

ABB solar inverters

Product manual PRO-33.0-TL string inverters



Power and productivity
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List of related manuals

PRO-33.0-TL manuals

Code (English)

PRO-33.0-TL Quick installation and start-up guide

[3AUA0000123263](#)

PRO-33.0-TL Product manual

[3AUA0000123261](#)

PRO-33.0-TL Service menu guide

[3AXD50000015823](#)

Option manuals and guides

FIO-01 Digital I/O extension user's manual

[3AFE68784921](#)

FIO-11 Analog I/O extension user's manual

[3AFE68784930](#)

VSN700 data logger

All manuals are available in PDF format on the Internet. See [Further information](#) on the inside of the back cover.

Product manual

PRO-33.0-TL string inverters

Table of contents



1. Safety



5. Mechanical installation



6. Electrical installation



8. Start-up



Table of contents

List of related manuals	2
-------------------------------	---

1. Safety

Chapter contents	11
Use of warnings and symbols	11
Warning labels on the inverter	13
Intended use	14
Safety during installation and maintenance	14
General safety	14
Electrical safety	15
Electrical safety rules	15
Inverter isolation	16
Grounding safety (PE)	17
Safe start-up and operation	18
Before you start the inverter	18
Correct installation country	18
During operation	18



2. Introduction

Chapter contents	19
Applicability	19
Target audience	19
Contents of the manual	20
Related documents	20
Quick installation and start-up flowchart	21
Terms and abbreviations	22

3. Hardware description

Chapter contents	23
Unit overview	23
Layout drawing	25
Block diagrams	26
Three-phase photovoltaic (PV) system	26
Block diagram	27
Features	28
Model identification label	29
Type designation label	30
Accessories	31
Connections and interfaces	31

4. Installation requirements

Chapter contents	33
Installation area	33

6 Table of contents

Photovoltaic array and inverter compatibility	35
String fuse nominal current rating IFN	35
Short-circuit and thermal overload protection	36
Inverter and AC output short-circuit protection	36
DC input reverse current protection and monitoring	36
String over-current protection and monitoring (-SX model)	36
Inverter and AC output cable thermal protection	36
External RCD	36
Grid configurations	36
Power cable requirements	37
Recommended AC output cable types	37
Control cable requirements	38
Recommended relay cable	38
Recommended cable for Modbus over EIA/RS-485	38
Recommended cable for remote control unit interface over EIA/RS-485	38
Cable lengths for EIA/RS-485 and remote control unit interfaces	39

5. Mechanical installation

Chapter contents	41
Mechanical installation procedure	41
Shipping package	42
Unpack the delivery	43
Install the wall-mounting plate	44
Wall-mounting plate details	44
Installation procedure	45
Move the unit	46
To use a crane	46
To move the inverter by hand	46
Vertical installation to the wall-mounting plate	47
Tilted installation to the wall-mounting plate	48

6. Electrical installation

Chapter contents	49
Special installation tools	50
First cover	50
DC input cover	51
Cable routes	52
Insulation test	53
Inverter	53
AC output cable	53
PV generator	53
Connection diagram	54
Connection procedure	55
Power cable connections	56
Connection area layout	56
AC cabling connection	57
DC cabling connection for standard and -S models	59
DC cabling connection for the -SX model	60
DC PV quick connector assembly (-SX)	61

Control cable connections	62
Connection area layout	62
Remote control unit terminal X1	63
Remote monitoring terminal X2	63
Remote monitoring interface data, termination resistor switch	63
Daisy-chaining EIA/RS-485 transmission lines	64
Control cable glands	65
Control cable installation	65
Option module installation	66
Environmental sensor installation	67
Supported environmental sensors	67
Connection diagrams for the environmental sensors	68
Environmental sensor installation procedure	69

7. Installation checklist

Checklist	71
-----------	----

8. Start-up

Chapter contents	75
Before start up	75
First start up	76
List of country codes	79
Remote monitoring setup	80
String configuration assistant (-SX model)	83
Programmable relay configuration using FIO-01 module	85
Relay output source values	86



9. Operation

Chapter contents	87
User interface	88
Operating modes	89
Control buttons	90
To edit parameters	90
LED status indicators	91
LED on control unit	91
Control board LEDs	91
LED status indications	91
Graphical display	92
Display layout	92
Energy view	92
Menu	93
Messages	98
Help	98
USB connector	98
Remote control unit installation	99
To remove the control unit from the inverter	99
To remove the control unit support	99
To install the control unit on to a wall	99

8 Table of contents

To connect the control unit to a PC	100
To connect the ABB PC tool to the inverter	100
To move files between the control unit and a PC	100

10. Maintenance

Chapter contents	101
Requirements for maintenance personnel	101
Maintenance overview	102
Fan service	102
String fuses and surge protection devices (-SX model)	102
Maintenance intervals	103
External fan replacement	104
Internal fan replacement	106
String fuse replacement (-SX model)	107
Surge protection device replacement (-SX model)	108
Control unit battery replacement	109
Spare part kits	109



11. Troubleshooting

Chapter contents	111
Inverter replacement	111
Fault messages	112
If there is an active fault message	112
Faults	112
Warning messages	118

12. Decommissioning

Chapter contents	121
To remove the inverter from service	121
Recycling	122

13. Technical data

Input side	123
Input protection	124
Output side	125
Output protection	126
Operating performance applying standard EN 50530	126
User interface and communication	127
Environmental	127
Physical	128
Safety	128
Derating	129
Disclaimers	130
Generic disclaimer	130
Cyber security disclaimer	130

14. Dimension drawing

Inverter dimensions 131
Required installation clearances 132

15. Navigation map

How to read the navigation map 133
The navigation map 134

Further information

..... 135





1

Safety

Chapter contents

- [Use of warnings and symbols](#) (p. 11)
- [Warning labels on the inverter](#) (p. 13)
- [Intended use](#) (p. 14)
- [Safety during installation and maintenance](#) (p. 14)
- [General safety](#) (p. 14)
- [Electrical safety](#) (p. 15)
- [Safe start-up and operation](#) (p. 18)



Obey the safety instructions when you install, operate and do maintenance on the inverter. Obey these instructions to prevent physical injury or death, and damage to the inverter or to connected equipment.

Use of warnings and symbols

These warnings and symbols are used in this document and on the equipment:



Risk of electric shock. This warning identifies dangerous electrical conditions which can cause injury, death and damage to the equipment.



Risk of electric shock for indicated time after isolation. After you isolate the equipment, wait the indicated time before you do work on the equipment.

This warning identifies dangerous electrical conditions which can cause injury, death and damage to the equipment.



Risk of danger. This warning identifies dangerous non-electrical conditions which can cause injury, death and damage to the equipment.



Hot surface. This warning identifies areas which can cause injury due to heat.



Refer to the instructions. This symbol indicates that it is mandatory to read the documentation of the equipment.



Direct current. This symbol indicates the presence of a direct electrical current.



Alternating current. This symbol indicates the presence of an alternating electrical current.



No isolation transformer. This symbol indicates that there is no isolation transformer in the unit.



Protective ground terminal. This symbol indicates a terminal that is used to connect the equipment to the protective electrical ground.



Warning labels on the inverter

Warning label on the left side:



WARNING!
Presence of two voltage sources
-Distribution network
-Photovoltaic panels



Isolate both voltage sources before any intervention

Isoler les deux sources de tension avant toute intervention





ABB
PRO-33.0-TL-SX-400



 P/N: 3G82991FK00

 **WO: 9876543**

 **SO: 123456789** **Q100**

 **SN: 1210012345** **wk:1012**

ABB  DRV VDE 0125-1-1  PROTECTIVE CLASS: Made in Italy

www.abb.com/solar MODEL: PRO-33.0-TL-OUTD-SX-400

$V_{dc\ max}$	$V_{ac\ max}$
$V_{dc\ MPPT}$	f_r
$V_{dc\ full\ power}$	$P_{out\ (cos\ \phi = 1)}$
$I_{dc\ max}$	$P_{out\ (cos\ \phi = 0.9)}$
$I_{sc\ max}$	$Cos\ \phi$
	$I_{sc\ max}$

 $-25\ to\ +60\ ^\circ C$
 $-13\ to\ +140\ ^\circ F$



PROTECTIVE EARTHING REQUIRED

Warning label under the first cover:






3AAU0000162076 A



WARNING! DANGEROUS VOLTAGE!

ATTENTION! TENSION DANGEREUSE!

ACHTUNG! GEFÄHRLICHE SPANNUNG!

ATTENZIONE! TENSIONE PERICOLOSA!

ATENCIÓN! VOLTAJE PELIGROSO!





3AAU0000013314 A



Intended use

Use the inverter only as part of a photovoltaic system when it is permanently connected to the electrical grid.

Safety during installation and maintenance

Obey the local regulations and standards and the instructions in this manual, when you do work on the:

- Inverter
- Input and output cabling
- Photovoltaic arrays

General safety



WARNING! Obey these instructions to prevent injury or death, or damage to the equipment.



- Do not repair a malfunctioning unit. Contact your supplier, the local ABB representative or an Authorized Service Center for instructions.
 - Make sure that dust or water does not go into the inverter during installation.
 - Use a hoist to lift the inverter. The inverter is heavy.
 - Make sure that cooling air inlets and outlets of the inverter are open.
-

Electrical safety



WARNING! Obey these instructions to prevent physical injury or death, or damage to the equipment.

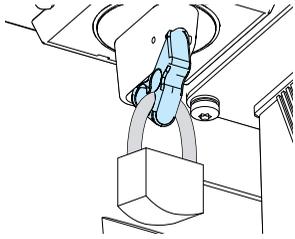
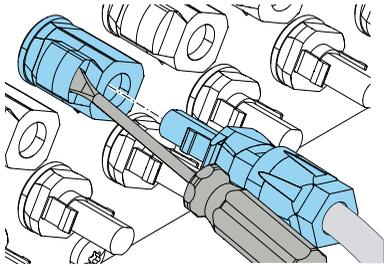
Only qualified electricians can install and connect the inverter.

■ Electrical safety rules

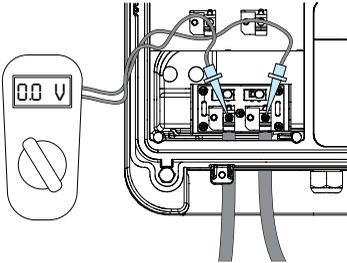
- Obey all electrical safety regulations of the installation country or region.
- Be aware that the inverter is connected to two voltage sources:
 - The photovoltaic (PV) arrays at the DC connectors
 - The public electrical grid at the AC connector
- Be aware that the DC terminals (DC+ and DC-) have dangerous voltages of up to 1,100 V.
- Do not do installation or cabling work, if the inverter is connected to the electrical grid or to the PV arrays.
- Do not do work on the control cabling, if the inverter or external control circuits are connected to power sources. There can be dangerous voltages (115 or 230 V) in the external control circuits even when the inverter is isolated from the PV arrays and the electrical grid.
- Do not do insulation resistance tests or voltage withstand tests on the inverter.
- Do not open the second cover of the inverter. Dangerous voltages can be present inside.
- Before you do work on the inverter, isolate the inverter from all power sources.
- Make sure that you can access the external AC breakers and fuses.
- Do not disconnect the DC connectors when they are under load. Use sealing caps to prevent water and dirt in the disconnected PV quick connectors.
- If it is present, the DC switch isolates the PV array from the electrical grid. The DC input and AC output connectors or DC fuses can have hazardous voltages regardless of the DC switch position.
- Be aware that the AC and DC cables can have dangerous voltages when they are not connected to the inverter.



Inverter isolation

To isolate the inverter from external power sources:	
1.	Open the main disconnect and circuit breaker(s) at the AC distribution board.
2.	<p>Set the DC switch on the bottom of the inverter to the OFF position (-S and -SX models).</p> <p> WARNING! The DC switch <u>does not</u> isolate the DC input connectors or fuses from the PV array.</p> <p>Lock the DC switch in the OFF position when you do work on the unit. To lock the DC switch, pull out the locking tab and secure it with a tag or a lock.</p>
	
3.	On the standard and -S models, open the DC switches and circuit breakers between the inverter and PV array to isolate the inverter from the PV array. If it is applicable, do the same on the -SX model.
4.	<p>Disconnect the AC cable from the inverter to completely isolate it from the electrical grid.</p> <p>Note: Although the inverter's automatic disconnection switches isolate the inverter electronics and solar array from the electrical grid, they do not completely isolate the inverter from the electrical grid. There can still be a High AC voltage in the inverter and at the AC cable terminals.</p>
	5. Wait at least 5 minutes for the internal capacitors to discharge.
6.	<p>Disconnect the DC cables from the inverter to completely isolate it from the PV array(s).</p> <p> WARNING! Do not disconnect the DC connectors while they are energized. The DC connection terminals carry dangerous voltages (up to 1,100 V). Even in dim conditions, the PV array supplies voltage to the inverter.</p>
	<p>PV quick connectors (-SX model):</p> <ol style="list-style-type: none"> Make sure that the DC cables are marked clearly for correct connection. Put a 3.5 mm flat screwdriver into the locking slot. Pull the connectors apart. Put protective caps on to the connectors to prevent a safety hazard.
	
continues on the next page	

To isolate the inverter from external power sources:

<p>6. Screw terminals (standard and -S model):</p> <p>a) Remove the first cover. Refer to <i>First cover</i> on page 50.</p> <p>b) Remove the DC input cover. Refer to <i>DC input cover</i> on page 51.</p> <p>c) Make sure that the DC cables are marked clearly for correct connection.</p> <p>d) Use a multimeter to make sure that there is no voltage between DC input terminals (DC+ and DC-), and no voltage between DC input terminals and ground (DC+ and PE terminal or DC- and PE terminal)</p> <p>e) Loosen the terminal screws.</p> <p>f) Loosen the cable glands.</p> <p>g) Pull the DC cables through the cable glands.</p>	
<p>7. Use a multimeter (impedance >1 Mohm) to measure that there is no voltage between ground (PE terminal) and the inverter input and output terminals.</p>	
<p>8. Disconnect any external power sources from the control connectors (for example, to the relay output).</p>	

■ Grounding safety (PE)

 **WARNING!** Obey these instructions to prevent injury or death, increased electromagnetic interference and equipment malfunction.

- Obey all of the electrical safety regulations of the installation country.
- Connect the protective earth (PE) to the inverter and associated equipment to ensure personal safety and electromagnetic compatibility.
- Make sure that the grounding connections meet the safety regulations.
- Do not connect the protective earth in a chain configuration. Connect each inverter directly to the protective earth (PE).
- Do not ground the DC+ or DC- live conductors.
- Do not use PV modules that require grounded DC+ or DC- conductors. The DC side and AC grid are not galvanically separated.
- Use a fixed PE connection, because the touch current of the inverter can be above 3.5 mA_{AC} or 10 mA_{DC} (as stated by IEC/EN 62 109, 5.2.5). Refer to *Power cable requirements* on page 37.



Safe start-up and operation



WARNING! Obey these instructions to prevent injury or death, or damage to the equipment.

■ Before you start the inverter

- Get the required permits and approvals from the local authorities.
- Tell the respective utility company about the grid connection.
- Make sure that all system equipment is suitable for operation.
- Do the necessary tests and measurements at the PV array and electrical grid side.
- If the inverter has internal fuses (-SX), make sure that the PV fuse rating is correct for your system. If it is necessary, change the fuse rating.

■ Correct installation country

When you start the inverter for the first time, a qualified and authorized electrician must set the correct installation country. This makes sure that the inverter meets the requirements of the local electrical grid. Refer to [First start up](#) on page 76.



■ During operation

- Monitor your system regularly. Refer to [Energy view](#) on page 92.
 - Do the required maintenance. Refer to [Maintenance intervals](#) on page 103.
-



Introduction

Chapter contents

- [Applicability](#) (p. 19)
- [Target audience](#) (p. 19)
- [Contents of the manual](#) (p. 20)
- [Related documents](#) (p. 20)
- [Quick installation and start-up flowchart](#) (p. 21)
- [Terms and abbreviations](#) (p. 22)

Applicability

The manual is applicable to these units:

Model	Reference in this manual
PRO-33.0-TL-OUTD-400	Standard model
PRO-33.0-TL-OUTD-S-400	-S model
PRO-33.0-TL-OUTD-SX-400	-SX model

Target audience

This manual is written for persons who plan the installation, and install, commission, use and do maintenance on the inverter.

Read the manual before you do work on the inverter. You are expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

Contents of the manual

The chapters of the manual:

Safety – Safety instructions for installation, commissioning, operation and maintenance.

Hardware description – Description of the hardware, block diagrams, features and options.

Installation requirements – Requirements for the installation area, power and control cabling, installation tools and electrical grid types.

Mechanical installation – Mechanical installation procedures.

Electrical installation – Electrical installation procedures.

Installation checklist – List of installation requirements.

Start-up – Start-up procedure.

Operation – User interface, functions and messages.

Maintenance – Maintenance requirements and procedures.

Troubleshooting – Fault messages and warning messages.

Decommissioning – Removing from service and recycling.

Technical data – Technical specifications and regulatory compliance.

Dimension drawing – Unit dimensions and installation clearances.

Navigation map – Menu structure of the user interface.

Related documents

Refer to the *List of related manuals* on the inside of the front cover of this manual.

Quick installation and start-up flowchart

Task	Refer to:
Plan the installation: Site conditions, inverter ratings, cables, cooling, installation area, equipment layout, compatibility with PV arrays and other system equipment. Select the cables and fastening components.	Installation requirements , page 33 Technical data , page 123 PRO-33.0-TL Quick installation and start-up guide Applicable accessory manuals
↓	
Unpack and examine the delivery. Examine the condition of the packaging and identify your inverter. Unpack and examine the condition, type and quantity of the equipment. Do not install or use damaged equipment.	Shipping package , page 42 Sales package and purchase order Model identification label , page 29 Mechanical installation , page 41 Technical data , page 123
↓	
Prepare the installation site.	Mechanical installation , page 41
↓	
Install the mounting bracket and the inverter.	Mechanical installation , page 41
↓	
Route and connect the cables. -SX model: Make sure that the inverter has the correct PV fuses.	Installation requirements , page 33 Electrical installation , page 49
↓	
Examine the installation.	Installation checklist , page 71
↓	
Commission the inverter.	Start-up , page 75

Terms and abbreviations

Term/abbreviation	Explanation
Control board	Inverter internal circuit board in which the inverter firmware runs.
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
I/O	Input/Output
IGBT	Insulated-gate bipolar transistor
Inverter	Converts direct current and voltage to alternating current and voltage.
Main disconnect	A manually controlled isolation switch which can be locked in the open position.
MPPT	Maximum power point tracking. An inverter firmware function that automatically operates the photovoltaic generator, array, string or module at its maximum power point.
Parameter	User-adjustable operation instruction to the inverter, or signal measured or calculated by the inverter.
Photovoltaic array	Group of parallel-connected photovoltaic strings
Photovoltaic cell	Solar cell or photovoltaic cell is an electronic device that converts solar energy into direct current by the photovoltaic effect. Photovoltaics is the field of technology related to the application of solar cells for solar energy. Assemblies of cells are used to make solar modules, or photovoltaic arrays, which generate electricity.
Photovoltaic components	In this manual, solar power system components based on photovoltaic effect are called photovoltaic cell, module, array, string and string combiner box.
Photovoltaic generator	The total of all photovoltaic strings of a solar power supply system, which are electrically interconnected.
Photovoltaic module	Packaged interconnected assembly of photovoltaic cells that can be installed as a single unit and connected to other panels to form an array.
Photovoltaic string	Circuit of series-connected photovoltaic modules.
Protective earth (PE)	Protective electrical grounding of the equipment or system.
RCMU	AC and DC sensitive residual current monitoring unit. Measures the currents in the L1, L2 and L3 conductors.
SPD	Surge protection device
String combiner box	Device that connects outputs of multiple photovoltaic source circuits (strings) into a combined output circuit or circuits.
String inverter	Low-power photovoltaic inverter which typically has one or a few string input(s). Converts direct current and voltage from a photovoltaic array to alternating current and voltage to the grid.
THD	Total harmonic distortion
TL	Transformerless, no galvanic separation between DC and AC circuits.



Hardware description

Chapter contents

- [Unit overview](#) (p. 23)
- [Layout drawing](#) (p. 25)
- [Block diagrams](#) (p. 26)
- [Features](#) (p. 28)
- [Model identification label](#) (p. 29)
- [Type designation label](#) (p. 30)
- [Accessories](#) (p. 31)
- [Connections and interfaces](#) (p. 31)

Unit overview

The PRO-33.0-TL transformerless string inverter converts the direct current (DC) from the photovoltaic arrays into a three-phase alternating current (AC). This AC is fed to the public electricity grid or to a load circuit which is connected to the public electricity grid.

The inverter is targeted for medium and large photovoltaic (PV) systems.

The inverter is IP65 rated and you can install it outdoors.

The inverter has three variable-speed fans which operate as needed: Two external fans on the sides of the inverter blow air to the heat sink. An internal fan prevents heat pockets in the unit. The exhaust vent is at the top rear of the unit.

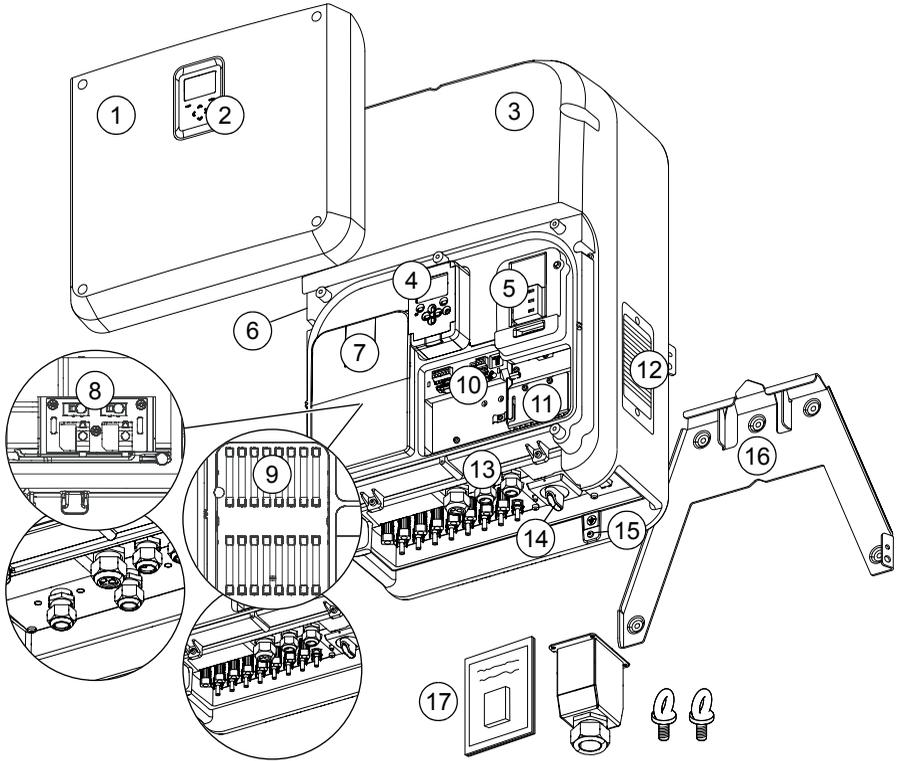
The inverter has three models:

Model	Description
PRO-33.0-TL-OUTD-400 (Standard model)	1 DC input connection to an external string combiner box. The connection uses screw terminals.
PRO-33.0-TL-OUTD-S-400 (-S model)	In addition to the standard model specification, it has an integrated DC switch which isolates the PV array from the electrical grid.
PRO-33.0-TL-OUTD-SX-400 (-SX model)	<p>This model has an integrated string combiner box with:</p> <ul style="list-style-type: none"> • An integrated DC switch, which isolates the PV array from the electrical grid. • 8 string inputs with PV quick connectors. The connectors have sealing caps. • Monitored string fuses (16 pcs) for both positive and negative inputs. • String current monitoring with configurable alarm limit. • Replaceable monitored surge protection device for DC input, Type II. <p>Accessories required for the -SX model:</p> <ul style="list-style-type: none"> • 3N750080000A, SUNCLIX DC cable connector kit, 8 pcs SUNCLIX DC+ connector and 8 pcs SUNCLIX DC-connector, or • Phoenix Contact SUNCLIX: DC+ connector PV-CF-S (1774674) and DC- connector PV-CF-M (1774687)

After the inverter is installed and commissioned, it operates automatically:

1. The inverter starts when there is sufficient daylight for the PV modules to generate an input voltage above the minimum operating limit.
2. The inverter verifies the status of the power line and then switches to the normal operating mode.
3. The inverter feeds current to the power line, and monitors both the PV arrays (DC) and power line (AC).
4. When the daylight is not sufficient to generate an input voltage below the minimum operating limit, the inverter goes to the stand-by mode. The inverter uses the AC power supply to keep the control unit on.
5. When the input voltage is lower than the threshold input voltage, the inverter goes to the sleep mode. It uses the AC power supply to keep the control unit on.

