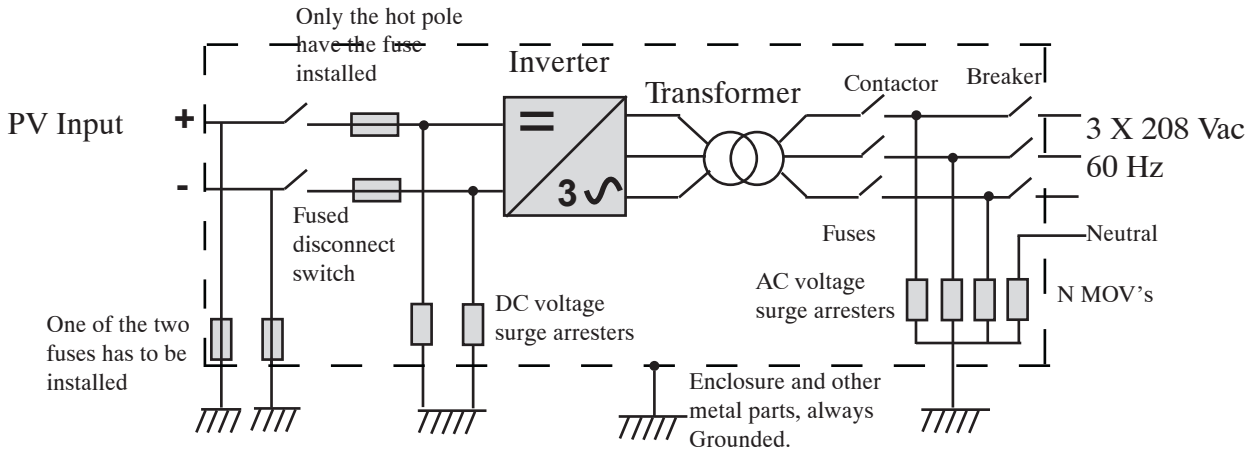
INGECON® SUN 15 U 208V with multi-inputs (optional)

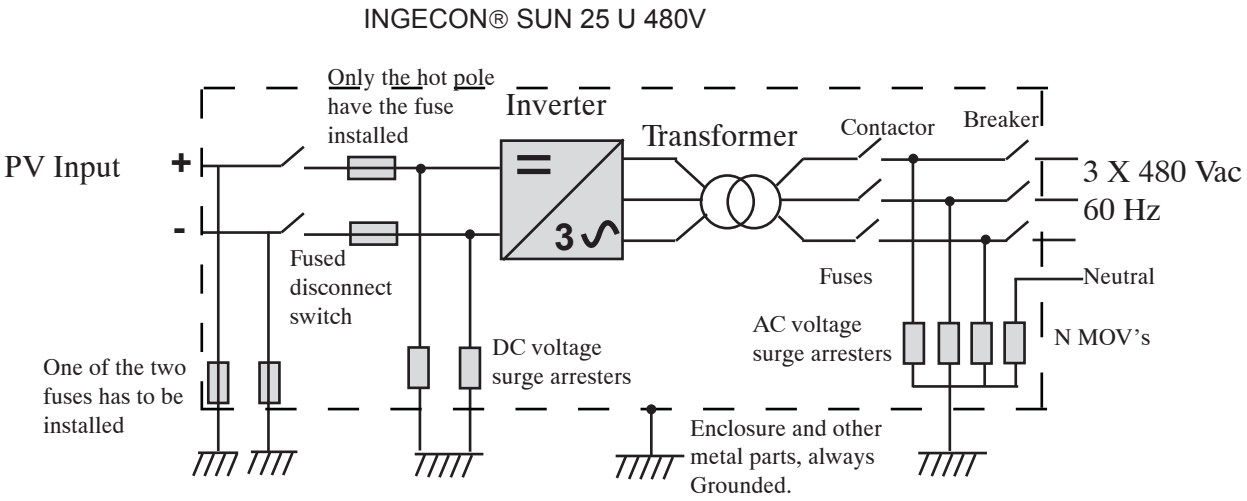


INGECON® SUN 15 U 480V with multi-inputs (optional)



INGECON® SUN 25 U 208V



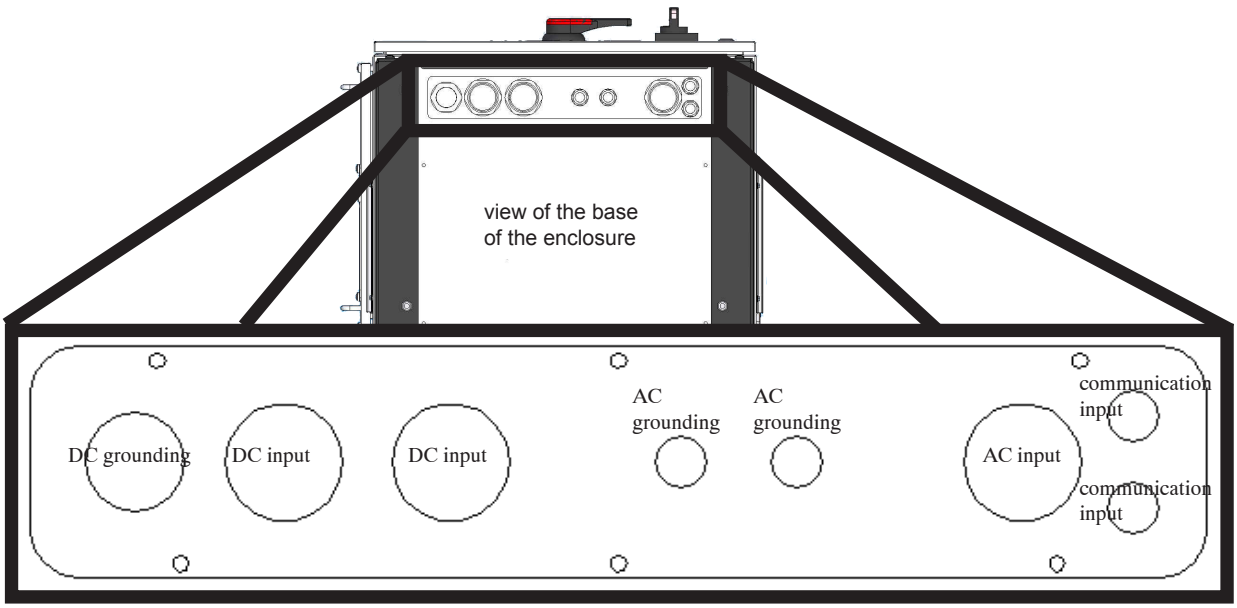


2.5 Conduit Entry

The INGECON® SUN SMART U wires musst go through the enclusure by conduits. On the base of the enclosure there are several knockouts designed to be opened and lodge a conduit.

Don't open any knockout that won't be used. It could affect to NEMA degree.

Knockouts have been designed to be used in wiring as picture shows. For a different use first ask INGETEAM.



In following tables are shown the conduits needed for each hole. The holes are the same for all INGECON® SUN SMART U

	Conduit	Hole
DC grounding hole	$1^1/_4$	1.69 in (43 mm)
DC input holes	$1^1/_2$	2 in (51 mm)
AC grounding holes	$^1/_2$	0.86 in (22 mm)
AC output hole	$1^1/_2$	2 in (51 mm)
communication wiring holes	$^1/_2$	0.86 in (22 mm)

	Number of wires	Section	Required size	Number of wires admitted
DC		AWG 1	41($1^1/_2$)	3
DC Multi	1	AWG 10	53(2)	29
DC Multi grounding	1	AWG 10	35($1^1/_4$)	13
AC 208 V	1	AWG 3	41($1^1/_2$)	5
Grounding AC 208	1	AWG 4	16($1^1/_2$)	1
Grounding DC	1	AWG 4	16($1^1/_2$)	1

3 Operating, Storage and Transport Conditions

3.1 Safety notice

Failure to comply with the instructions provided in this section could cause damage to the equipment.
Ingeteam Energy S.A. assumes no liability whatsoever for any damage derived from non-compliance with these instructions.

3.2 Equipment reception

WARNING: Equipment is heavy.

Packed equipment weights approximately 255 kgrs or 325 kgrs. 15 kW or 25 kW models. Read carefully this instructions until moving the pack.

On reception, please check the terms indicated in the Delivery Note, sign the box: FIRMA RECEPTOR MERCANCIA, to indicate that you have received the merchandise, and return the signed copy to the sender's address.

CAUTION.

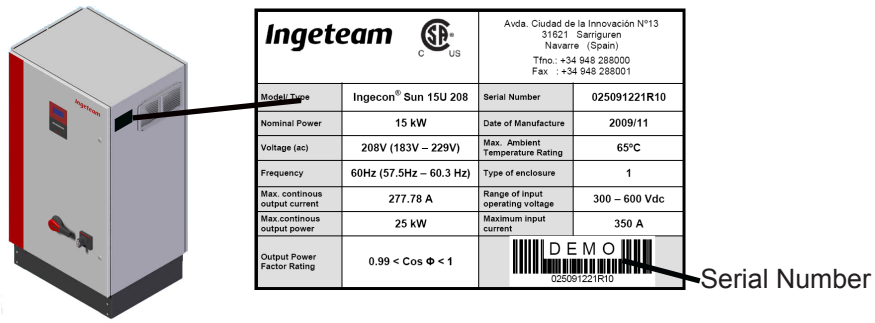
Do not storage in environments up to 55ºC or less than -20ºC of temperature. Avoid humidity.

Palets with following characteristics will be received:

MODEL	PALET TYPE	WEIGHT (pounds)	HEIGHT/WIDTH/LENGTH (in)
15U 208	Wooden: Bubble wrap	771	55 / 35 / 25
15U 480		771	55 / 35 / 25
25U 208		771	55 / 35 / 25
25U 480		771	55 / 35 / 25

Identifying the equipment

The serial number clearly identifies the inverter. All communications with Ingeteam Energy S.A. should indicate this number:



Damage during transport

Should the equipment sustain damage during transport:

1) Do not install it

2) Notify your distributor immediately of this situation, within 5 days as of the reception date.

Should it be necessary to return the equipment to the manufacturer, the original packaging should be used.

3.3 Handling and unpacking

It is exceedingly important to correctly handle the equipment at all times in order to ensure that:

- The packaging remains intact and the equipment is maintained in optimum condition right from shipment until unpacking.
- The equipment is not knocked and / or dropped, which could affect the mechanical characteristics, such as poor door closure, loss of IP rating etc.
- Every effort is made to prevent vibrations which could lead to subsequent malfunctioning.

Should any anomaly be observed, please contact INGETEAM immediately.

Disposal of the packaging

All the packaging can be given to an authorised non hazardous waste manager.

If available, each part of the packaging should be disposed of as follows:

Plastic (polystyrene, bag and bubble wrap): Plastics and containers municipal container.

Cardboard: Paper and cardboard municipal container.

3.4 Equipment transport

Correct transport and storage are the first steps required for correct equipment use and operation. Considering the indications given in section 3.3 and as a preventive measure INGETEAM would recommend working with hauliers specialising in the transport of special and / or fragile equipment.

During transport and storage the equipment should be protected from mechanical impacts, vibrations, water projections (rain) and any other product or situation which could damage or alter its performance.

Failure to comply with these instructions could void the product warranty, for which INGETEAM is not liable.

When moving this equipment, bear in mind that the equipment centre of gravity is at 1/3 the height of its plan view projection.

Transport by truck

To transport the INGECON®-SUN SMART U on a truck, it is essential to maintain the equipment upright and correctly anchored, considering its weight and dimensions, in order to avoid it tipping over or being damaged by impact.

Moving the equipment with a fork lift truck

At least the following points should be observed:

1) Ensure that the packaged equipment is centred over the forks.

2) Try to ensure that the equipment is placed as close as possible to the connection between the fork and the carriage.

3) Ensure that the forks are perfectly level, to prevent the equipment from being tipped off..

4) In any event, observe the instructions provided in the fork lift truck manual.

3.5 Storage

If the equipment is not to be installed immediately after reception, then the following points should be taken into account in order to avoid deterioration:

- The package should be stored upright.
- Keep the equipment free from dirt (dust, shavings, grease …) and out of the reach of rodents.
- Avoid contact with water jets, welding sparks, etc.
- Cover the equipment with a breathable, protective material in order to avoid condensation caused by ambient humidity.
- The equipment stored at the manufacturing plant and that stored on the customer's premises must be maintained with the ambient conditions indicated in section 3.2.5.
- It is extremely important to protect the equipment from contact with chemicals, which could cause corrosion, and also from saline atmospheres.

3.6 Conservation

In order to conserve the equipment correctly, the original packaging should not be removed until just before the equipment is due to be installed.
In the event of prolonged storage, we would recommend storage in a dry place, avoiding abrupt temperature changes, as far as possible.

Should the packaging be damaged /cuts, holes, etc) the equipment will not be maintained in optimum condition before installation.

INGETEAM ENERGY S.A. assumes no liability if this condition is not complied with.

3.7 Waste disposal

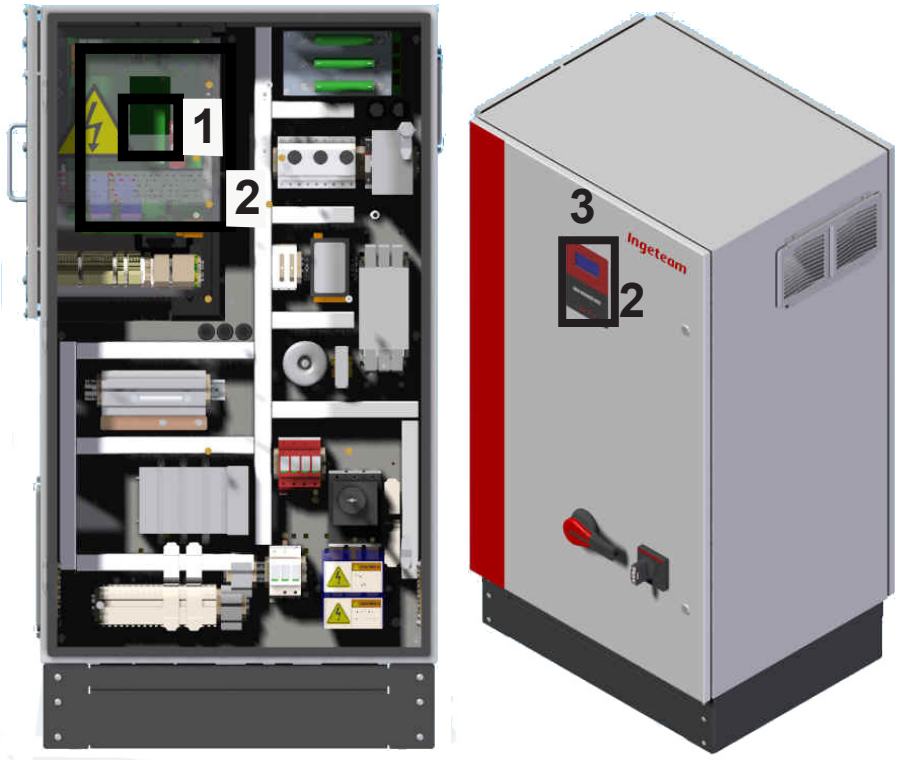
During the installation, start-up and maintenance procedures, the waste generated must be adequately treated in compliance with the country-specific regulations. At the end of the equipment useful life, the waste must be given to an authorised manager.

In this section, Ingeteam Energy S.A., in its commitment to an environmentally friendly policy, provides Authorised Managers with information on the location of the components to be decontaminated.

Those equipment components which must be specifically treated are:

1. Batteries or accumulators
2. Printed circuit boards
3. Liquid crystal displays.

The following photos show the location of these components.



4 Safety instructions

4.1 Contents

This section contains the safety instructions to be followed when installing, operating and accessing the equipment.

Failure to comply with these “Safety Instructions•may result in physical injury or even death, or cause damage to the equipment.

Before operating the equipment, please read these “safety instructions” carefully.

4.2 Symbols

Safety warnings provide information on conditions that could cause serious bodily injury or death and / or damage to the equipment. Together with the warning sign, instructions are given as to how to avoid such hazards.

These symbols are listed below with an explanation of their meaning.

Danger. High voltage. Stay away!
A warning that the high voltage present in the equipment could cause physical injury or even death and / or damage to the equipment.

General warning!: regarding conditions that could result in physical injury and / or damage to the equipment.

Caution hot surface!: warning about the presence of hot parts that could cause serious burns.

All work-specific safety warnings and notes are included in each corresponding chapter and are also repeated and completed at the critical points in that chapter.

Please read this information carefully. It has been written with your personal safety in mind, whilst ensuring the maximum service life for the equipment itself and for any devices connected to it.

4.3 General safety conditions

The installation, commissioning, inspection and maintenance operations may only be performed by suitably qualified personnel, trained to work with electrical equipment (hereinafter qualified personnel). You are reminded that it is mandatory to comply with all safety regulations and standards applicable to electrical work.

The opening of the various compartment enclosures in no way implies that no voltage is present inside. Access is therefore restricted to qualified personnel, observing the safety conditions established in this document.

The set of conditions detailed below should be considered to be the minimum requirements. It is always advisable to disconnect from the mains. The installation could be faulty, causing undesirable voltage returns. There is an electrical discharge hazard.

In addition to the safety measures indicated in this manual, any general measures that may be applicable should also be taken into account (installation-specific, country-specific, etc).

According to the basic safety standards and regulations, the electrical installation must not entail fire or explosion hazards. Workers must be properly protected against the risk of accidents caused by direct or indirect contact. The electrical installation and the protective devices must take account of the voltage, all external conditioning factors and the competence of those people having access to the installation parts.

According to the basic safety standards and regulations, all work equipment must be adequate for protecting exposed workers against the risk of direct or indirect contact with electricity. At any event, the electrical parts of the equipment must comply with the provisions of the corresponding specific standards and regulations.

According to the basic safety standards and regulations, for voltage work, all workers performing work in the open air shall stop work in the event of storms, heavy rainfall, strong winds, snow or any other unfavourable environmental condition that hinders visibility or the handling of tools. Work on indoor installations directly connected to overhead electricity lines must be interrupted in the event of a storm.

INGETEAM assumes no liability whatsoever for damages caused by the improper use of the equipment. Any work on any of this equipment and involving a change in the original electrical layout, must fist be proposed to INGETEAM. This proposed new layout must then be studied and authorised by INGETEAM.

The necessary safety measures must be in place to prevent unauthorised persons from handling the equipment and to keep them away from the vicinity of the equipment. Warning signs to indicate the presence of personnel at work:

Lockout mechanisms or mechanical locking, by padlocks with keys, for circuit breakers of an appropriate type.

These instructions must be easily accessible, close to the equipment and within easy reach of all users.

Before installing and commissioning the equipment, please read these safety instructions and warnings carefully and all the warning signs placed on the equipment. Ensure that all warning signs are perfectly legible and that any damaged or missing signs are replaced.