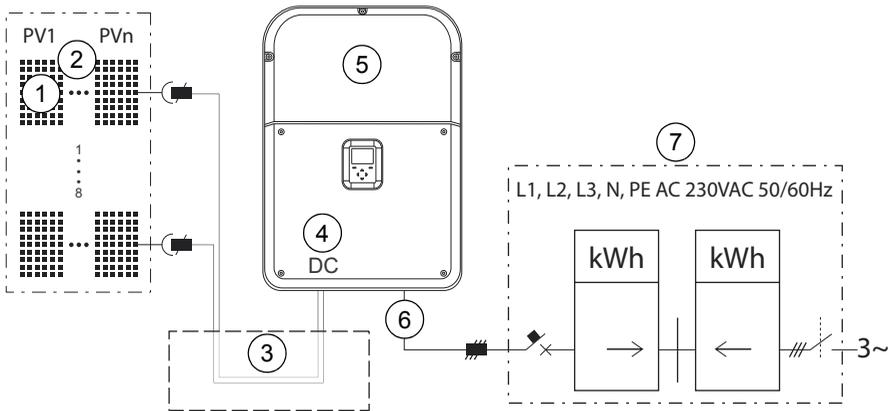
Layout drawing



No.	Description	No.	Description
1	First cover	10	Control board terminals
2	Display and keypad	11	Internal fan
3	Second cover	12	External fans, 2 pcs (one on each side)
4	Control unit	13	Cable glands for control cables, 3 pcs
5	Monitored input surge protection devices (-SX)	14	DC switch (-S & -SX)
6	Type designation label	15	AC output terminal
7	DC input cover	16	Wall mounting plate
8	DC input (standard & -S): Screw terminals and cable glands	17	Supplied accessories: Documentation, AC connector housing, eye bolts, etc.
9	DC input (-SX): PV quick connectors and monitored string fuses, 16 pcs		

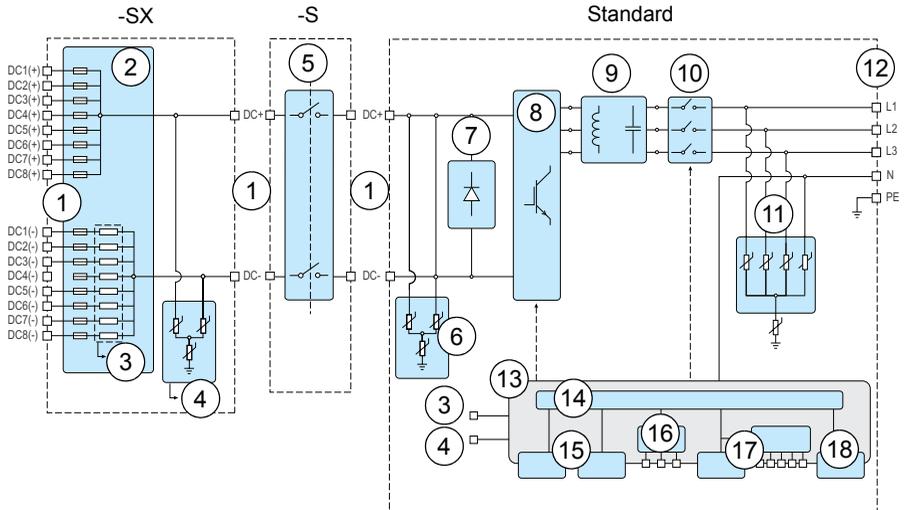
Block diagrams

■ Three-phase photovoltaic (PV) system



No.	Description
1	Photovoltaic module/panel strings
2	Array of PV modules/panels
3	String combiner box (Standard & -S)
4	1 DC input connection (Standard & -S) or 8 parallel string connections (-SX)
5	Three-phase string inverter
6	Three-phase AC output
7	AC distribution board

Block diagram



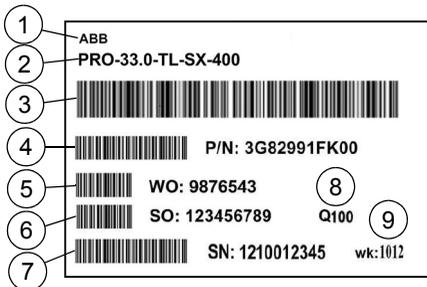
No.	Component	Description
1	Input terminals	DC cabling from the PV arrays with PV quick connectors (-SX) or with screw terminals (standard & -S)
2	Input board with string fuses (-SX)	Circuit board with optional string fuses for both poles (positive and negative) and string measurement functions.
3	String current monitoring (-SX)	Measures the string current.
4	Monitored surge protection (-SX)	Protects the inverter from induced voltage spikes caused by lightning or electrostatic induction. The inverter monitors the SPD and informs the user when it must be replaced.
5	DC switch (-S & -SX)	On/Off switch to isolate the PV array from the electrical grid.
6	Input varistors	Inverter overvoltage protection components. (standard & -S)
7	Reverse polarity protection diode	Protects the inverter from reverse connected inputs.
8	Inverter	DC to AC conversion and maximum power point tracker (MPPT)
9	Line filter	Three-phase output current filter.
10	AC relays	AC disconnecting relays.
11	AC output varistors	Protects the inverter from overvoltage peaks.
12	AC terminals	AC cabling connection.
13	Control board	Controls and interfaces to the inverter.
14	Control and monitoring	Control and monitoring circuits.
15	Extension modules	Extension module slots for optional modules.
16	Monitoring interface	Remote monitoring interface.
17	Control unit	Removable control unit and remote control unit interface.
18	Status LEDs	Inverter status LEDs on the control board.

Features

Feature	Description
Automatic operation	The inverter starts and stops automatically based on the amount of solar radiation. It connects to and disconnects from the electrical grid automatically according to country requirements. The inverter monitors itself and generates information to the user.
DC reverse polarity protection, monitored	The inverter has a short-circuit diode between the DC terminals to protect the internal electronics from reverse voltages. The inverter informs the user of a reversed DC connection.
DC ground-fault monitoring	In accordance with VDE0126-1-1 and IEC62109-2, the inverter monitors the impedance between the electrical ground and the DC terminals before it connects to the electrical grid.
MPPT	Maximum power point tracking. MPPT automatically operates the PV generator, array, string or module at its maximum power point.
Residual current detection	In accordance with VDE0126-1-1 and IEC62109-2, the inverter has a DC and AC sensitive residual current monitoring unit (RCMU) which measures the L1, L2 and L3 currents. If residual currents (DC or AC) are detected, the inverter disconnects from the grid.
AC grid monitoring with anti-islanding	In accordance with VDE0126-1-1 and IEC62116, the inverter monitors the voltage and frequency of the electrical grid. The inverter stops the power conversion and disconnects from grid if a missing electrical grid is detected (anti-islanding).
AC overcurrent trip, monitored	The inverter software has an over-current trip function. The inverter informs the user if an over-current trip occurs.
AC short-circuit protection	If an external AC side short circuit occurs, the inverter disconnects from the grid to protect its electronics.
Overtemperature protection	If the inverter detects harmful internal temperatures, it temporarily limits the output power. If the internal temperature rises to dangerous limits, the inverter stops power conversion and disconnects from the grid.
DC switch (-S & -SX)	The manual DC switch which isolates the PV array from the electrical grid.
DC string fuses, monitored (-SX)	The string fuses protect the PV modules and string cabling against earth faults due to installation errors or faulty components. There are string fuses on both the negative and positive inputs.
String monitoring (-SX)	String monitoring measures the current in each string and compares it to the average current of selected strings. The feature gives a warning when the current in one of the strings deviates from the average. You can set the threshold value.
Input surge protection devices, monitored (-SX)	The surge protection device (SPD) protects the inverter from induced voltage spikes, for example, from thunderstorms. The inverter monitors the SPD and informs the user when it must be replaced.
Input varistors	Input overvoltage protection varistors which protect the inverter from induced voltage spikes.

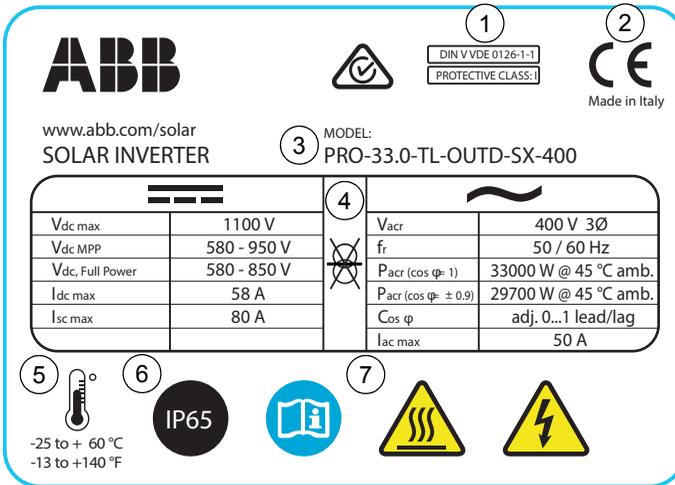
Feature	Description
Control unit	The control unit has a graphical display and a keypad with a dedicated help key. The user interface has comprehensive system monitoring, setup assistance and help menus.
Status LEDs	The status LED shows the operational status of the inverter. The control unit has one bi-color (green/red) LED. The inverter control board has green and red LEDs. Remove the control unit to see the control board LEDs.
Remote monitoring interface	A (hardwired) serial communication link for the Modbus RTU protocol or ABB control unit protocol. Use the remote monitoring interface to connect the inverter to an external monitoring or control system. You can connect other inverters and equipment with the Modbus RTU to this serial link, such as weather sensors, displays, media converters, dataloggers, etc. ABB offers a data logger that is compatible with the inverter. The data logger has an integrated web interface, and Ethernet and monitoring portal connectivity.
Option module slots	There are two option module slots. One slot is reserved for future fieldbus option modules and one slot for future I/O extension modules.

Model identification label



No.	Description
1	Company name
2	Model
3	Manufacturer ID
4	Part number
5	Work order
6	Sales order
7	Serial number
8	Quantity
9	Date code

Type designation label



No.	Description
1	Classification of protection against electric shock by IEC 62109
2	Compliance marking (CE)
3	Type designation
4	Ratings
5	Operating temperature range
6	Ingress protection class (IP65)
7	Warning and instruction symbols

The type designation with the model, configuration, power and rating of the inverter.

PRO	-33.0	-TL	-OUTD	- / -S / -SX	-400
Product series	Nominal output power [kW]	TL = Transformerless	OUTD = Outdoor unit	None = standard model -S = standard model + DC switch -SX = PV quick connectors, integrated string combiner box with fuses, DC switch, monitored input surge protection devices and string current monitoring.	Nominal AC output voltage [V]

Accessories

The inverter has two slots for I/O extension and fieldbus adapter modules:

- SLOT 1 supports I/O extension modules:
 - FIO-01 Digital I/O extension module
 - FIO-11 Analog I/O extension module
- SLOT 2 supports future fieldbus adapter modules.

Connections and interfaces

Refer to [Connection diagram](#) on page 54 and to [Connection area layout](#) on page 56.

Connection	Description
DC input connectors	Connection point for the PV arrays. The standard and -S models have a pair of DC screw terminals to attach the DC cables from an external string combiner box. The -SX model has 8 pairs of plug type PV quick DC connectors to attach up to 8 separate strings of PV panels to the inverter.
AC connector	AC connection to the electrical grid.
Remote control unit terminal X1	Reserved for control unit (display unit) remote installations.
Remote monitoring terminal X2	Connection to a remote monitoring adapter.
Option module terminal, SLOT 1	Connection for I/O extension modules.
Option module terminal, SLOT 2	Connection for fieldbus adapter modules.
Control cable shield grounding	Clamps to ground the control cable shields to the protective earth.
Additional PE terminal	Use this terminal according to your local electrical installation guidelines. Refer to Power cable requirements on page 37.



Installation requirements

Chapter contents

- [Installation area](#) (p. 33)
- [Photovoltaic array and inverter compatibility](#) (p. 35)
- [Short-circuit and thermal overload protection](#) (p. 36)
- [Grid configurations](#) (p. 36)
- [Power cable requirements](#) (p. 37)
- [Control cable requirements](#) (p. 38)

Installation area

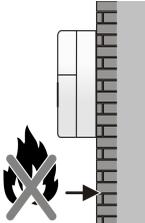
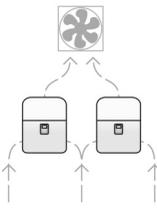
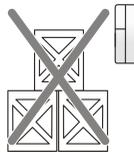
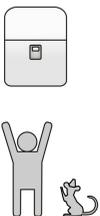
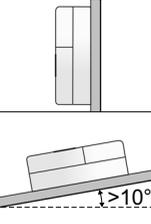
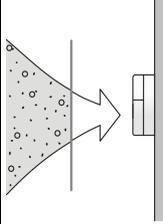


WARNING! Do not install the inverter:

- Near corrosive, explosive or flammable materials
 - Where it is subject to impacts or vibration
 - In a dusty place
 - In an area with conductive dust
 - In an area where snow or sand piles
 - Near to a heat source. Heat decreases the power output and the service life of the unit.
-

You can install the unit indoors and outdoors when the safety, ambient condition and free space requirements are met. The installation area must meet the requirements in [Technical data](#) on page 123.

34 Installation requirements

<p>The supporting structure and fastenings must support the weight of the unit and must be non-flammable.</p>		<p>The installation space must be cooled adequately for all of the equipment inside. Refer to Technical data on page 123 and Required installation clearances on page 132.</p>	
<p>The installation area must be accessible in emergencies and for maintenance.</p>		<p>The installation area must be out of reach of children and pets.</p>	
<p>The unit can produce noise or vibration which can disturb people. Several inverters in the same space increases the noise. Consider this when you select the installation area and materials.</p>		<p>When you select the installation area, make sure that all labels on the inverter are always visible.</p>	
<p>Do not install the unit in direct sunlight. Power derating occurs if the internal temperature of the unit is too high. Protect the unit from ice and snow.</p>		<p>Install the inverter vertically or tilted 10...90 degrees to the rear. Do not install the inverter tilted to the front or upside down.</p>	
<p>Prevent exposure to dust and harmful gases such as ammonia.</p>			

Photovoltaic array and inverter compatibility

Make sure that:

- The PV modules and DC cables are Protection Class II certified (double insulated).
- The PV modules are not grounded to the DC+ or DC- terminals.
- The PV modules are of the same type and that they have a IEC 61730 Class A rating.
- The PV strings have an equal configuration for optimized energy output.
- The PV string and array maximum short-circuit currents and open-circuit voltages for DC inputs match the rated values of the inverter under local ambient conditions. Refer to [Technical data](#) on page 123.
- The PV array operating voltage range is in the MPPT voltage range at all ambient temperatures. Refer to [Technical data](#) on page 123. The string voltage tends to increase in low ambient temperatures.
- The -SX model is equipped with 15 A string fuses (refer to [Technical data](#) on page 123 for fuse types). Make sure that the 15 A string fuses are sufficient and compatible with the PV array design and installation materials. The nominal current of the string fuses is defined at 25 °C. Take into account the possible temperature deviations when you select fuses.

■ String fuse nominal current rating I_{FN}

- Read the nominal short-circuit current I_{SC} rating from the data sheet of the PV module.
- Read the maximum allowed series fuse rating or reverse current rating I_R from the data sheet of the PV module.
- Define the conductor current carrying capacity I_C of the used string cable type in the planned installation conditions.
- The correct nominal current rating I_{FN} of the string fuse in the planned installation conditions:

$$I_{FN} \geq 1.56 \times I_{SC}$$

$$I_{FN} \leq I_R \text{ or if } I_R \text{ is not specified in module data sheet } I_{FN} < 2 \times I_{SC}$$

$$I_{FN} \leq I_C$$

When you use this formula to select the fuses, take into account the factors that can cause adjustments to the formula:

- The thermal derating of the fuse.
- The effective radiation at the installation site.
- The PV module I_{SC} temperature dependence at the site.
- The maximum return current of the PV modules.

Short-circuit and thermal overload protection

■ Inverter and AC output short-circuit protection

The inverter has an automatic AC over-current trip function which limits inverter damage if there is, for example, an AC side short-circuit. Install an external circuit breaker at the AC distribution board to protect the AC cable according to the local regulations, the appropriate AC line voltage and the rated current of the inverter.

■ DC input reverse current protection and monitoring

The inverter has a reverse polarity protection diode between the positive and negative DC inputs to protect the inverter from reverse DC input connections. The inverter generates a fault if reverse current flows between the positive and negative DC inputs.

■ String over-current protection and monitoring (-SX model)

The -SX model has pre-assembled string fuses on both positive and negative DC inputs. Correctly-sized string fuses reduce the risk of fire and damage to the PV array, DC cables and components, if short circuits or reverse connection of PV modules or strings occur.

■ Inverter and AC output cable thermal protection

The inverter protects itself against thermal overload. A circuit breaker must be installed on the AC distribution board side to protect AC cabling and electrical grid interface devices.

■ External RCD

The inverter has an integrated DC and AC sensitive RCMU which can detect residual (fault and leakage) currents. If the residual current is over $300 \text{ mA}_{\text{rms}}$ or a rapid rise of over $30 \text{ mA}_{\text{rms}}$ is detected, the inverter disconnects from the grid.

The inverter can generate leakage currents of up to 300 mA. The total operational leakage current depends on the operating conditions and on the type of PV module. Exact values for leakage currents cannot be given.

If an external RCD is required by local regulations, use an RCD which has a nominal rating of 300 mA per connected inverter.

Grid configurations

The permitted earthing configurations are TN-S, TN-C, TN-C-S and TT. IT earthing is not permitted.

Power cable requirements

Select the DC and AC cables according to the local regulations and the following rules:

- Use cables that are rated for at least 70 °C maximum permissible temperature of conductor in continuous use.
- Use double-insulated DC cables.
- Use a DC cable that is rated for at least 1,000 V_{DC} and which is approved for photovoltaic applications. If the PV system voltage exceeds 1,000 V, select the DC cable according to the system voltage.
- Use an AC cable that is rated for at least 500 V_{AC}.
- The AC cable must have either L1, L2, L3, N and PE or L1, L2, L3 and PE conductors. Obey the local regulations.
- You can use copper and aluminium AC cables.
- Dimension the AC cables to carry the inverter load current with a maximum voltage drop of 1% between the inverter and the AC distribution board.
- Connect the PE conductor primarily to the AC connector.
- The minimum permitted PE conductor cross-sectional area is 10 mm² for a copper (Cu) conductor. If the cable has a smaller PE conductor, connect an additional PE conductor of at least 6 mm² with a cable lug to the auxiliary PE terminal of the inverter.
- (-SX model) Use Phoenix Contact SUNCLIX PV quick connectors:
DC+: PV-CF-S (1774674)
DC-: PV-CM-S (1774687)

Maximum recommended AC cable lengths per nominal output power (based on 1% maximum AC cable losses)			
Conductor (Cu) cross-section		33,000 W 48 A_{rms}	
mm²	AWG	m	ft
10	7	23	75
16	5	36	118
25	3	57	187

■ Recommended AC output cable types

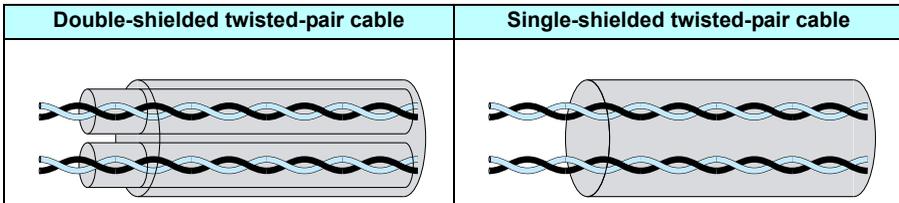
The outer diameter of the AC output cable must be 22...32 mm (0.9...1.2 in.).

With the supplied reducer seal for the cable gland, the outer diameter can be 14...26 mm (0.6...1.0 in.).

Control cable requirements

Use shielded control and data cables.

A double-shielded cable is the best alternative for low-voltage digital signals over several communication cables, but a single-shielded twisted-pair cable can also be used.



Do not mix 24 V_{DC} and 115/230 V_{AC} signals in the same cable.

Relay-controlled signals can share the same cables as digital signals, if their voltage does not exceed 48 V. Run relay-controlled signals as twisted pairs.

Communication signals can share the same cable, if the data conductors run in the same twisted pair and both interfaces have separate ground conductors.

Route control cables according to [Cable routes](#) on page 52.

■ Recommended relay cable

Cables with a braided metallic screen (for example, Lapp Kabel ÖLFLEX or equivalent) have been tested and approved by ABB.

■ Recommended cable for Modbus over EIA/RS-485

Use a shielded twisted-pair cable (STP) with an impedance of 100...150 ohm with 120 ohm terminating resistors. For example, Lapp Kabel UNITRONIC® LiHCH (TP) or equivalent.

■ Recommended cable for remote control unit interface over EIA/RS-485

Use a shielded twisted-pair (STP) cable (for example, Lapp Kabel UNITRONIC® LiHCH (TP) or equivalent). Terminating resistors are not required.

■ Cable lengths for EIA/RS-485 and remote control unit interfaces

The approximate cable distance without termination, using a twisted-pair cable, 24 AWG or conductor diameter of 0.5 mm (0.2 mm²):

Baud rate (bits/s)	Distance (m)	Baud rate (bits/s)	Distance (m)
1,200	1,200	19,200	840
2,400	1,200	38,400	420
4,800	1,200	57,600	280
9,600	1,200	115,200	140
14,400	1,120	230,400	70

5

Mechanical installation

Chapter contents

- [Mechanical installation procedure](#) (p. 41)
- [Shipping package](#) (p. 42)
- [Unpack the delivery](#) (p. 43)
- [Install the wall-mounting plate](#) (p. 44)
- [Move the unit](#) (p. 46)
- [Vertical installation to the wall-mounting plate](#) (p. 47)
- [Tilted installation to the wall-mounting plate](#) (p. 48)

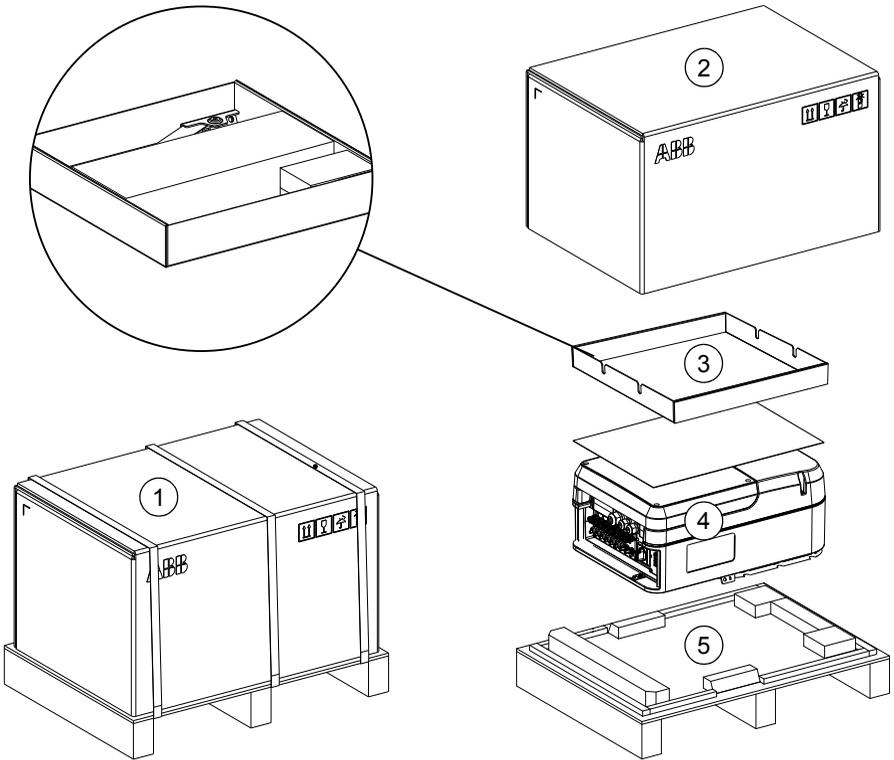


WARNING! Obey these instructions to prevent physical injury or death, or damage to the equipment.

Mechanical installation procedure

1. Examine the delivery for damage.
 2. Unpack the delivery.
 3. Make sure that the delivery is correct.
 4. Make sure that the installation area is suitable and ready.
Refer to [Technical data](#) on page 123 and [Required installation clearances](#) on page 132.
 5. Install the wall-mounting plate.
 6. Move the unit to the installation area.
 7. Lift the unit onto the wall-mounting plate.
 8. Lock the unit onto the wall-mounting plate.
-

Shipping package



No.	Description
1	Shipping package
2	Shipping cover
3	Accessory tray with wall-mounting plate, installation accessories and manuals
4	Inverter
5	Shipping pallet

Unpack the delivery

1. Examine the package for damage.
2. Before you open the package, read the package labels to make sure that the delivery is correct.
3. Move the inverter in its package to the installation area.
4. Open the shipping cover and examine the contents. Make sure that the package contains the installation accessories:
 - Wall-mounting plate, locking screws M5x20 T25 stainless steel and washers
 - AC connector housing
 - Reducer seal for the AC cable gland
 - 2 M25 and 1 M32 reducer seals for single-cables in the control cable glands
 - 2 lifting eye bolts M10
 - Quick installation and start-up guide
5. Examine the type designation label on the inverter to make sure that it is the correct unit. Refer to [Model identification label](#) on page 29 and [Accessories](#) on page 31.
6. Do not remove items from the package until you are ready to install them.
7. Read the instructions and keep them available at the installation area.

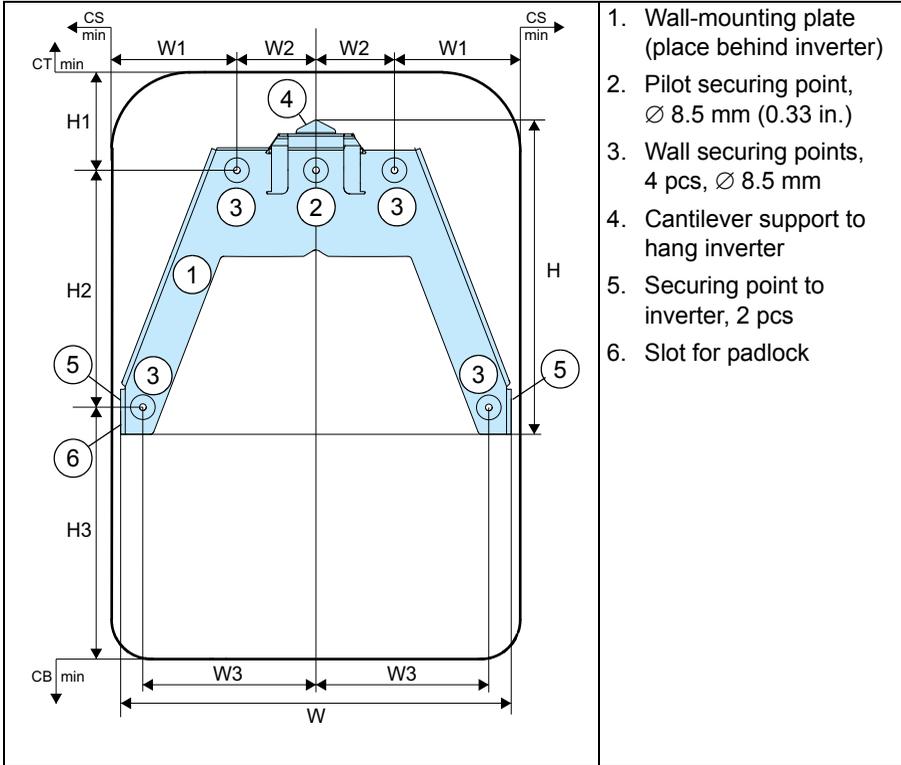
Refer to [Move the unit](#) on page 46 before you move the inverter.



Install the wall-mounting plate

Refer to [Dimension drawing](#) on page 131 for information on inverter dimensions and space requirements.

Wall-mounting plate details



	Mounting dimensions								Clearances		
Units	H	H1	H2	H3	W	W1	W2	W3	CB	CS	CT
mm	399	125	300	318	507	160	100	220	500	350	250
inches	15.71	4.92	11.81	12.52	19.96	6.30	3.94	8.66	19.7	13.8	9.8

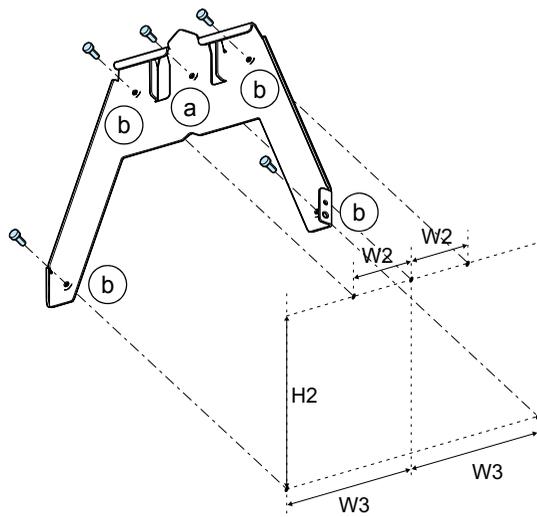
■ Installation procedure



WARNING! Make sure that dust or other contaminants do not go into the inverter during the installation.



WARNING! Make sure that the mounting surface can hold the weight of the unit.



To install the wall-mounting plate:

1. Use the pilot securing point (a) to mark the position of the wall-mounting plate in the intended place.
2. If it is necessary, make a hole in the surface and install an appropriate plug.
3. Install the pilot screw, but do not tighten it.
4. Let the wall-mounting plate hang from the pilot screw or use a spirit level to make sure that it is level.
5. Mark the remaining 4 securing points (b).
6. If it is necessary, make holes on to the mounting surface and install the appropriate plugs.
7. Use the appropriate screws to fasten the wall-mounting plate to the mounting surface.
8. Tighten the pilot securing screw.

Move the unit



WARNING! Use a hoist when you lift the heavy unit. The unit weighs approximately 67 kg (148 lbs) and is top heavy.

Move the unit to the installation area.

To install the wall-mounting plate, refer to [Install the wall-mounting plate](#) on page 44.

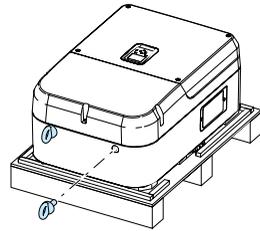
You can lift the inverter with a crane or by hand.

■ To use a crane

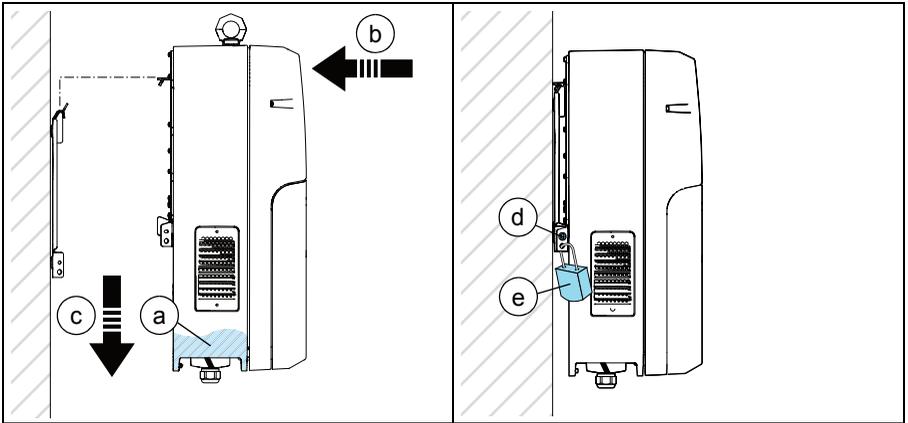
1. Install the 2 eye bolts to the top of the inverter.
2. Attach the lifting hooks to both eye bolts.
3. Lift the inverter carefully and steady it manually.

■ To move the inverter by hand

- At least two persons are required (follow local occupational safety regulations).
- Lift the inverter upright carefully.
- Use the handholds on the bottom of the inverter.



Vertical installation to the wall-mounting plate



1. Tilt the unit to the upright position.
2. Lift the inverter from the lifting positions (a) on the sides of the connection area and stabilize it from the top.
3. Move the inverter on to the wall-mounting plate so that the inverter is slightly above the wall-mounting plate (b).
4. Lower the inverter into the hook on the wall-mounting plate (c).
5. Install and tighten the 2 M5x20 (T25) screws and washers (one on each side) to secure the inverter (d) to the wall-mounting plate.
6. Use a padlock to prevent unauthorized removal (e).
7. If it is necessary, remove the eye bolts.

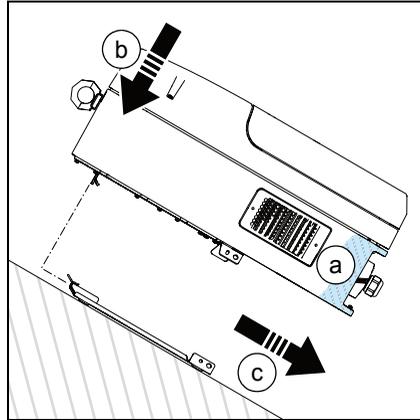


Tilted installation to the wall-mounting plate

You can install the inverter to a tilted surface 10...90 degrees from horizontal.

Do not install the inverter tilted to the front.

1. Lift the inverter from the lifting positions (a) on the sides of the connection area and stabilize it from the top.
2. Tilt the inverter back to correspond to the installation angle.
3. Move the inverter on to the wall-mounting plate so that the inverter is slightly above the wall-mounting plate (b).
4. Lower the inverter into the hook on the wall-mounting plate (c).
5. Install and tighten the 2 M5x20 (T25) screws (one on each side) to secure the inverter to the wall-mounting plate.
6. Use a padlock to prevent unauthorized removal.
7. If it is necessary, remove the eye bolts.



6

Electrical installation

Chapter contents

- [Special installation tools](#) (p. 50)
- [First cover](#) (p. 50)
- [DC input cover](#) (p. 51)
- [Cable routes](#) (p. 52)
- [Insulation test](#) (p. 53)
- [Connection diagram](#) (p. 54)
- [Connection procedure](#) (p. 55)
- [Power cable connections](#) (p. 56)
- [Control cable connections](#) (p. 62)
- [Option module installation](#) (p. 66)
- [Environmental sensor installation](#) (p. 67)



WARNING! Do not do electrical work on the unit unless you are a qualified electrician. Obey the instructions in Chapter [Safety](#) on page 11. Failure to obey the safety instructions can cause injury or death, electromagnetic interference and equipment malfunction.

Obey all applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaks the local laws or regulations. If you do not obey the recommendations given by ABB, the inverter may experience problems that the warranty does not cover.



Special installation tools

In addition to standard installation tools, you need these tools:

- Torx drivers (T20, T25)
- Philips screwdrivers (PZ1, PZ2)
- Cable and wire strippers
- Crimping tool and cable lugs
- Multimeter

First cover

The electrical installation procedures can require you to remove the first cover.



WARNING! Prevent the heavy cover from falling when you loosen the captive screws.



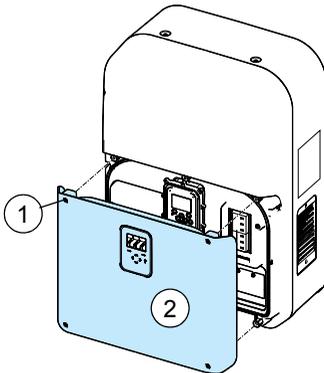
WARNING! When you open the first cover, make sure that water does not go into the inverter.

To remove the first cover:

1. Loosen the 4 captive screws (T25).
2. Hold the heavy cover firmly and pull it towards you.

To attach the first cover:

1. Align the first cover with the unit.
2. Push the cover into place.
3. Tighten the 4 captive screws (T25) to 4 N·m.



DC input cover

The electrical installation procedures can require you to remove the DC input cover.

To remove the DC input cover, you must remove the first cover (refer to [First cover](#) on page 50).



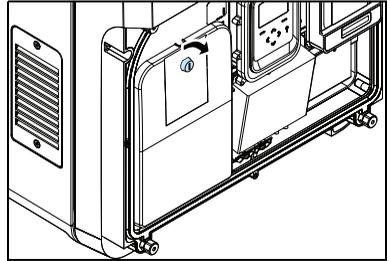
WARNING! Completely isolate the unit from power sources before you open the cover. Obey the instructions in Chapter [Safety](#) on page 11.

To remove the DC input cover:

1. Use a suitable coin or flat screwdriver to turn the lock clockwise.
2. Pull the top of the DC input cover to remove it.

To attach the DC input cover:

1. Align bottom edge of the DC input cover with the unit.
2. Push the top of the cover into place.
3. Turn the lock counterclockwise to lock the DC input cover.



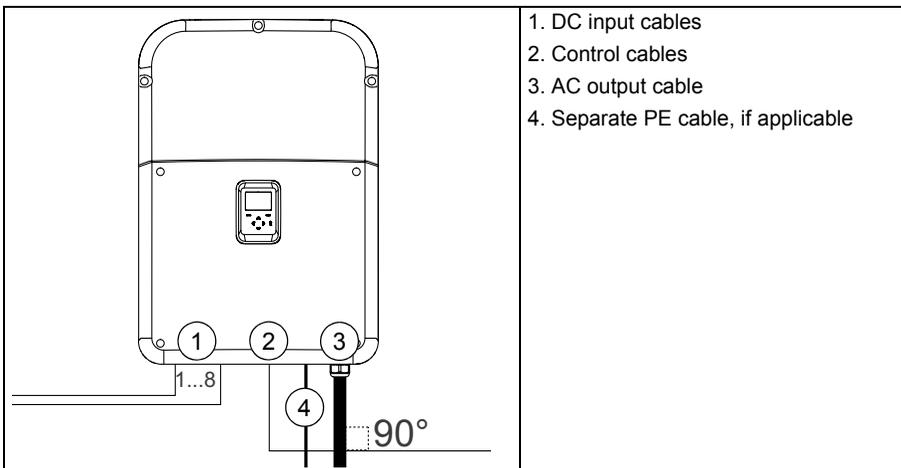
Cable routes

If it is possible, install the input, output and control cables in separate trays.

If the control cables must go over power cables, align them at an angle of 90 degrees. Make sure that the control cables are installed at least 20 cm (8 inches) from the DC input and AC output cables. Do not put any cables behind the inverter.

Ground and bond metal cable trays to each other. Aluminum trays improve potential equalization.

Route all cables so that they do not prevent access to the DC switch (if present).



Insulation test

Before the grid connection, the inverter measures the impedance between the DC terminals and ground. If the impedance is less than the preset value, the inverter shows a fault message and it does not connect to the grid.

■ Inverter

The inverter is tested for insulation between the main circuit and the chassis (1,500 V_{DC}) at the factory. Do not perform any voltage tolerance or insulation resistance tests on any part of the inverter.

■ AC output cable

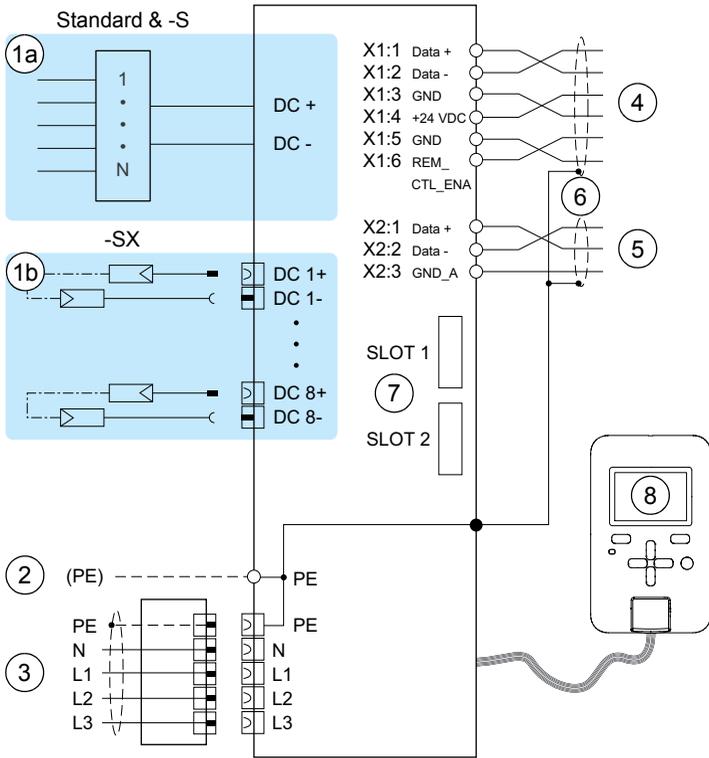
Before you connect the AC output cable, make sure that it obeys the local regulations.

■ PV generator

Make sure that the insulation of the PV generator obeys the local regulations and the manufacturer instructions. Fully disconnect the PV generator from the inverter during the insulation test.



Connection diagram



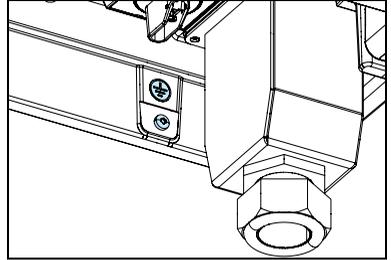
No.	Description	No.	Description
1a	Standard & -S: 1 pair DC input screw terminals and string combiner box	4	Remote control unit terminal X1
		5	Remote monitoring terminal X2
1b	-SX: 8 pairs of PV quick DC connectors	6	Clamp connections for cable shields
2	Additional PE terminal*	7	Option module SLOT 1 and SLOT 2
3	AC cable connector (PE, N, L1, L2, L3)	8	Control unit
* Required if the conductivity of the primary PE conductor is not sufficient. Refer to Power cable requirements on page 37.			

Connection procedure



WARNING! Do not do electrical work on the unit unless you are a qualified electrician. Obey the instructions in Chapter [Safety](#) on page 11. Failure to obey the safety instructions can cause injury or death, electromagnetic interference and equipment malfunction.

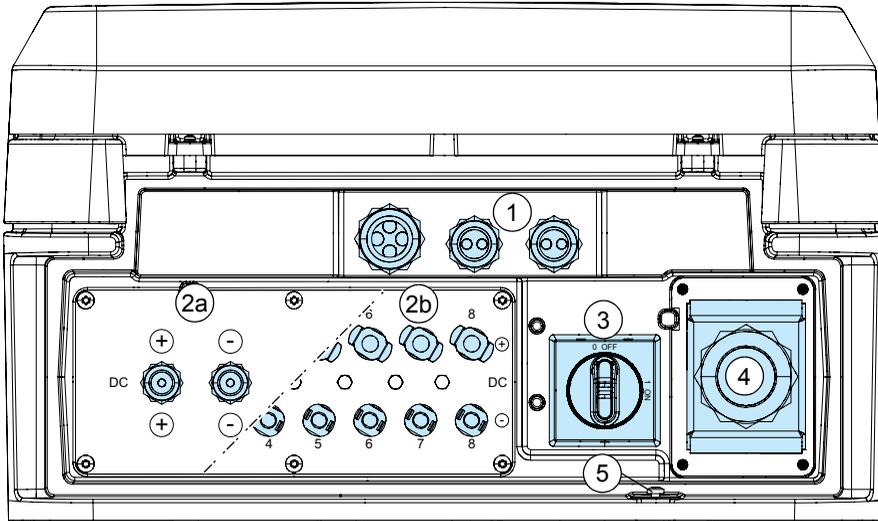
1. Connect the AC cabling. Refer to [AC cabling connection](#) on page 57.
2. If it is necessary, install a protective earth (PE) connection with a cable lug to the auxiliary PE point. Refer to [Power cable requirements](#) on page 37.
3. Connect the DC cables to the inverter:
 - For screw terminals, refer to [DC cabling connection for standard and -S models](#) on page 59.
 - For PV quick connectors, refer to [DC cabling connection for the -SX model](#) page 60.
4. Install the control cables. Refer to [Control cable connections](#) on page 62 and [Control cable glands](#) on page 65.
5. Install the option modules. Refer to [Option module installation](#) on page 66.
6. Make sure that all wiring is correct, safe and secure.



Power cable connections

Refer to [Power cable requirements](#) on page 37.

■ Connection area layout



No.	Description
1	Cable glands for control cables: <ul style="list-style-type: none"> • 1x M32 with a plug insert with four 8 mm holes and plugs. • 2x M25 with a plug insert with two 6 mm holes and plugs.
2a	Standard and -S models: DC input cable glands 2x M20 for cable diameters 6...12 mm.
2b	-SX model: DC inputs with PV quick connectors (16 pcs)
3	DC switch (-S & -SX)
4	AC output connection
5	Position for additional PE cable and cable lug, M5 thread

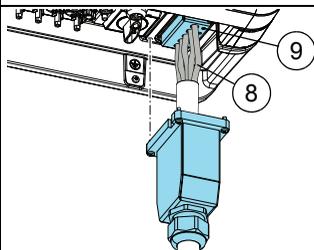
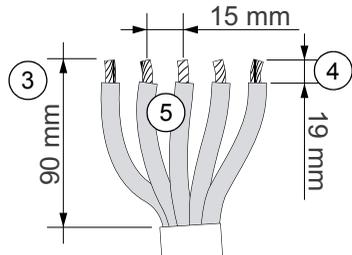


■ AC cabling connection

⚠ WARNING! Do not do electrical work on the unit unless you are a qualified electrician. Obey the instructions in Chapter [Safety](#) on page 11. Failure to obey the safety instructions can cause injury or death, electromagnetic interference and equipment malfunction.

For information on the AC output specifications, refer to [Technical data](#) on page 123.

To connect the AC cable:	
1.	Isolate the inverter from all power sources. Refer to Inverter isolation on page 16.
2.	Put the AC cable through the AC connector housing. If the outer diameter of the cable is 14...26 mm, use a suitable reducer seal. Refer to Recommended AC output cable types on page 37. Note that with aluminium cables, you must remove the non-conductive oxide film from the end of the conductors with a blade, and then immediately dip the conductors into a non-acid and non-alkali, that is, neutral vaseline. You must repeat this procedure, if you connect the conductors again.
3.	Remove 90 mm of the outer insulation jacket from the AC cable.
4.	Remove 19 mm of the insulation jacket of each conductor.
5.	Align the conductors with approximately 15 mm between them. This makes it easier to install the conductors into the AC terminals.
6.	Attach non-insulated wire-end sleeves. Insulated sleeves can cause damage to the AC connector.
7.	If the cable shield is the PE conductor, mark it with insulation tape.
8.	Install the conductors into the L3, L2, L1, N and PE terminals. You can install the phase conductors in any order.
9.	Tighten the terminal screws to 4...4.5 N·m.



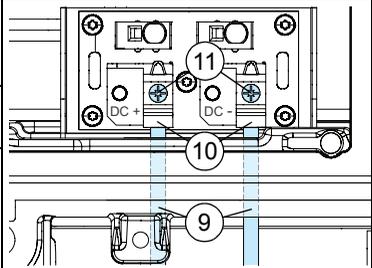
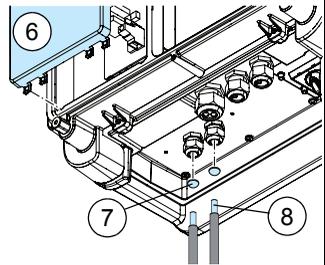
To connect the AC cable:		
10.	Before you put the connector housing in place, make sure that the rubber seal is in position in the inverter frame.	
11.	Tighten the 4 screws to 4 N·m.	
12.	Tighten the cable gland of the connector housing to 7.5 N·m.	
13.	If it is necessary, attach an additional PE connector with a cable lug to the second PE connection point.	