4.4 General observations

This section defines the preventive measures to be adopted when performing all types of work on the equipment, in order to work safely and control unavoidable hazards.

Protection against direct contact is provided by the enclosure with a protection rating of NEMA 3R.

The equipment has been tested to the applicable standards and regulations to ensure that it complies with the safety requirements, the insulation distance values and the leakage lines for the voltages used.

The tools and / or equipment used for the equipment manipulation tasks must have double reinforced insulation (class II).

4.4.1 Hazards present and general preventive measures

- **Impact against stationary objects:**
  - Inform the workers of the hazard.
  - Adequate lighting.
  - Work carefully.
  - Maintain sufficient distance to avoid contact with the hazard (control rod on circuit breaker door).

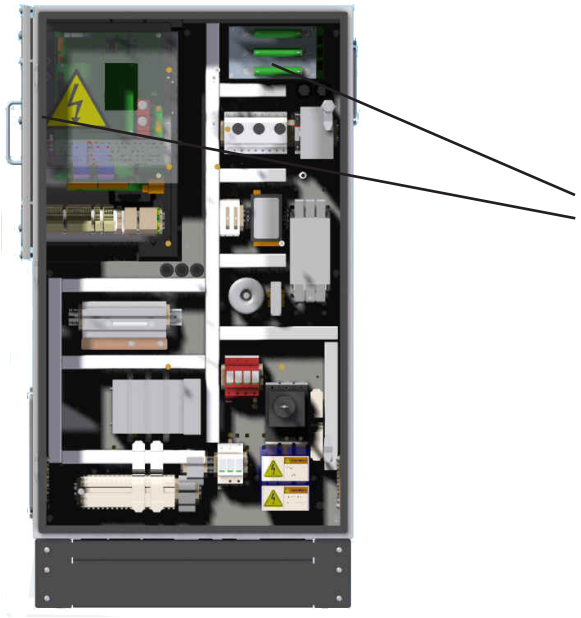
- **Blows, jabs and cuts with objects and / or tools:**
  - Keep the cover closed when not working in the cubicle.
  - Adequate lighting.
  - Good housekeeping.
  - Mandatory use of a helmet, safety footwear and gloves when required.

- **Particle projection (fan):**
  - It is advisable to use anti-impact glasses when accessing the fan area.

- **Electrical hazard:**
  - Comply with the provisions in the PPE section and in the General Safety Conditions section.
  - Inform the workers of the hazard.
  - Comply with the provisions of applicable Federal, Statal and Local laws and rules.

4.4.2 Hazards and additional measures in manipulation work

- **Thermal contact:**
  - Inform the workers of the hazard.
  - It is advisable to wear gloves.
  - Disconnect the power supply and wait 10 minutes to allow the hot parts in the equipment interior to cool down (R1, RAD1).



4.5 Type of tasks to be performed

Preventive maintenance tasks performed on the electric panels can involve Inspection, Operational or Manipulation tasks, depending on each particular case.

It is strictly forbidden to access the enclosure through a cubicle other than the one described in this manual. Before opening any of the enclosure covers (side, rear, top) the exterior power supply to the panel must first be cut off.

4.5.1 Inspection tasks

Deficinición: Implican la apertura de la envolvente para tareas de inspección visual.

4.5.2 Operational tasks

Definition: Tasks involving loading software, checking and regulating the heating / ventilation systems. Voltage checks at safe measurement points.

Equipment preventive maintenance tasks not including the electric panels, performed from the man - machine interface.

For operational work referring to checking and changing the automatic breaker settings, it is strictly forbidden to manipulate or access any of the breaker parts (terminals, cables, protective devices) during this operation other than the specific control for checking and / or changing the breaker setting.

4.5.3 Manipulation tasks

Definition: Tasks involving the assembly and / or replacement of parts and components, in addition to the adjustment of the settings on the electric panel.

BEFORE MANIPULATION WORK, A CHECK SHOULD ALWAYS BE MADE TO ENSURE THAT NO VOLTAGE IS PRESENT

IT IS MANDATORY TO COMPLY WITH THE FOLLOWING 5 GOLDEN RULES

1. Disconnect

Open all possible voltage sources. Take into account the fact that capacitors or other devices powered from uninterrupted power sources (UPS - SAI) will still hold voltage after disconnection.

2. Prevent any possible reconnection of the power

The switching devices used to disconnect the installation should be blocked to guard against any possible reconnection.

3. Check that no voltage is present

Check all the live parts of the electrical installation or as close as possible to the work area in order to ensure that no voltage is present.

4. Ground and short circuit the equipment

In low voltage installations, where there is a risk that the parts might accidentally become live due to induction or for any other reason. And always in high voltage installations..

5. Demarcate and place warning signs in the work area.

4.5.4 Personal Protection Equipment (PPE)

Inspection:

It is mandatory to wear helmet compliant with security standards. It is also mandatory to wear safety gloves, of the mechanical type, for voltage free work.

Operational task:

It is mandatory to wear a helmet compliant with with security standards. It is also mandatory to wear safety gloves, of the mechanical type, for voltage free work.

It is also mandatory to wear dielectric gloves that are compliant with with security standards. and a safety face mask that provides protection against short electric arcs and is compliant with with security standards, in tasks involving adjusting the heating / ventilation systems, when connecting and disconnecting the voltage and when performing checks at safe measurement points.

Manipulation:

It is mandatory to wear a helmet compliant with with security standards..

It is also mandatory to wear dielectric gloves that are compliant with with security standards. and a safety face mask that provides protection against short electric arcs and is compliant with with security standards., when connecting and disconnecting the voltage and when accessing cubicles with live parts.

5 Installation

Before installing the INGECON® SUN SMART U , the packaging should be removed, taking particular care not to damage the housing.

The packaging interior should be checked for dampness. Should there be any signs of moisture, then the equipment should not be used until it has been shown to be completely dry.

All installation operations must observe the rules and regulations in force.

General rules:

The Ingecon® Sun inverter should only be installed by qualified personnel, observing the general safety conditions set out in this manual. The inverter operates with high voltages and currents that can be hazardous.

Should any water condensation or high humidity inside the equipment be detected, it is essential that the equipment be dried before any electrical connection is made.

5.1 General installation requirements

Ventilation and work space must be adequate for maintenance tasks, in compliance with the rules and regulations in force.

The exterior connection devices must be adequate and sufficiently close, as established in the rules and regulations in force.

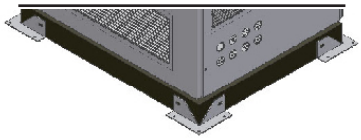
The lead-in cable section must be adequate for the maximum current.

Particular care shall be taken to ensure that there are no obstacles blocking the equipment air inlets and outlets and preventing adequate ventilation.

5.2 Anchoring the equipment to the floor

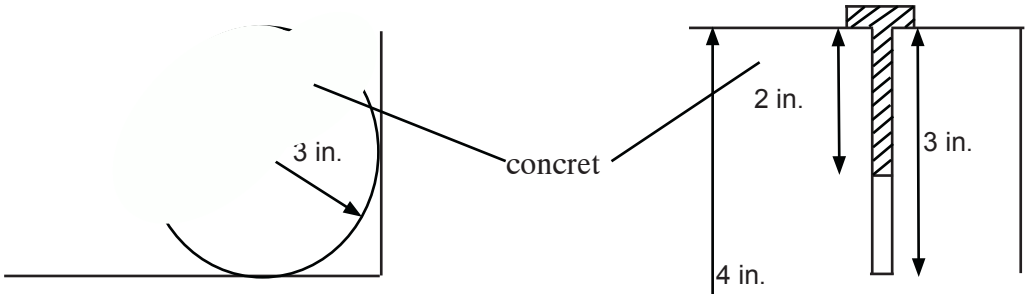
INGECON®-SUN SMART U can be equipped with an optional docking system.

The system consists of 4 plates bolted to the four corners of the inverter's base to secure the inverter to the concrete pad.



The system requires following next screwing prescriptions:

- Minimun distance between the center of thedrill on the concrete slab to its borders of 3 in (76 mm).
- Diameter of the drill on the concrete slab to its borders of 0.31 in (8 mm).
- Minimun depth of thedrill on the concrete slab of 3 in (76 mm).
- Minimun thickness of the concrete slab of 4 in (102 mm).
- Torque of 14.75 lb-ft (20 Nm).
- Minimun depth of the screw of 2 in (51 mm).



5.3 Opening the equipment

Before opening the front door, make absolutely certain that there are no live voltages inside the cabinet.

For this, the equipment needs to be disconnected from the PV array and from the power grid.

LIkewise, it is essential to close the equipment before connecting it to the PV array or power grid.

For Inspection, Operation or Manipulation tasks:

Make an electrical check to ensure that no part of the equipment is in electrical contact with either the grid or any of the PV panels.

The use of safety gloves and glasses homologued for electrical risk is compulsory to ensure lack of voltage.

After disconnecting the equipment from the PV array and power grid, wait at least 5 minutes before opening the door. Due to its internal capacitance, the inverter may maintain hazardous voltage levels.

Whilst the panels are receiving light, the DC cables may be under hazardouse voltage levels.

5.4 Order of connection

Once the equipment has been mounted in its definitive location, the electrical connections can be made to the auxiliary equipment, the Power Grid and the PV array.

The Ingecon® Sun inverter electrical connection must be made by qualified personnel, observing the general safety conditions set out in this manual. The inverter operates under hazardous voltages and currents.