■ DC cabling connection for standard and -S models

 **WARNING!** Do not do electrical work on the unit unless you are a qualified electrician. Obey the instructions in Chapter [Safety](#) on page 11. Failure to obey the safety instructions can cause injury or death, electromagnetic interference and equipment malfunction.

To connect the DC cables on standard and -S models:	
1.	Set the DC switch to off on the inverter (-S model) and isolate the inverter from all power sources. Refer to Inverter isolation on page 16.
2.	Make sure that the strings are compatible with the inverter. Refer to Photovoltaic array and inverter compatibility on page 35.
3.	Make sure that the DC cables are marked with the correct polarity (+ or -). The markings must be permanent so that they can be read throughout the lifetime of the inverter.
4.	Use a voltmeter to make sure that the polarity of the strings is correct. Make sure that the polarity corresponds to the cable markings.
5.	Isolate the DC input cabling from the PV array.
6.	Remove the DC input cover. Refer to DC input cover on page 51.
7.	Remove the cable gland sealing plugs.
8.	Remove 16 mm of the insulation from the cables.
9.	Put the string cables through the cable glands. The cable glands accommodate cable diameters of 6...12 mm.
10.	Put the conductors into the correct screw terminals according to their polarity.
11.	Tighten the screw terminals (with a 1.0x5.5 flat or PZ2 driver) to 2.4...4.0 N·m.
12.	Make sure that the wires are secure and cannot be pulled from the terminals.
13.	Make sure that the polarities are correct.
14.	Make sure that the cables are routed tidily and have no sharp bends.
15.	Tighten the cable glands.
16.	Attach the DC input cover.



■ DC cabling connection for the -SX model



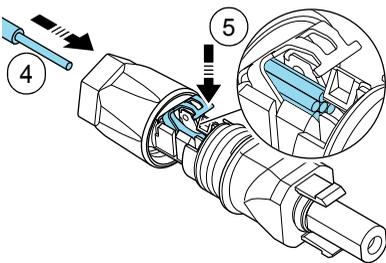
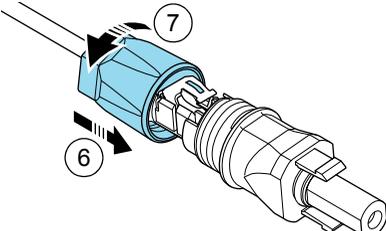
WARNING! Do not do electrical work on the unit unless you are a qualified electrician. Obey the instructions in Chapter [Safety](#) on page [11](#). Failure to obey the safety instructions can cause injury or death, electromagnetic interference and equipment malfunction.

To connect the DC cables on the -SX model:	
1.	Make sure that the DC switch is set to OFF on the inverter.
2.	Isolate the inverter from all power sources. Refer to Inverter isolation on page 16 .
3.	Install the PV quick connectors to the DC input cables. Refer to DC PV quick connector assembly (-SX) on page 61 .
4.	Make sure that the DC cables have permanent string number and polarity markings.
5.	Measure that the polarity of the strings at the DC connectors is correct.
6.	Remove the sealing caps from the applicable connectors at the inverter. Keep the unused sealing caps at the installation site.
7.	Connect the strings to the inverter one string at a time. Start with connectors DC1+ and DC1-. Do not make sharp bends in the cables close to the connectors.
8.	Attach the cables to suitable supports outside the inverter.



■ DC PV quick connector assembly (-SX)

⚠ WARNING! Do not do electrical work on the unit unless you are a qualified electrician. Obey the instructions in Chapter *Safety* on page 11. Failure to obey the safety instructions can cause injury or death, electromagnetic interference and equipment malfunction.

To assemble the PV quick connector:			
1.	Make sure that the DC cables are isolated from power. Refer to <i>Inverter isolation</i> on page 16.		
2.	Use Phoenix Contact SUNCLIX connectors. Make sure that the cables are of the correct type and diameter. Refer to www.phoenixcontact.com for more information.		
	Connector type	Cable cross section	Cable outer diameter
	DC+: PV-CF-S (1774674)	2.5...6.0 mm ²	5.0...8.0 mm
	DC-: PV-CM-S (1774687)		27 A (2.5 mm ²) 40 A (4.0...6.0 mm ²)
3.	Remove 15 mm of the insulation to expose the conductor.		
4.	Install the conductor into the spring cage contact of the connector. Make sure that the conductor is fully in the connector.		
5.	Fully close the spring.		
6.	Install the cable gland over the spring cage contact.		
7.	Tighten the cable gland to 2 N·m.		

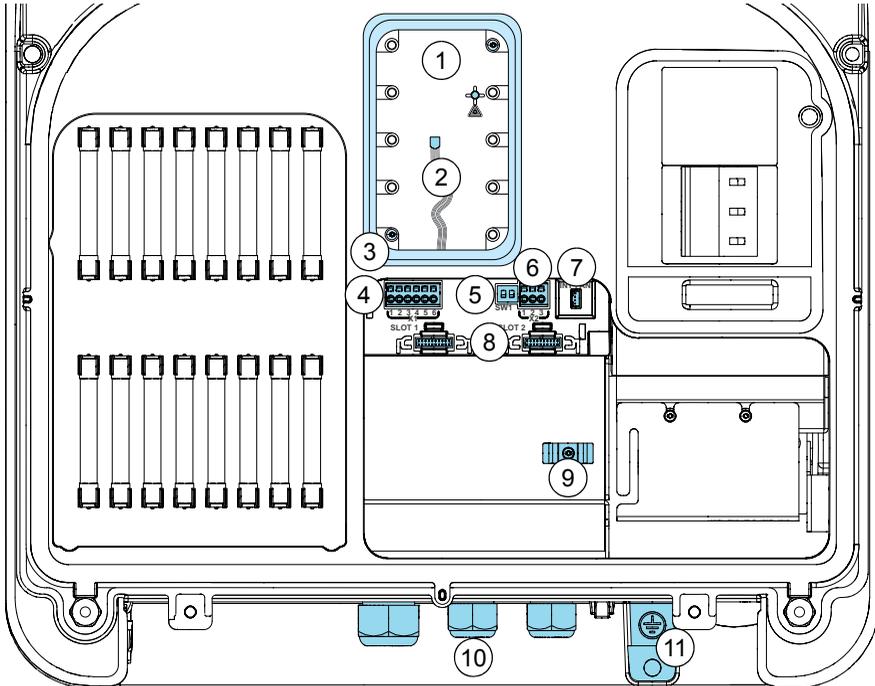


To disassemble the PV quick connector, refer to the manufacturer's documentation.

Control cable connections

Refer to [Control cable requirements](#) on page 38.

■ Connection area layout



No.	Description
1	Status LEDs on control board.
2	X8 RJ45 data type 8P8C plug connector, RS-485 interface for control unit.
3	Control unit support (that can be used as a wall-mounting support).
4	X1 remote control unit spring terminal (RS-485 interface).
5	S1:1 Selector switch, not in use, default always OFF. S1:2 Selector switch for embedded fieldbus network termination (ON), default OFF.
6	X2 remote monitoring spring terminal.
7	Connector for internal fan (Int. Fan).
8	SLOT 1 and SLOT 2 for Fieldbus option modules.
9	Clamp connectors to connect cable shields to protective earth.
10	Cable glands for control cables (1x M32 and 2x M25).
11	Additional PE terminal.

Remote control unit terminal X1

Pin	Name	Description
X1:1	Data +	RS-485 non-inverting signal
X1:2	Data -	RS-485 inverting signal
X1:3	GND	Functional ground
X1:4	+24 VDC	+24 V _{DC} output
X1:5	GND	Functional ground
X1:6	REM_CTL_ENA	Remote control enable signal

Remote monitoring terminal X2

Pin	Name	Description
X2:1	Data +	Inverter RS-485 transmit data
X2:2	Data -	Inverter RS-485 receive data
X2:3	GND_A	Functional ground, isolated

Remote monitoring interface data, termination resistor switch

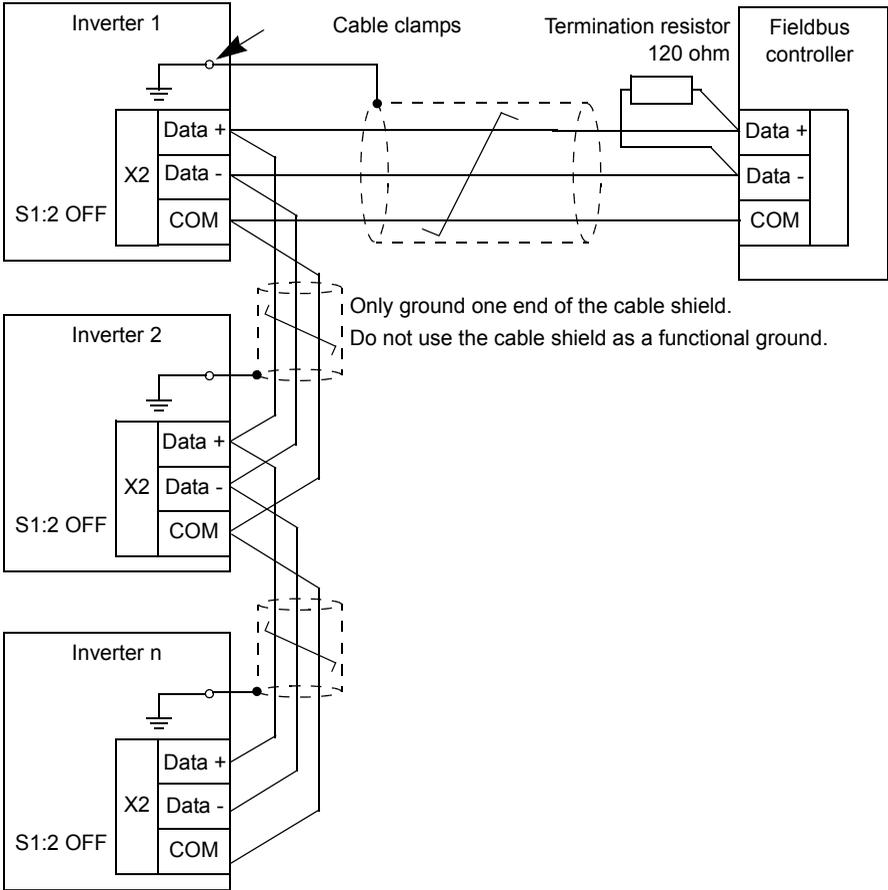
Switch	Name	Description
S1:1	BIAS_ENA	Not used. The default is OFF.
S1:2	TER_ENA	120 ohm termination resistor enable. Set to ON at the end of the embedded fieldbus network. The default is OFF.



Daisy-chaining EIA/RS-485 transmission lines

Daisy-chaining is reliable and recommended when several inverters are connected to Modbus over an EIA/RS485 transmission line.

When wiring a daisy-chain network to the inverter terminals, use suitable crimped wire-end sleeves (with a maximum diameter of 2 mm) to join the wires together for a reliable connection.



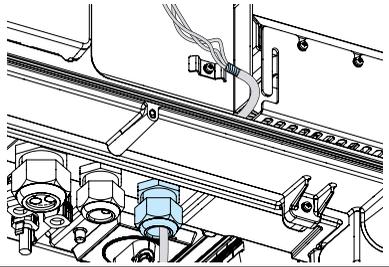
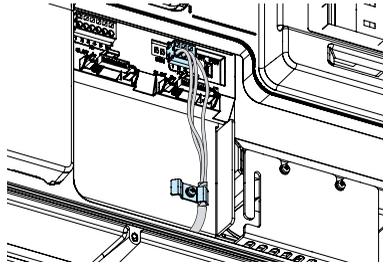
■ Control cable glands

There are three control cable glands at the bottom of the unit:

- 1x M32 gland (4-hole insert with plugs for cables of up to 8 mm) for FIO module cables.
- 2x M25 glands (2-hole insert with plugs for cables of up to 6 mm) for communication cables (middle gland) and remote monitoring (right gland) cables.

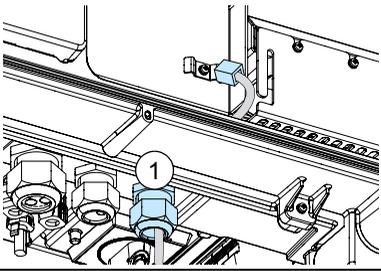
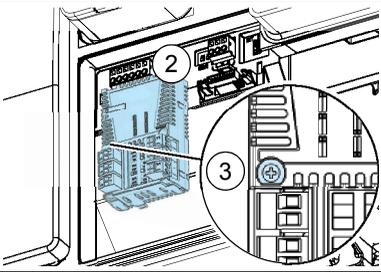
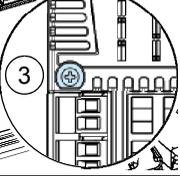
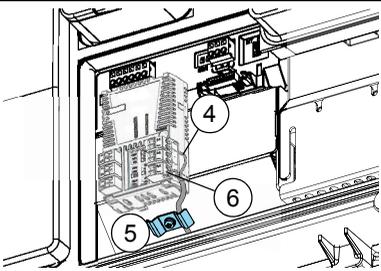
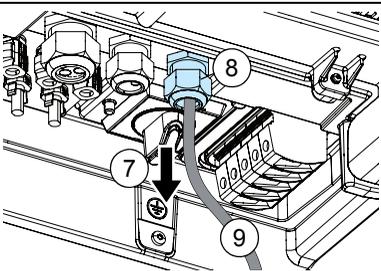
■ Control cable installation

Refer to [Control cable glands](#) on page 65 for information on how to select the gland.

To install the control cables:		
1.	Loosen and remove the gland nut to open the appropriate cable gland.	
2.	Remove the plug insert to remove the required plugs.	
3.	Replace the plug insert and gland nut, but do not tighten the gland.	
4.	Put the cables through the gland.	
5.	Remove 160 mm of the outer cable shell.	
6.	Ground the cable shield with the grounding clamp. Torque the clamp screw to 2 N·m.	
7.	Remove 8...9 mm of the insulation from each wire.	
8.	Install the wires in the appropriate terminals. Refer to Control cable connections on page 62.	
9.	Tighten the gland. Make sure that the gland seals around the cable and that the cable does not move when pulled.	



Option module installation

To install an option module:		
1.	Install the applicable cables for the option module. Refer to Control cable glands on page 65 and Control cable installation on page 65.	
2.	Install the option module in the correct slot: <ul style="list-style-type: none"> • I/O extension modules in SLOT 1 • Fieldbus adapter modules in SLOT 2 	
3.	Tighten the option module fixing screw.	
4.	If it is necessary, prepare the cable wires. Refer to the instructions in the option module kit.	
5.	If it is necessary, ground the cable shields to the grounding clamps.	
6.	Connect the applicable control cables to the option module connectors.	
7.	Pull the excess cable through the gland.	
8.	Tighten the cable gland.	
9.	Make sure that the cable cannot be pulled through the cable gland.	



Environmental sensor installation

To connect external environmental sensors to the inverter, install the FIO-11 Analog I/O extension module. Refer to [Option module installation](#) on page 66 and *FIO-11 Analog I/O extension user's manual* (3AFE68784930 [EN]).

If the external sensor requires a power supply, connect it to the X1 remote control unit terminal. Note that if the remote control unit and environmental sensors require a power supply, you cannot use them at the same time.

Supported environmental sensors

The supported environmental sensors and the correct FIO-11 terminals:

Model	Type	Output signal	FIO-11 terminal mode	FIO-11 terminals	Power supply +24 V _{DC}	In menu
PVI-AEC-IRR	Irradiation sensor	0...10 V _{DC}	X73:AI3 voltage input	X73:AI3	X1	Irradiation 1
PVI-AEC-IRR-T	Irradiation sensor with cell temp. sensor	0...10 V _{DC}	X72:AI2 & X73:AI3 voltage input	X72:AI2 temp X73:AI3 irradiation	X1	Temperature 2 Irradiation 1
PVI-AEC-RAD-13TC	Irradiation sensor	0...10 V _{DC}	X73:AI3 voltage input	X73:AI3	X1	Irradiation 1
PVI-AEC-RAD-13TC-T	Irradiation sensor with cell temp. sensor	0...10 V _{DC}	X72:AI2 & X73:AI3 voltage input	X72:AI2 X73:AI3	X1	Temperature 2 Irradiation 1
PVI-AEC-CONV-T100	PT100/0...10V converter	0...10 V _{DC}	X72:AI2 voltage input	X72:AI2	X1	Temperature 2
PVI-AEC-T1000-INTEGR	Ambient temp. sensor with integrated converter	0...10 V _{DC}	X72:AI2 voltage input	X72:AI2	X1	Temperature 2
PVI-AEC-PYR-1300	Pyranometer 0...1300 W/m ²	0...20 mA	X73:AI3 current input	X73:AI3	X1	Irradiation 2
PVI-AEC-T100-ADH	Adhesive PT100 module temp. sensor	3-wire	X71:AI1 voltage input X74:AO1 current output	X71:AI1 X74:AO1	No	PT sensor temperature
PVI-AEC-T1000-BOX	PT1000 ambient temperature sensor	3-wire	X71:AI1v oltage input X74:AO1 current output	X71:AI1 X74:AO1	No	PT sensor temperature



■ Connection diagrams for the environmental sensors

Connect the environmental sensors as follows:

Model	Type	Connection diagram	Connections
PVI-AEC-IRR PVI-AEC-RAD-13TC	Irradiation sensor		<ol style="list-style-type: none"> 1. X73, AI3+ 2. Control board X1, pin 4, +24 V_{DC} 3. X73, AI3- Control board X1, pin 5, GND
PVI-AEC-IRR-T PVI-AEC-RAD-13TC-T	Irradiation sensor with cell temp. sensor		<ol style="list-style-type: none"> 1. X72, AI2+ 2. X73, AI3+ 3. Control board X1, pin 4, +24 V_{DC} 4. X72, AI2- X73, AI3- Control board X1, pin 5, GND
PVI-AEC-T1000-INTEGR	Ambient temp. sensor with integrated converter		<ol style="list-style-type: none"> 1. X72, AI2+ 2. Control board X1, pin 4, +24 V_{DC} 3. X72, AI2- Control board X1, pin 5, GND
PVI-AEC-T100-ADH	Adhesive PT100 module temp. sensor		<ol style="list-style-type: none"> 1. X71, AI1+ 2. X74, AO+ 3. X71, AI1- 4. X74, AO-
PVI-AEC-T1000-BOX	PT1000 ambient temperature sensor		<ol style="list-style-type: none"> 1. X71, AI1+ 2. X74, AO+ 3. X71, AI1- 4. X74, AO-



■ Environmental sensor installation procedure

To install an environmental sensor:

1. Isolate the inverter from all power sources. Refer to [Inverter isolation](#) on page 16.
2. Install the FIO-11 Analog I/O extension module. Refer to [Option module installation](#) on page 66 and [FIO-11 Analog I/O extension user's manual](#) (3AFE68784930 [EN]).
3. To connect the environmental sensor, refer to [Supported environmental sensors](#) on page 67 and [Connection diagrams for the environmental sensors](#) on page 68.
4. Connect the inverter.
5. Start the inverter.
6. Set the inverter operation to *Disabled*. Refer to [Service submenu](#) on page 97.
7. Do the set up for the FIO-11 Analog I/O extension module.
 - In the control unit, open *Menu -> Communication -> Extension I/O*.
 - Select *FIO-11* as the option module type.
 - To configure the environmental sensor, refer to the [PRO-33.0-TL Service menu guide](#) (3AXD50000015823 [EN]).
8. Set the inverter operation to *Enable*. Refer to [Service submenu](#) on page 97.







Installation checklist

Two persons are needed to read and fill in the checklist. Obey the instructions in chapter [Safety](#) on page [11](#) before you do work on the inverter.

Site owner and contact details:	Installation company and address:
Site address:	Installer names and contact details:
	1.
	2.

Checklist

Inverter types:	
<input type="checkbox"/>	PRO-33.0-TL-OUTD-400 QTY: ___ pcs.
<input type="checkbox"/>	PRO-33.0-TL-OUTD-S-400 QTY: ___ pcs.
<input type="checkbox"/>	PRO-33.0-TL-OUTD-SX-400 QTY: ___ pcs.

Accessories:	
<input type="checkbox"/>	FIO-01 I/O module QTY: ___ pcs.
<input type="checkbox"/>	FIO-11 I/O module QTY: ___ pcs.

Accessories:	
<input type="checkbox"/> PV quick connector cable-side kit (-SX)	QTY: ____ pcs.

Mechanical installation (refer to Mechanical installation on page 41)	
	Make sure that:
<input type="checkbox"/>	The mechanical installation and markings correspond to the system's layout and design drawings.
<input type="checkbox"/>	The installation area is properly selected.
<input type="checkbox"/>	There is sufficient free space and cooling airflow (refer to Required installation clearances on page 132).
<input type="checkbox"/>	The ambient operating conditions are suitable (refer to Technical data on page 123).
<input type="checkbox"/>	The inverter is properly fastened to the installation base and secured to mounting plate.
<input type="checkbox"/>	There are no tools, foreign objects or dust from drilling outside or inside of the inverter.
<input type="checkbox"/>	The type labels on the inverters are intact and visible.
<input type="checkbox"/>	The user's guide is near the inverter where users can find it.

Electrical installation (refer to Electrical installation on page 49)	
	Make sure that:
<input type="checkbox"/>	The electrical installation and markings correspond to the system's wiring diagrams.
<input type="checkbox"/>	The electrical installation and markings correspond to the AC distribution board wiring diagrams.
<input type="checkbox"/>	The electrical ratings of the PV array and components are compatible with the inverter.
<input type="checkbox"/>	The PV array and string voltages do not exceed the maximum input voltage of the inverter. Note: In low temperatures, PV string voltages tend to increase from the nominal.
<input type="checkbox"/>	The AC line (grid) voltage matches the nominal output voltage (400 V _{AC} line-to-line) of the inverter.
<input type="checkbox"/>	The DC power cable connections at the DC+ and DC- connectors are correct, and that the polarity of the connected strings is correct. Make sure that the cables are properly secured and cannot be pulled from the inverter.
<input type="checkbox"/>	Unused DC input connectors or cable glands have sealing caps on.
<input type="checkbox"/>	The DC string fuses are rated correctly (refer to Technical data on page 123).
<input type="checkbox"/>	-SX model: The inverter has string fuses for each input. If string fuses are not installed in the inverter, make sure that the external fuses have the correct rating for your installation.
<input type="checkbox"/>	The insulation of the assembly is sufficient (refer to Insulation test on page 53).
<input type="checkbox"/>	The inverter has a proper connection to the Protective Earth (refer to Grounding safety (PE) on page 17).
<input type="checkbox"/>	The AC power cable connections at L1, L2, L3 and PE and their tightening torques are correct (refer to AC cabling connection on page 57).
<input type="checkbox"/>	The power cables are routed correctly (refer to Cable routes on page 52).

Electrical installation (refer to <i>Electrical installation</i> on page 49)	
<input type="checkbox"/>	The external control connections to the inverter are OK (refer to <i>Control cable connections</i> on page 62).
<input type="checkbox"/>	The external line circuit breakers have correct ratings (refer to <i>Technical data</i> on page 123).
<input type="checkbox"/>	The AC distribution board is installed, wired and inspected correctly, and according to local regulations.
<input type="checkbox"/>	The external AC distribution board and its line circuit breakers and fuses can be accessed.
<input type="checkbox"/>	All shrouds and covers are in place and secured.

Control installation (refer to <i>Electrical installation</i> on page 49 and <i>Start-up</i> on page 75)	
	If external monitoring or control is used, make sure that:
<input type="checkbox"/>	A suitable communication cable is used (refer to <i>Control cable requirements</i> on page 38).
<input type="checkbox"/>	The daisy-chaining of the communication cable is correct (refer to <i>Control cable connections</i> on page 62 and <i>Daisy-chaining EIA/RS-485 transmission lines</i> on page 64).
<input type="checkbox"/>	The remote monitoring setups are properly configured and tested (refer to <i>Remote monitoring setup</i> on page 80).
<input type="checkbox"/>	If a datalogger connection to the internet is used, the internet connection operates.

Serial numbers of installed inverters:	
Installation checked (DD/MM/YYYY):	
Installer signatures:	

8

Start-up

Chapter contents

- [Before start up](#) (p. 75)
- [First start up](#) (p. 76)
- [List of country codes](#) (p. 79)
- [Remote monitoring setup](#) (p. 80)
- [String configuration assistant \(-SX model\)](#) (p. 83)
- [Programmable relay configuration using FIO-01 module](#) (p. 85)



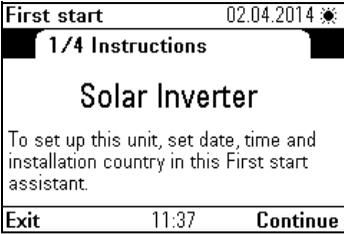
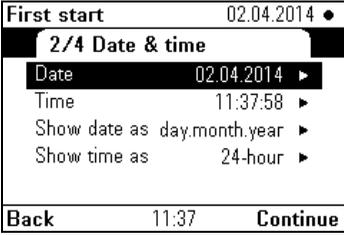
WARNING! Only qualified electricians are permitted to do the start-up. Obey the safety instructions in chapter [Safety](#) on page 11.

Before start up

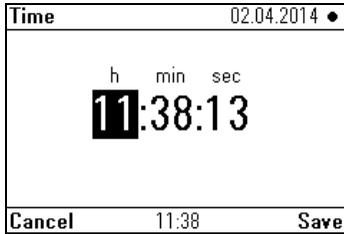
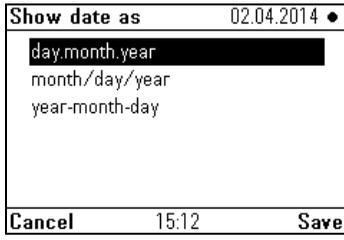
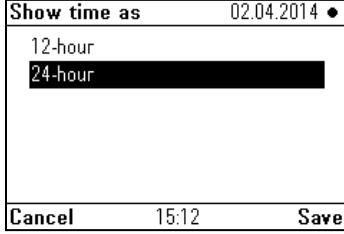
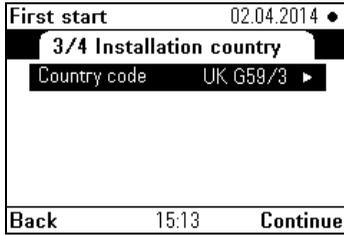
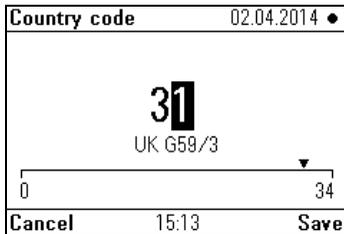
Preliminary procedures	
<input type="checkbox"/>	Make sure that the mechanical and electrical installation of the inverter is correct. Refer to chapter Installation checklist on page 71.
<input type="checkbox"/>	Make sure that the mechanical and electrical installation of the rest of the photovoltaic (PV) system is finished and inspected.
<input type="checkbox"/>	Make sure that the grid owner (or other local authority) is informed about the planned grid connection of the photovoltaic (PV) system and that the plan is approved.
<input type="checkbox"/>	Make sure that the PV array gets sufficient sunlight during the start-up procedure. Although the inverter can be started without daylight, adequate sunlight is needed to make sure that the PV array and grid feed work correctly.



First start up

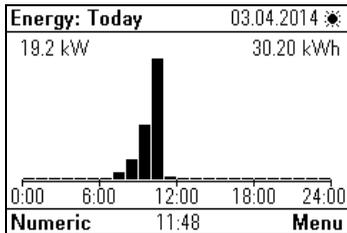
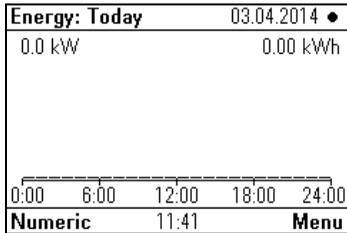
First start-up procedures	
<input type="checkbox"/>	Set the AC line circuit breaker to ON at the AC distribution board.
<input type="checkbox"/>	Wait for the inverter to start.
<input type="checkbox"/>	<p>After the start-up sequence, select the user interface language with the up and down arrow keys.</p> <p>English is the default language.</p> <p>After you select the language, wait for the control unit to load the language.</p>
	
<input type="checkbox"/>	The <i>First start</i> assistant opens when the inverter starts for the first time and until the settings are confirmed.
<input type="checkbox"/>	Push the right softkey to continue.
	
<input type="checkbox"/>	Next, set the date, time and their formats. To set the date, select <i>Date</i> and push the right arrow key.
	
<input type="checkbox"/>	Set the date with the up and down arrow keys. Move between the day, month and year with the right and left arrow keys.
<input type="checkbox"/>	Push the right softkey to save the date.
	



First start-up procedures	
<input type="checkbox"/> Select <i>Time</i> and push the right arrow key. Set the time with the up and down arrow keys. Use the right and left arrow keys to move between the hours, minutes and seconds.	
<input type="checkbox"/> Push the right softkey to save the time.	
<input type="checkbox"/> Select <i>Show date as</i> and push the right arrow key. Select the date format and push the right softkey to save the format.	
<input type="checkbox"/> Select <i>Show time as</i> and push the right arrow key. Select the time format and push the right softkey to save the format.	
<input type="checkbox"/> To set the grid code settings, select <i>Country code</i> and push the right arrow key. Refer to List of country codes on page 79.	
<input type="checkbox"/> Select the country code with the left and right arrow keys. This sets the correct grid connection parameters for the location. If the installation country is not in the list, contact your supplier to make sure that the inverter can be used in your country. Push the right softkey to save the installation country.	



First start-up procedures	
<input type="checkbox"/>	Make sure that the date, time and installation country settings are correct.
<input type="checkbox"/>	If you need to correct the settings, push Back with the left softkey.
<input type="checkbox"/>	Push the right softkey to confirm the installation country. Only authorized ABB service partners can change the installation country.
<input type="checkbox"/>	The <i>Energy: Today</i> view is shown.
<input type="checkbox"/>	On the -S and -SX models, set the inverter DC switch to ON. Set the external DC switches or circuit breakers to ON.
<input type="checkbox"/>	When adequate DC voltage is available, the inverter starts to transfer power from the PV arrays. The inverter then does the system safety checks. If the safety checks complete without errors, the inverter connects to the AC grid.

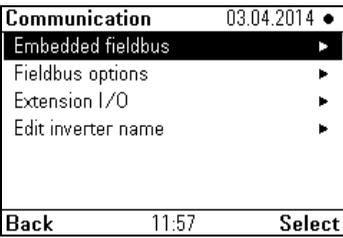


List of country codes

No.	Country	Grid codes
1	Australia	AS4777.3 (2005)
2	Austria	EN50438 + Önorm E8001-4-712
3	Belgium	C10/C11
4	Brazil	CEI-021+ ABT-NBR
5	China	N/A
6	Custom	N/A
7	Cyprus	EN50438 (2013) Cyprus limits
8	Czech	EN50438 (2013) Czech limits
9	Denmark	VDE4105 + EN50438 Danish limit
10	Finland	VDE4105 (2011)
11	France	VDE0126/A1 VFR2014
12	Germany LV	VDE4105 (2011)
13	Germany MV	BDEW/TR3/TR4/TR8
14	Greece	PPC Greece
15	Israel	AS4777.3 (2005)
16	Italy LV	CEI 0-21 (2013/12)
17	Italy MV	CEI 0-16 (2013/12)
18	New Zealand	AS4777.3 (2005)
19	Poland	EN50438 (2013) Generic
20	Portugal	EN50438 (2013) Generic
21	Romania	VDE0126 (2013)
22	Singapore	G59/3
23	Slovakia	VDE0126 (2013)
24	South Africa	SAGC 2.6 Category A3
25	Spain	RD661(2007) >100 kW
26	Sweden	EN50438 (Swedish limits) (2013)
27	Switzerland	VDE4105 (2011)
28	Taiwan	VDE4105 (2011) + 380V/60Hz
29	Thailand MEA	MEA (2013)
30	Thailand PEA	PEA (2013)
31	Turkey LV	VDE4105 (2011)
32	UK	G59/3
33	Turkey HV	BDEW/TR3/TR4/TR8



Remote monitoring setup

To set up the remote monitoring interface:			
<input type="checkbox"/>	From Menu -> Communication -> Embedded Fieldbus	 <p>The screenshot shows a menu titled 'Communication' with the date '03.04.2014' and a diamond icon. The menu items are: 'Embedded fieldbus' (highlighted with a black background and a right-pointing arrow), 'Fieldbus options' (with a right-pointing arrow), 'Extension I/O' (with a right-pointing arrow), and 'Edit inverter name' (with a right-pointing arrow). At the bottom of the menu, there is a 'Back' button, the time '11:57', and a 'Select' button.</p>	
<input type="checkbox"/>	Set parameters: To change parameter values: 1. Do the changes to a parameter. 2. Select the <i>Comm control</i> parameter. 3. Select <i>Refresh settings</i> .		
	Parameter	Values	Description
	<i>Protocol enable</i>	None Modbus RTU (default)	Enables/disables the embedded fieldbus interface and selects the protocol to use. No communication. EFB is enabled and it uses the Modbus RTU protocol.
	<i>Node address</i>	1...247 (default: 1)	Node address of the inverter. All devices must have different addresses.
	<i>Baud rate</i>	Autodetect 9.6 kbps, 19.2 kbps, 38.4 kbps, 57.6 kbps, 76.8 kbps, 115.2 kbps	Sets the data transfer rate. The inverter automatically sets the transfer rate after monitoring traffic. Note: Set the Parity parameter before you enable autodetection. The default value is 19.2 kbps.
	<i>Parity</i>	8 NONE 1 (default) 8 NONE 2 8 EVEN 1 8 ODD 1	Sets the number of data bits, the type of the parity bit and the number of stop bits. 8 data bits, no parity bit, 1 stop bit 8 data bits, no parity bit, 2 stop bits 8 data bits, even parity bit, 1 stop bit 8 data bits, odd parity bit, 1 stop bit



To set up the remote monitoring interface:			
	<i>Comm control</i>		Commits the changes in the EFB settings or activates the silent mode.
		<i>Enabled</i>	Normal operation.
		<i>Refresh settings</i>	Commits the modified EFB settings. Reverts automatically to <i>Enabled</i> .
		<i>Silent mode</i>	Activates the silent mode (no messages are transmitted). The silent mode can be canceled with the <i>Refresh settings</i> item.
	<i>Comm diagnostics</i>	Bit positions:	Status of the EFB communication. Read-only parameter.
		<i>0 – Init failed</i>	1 = EFB initialization failed
		<i>1 – Addr config err</i>	1 = Node address not allowed by protocol
		<i>2 – Silent mode</i>	1 = Inverter not allowed to transmit 0 = Inverter allowed to transmit
		<i>3 – Autobauding</i>	1 = Inverter attempting to determine transfer rate
		<i>4 – Wiring error</i>	1 = Errors detected (Data+/Data-wires possibly swapped)
		<i>5 – Parity error</i>	1 = Error detected: Check the <i>Baud rate</i> and <i>Parity</i> parameters.
		<i>6 – Baud rate error</i>	1 = Error detected: Check the <i>Baud rate</i> and <i>Parity</i> parameters.
		<i>7 – No bus activity</i>	1 = 0 bytes received in last 5 seconds.
		<i>8 – No packets</i>	1 = 0 packets (addressed to any device) detected in last 5 seconds.
		<i>9 – Noise or addressing error</i>	1 = Errors detected: Interference or another device online with the same address.
		<i>10 – Comm loss</i>	1 = 0 packets addressed to the inverter received within timeout.
		<i>11 – CW/Ref loss</i>	1 = No control word or references received within timeout.
		<i>12 – Not active</i>	Reserved.
		<i>13 – Protocol 1</i>	1 = Protocol-dependent status information.
<i>14 – Protocol 2</i>	1 = Protocol-dependent status information.		
<i>15 – Internal error</i>	1 = Problem with the calls to the inverter control program.		



To set up the remote monitoring interface:			
	<i>Received packets</i>	0...4294967295	Count of the received valid packets addressed to the inverter. In normal operation, the number increases constantly. To reset the count, push the <i>Reset</i> button on the control unit for 3 seconds.
	<i>Transmitted packets</i>	0...4294967295	Count of the transmitted valid packets addressed to the inverter. In normal operation, the number increases constantly. To reset the count, push the <i>Reset</i> button on the control unit for 3 seconds.
	<i>All packets</i>	0...4294967295	Count of the valid packets addressed to any device on the bus. In normal operation, the number increases constantly. To reset the count, push the <i>Reset</i> button on the control unit for 3 seconds.
	<i>UART errors</i>	0...4294967295	Count of the character errors received by the inverter. An increasing count indicates a configuration problem. To reset the count, push the <i>Reset</i> button on the control unit for 3 seconds.
	<i>CRC errors</i>	0...4294967295	Count of the packets with a CRC error received by the inverter. An increasing count indicates interference on the bus. To reset the count, push the <i>Reset</i> button on the control unit for 3 seconds.



String configuration assistant (-SX model)

The -SX inverter model measures each individual string current. When the function operates, it detects reverse string currents, blown fuses and current deviations in the measured strings. The standard and -S models can detect a reverse total input current.

In the -SX model, string monitoring measures the current in each string and compares it to the average current of selected strings. The feature generates a warning when the current in one of the strings deviates from the average. You can set the threshold value with the string configuration assistant. You can use this feature to give a message of strings with low performance to the PV plant operator. The string monitoring function is not enabled by default.

String configuration													
<input type="checkbox"/>	From the <i>Main</i> view, select <i>Menu</i> with the right softkey.												
<input type="checkbox"/>	<div style="display: flex; align-items: flex-start;"> <div style="flex: 1;"> <p>Select <i>String monitoring</i>.</p> </div> <div style="flex: 2; border: 1px solid black; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: left;">Menu</td> <td style="text-align: right;">03.04.2014 ☀</td> </tr> <tr> <td> Communication</td> <td style="text-align: right;">▶</td> </tr> <tr> <td> System info</td> <td style="text-align: right;">▶</td> </tr> <tr> <td> Backups</td> <td style="text-align: right;">▶</td> </tr> <tr> <td> String monitoring</td> <td style="text-align: right;">▶</td> </tr> <tr> <td>Exit</td> <td style="text-align: right;">11:52 Select</td> </tr> </table> </div> </div>	Menu	03.04.2014 ☀	 Communication	▶	 System info	▶	 Backups	▶	 String monitoring	▶	Exit	11:52 Select
Menu	03.04.2014 ☀												
 Communication	▶												
 System info	▶												
 Backups	▶												
 String monitoring	▶												
Exit	11:52 Select												
<input type="checkbox"/>	<div style="display: flex; align-items: flex-start;"> <div style="flex: 1;"> <p>Select <i>String configuration</i>.</p> </div> <div style="flex: 2; border: 1px solid black; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: left;">String monitoring</td> <td style="text-align: right;">03.04.2014 ☀</td> </tr> <tr> <td>String configuration</td> <td style="text-align: right;">▶</td> </tr> <tr> <td>String currents</td> <td style="text-align: right;">▶</td> </tr> <tr> <td>Back</td> <td style="text-align: right;">11:54 Select</td> </tr> </table> </div> </div>	String monitoring	03.04.2014 ☀	String configuration	▶	String currents	▶	Back	11:54 Select				
String monitoring	03.04.2014 ☀												
String configuration	▶												
String currents	▶												
Back	11:54 Select												
<input type="checkbox"/>	<div style="display: flex; align-items: flex-start;"> <div style="flex: 1;"> <p>Push the right softkey to continue.</p> </div> <div style="flex: 2; border: 1px solid black; padding: 5px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: left;">String configuration</td> <td style="text-align: right;">03.04.2014 ☀</td> </tr> <tr> <td colspan="2" style="text-align: center;">1/6 Instructions</td> </tr> <tr> <td colspan="2">Take string current monitoring into use. If you want to proceed press Continue. Otherwise press Exit.</td> </tr> <tr> <td>Exit</td> <td style="text-align: right;">11:54 Continue</td> </tr> </table> </div> </div>	String configuration	03.04.2014 ☀	1/6 Instructions		Take string current monitoring into use. If you want to proceed press Continue. Otherwise press Exit.		Exit	11:54 Continue				
String configuration	03.04.2014 ☀												
1/6 Instructions													
Take string current monitoring into use. If you want to proceed press Continue. Otherwise press Exit.													
Exit	11:54 Continue												



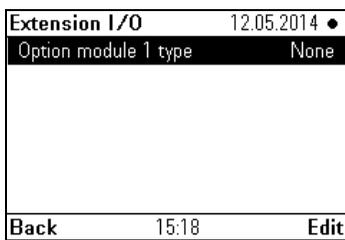
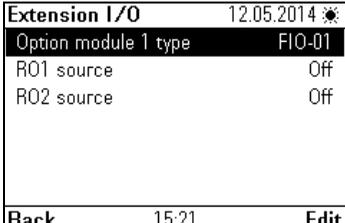
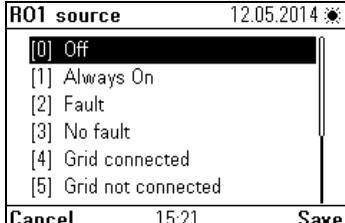
String configuration									
<input type="checkbox"/> Push the right softkey to continue.	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: right;">String configuration 03.04.2014 ☀</p> <p style="text-align: center;">2/6 Instructions</p> <p>Check which strings are connected to the inverter. Use up and down arrows to select string and right arrow to modify. To continue without editing press Continue.</p> <hr/> <p style="text-align: right;">Back 11:54 Continue</p> </div>								
<input type="checkbox"/> Tick the boxes to select the applicable strings. Push the right softkey to continue.	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: right;">String configuration 03.04.2014 ☀</p> <p style="text-align: center;">3/6 Select strings</p> <p>Select which strings are connected.</p> <p><input checked="" type="checkbox"/> 5</p> <p><input checked="" type="checkbox"/> 6</p> <p><input checked="" type="checkbox"/> 7</p> <p><input type="checkbox"/> 8 Select ▶</p> <hr/> <p style="text-align: right;">Back 11:54 Continue</p> </div>								
<input type="checkbox"/> Push the right softkey to continue.	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: right;">String configuration 03.04.2014 ☀</p> <p style="text-align: center;">4/6 Monitored strings</p> <table style="width: 100%; border: none;"> <tr> <td><input checked="" type="checkbox"/> 1</td> <td><input checked="" type="checkbox"/> 5</td> </tr> <tr> <td><input checked="" type="checkbox"/> 2</td> <td><input checked="" type="checkbox"/> 6</td> </tr> <tr> <td><input checked="" type="checkbox"/> 3</td> <td><input checked="" type="checkbox"/> 7</td> </tr> <tr> <td><input checked="" type="checkbox"/> 4</td> <td><input type="checkbox"/> 8</td> </tr> </table> <hr/> <p style="text-align: right;">Back 11:54 Continue</p> </div>	<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 5	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 6	<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 7	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 8
<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 5								
<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 6								
<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 7								
<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 8								
<input type="checkbox"/> Set the alarm limits. A warning is displayed if the current deviation in a string is more than the set limit. The limit is in percentages of the average current of the monitored strings. Push the right softkey to continue.	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: right;">String configuration 03.04.2014 ☀</p> <p style="text-align: center;">5/6 Set alarm limit</p> <p>Set relative current alarm limits for String Current Monitoring.</p> <p style="text-align: right;">Input DC current limit 30 % ▶</p> <hr/> <p style="text-align: right;">Back 11:54 Continue</p> </div>								
<input type="checkbox"/> Push the right softkey to confirm the string current monitoring settings. Push the left softkey to exit the assistant without making any changes.	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: right;">String configuration 03.04.2014 ☀</p> <p style="text-align: center;">6/6 Confirmation</p> <p>Complete settings by pressing Confirm. If you want to exit without changing anything press Exit.</p> <hr/> <p style="text-align: right;">Exit 11:54 Confirm</p> </div>								



Programmable relay configuration using FIO-01 module

The inverter supports RO1 and RO2 relay output configurations. You can set the relay outputs to show the status of the inverter with an audible alarm or a signal light.

For installation information, refer to [Option module installation](#) on page 66 and the FIO-01 user manual.

To configure the FIO-01 extension module:		
<input type="checkbox"/>	Open Menu -> Communication -> Extension I/O.	 <p>Extension I/O 12.05.2014 ●</p> <p>Option module 1 type None</p> <p>Back 15:18 Edit</p>
<input type="checkbox"/>	Select <i>Option module 1 type</i> and then <i>FIO-01</i> .	 <p>Extension I/O 12.05.2014 ☼</p> <p>Option module 1 type FIO-01</p> <p>RO1 source Off</p> <p>RO2 source Off</p> <p>Back 15:21 Edit</p>
<input type="checkbox"/>	Select the source for the relay output. Refer to Relay output source values on page 86.	 <p>RO1 source 12.05.2014 ☼</p> <p>[0] Off</p> <p>[1] Always On</p> <p>[2] Fault</p> <p>[3] No fault</p> <p>[4] Grid connected</p> <p>[5] Grid not connected</p> <p>Cancel 15:21 Save</p>



■ Relay output source values

Name/value	Description
[0] Off	The relay output activates when the inverter is off.
[1] Always on	The relay output activates when the inverter is on.
[2] Fault	The relay output activates when there is a fault.
[3] No Fault	The relay output activates when there is no fault.
[4] Grid connected	The relay output activates when there is grid connection.
[5] Grid not connected	The relay output activates when there is no grid connection.
[6] Power level 20%	The relay output activates when the output power is more than 20% of the rated power.
[7] Power level 40%	The relay output activates when the output power is more than 40% of the rated power.
[8] Power level 70%	The relay output activates when the output power is more than 70% of the rated power.





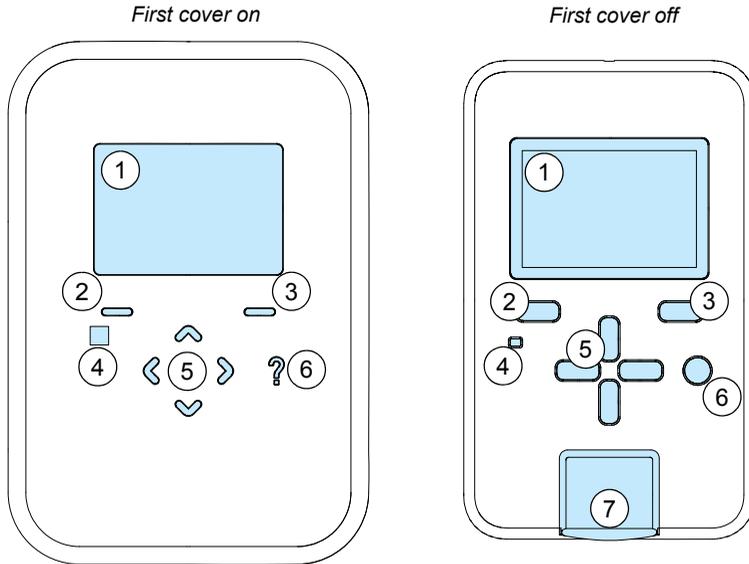
Operation

Chapter contents

- [User interface](#) (p. 88)
 - [Operating modes](#) (p. 89)
 - [Control buttons](#) (p. 90)
 - [LED status indicators](#) (p. 91)
 - [Graphical display](#) (p. 92)
 - [USB connector](#) (p. 98)
 - [Remote control unit installation](#) (p. 99)
 - [To connect the control unit to a PC](#) (p. 100)
 - [To connect the ABB PC tool to the inverter](#) (p. 100)
 - [To move files between the control unit and a PC](#) (p. 100)
-

User interface

The control unit is behind the first cover. Normally, you control the inverter with the buttons on the first cover.