The basic inverter connections should be made in the following order:

5.5 - 5.7 Communication accessories (optional).

5.8 Grounding connection.

5.9 Power Gridconnection.

5.10 PV array connection.

5.5 GSM / GPRS - Modem communication connection

At the installer's request, optionally, the inverters may incorporate hardware to enable a GMS / GPRS communication link to be established with the inverter.

Consult the communication accessory installation manual **«AAX2002IKI01** Communication Accessories Installation Manual**».**

5.6 RS-485 line- Communication connection

At the installer's request, optionally, the inverters may incorporate hardware to enable communication through an RS-485 serial line.

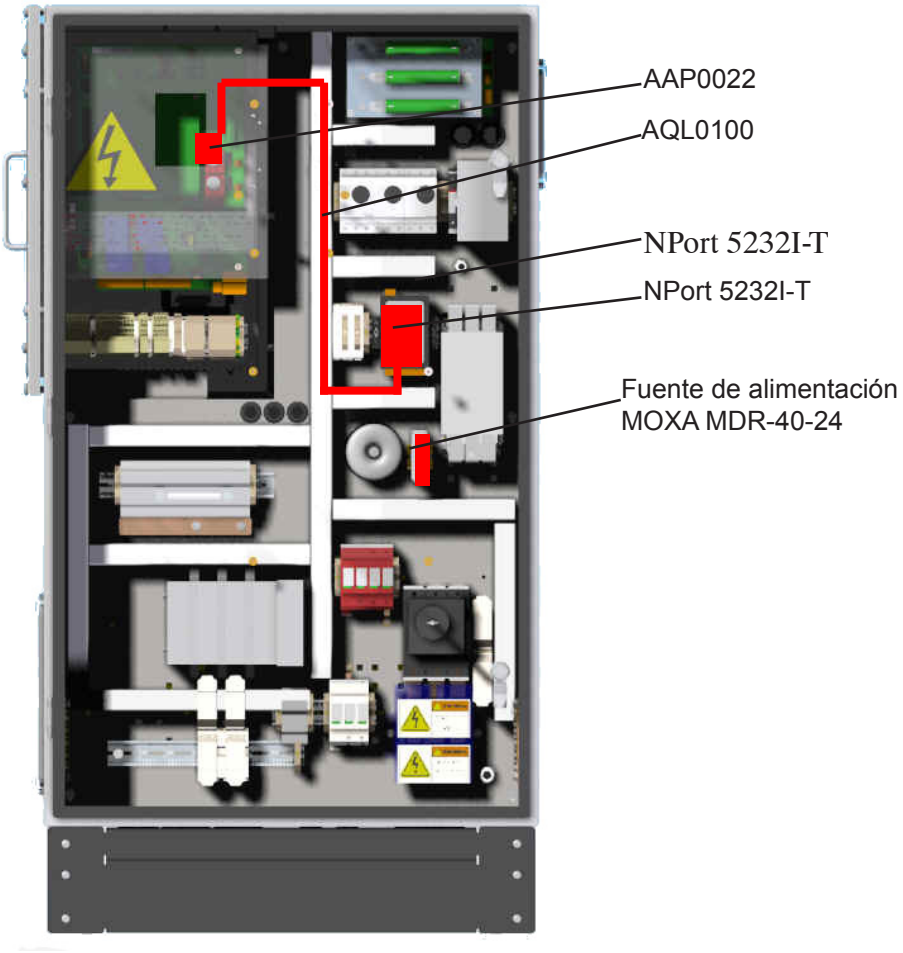
In all these units, the auxiliary signals are directly connected to card «AAP0022 Com RS-485»

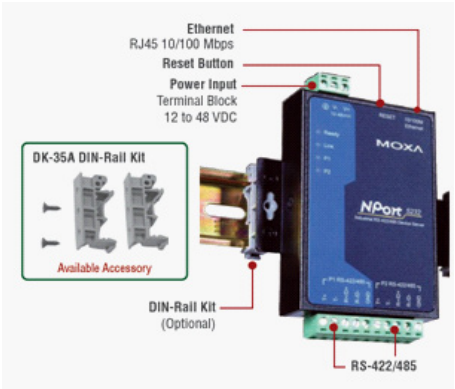
Consult the communication accessory installation manual **«AAX2002IKI01** Communication Accessories Installation Manual**».**

5.7 Ethernet- Communication connection

At the installer's request, optionally, the inverters may incorporate hardware to enable communication through Ethernet.

Following picture shows the place where each accessorie may be installed and where Ethernet wire may be connected:





Ethernet communications installation require following steps:

1 Install the components shown in upper picture.

2 NPort will be settled in DIN rail using the provided DIN rail kit.

3 Connect the components.

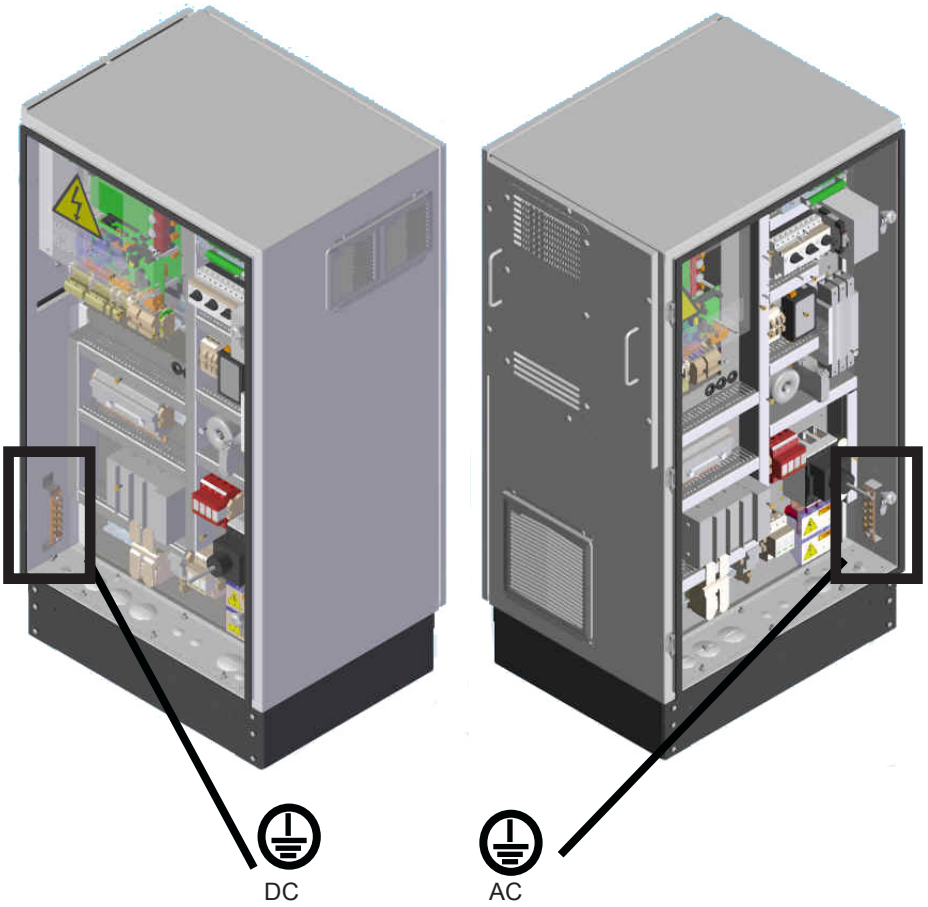
4 Connect AAP0022 communication board with NPort through AQL0100 wire.

Consult the communication accessory installation manual **«AAX2002IKI01 Communication accessories Installation Manual.»**

5.8 Grounding

The metal parts of the inverter (equipment ground) are electrically connected to the earth bar located on the front of the unit.

To guarantee personal safety, this point must be connected to the installation AC and DC Ground.



WARNING

One of the two fuse - holders connected to Ground from positive and negative poles must be connected with a proper fuse, manteining the other opened.

5.9 Connection to the Power Grid

The ports for the Power grid connection cables are located on the cabinet base.

If the distance between the inverter and the Grid connection point requires the use of a greater cable section, then the use of an external distribution box, located close to the inverter, is compulsory in order to change from one section to another.

The cable section shall always be based on the equipment power rating. See IMPORTANT SAFETY INSTRUCTIONS

The inverter protections at the grid connection support a short-circuit current of up to 50 kAmp.

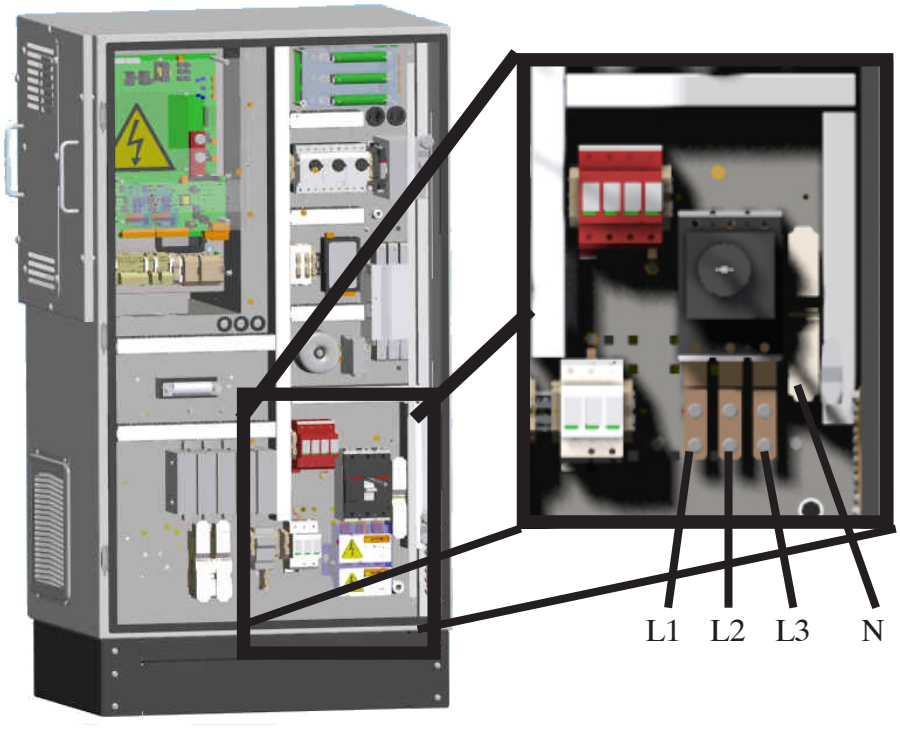
Prior to any manipulation, check that there is no electrical hazard at the power input from the grid.