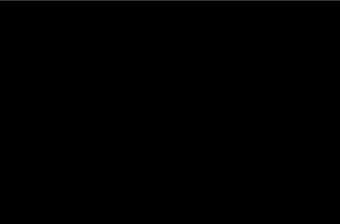
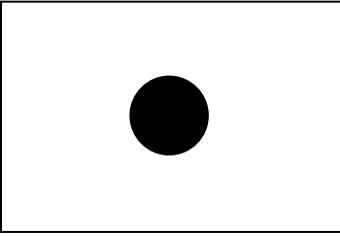
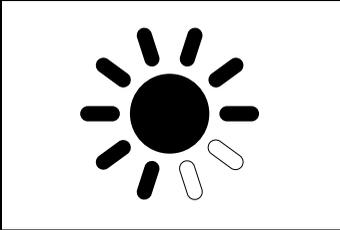


No.	Description
1	Graphical display
2	Left softkey
3	Right softkey
4	Status LED, dual color green or red
5	Up/Down/Left/Right arrow keys
6	Help key
7	USB connector and lid (for service use only)

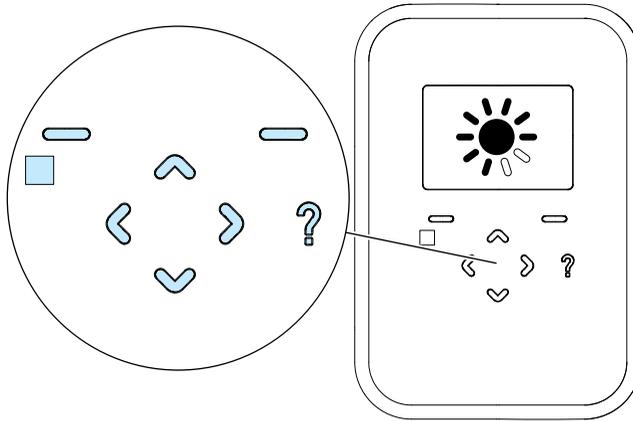
The user interface is a control unit with buttons, LEDs and a graphical display. There are status LEDs also on the inverter control board, which are visible when the control unit is removed. Refer to [LED status indicators](#) on page 91.

For information on the user interface menu structure, refer to [Navigation map](#) on page 133.

Operating modes

Mode	Example view	Description
Sleep		<p>A low power mode with only essential functions. The inverter starts the sleep mode when the DC input voltage is less than the threshold value and there is no control unit activity. The power meter shows "-- kW".</p>
Stand-by		<p>From the sleep mode, the inverter goes to the stand-by mode when the DC voltage increases to more than the threshold value or when there is control unit activity.</p> <p>In the stand-by mode, the inverter monitors the grid connection. The power meter shows "-- kW".</p> <p>In the stand-by mode, the inverter can draw power from the PV array or electrical grid.</p>
Normal operation		<p>The inverter operates and feeds electrical power to the grid.</p> <p>The sun symbol shows the current output power, e.g. 80% (with 8 out of ten rays).</p> <p>The power meter shows the output power as "#.## kW".</p>
Warning		<p>A warning has been triggered.</p> <p>Normal operation continues automatically if the cause of the warning is temporary, for example, if there's a temporary power outage.</p> <p>Read the warning events from the control unit.</p> <p>The power meter shows "-- kW".</p>
Fault		<p>A fault has occurred.</p> <p>The inverter goes into the stand-by mode and user action is needed to start normal operation.</p> <p>Read the fault events from the control unit.</p> <p>The power meter shows "-- kW".</p>

Control buttons



Use the buttons to navigate the menus:

- Use the up and down arrow keys to scroll up and down to different items in the menu screens and to adjust values. Push and hold the button to scroll through the choices. To set a parameter to the default value, push the up and down arrow keys at the same time.
- Use the left and right arrow keys to go to the previous (higher level) and next (lower level) menu screens. They also move the cursor horizontally when you edit parameters.
- Use the left softkey to select the actions shown on the bottom left of the display. You usually use it to cancel and exit actions. Push and hold the button to go to the Energy view. In the Energy view, use this button to toggle between numeric and graphical displays.
- Use the right softkey to select the actions shown on the bottom right of the display.
- Push the *Help* (?) button to open the contextual help screens.
- To make a screen capture of the user interface, push the left, up and right arrow keys at the same time. The control unit can store up to 15 screen captures. To move the screen captures to a PC, refer to [To move files between the control unit and a PC](#) on page 100.

■ To edit parameters

To edit a parameter, select the parameter in the menu. Use the arrow keys to select and adjust the parameter, and then use the right softkey to accept the selection. To set a parameter to the default value, push the up and down arrow keys at the same time.

LED status indicators

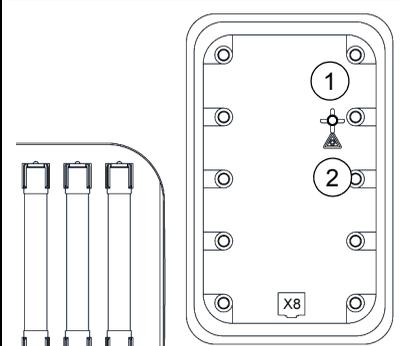
The inverter has a LED on the control unit and 2 LEDs on the control board. To see the control board LEDs, remove the control unit.

LED on control unit

The status LED on the control unit shows the status of the inverter. Refer to [User interface](#) on page 88 and [LED status indications](#) on page 91.

Control board LEDs

You can see the control board LEDs through the window in the first cover when the control unit is removed. The control board has 1 bi-color LED (1) and 1 red warning symbol LED (2) which is on when there is a danger of electric shock.

Control board LEDs	Description
	<ol style="list-style-type: none"> 1. Status LED: red or green, OFF, ON or flashing. 2. Danger of electric shock: red, steady ON, if inverter has diagnosed an active ground fault.

LED status indications

Status	Status LED
Sleep	OFF
Fault	ON red
	Active fault that requires user action.
Warning	Flashing red (1 s ON, 2 s OFF)
	Active warning. The warning does not prevent inverter power feed to the grid, but the output power may be limited.
Stand-by	Flashing green (1 s ON, 2 s OFF)
	The inverter is in stand-by mode.
Limited operation	Flashing green (3 s ON, 1 s OFF)
	The inverter is in power feed mode with limited power output.
Normal operation	ON green
	The inverter is in power feed mode.

Graphical display

The graphical display shows:

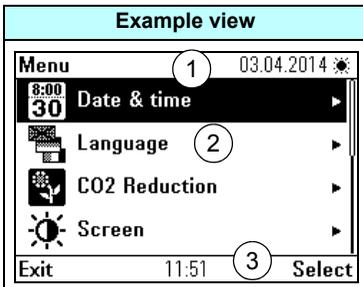
- Operational status
- Menus
- Performance monitoring
- Event messages (for example, faults, warnings and maintenance reminders)
- Help texts

Refer to [Start-up](#) on page 75 for information on settings necessary when the inverter is started for the first time.

Refer to [Navigation map](#) on page 133 for a map of the inverter menu hierarchy.

Display layout

The graphical display has the general layout shown in the example view. Some special screens have a different layout.

Example view	No.	Area	Description
	1	Status bar	Current view, date and status icon. Not shown in special screens.
	2	Content area	Current view contents, e.g. menu, parameter, help text, etc.
	3	Softkey bar	Softkey commands and the real-time clock, if enabled. The commands depend on the view.

Energy view

The *Energy* view shows the status and history of the power produced by the system. This view is shown when the inverter starts and detects user interaction.

The user can toggle back and forth between numeric and graphical histogram views. The histograms show one column per hour, day, month or year. The current column is always shown in a different shade to the others. Use the left and right arrow keys to choose between different time periods. Note that if you change the date and time settings, this has an effect on the energy views.

In the *Energy: Today* view, the number in the upper right corner shows the cumulative value of energy produced during the day so far. The number in the upper left shows the current output power in kW. If the inverter is disconnected from the grid or is not feeding power, then "-- kW" is shown.

The format (12-hour or 24-hour) of the time points below the graph depends on the country settings. You can set the format in the *Date and time* submenu.

In the *Energy: This week*, *Energy: This month*, *Energy: This year*, and *Energy: 24 years* views, the number in the upper right corner shows the cumulative value of energy produced during the week, month, year and 24 years respectively.

The *Total* view shows cumulative values since the unit was installed. The *Energy output* and *Operation time* are always shown. The *CO₂ reduction* header and value are shown only if a reduction standard has been set with *Menu -> CO₂ reduction*.

The *Technical info 1* and *Technical info 2* views show the actual DC input, actual AC output voltage and actual AC power values.

The *Sun* view shows the current state of the unit and the output power in graphical format. Refer to [Operating modes](#) on page 89 for examples. Use the up arrow to access the *Sun* view.

When the unit is in the power feeding mode, a full sun and ten rays are shown. The rays fill to indicate the current output power. For example, if half of the rays are filled, the unit operates at 50% output power.

■ Menu

You can use the *Menu* to change parameters and access event logs.



Date & time submenu

Use this submenu to set the date and time, and their display formats. Refer to [First start up](#) on page 74.

Date & Time	04.04.2014 ☀
Date	04.04.2014
Time	12:48:13
Show date as	day.month.year
Show time as	24-hour
Week start day	Monday
Daylight saving	Off
Back	12:48 Edit



Language submenu

The *Language* menu shows the available and selectable control unit languages. Refer to [First start up](#) on page 76.

Language	11.05.2015 •
English (US)	
Deutsch	
Italiano	
Français	
Español	
Back	15:28 Select



CO2 Reduction submenu

You can use the carbon dioxide (CO₂) reduction factor to calculate how many tonnes of carbon dioxide emissions would be produced with conventional electrical energy sources instead of solar power. The default value is 0.7 t/MWh. If you set the value to 0, the CO₂ reduction header does not show in the *Energy* view.

CO2 Reduction	04.04.2014	
CO2 reduction factor	0.700	
Back	12:48	Edit

Traditional electrical energy sources produce carbon dioxide emissions. Their amount depends on the local electricity production mix. Ask the carbon dioxide emission data from your local electrical company or carbon monitoring institute. Solar energy offsets production from traditional energy sources and reduces carbon dioxide emissions.



Screen submenu

Use the *Screen* submenu to set the screen brightness, contrast and screensaver delay.

By default, the display backlight is on when the inverter operates. When the inverter is in the sleep mode, the control unit and display are off. The control unit wakes up and the backlight illuminates when you use the keypad.

If you do not use the keypad for a preset time, the *Sun* view appears.

You can set the *Reduced backlight* function ON to dim the backlight when the keypad is not used for a preset time.

Screen	04.04.2014	
Contrast	80 %	
Brightness	85 %	
Reduced backlight	Off	
Reduced backlight brightness	25 %	
Screensaver delay	5 min	
Backlight delay	1 min	
Back	12:48	Edit

Events submenu

The *Events* submenu lists faults and other events. It also lists active faults and warnings.

The lists show the date and type of the fault or event. Push the *Help* (?) button to see more information on the event.

Events are kept in the event log. The inverter removes the oldest logs when the memory is full.

Fault detail view example:

Events	04.04.2014	
Faults		
Other events		
Active faults		
Active warnings		
Back	12:48	Select

Fault details	04.04.2014	
Name:	Overcurrent (2E00 hex)	
Aux code:	0000 0000 hex	
Time:	04.04.2014 12:54:08	
Reset:	Not yet reset	
On time:	1 03:00:44	
— Parameter values at fault time —		
101.00 Grid voltage		
Back	12:54	Reset

Communication submenu

The *Communication* submenu has communication setups for embedded fieldbus, Fieldbus adapters and extension I/O modules.

The menu shows a subset of the parameter groups which are used to set up communications.

Communication	03.04.2014	
Embedded fieldbus		
Fieldbus options		
Extension I/O		
Edit inverter name		
Back	11:57	Select

System info submenu

The *System info* submenu has information on the inverter and control unit.

System info	08.05.2015	●
Inverter		▶
Control unit		▶
Back	14:46	Select

Inverter view example:

Inverter	08.05.2015	●
Panel bus id:	2	
LP version:	KLULO v1.63	
FW version:	KLUF0 v1.63	
Product name:	PRO-33.0-TL	
Product type:	PRO-33.0-TL	
Product model:	PRO-33.0-TL-OUTD-SX-400	
Serial number:	1296251515	
Back	14:46	

Control unit view example:

Control unit	08.05.2015	●
Product type:	PVS-AP-L	
HW version:	A	
	Flash AT32	
FW version:	KPAPP v4.70.200.3	
Serial number:	A4310057SB	
Manufacturing date:	31.07.2014	
Back	14:46	

String monitoring submenu (-SX model)

The *String monitoring* submenu has the *String configuration* assistant for string current monitoring, and the *String currents* view to show the actual string current values.

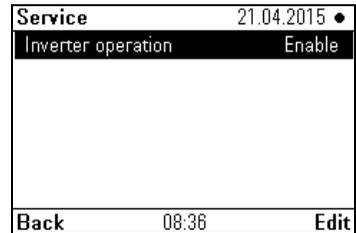
String monitoring	03.04.2014	☀
String configuration		▶
String currents		▶
Back	11:54	Select

Service submenu

In the *Service* submenu, you can enable and disable inverter operation.

In the *Enable* mode, the inverter can connect to the grid. In the *Disable* mode, grid connection is not possible.

At the factory, the inverter operation is set to *Enable*. The *Disable* mode is used primarily during configuration or maintenance. After configuration, the inverter is set to the *Enable* mode, to allow connection to the grid.



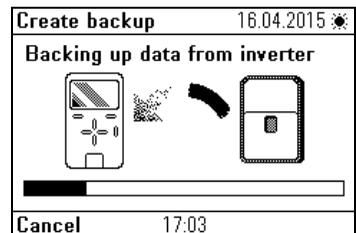
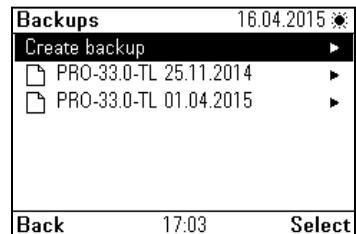
Backups submenu

In the *Backups* submenu, you can save parameter settings in the memory of the control unit. You can later restore the parameter settings to the inverter. You can make up to 2 backup files in the control unit.

You can copy backup files to and from a PC with a file manager such as Windows Explorer. To copy files to a PC, connect the control unit to the PC through the USB connection. Refer to [To connect the control unit to a PC](#) on page 100.

To create a parameter backup:

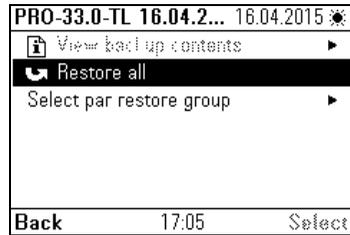
1. In the *Backups* submenu, select *Create backup*.
2. If there are 2 previous backups, select the backup file that you wish to replace and select *Replace*. If there is a free backup slot, this step is not necessary.
3. After the backup process, the control unit goes back to the *Backups* submenu.



If the backup process stops before it is done, the control unit does not replace the previous backup file. You can stop a backup process without risks.

To restore a parameter backup:

1. In the *Backups* submenu, select the backup file that you wish to restore.
2. Select *View backup contents* to make sure that the backup file is correct.
3. Select the restore option:
 - To restore all settings from the backup file, select *Restore all parameters*.
 - To restore a parameter set from the backup file, select *Select par restore group*. Then select the desired parameters from the list and select *Restore*.
4. After the restore process, the control unit goes to the *Backups* submenu.



Messages

Messages indicate the presence of a fault, warning or maintenance reminder. Push the left softkey to hide or clear the message. If there are several messages, clear the most recent message to see the other messages.

Help

The help pages contain context-sensitive instructions and descriptions of functions and parameters. Push the *Help* (?) button to display the help page for the selected fault, menu item, parameter, etc.

USB connector

You can use the USB connector to connect the control unit to a PC. When it is connected, the control unit acts as a USB adapter for data transfer between the PC tool and the inverter. You can also transfer data between the PC and the control unit through the USB connection.

Remote control unit installation

You can install the control unit in a remote location.

■ To remove the control unit from the inverter

1. Open the first cover (refer to [First cover](#) on page 50).
2. Open the USB connector lid (refer to [User interface](#) on page 88).
3. Push the lever at the bottom of the control unit and pull the control unit to remove it.
4. Disconnect the control unit cable from the back of the control unit. Leave the control unit cable in the inverter.

■ To remove the control unit support

1. Remove the screws at the top right and bottom left from the control unit support in the inverter.
2. Carefully remove the control unit support from the inverter.

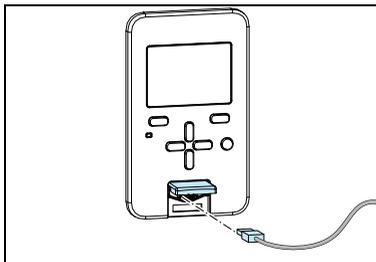
■ To install the control unit on to a wall

1. Use 4 suitable screws to attach the control unit support to the surface.
 2. Route the remote control unit cable with the RJ45 connector into the control unit support. Refer to [Recommended cable for remote control unit interface over EIA/RS-485](#) on page 38.
 3. At the inverter, route the remote control unit cable through a suitable cable gland into the inverter.
 4. Connect the remote control unit cable to the X1 connector in the inverter. Refer to [Remote control unit terminal X1](#) on page 63.
 5. Close the first cover.
-

To connect the control unit to a PC

Use the USB connector of the control unit to connect it to a PC:

1. Open the first cover (refer to [First cover](#) on page 50).
2. Open the USB connector lid (refer to [User interface](#) on page 88).
3. Connect a USB cable to the USB connector of the control unit.
4. Connect the USB cable to a PC.



The control unit shows the USB connection view. In this mode, the control unit does not respond to its keys. You can use the inverter and control unit only with the PC.

To connect the ABB PC tool to the inverter

You can use the control unit to connect the ABB PC tool to the inverter. When you use the control unit in this way, you can access the inverter only from the PC tool.

1. Install the ABB PC tool on to the PC.
2. Connect the control unit to the inverter.
3. Connect the control unit to the PC (refer to [To connect the control unit to a PC](#) on page 100).
4. If Windows prompts you to install USB drivers, refer to *Drive composer user's manual* (3AUA0000094606 [English]).

To move files between the control unit and a PC

1. Connect the control unit to the PC (refer to [To connect the control unit to a PC](#) on page 100).
2. If Windows prompts you to install USB drivers, refer to *Drive composer user's manual* (3AUA0000094606 [English]).

The control panel appears as an MTP device in Windows Explorer.

3. Open the ABB Drives Assistant control panel in Windows Explorer, and go to the directory where the files are stored:
 - Screenshots are stored in: ABB Drives Assistant control panel\ABB Drives Assistant control panel_a\screen
 - Backup files are stored in: ABB Drives Assistant control panel\ABB Drives Assistant control panel_a\backup
 4. Copy files to and from the folders with Windows Explorer.
-

10

Maintenance

Chapter contents

- [Requirements for maintenance personnel](#) (p. 101)
- [Maintenance overview](#) (p. 102)
- [Maintenance intervals](#) (p. 103)
- [External fan replacement](#) (p. 104)
- [Internal fan replacement](#) (p. 106)
- [String fuse replacement \(-SX model\)](#) (p. 107)
- [Surge protection device replacement \(-SX model\)](#) (p. 108)
- [Control unit battery replacement](#) (p. 109)
- [Spare part kits](#) (p. 109)



WARNING! Do not do electrical work on the unit unless you are a qualified electrician. Obey the instructions in Chapter [Safety](#) on page 11. Failure to obey the safety instructions can cause injury or death, electromagnetic interference and equipment malfunction.

Requirements for maintenance personnel

The maintenance person is typically the building or photovoltaic (PV) system caretaker. During commissioning, the commissioning electrician shows the maintenance person the procedures and tells them how to order spare parts.

Maintenance overview

The unit monitors itself. If a malfunction occurs, the control unit shows the fault to the user. You can use a remote monitoring adapter to monitor the unit.

ABB recommends that you examine the operation of the unit regularly. Refer to [Maintenance intervals](#) on page 103.

If damage to the unit occurs, the whole unit is usually replaced. Contact your local ABB service provider for assistance.

■ Fan service

The inverter has three fans that run when needed depending on the temperature inside the inverter. The inverter software controls the fan speed. The lifetime of the fans depends on the installation area and internal temperature of the inverter. The typical replacement time for the fans is after eight years of use.

The inverter shows a warning to the user when the fan run-time counter is near the calculated life time. After this warning, the inverter and fans operate normally, but you must replace the fans to guarantee the optimal operation of the inverter.

If the fans do not operate when they should, the inverter shows a warning to the user. In this case, the inverter continues to operate, but it can limit the output power or suffer overtemperature trips.

Replace the external and internal fans when the unit indicates or if they malfunction. Refer to [External fan replacement](#) on page 104 and [Internal fan replacement](#) on page 106.

Refer to the *PRO-33.0-TL Service menu guide* (3AXD50000015823 [EN]) for information on how to reset the fan run time counters.

■ String fuses and surge protection devices (-SX model)

On the -SX model, you can replace the string fuses and replace surge protection devices. Refer to [String fuse replacement \(-SX model\)](#) on page 107 and [Surge protection device replacement \(-SX model\)](#) on page 108.

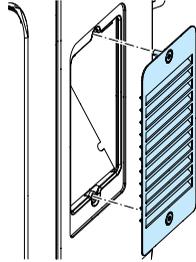
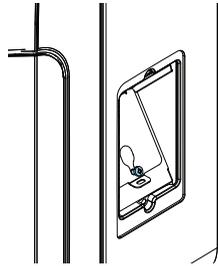
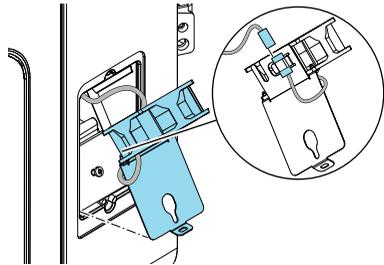
Maintenance intervals

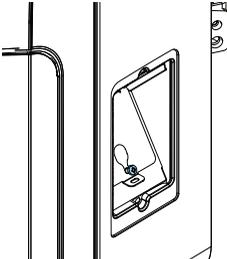
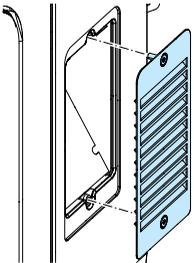
The maintenance intervals recommended by ABB are for a typical inverter, in a typical location for a typical operating duration. Shorten the maintenance intervals, if the inverter is in extreme environmental conditions.

Interval	Action	Instruction
Monthly	Read the event log.	Use the control unit to read the recent event logs from the <i>Events</i> view. The events are kept in the memory until the memory is full. When the event memory is full, the inverter removes the oldest events.
	Make sure that the fans operate.	Read the <i>Events</i> view for possible fan faults. The fans operate only when cooling is required. Replace the fan(s) when the inverter displays a fan fault or a replacement reminder.
	Examine the operating environment.	Make sure that the inverter is in the intended operating environment. Make sure that the installation environment is clean, dry, and free of obstacles, and that the ambient temperature is not too high.
	Clean the operating environment.	Clean the inverter installation space and mounting area regularly to remove dust and dirt. This prevents clogging of the fans and heat sink of the inverter.
Monthly (Yearly if the inverter is indoors with restricted access)	Examine the connections.	Make sure that the cables are correctly routed. Cables must be tidy, secure and in good condition. Make sure that the connectors are correctly connected and that they are in good condition. Make sure that the screw and spring terminal connections are tight.

External fan replacement

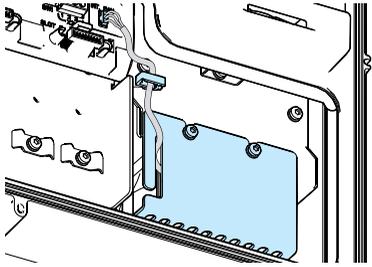
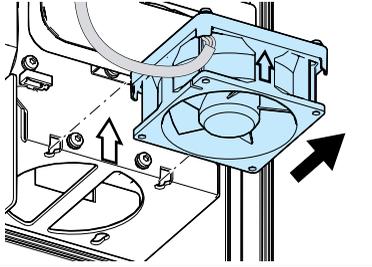
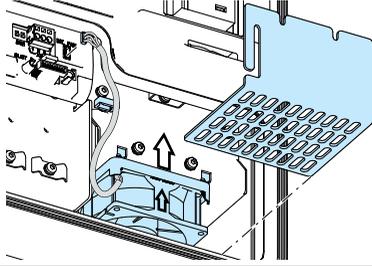
The unit has two external fans (one on each side) which blow air into the main heat sink.