The use of safety gloves and glasses homologued for electrical risk is compulsory to ensure lack of voltage.

These models are equipped with three plates with two M8 holes to connect three phases, and a terminal bi-metal connector to connect the neutral with a M6 hole.

Note: aximum permitted section for neutral terminals is AWG 2.

To access these terminals, the protective polycarbonate strip needs to be removed.



5.10 Connection to the PV array

The cables connecting the equipment to the PV array access the unit through the PG cable glands located on the cabinet sides or base.

Prior to any manipulation, always check to ensure there is no electrical hazard at the PV array voltage input.

Never forget that any incident light on the panels generates voltage at the panel terminals.

Therefore the inverter interior may hold voltages of up to 600 volts even when not connected to the Grid.

The use of safety gloves and glasses homologued for electrical risk is compulsory to ensure lack of voltage.

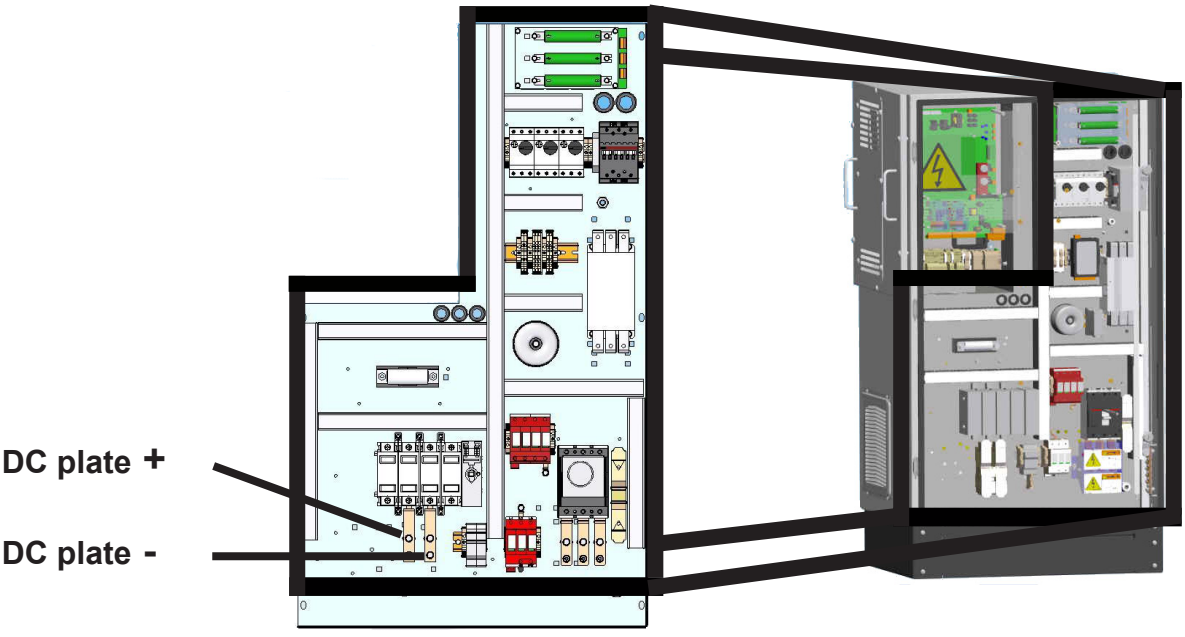
Caution:

Connect the positive pole of the string of panels to the terminals marked ⊕, and the negative pole to the terminals marked ⊖.

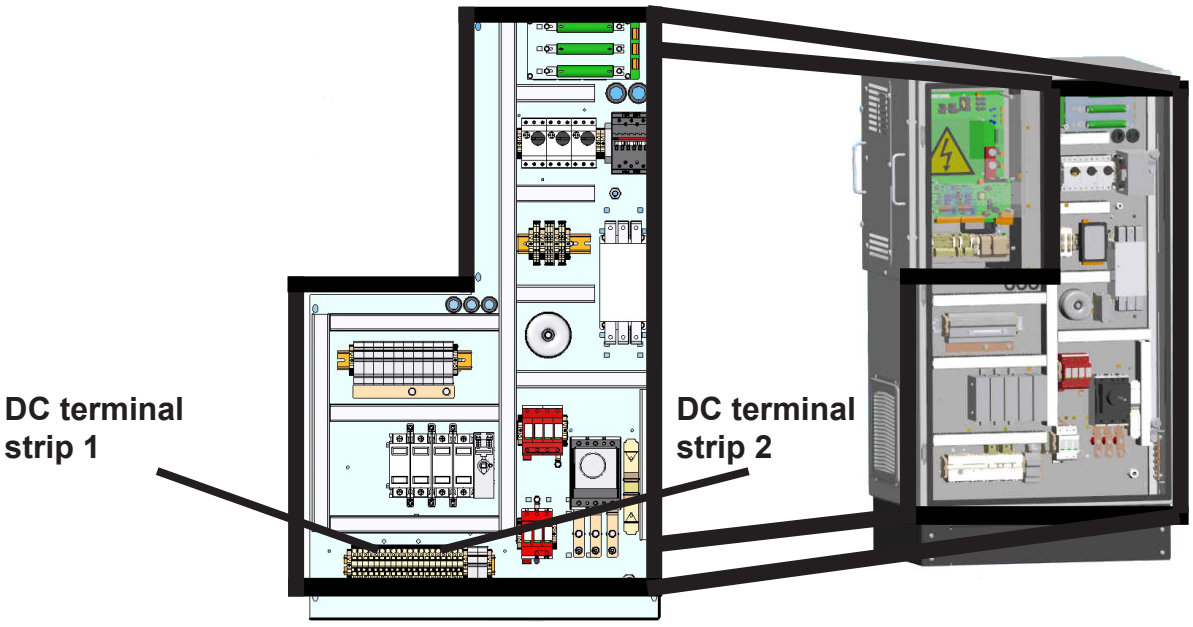
If the distance between the inverter and the PV array connection point requires the use of a greater cable section, then the use of an external distribution box, located close to the inverter, is compulsory in order to change from one section to another.

In following pictures the plates or terminals of each model are shown:

INGECON® SUN 15 U 208V and INGECON® SUN 15 U 480V.
This units are equiped with two terminal, one for each pole, for wires with a maximum section AWG 2.

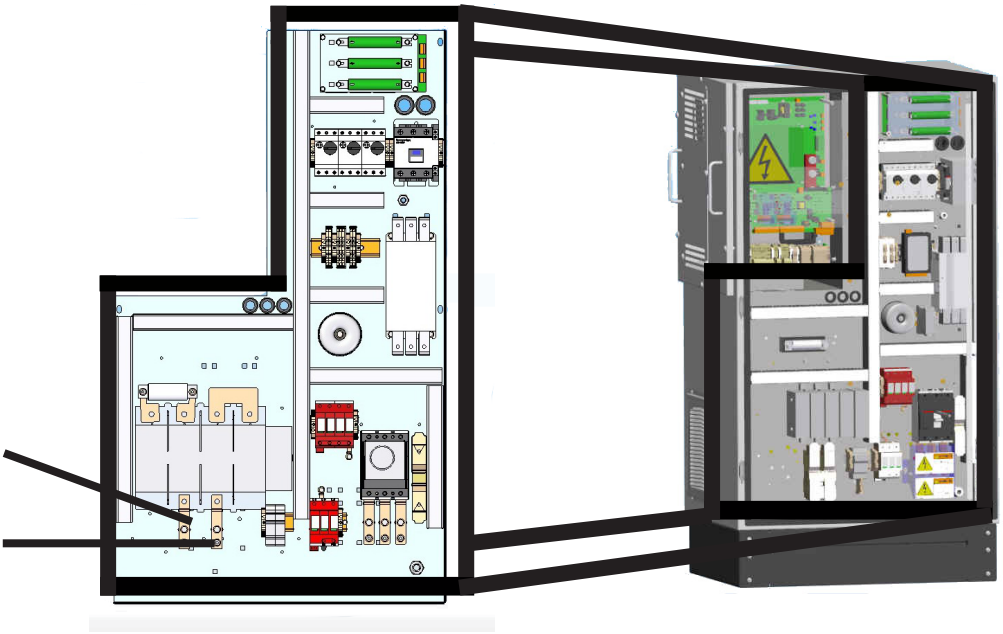


INGECON® SUN 15 U 208V and INGECON® SUN 15 U 480V with multi input.
This units are equiped with a terminal strip of 10 connectors for each pole for wires with a maximum section AWG 6. Wires have to be equiped with insulated terminals.



This option has to be required when equipments are ordered. Pole that installer intend to ground has to be indicated. Positive pole and negative pole will connect to DC terminal strip 1 or DC terminal strip 2 depending on the pole that has been grounded:
- When positive pole is grounded, positive pole is connected in DC terminal strip 2, and negative pole to DC terminal strip 1.
- When negative pole is grounded, positive pole is connected in DC terminal strip 1, and negative pole to DC terminal strip 2.

INGECON® SUN 25 U 208V and INGECON® SUN 25 U 480V.
These units are equipped with two copper plates with two M8 holes for wires with a maximum section AWG 2.



To access these terminals, the protective polycarbonate strip needs to be removed in INGECON® SUN 25 U 208V and INGECON® SUN 25 U 480V models. INGECON® SUN 15 U 208V and INGECON® SUN 15 U 480V don't include this protective polycarbonate strip.

After work on the terminals has been completed, it is compulsory to replace the protective polycarbonate strip.

6 Commissioning

6.1 Equipment inspection

The INGECON® SUN SMART U are equipped with thermal magnetic breakers to protect different parts of the installation. These breakers need to be closed prior to starting-up the installation.

Prior to operating the thermal magnetic breakers, check that there is no electrical hazard at any point of the equipment interior.

When checking that no voltage is present, it is mandatory to use idelectric gloves and safety glasses certified for electrical hazards.

6.1.1 Inspection

Before starting up the inverters, a general inspection should be made of the equipment, consisting primarily in:

• Cabling inspection:

- Check for loose cables

- Check that the protective switchgear, such as thermal magnetic breakers, switches, surge arrestors and fuses in general are all in good condition and are in the correct position.

It is strictly forbidden to remove the methacrylate type protections to make the visual inspection.

• DC Module:

Check that the DC surge suppressors are correctly inserted in their base and that their «status window» is not red.

• Electronics block Module:

Check that the protective thermal magnetic breaker controls are in the correct position.

Also check that, in each module, the DC capture fuses are correctly placed on the green board located under the electronics block to the right.

• AC Module:

The following checks should be made on the AC output module:

- Auxiliary thermal magnetic switch to ON

- Fuses correctly inserted in the base.

- Surge suppressors correctly inserted in the base. Check that the status window is not red.

6.1.2 Equipment seal

During installation, it is important to ensure that the unit IP rating is maintained.

At all connections through the tapered grommets, ensure that there is sufficient cable length inside the equipment so that there is no pull on the terminals and internal connection points.

Check to ensure that any unused tapered grommets are hermetically sealed.

Safety measures

In order to open the cabinet front door, the AC thermal magnetic breaker (if included in the version) and the DC breaker must be in the OFF position. Likewise, in order to close the door, they must also be in this position.

Do not change the position of the AC thermal magnetic breaker or the DC breaker with the door open. Do not operate the breaker door controls or force the position of the internal electrical devices they control.

6.2 Power-up

Once a general visual inspection has been made, and the cabling has been checked, switch the equipment on, but without starting it up, following the guidelines set out in the instruction manual for the model in question.
It is mandatory to perform the tasks indicated in this point with the equipment door always closed, to prevent any possible contact with live parts without IP2X protection.

6.2.1 Start-up

Check that the inverter lights up and that no error indicating LED on the display remains on, except for the manual stop LED. Then check that the variables in the monitoring menu are coherent; in particular the Vac and Vdc voltages.
The Vdc value indicates the PV array voltage all the time.
Within this screen it is possible to check whether the PV array is balanced. To do so, on the Vdc display screen, click on OK and confirm that the PVP and PVN values displayed (indicating the voltage for each PV array pole to earth) are similar.

Finally, in the monitoring menu, check that there are no inverter alarms displayed: Alarm 1000H.

Once the tasks described above have been performed, you can start-up the inverter. Non compliance with the above mentioned checking and inspection tasks shall exempt INGETEAM ENERGY S.A. from any type of liability with regard to possible damage to the installation or to the inverter itself and resulting from the said non-compliance.

6.2.2 Checking and measurement

Once the equipment has connected to the grid, the green LED will remain on. Check the display to ensure that no error-indicating LED is on.
Check that the monitoring menu parameters are coherent:

- The PV array voltage must be between 300 and 600 Vdc and must continue to be balanced (similar PVP and PVN values).
- The Vac voltage indicated on the display must be within the operating ranges.
- The grid frequency must be 50 or 60 Hz.
- The RMS value of the Iac1, Iac2 and Iac3 currents shown must be similar.
- There must be no alarm displayed on the inverter (Alarm 0000H).

It is always advisable to use a current clamp to check the wave form of the current generated in the three phases. To make this measurement, it is mandatory to use the PPE indicated in IMPORTANT SAFETY INSTRUCTIONS.

7 Preventive maintenance

The recommended preventive maintenance tasks shall be performed on an ANNUAL basis, except for the inspection of fans and filters which should be conducted each MONTH.

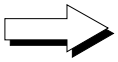
Maintenance operations must be performed by qualified personnel. There is an electrical discharge hazard.

To access the various compartments, the safety recommendations set out in Chapter 1 must be taken into account.

All the maintenance checks included herein should be performed with NO VOLTAGE PRESENT IN THE INVERTER and in safe manipulating conditions.

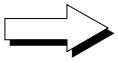
The following sections indicate the actions to follow for the correct maintenance of the INGECON® SUN SMART U inverters.

7.1 Maintenance tasks



Check the condition of the enclosure.

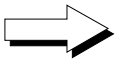
A visual inspection should be made of the enclosure condition, checking the condition of the seals, doors and handles and also that the equipment is firmly secured to its anchors at the base and at the top, if applicable. Likewise, the enclosure should be checked to ensure that it is free from knocks, scratches or rust which could degrade the cabinet or cause it to lose its Protection Rating. Should any defects of this nature be observed, then the parts affected should be replaced immediately.



Check the condition of the cables and terminals.

- Check that the cables are guided correctly in order to ensure that they cannot come into contact with live parts.

- Check the insulation for damage and hot points, inspecting the colour of the insulation and terminals.



Torque of the nuts and bolts securing the bus bars and power cables.

Check the torque by applying the forces indicated in the following table:

M8	24 Nm
M10	47 Nm
M12	64 Nm

In compliance with DIN 13.

Make a visual inspection to ensure that the bars connecting the AC lead-in maintain their safety distances and also their electrical properties.

Check that there is no moisture in the cabinet interior.

If moisture is detected, it is essential to dry it up before making the electrical connections.

Check that the cabinet components are correctly secured to their corresponding anchors.

Check that the equipment is correctly ventilated. To do so:

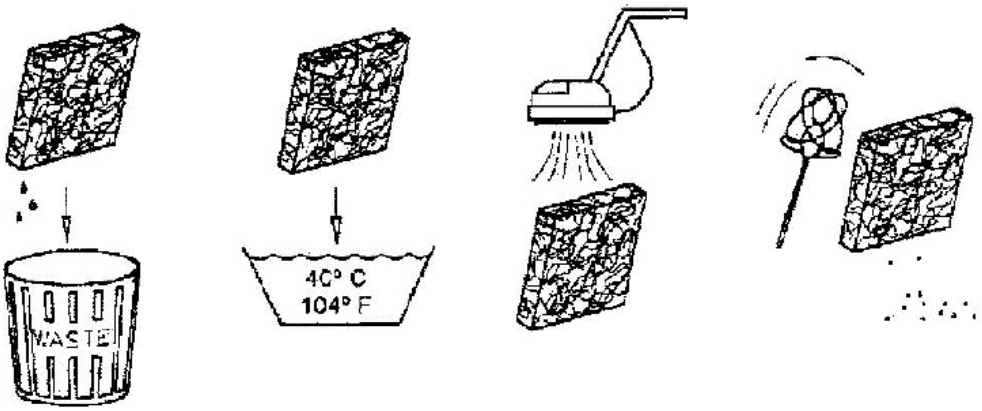
Check the condition of the air outlet fans and clean and replace if necessary.
Clean the ventilation grids.
Check the condition of the front ventilation grid filters.
To do so, dismount the air intake grid, the filter is inside it.
- Unscrew the four screws securing the grid and which are accessed from the inside face of the door.

- Dismount the grid.

- Remove the filter from inside the grid

The accumulation of dust and dirt in the filter can affect the cooling capacity of the fan and cause the equipment to overheat. To resolve this problem, clean the filter and grid and remount:

- When the filter is moderately dirty and dry, tap gently until the dirt has been removed
- If it is not possible to remove the dirt, then wash in water at 104 ºF (40ºC).
- The filter should be replaced with a new one when it is very dirty and full of oil and / or grease.



If the error persists, contact Ingeteam EnergyS.A.

During operation, the inverters make a buzzing noise.

Check the characteristics of the surroundings to ensure that this buzzing noise is not amplified or transmitted.

Position the equipment in a place which is easily accessible for installation and maintenance work, with sufficient room to use the keyboard, read the display and use the various access points to the equipment interior.

8 Troubleshooting

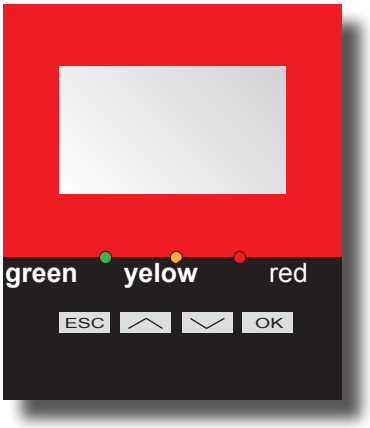
This is a guide to help resolve any problems that may arise during the installation of the INGECON® SUN SMART U.