To replace an external fan:		
1.	Open the main disconnect and circuit breaker(s) at the AC distribution board.	
2.	On the -S and -SX models, set the DC switch to the OFF position.	
3.	If present, open the circuit breakers or external DC switches between the inverter and PV array(s).	
4.	Loosen the 2 captive screws which lock the fan grill.	
5.	Remove the fan grill.	
6.	Loosen the locking screw.	
7.	Remove the fan assembly.	
8.	Disconnect the fan cable with a flat screw driver.	
9.	Connect the fan cable of the new fan. Make sure that the fan power connector is correctly in the clip.	
10.	Align and push the fan assembly into the fan duct.	

To replace an external fan:	
<p>11. Tighten the locking screw to lock the fan assembly in position.</p>	
<p>12. Put the fan grill into position in the correct orientation.</p> <p>13. Tighten the 2 M5x16 captive screws to 1 N·m to lock the fan grill in position.</p>	
<p>14.</p>	<p>Close the main disconnecter and circuit breaker(s) at the AC distribution board.</p>
<p>15.</p>	<p>Close the applicable circuit breakers between the inverter and PV array(s).</p>
<p>16.</p>	<p>On the -S and -SX models, set the DC switch to the ON position.</p>

Internal fan replacement

The unit has one internal fan under the first cover.

To replace the internal fan:		
1.	Open the main disconnect and circuit breaker(s) at the AC distribution board.	
2.	On the -S and -SX models, set the DC switch to the OFF position.	
3.	If present, open the circuit breakers or external DC switches between the inverter and PV array(s).	
4.	Remove the first cover. Refer to First cover on page 50.	
5.	Disconnect the internal fan cable.	
6.	Remove the cable from the cable clip and the slot in the finger guard.	
7.	Loosen the fixing screws (T20) of the finger guard.	
8.	Remove the finger guard.	
9.	Pull the fan assembly (fan and rubber sleeve) to remove it.	
10.	Attach the rubber sleeve to the new fan.	
11.	Align the fan assembly with the bracket so that the air flow direction is correct.	
12.	Push the rubber feet into the bracket slots firmly. Make sure all 4 feet are in place.	
13.	Attach the finger guard and torque the fixing screws to 2 N·m.	
14.	Pull the cable through the slot and cable clip.	
15.	Connect the fan cable.	
16.	Attach the first cover.	
17.	Close the main disconnect and circuit breaker(s) at the AC distribution board.	
18.	Close the applicable circuit breakers between the inverter and PV array(s).	
19.	On the -S and -SX models, set the DC switch to the ON position.	

String fuse replacement (-SX model)

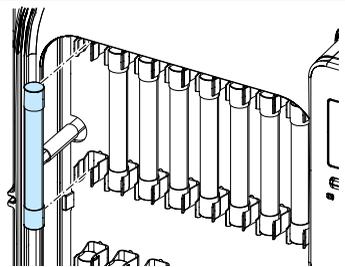
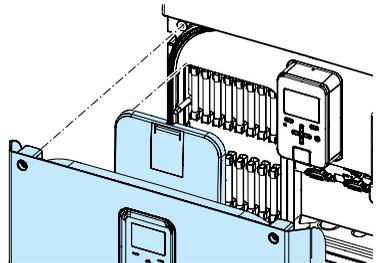
If string fuses need to be replaced:

- Examine the PV array and string cabling for damage.
- Make sure that the sizing of the PV array and string cabling is correct.
- Use a continuity checker to measure both fuses of each string input.
- Make sure that the nominal rating of the fuses is correct.
- Record the date and position of changed fuses. If the same fuse blows again, further troubleshooting is required.
- Monitor the inverter to make sure that it operates correctly.



WARNING! Completely isolate the unit from power sources before you open the covers. The DC switch does not isolate the fuses from the PV arrays.

To replace a string fuse:	
1.	Completely isolate the unit from external power sources. Refer to Inverter isolation on page 16.
2.	Remove the first cover. Refer to First cover on page 50.
3.	Remove the DC input cover. Refer to DC input cover on page 51.
4.	Remove the applicable string fuse(s).
5.	Install the new string fuse(s). For fuse information, refer to Technical data on page 123.
6.	Attach the DC input cover.
7.	Attach the first cover.
8.	Connect the unit. If necessary, refer to Electrical installation on page 49.



Surge protection device replacement (-SX model)

The surge protection device has 3 consumable cartridges. When the indicator on a cartridge is red, replace all three cartridges to ensure surge protection.

To replace the SPD:

1. Set the inverter DC switch to OFF.
 2. Remove the first cover. Refer to [First cover](#) on page [50](#).
 3. Replace cartridges with new ones of the same type. Refer to [Technical data](#) on page [123](#).
 4. Attach the first cover.
 5. Set the inverter DC switch to ON.
 6. Monitor the inverter to make sure that it is working correctly.
-

Control unit battery replacement

The control unit battery is necessary for the real-time clock (RTC). The life of the battery is typically more than 10 years.

To replace the control unit battery:

1. Remove the first cover (refer to [First cover](#) on page 50).
2. Open the USB connector lid (refer to [User interface](#) on page 88).
3. Push the lever at the bottom of the control unit to release it.
4. Disconnect the cable from the back of the control unit.
5. Turn the battery cover on the back of the control unit counterclockwise.
6. Remove the battery cover.
7. Carefully remove the control unit battery.
8. Carefully install a new CR2032 battery in the control unit.
9. Put the battery cover in position.
10. Turn the battery cover clockwise to lock it.
11. Connect the control unit cable.
12. Put the control unit into the holder and push to lock it in position.
13. Close the USB connector lid.
14. Attach the first cover.

Spare part kits

Contact your local ABB service provider to order spare part kits.

Order code	Item name	Description
3N750000000A	Fan kit	Fan spare part kit (2 external fans and 1 internal fan)
3N750010000A	PVS-AP-L Control unit	Control unit spare part kit
3N750070000A	SPD cartridges, ABB	DC side replaceable surge protection cartridge kit from ABB
3N750090000A	SPD cartridges, Phoenix Contact	DC side replaceable surge protection cartridge kit from Phoenix Contact
3N7500A0000A	Fuse kit 12 A, 16 pcs	12 A fuse spare part kit with 16 fuses
3N7500C0000A	Fuse kit 15 A, 16 pcs	15 A fuse spare part kit with 16 fuses

A large, bold, black number '11' is centered within a light blue square. The square has rounded corners and a thin white border.

Troubleshooting

Chapter contents

- [Inverter replacement](#) (p. 111)
- [Fault messages](#) (p. 112)
- [Warning messages](#) (p. 118)

Inverter replacement

If the inverter needs to be replaced:

1. Do the decommissioning for the old unit. Refer to [Decommissioning](#) on page 121.
2. Install the new unit. Refer to:
 - [Installation requirements](#) on page 33
 - [Mechanical installation](#) on page 41
 - [Electrical installation](#) on page 49
 - [Installation checklist](#) on page 71

Fault messages

■ If there is an active fault message

Use the “reset” button on the control unit or start the inverter again.

Examine the inverter for a few minutes to see whether it returns to normal operation.

- If the inverter appears to operate normally, monitor the operation closely for a few days.
- If a fault cannot be reset or if it occurs frequently, record the event date and time, and inverter serial number, and contact your system supplier.

■ Faults

Code	Fault	Cause	What to do
11776	AC overcurrent	<ul style="list-style-type: none"> - AC-side short-circuit - Sudden AC-side voltage drop 	<p>If the AC-side circuit breaker on the electrical distribution board is tripped, an electrician must examine your electrical system. Report the behaviour to your system supplier.</p> <p>If the AC-side circuit breaker is not tripped, reset the fault from the control unit:</p> <ol style="list-style-type: none"> 1. Power down the inverter: Set the DC switch and the AC-side circuit breakers to the OFF position. 2. Wait until the DC bus voltage drops below $300 V_{DC}$ and the control unit switches OFF. 3. Restart the inverter: Set the DC switch and the AC circuit breakers to the ON position. 4. Monitor the inverter for a few minutes to see if it returns to normal operation. 5. Monitor the inverter carefully for a few days. <p>If the fault occurs frequently, record the event date and time, and inverter serial number, and contact your system supplier.</p>
15873	FRT grid fault	A grid voltage disturbance exceeded the FRT trip curve	Restart the inverter and monitor that it connects to the grid.
15876	DC overvoltage	<ul style="list-style-type: none"> - DC voltage of over $1,100 V_{DC}$ - The system may have too many PV modules in series 	<p>Read and record the DC voltage from the “Technical info 1” page on the control unit.</p> <p>If the DC voltage is more than $1,100 V_{DC}$, set the DC switch and external DC switches to the OFF position. The DC voltage on the “Technical info 1” page should decrease.</p> <p>If the DC voltage does not decrease (-SX model), disconnect all of the PV quick connectors.</p> <p>If the fault is active but the DC voltage is less than $1,100 V_{DC}$, reset the fault and monitor that the inverter returns to normal operation.</p> <p>If the inverter returns to normal operation, monitor the inverter for a few days. Record the event date and time, and contact your system supplier.</p>
24068	PU logic error	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.

Code	Fault	Cause	What to do
24069	Rating ID mismatch	After a firmware update, the hardware of the inverter does not match the information stored in the memory.	Restart the inverter.
24079	IGBT state feedback	The IGBTs are not switching correctly.	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
24081	Unknown PU fault	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28160	FPGA version incompatible	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28161	FBA mapping file	Fieldbus adapter initialization error	Contact your system supplier.
28163	Task overload	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28164	Stack overflow	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28165	Internal file load	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28166	Internal record load	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28168	Memory unit detached	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28169	Internal SSW fault	Internal fault. Can occur during firmware update.	If the fault occurred during the firmware update, but is not active after the update, no action is needed. In other cases, restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28171	Kernel overload	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28172	Parameter system	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28175	EFB communication loss	Communication error between the inverter and the master controller.	Examine the cabling and settings at the master controller.
28185	Synchronization fault	The inverter was not able to synchronize with the grid after a grid fault (LVRT).	1. Restart the inverter. 2. Make sure that the inverter returns to normal operation. 3. Monitor the inverter for a few days.
28186	Rating ID fault	Internal fault	Restart the inverter. If the same fault occurs again, power down the inverter and contact your system supplier.
28191	Licensing fault	A license is required for the inverter to operate. The license is missing.	Contact ABB to replace the unit.

Code	Fault	Cause	What to do
28197	Backup/restore timeout	Temporary communication error between the control or PC tool and the inverter.	Examine the communication, reset the fault and do the operation again.
32267	FBA communication	Communication between the inverter and the fieldbus adapter or between the master controller and the fieldbus adapter is lost.	<ol style="list-style-type: none"> 1. Make sure that the master controller can communicate. 2. Examine the adapter settings and status. Refer to the user documentation of the fieldbus interface. 3. Examine the cable connections.
32272	Ext. I/O communication loss	The inverter cannot communicate with the extension I/O module	<ol style="list-style-type: none"> 1. Power down the inverter. 2. Make sure that the module is correctly installed in Slot 1. 3. Restart the inverter. <p>If the same fault occurs again, the module may be broken.</p>
37120	Ground current	<p>- Leakage current to ground because of human, animal or other contact between electrical parts and ground.</p> <p>- Leakage current to ground because of water or high humidity.</p>	<ol style="list-style-type: none"> 1. Power down the inverter. 2. Make sure that no people, animals or other objects are in danger or in contact with the electrical parts of the PV system. 3. Visually examine the cabling of the PV system for faults or burn marks. 4. If the system looks normal, restart the inverter. <p>If the same fault occurs again, immediately isolate the inverter from all power sources.</p> <p>Request a service visit from your system supplier. Your PV system might have a dangerous AC or DC side isolation fault and contact to ground.</p>
37121	RCMU sensor	Fault in the residual current monitoring unit (RCMU).	<ol style="list-style-type: none"> 1. Power down the inverter. 2. Restart the inverter. <p>If the same fault occurs again, immediately isolate the inverter from all power sources and contact your system supplier.</p>
37122	Ground current measurement	Fault in the internal ground current measurement circuit.	<ol style="list-style-type: none"> 1. Power down the inverter. 2. Restart the inverter. <p>If the same fault occurs again, power down the inverter and contact your system supplier.</p>
37123	Grid relay	Faulty grid relay.	<ol style="list-style-type: none"> 1. Power down the inverter. 2. Restart the inverter. <p>If the same fault occurs again, power down the inverter and contact your system supplier.</p>
37130	HW mismatch	Internal HW board and SW versions do not match.	<ol style="list-style-type: none"> 1. Power down the inverter. 2. Restart the inverter. <p>If the same fault occurs again, power down the inverter and contact your system supplier.</p>
37136	String current deviation Note: Can also be configured as a warning.	Current deviation between strings.	<ol style="list-style-type: none"> 1. Read the aux code (1...8) from the Events menu -> Active faults -> String current deviations. The aux code number refers to the affected string. 2. Examine the affected string for shading. 3. Make sure that the panels in the affected strings do not have damage. 4. Make sure that the string monitoring configuration settings are feasible.

Code	Fault	Cause	What to do
37137	Reverse string current	<p>- Reverse input current (standard/-S model).</p> <p>- Reverse fuse board current (-SX model).</p>	<p>Standard/-S model: Read the aux code from the Events menu -> Active faults. Aux code (255) refers to reverse current in the DC input terminals. Power down the inverter and contact authorized service personnel to make sure that your installation does not have short circuits and connection errors.</p> <p>-SX model: Read the aux code from the Events menu -> Active faults. The aux code refers to affected DC input terminal on the bottom of the inverter. Read the string current values from the Events menu -> String monitoring -> String current. If there are no negative values, reset the fault. If a value shows negative current, the fault is still active: power down the inverter. Make sure that all of the DC connectors are in their correct positions according to the cable markings. Do not remove the DC cables, because it can cause an electrical shock. If there are no connection errors, restart the inverter. If the cable markings are unclear or missing, or if the same fault occurs, power down the inverter and contact your system supplier. Request a service visit to check the polarity and order of DC input connectors and fuses, and to check the PV system installation for short circuits and connection errors.</p>
37138	Blown string fuse Note: Can also be configured as a warning.	Failed DC string fuse.	<p>1. Read the aux code (1...8) from the Events menu -> Active faults -> String current deviations. The aux code refers to the affected string. If the aux code refers to a string that is not connected, run the string configuration assistant with the proper settings. 2. Reset the fault.</p> <p>If the same fault occurs again, power down the inverter and contact authorized service personnel to replace the failed string fuses.</p>

Code	Fault	Cause	What to do
37152	Control board overtemperature	The inverter control board temperature is more than the trip limit despite the output current reduction function.	<ol style="list-style-type: none"> 1. Measure the installation environment temperature. 2. Make sure that the cooling fans operate and that air flows out of the rear of the inverter. A DC voltage of over ~300 V is required for the fans to run. 3. Make sure that there are no internal (57635) or external fan failures (57636, 57637). 4. Clean the external and internal fans with a vacuum cleaner or air blower. Refer to Maintenance on page 101. 5. Reset the fault. 6. Monitor that the inverter returns to normal operation. <p>If the same fault occurs again, power down the inverter and contact your system supplier.</p> <p>Your system might:</p> <ul style="list-style-type: none"> • Be connected to too many solar panels. • Be installed in a location that is too hot. • Have inadequate cooling air flow.
37153	Inverter overtemperature	The inverter temperature is more than the trip limit despite the output current reduction function.	<ol style="list-style-type: none"> 1. Measure the installation environment temperature. 2. Make sure that the cooling fans operate and that air flows out of the rear of the inverter. A DC voltage over ~300 V is required for the fans to run. 3. Make sure that there are no internal (57635) or external fan failures (57636, 57637). 4. Clean the external and internal fans with a vacuum cleaner or air blower. Refer to Maintenance on page 101. 5. Reset the fault. 6. Monitor that the inverter returns to normal operation. <p>If the same fault occurs again, power down the inverter and contact your system supplier.</p> <p>Your system might:</p> <ul style="list-style-type: none"> • Be connected to too many solar panels. • Be installed in a location that is too hot. • Have inadequate cooling air flow.

Code	Fault	Cause	What to do
37154	Line filter overtemperature	The inverter line filter temperature is more than the trip limit despite the output current reduction function.	<ol style="list-style-type: none"> 1. Measure the installation environment temperature. 2. Make sure that the cooling fans operate and that air flows out of the rear of the inverter. A DC voltage over ~300 V is required for the fans to run. 3. Make sure that there are no internal (57635) or external fan failures (57636, 57637). 4. Clean the external and internal fans with a vacuum cleaner or air blower. Refer to Maintenance on page 101. 5. Reset the fault. 6. Monitor that the inverter returns to normal operation. <p>If the same fault occurs again, power down the inverter and contact your system supplier.</p> <p>Your system might:</p> <ul style="list-style-type: none"> • Be connected to too many solar panels. • Be installed in a location that is too hot. • Have inadequate cooling air flow.
37189	AC voltage measurement	Fault in the internal AC voltage measurement circuitry.	<ol style="list-style-type: none"> 1. Power down the inverter. 2. Restart the inverter. <p>If the same fault occurs again, power down the inverter and contact your system supplier.</p>
37190	DC protection	High DC component in the output current.	<ol style="list-style-type: none"> 1. Reset the fault. 2. Monitor the inverter for a few days. <p>If the same fault occurs again, power down the inverter and contact your system supplier.</p>
37191	Isolation	Low impedance between DC+ or DC- bus of the inverter and the ground.	<ol style="list-style-type: none"> 1. Power down the inverter. 2. Make sure that no people, animals or other objects are in danger or in contact with the electrical parts of the PV system. 3. Visually examine the cabling of the PV system for faults or burn marks. 4. If the system looks normal, restart the inverter. <p>If the same fault occurs again, power down the inverter and contact your system supplier.</p>
37192	Input overcurrent	The inverter was not able to limit the input current to the maximum value during a sudden change in operating conditions.	<ol style="list-style-type: none"> 1. Restart the inverter. 2. When the inverter returns to normal operation, monitor the inverter for a few days.

Warning messages

Warnings do not prevent inverter power feed to the grid, but the output power may be limited.

The warning message disappears automatically when the triggering condition disappears.

Code	Warning	Cause	What to do
44552	FRT grid warning	The trigger level for the FRT tripping curve was exceeded.	No user actions required. This is an informative warning about grid disturbance.
44590	Extension AI parameterization	The slide switch (current/voltage input) setting on the module does not match the software settings.	<ol style="list-style-type: none"> 1. Check the correct input signal type 2. Set the slide switch accordingly 3. Adjust the software settings to match the positions of the slide switches in the Communications menu.
44591	Extension I/O configuration failure	The extension I/O type setting and physical module type do not match.	Check the module type and correct the type setting in the Communications menu.
44592	FBA communication	The communication between the inverter and fieldbus adapter module or between the master controller and fieldbus adapter module was lost.	<ol style="list-style-type: none"> 1. Make sure that the master controller can communicate. 2. Examine the adapter settings and status. Refer to the user documentation of the fieldbus interface. 3. Examine the cable connections.
57601	DC overvoltage	<p>- DC voltage over the limit during operation.</p> <p>- Very low ambient temperatures can raise the PV array voltage over the limit.</p>	<p>Read and record the DC voltage on "Technical info 1" page of the control unit.</p> <p>Contact your system supplier about your PV system design.</p>
57605	Self-test not completed	The self-test did not complete.	<p>When country code 14 (Italy) is selected, the inverter does not connect to the grid until the self-test procedure completes.</p> <p>Complete the self-test procedure.</p>
57610	HW config mismatch	Internal HW board and SW versions do not match.	<ol style="list-style-type: none"> 1. Power down the inverter. 2. Restart the inverter. <p>If the same warning occurs again, power down the inverter and contact your system supplier.</p>
57616	String current deviation Note: Can also be configured as a fault.	Current deviation between strings.	<ol style="list-style-type: none"> 1. Read the aux code (1...8) from the Events menu -> Active faults -> String current deviations. The aux code refers to the affected string. 2. Examine the affected string for shading. 3. Make sure that the panels in the affected strings are undamaged. 4. Make sure that the string monitoring configuration settings are feasible.

Code	Warning	Cause	What to do
57618	Blown string fuse Note: Can also be configured as a fault.	One or more failed DC string fuses.	Read the aux code (1...8) from the Events menu -> Active warnings. The aux code refers to the affected string. If the aux code refers to a string that is not connected, run the string configuration assistant with the proper settings. If the same warning occurs again, power down the inverter and contact authorized service personnel to replace the failed string fuses.
57632	Control board overtemperature	High temperature in the control electronics. The inverter adjusts the output current and power until the internal temperature decreases. The inverter automatically returns to normal operation.	Monitor the inverter for a few days. Contact authorized service personnel if the warning occurs frequently.
57633	Inverter overtemperature	High temperature in the power electronics. The inverter adjusts the output current and power until the internal temperature decreases. The inverter automatically returns to normal operation.	Monitor the inverter for a few days. Contact authorized service personnel if the warning occurs frequently.
57635	Internal fan	Internal fan failure. The inverter continues to operate but it might limit the output power or suffer overtemperature trips.	Contact authorized service personnel to replace the internal fan and report the fan failure to the system supplier.
57636	External fan 1	External fan 1 failure. The inverter continues to operate but it might limit the output power or suffer overtemperature trips.	Contact authorized service personnel to replace the external fan and report the fan failure to the system supplier.
57637	External fan 2	External fan 2 failure. The inverter continues to operate but it might limit the output power or suffer overtemperature trips.	Contact authorized service personnel to replace the external fan and report the fan failure to the system supplier.
57638	Internal fan run time	The internal fan has reached the end of its life. The inverter and internal fan continue to operate normally.	Contact authorized service personnel to replace the internal fan.
57639	External fan 1 run time	The external fan 1 has reached the end of its life. The inverter and external fan continue to operate normally.	Contact authorized service personnel to replace the external fan.
57640	External fan 2 run time	The external fan 2 has reached the end of its life. The inverter and external fan continue to operate normally.	Contact authorized service personnel to replace the external fan.
57641	SPD connected	The surge protection cartridge is correctly assembled. This event is reported only once, the first time a surge protection cartridge is installed.	Informative warning (no action needed).

Code	Warning	Cause	What to do
57648	Surge detection	Surge protection cartridge failure. The inverter continues to operate, but the protection level against voltage surges is decreased.	Contact authorized service personnel to replace the surge protection cartridge. Replace the surge protection cartridge to prevent damage from voltage peaks.
57649	Control board temperature sensor	Inverter control board temperature sensor failure. The inverter continues to operate and uses the remaining temperature sensors and SW calculations. The power output can be limited and the system performance is decreased.	1. Power down the inverter. 2. Restart the inverter. If the warning occurs again, read the serial number of the inverter and contact the system supplier.
57650	Line filter overtemperature	High temperature in the line filter. The inverter temporarily adjusts the output current and power until the internal temperature decreases. The inverter automatically returns to normal operation.	Monitor the inverter for a few days. Contact authorized service personnel if the warning occurs frequently.
57651	AC voltage calibration	Calibration coefficients cannot be read from the internal calibration data file. The AC voltage measurements can still be within correct accuracy, but the system cannot verify the calibration coefficients the inverter is currently using.	1. Power down the inverter. 2. Restart the inverter. If the warning occurs again, read the serial number of the inverter and contact your system supplier.
57652	Autoreset	An automatically resettable fault has activated.	No user actions required. Faults are automatically reset.
57653	Reverse string current	Reverse current in the DC input terminals (-SX model)	1. Read the aux code (1..8) from the Events menu -> Active warnings -> Reverse string current. The aux code number refers to the affected string. 2. Examine the affected string for shading and reverse connection. 3. Make sure that the panels in the affected string are undamaged.

12

Decommissioning

Chapter contents

- [To remove the inverter from service](#) (p. 121)
- [Recycling](#) (p. 122)

To remove the inverter from service

For information on how to move the inverter, refer to [Move the unit](#) on page 46.



WARNING! Use a hoist when you lift the heavy unit. The unit weighs approximately 67 kg (148 lbs) and is top heavy.