An explanation is also given as to how to perform simple component replacement operations and adjustments of the equipment settings.

Any problems occurring in the Ingecon® Sun must be resolved by qualified personnel, observing the general safety conditions set out in this manual.

8.1 LED indicators

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



8.1.1 Green LED

This LED must be on when the start-up process and operation are normal, whilst the other LEDS must remain off. There are three ON modes:

8.1.1.1 Slow flashing

To indicate on-hold status due to low irradiance. The flashing is every 3 seconds. When this alarm comes on, it means that the PV array has not sufficient irradiance to provide the inverter with the minimum voltage to delivery energy. This is the typical situation between sunset and sunrise or when rain, clouds or other atmospheric phenomena darken the PV array zone.
Should this situation arise on a day which is not particularly dark, then check that the panels are clean and correctly connected.

8.1.1.2 Fast flashing

This flashing indicates that the PV array is providing sufficient voltage to the inverter in order to deliver energy and that it is getting ready to start-up. In this status, the inverter checks the grid parameters in order to delivery current to the grid at the exact grid voltage and frequency. This process lasts around one minute (configurable).

8.1.1.3 Light constantly on

The inverter is connected to the grid.

8.1.2 Orange LED

This LED indicates that alarms have been triggered in the inverter.

8.1.2.1 Fast flashing

This flashing indicates that an alarm has been triggered in the inverter, however the malfunction is not serious enough to cause shutdown. The most frequent alarm of this type is for protection against high temperatures: The inverter is in self-limiting mode, because it has reached the maximum acceptable temperature.
In this situation, check that the fans are operating, that the air inlets and outlets are free from obstacles and that there are no heat sources close to the inverter. If the error persists, contact Ingeteam Energy S.A.

8.1.3 Red LED

This LED indicates that alarms have been triggered in the inverter.

8.1.3.1 Constantly on

The inverter shuts down. This flashing indicates that an alarm has been triggered in the inverter, requiring it to shut down. The most frequent alarms which force the inverter to shut down are as follows:

1000H, Manual shutdown. The equipment has been manually stopped. Check that the emergency stop button has not been accidentally pressed and try and activate from the display, by removing the manual shut down order.

0001H, Grid Frequency out of limit..

0002H, Grid Voltage out of limit.
This is usually caused by a grid outage. Once the situation is back to normal, the inverter will start operating again. If not, check the Grid connection lines. If the grid quality parameters are adequate, then inspect the grid connection lines.
If the error persists, contact Ingeteam Energy S.A.

0400H, Insulation failure in the DC circuit.

An insulation failure can be life threatening.

An insulation failure must only be repaired by qualified personnel.

0020H, Alarm due to the overheating of the power electronics.
The equipment temperature is too high and it has stopped delivering current to the grid. Once it has cooled down it will reconnect to the grid.

8.1.4 Three LED flashing simultaneously

This LED code indicates a failure in the inverter. This failure can de caused by:
- Electronics failure
- Contactor failure. Check that neutral is correctly connected.

If the error persists, contact Ingeteam Energy S.A.

8.2 List of alarms and stop reasons

The following table shows the shutdown reasons that could be related to each alarm.

	ALARM	STOP REASONS	DESCRIPTION
0x0000		None	No alarm, the unit should connect providing that it has sufcient power.
0x0001	Frequency Alarm	FREC	Grid frequency out of range.
0x0002	Voltage Alarm	VAC	Grid voltage out of range.
0x0004	Sat PI Alarm	CURR.PI.SAT	Internal current loop failure
0x0008	Reset DSP Alarm	WD.RESET	Indicates that the Inverter has been re-set by Watch Dog, inverter firmware failure.
0x0010	RMSCurrent Alarm	PEAK.CURR	The RMS value for the current is above the permitted maxmum.
0x0020	Elect Temp Alarm	TEMPERATURE	The power electronics temperature is over 80ºC.
		AUX.TEMP	The auxiliary temperature sensor has detected an alarm.
0x0040	ADC Reading Alarm	ADC READING	Above normal reading in the ADC at an unexpected input. Loss of synchronisation.
		ADC LAT	Digital to Analogue Converter internal error
		HW DESCX	Error in the master - slave system or fibre optics
0x0080	Current Alarm	RMS CURRENT	Instantaeous current value out of range
0x0100	AC Protect Alarm	VARISTORS	Error in the AC varistors
		CONTACTOR	The contacator status is not correct, compared to the inverter status.
		AC.PROT	Error in one of the AC protections, surge suppressors, fuses …
		AC.MAG.PROT	Error in the three phase input thermal magnetic breaker
0x0200	DC Protect Alarm	DC.PROT	DC input fuses blown or DC surge suppressors
0x0400	Ground Fault Alarm	INS.FAILURE	Insulation failure at the PV array or inverter interior
		VARISTORS	Error in DC varistors
0x0800	Current Fault Alarm	FAULT(1) FAULT(2) FAULT(3)	Fault in power electronics branch 1 Fault in power electronics branch 2 Fault in power electronics branch 3
0x1000	Manual Stop Alarm	MANUAL STOP	Manual shutdown due to emergency button, display or comunication
0x2000	Configuration Alarm	CONFIG	Shutdown due to Firmware modification
		FIRMWARE.CH	Shutdown due to Firmware loading
0x4000	High Vdc Alarm	VIN	High voltage at DC input
0x8000	Low Vdc Alarm	MIN VPV	Stoppage due to low input voltage.
		HW DESCX	Internal stoppage reason, hardware failure
		LOW POWER	Shutdown due to low power delivery (habitual stoppage at dusk)
	Fatal Error Alarm	FATAL ERROR	Due to five consecutive errors in the branches or to consecutive contactor stoppage reasons

8.3 Inverter alarms caused by protections

0100H, AC circuit protections.

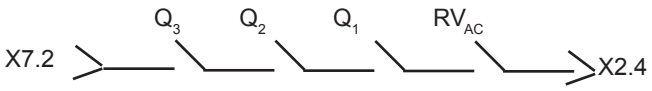
It appears when an AC protection has shotdown.

Monitorised elements are:

Q_1, Q_2, Q_3,RV_{AC}

Which are the AC Filters and AC Measures Protections and AC Surge Arresters Protections and contactor.

In normal operation, every switch has to be closed except of contactor circuit. If there is and alarm, signal circuit has to be checked to verify where the circuit is opened. There may be several causes, as broken circuit cables, shotdown protection, fused Surge Arrester, connector.

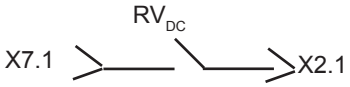


0200H, DC circuit protection.

It appears when an DC protection has shotdown.

Monitorised elements are:

RV_{DC}



In normal operation, every switch has to be closed.

If there is and alarm, signal circuit has to be checked to verify where the circuit is opened.

There may be several causes, as broken circuit cables, shotdown protection, fused Surge Arrester, conector .

4000H, Overvoltage at panels input.

It informs about a voltage out of range in PV input.

A voltage over 600 Vdc damages the inverter.

8000H, Very low voltage at panels input.

It informs about a voltage out of range in PV input.

The inverter will wait till the voltage reaches the necessary value to connect.

9 Operating the display

The Ingecon® Sun inverters are equipped with a “Screen and Keypad” set for man - machine communication.

This interface allows the key internal parameters to be displayed and makes it possible to adjust the entire system during installation.

The parameters, variables and commands are organised into menus and sub-menus.

9.1 Keypad and LEDs

The keypad comprises the following four keys:

ESC **Esc.** To exit the parameter exit mode without making changes, to exit a menu and return to a higher level, to not confirm or not accept a change or proposal.

Up. To scroll up a list of parameters or folders with the same level, or to increase the value of an editable parameter by one basic unit.

Down. To scroll down a list of parameters or folders with the same level, or to decrease the value of an editable parameter by one basic unit.

OK **OK.** To validate a parameter change, to access a lower level menu, to confirm a change or to accept a proposal.

There are three LEDs on the faceplate as follows:

Green LED.

Slow flashing: On-hold status due to low irradiance.

Fast flashing: Start-up process.

On: inverter connected to the grid.

Orange LED.

Fast flashing: Alarm triggered, which does not stop the inverter from operating.

Red LED.

ON: Alarm triggered which shuts down the inverter.

Special combinations:

Rapid flashing of all three LEDs: Fatal error status.

9.2 Display

The display comprises:

A top line showing the current date and time. The internal clock automatically changes from summer to winter time.

Under the top line, to the left, there is the node nº for the data displayed.

The centre displays the instantaneous values for the PV array voltage, power delivered by the inverter and output voltages..

The bottom line shows the functions corresponding to each of the keys.

When the inverter has been stopped manually, the word “Stop” (shut down) appears instead of the value for the power delivered.

The functions of the keys for the initial screen, when in normal status are:


Manual Stop

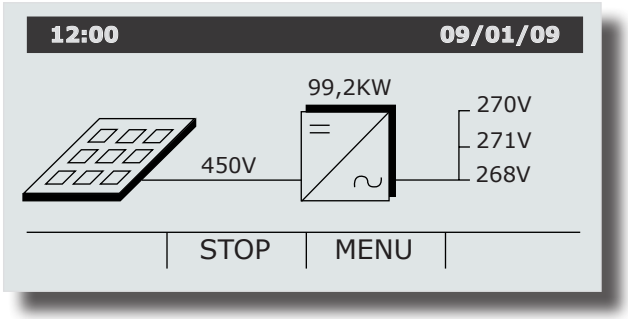

Access to the principal menu.