To remove the inverter from service:

1. On the -S and -SX models, set the DC switch to OFF.
 2. Electrically isolate the inverter. Refer to [Inverter isolation](#) on page 16.
 3. Open the disconnecting switches and circuit breakers on the DC side.
 4. Open the disconnecting switches and circuit breakers at the AC distribution board.
 5. Disconnect the AC cable connector.
 6. Disconnect the DC cable connectors.
 7. Remove the first cover. Refer to [First cover](#) on page 50.
 8. If applicable, disconnect the auxiliary power cables. The power supply from the external control equipment must be disconnected with a circuit breaker or power switch.
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9. Disconnect the control cables. The power supply from the external control equipment must be disconnected with a circuit breaker or power switch.
10. Make sure that the disconnected cables do not cause danger.
11. If applicable, remove the protective earthing connections.
12. If applicable, remove the lock that holds the inverter.
13. Remove the locking screws from the back of the inverter.
14. To remove the inverter from the wall-mounting plate, tilt the bottom of the inverter outwards and lift the inverter upwards.
15. Remove the wall-mounting plate from the wall.
16. Recycle the inverter and wall-mounting plate responsibly.



WARNING! Do not open the inverter. Dangerous voltages may still be present inside, even after it is disconnected.

Recycling

Do not dispose of inverter with normal waste.

At the end of its operational life, return the inverter to any recycling facility which receives and handles electronic goods. Alternatively, the product can be returned to ABB. Please contact your local ABB representative for assistance.

13

Technical data

Input side

Inverter type	PRO-33.0-TL-OUTD-[-S/SX]-400
Recommended maximum PV array power ($P_{PV, max}$)	45,000 Wp Recommended maximum input power
Absolute maximum DC input voltage ($V_{max, abs}$)	1,100 V Inverter does not start to operate at over 1,000 V _{DC}
Start-up DC input voltage (V_{start})	610 V
Operating DC input voltage range ($V_{DC, min} \dots V_{DC, max}$)	580...950 V
Rated DC input voltage (V_{DCR})	580 V
Rated DC input power (P_{DCR})	33,700 W
Number of independent MPPTs	1
MPPT input voltage range ($V_{MPPT, min} \dots V_{MPPT, max}$) at P_{ACR}	580...850 V
Maximum DC input current ($I_{DC, max}$)	58 A
Maximum input short-circuit current	80 A
DC connection type	<p>Standard and -S model: Screw terminals (6...25 mm²) Type: Weidmueller LXBL/15.00/01/90</p> <p>-SX model: 8 pairs of Phoenix Contact SUNCLIX Inverter terminals (preassembled): DC+: PV-FT-C2M-HSG (1704925) DC-: PV-FT-C2F-HSG (1704926) Compatible cable connectors (not included in delivery): DC+: PV-CF-S (1774674) DC-: PV-CM-S (1774687)</p>

Input protection

Inverter type	PRO-33.0-TL-OUTD-[-/S/SX]-400
Reverse polarity protection	Inverter protection only, from limited current source, via short-circuit diode and for fused -SX model when more than 2 strings are connected.
Input overvoltage protection (Std & -S)	3 varistors
Input overvoltage protection (-SX)	3 plug-in modular surge arresters, Type II
Plug-in modular surge arrester type	Phoenix Contact VAL-MS-1000DC-PV/2+V-FM or ABB OVR PV 40 1000 P TS BW
Replaceable surge arrester modules	Phoenix Contact VAL-MS-1000DC-PV-ST 2800624 or ABB OVR PV 40-1000 C 2CTB803950R0100
Photovoltaic array isolation control	According to local standard
Insulation monitoring	Impedance measurement between DC terminals and ground
DC switch rating and type (-S & -SX)	58 A / 1000 V, 50 A / 1200 V, Benedict LS32 V 7774
PV string fault current protection (-SX)	Solar string fuse, 10x85 mm, 1,100 V _{DC} , all input terminals monitored
PV string fuse rating (-SX)	15 A / 1,100 V
Tested and approved solar string fuse types (-SX)	ETI CH10x85 gPV, 12 A / 1,500 VDC, Art.:002625205 ETI CH10x85 gPV, 15 A / 1,500 VDC, Art.:002625240 Mersen DC10-1200VDC, 12.5 A / 1,200 VDC, DC10HEL12C12.5 Mersen DC10-1200VDC, 16 A / 1,200 VDC, DC10HEL12C16 Littelfuse SPXV012.T, 12 A / 1,500 VDC Littelfuse SPXV015.T, 15 A / 1,500 VDC
PV string fuse maximum rating (-SX)	20 A
String current measurements (-SX)	Individual string current monitored, configurable alarm limit
Overvoltage category	OVC II

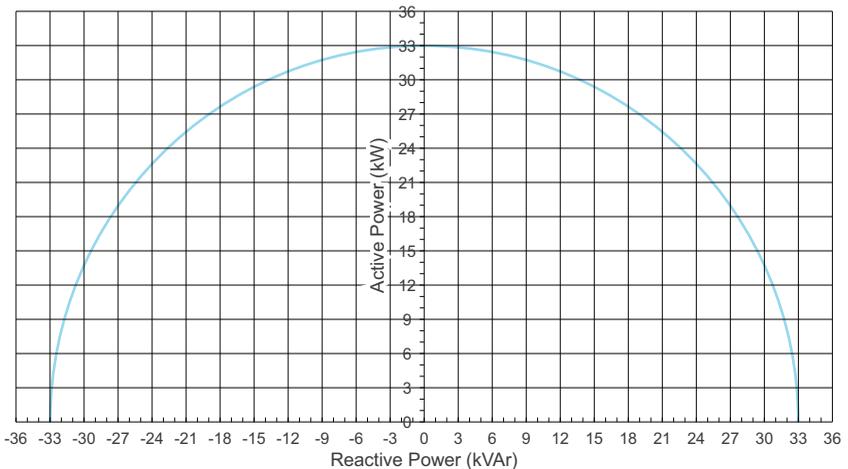
Output side

Inverter type	PRO-33.0-TL-OUTD-[-/S/SX]-400
AC grid connection type	Three phase 3W + PE or 4W + PE
Rated AC power ($P_{AC, R}$, @cos >0.99)	33,000 W
Maximum apparent power (S_{max})	33,000 VA
Rated AC grid voltage ($V_{AC, R}$)	400 V
AC voltage range	320...480 V Range varies according to the country grid standard.
Rated AC output current ($I_{AC, R}$)	47.8 A
Maximum AC output current ($I_{AC, max}$)	50.3 A
Rated output frequency (f_R)	50 Hz / 60 Hz
Output frequency range ($f_{min}...f_{max}$)	47...53 Hz / 57...63 Hz Range varies according to the country grid standard.
Nominal power factor and adjustable range	>0.995, with $P_{acr} = 33.0$ kW, adj. ± 0.9 with $P_{acr} = 29.7$ kW, adj. $\pm 0...1$ with $S = 33.0$ kVA

PQ diagram, with

- Over 95...110% of the nominal grid voltage
- The DC voltage is over 580...850 V
- The temperature is under 40 °C

PQ Diagram



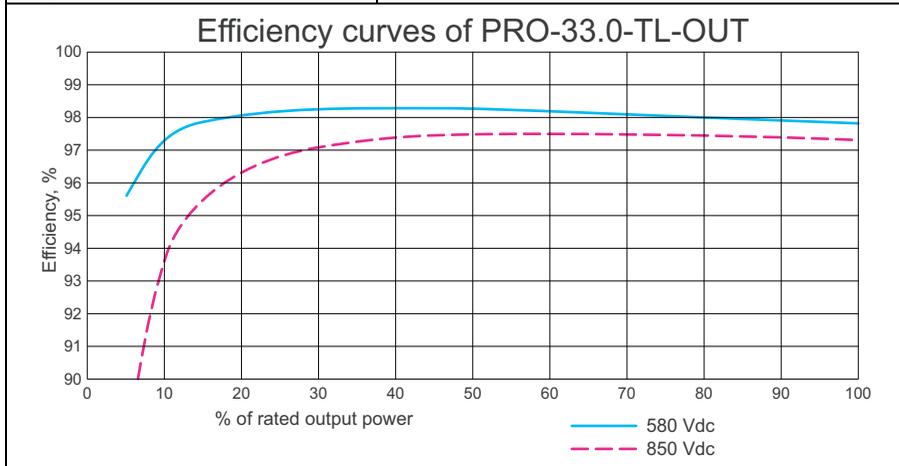
Total current harmonic distortion	< 3%
AC connector type	Fixed plug, 4-pole + PE
AC connector ratings	Conductor cross section 10...25 mm ² Cable diameter 22...32 mm (14...26 mm with reducer seal) Maximum current 125 A Maximum voltage 630 V _{AC}

Output protection

Inverter type	PRO-33.0-TL-OUTD-[-/S/SX]-400
Protection class	Class 1 (IEC 62103)
Oversvoltage category	OVC III
Grid monitoring	Automatic grid relays, DC and AC sensitive residual current monitoring unit, anti-islanding functions according to IEC and VDE standards.
Maximum AC overcurrent protection	50.3 A
Output oversvoltage protection	5 varistors
Recommended tripping curve type of external circuit breaker	Type B/C
Minimum / (maximum) permitted nominal current rating of external circuit breaker	63 A / (80 A)
External RCD type	If the local regulations require it, use Type A 300 mA external RCD

Operating performance applying standard EN 50530

Inverter type	PRO-33.0-TL-OUTD-[-/S/SX]-400
Maximum efficiency (η_{max})	98.3%
Weighted efficiency (EURO/CEC)	98.0% / 98.1%



MPPT adjustment efficiency:	
Power range of P_{AC} nominal <20%	99.5%
Power range of P_{AC} nominal >20%	99.9%
Night-time consumption	< 1 W
Standby consumption	< 20 W

User interface and communication

Inverter type	PRO-33.0-TL-OUTD-[-/S/SX]-400
Control unit type	PVS-AP-L graphical display, detachable
Control unit communication	ABB control unit protocol over EIA-485
Remote monitoring communication	Modbus RTU protocol over EIA-485 or ABB control unit protocol over EIA-485
Remote monitoring adapter type	VSN700-03-/05 data logger (optional)
Electrically isolated relay output	with FIO-01 accessory
PV plant sensor connection	with FIO-11 accessory

Environmental

Inverter type	PRO-33.0-TL-OUTD-[-/S/SX]-400
Environmental category	Outdoor, avoid installation subject to direct sunlight or rainwater
Ingress protection class	IP65/IP54 monitored fans
Ingress protection class with first cover open	IP20
Pollution degree class	PD3
Ambient temperature range allowed during operation	-25...+60 °C (-13...+140 °F)
Maximum ambient temperature for nominal power output	+45 °C (+113 °F) Output current decreases according to the temperature rise rate in the inverter
Ambient temperature range allowed during storage and transportation	-40...+70 °C (-40...+158 °F)
Relative humidity level allowed, not condensing	0...100%
Maximum installation altitude above sea level	3,000 m (9840 ft) Above 1,000 m (3280 ft), the maximum power derating depends on the ambient temperature
Minimum installation clearances (Top/Sides/Bottom)	250/350/500 mm (9.8 in./13.8 in./19.7 in.)
Noise emissions (at the operator's position):	Values determined according to standards IEC 62109-1, ISO4871 and the noise test code in ISO3746. The declared noise emission values are the sum of the measured values and the associated uncertainty. They represent the upper boundaries of the range which is likely to occur in measurements. The measurement distance was 1 m and the operating conditions applied to each inverter were: 580 V _{DC} , 400 V _{AC} , 50 Hz, nominal power output, fans running.
A-weighted sound power level	67 dBA

Physical

Inverter type	PRO-33.0-TL-OUTD-[-/S/SX]-400
Unit width	520 mm (20.5 in.)
Unit height	743 mm (29.3 in.) + 100 mm (3.9 in.) (AC connector)
Unit depth	342 mm (13.5 in.) (incl. wall-mounting plate)
Unit weight	Standard & -S: <66 kg (146 lbs) -SX: <67 kg (148 lbs)
Package dimensions (Width/Height/Depth)	600/800/571 mm (23.6 in./31.5 in./22.5 in.)
Package weight	<86 kg (190 lbs)

Safety

Inverter type	PRO-33.0-TL-OUTD-[-/S/SX]-400
Isolation level	Transformerless
Markings	CE according to LVD 2006/95/EC and EMCD 2004/108/EC RCM mark
Safety and EMC	EN 62109-1:2010, EN 62109-2:2011, EN 61000-6-2, EN 61000-6-3, EN 61000-3-11, EN 61000-3-12
Certifications and approvals	CEI 0-21, CEI 0-16, VDE 0126-1-1, VDE 0126-1-1/A1 VFR2014, VDE-AR-N4105, G59/3, MEA, PEA, IEC 61727, IEC 62116, EN 50438, NRS 097-2-1, SAGC, RD661, RD1669, UNE206007-1, AS4777/AS3100, PPC Greece

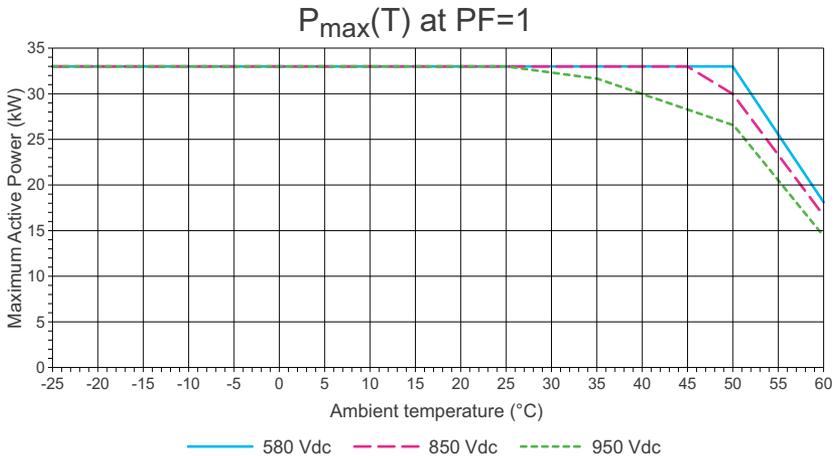
Derating

The inverter monitors its internal temperature and derates the power output when necessary to prevent damage to the inverter, protection devices and cabling. If the temperature of the inverter rises or the operational currents are too high, the inverter disconnects from the electrical grid and gives the overtemperature fault. When the internal temperature decreases, the inverter connects to the grid again.

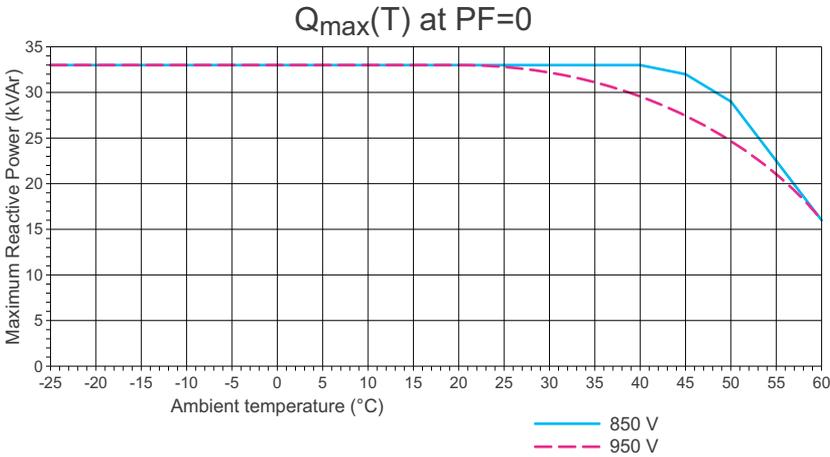
The nominal output power can be achieved in ambient temperatures of up to 45 °C (113 °F) in the whole MPP operating voltage range. At the minimum MPP voltage 580 V_{DC}, the nominal output power can be achieved even at 50 °C (122 °F). In the ambient temperature range of 45...60 °C (113...140 °F), the output power is derated.

The power derating curves are applicable up to 1,000 m (3280 ft) above sea level. If the inverter is installed above 1,000 m, the cooling capacity is reduced due to the thinner air. The inverter temperature management attempts to compensate for the reduced cooling. The power derating can start at temperatures lower than those mentioned above.

Active power vs. temperature at power factor = 1:



Reactive power vs. temperature at power factor = 0:



Disclaimers

■ Generic disclaimer

The manufacturer shall have no obligation hereunder with respect to any product which (i) has been improperly repaired or altered; (ii) has been subjected to misuse, negligence or accident; (iii) has been used in a manner contrary to the Manufacturer's instructions; or (iv) has failed as a result of ordinary wear and tear.

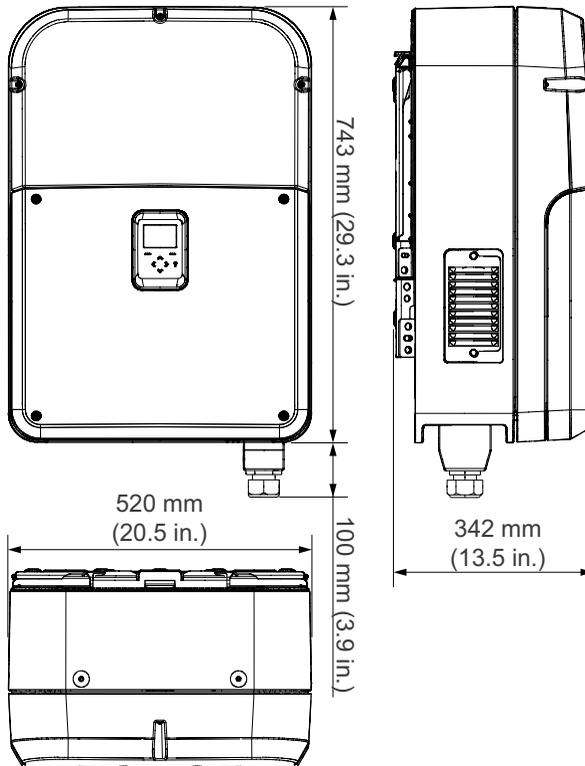
■ Cyber security disclaimer

This product is designed to be connected to and to communicate information and data via a network interface. It is Customer's sole responsibility to provide and continuously ensure a secure connection between the product and Customer network or any other network (as the case may be). Customer shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

14

Dimension drawing

Inverter dimensions



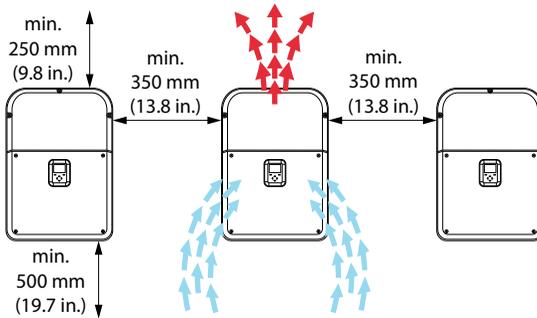
Required installation clearances

Make sure that:

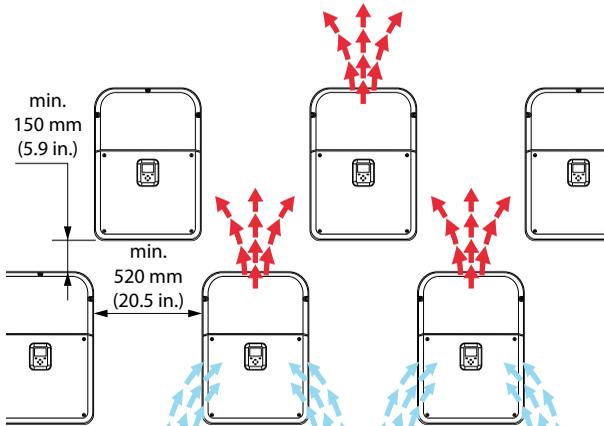
- You obey the minimum installation clearances.
- There is sufficient cooling airflow.
- The cooling fans can be accessed for maintenance.
- The inverter labels can be read.

Recommendations:

- If it is possible, install several inverters in one row, not on top of each other.
- Leave as much space between several inverters as possible.
- Install inverters as low as possible.



- When you install inverters on top of each other, obey these minimum clearances:



15

Navigation map

How to read the navigation map

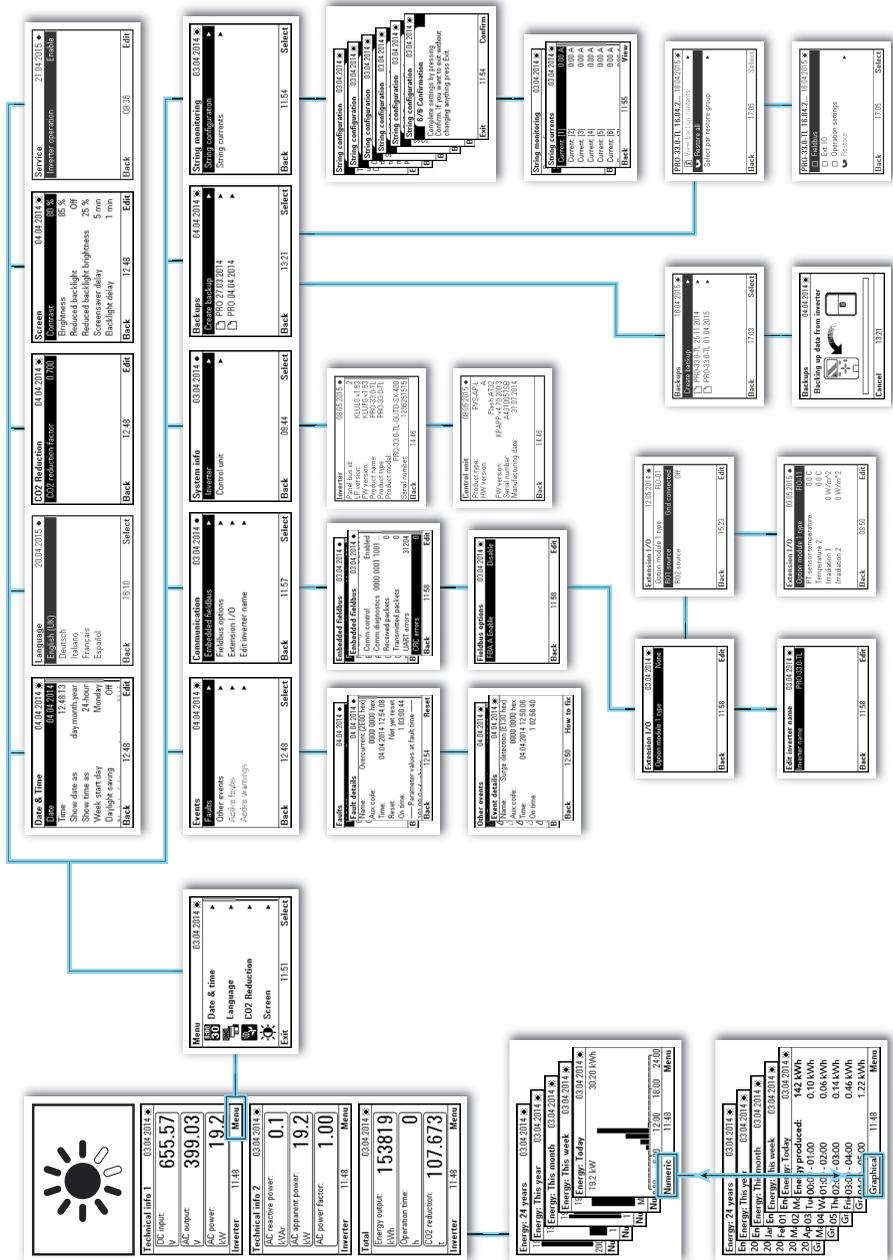
The left side of the map shows the normal operation views:

- Select *Inverter* to choose the inverter.
- Select *Menu* to open the control unit menu.
- Select *Numeric* or *Graphical* to change between the *Energy* views.

The right side of the map shows the menu structure:

- Select the menu item from the list to open the corresponding settings.
 - The *String monitoring* item is applicable only to the -SX model.
-

The navigation map



Further information

More information about ABB products for solar applications on the Internet:

www.abb.com/solarinverters

Contact us

www.abb.com/solarinverters

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