Change node

When an alarm is triggered for the inverter, ALRM will flash in the bottom empty box and the ESC key will also be enabled.

Press to display all the currently present.

For example:



To exit this screen, re-click on ESC.

9.3 Main menu

The main menu is structured into the following sub-menus:

MONITORING:

The menu displays the values of the principal parameters and internal variables, providing information on the equipment operating status.

STOP REASONS:

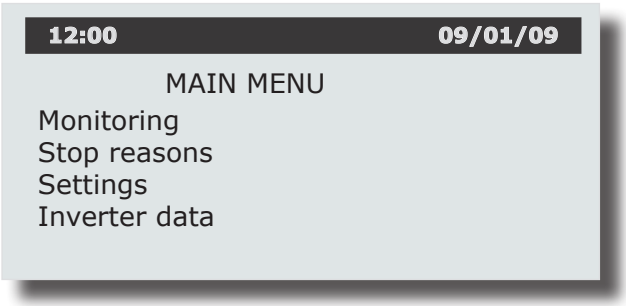
This option shows the five latest reasons for which the inverter has shut down.

SETTINGS:

This menu displays all the settings affecting the inverter.

INVERTER DATA:

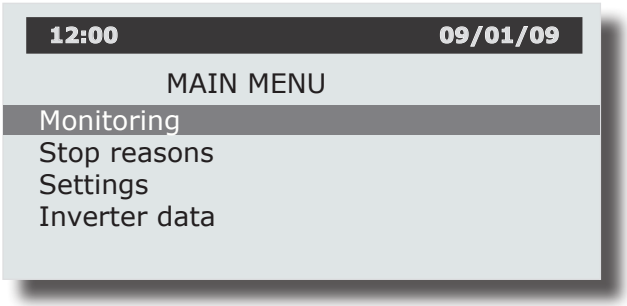
This option displays the inverter data.



9.4 Monitoring

Select the Monitoring menu and press the OK key to access it.

The organisation of the screens and the meaning of the variables in this menu are indicated below:



Screen 1.

Pac: Power the inverter is delivering to the Power Grid in kW.

Pdc: Power provided by the solar panels in kW.

Etot: Total energy in kWh delivered by the inverter to the Grid since it left the factory. The recording of the serial number on the unit marks the start of this power record.

E.Par: Total energy in kWh delivered by the inverter to the Grid since last time generated power record was set to zero.

Screen 2.

Vdc: Voltage provided by the solar panels to the inverter in Volts.

Vac1: Inverter output voltage for Power Grid phase 1 in volts.

Vac2: Inverter output voltage for Power Grid phase 2 in volts.

Vac3: Inverter output voltage for Power Grid phase 3 in volts.

Screen 3.

Idc: Current provided by the solar panels in Amps.

Iac1: Output current for Grid phase 1 in Amps.

Iac2: Output current for Grid phase 2 in Amps.

Iac3: Output current for Grid phase 3 in Amps.

Screen 4.

Frec1: Output frequency in phase 1.

Frec2: Output frequency in phase 2.

Frec3: Output frequency in phase 3.

Cos.Phi: Cosine of phi. This is the cosine of the phase angle existing between the grid voltage and the current delivered by the inverter

Screen 5.

Rpv: Impedance between PV array and Ground.

Rpv+: Impedance between + pole of PV array and Ground.

Rpv-: Impedance between - pole of PV array and Ground.

Screen 6.

Alarms: Current inverter alarm status.

0000H, Everything is operating correctly.
0001H, Grid frequency is out of range
0002H, Grid voltage is out of range
0004H, Current PI saturation (internal alarm)
0008H, Unexpected reset (internal alarm)
0010H, Continuous over-current at the output (Internal alarm)
0020H, Temperature, power electronics
0040H, AD converter reading (inverter internal alarm)
0080H, Instantaneous overcurrent at the output (Internal alarm)
0100H, AC circuit protections
0200H, DC circuit protections
0400H, DC circuit insulation failure
0800H, Failure in power electronic
1000H, Alarm due to a manual stop
2000H, Alarm caused by a configuration change
4000H, Overvoltage at the input from the panels
8000H, Voltage very low at the input from the panels

Alarmas Hist: From the«Alarma Inv» menu, pressing provides access to the submenu «Hist.Alarm», which shows the history of all alarms that have been activated since the inverter was last connected to the grid.

TempInt: **Inverter Power Electronics Temperature**.

TempCI: **Inverter Control Electronics Temperature**.

Screen 7.

N.Conex: The number of connections to the Grid made throughout all the operating hours.

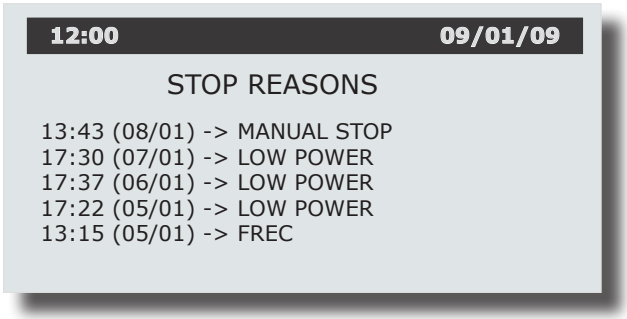
N.ConexPar: The number of connections to the Grid made since last RESET.

T.Conex: The number of hours that the inverter has been active since last RESET.

T.ConexPar: The number of connections to the Grid made since last RESET.

9.5 Stop reasons

This menu lists the last five reasons for an inverter shutdown and the corresponding time and date.



Meaning of the shutdown reasons:

-> VIN	High input voltage at the panels.
-> FREC	Incorrect grid frequency.
-> VAC	Incorrect grid voltage.
-> VARISTORS	Varistor failure.
-> INS.FAILURE	DC insulation failure.
-> RMS CURRENT	Over current maintained at AC output.
-> TEMPERATURE	Over temperature at the power electronics.
-> ONFIG	Stoppage due to configuration change.
-> MANUAL STOP	Manual stoppage.
-> MIN VPV	Low input voltage at panels.
-> HW DESCX	Internal fault.
-> PEAK.CURR	Instantaneous surge current at AC output.
-> FIRMWARE.CH	Stoppage due to firmware change.
-> ADC READING	AD converter reading failure (internal).
-> LOW POWER	Insufficient solar irradiance. No alarm generated.
-> DC.PROT	Error at input fuses.
-> AUX.TEMP	Redundant temperature sensor fault.
-> AC.PROT	AC protection.
-> AC.MAG.PROT	Error at the AC thermal magnetic breaker.
-> CONTACTOR	Contactor closure error.
-> WD.RESET	Stoppage due to Watch Dog reset (internal).
-> ADC LAT	Error at the AD converter (internal).
-> FATAL ERROR	Inverter fatal error.
-> FAULT(1)	Power electronics failure.
-> FAULT(2)	Power electronics failure.
-> FAULT(3)	Power electronics failure.
-> CURR.PI.SAT	Current PI saturation (internal).
-> SPI COM	Communication failure with the redundant system.
-> RED	The redundant system has triggered a shutdown.
-> PIB.PROT	The PIB has triggered a shutdown.

9.6 Settings

Date and Time

This menu serves to change the current time and date. The internal clock automatically changes from summer to winter time.

Inverter number change

This menu assigns the inverter a node number. This is required to configure communications.

Language

This option serves to select the display language.

From the main screen, press the “down” arrow (an arrow pointing downwards) to access the main menu.

From the main menu, use the ⌃ or ⌄ keys to scroll through the menu to the “Settings” settings position, once highlighted press OK to access the sub-menu.

In the “Settings” submenu, use the ⌃ or ⌄ keys to scroll through the menu to the “Idioma” language position. Once highlighted, press OK to access the language change screen.

The language change screen is as follows:

Press the arrows ⌃ ⌄ to scroll through the different languages.

Grid quality

This menu serves to modify the grid quality parameters. This menu is only enabled once the security code has been entered.

Grounding

This option serves to modify the PV array grounding type. This menu is only available once the security code has been entered.

Connection time

This menu serves to modify the on-hold time before the inverter connects to the grid. This menu is only available once the security code has been entered.

Total reset

This option allows the user to reset all the inverter counters. This menu is only available once the security code has been entered.

Other settings

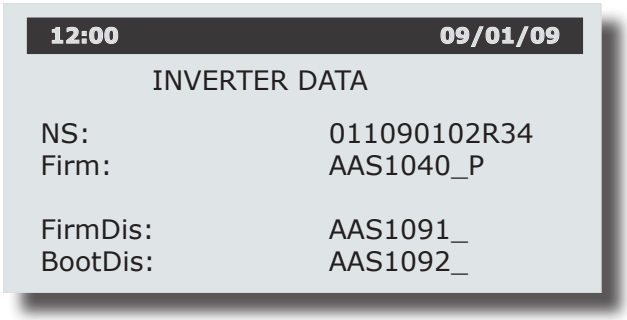
A number of internal settings.

CAN number change

This menu serves to change the electronics block node number. This is necessary to configure the speed controllers. Given the fact that this action includes operations which alter the hardware, the equipment configuration section explains how to make the node number change.

9.7 Inverter data

Inverter data are shown in this screen:



Serial Number (SN)

Number that identifies the inverter.

Firmware Version (Firm)

Name and Version of the Firmware of the inverter.

Display Firmware Version (FirmDis)

Name and Version of the Firmware of the display.

Displayl Boot Version (BootDis)

Name and Version of display's Boot.

NOTES

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